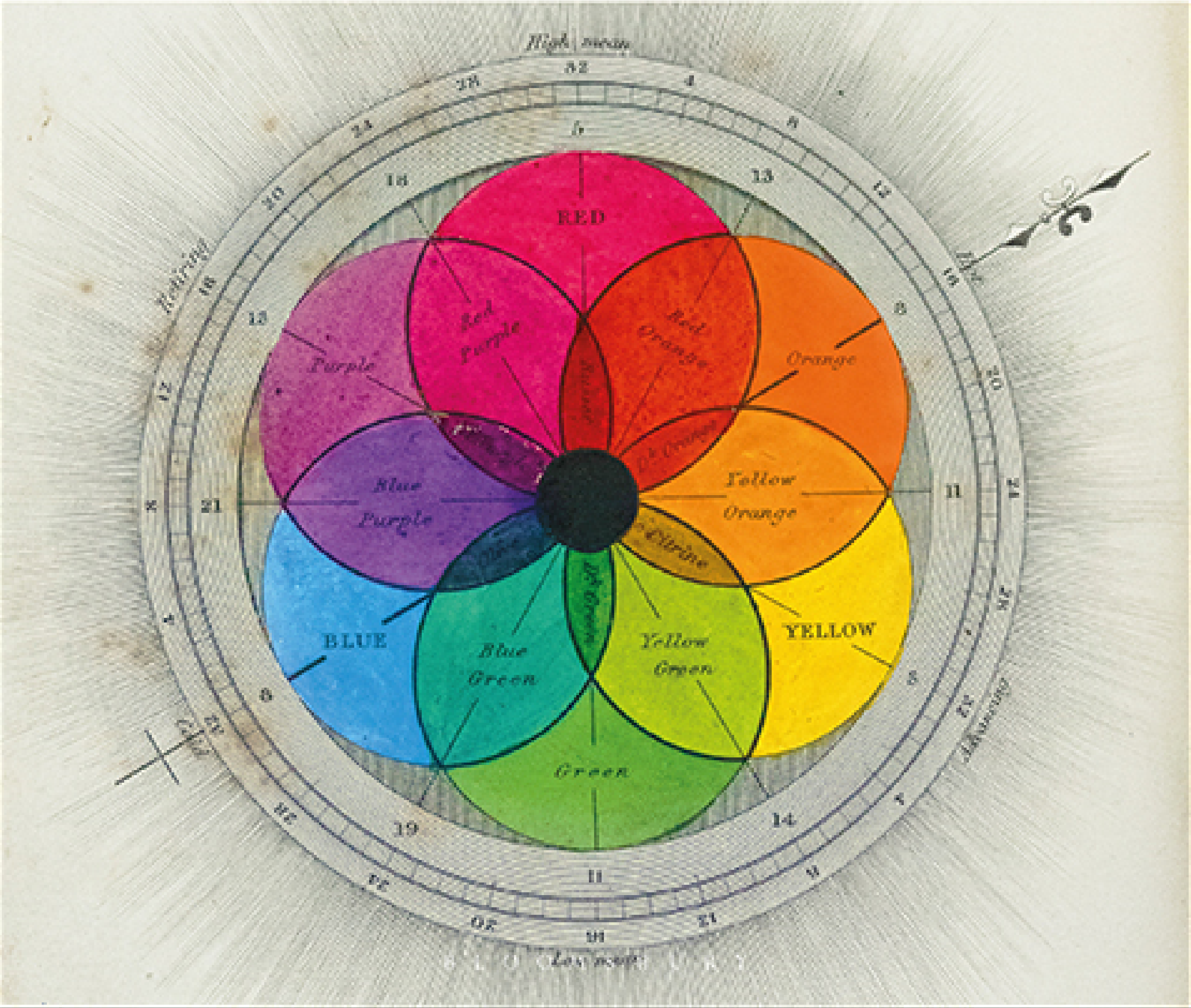
A CULTURAL HISTORY OF COLOR
IN THE AGE OF INDUSTRY

Edited by Alexandra Loske



A CULTURAL HISTORY OF COLOR

VOLUME 5

A Cultural History of Color
General Editors: Carole P. Biggam and Kirsten Wolf

Volume 1
A Cultural History of Color in Antiquity
Edited by David Wharton

Volume 2
A Cultural History of Color in the Medieval Age
Edited by Carole P. Biggam and Kirsten Wolf

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A Cultural History of Color in the Age of Enlightenment
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Volume 5
A Cultural History of Color in the Age of Industry
Edited by Alexandra Loske

Volume 6
A Cultural History of Color in the Modern Age
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Edited by Alexandra Loske

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SERIES PREFACE

A Cultural History of Color is a six-volume series examining the changing cultural understandings, interpretations, and utilizations of color throughout history. Each volume has the same structure and begins with a general overview of the major attitudes toward and uses of color in the historical period examined. The introduction is followed by contributions from experts, who investigate color under ten chapter headings that are identical in each of the volumes: philosophy and science; technology and trade; power and identity; religion and ritual; body and clothing; language and psychology; literature and the performing arts; art; architecture and interiors; and artifacts. Accordingly, the reader has the option of taking either a synchronic or a diachronic approach to the information provided. One volume can be read to gain a broad knowledge of color in a specific period or, alternatively, a theme or topic can be followed throughout history by reading the appropriate chapter in several volumes. The six volumes divide the history of color as follows:

Volume 1: A Cultural History of Color in Antiquity (*c.* 3000 BCE–500 CE)
Volume 2: A Cultural History of Color in the Medieval Age (500–1400)
Volume 3: A Cultural History of Color in the Renaissance (1400–1650)
Volume 4: A Cultural History of Color in the Age of Enlightenment (1650–1800)
Volume 5: A Cultural History of Color in the Age of Industry (1800–1920)
Volume 6: A Cultural History of Color in the Modern Age (1920–the present)

The general editors wish to dedicate the *Cultural History of Color* to the memory of their husbands who provided so much love and support: William Biggam (1944–2016) and Phillip Pulsiano (1955–2000).

General Editors, Carole P. Biggam and Kirsten Wolf

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I wish to dedicate this book to the artist and color theorist Carry van Biema (1881 Hanover–1942 Auschwitz), and to Stuart Durant (d. 2020), who introduced me to her work.

Introduction

ALEXANDRA LOSKE

It is hard to underestimate the seismic changes many aspects of color underwent from the beginning of the nineteenth century until the end of World War I. Many of these changes, which include an enormous increase in available colors, pigments, and other painting and decorating materials, are intrinsically linked to commerce, advertising, and production on an industrial scale. In turn, these factors respond to and sometimes trigger political, social, and practical situations. The world or—more prosaically—its consumers and suppliers embraced color like never before. Inventions, such as steam power, lithography, photography, and, later in the nineteenth century, electricity, motor cars, and eventually aviation and cheaper color printing were all determining factors in new and exuberant attitudes toward color in all aspects of life, as detailed in the chapters in this volume. Color was literally and metaphorically splashed around with the help of advanced technologies, industrial manufacturing, urbanization, and the vast number of people globally who were able and keen to discuss, disseminate, purchase, and embrace color.

Color historians pinpoint several milestones in this colorization of the world. They include the invention and commercial availability of new pigments, such as chrome yellow (from *c.* 1810) and synthetic "French" ultramarine (1826), or the discovery of aniline dyes through synthesizing quinine in 1856, but the story is complex, and the interaction of many events, inventions, and philosophical and scientific discourses all inspired artists, designers, business people, and consumers to move from subtle and naturalistic coloring to an expressive polychromy.

These developments found public expression in several large-scale world fairs from the mid-nineteenth century onwards, which essentially showcased current tastes and the scope of manufacturing power in the host countries and beyond. The most significant fair in western Europe was the Great Exhibition of the Works of Industry of All Nations at the Crystal Palace in Hyde Park, London (May 1–October 15, 1851), which was followed eleven years later by the even more extensive International Exhibition of 1862 in South Kensington, London. For both fairs, official literature was published, in which color, pigment production, fashionable color, and applied color theory were discussed (Figure 0.1).

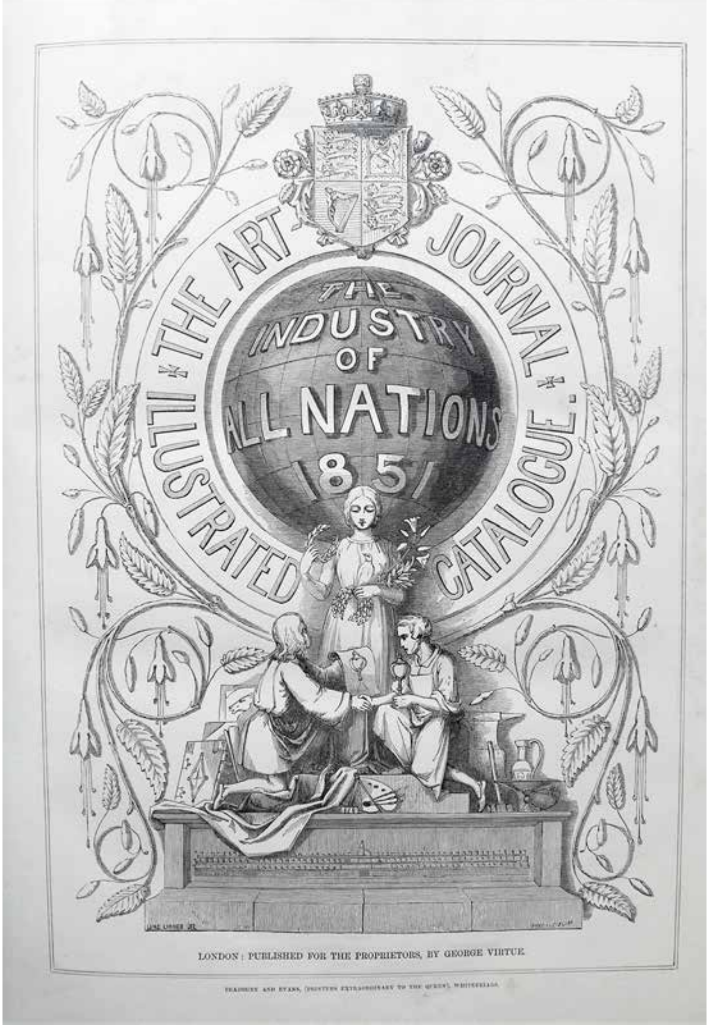

FIGURE 0.1 Title page of *The Art Journal Illustrated Catalogue* (London, 1851). Courtesy of Alexandra Loske.

The nineteenth century also witnessed an unprecedented surge in specific publications on color and painters' materials, such as manuals for housepainters and artists, as well as theoretical treatises on color. There were several reasons for this increase, and they spanned both the ideas and principles rooted in Enlightenment ideals as well as notions of beauty, harmony, and composition stipulated by the Romantic movement, combining ideas from the sciences, philosophy, and the fine and applied arts. The surge was fueled by a variety of interdisciplinary factors, among them the invention and widespread availability of new pigments, scientific research and discoveries in relation to color in general, color perception, and pigment production, along with developments in printing technology and publishing, particularly with regard to colored illustrations. From the 1820s onwards, there is a sharp increase in lavishly illustrated amateur painting manuals, which often provided precise guidance as to which colors should be used at what stage in the creation and composition of a painting. The very literal painters' palettes illustrating John Cawse's (1778–1862) 1840 edition of *The Art of Painting Portraits, Landscapes, Animals, Draperies, Satins, &c. in Oil Colours* are a particularly pleasing example from an aesthetic point of view (see Plate 0.1).

The desire to explain, systematize, and formalize color came from scientists, historians, writers, poets, and philosophers. The effect of colors on the observer, their aesthetic qualities, ideas of color harmony, and their applications in fine arts and design became as important as scientific analysis. A blurring of boundaries between scientific treatises and intellectual concepts of color is noticeable in publications throughout the nineteenth and in the early twentieth centuries. There was also significant cultural exchange among color writers across Europe, specifically France, Germany, and Britain, with many treatises being swiftly translated into other languages and some published in bilingual editions. This surge of interest culminated in Johann Wolfgang von Goethe's *Zur Farbenlehre*, an imposing and much criticized theory that was published in 1810.

Color theorists and authors of color manuals were often scientists as well as artists or poets, and many authors referred to other disciplines in their works on color. A surprising number of writers on color were botanists, astronomers, geologists, or entomologists, which might explain, at least partly, a heightened interest in and awareness of accurate color representation. Other factors that help explain the increase in publications on color in this period are the promotion and much-needed formalization of the arts in the form of art societies. In Britain, for example, the Society of Artists was founded in 1761, followed by the establishment of the Royal Academy in 1768. Half a century later, these institutions led the way in publishing about, discussing, and promoting the concept of color and its application in the arts. In some ways related to the institutionalization of the arts is the rise of watercolor and, to a lesser degree, oil painting as a pastime for the general public, resulting in the publication of many painting manuals for amateurs, which now provide us with a valuable and general overview of the status of color in the industrial age beyond the limits of science and philosophy.

This introduction highlights a few of the many aspects of color in the period from *c*. 1800 to 1920 and what informed and triggered them. It introduces a few key or exemplary figures that help us understand certain developments and changes in attitudes to color. Some of these figures are discussed in greater detail by the chapter authors, while others, such as the first recorded women writers on color, are included here in order to highlight the multifaceted and complex history of color in the industrial age.

COLOR BEFORE 1800: FROM IMMATERIAL TO MATERIAL

In many ways, the attitude toward and unprecedented interest in color in the industrial age is a response to what happened in the previous century. In the eighteenth century, two events proved highly symbolic and significant in the history of color. In Berlin around 1706, Heinrich Diesbach, the chemist and colorman, invented what is commonly referred to as the first "modern" pigment. At the time, Diesbach was working and experimenting with the alchemist Johann Konrad Dippel (1673–1734). The pigment became known as Prussian blue, Berlin blue, or, occasionally, Parisian blue—in reference to its place of origin or manufacture. It is an iron compound ($[Fe_4[Fe(CN)_6]_3]$) and provided a good alternative to the expensive mineral pigment ultramarine.

The invention of synthetic color marked the beginning of a new era of pigment production and had an immediate impact on fine arts. Sarah Lowengard considers Prussian blue an excellent example of a pigment that found a great variety of uses and was therefore truly interdisciplinary. "As a manufactured color," Lowengard argues, "Prussian blue, like Naples yellow, Turner's yellow, and Scheele's green, involved materials and production methods that crossed the traditional boundaries of several groups: colormakers, apothecaries, drysalters, and manufacturing chemists" (Lowengard 2006: 3). Disputes were frequently about synthetic pigments, which reflected both the economic implications and marketability of new pigments and scientific and intellectual interest in color studies and pigment production. The early eighteenth century may thus be regarded as the beginning of a new age in color production, which came to fruition in the industrial age.

The other milestone in modern color history was Isaac Newton's *Opticks: A Treatise of the Reflexions, Refractions, Inflections and Colours of Light* (1704), which became the main focus of and reference point for much intellectual discussion in the field of color studies in the eighteenth and nineteenth centuries. In his treatise, Newton explained that his aim was "not to explain the Properties of Light by Hypotheses, but to propose and prove them by reason and experiment," making *Opticks* exemplary of the values of the Enlightenment and the so-called "Age of Reason." By experimenting with rays of light directed through prisms, Newton identified and systematized seven spectral colors: red, orange, yellow, green, blue, indigo, and violet. These colors represent the range of electromagnetic radiation, known as wavelength, as seen by the human eye. Newton's division of the spectral range into seven colors was subjective, if not entirely arbitrary. He provided a color diagram in the form of a color circle comprising these colors, in which the far ends of the spectrum (violet and red) met. Newton was especially interested in the association of music and color and related each segment to one of the seven diatonic intervals. The notion that color and music are linked was later explored by George Field (*c.* 1777–1854) and remained popular until well into the twentieth century, with abstract artists such as Wassily Kandinsky (1866–1944) and Robert (1885–1941) and Sonia Delauney (1885–1979) exploring synesthetic aspects of color and music.

As evident from the title of his book, Newton's theory was almost exclusively concerned with the study of immaterial or additive color, that is, the color of light. However, most artists, designers, scientists, illustrators, and decorators needed to learn about material or subtractive color, that is, pigments and paints. Newton's optical theory was quickly disseminated, discussed, and promoted in European intellectual circles. Among his early supporters were the French philosopher Voltaire (1694–1778) and the mathematician Brook Taylor (1685–1731), who shared Newton's interest in the correspondence between the color spectrum and musical scales. Many subsequent publications on color and optics referenced and discussed Newton, though not always favorably. An early opponent was the French Jesuit mathematician and scientist Louis-Bertrand Castel (1688–1757), who in 1740 criticized the limitations of the color range identified by Newton in his work *L'Optique des couleurs* (Color Optics; 1740) (Lowengard 2006: 13–16). Castel's criticism foreshadows the strongly anti-Newtonian "polemic" part of Goethe's *Zur Farbenlehre* in which he not only questioned and tested the validity of Newton's research methods and findings, but also proposed different orders of color and applied moral and aesthetic values to color.

Despite his focus on colored light rather than material color, Newton proved tremendously influential on scientists and artists throughout the eighteenth and nineteenth centuries. Shortly after the publication of *Opticks,* attempts were made to create color systems and color diagrams, based on material color, suitable for application in the visual arts. In Britain, the entomologist Moses Harris (1730–*c.* 1788) produced the first comprehensive system of colors applicable to painting and also one of the first color circles representative of a color system in his short but influential work *The Natural System of Colours*. The date of the first edition, which was dedicated to Sir Joshua Reynolds (1723–92), is uncertain, but is considered to be between 1769 and 1776.[1] A posthumous edition from 1811 found an even wider readership, which is indicative of the new interest in color theory in the nineteenth century. By the 1830s his work was greatly discussed, taught, and his wheel reproduced in print by art teachers and scholars (Phillips 1833: 340–3; Mérimée 1839: 349–61).

Harris pays tribute to Newton's prismatic spectrum but then focuses on subtractive color mixtures and the qualities of certain pigments. He states that:

> By the term colour, or colours, we would be understood to mean one or all of those appearances which are seen in the rainbow refracted by the prism, or that so beautifully decorate the leaves of flowers, or any other substance except such as are white, which is but a term for a total privation or absence of colour.
>
> (Harris *c*. 1769–*c*. 1776: 4)

Accordingly, Harris combines the concept of Newton's prismatic spectrum with concepts of beauty in nature, which are reminiscent of notions expressed by Edmund Burke (1729–97) and William Hogarth (1697–1764) in the mid-eighteenth century.

One of Harris's aims was to provide a source of reference for painters and color-makers based on the principle of three primary colors (the "primitives" of red, yellow, and blue) and three "mediates" (orange, green, and purple), thus reducing Newton's seven colors to six, omitting indigo. Harris illustrated his work with copper plates showing two concentric circles, each comprising eighteen sectors of "prismatic" and "compound" colors at varying degrees of intensity, resulting in a total of 660 different tints. In the center of each circle, he placed overlapping triangles of the "primitive" colors. Where these three colors overlapped, they created black, the result of mixing yellow, red, and blue paint. The triangles in the circle of compounds were the "mediates" of orange, green, and purple, which also created black when mixed together. This complex system could not be represented by the mechanical coloring techniques available at the time. Aquatinting, although suitable for pictorial images, did not represent a reliable and accurate technique for this subject, so all of Harris's plates remained hand-colored, even in the new edition of 1811 (Plate 0.2) and the version included in William B.S. Taylor's 1839 translation of Mérimée's manual, *The Art of Painting in Oil and Fresco* (Mérimée 1839).

Despite his use of some of Newton's vocabulary, Harris clearly wrote for painters, color-makers, and scholars. His small but influential work can perhaps be considered a link between color theorists and writers of painters' manuals, as well as a bridge between scientific and aesthetic ideas associated with the later eighteenth and early nineteenth centuries. Harris was aware of the difficulties faced by artists when using pigments, and hoped that his color circles would provide guidance and assistance:

> Colours, which we may call material or artificial, are very imperfect in themselves; and, being made of various substances, as animal, vegetable and mineral, renders it extremely difficult, if not impossible, to effect the colouring of the schemes with any degree of perfection.
>
> (Harris *c*. 1769–*c*. 1776: 8)

At the beginning of the nineteenth century, the discussion of color was part of aesthetic discourse and teaching and also played a role in academic publications, although *colore* had not yet quite achieved the same status as *disegno* (design, drawing). In his *Discourses*, that is, lectures delivered at the Royal Academy between 1769 and 1790, the Academy's President, Joshua Reynolds, had still discussed color and coloring sparingly and largely in the context of the Italian masters, and even then only as a subordinate element in the art of painting. Although Reynolds was noticeably cautious about the use of "distinct" colors (by which he probably meant primary tints in high saturation), it is interesting that he discussed the principle of the three primaries at all. His comparison of "distinct" colors with martial music in Discourse IV, delivered in December 1771 both unwittingly referenced Newton's analogies to music and anticipated musical analogies made a generation later by the colorman George Field (discussed below), which were picked up again in the early twentieth century by avant-garde artists and color theorists (Reynolds 1801: 88–89).

Only one generation later, many scholars, art teachers, and artists discussed color with confidence and positioned it as a fundamental aspect of the arts, especially with regard to its materiality. For example, the landscape painter David Cox (1783–1859), who published many handbooks on painting, discussed contrast and the purity of colors in the context of both composition and color mixing. In one of his earliest publications, he acknowledged the basic order of three primaries and three secondaries in painting, but recommended a reduced palette:

> It will be observed that red, blue and yellow, the primitive, or simple tints, do not afford the most pleasing contrasts; nor do the derivative, or compound tints, orange, purple or green […] of which is learned, that real beauties, as applied to the art of painting, do not consist in a multiplicity of colours, but in the just combination of a few.
>
> (Cox 1811: 20)

These comments are presented as part of an argument for the measured use of contrasting tints for best effects, with Cox showing a clear understanding of pigment mixing, the concept of the color wheel, and its application to composition: "All colours or rather tints, when used simple, are clearer than when compounded, and they appear to greater advantage, whatever the strength, by being judiciously opposed to compound tints" (Cox 1811: 19). This concern with contrast and harmonizing tints became a major aspect of most nineteenth-century publications on color and continued well into the twentieth century.

Eighteenth-century ideas of beauty did not embrace the experimental and exuberant use of color witnessed by the early nineteenth century. The idea of beauty was expressed poignantly by Johann Joachim Winckelmann (1717–68) in his *Geschichte der Kunst des Alterthums* (History of the Art of Antiquity; 1764), in which he attributes the essence of beauty to pure white shades, here seen in relation to sculpture, while color should serve merely as a tool in order to assist beauty. The allusions to Newton's concept of white light may or may not be coincidental:

> Color contributes to beauty, but it does not constitute beauty in itself; rather it heightens beauty and its forms. Since white is the color which reflects the greatest number of light rays, and thus becomes the most easily recognized, a beautiful body will appear more beautiful the whiter it is.
>
> (Winckelmann 1764: 147–8; my translation)

These purist and chaste ideals of beauty changed dramatically in the early nineteenth century. Color began to take the lead in the creation of "the beautiful" or "the picturesque," which culminated in the application of the concepts of color contrast, primary and secondary tints (as seen in color wheels), and higher saturated tints, especially in fashion and interior decoration.

FIGURATIVE REPRESENTATIONS OF COLOR

Even though most illustrations of color studies and color theory display a certain degree of abstraction and had to serve the purpose of visualizing concepts and systems, it is worth noting that figurative or allegorical representations were also produced. These representations were rarely of instructional use; nonetheless they shed light on the popular reception of color literature and color theories. The rainbow as a motif had been used for centuries, mainly as a symbolically charged trope in both landscape painting and portraiture, though not necessarily with much regard for optical correctness, as is evident from, for example, the *Rainbow Portrait*, from around 1600 to 1602, of Elizabeth I at Hatfield House, attributed to Isaac Oliver. Rainbows, color ranges, and palettes often featured in allegories of painting, usually represented by a woman. Associations of color and the art of painting with women are likely to have their origins in Greek mythology, where the goddess Iris was the personification of the rainbow and a messenger of the gods.

The post-Newtonian era saw a shift in style in which rainbows and figurative representations of color were presented. Many early post-Newtonian images concerning color were literal and included narrative references to the story of Newton's experiments with prisms. Figurative and allegorical representations of color continued to be published throughout the eighteenth century alongside the abstract diagrams and charts. They appear to have had a popular appeal as "furniture prints" (affordable, as opposed to valuable art), as suggested by Angelica Kauffmann's *Colouring* (1780). Kauffmann was a founding member of the Royal Academy, London, and, incidentally, one of Goethe's friends. In 1778 she had been commissioned to produce ceiling roundels for the new Council Chamber in the Royal Academy, when it was still located at Somerset House, The Strand. The four roundels, painted in oil, depict the "four elements of art": *Design*, *Invention*, *Composition*, and *Colour*. Kauffmann's *Colour* or *Colouring* figure depicts a female painter dipping her paint brush into a Newtonian rainbow. A further symbol that alludes to color is a chameleon in the foreground (Figure 0.2).

FIGURE 0.2 Francesco Bartolozzi (engr.) after Angelica Kauffman, "Colouring," 1778. Photograph by Clive Boursnell. Courtesy of Alexandra Loske.

This conflation of the symbols of color theory and the material aspects of painting, combined with references to Newton, also appears in a 1785 print by Charles Taylor (1756–1832), entitled "Theory of Colours" and published in *The Artist's Repository and Drawing Magazine* (Figure 0.3). In this print, a female figure is depicted holding a prism against the sunlight, as if recreating

FIGURE 0.3 "Theory of Colours," published by Charles Taylor (London, 1785). Photograph by Clive Boursnell. Courtesy of Alexandra Loske.

Newton's original experiments of splitting white light. Expressing indebtedness to "the immortal philosopher" Newton, the engraving is described in the text as "The Theory of Colours, therefore, is represented by a figure employed in separating by a prism, a ray of light, and contemplating its effect on a board which receives the ray" (Fitzgerald 1785–8: 2:126). Of importance here is that, despite the topics of theory and immaterial color, multiple pictorial references are made to painting and even the production of pigments: gathered on the table next to the figure are a painter's palette with paint brushes, a phial, a book (an allusion to the theory underpinning painting), and flowers, which allude both to the genre of flower painting and the study of nature in general. This small but significant engraving (one of several in the magazine using female figures representing color) reflects the appreciation and status of color studies and color theory toward the end of the eighteenth century and refers to their application in the fine arts and even pigment production.

In the nineteenth century, figurative pictorial images of color theory, optical concepts, or the art of painting in general paved the way for much more literal and narrative illustrations, which can often be explained by the need for advertising and marketing. A number of decorative prints depicting Newton carrying out his experiments with prisms and light were produced throughout the nineteenth century. An example is a posthumously published print after George Romney entitled *Newton with the Prism* (1809). The scene is imagined and romanticized, showing Newton surrounded by scientific instruments and apparently performing his experiments with a prism in order to educate the two young women present; this is perhaps indicative of the association of the art of watercolor, and in particular flower painting, with pastimes for young ladies.

More prosaically, David Cox's frontispiece for *The Young Artist's Companion* from 1825 shows an assembly of artist's materials and tools in a studio environment carefully arranged in the style of a still life, whereas the frontispiece of an 1844 color manual by Rudolph Ackermann (1764–1834) depicts a young Queen Victoria and Prince Albert happily pursuing the art of watercolor painting surrounded by Ackermann artist's materials. Here, visible patronage, product placement, and advertising assume the role of allegorical representation or instructive value.

In 1833, another figurative representation of color or coloring appeared in a satirical publication on the art of painting: Henry Warren's *Hints upon Tints, with Strokes Upon Copper and Canvass*. In this curious volume, satirical poems in which painters and overenthusiastic readers of color literature are mocked, appear alongside advocates of the latest edition of serious publications on house painting. Some elements of art, for example, color, drawing, freedom, composition, and execution, are illustrated in humorous sketches that largely play on the double meanings of words. Color is here represented as a "person of colour," the face of what appears to be an Arab in headscarves. While orientalizing in its approach, the publication highlights the degree to which discussions, lectures, and publications about color and the arts in general had become part of the public consciousness, certainly enough to warrant a lengthy satirical response.

COLORS OF THE MIND: THE RISE OF COLOR LITERATURE IN THE NINETEENTH CENTURY

The nineteenth century witnessed a renewed surge in painters' manuals and general publications on color, as well as theoretical treatises on color. In addition to new works, several of the eighteenth-century treatises on color were published in new editions. Examples include the abovementioned work by Moses Harris, and a 1774 color list by the German geologist Abraham Gottlob Werner, included in his publication *Von den äusserlichen Kennzeichen der Fossilien* (On the External Characteristics of Fossils; 1774). This work was translated, edited, and ingeniously illustrated by the Scottish painter Patrick Syme (1774–1845), and published under the title *Werner's Nomenclature of Colours* in 1814. It proved popular, and in 1821 a second edition was produced (see Plate 0.3 and Figures 9.3 and 9.4). In some cases, manuscripts from previous centuries that had never before been printed were resurrected and published for the first time. Although this may be attributed to a continuation of the scientific, practical, and aesthetic interest in color prevalent in the eighteenth century, certain social and historical factors help explain the reason for a concentration of color literature published in the nineteenth century.

Many of the early nineteenth-century publications on color must be evaluated first in the context of the history of painting in watercolor (specifically landscape and flower painting) and the aesthetic ideals of the Picturesque and the Romantic movements, but the interest in color quickly expanded to other areas, including other forms of painting (in oil and fresco) as well as interior decoration. The design, scope, and format of books on color were also strongly influenced by developments in publishing and book illustration with noticeable changes that coincided with the introduction of chromolithography from around 1820 onwards. Prior to the 1820s, many illustrated books contained either hand-colored woodcuts, copper etchings or engravings, or, from around 1800, aquatinted engravings from either steel or copper plates. The hand-coloring of illustrations in books was expensive and labor-intensive and accounts for the limited circulation and the scarcity of surviving original editions of many books with high-quality hand-coloring.

A number of professional organizations that promoted the art of watercolor painting were founded in the early nineteenth century; this shows that painting in watercolors was, due to the affordability and ease of use of the medium, an extremely popular pastime and could be pursued both at a professional and an amateur level. The popularity of watercolor painting was fueled by the commercial production of portable painting equipment, such as small watercolor boxes or satchels. In 1842, collapsible tubes for oil paints became commercially available and widened the already large field of amateur painting manuals to oil painting manuals.

THE WIDENING APPEAL OF COLOR AND COLOR THEORY

Many of the early nineteenth-century color writers had connections with the Royal Academy and focused on themes such as light and shade, composition, color harmony, and color contrast. Academics, artists, and other associates of these institutions lectured on color, proposed color theories (for example James Sowerby and Benjamin West), or published practical color manuals (among many others, John Burnet, Julius Caesar Ibbetson, David Cox, and John Varley). The boundaries between these genres of color literature were often blurred; color theories were occasionally embedded in books on interior design or painting manuals. A particularly good example of the former is the published work of Humphry Repton (1752–1818), who embarked on a career in landscape gardening in 1788 shortly after the death of the leading British landscape designer Lancelot "Capability" Brown in 1783. In an attempt to fill the vacuum created by the death of Brown, he quickly established for himself a remarkable career, working for a wide range of clients, while at the same time writing a number of critically acclaimed books on his profession. Repton soon became known for his lavishly produced portfolios in quarto or folio size; these became known as "Red Books," because many of them were bound in red morocco. They comprised watercolor paintings of "before and after" views of gardens, landscape settings, and even buildings.

In a number of other publications, Repton also experimented with atmospheric and seasonal light conditions and their effects on color in landscape and interiors. While this may be typical of a landscape designer associated with the Picturesque movement, Repton is remarkable for making specific references to color theories and theorists of the eighteenth and nineteenth centuries. In 1803, he published a compilation of extracts from the texts and images of some of his "Red Books" entitled *Observations on the Theory and Practice of Landscape Gardening*. In this book, he commented on the importance of the careful application of color to ornament, albeit mostly in respect of exterior decoration: "While treating on the subject of ornaments and decorations, I must not omit to mention colors, since improper coloring may destroy the intended effect of the most correct design and render ridiculous what would otherwise be beautiful" (Repton 1803: 161).

In the concluding chapter of his *Observations*, Repton explained his interest in color theory and how the application of the four elements of the art of painting could be applied to his work:

> The Art of Painting has been usually treated under four distinct heads, viz. Composition; Design, or Drawing; Expression, and Colouring. Each of which may, in some measure, be applied to Landscape Gardening, as it has been treated in this work.
>
> (Repton 1803: 213)

Coloring, he noted, relates to "certain artificial objects," by which he meant architectural ornament and building materials. He then informed the reader about conversations with the politician William Wilberforce (1759–1833) about a "new theory of colours and shadows" by the mathematician Isaac Milner (1750 – 1820). Repton was so fascinated with Milner's article that he went to great length in order to obtain permission to reproduce it in full in *Observations*, in which he included a line engraving illustrating an experiment concerning colored shadows and a hand-colored symmetrical color wheel comprising red, orange, yellow, green, blue, and purple (Repton 1803: 213–19). Milner's theory, which appears not to have been published in any other context or on its own, is a concise and lucidly written theory based on the principle of complementary colors and ideas of color harmony expressed by many other theorists and writers of color manuals in the early nineteenth century.

In his last publication, *Fragments on the Theory and Practice of Landscape Gardening* (1816), Repton revisited some of his ideas concerning color introduced in *Observations*. He devotes an entire chapter each to the themes of contrast and color. In the chapter "Concerning Contrasts," he elaborates on contrasts observed in a landscape with regard to light conditions and how they affect the appearance of foliage. He further discusses the color schemes of gardens and the varieties of texture and size of plants and flowers. In the chapter "Of Colours," he again refers to Milner's color theory, before proceeding to explain that he had carried out some experiments with prisms himself, from which he derived some recommendations for the use of color in creating landscape paintings, printing, and the coloring of prints. Repton illustrated this chapter with a plate that shows the rainbow colors he observed during his experiments with prisms (see Plate 0.4). To this he added a "Diagram to explain the Harmony of Colours" comprising the three primaries (red, blue, and yellow) and three secondaries (violet, orange, and green). The complex plate also includes color diagrams illustrating the duality of cold and warm tints, as well as two pictorial images showing the colors of a landscape early in the morning, in twilight, before sunrise, and just after sunrise. Finally, Repton included a list of the relative proportions of each color in Newton's color wheel, in which blue and green dominate with sixty degrees each. The plate is a visual equivalent to Moses Harris's, or indeed Isaac Milner's, combination of additive and subtractive color theories with the aim of making them applicable to the arts.

Although Repton focused mainly on color theory and predominantly with a view to landscape gardening and painting, the fact that he considered his own findings useful for producing and coloring prints is typical of the interdisciplinary nature of color studies in the nineteenth century. His findings may even be indicative of the attempts of architects and designers to contemplate a practical use of color theory in the early nineteenth century.

Considerable research and publication activity is noticeable in and around Royal Academy circles, and yet some members of the older generation of academics still taught according to the ideals of Burke or Winckelmann. John Opie's (1761–1807) lectures delivered at the Royal Academy in 1806 and published posthumously in 1809 are examples of this generational divide. Opie clearly subscribed to the neoclassical hierarchy of form over color:

> Colour represents nothing, and lights and shadows have no meaning, till they are circumscribed by form. Drawing is therefore evidently the foundation and first element of the art, without which all the others, ideal or practical, are not merely useless, but non-entities.
>
> (Opie 1809: 22)

Evidently, there was considerable debate about these issues in art institutions and academies for quite some years and well into the nineteenth century.

THE IMPACT OF GOETHE

Of particular intellectual interest was the work on color by the German poet and playwright Johann Wolfgang von Goethe (1749–1832). Goethe had begun experimenting with color in the 1780s and had published a short treatise on color, *Beyträge zur Optik* (Contributions to Optics), in 1791–2. In this work, he proposed a dualistic color system based on the polarity of darkness and light, represented by the "pure" colors blue and yellow, from which all other colors can be produced, including the "impure" red (Goethe 1791–2: 18). Goethe argued further that black and white are not colors but representations of total darkness and the brightest light (17–18).

Rolf Kuehni and Andreas Schwarz comment that "Goethe did not distinguish between additive and subtractive color mixture" and had "little interest in color order beyond the hue circle" (Kuehni and Schwarz 2008: 62), but that he did acknowledge the existence of black and white pigments and frequently referred to paint and pigments available to the artist, suggests that he might not have fully acknowledged the difference between material and immaterial color.

Readers of *Beyträge zur Optik* were encouraged to recreate certain experiments with three-sided prisms, which included looking through a prism at various objects and surfaces. To that effect, Goethe included an expensively produced set of twenty-seven woodblock printed and colored playing cards. These were wrapped in brown paper with a woodcut vignette that depicted tools and motifs of color studies, including an eye surrounded by a rainbow set against the rays of the sun, with a prism and a mirror lying in the foreground.

Goethe pursued his research into color for twenty more years. It culminated in the publication that was probably the most substantial treatise on color composed in the nineteenth century: *Zur Farbenlehre* (On the Doctrine of Colors), which was published in three volumes (one of them including a series of colored plates) in 1810. As discussed in the chapter by Georges Roque in this volume, Goethe was anti-Newtonian in his approach and attempted to prove Newton wrong by elaborately recreating his prismatic experiments. However, the real impact of Goethe lies perhaps in the sheer volume, complexity, and variety of his intellectual output on the subject of color. Whereas Newton sought to be as objective and rational as possible, Goethe's approach reflected the times he lived in: individual perception and emotions associated with color were more important to him than hard scientific facts and predictability.

The first "didactic" volume of the *Farbenlehre* was translated into English by Charles Lock Eastlake and published in 1840 (Goethe 1840), but, according to Ian Bristow, Eastlake had finished the translation by 1820 (Bristow 1996: 189), which indicates that aspects of Goethe's color studies were discussed in academic circles soon after its publication in German. There is no doubt that *Farbenlehre* greatly influenced other academics and artists concerned with color in the mid- and late nineteenth century, notably J.M.W. Turner (1775–1851). Turner owned a copy of Eastlake's translation and made extensive annotations,[2] which is a testimony to his thorough and critical examination of the work. John Gage studied the annotations carefully and came to the conclusion that Turner considered Goethe's concept of complementary colors for harmonious compositions "far too rigid a framework within which to understand and express the diversity of natural coloration" (Gage 1969: 116). Despite his notable "suspicion of colour theory in a more general sense" (18), Turner was inspired to paint two canvasses with direct references to Goethe's *Farbenlehre* with the titles: *Light and Colour (Goethe's Theory): The Morning after the Deluge, Moses Writing the Book of Genesis* (exhibited 1843, Tate Gallery no. N00532); and *Shade and Darkness—the Evening of the Deluge* (exhibited 1843, Tate Gallery no. N00531), in which he explores Goethe's concepts of polarity in his color system, aspects of light and shade, and spiritual dimensions of color in painting.[3]

Within the context of Romantic art, Gage assigns Goethe a substantial legacy and considers him exemplary of a new generation of artists and writers, who "sought to extract new meanings for colours from their positions in space"

(Gage 1993: 194) and began to consider subjective color perception, emotional responses, and analogies between colors and character qualities and moral connotations. Significantly, Gage dedicated an entire chapter of *Colour and Culture* to "Colours of the Mind: Goethe's Legacy" (191–212), in which he stressed the importance of the shift toward the consideration of the subjective experience of color.

GEORGE FIELD: A COLORMAN IN SEARCH OF PERFECT PIGMENTS

George Field (*c*. 1777–1854) enjoyed a long and successful life, and his career is well recorded. He was a pigment maker, chemist, and color researcher, who published his first book, *Chromatics, or, An Essay on the Analogy and Harmony of Colours*, in 1817 in a small edition of 250 copies. He continued to write and publish on color until his death, and further editions of his works were published until the 1880s. His steady output, commercial success, connections with the art world, and wide-ranging research interests make Field's work an excellent example of the nature of color literature and the changing attitudes toward the use of color and pigments in the nineteenth century. He is also one of the most important links between color theory and its application and is therefore one of the key figures discussed by the contributors to this book.

Field followed in the tradition of attempting to present color systems visually. Great care was taken with the book's illustrations, which comprise color charts, diagrams, and variations of the color circle in the form of overlapping triangles forming star shapes (see Plate 0.5). All seventeen charts and plates in *Chromatics* are hand-colored, possibly by Field himself or under his close supervision, and the book was a high-price publication. The subtitle (*An Essay on the Analogy and Harmony of Colours*) also reveals the focus of the early nineteenth century on harmonious composition and a Goethean interest in finding not just geometric representations for color systems but also analogies and symbolic associations. Like Newton, Field was of the opinion that there was a strong connection between color and music, an analogy explored by him in his later publications. In contrast to Newton, though, he echoed Goethe in arguing for a basic principle of duality, where yellow and blue form a polarity associated with light and shade as well as activity and passivity. Frederick Burwick argues in his *The Damnation of Newton* that this notion had its origin in Romantic ideas, which had been popularized by Goethe and "become a commonplace in contemporary studies on colour" (Burwick 1986: 38–9). Like Goethe, who combined this concept of polarity with a symmetrical color system based on three primaries (or primitives) and three secondaries, as illustrated in several color circles, Field likewise recognized and promoted the concept of three primary colors. A practicing Christian as well as a scientist, Field combined this trichromatic concept of the primary subtractive colors, red, yellow, and blue, with Christian concepts of the Holy Trinity, going so far as to identify the purest and most stable pigments as earthly representations of this vision, namely madder reds, lemon yellow, and ultramarine blue.

Aside from these spiritual, metaphysical, and analogous interpretations of color, Field gained the unrivalled status of the most important color researcher and color maker of the nineteenth century on the basis of his lifelong search for "perfect pigments" and his deep understanding of the artist's craft without ever having been a practicing artist himself. He states in the final pages of *Chromatics* that perfection can perhaps only be achieved by combining pigments of the same color:

> Pureness, brilliancy, durability, depth, and transparency are but some among the many requisites of a perfect pigment, never wholly united in the same substance: hence it is generally necessary to employ two pigments of the same colour if we would produce the fullest effect, the one allied to the principle of light, the other to that of shade.
>
> (Field 1817: 56)

Field's most influential and extensive work, *Chromatography*, was published in 1835, but he had experimented with pigments and pigment manufacture since 1804. He recorded his observations in extensive notebooks and was particularly concerned with the invention of tools and machines for the extraction, filtration, and production of pigments. In 1808, he began supplying pigments to artists, other colormen, tradespeople, artists' suppliers, printers, and publishers, including Rudolph Ackermann. He also supplied William Winsor and Henry Newton who, in 1832, founded the art materials supplier Winsor & Newton. During his early color research, Field was based in London, but by 1808 he was operating on a large scale as a manufacturer of lake pigments, having built and established a factory at Conham near Bristol. A few years later, he moved back to London, where, by 1813, he had established an even larger pigment factory at Hounslow Heath. His enterprise was successful in that he responded to the ever-increasing demand for reliable pigments, and by 1824 he had moved his factory and residence to Syon Hill Park on the estate of his lifelong supporter and patron, the third Duke of Northumberland.

Chromatography was translated into German and published in Weimar in 1836, which is an indication of the continued pan-European interest in color studies. Field was responding to the need for not only quality pigments but also scientifically sound and reliable published information on color and pigments. This explains the continued popularity of Field's publications, all of which were reprinted in expanded or revised editions. Gage criticizes the shrewdness with which Winsor & Newton reissued and repackaged some of Field's work, but that in itself reflects changing demands and developments in art and print culture (Gage 2001: 22–3).

Field's pigments literally withstood the test of time, and from the 1850s onward they were used and praised by the Pre-Raphaelites (in particular William Holman-Hunt and John Everett Millais).[4] They were also singled out by Mary Philadelphia Merrifield in her 1844 translation of Cennino Cennini's *Libro dell'arte* (*A Treatise on Painting*, discussed below), who commented on their high quality and durability. Regrettably, there is no precise documentation listing the full range of pigments supplied by Field. A comparison of his manuscripts, the lists included in *Chromatography* and its later editions, and references by contemporaries, reveal that he traded in madder lakes, ultramarine and lemon yellow, chrome yellow, a variety of other yellows, Prussian blue, vermilion, chrome green, citrine lake, russet, olive lake, and an orange vermilion.

Field's particular interest in the stability and general quality of pigments, as well as the commercial aspect of pigment production, probably makes him the most significant advocate of color theory and its application in arts and design in his period. Moreover, he provided a link between early nineteenth-century Romantic ideas and mid- and late nineteenth-century commercial interests. The application of Field's work in the decorative arts and in architecture has been discussed by Gage, who associates the renewed interest in Field's work with the publicity created by Owen Jones's designs for the interior of Joseph Paxton's Crystal Palace for the Great Exhibition in 1851. Sir Henry Cole, the instigator of the exhibition, had invited Field to exhibit his materials (presumably tools and machinery used for pigment production and the pigments themselves), but Field declined, possibly because of his advanced age (Gage 2001: 22). However, Jones's proposal of an interior based on the principle of a reduced color scheme of the three highly saturated primary colors in specific proportion was influenced both by his studies of the decorative schemes of the Alhambra in Granada, Spain, and by Field's chromatic system. Jones's schemes were carried out and may have formed the only known application of Field's theories to architecture and interior design on a grand scale. By the mid-nineteenth century, discussions about the status and role of color in art had clearly penetrated many different disciplines and areas of art and commerce, including architectural color, fashion, advertising, and decoration.

FASHIONABLE COLORS, PAINTS, AND MAGAZINES

In 1794, the American-British-German scientist Sir Benjamin Thompson, Count Rumford (1753–1814), addressed the Royal Society in London on color harmony, colored shadows, and the order of the color wheel. Soon afterwards, he alluded to color in fashion in the broadest sense in his *Conjectures Respecting the Principle of the Harmony of Colors* which first appeared in his *Philosophical Papers* (1802). He commented on the usefulness of these principles not only to painters but to "ladies [who] may choose ribbons for their gowns, or those who furnish rooms may arrange their colors upon principles of the most perfect harmony and of the purest taste" (Thompson 1875: 63–71).

Early nineteenth-century publications concerned with color included many books and popular magazines on fashionable interiors and design in general. It appears that the introduction of colored plates in a number of these publications both reflected and fueled an interest in color in interior design. Of particular importance in this context are the publications of the aforementioned Rudolph Ackermann who embraced new techniques in color printing and became the leading publisher of color plates in Britain. From the late 1790s onwards, Ackermann published a large number of illustrated books on design, fashion, travel, topography, and manuals for painters and decorators. Between 1809 and 1828, he published an immensely popular monthly journal entitled *The Repository of Arts, Literature, Commerce, Manufactures, Fashions and Politics* (in 1829, it was renamed *Repository of Fashion*), which included hand-colored plates showing the latest dress fashions, London buildings and their interiors, and furniture designs. The early editions are remarkable for their "Allegorical Wood-Cut" plates, to which were attached samples of fabrics for use in dressmaking, soft-furnishing, or upholstery, making the color, texture, and design of these fabrics tangible. Some issues also included specimens of drawing or embossed paper for use in interior decoration. These swatches were accompanied by descriptive text with information about where to purchase the material.

The fashion plates, fabric samples, and accompanying descriptions constitute a lively image of fashionable colors and designs in the first half of the nineteenth century. Color was clearly a predominant topic in Ackermann's *Repository*, but it is also the object of intellectual discussion in the early issues. Between June 1809 and December 1810, the first article in each issue of the *Repository* was a letter by the otherwise anonymous author "Juninus" entitled "On the Splendour of Colours." This column discussed topics relating to the arts in a playful manner, using the format of fictional correspondence between a recently deceased "Miss K." (Kitty) and a number of other characters. The topics were wide-ranging and included specific works of art (contemporary or historical, paintings as well as prints), artists' styles and careers, subjects in art, the elements of painting, different genres of painting, color in architecture, color in ancient Rome, philosophical discussions concerning art, and the teaching of art at the Royal Academy (the latter with frequent references to Joshua Reynolds).

Many of the "Juninus" columns on color were concerned with the quality, manufacture, and sourcing of pigments, not only in relation to specific works of art, artists, and techniques, but they also revealed a general scientific and commercial interest. The October and November 1809 issues included a detailed list of commercially available pigments and binders with notes on their history, manufacture, chemical makeup, and specific qualities ("Juninus" 1809a: 219–23; b: 285–9). It is effectively a chart of artists' pigments available in 1809, without color illustration, but nevertheless useful as a reference. Color and coloring were presented as synonymous with the arts in general, reflecting the general interest in all aspects of color in the Regency period. From 1811 onwards, Juninus's contributions were given the more generic title "Conversations on the Arts."

Magazines such as Ackermann's *Repository* clearly also tapped into new ideas of fashionable home design, and their popularity coincided with the introduction of the term and concept of "interior decoration" in print. In 1807, the Dutch-born designer and collector Thomas Hope (*c*. 1769–1831) published *Household Furniture and Interior Decoration*, based on his own designs, which were inspired mostly by classical aesthetics (see Figures 9.1 and 9.2). The book is notable and relevant in this context for several reasons. Firstly, Hope's designs frequently embedded exotic and polychromatic elements in his overtly neoclassical designs. Secondly, and more generally, Hope's book introduced the term "interior decoration" into the English language. Thirdly, the book, although not dealing specifically with color, considered and discussed the effect of design schemes on the sensual experience of an interior and stresses the significance of each individual object in the larger context of an interior design scheme. Hope deliberately illustrated his book with uncolored outline engravings in order to make it affordable for craftsmen and designers, thus sacrificing the depiction of "the harmonious blending, or the gay opposition of the various colors" (Hope 1807: 15).

This new sensitivity to color in people's immediate surroundings culminated soon after in one of the most influential publications that aimed specifically to apply color theory to interior design. This was David Ramsay Hay's *The Laws of Harmonious Colouring Adapted to House-Painting*. Hay was a Scottish interior decorator who, later in life, enjoyed royal patronage and received a number of high-profile commissions, including the interior decoration of the Palace of Holyroodhouse in Scotland. His treatise was first published in Edinburgh in 1828, which coincided with Hay's establishment of his business as an interior decorator in that city, and it appeared in six editions up to 1847. In the third edition (1836), Hay changed the subtitle of the work from *Adapted to House-painting* to *Adapted to Interior Decorations, Manufactures, and Other Useful Purposes,* thereby widening the scope of its applicability.

The Laws of Harmonious Colouring is a seminal work in the field of architectural color, because it presents a fully developed sense of both the application of color theory to interior design and the importance of color perception, individual taste, and aesthetic principles applied to interiors. In Hay's view, architectural color and color schemes must reflect and respond to the function of the building and each individual room, the owner's personal taste, geographical location, and orientation with regard to light. With his generous references to other color researchers and historical sources (he mentions, for example, Leonardo da Vinci, Newton, George

Field, and Syme), he is exemplary of a new generation of color writers who had both internalized eighteenth- and early nineteenth-century color studies and applied them successfully to the now fully established genre of interior decoration. Hay's publications predate those of the French chemist Michel Eugène Chevreul (1786–1889), who published *De la loi du contraste simultané des couleurs et de l'assortiment des objets colorés* (On the Law of the Simultaneous Contrast of Colors and of the Matching of Colored Objects) in 1839, in which he stressed the applicability of his color theory to a wide range of disciplines within the arts, including "la décoration des edifices" (literally, "the decoration of buildings," but translated in 1854 as "interior decoration").

Like many of his contemporaries, Hay developed a trichromatic color system based on primary, secondary, and tertiary colors. He was especially influenced by Goethe, Field, and his countryman Syme, whose editions of *Werner's Nomenclature* (1814 and 1821) influenced his own *Nomenclature of Colours, Hues, Tints, and Shades* (1845) (see also Kuehni and Schwarz 2008: 76–7). Patrick Baty considers this complex but popular later work of the utmost importance, because it includes a rare collection of 240 named color samples in the form of hand-painted card triangles, which were pasted on to the plates and probably produced by the author (see Plate 2.2). He argues that "therein lies its significance as a reference source today. Instead of relying on twenty-first-century interpretations of color names, with Hay's *Nomenclature* one can see examples of what was felt to be 'drab colour', 'sage green', 'olive' etc. in the 1840s" (Baty 2017: 139).

Despite his indebtedness to historical texts and research, Hay also displays awareness of contemporary trends and fashions and offers consumers advice on where to source quality materials for decorating their homes. Rather daringly, he states that "this branch of industry has suffered greatly from an inferiority in the design and colouring of our patterns of all kinds of fancy goods," and rates any products coming from France as far superior due to the lack of opportunities for training and the study of the art of design in Britain (Hay 1836: 53–4). An example is the color *giraffe*, a name given to a particular shade of yellow that resembled an actual giraffe: "A rich hue of green upon the walls of a drawing room, accompanied by cream colour, French-white, and gilding on the cornice, ceiling, and wood-work, with damask hangings of giraffe and gold colour" (48). The color was named in response to the public interest in the first living giraffes that arrived in France and England in 1827, which resulted in fashionable ornament, hairstyles, fabrics, and accessories inspired by this animal's features. One of several examples can be seen in Ackermann's *Repository* from 1828, which shows and describes "giraffe color" dresses (see Plate 0.6).

"THE COLOR OF LIFE": CHROMATIC METAPHORS

Despite the industrialization and commercialization of color, a relationship with it was also developed on a visceral and emotional level. Indeed, both the material and visual qualities of color and pigments came to be used increasingly as metaphors in literature and poetry, often with surprising analogies to the human body and human emotions.

In the early nineteenth century, J.M.W. Turner, one of the painters who embraced color in a radical and fearless way and engaged with color theory, composed a poem in praise of the color/pigment vermilion in a notebook and placed color in the painter's hands:

> Those far faint lines Vermilion dyed
> With wonder view'd—enchanted cried
> Vermilions honors mine and hence to stand
> The Alpha and Omega in a Painters hand!
>
> (cited in Mitchell 2013: 58–9)

In 1847, Emily Brontë (1818–48) put the following words into the mouth of her famous character Catherine in her novel *Wuthering Heights*, comparing the color of blood to wine, and using this as a metaphor for a colorful mind: "I've dreamt in my life dreams that have stayed with me ever after, and changed my ideas: they've gone through and through me, like wine through water, and altered the colour of my mind" (Brontë 1847: 70). One of the most famous examples of color representing strong emotions can be found in the novel *Moby-Dick* by Herman Melville (1819–91), in which color is synonymous with the sublime and with fear of the unknown. An entire chapter of the novel, "The Whiteness of the Whale," lists the symbolic meanings of white through history and in many cultures, before associating the white color of the whale with terror, death, ghostliness, and snowbound landscapes. Melville's narrator muses that it is the,

> elusive quality […] which causes the thought of whiteness, when divorced from more kindly associations, and coupled with any object terrible in itself, to heighten that terror to the furthest bounds. Witness the white bear of the poles, and the white shark of the tropics; what but their smooth, flaky whiteness makes them the transcendent horrors they are? That ghastly whiteness it is which imparts such an abhorrent mildness, even more loathsome than terrific, to the dumb gloating of their aspect. So that not the fierce-fanged tiger in his heraldic coat can so stagger courage as the white-shrouded bear or shark.
>
> (Melville 1851: 209)

Significantly, the last lines of the chapter read like an excursion into color theory, albeit infused with symbolism, when the narrator ponders the inherent nature of the color white:

> Or is it, that as in essence whiteness is not so much a color as the visible absence of color, and at the same time the concrete of all colors; is it for these reasons that there is such a dumb blankness, full of meaning, in a wide landscape of snows—a colorless, all-color of atheism from which we shrink? (Melville 1851: 216)

This association of body, mind, and emotion with color is used again at the end of the nineteenth century in the prose and poetry of Alice Meynell (1847–1922), who in 1896 published a collection of essays entitled *The Colour of Life*. The title of the book is a quote from the title of the first essay, in which the author discusses the human figure in relation to the urban context of London and the wider world in metaphorical and actual chromatic terms. City, landscape, and atmospheric condition are experiences and described through the medium of color. "The true colour of life," Meynell muses,

> is not red. Red is the colour of violence, or of life broken open, edited, and published [...]. The true colour of life is the colour of the body, the colour of the covered red, the implicit and not explicit red of the living heart and the pulses. It is the modest colour of the unpublished blood. (Meynell 1896: 1)

In Meynell's view, color is a symbol of life itself, a pulsating force of creativity and sensation. This use of color as a powerful symbol is just one example of color as an expressive tool in art and literature at the end of the nineteenth century, which culminated in the bold use of color in expressionism in the early twentieth century and paved the way for abstract art and color field painting.

In the early twentieth century, the association of the human figure with color was also explored in the popular work published by the theosophists Charles Webster Leadbeater (1854–1934) and Annie Besant (1847–1933). Besant and Leadbeater co-authored *Thought-Forms: How Ideas, Emotions and Events Manifest as Visible Auras* (1901), in which they discussed the color of auras and proposed that emotions change the color of any living being's cloud-like aura. In 1902, Leadbeater published his own work on the subject, *Man Visible and Invisible: Examples of Different Types of Men as Seen by Means of Trained Clairvoyance*. The book's frontispiece, entitled "Key to the Meanings of Colour," is a table of twenty-five colors, where each is assigned a character trait, emotion, or disposition, such as high spirituality, selfish religious feeling, fear, jealously, sensuality, or avarice. Leadbeater devoted an entire chapter to the meaning of colors surrounding astral bodies. Although questionable on a scientific level, the popularity of writings of this kind highlights the dramatic changes in attitudes to color, from consideration of the materiality of paint to the use of color as an expressive tool and a mirror of emotions and beliefs (see Plate 0.7).

WOMEN IN COLOR HISTORY

Despite the surge in illustrated literature on color in the early nineteenth century and significant advances in printing and color reproduction as the century progressed, few women published on the topic of color before the twentieth century. The industrial age is witness to the first examples of women not only using color (in acceptable pastimes, such as painting in watercolor within the range of the domestic sphere), but also to a slow and steady increase in the female presence in color history. This paved the way for publications on the topic by women in the early twentieth century and coincided with the rise of avant-garde groups, the opening of a few art colleges for women, and the advent of Modernism and Expressionism, during which women gained a stronger voice both with their art and their publications (for further discussion, see Loske 2018). The lack of formal and higher education explains the largely observational, practical, and phenomenological approach by women. Some early women writers on color relied on experience gained from being art teachers, while others based their knowledge on a careful study of artworks in galleries. Yet others relied on books that they had read or transcribed in libraries or their experiments on color, painting techniques, and artists' materials in a domestic environment. In his extensive bibliography *Books on Colour 1495–2015*, Roy Osborne estimates that, in the nineteenth century, approximately 430 original books on color were published in Europe, Asia, and the Americas, compared to an estimated 1,500 in the twentieth century (not counting translations and reprints) (Osborne 2015: 5, 21). Of the nineteenth-century publications, fewer than twenty were authored by women, although it should be cautiously added that a few were anonymous, and some may never have been recorded. Few women wrote about color generally; typically, they considered color in specific contexts, frequently in botany, horticulture, or flower painting, the latter being considered a "polite art" and thus suitable for ladies. Among these are Anne Pratt (1806–1893), who wrote *Flowers and their Associations* (1840) and Elizabeth Twining (1805–1889). Twining's two-volume *Illustrations of the Natural Order of Plants* (1849–55), contained 160 hand-colored lithographic plates. Her French contemporary Marie-Élisabeth Cavé (Boulanger) (*c.* 1810–83) wrote a somewhat more theoretical work, *La Couleur* (1863),[5] that dealt with the methods of the painter Eugène Delacroix and had some impact internationally.

The last two decades of the nineteenth century witnessed an increase in practical handbooks and textbooks on color, as well as an interesting example of literary criticism by the American writer Alice Edwards Pratt (1860–1902).

Her doctoral thesis was published as *The Use of Color in the Verse of the English Romantic Poets* (1898) and may be cautiously regarded as marking the beginning of the inclusion of women in the scholarly canon of color literature. The book contains several tables and color lists, but no illustrations. Other less academic works often deal with familiar subjects long associated with the female sphere, such as fashion, flowers, home decoration, and teaching guides. This tendency continues into the twentieth century, but the dramatic rise in publications generally provided opportunities also for experimental writing. Three writers serve here as case studies of how women published on color in the early nineteenth, mid-nineteenth, and very early twentieth centuries.

MARY GARTSIDE: THE FIRST WOMAN WRITER ON COLOR?

The first woman identified in color history as an author of published treatises on color is the English flower painter Mary Gartside (*c.* 1755–1819). There are very few details about her life, but it is known that she taught watercolor painting to ladies and exhibited botanical drawings at the Royal Academy in 1781 and at other London venues until 1808.[6] Between 1805 and 1808, she published three books on painting in watercolor that reflect her interest in color theory and its applications. In chronological order, these books are: *An Essay on Light and Shade* (1805), *Ornamental Groups, Descriptive of Flowers, Birds, Shells, Fruit, Insects etc.* (1808b), and the second, expanded edition of her first book with the new title *An Essay on a New Theory of Colours* (1808a). The last-named book was intended as the first of a three-volume set, but volumes two and three never appeared. Gartside died in December 1819 in Shropshire, England. She was remembered in London's *Sun* newspaper not only for her flower paintings but also for her scientific knowledge (*Sun* [London], December 25, 1819, p. 3).

Although Gartside's books were painting manuals for a female readership, she managed to make a place for herself among color theorists, as indicated by the term "new theory" in the second edition. She makes reference to some of the most influential color writers in history, including Isaac Newton and Moses Harris, and displays solid knowledge of contemporary color studies. It is possible that she was a friend of color theorist and botanist James Sowerby.

An Essay on Light and Shade was published in quarto format and followed an only recently discovered undated twelve-page pamphlet entitled *An Essay on Light and Shadow* (*c.* 1804), published presumably shortly before this more substantial book. The 1805 *Essay* comprises fifty-four pages, an engraved title page, two pictorial engraved plates (soft ground etchings, which were also included in the earlier pamphlet), two colored tables, a further colored engraving, and eight colored plates. The two soft ground etchings show round objects in relation to an observer's eye and to light conditions, illustrating the principles of foreshortening and shading. The two tables are copper-plate line engravings showing seven "prismatic colours" and seven "compound tints of a second order, composed from the pure prismatic compounds." The other engraving provides the outline for Gartside's own color circle, in which she adjusts Newton's order of colors to serve her own argumentation and application of her theory to material color. A section of the circle is colored-in by hand.

What makes Gartside's works truly remarkable are her illustrations of eight colors—white, yellow, orange, green, blue, scarlet, violet, and crimson—in the form of full page, freely painted watercolor "blots." These blot images appear organic and are vaguely reminiscent of flower heads, but remain abstract (see Plate 0.8). Gartside's aim was to reduce examples of harmonious compositions to their color layout and show degrees of brightness within the colors. In color literature from the early nineteenth century, there is no other example of a representation of color systems that is as inventive and radical as Gartside's blots, but she may have inspired later color writers who also produced abstract color blots, such as George Barnard, who included a plate of very similar blots in *The Theory and Practice of Landscape Painting in Water-Colours* ([1855] 1858), and Emily Noyes Vanderpoel at the beginning of the twentieth century (see below). A similar use of abstraction and reduction is found in Frank Howard's painting manual *Colour, as a Means of Art* (1838), in which he made reference to old and new master paintings and reduced them to their chromatic layout, illustrated in colored lithographs with additions by hand in watercolor, gouache, and pencil (see Plate 0.9).

In critical literature on color, Gartside was overlooked until the mid-twentieth century, when Frederic Schmid discussed her work in relation to Moses Harris and credited her with having produced one of the earliest color wheels. Schmid was the first to reproduce both her color wheel and one of her blots in print (though not in color) in *The Practice of Painting* (1948). He commented that the blots were:

> very fantastic and modern, [reminiscent] of a modern painting by the Swiss Giacometti, or even a Walt Disney film. Strange as it sounds, these plates with a formless mass of dabs of colours ranging through the whole scale of prismatic colours and their mixtures, are of a fascinating beauty.
>
> (Schmid 1948: 113)

Gartside's blots appear fresh and timeless because of their abstract quality and chromatic intensity, but their inclusion raises questions about production methods and the degree of the author's involvement. Gartside herself may have painted some of the sets of color blots, though with a cautiously estimated print run of between 150 and 200 it means that, in total, between 1,650 and 2,200 plates needed to be colored. It is unlikely that Gartside would have been able to produce this number of plates herself. Her professional circumstances suggest that she might have employed students and colleagues. Gartside's *Ornamental Groups* was a lavishly produced imperial folio, intended as a companion to her *New Theory of Colours*. It was to illustrate the application of her color theory to watercolor painting and included twenty full-page aquatint engravings by the author herself.

MARY PHILADELPHIA MERRIFIELD: TRAVELING, TRANSCRIBING, AND TRANSLATING

The second woman who left a significant mark on color research in the nineteenth century is the abovementioned English writer Mary Philadelphia Merrifield (1804–1889), whose main focus was on historical color research. She is best known for the first English translation of one of the first comprehensive works on artists' materials, recipes, and techniques. This is her translation of Cennino Cennini's *Libro dell'arte*, which was published in 1844 under the title *A Treatise on Painting*, *Written by Cennino Cennini in the Year 1437*.[7] Cennini's book was written in Florence in the early fifteenth century, but had been published in its original Italian form only in 1821. As a result of the success of her translation, Merrifield was commissioned by the British government to travel to France and Italy between 1844 and 1846, in order to identify and transcribe medieval and Renaissance manuscripts on color, and to research the make-up of early pigments and Italian methods of painting. The trip resulted in several important publications, including *The Art of Fresco Painting* (Merrifield 1846), followed by the significant *Original Treatises: Dating from the XIIth to XVIIIth Centuries on the Arts of Painting, in Oil, Miniature, Mosaic, and on Glass; of Gilding, Dyeing, and the Preparation of Colours and Artificial Gems* (1849).

Merrifield, who in her first publication on color promoted Field's work, was invited to provide an essay on Owen Jones's color scheme in the *Illustrated Catalogue* accompanying the Great Exhibition of 1851, published by *The Art Journal*. She entitled her essay "The Harmony of Colours as Exemplified in the Exhibition," in which she not only explained Jones's scheme but also touched upon the variety of forms and objects in interior design with regard to color and pigments (Figure 0.4). She concluded that the same principles apply to painting a picture and designing an interior or decorative object:

> The attainment of a good and harmonious style of color in painting is the result of much observation and study, not only of nature, but of the works of other artists: the same steps must be followed in Art-manufactures, or the same results will not be attained. When the principles by which the harmony of colour is regulated are clearly understood, they are easily carried into practice.
> (Merrifield 1851: VIII‡ [p. 352])

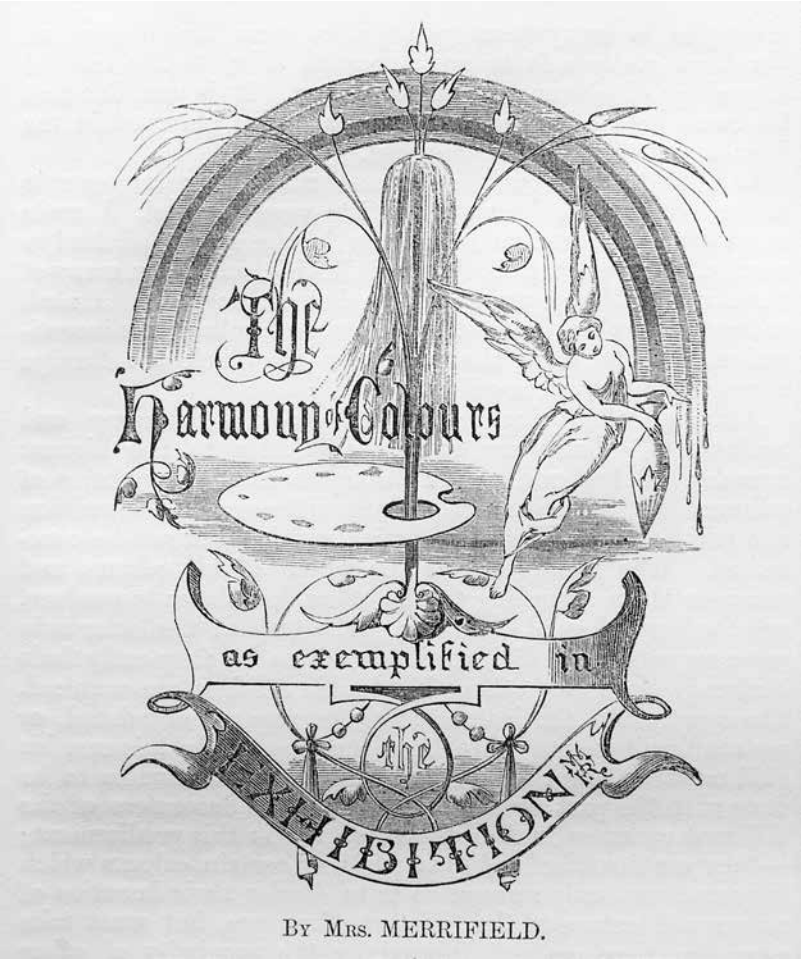

FIGURE 0.4 Vignette accompanying Mary Merrifield's essay "The Harmony of Colours …" in *The Art Journal Illustrated Catalogue* (London, 1851). Courtesy of Alexandra Loske.

Merrifield, who was probably privately educated and not allowed to attend university, also wrote about the application of color theory in art, fashion, and architecture. From the early 1850s onwards, she also wrote several books, in which she provided practical advice on painting and drawing, in a series of artists' handbooks published by Winsor & Newton. Several editions of these books appeared and were still being reissued by Winsor & Newton after her death. They are typical examples of the concise and affordable handbooks on art that began to appear in the mid-nineteenth century in the sense that they are sparsely illustrated with only a few engravings or monochromatic lithographs and aimed at a general readership. Merrifield herself is an outstanding example of a nineteenth-century woman who acquired expertise in a particular area despite the lack of formal higher education. Her knowledge was almost exclusively based on observation, accumulation of facts, and independent research (see also Loske 2016).

EMILY NOYES VANDERPOEL: A CREATIVE COLOR ANALYST

The early twentieth century was a turning point for women with regard to writing and publishing on color. The number of publications by women mushroomed, especially in the United States, where the publishing industry was not as badly affected by World War I as in Europe, and where the cultural atmosphere appears to have been more progressive and inclusive.

In 1902, the New York-born artist Emily Noyes Vanderpoel (1842–1939; see Loske 2019) published *Color Problems: A Practical Manual for the Lay Student of Color,* an intriguing and ambitiously illustrated handbook on color. Although the subtitle describes the book as a practical manual, it pushed the boundaries of genres, especially with regard to the visual representation of color order and harmony. A chronological list of color literature at the end of the volume shows that Vanderpoel also conducted research on the topic in languages other than English. She gave as one of the aims of the book the applicability of scientific color studies to a variety of disciplines beyond fine art:

> Painters of pictures must study color as well as lines and composition; but a better understanding of color would also be of great value to decorators, designers, lithographers, florists, dressmakers, and milliners; women in their dress and home decoration, and many others. For such, to combine the essential results of the scientific and artistic study of color in a concise, practical manual, and to classify the study of color in individual eyes, in light, in history and in nature, has been the aim of the author of this book.
>
> (Vanderpoel 1902: vii)

This approach was not uncommon in color literature in the late nineteenth and early twentieth centuries, but Vanderpoel excels with the geometric and abstract style of her illustrations, which is similar to Gartside's approach almost one hundred years earlier.

Vanderpoel explains in her introduction the importance of images: "Color cannot be fully appreciated by any written description, the text has been made as brief as possible, the plates full and elaborate" (Vanderpoel 1902: vii–viii). The plates include some more predictable images of the optical range, color contrast, gradation, and tables of complementary colors, all neatly visualized in a relatively small format. Others are more experimental. The book was published with a set of transparent overlays (possibly made of celluloid) and instructions on how to use them with some of the plates (see Plate 0.10). Most plates show a high degree of abstraction, including one color blot ("harmonies"), which suggests the influence of Gartside, while some of the color contrast plates might be precursors of Josef Albers's color squares from *Interaction of Color* (1963). Vanderpoel also includes sketches comprising only simple brushstrokes, largely based on the observation of nature, for example: *Color Note from a Bluebird—A Harmony of Cobalt and Light Red*, or *Color Note from Evergreens Against a Gray-Blue Rain Cloud*.

Vanderpoel's most imaginative plates are dozens of so-called "color analyses," in which she breaks down an object or a design pattern into its chromatic components and presents the resulting color key on a 10×10 square grid, with the proportional distribution of each color noted below to the total of 100 squares. A piece of Chinese porcelain, for example, is broken down into 50 parts deep lapis lazuli blue, 29 parts turquoise blue, 12 parts ochre yellow, and 9 parts violet (see Plate 0.11). Vanderpoel's way of visualizing the order of color and their layout was measured, methodical, mathematical, and abstract, but at the same time surprisingly simple. It is likely that these images influenced or were influenced by the development of abstract art and design in the twentieth century. *Color Problems* was clearly a commercial success, since it was reissued in London and Bombay only twelve months after it was first published. In 2018, the book was republished by the New York press Sacred Bones in facsimile format, which even included reproductions of the transparent overlays.

These women writers have been chosen as examples of significant but as yet little-researched contributors to the canon of color literature. The aim has been to highlight the innovative techniques they applied to researching, publishing, and promoting their books on color. Although there were still only few examples of women in color literature, the nineteenth century was nevertheless a time during which women were able to assert their place in color history, and this was, of course, much helped by the popularization of color in general and painting as an acceptable pastime for women. These early women writers on color cleverly and assuredly utilized the possibilities offered by the age of industry, and they certainly paved the way to a larger wave of women writers and artists working on color in the twentieth century. The sheer scope of the commercialization and commodification of art, artists' materials, fashion, and print culture, is what makes the nineteenth and early twentieth centuries such a rich and opulent cultural period, which is reflected in how artists, writers, philosophers, teachers, manufacturers, and consumers—some women included—approached and embraced color. In addition to scientific findings, many of the philosophical speculations and theories about color in the eighteenth century were further developed or modified in the nineteenth century, and in turn informed the arts, print culture, and manufacturing of the early twentieth century.

CHAPTER ONE

Philosophy and Science

GEORGES ROQUE

> *The ox becomes furious if a red cloth is shown to him; but the philosopher, who speaks of colour only in a general way, begins to rave.*
>
> —Goethe (1840: xli)

Johann Wolfgang von Goethe (1749–1832) is an adequate starting point for this chapter, since he clearly conceived of his studies on color in opposition to those of Isaac Newton (1642–1727), though criticisms of Newton's theories had emerged before Goethe. Chemists from the 1780s, in particular, considered it a mistake to think that color depended on physics only and was therefore independent of the chemical composition of bodies. Chemists examining dyes were among the first to rebel against Newton, since it was easy for them to demonstrate that color can be modified by dyes, and that color changes depend on chemical and not physical processes. Accordingly, strong criticism came from chemists involved in the dyeing industry, including Claude-Louis Berthollet in France and Edward Bancroft in England (Shapiro 1993: 216–25).

The case of Goethe is different, however, since his criticisms go beyond the dispute between chemists and physicists: Goethe's general vision of color is hardly compatible with that of Newton. His first work on the topic was *Beyträge zur Optik* (Contributions to Optics; 1791–2). His continued work on color led to his seminal book *Zur Farbenlehre* (On the Doctrine of Colors; 1810), which was translated into English under the title *Goethe's Theory of Colours* by Charles Lock Eastlake and published in 1840.[1] It must be stressed, however, that the volume is just the first part of a threefold project. In the introduction to his *Theory of Colours,* Goethe explains that the work consists of three parts: the *Theory of Colours*, the didactic one, is the first volume; the polemical part, which is devoted to a detailed critique of Newton's theory forms the second volume; and the third volume is concerned with history and contains an impressive overview of color conceptions from antiquity until the end of the eighteenth century.

Generally, Goethe's critique of Newton has not been well received except by philosophers, such as Schopenhauer (see below).[2] Most scientists and especially physicists at the time rejected it, claiming that Goethe was not a scientist but a poet and therefore unable to criticize the great Newton. However, such a view does not take into account Goethe's important contributions to science, especially botany, as witnessed by his elegy *Versuch die Metamorphose der Pflanzen zu erklären* (known in English as "The Metamorphosis of Plants"; 1790). This celebrated work is considered a landmark and Goethe a father of morphology (Petitot 2004: 13). Although he was critical of Goethe's polemic stance toward Newton, even Hermann von Helmholtz (1995: 2–3) acknowledged the importance of his discoveries in anatomy and botany. Because of the attitude of scientists, who were of the opinion that a poet could not contradict Newton, Goethe's refutation of Newton's theories has long been overlooked. Things have changed, and now Goethe's studies on color are analyzed with a more open mind (Sepper 1988: 1–21).

But why was Goethe so skeptical of Newton? There are several explanations. One has to do with Newton's general understanding of color as a physical phenomenon in opposition to Goethe, who had a wider conception of color not limited to physics, since his point of departure was experiments based on visual perception. This explains his philosophy of color and also the main division of his treatise into three parts, which examined colors from the point of view of their physiological, physical, and chemical properties: "The first are fleeting and not to be arrested; the next are passing, but still for a while enduring; the last may be made permanent for any length of time" (Goethe 1840: xli).

Accordingly, Goethe had a comprehensive conception of color, which goes beyond Newton's view. This explains not only the differences between the two writers but also the fact that Goethe's experiments produced results different from those obtained by Newton. From this perspective, the difference is not a difference between a scientist and a poet, but rather a difference between a physical and a physiological approach to color (Sepper 1988: x, 103). Furthermore, Goethe was reluctant to accept the idea that color was an area of optics and that therefore a mathematical method was necessary in order to analyze it (Goethe 1840: 287, para. 725).

In contrast, Goethe took into account the physiological phenomena that he had observed, which have a lot to do with the relationship between light and color. From this point of view, Goethe could not accept that, according to Newton, light is heterogeneous and contains all colors, each with its own refrangibility. In his opinion, colors needed light as well as darkness: "We will here only anticipate our statements so far as to observe, that light and darkness, brightness and obscurity, or if a more general expression is preferred, light and its absence, are necessary to the production of colour" (Goethe 1840: xlii). Nonetheless, one more element has to be considered in order to understand what he calls a "basic phenomenon" (*Urphänomen*) in the field of vision:

> Such a basic phenomenon is that which has lately engaged our attention. We see on the one side light, brightness; on the other darkness, obscurity: we bring the turbid medium between the two, and from these contrasts and this medium the colours develop themselves.
>
> (72, para. 175)

Goethe's interest in the opposition between darkness and light does not have its origin only in his belief in the old theory, according to which colors are produced by mixing dark and light in different degrees. It also arose from his experiments, in which black and white are almost always involved. The reason is that in Goethe's view, "black, as the equivalent of darkness, leaves the organ in a state of repose; white, as the representative of light, excites it" (Goethe 1840: 6–7, para. 18). Hence the dialectical dynamic between black and white, which Goethe explores in many practical ways. One of these experiments concerns colored shadows, since they involve both light and shadow (29, para. 62).[3] Colored shadows belong to physiological colors, which are the topic of the first part of his *Zur Farbenlehre*. He therefore explains their importance at the very beginning of his book: "We naturally place these colours first, because they belong altogether, or in a great degree, to the subject—to the eye itself. They are the foundation of the whole doctrine" (Goethe 1840: 1, para. 1). Goethe gathered most of these phenomena from several scientific sources now called post-images, that is, colored images that persist on the retina for a few seconds after having been produced. Yet these induced colors depend on the colors previously perceived. As Goethe rightly noted, these colors are complementary:

> In order at once to see what colour will be evoked by this contrast, the chromatic circle may be referred to. The colours are here arranged in a general way according to the natural order, and the arrangement will be found to be directly applicable in the present case; for the colours diametrically opposed to each other in this diagram are those which reciprocally evoke each other in the eye. Thus, yellow demands purple; orange, blue; red, green; and *vice versa*: thus again all intermediate gradations reciprocally evoke each other; the simpler colour demanding the compound, and *vice versa*.
>
> (21, para. 50)

Hence the importance of his chromatic circle (see Plate 1.1), for which Goethe relies on the concept of complementary colors that began to be used in the scientific literature; he was acquainted with complementary colors after having read an essay by Jean Henri Hassenfratz (Matthaei 1962; Roque 2009: 70–2). Beyond the issue of colored shadows, complementary colors are, in his opinion, also important for aesthetics and color harmony. As Goethe explains,

> These phenomena are of the greatest importance, since they direct our attention to the laws of vision, and are a necessary preparation for future observations on colours. They show that the eye especially demands totality [*Totalität*], and seeks to eke out the colourific circle in itself. The purple or violet colour suggested by yellow contains red and blue; orange, which responds to blue, is composed of yellow and red; green, uniting blue and yellow, demands red; and so through all gradations of the most complicated combinations. That we are compelled in this case to assume three leading colours has been already remarked by other observers.
>
> (Goethe 1840: 28, para. 60)

Considering complementary colors as harmonious soon became the mainstream conception during the nineteenth century (Roque 2009: 79–90). What remains original is the way Goethe understood this through the idea of totality: if a given color produces in the eye the sensation of its complementary color, the reason would be that the eye looks for reestablishing the idea of totality. Hence the fact that this totality would be the chromatic harmony par excellence (Goethe 1840: 317–18, paras. 805–10; Pawlik 1979: 87–96).

Another contribution to color philosophy and theory made by Goethe is color classification. His point of departure is again what he calls the basic phenomenon, that is, that light as seen through a turbid medium appears as yellow, and darkness, seen through the same medium, appears as blue (Goethe 1840: 61–2, paras. 150–1). From these two basic colors, yellow and blue, the other colors can be produced, according to Goethe; by mixing them, for example, one produces green. Yet,

> each of the two first-named colours can however of itself produce a new tint by being condensed or darkened. They thus acquire a reddish appearance which can be increased to so great a degree that the original blue or yellow is hardly to be recognised in it.
>
> (Goethe 1840: xlii)

Goethe rightly notes that such a conception of generation and classification of colors is quite helpful for painters and dyers. Interestingly, he once commented that his own interest in colors arose from looking at paintings (Schopenhauer 1986: 17). Indeed, his chromatic system was of considerable help to painters, since it provided an organization of colors as well as an outline of their possible symbolic meanings, taking into account their relationship to light and darkness and the result of mixing blue and yellow. For instance, yellow “carries with it the nature of brightness, and has a serene, gay, softly exciting character"; "blue gives us an impression of cold, and thus, again, reminds us of shade"; and red "conveys an impression of gravity and dignity, and at the same time of grace and attractiveness" (Goethe 1840: 307, para. 766; 311, para. 782; 314, para. 796). Finally, since green is the result of mixing blue and yellow, it is supposed to combine their features. Hence the fact that,

> the eye experiences a distinctly grateful impression from this colour. If the two elementary colours are mixed in perfect equality so that neither predominates, the eye and the mind repose on the result of this junction as upon a simple colour […]. Hence for rooms to live in constantly, the green colour is most generally selected.
>
> (316, para. 802)

For artists selecting color combinations, Goethe provided very useful tools. This is in particular the case for Joseph Mallord William Turner (1771–1851) (Gage 1969: 173–88) and Philipp Otto Runge (1777–1810) (Matile 1979: 219–49; Gage 1999: 169–76) in the nineteenth century. At the beginning of the twentieth century, Wassily Kandinsky (1866–1944) based his own color system on that of Goethe, and Piet Mondrian (1872–1944) was also interested in Goethe's ideas (Roque 2018: 124–6).

In addition to the field of art, Goethe's *Theory of Colours* made an important contribution to a new understanding of color generally. It marked a shift from an interest from the physics of light and optics toward an approach based on observation, experiments, and the physiology of the eye (Crary 1990: 70). Not surprisingly, scientists involved in the incipient physiological optics read his works and learned from him, especially Jan Evangelista Purkinje (1787–1869) and Johannes Peter Müller (1801–1858), the teacher of Helmholtz (Gage 2011). Karl Ewald Konstantin Hering (1834–1918), too, should be mentioned, since he praised Goethe's color theory (Gage 1993: 202). It has been suggested that Goethe's insistence on the basic opposition between yellow and blue "made his system the ancestor of Hering's opponent-colour system" (202).[4] As far as philosophy is concerned, the same opposition of light and darkness made his system attractive to Romantic philosophers, such as Friedrich Wilhelm Joseph von Schelling (1775–1854), Georg Wilhelm Friedrich Hegel (1770–1831), and Arthur Schopenhauer (1788–1860) (Gage 1993: 202).

Schopenhauer was a philosopher well known for his book *Die Welt als Wille und Vorstellung* (*The World as Will and Representation*). He was one of very few contemporary philosophers interested in Goethe's color theory. After having completed his doctoral dissertation *Über die vierfache Wurzel des Satzes vom zureichenden Grunde* (On the Fourfold Root of the Principle of Sufficient Reason; 1813), he sent a copy of it to Goethe, who found it interesting and therefore asked Schopenhauer if he would like to study his *Farbenlehre*.

Schopenhauer accepted the offer, subsequently wrote a first version of his book *Ueber das Sehn und die Farben* (*On Vision and Colors*) and sent the manuscript to Goethe in 1815 for comments. Since Goethe was slow in returning the manuscript, it was not published until 1816. In 1830, Schopenhauer published a revised version in Latin, and at the end of his life (1854), a second edition of the original German.

Schopenhauer's book raises two issues. One is its importance within Schopenhauer's work, and the other is the relationship between Schopenhauer and Goethe. With regard to the first issue, some philosophers believe that without Goethe's suggestions, Schopenhauer would not have involved himself in the matter of color, which would therefore have remained purely a digression in his philosophy (see Pilar López de Santa María, in Schopenhauer 2013: 25). However, others believe that Schopenhauer's color theory forms part of his philosophy, as rightly advocated by Maurice Elie in the introduction to his French translation of *On Vision and Colors* (Schopenhauer 1986). Indeed, Schopenhauer explicitly refers to his book on color in *The World as Will and Representation* (Schopenhauer 1969: vol. 1, bk 1, 12). Furthermore, after enumerating all the phenomena analyzed, including "the attribution of color to external objects whereas it is merely an inner function, a division, through polarization, of the activity of the eye," he added that "all these are solid and irrefutable proofs that all perception is not only of the senses, but of the intellect; in other words, pure knowledge through the understanding of the cause from the effect" (vol. 1, bk 1, 13). This is, in fact, what he establishes in the first part of his essay *On Vision and Colors*. Accordingly, it comes as no surprise that he already referred to this essay in the preface of the first edition of *The World as Will and Representation*. After having mentioned that he is reluctant to quote himself all the time, he added:

> For I have left out all that is to be found in the first chapter of my essay *On Vision and Colors*, which otherwise would have found its place here, word for word. Therefore an acquaintance with that short earlier work is also presupposed.
>
> (vol. 1, xiv)

The reason is explained below.

The other issue, the relationship between Goethe and Schopenhauer, is a complicated one, as reflected in their correspondence. When Schopenhauer sent his doctoral dissertation to Goethe, he was only twenty-six years old. This does not mean, however, that he always agreed with the poet. In his letters to Goethe, there is a mixed sense of both respect and independence. In some instances, he makes it clear that he considers himself right and Goethe wrong. The tone of some of the letters explains why Goethe was reluctant to help

Schopenhauer publish his book. Moreover, when Schopenhauer sent him *The World as Will and Representation,* Goethe did not acknowledge its receipt.

Schopenhauer was undeniably one of the strongest advocates of Goethe's theory, but he did not accept it blindly. On the contrary, he wrote to Goethe that he had proposed a first "true" theory of color, whereas Goethe had just collected facts, and that a theory of color was missing in his *Zur Farbenlehre*. Then, comparing Goethe's theory to a pyramid, Schopenhauer considered his own theory as the summit of this pyramid (letter to Goethe, November 11, 1815).[5] From this, one may conclude that Schopenhauer's theory deserves to be analyzed in itself and not just as a mere defense of Goethe's. What Schopenhauer wrote in this letter to Goethe was in fact explicit in his introduction to the book, when he considers that Goethe's *Theory of Colours* "is really a systematic presentation of facts, but it remains thereby" (Schopenhauer and Runge 2010: 44). In other words, according to Schopenhauer, Goethe did not propose a true theory of colors. It is clear, therefore, that Schopenhauer presented his aim in writing that book as providing the theory that is lacking in Goethe's (45). His is clearly a philosophical essay, even though in the preface to the second edition Schopenhauer claimed that "its contents belong only for the smaller part to philosophy and for the greater part to physiology" (38). Such a warning seems rather rhetorical, as the next phrase makes his philosophical aim explicit. From the very beginning of the chapter, Schopenhauer holds that "All intuitive perception [*Anschauung*] is intellectual" (48). This philosophical position explains his interest in vision, as a means of showing the importance of his conception of intuition as belonging to understanding.

Yet, what is the theory Schopenhauer puts forward as his own? It has a lot to do with the concept of polarity, so important to nature philosophers, and Friedrich Wilhelm Joseph Schelling (1775–1854) in particular, but also to Goethe (Schopenhauer 1986: 20–4). Schopenhauer combines two kinds of facts. Firstly, the duality of light and darkness, on which Goethe insisted, since the activity of the retina depends on the degree of lightness or darkness. And secondly, the concept of complementary colors, which was also acknowledged by Goethe (Schopenhauer and Runge 2010: 64). As a result, Schopenhauer considers that,

> *Color is the qualitatively divided activity of the retina*. The difference between colors is the result of the difference between the qualitative halves in which this activity can be divided, and of their ratio to one another. These halves can only be equal once, when they show true red and perfect green. They can be *unequal* in innumerable ratios; therefore the number of possible colors is infinite. Every color, after its appearance, will be followed by its *complement to the full activity of the retina*, which remained behind in the eye as physiological spectrum.
>
> (68; emphasis in the original)

In the chapter on polarity, he considers this polar activity as a clear example of polarity as a general law of nature (Schopenhauer and Runge 2010: 71). Such is the theory of color put forward by Schopenhauer through which he believed that he had proposed a general theory of color beyond a mere accumulation of facts. Perhaps Schopenhauer's most important contribution to color is his insistence on basing it on physiological grounds. This is clear from his criticism of Newton, since he remarked that "the object of his [Newton's] study was light when it should have been the eye" (75), so that "we have gone back from light to the eye in our explanation of color, so that for us colours are nothing more than actions of the eye itself, appearing in polar contrasts" (76). Interestingly, Schopenhauer considered that Goethe, too, "had not advanced to the ultimate ground of all color phenomena in general, which is purely physiological" (86).

After this brief review of the basic ideas expressed by Schopenhauer in his book, it is possible to better understand why it constitutes the ground for *The World as Will and Representation*, the very beginning of which reads:

> "The world is my representation": this is a truth valid with reference to every living and knowing being, although man alone can bring it into reflective, abstract consciousness. If he really does so, philosophical discernment has dawned on him. It then becomes clear and certain to him that he does not know a sun and an earth, but only an eye that sees a sun, a hand that feels an earth; that the world around him is there only as representation, in other words, only in reference to another thing, namely that which represents, and this is himself.
>
> (Schopenhauer 1969: vol. 1, bk 1, 3)

From this first paragraph of Schopenhauer's main work, it is easy to understand why perception is so important to him. If the world is a person's representation, the best evidence of it is visual perception. From this point of view, the example given is quite significant: "We don't know a sun […] but only an eye that sees a sun." This is a clear reminder of his claim against Newton, that is, that Newton was interested in light instead of what happens in the eye. It is also worth noting that he often refers to George Berkeley's (1685–1753) idealism as a source for his own (see, for instance, Schopenhauer 1969: vol. 1, bk 1, para. 13). Yet, Berkeley (1709) was also very interested in visual perception. To summarize, Schopenhauer proposed a shift to a purely physiological understanding of color. If he insisted on sensations as subjective, he still made a distinction between subject and object, even though he considered them closely related and inseparable. Soon, such a distinction would be abolished in Ernst Mach's monism of sensations (Mach 1959). Not surprisingly, Wilhelm Ostwald (1853–1932), himself a leader of the monist movement in Germany, when working on color theory, wrote an essay on Goethe's and Schopenhauer's color theory

(Ostwald 1918). The path to an understanding of colors through a physiological approach is also obvious in the discussion below.

Michel Eugène Chevreul (1786–1889) was one of the most important chemists of nineteenth-century France. He was a pioneer of organic chemistry and, analyzing samples of soaps, discovered the nature of animal fat and named the different acids it contains. His discovery eventually led to important improvements in the field of industry, in particular in candles, since they made it possible to make candles that shed more light and produced less smoke. Because of his fame as a chemist, he was in 1824 appointed director of the dyeing department of the Gobelins Manufactury in Paris, where he worked for almost sixty years. At Gobelins, he developed a considerable amount of work on color, including color classification and color applied to industry, and he wrote his most famous book *De la loi du contraste simultané des couleurs* (*The Principles of Harmony and Contrast of Colours*), first published in 1839.[6]

Chevreul's work on color had its origin in a complaint from the Gobelins' weavers about the dyers in the department of dyeing. The problem was the black samples of wool used for the shades of blue and violet draperies, which seemed dull to the weavers. Chevreul tested the wools dyed in black in his workshop and then compared them with those dyed in the best places in London and Vienna. However, he realized that the black-dyed threads from his workshop were as black as those produced elsewhere. This led him to understand that the problem was not one of dye; rather, it was a physiological one related to visual perception and in particular to the perception of juxtaposed samples of dyed threads of wool. This discovery was, of course, a surprise. As a chemist, it was hard for him to acknowledge that the cause of the phenomenon he observed was "certainly at the same time physiological and psychical" (Chevreul 1864: 101).

Chevreul constitutes a particular case in nineteenth-century color theory. He was led to a psychophysiological approach to color through his own experiments and ignored what had been achieved in Germany, since he was not familiar with the German language. However, he was acquainted with the sources used by Goethe and Schopenhauer, in particular those on "accidental" and shadowed colors (for example, Darwin 1785; Scherffer 1785; and Buffon 1977; see Chevreul 1855: 64–5, paras. 122–31).

Through his experiments, Chevreul soon realized that perceiving an isolated sample of color and perceiving it juxtaposed to samples of other colors were two different things. He thought that he had understood the reason for the problem raised by the weavers: the black threads dyed in his workshop were perfectly black when seen in isolation, but less black when seen next to violet or blue threads. He spoke about it with André-Marie Ampère (1775–1836), one of the founders of classical electromagnetism, whom he often met at the Académie des Sciences, and his famous colleague told him: "So long as the result of your observations is not expressed by a law, they are valueless to me" (Chevreul 1855: para. 940).

The problem, however, was not a simple one, since as a chemist Chevreul was not familiar with the kind of phenomena he observed, but fortunately, he was very interested in methodology. After discovering the acids contained in animal fat, he wrote a book about the method he had used in order to make his discoveries possible; he called this method experimental *a posteriori* and then applied the same method to color perception: "Facts are observed, defined, described, then they become generalized in a simple expression which has all the characters of a law of nature. This law, once demonstrated, becomes an *a priori* means of assorting colored objects" (Chevreul 1855: xiii, author's preface).

From the facts observed and verified, he was able to deduce a law, generally referred to in English as the "law of simultaneous contrast of colors" as per the title of *De la loi du contraste simultané des couleurs* (1839):

> All the phenomena I have observed seem to me to depend upon a very simple law, which, taken in its most general signification, may be expressed in these terms: *In the case where the eye sees at the same time two contiguous colors, they will appear as dissimilar as possible, both in their optical composition and in the height of their tone.*
>
> (para. 16; emphasis in the original)

Chevreul brilliantly anticipated what would be demonstrated a century later, that is, that the brain has a tendency to exaggerate differences, above all at the boundaries of juxtaposed colors. Contrast is now understood as an "antagonistic system" in the receptor cells of the retina (Jameson and Hurvich 1975: 128). Such an exaggeration of differences means that contrast perception discriminates colors to a higher degree. Paradoxically, Chevreul first showed this in a black-and-white plate in his 1839 publication, since, as he noted, the phenomenon works for both hue and brightness (by him called "tone").

In Figure 1.1, O and O', on the one hand, and P and P', on the other, have exactly the same brightness, but when O and P are juxtaposed, O' seems lighter than O and P' darker than P. This plate illustrates quite well the difference between our perception of the brightness of the same sample when seen isolated and when juxtaposed with another with a different degree of brightness. The image at the bottom of the plate illustrates an effect known as "Chevreul's illusion" (Morrone et al.1994): each stripe (except the two extremes), being lighter than the following (when looking at them from left to right), produces a double effect, since the left half of each stripe appears darker and the right half lighter, due to the influence of the preceding and following stripes.

But what happens when colors (that is, hues) are juxtaposed? Chevreul noted that the same thing occurs, but that the contrast is double with regard to both hue and brightness (although he was aware of saturation, which he

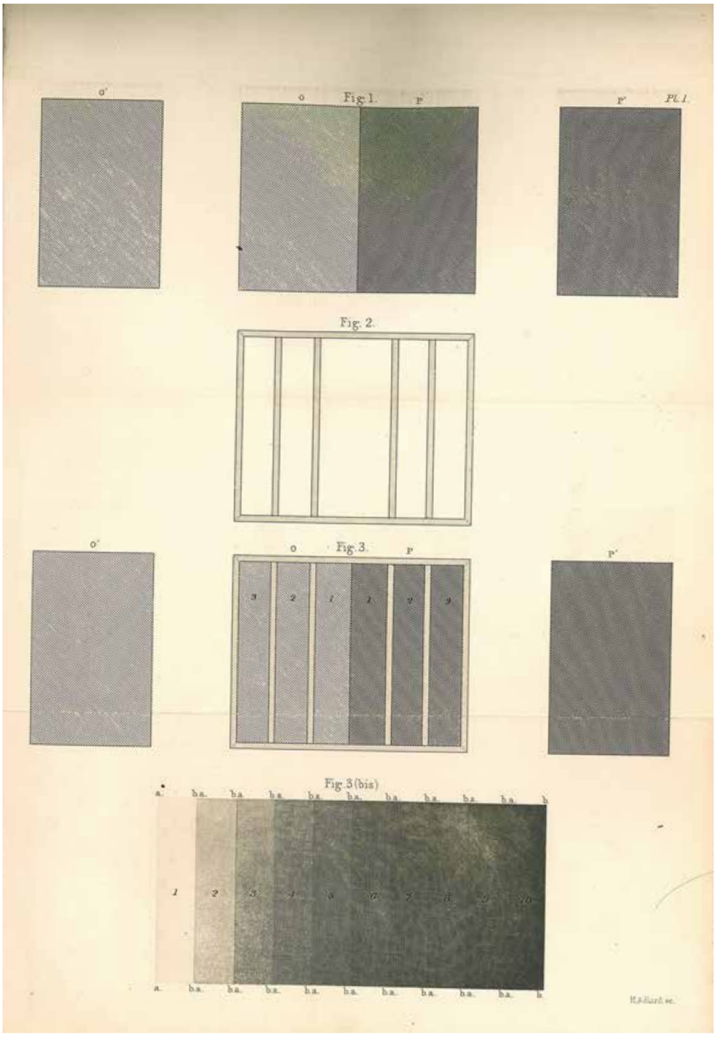

FIGURE 1.1 Illustration of the contrast of brightness; from M. E. Chevreul, *De la loi du contraste simultané des couleurs* (1839; later reprint). Courtesy of Alexandra Loske.

called *nitens*, he ignored a contrast of saturation). This is evident from the most general paragraph describing his law of simultaneous contrast:

> If we look simultaneously upon two stripes of different tones of the same color, or upon two stripes of the same tone of different colors placed side by side, if the stripes are not too wide, the eye perceives certain modifications which in the first place influence the intensity of color, and in the second, the optical composition of the two juxtaposed colors respectively. Now as

> these modifications make the stripes appear different from what they really are, I give to them the name of *simultaneous contrast of colors*; and I call *contrast of tone* the modification in intensity of color, and *contrast of color* that which affects the optical composition of each juxtaposed colour.
>
> (Chevreul 1855: para. 8; emphasis in the original)

How Chevreul illustrates what he calls contrast of tone is now easier to understand. It is the exaggeration of difference in the case of brightness, which means that a light tone will appear lighter when juxtaposed with a darker one, and that a dark tone will appear darker when juxtaposed with a lighter one. But how does the contrast of color work? How can the difference between two juxtaposed hues be exaggerated? To answer these questions, Chevreul relied on complementary colors and his readings of the sources mentioned above. Since a color that is most different from another color is its complementary color (according to him, red/green, orange/blue, greenish yellow/violet, and indigo/orange yellow), exaggerating differences means that when one sees a given color juxtaposed with another one, one perceives each one as slightly tinted by the complementary color of the other one. As Chevreul puts it: "The modifications of contiguous colors are precisely such as would result from the addition to each of them of the color which is complementary to its neighbor" (Chevreul 1855: para. 20).

The first example given is a juxtaposition of orange and green. In this case, the modification perceived is the following: "Blue, the complementary of orange, added to green, makes it bluer, or less yellow. The complementary of green (red), added to orange, the latter becomes redder, or less yellow, and brighter" (Chevreul 1855: para. 21). According to Chevreul, then, when seen juxtaposed, the two colors appear modified. There is, however, one exception, and that is when the two juxtaposed colors are complementary. What happens when, for example, green and red are juxtaposed? The green appears slightly tinted with the complementary of red, which is green, so that the green will be perceived as greener, and conversely the red will appear redder. As a result, the two complementary hues enhance each other when juxtaposed. This explains the success of the harmony of complementary colors, especially for artists keen on giving more intensity to their hues. Unlike what is generally assumed, however, Chevreul was not a partisan of the harmony of complementary colors (Roque 2009: 143–5).

So far, the focus has been on one kind of contrast, the simultaneous contrast of colors, which occurs when two contiguous colors are viewed simultaneously. However, Chevreul's other important contribution is his general classification of contrasts. In addition to the simultaneous one, he distinguishes *successive* contrasts:

> The successive contrast of colors includes all the phenomena which are observed when the eyes, having looked at one or more colored objects for

> a certain length of time, perceive, upon turning them away, images of these objects, having the color complementary to that which belongs to each of them.
>
> (Chevreul 1855: para. 79)

This distinction is very useful and helped differentiate phenomena, which until then had been confused. It is still in use, although simultaneous contrast is now often related to chromatic induction, while successive contrast is generally associated with chromatic adaptation. For this reason, the concept of after-images is now more used instead of that of successive contrast. Chevreul also came up with the theory of a mixed contrast, which combines simultaneous and successive contrast (Chevreul 1855: para. 81).

Chevreul's *The Principles of Harmony and Contrast of Colours and their Applications to the Arts* was a huge success not only in France, but also in other countries. It was almost immediately translated into German (1840) and then into English (UK 1854, USA 1857). Because it was unchallenged at the time, Chevreul's work on color had an enormous influence on an impressively wide range of fields, including not only tapestry but also wallpaper fabricants, stained glass restoration, shop signs, horticulture, and, not least, the fine arts. After the publication of his main book on color, he continued to work on color and made other important contributions to the field, in particular in the form of his later lithographed color circles (see Plate 1.2). Last but not least, it is worth emphasizing that his law of simultaneous contrast of colors is still valid today (Mollon 1997).

The German scientist and philosopher Hermann von Helmholtz (1821–94) may be considered the founder of modern physiological optics. It took him more than ten years to write his monumental treatise *Handbuch der physiologischen Optik* (*Treatise on Physiological Optics*). The first volume was published in 1856, the second in 1860, and the third in 1866.

Helmholtz acknowledged the importance of Chevreul in his chapter on contrast and in particular the distinction between simultaneous and successive contrast (Helmholtz 1924–5: 2:265, para. 24), but his contribution went much further. With Helmholtz, a new dimension in the history of color theory begins. Goethe was essentially a poet and writer, Schopenhauer a philosopher, and Chevreul a chemist. Helmholtz studied medicine, physiology (with Johannes Müller), and physics. Accordingly, he was well prepared to deeply change the incipient field of physiological optics. Goethe embraced chemical, physical, and physiological aspects of color; Schopenhauer focused on the retina, which is only the first step of a large and complex process leading to visual perception; and Chevreul, although he rightly thought that the phenomena he analyzed were both physiological and psychological, was not interested in understanding how this could be possible.

Helmholtz must be credited with the idea of clearly separating different steps in visual perception. His fascinating essay "The Recent Progress of the Theory of Vision" was published in 1868, and the English translation in 1885 (Helmholtz 1885). It is divided into three sections corresponding to three successive approaches: physical, physiological, and psychical (what now would be called psychophysiological). He explains in the introduction:

> I shall first describe the *physical* characters of the eye as an optical instrument; next the *physiological* processes of excitation and conduction in the parts of the nervous system which belong to it; and lastly I shall take up the *psychological* question, how mental apprehensions are produced by the changes which take place in the optic nerve.
>
> (Helmholtz 1995: 128; emphasis in the original)

This division into three sections narrowly corresponds to the process of visual perception itself. From this point of view, each step might be associated with a key concept, that is, *impression, sensation*, and *perception. Impression* is a physical process occurring on the retina. *Sensation* is a physiological process taking place in the brain, a process by which the impressions carried by the optic nerve are transformed. And finally, the different sensations are combined into the brain, and shape visual *perception* (Helmholtz 1995: 148).

The importance of the distinction between impression and sensation lies in its consequences for the understanding of the mechanisms at stake. Helmholtz makes a radical differentiation between impression, which implies a process of resemblance and sensation, which excludes resemblance, since it involves a mental process. Convinced that sensations do not provide "a true impression of corresponding qualities in the outer world" (Helmholtz 1995: 165), Helmholtz was led to develop a semiotic approach already sketched by his master Johannes Müller. Opposing sign (*Zeichen*) and image (*Bild*), he was of the opinion that signs in visual perception—as a construction of the mind—are arbitrary, as arbitrary as the relation between a word and the object it denotes (121–2). Interestingly, when opposing an image that implies resemblance and a sign or a symbol that does not, he anticipated the semiotic approach of Charles Sanders Peirce (1839–1914) and, in particular, the opposition between icon and symbol. It is worth noting, too, that both share the idea that perception (for Helmholtz) and sensation (for Peirce) are the result of an inference; moreover, Peirce himself was interested in color (Engel-Tiercelin 1984).

Helmholtz's remarkable new approach definitively breaks with the old conception, according to which an image of the object is impressed in the wax of the mind by the seal of experience. As a result, the colors perceived by the brain are not "faithful" but arbitrary. The most radical expression of this idea is probably to be found in the passage, in which Helmholtz maintains that the visual sensations "give us, it is true, information respecting the properties of things without us, but no better information than we give a blind man about color by verbal descriptions" (Helmholtz 1995: 14). Such a view was truly groundbreaking (Lenoir 1993; Roque 2013).

Another debate to which Helmholtz made an important contribution was that of primary colors. How many are there and which ones? Within the artistic milieu at the beginning of the seventeenth century, the idea emerged that there were three primary colors, red, blue, and yellow, since by mixing them one could obtain green, orange, and violet, which were therefore considered secondary colors. This scheme soon became a paradigm and so influential that many scientists even in the first half of the nineteenth century, such as David Brewster (1781–1868), also considered red, blue, and yellow the primary colors (Sherman 1981: 20–33). It is worth noting that Newton, when confronted with the complex task of deciding into how many colors the prism could be broken down, first thought of the three primary colors of the painters, and then changed his mind several times before finally opting for seven colors (Shapiro 1980: 221–2). It is well known that Newton opted for seven colors due to the analogy with music, dividing blue into blue and indigo, which was rather unpractical. As mentioned above, Chevreul adopted the Newtonian division, which complicated matters, when he tried to determine the exact complementary colors of violet blue and indigo; the complementary color of violet was greenish yellow, and that of indigo was orange yellow. For this reason, it was easier to reduce the colors to six: three primaries and three secondaries. Interestingly, it seems that artists were the first to eliminate the seventh color, indigo (Roque 2009: 102–5). Although some scientists, such as Chevreul, respected and adopted the Newtonian division, not everyone did, especially when atttempting to understand not only the division of the spectrum but also the primary colors to which the retina is sensitive. Thomas Young (1773–1829) is a good example. He, too, first believed that the three basic colors to which the retina is sensitive are red, blue, and yellow (the artistic model), before he chose red, green, and violet (Sherman 1981: 10–14).

Challenging Newtonian ideas, therefore, implied important research undertaken by physicians, who proposed an alternative to the physical ideas of Newton when studying the relation of color perception to vision. Robert Waring Darwin (1766–1848), the father of Charles Darwin, concluded from a series of ocular experiments that the retina is responsible for the sensation of vision. Young, who was also trained as a physicist, made important contributions to vision and color vision. In fact, he is regarded as the founder of the trichromatic theory, since he suggested that color vision was due to the fact that each point of the retina was excited by only three principal colors (Sherman 1981: 11–16). As a result, color vision had to be understood not only as a property of light but also as a property of the eye.

Helmholtz, too, had been trained as a physician, but, as noted above, he had training also in physiology and physics. Accordingly, he was able to confirm the hypotheses of Young, which were, according to Helmholtz:

> 1. The eye is provided with three distinct sets of nervous fibres. Stimulation of the first excites the sensation of red, stimulation of the second the sensation of green, and stimulation of the third the sensation of violet. 2. Objective homogeneous light excites these three kinds of fibres in various degrees, depending on its wave-length. The red-sensitive fibres are stimulated most by light of longest wave-length, and the violet-sensitive fibres by light of shortest wave-length.
>
> (Helmholtz 1924–5: 2:143, para. 20; see Figure 1.2)

In relation to what precedes, Helmholtz made another crucial contribution to color research when distinguishing between color mixing of *pigments* and *lights* (Helmholtz 1924–5: 2:121–6, para. 20; 1995: 154). In the same way as the three primary colors of painters were considered universal primary colors, the rules for their mixing were not clearly distinguished from those of colored lights. Even Newton was misled and confused about this matter, despite the fact that he was aware of the difference between the two types of mixing color (Roque 2009: 73–4). For this reason, Helmholtz recommended not "mixing powdered or liquid pigments [...] although Newton and many

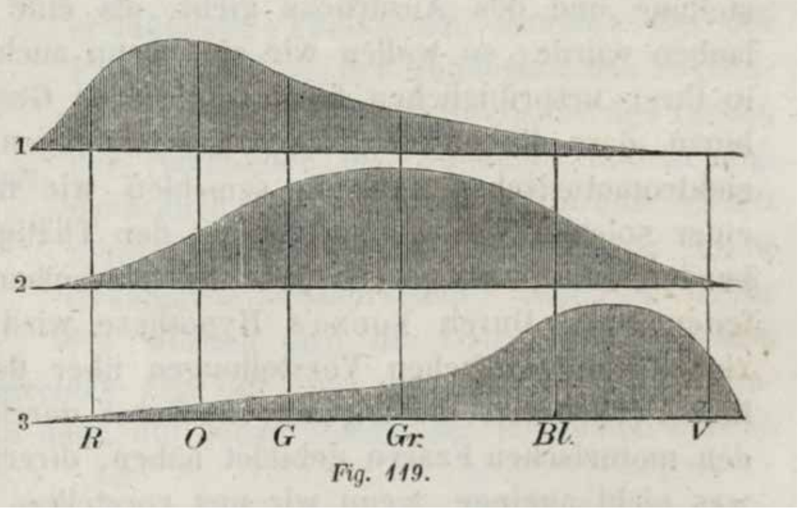

FIGURE 1.2 Illustration of the three wavelengths to which the "fibers" of the retina are sensitive, from an English translation of Hermann von Helmholtz's *Handbuch der physiologischen Optik* (Leipzig, 1867). Available online: https://archive.org/details/handbuchderphysi00helm/page/291.

other physicists have supposed that it was equivalent to [...] the method of mixing the colors of the spectrum" (Helmholtz 1924–5: 2:121, para. 20). As a result, the three color primaries of pigments (red, blue, and yellow) should be studied separately from the three color primaries of light (red, green, and violet), not least because of the results of mixing them. When mixed, the three primary pigment colors tend to produce a dull gray, while the three primary colors of light tend to produce white. The former is now called *substractive* mixture and the latter *additive* (for a summary, see Roque 2009: 74–9).

Finally, Helmholtz realized that three criteria are sufficient to define a given color: hue, brightness, and saturation (Helmholtz 1924–5: 2:132, para. 20; 1995: 158). These three criteria are still generally accepted, although it has been proposed to add a fourth one in order to take into account the qualities of a colored surface (matte, brilliant, and so forth; Caivano 1991). Current philosophy of perception still owes a lot to Helmholtz (Bouveresse 1995: 35–304). As far as the arts are concerned, Helmholtz's lecture on painting ("On the Relation of Optics to Painting"), which contains an important section on color, was also very influential among painters, as was his conception of sensation (Roque 2013: 124–9).

Due to the importance of his findings, it is easy to get the impression that Helmholtz's ideas were largely accepted at the time. However, this was not the case. Ewald Hering (1834–1918), who in 1878 published his *Die Lehre vom Lichtsinne* (Theory of the Light Sense), questioned Helmholtz's theory. The controversy had to do with both philosophical and methodological issues (Turner 1994). Helmholtz considered his own theory empiricist and that of Hering's nativist. Conversely, for Hering his theory was physiological, while Helmholtz's was spiritualist. Color theory was also involved in this controversy. In opposition to the trichromatic theory of Young, Helmholtz, and James Clerk Maxwell (1831–79), Hering proposed a quadrichromatic theory based on oppositions of antagonistic colors (red and green, blue and yellow, plus black and white). According to Hering, there were not three, but four basic colors (red, green, yellow, and blue). If the discovery of three kinds of cones in the retina, sensitive to three different wavelengths corresponding roughly to red, blue, and green, gave support to Helmholtz and the trichromatic theory, the discovery that the receptive fields of the ganglion cells are based on an antagonistic system of dual hue-coding (red green and yellow blue), enabled Hering to evolve his ideas (Hurvich and Jameson 1957). However, it should be noted that the two theories are not necessarily incompatible. Not only does the trichromatic theory work well at the level of how the three kinds of cones are excited by colors, but the quadrichromatic theory also works at the level of how the nervous system processes the information given by the retina (Bouveresse 2004: 220).

Before turning to electromagnetism and proposing the equations that made him famous, Maxwell showed interest in color vision and worked within the

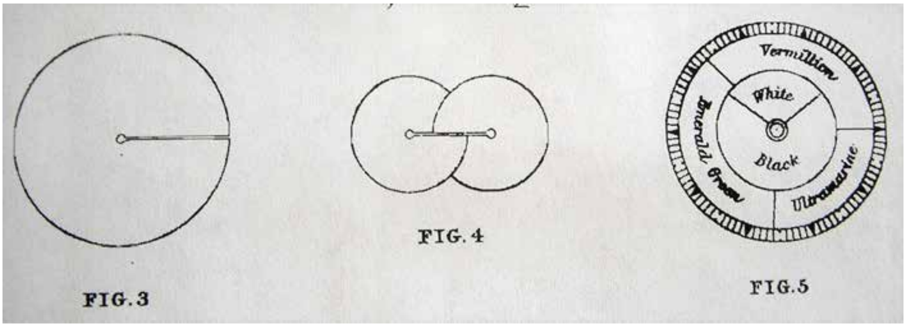

FIGURE 1.3 Spinning disk, detail of plate VI, from J.C. Maxwell's "Experiments on Colour as Perceived by the Eye, with Remarks on Colour Blindness" (*Proceedings of the Royal Society of Edinburgh*, 21 (2) [1857]). Available online: https://archive.org/details/transactionsofro21royal/page/298.

general line of research mentioned above. The title of his first major publication on color, published in 1857, is "Experiments on Colour as Perceived by the Eye, with remarks on Colour Blindness" (Maxwell 1857). Ignoring Helmholtz's experiments and publications, Maxwell carried out his own experiments with spinning color disks, supposing, in accordance with Young's theory, that the three primary colors were red, green, and blue, and using papers colored with vermilion, ultramarine blue, and emerald green (Figure 1.3). He demonstrated that yellow was not a primary color, since it could be obtained by mixing red and green papers on spinning disks, while it was impossible to obtain a green color by mixing with the same method blue and yellow papers. He therefore confirmed what Helmholtz had shown, in particular that the same three colors, when mixed in correct proportions, again using spinning disks, made it possible to produce white. He made further contributions to color vision with the help of his experiments on disks (Figure 1.4).

These contributions include, firstly, the possibility of easily increasing or decreasing the portion of each color, and secondly, the fact that using at the center another set of smaller disks of white and black was very useful in order to make comparisons with the results obtained with the bigger disks. Maxwell proposed precise equations for each color obtained when mixing the three primaries. In order to graphically represent colors, he also proposed an equilateral triangle. According to his own description:

> Vermilion, ultramarine, and emerald green, being taken (for convenience) at the angles of an equilateral triangle. Any colour compounded of these three is to be represented by a point found by conceiving masses proportional to the several components of the colour placed at their respective angular points, and taking the center of gravity of the three masses.
>
> (Maxwell 1857: 279–80)

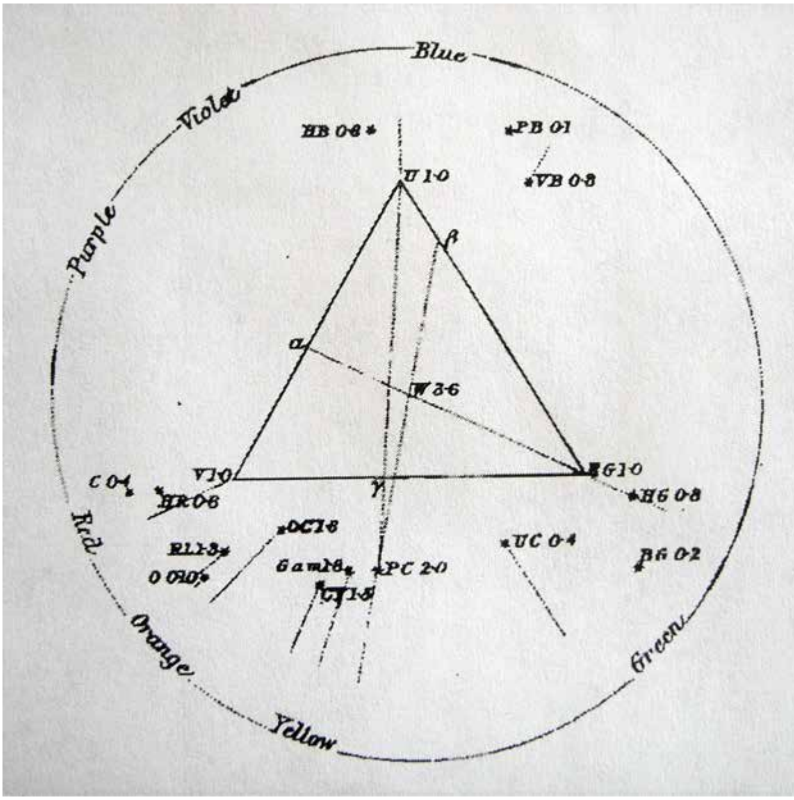

FIGURE 1.4 Color diagram, detail of plate VI, from J.C. Maxwell's "Experiments on Colour as Perceived by the Eye, with Remarks on Colour Blindness" (*Proceedings of the Royal Society of Edinburgh*, 21 (2) [1857]). Available online: https://archive.org/details/transactionsofro21royal/page/298.

His experiments on colors created by mixing the three light primaries on rotating disks also led him to propose a model for color photography, using filters of the three additive colors (Sherman 1981: 153–222). Accordingly, Maxwell's measurements opened the way to the further development of color diagrams. Two of the most influential in the twentieth century are the American educator Albert Henry Munsell's (1858–1918) *A Color Notation* (1905, 1981) of 1905, and the German mathematician Friedrich Wilhelm Ostwald's (1853–1932) *Die Farbenfibel* (*The Color Primer*; 1969) of 1916.

The major shift that occurred in the age of industry is from physics to physiology, from light to the eye. To be sure, some naturalists were already interested in phenomena such as colored shadows; however, they did not consider these phenonema normal and regarded them as subjective and hence "accidental." Most of the authors dealt with in this chapter claim that these subjective phenomena are not accidental but constitute normal features of color vision (Goethe 1840: 2, para. 3; Chevreul 1855: para. 945; Schopenhauer and Runge 2010: 83).[7] The major shift, then, is that color perception, as organized by the eye, constitutes the stable ground on which color science can be based. This meant a dramatic change with the idea generally accepted by philosophers that colors, as depending on vision, were mere secondary qualities. According to John Locke (1632–1704), primary qualities are properties of objects themselves (solidity, extension, motion, and so forth), while secondary qualities, such as colors or smells, "are in truth nothing in the objects themselves but powers to produce various sensations in us" (Locke 1998: bk 2, ch. 8, para. 14), sensations that depend on the primary qualities of objects. Accordingly, primary qualities,

> may be called *real qualities*, because they really exist in those bodies. But *light, heat, whiteness* or *coldness are no more really in them than sickness or pain is in* manna. Take away the sensation of them; let not the eyes see light or colours […] and all colours, tastes, sounds, as they are such particular *ideas*, vanish and cease.
>
> (bk 2, ch. 8, para. 17; emphasis in the original)

Such a radical change is clear in the authors analyzed in this chapter. For this reason, Chevreul proposed the still used concept of "organoleptic properties" in order to take into account and methodologically acknowledge properties that depend on the organs of human beings, such as smell, taste, or color, which represent an important epistemological break (Roque 2009: 44–8). Because of this method, he could scientifically consider subjective colors capable of being analyzed. Yet, why were "accidental" colors accidental? Georges-Louis Leclerc, Earl of Buffon (1707–1788), who came up with the concept of accidental colors, considered them as being opposed to natural colors. But what are "natural" colors? According to Buffon, the difference is that accidental colors "depend on our organ as well as on the action of light," while natural colors "depend only on the properties of light" (Buffon 1977: 141–2). Yet, if natural colors depend only upon the properties of light (Newton's theory), how could one see them? Buffon is unable to provide any answer. For him and his contemporaries, the opposition rests on that between the objectivity of the laws of physics and the subjectivity of color perception. Locke's conception of primary qualities belongs to the same epistemological frame, since such qualities are independent of any observer. Hence Schopenhauer's interest in visual perception and his main claim that "the world is my representation" (Crary 1990: 74–9; Roque 2009: 31–5).

CHAPTER TWO

Technology and Trade: Chemistry, Capitalism, and the Materialities of Modern Color Theory

LAURA ANNE KALBA

Professing to represent every, or nearly every, color known to humankind ordered in an easily consultable, satisfyingly coherent way, color charts stand among the most iconic and visually attractive realizations of modern science and industry. But what sort of artifacts are these neatly bound nomenclatures, color wheels, and atlases, really? Designed to serve as standards for the precise and accurate identification of colors—be it those of a fish, flower, stick of butter, or skein of yarn—nineteenth- and early twentieth-century color charts neither looked nor functioned like the typical scientific or technical illustration. They do not actually imitate or represent anything outside of themselves; they are neither icons, indices, nor symbols.

A testimony to the enduring epistemological authority of quantification, most of the color charts discussed in this chapter substituted common names with numerical values, purportedly making it possible to "measure" color. In reality, however, the typical color chart functioned more like a compendium of preestablished data points than a thermometer; they allowed users to carry out visual comparisons with more or less arbitrarily defined standards, rather than the taking of bona fide color "measurements." Their seductive, yet matter-of-fact appearance camouflages their ontological complexity. As historian of science Sean Johnston eloquently puts it, "Color charts and color trees were not merely illustrations of the system; they *were* the system; they embodied it. They acted simultaneously as standard, documentation and example" (Johnston 1996: 391; emphasis in the original). At one and the same time *thing* and *thought*, they tell the story of how color science, technology, and trade were deeply intertwined—how scientific color theories were conditioned by particular material and commercial contexts, and vice versa.[1]

This chapter starts from the basic premise that color science, technology, and trade were fundamentally connected to one another, highlighting how the development of inexpensive, synthetic colorants and the attendant development of a mass-consumer culture increasingly based on the sensual appeal of color were never simply about improving companies' bottom lines.[2] By tailoring their production to cost-conscious middle- and later working-class consumers, Western manufacturers of pigments, paints, and dyes as well as fashionable finished products, from silk ribbons to automobiles, realized incredible profits. Indeed, according to several contemporaneous observers, the growth of synthetic dye industries in the latter half of the nineteenth century constituted a prime example of modern capitalism's accelerated rate of expansion and unique capacity to both enrich and enlighten the masses. What is more, the expansion of European and eventually American colorant production typically came at the expense of natural pigment and dyestuff producers in the Middle East, Africa, Asia, and other less industrialized regions of the globe, whose populations were subjected to increasing economic and political control by imperial powers. As Regina Blaszczyk and Uwe Spiekermann have rightly pointed out, "the histories of globalization and Western cultural, economic, and technological supremacy can be retold with the story of color" (2017: 11).

And yet, the history of mass-produced and mass-reproduced color is more than simply another chapter in the history of Western global economic and political domination, mirroring that of soap, cotton, sugar, and other more or less utilitarian commodities that have typically served as a fulcrum for understanding the intertwined progress of colonialism and capitalism.[3] Attracting attention from not only chemists, industrialists, and business people but also artists, anthropologists, physicists, physicians, and psychologists, few topics generated, and continue to generate, the same degree of sustained, cross-disciplinary interest as color. In addition to fueling Western industrial and political expansion, the accelerated industrial production of colorful objects and images also provided elites with powerful conceptual tools with which to make sense of themselves, the rapidly changing world in which they lived, and their place within it. To put it another way, modern color technologies not only permanently altered the look and feel of everyday life but also provided individuals with new means to conceptualize and represent it.

More than the invention of dyes and pigments or new manufacturing processes per se, this chapter focuses on the interplay between science, technology, and trade from the 1800s to the 1920s. Looking at the theories and tools of British colorman George Field (*c.* 1777–1854), French chemist Michel Eugène Chevreul (1786–1889), and the American artist Albert H. Munsell (1858–1918), it shows how and why the idea that science could restore order to the chromatic chaos of the marketplace proved extremely appealing to commercial artists, industrialists, and tastemakers. The appeal was not only technical and financial: by following the guidance of the ostensibly eternal, objective laws of science, those at the apex of social, economic, and racial hierarchies set their ways of making and seeing color apart from that of so-called exotic and primitive peoples, who had traditionally supplied Westerners with the bulk of their dyes and pigments, and uncouth chromophiles closer to home, whose age, gender, or class likewise predisposed them to overindulge in the sensuous pleasures of color. The project of modern color science was as much about categorizing and controlling color as it was about categorizing and controlling people.

In practice, the taming of technology, trade, and taste by science proved extremely challenging, if not downright impossible. To begin, the insights of so-called color scientists were inextricably linked to technology and trade, and the concrete materialities of commercially-available goods, from glass prisms to inks. Self-assured proclamations before fellow-experts notwithstanding, there was simply no separating scientific research about color and the material things that made it possible (Rossi 2017: 113–29). Moreover, in debates surrounding how best to "civilize" the production and consumption of color, the defenders of ordering systems and so-called scientific laws of color harmony deployed a mix of scientific, economic, and aesthetic evidence, undermining any sense that these constituted separate realms of human experience and knowledge. Comparing the public reception of Field's, Chevreul's, and finally Munsell's respective theories, one cannot fail to notice the pivotal role played by the distinct technological and economic contexts in which they emerged. As demonstrated below, the popular success of Munsell's color charts, relative to those of his predecessors, had as much to do with company directors' business acumen and the particular technological and economic conjecture of the times as with their inherent scientific validity. By the end of the 1920s, it was not only dyes and pigments the West was exporting abroad but also its scientific color theories and management systems.

FROM EVERY PART OF THE GLOBE AND THEN SOME: GEORGE FIELD, DAVID RAMSAY HAY, AND THE "SCIENCE" OF GOOD TASTE

The revised and expanded edition of George Field's *Chromatography*, published by the famed British manufacturer of fine art materials, Winsor & Newton, in 1869 compared the painter's box to a "museum of curiosities, from every part of the universe." In order to constitute this miniature *Wunderkammer*, the book elaborates, "the mines yield their treasures, as well as the depths of the sea: to it come Arab camel, and English ox, cuttle-fish and crawling coccus: in it the Indian indigo lies next to the madder of France, and the gaudy vermilion of China brightens the mummy of Egypt. Varied, indeed, are the sources whence we derive our pigments" (Salter and Field 1869: 60). Appearing in neither the 1835 nor 1841 editions of the book, the passage was penned not by Field, but rather Thomas W. Salter, who, in the process of "[bringing] the book down to the present time," made substantial revisions to the colorman's original text. The global networks of exchange that undergirded the manufacturing of artists' materials in the nineteenth century were, of course, already well evident during Field's own lifetime—indeed, seen as a measure of their scientific and technological achievement and the quality of their products, these networks were often explicitly celebrated by manufacturers.

At the Great Exhibition of the Works of Industry of All Nations, also known as the 1851 World's Fair (Figure 2.1), leading British manufacturers of artists' pigments and paints vied with one another for the attention of jury members in charge of judging displays and picking the winners of this unprecedented international competition. Founded in 1832, Winsor & Newton set out to lure passersby with raw artists' pigments as well as prepared watercolors and oil paints made from madder, cochineal, lapis lazuli, uranium, cadmium, chromium, "and all the rarer kinds of chemical pigments" (*Official Descriptive and Illustrated Catalogue* 1851: 178); meanwhile, George Rowney & Co. strove to impress visitors with its different varieties of Naples yellow, carefully divided into tints. Reeves & Sons showed off its watercolors made with wax, and Roberson & Co., its watercolor paints in collapsible tubes (*The Crystal Palace and its Contents* 1852: 394). Echoing the pro-trade, imperialist discourse touted by the organizers, the artist William Linton observed how the display of dazzling colors in this and other sections of the Crystal Palace, dedicated to raw pigments, originated "from almost every part of the globe" (Linton 1852: 53).

The prominent colorman George Field, "one of the best-known figures in the art-world of his day," was noticeably absent from the colorful, commercial fray, despite having received a personal invitation from the exhibitions' lead organizer, Henry Cole (Gage 2001: 1, 22). Being a supplier of raw pigments to manufacturers of artists' paints, some of whom were showing their products at

FIGURE 2.1 "Interior view of the Great Exhibition, Main Avenue West," from *The Art Journal Illustrated Catalogue* (London, 1851). Courtesy of Alexandra Loske.

the exhibition, Field may have felt that his presence was redundant. It is hard to know for certain why he abstained from participating (22, 71).[4]

Born in or around 1777, Field first became interested in colorants—red madder dyes more specifically—in his twenties. From his early work on dyestuffs, he soon moved on to artists' pigments and paints, founding, by 1808, a factory in Conham outside Bristol, initially dedicated to the production of madder lake pigments. Having mastered the process of transforming red madder dye into red madder pigment, he then expanded his production to include a natural ultramarine, derived from lapis lazuli, and a pale yellow paint, marketed under the name *Lemon Yellow*, made first from platinum and then barium chromate. He developed several other paint colors during the course of his career—a chrome green; a dark yellow color sold under the name *citrine*; and a brown lake made from madder, which he called *Field's Russet,* to name just a few—systematically testing each one in his factory laboratory.

Surviving notebooks reveal an adroit technologist concerned with supplying a coterie of discerning artists with trustworthy, durable materials. In 1809 alone, Field tested the permanence of and wrote up results for over one hundred different samples (Harley 1979: 76). As he saw it, however, the making of artists' pigments and paints was more than simply a matter of mastering a few good recipes. It was, he insisted, a highly scientific, specialized occupation (Hamilton 2015: 180). The age of the artist making their own materials was definitely over, he warned. His was "a pursuit accidental and subordinate to painting, in which the pictorial artist can never attain the skill of the chemical colourist without a proportionate sacrifice to his own art, if not, unhappily, of his fortune also" (Field 1835: x). Field was not alone in this position. His colleagues and competitors, including the above-mentioned Winsor & Newton, Roberson & Co., and Reeves & Sons, likewise readily acknowledged the central importance of science—chemistry, in particular—in their field of work (Hamilton 2015: 188).

This emphasis on chemistry was not, however, unique to colormen who produced small quantities of high-quality oil and watercolor paints for professional and amateur artists. Housepainters, decorative and industrial artists, and those who supplied them with their materials were similarly enthralled with recent developments in the sourcing, extraction, and transformation of organic and, especially, inorganic pigments into paints, inks, colored pencils, crayons, and pastels. Traditionally limited to practical matters, now even the most run-of-the-mill handbook included explicit references to "the numerous recent discoveries in Chemistry" (The Painter, Gilder, and Varnisher's Companion 1851: iii).

Starting in the late eighteenth century, chemists, adopting the empirical laboratory methods embraced in other branches of natural philosophy, became increasingly adept at identifying the chemical composition of familiar pigments and dyes as well as at ascertaining the coloring properties of newly isolated and identified elements. Due to the combined presence of Jean-Antoine Claude Chaptal (1756–1832), Claude Louis Berthollet (1748–1822), and Louis Nicolas Vauquelin (1763–1829), early nineteenth-century Paris emerged as one of the leading international centers for the study of chemistry and its multifarious, colorful applications (Bensaude-Vincent and Stengers 2001: 130).[5] Marked by the introduction of a slew of manmade, inorganic pigments, the first third of the nineteenth century marked the beginning of a new era in the production and consumption of color. It was not long before influence of French color chemistry was visible everywhere, from the palettes of students attending the École des Beaux-Arts in Paris to the coaches and castles of the British aristocracy to Prussian laundresses' wash basins.

By the 1850s, many of these newer synthetic pigments were already being produced on an industrial scale. Expert visitors to the World's Fair remarked mostly on the magnitude, efficiency, and, of course, beauty of pigment and paint manufacturers' production. Natural pigments, most notably madder and cochineal lakes, received considerable praise. But on the whole, these received far less attention from jury members eager to draw attention to the scientific and technological advancements achieved in recent years. The true stars of the show were the copper-arsenic based greens, Prussian and cobalt blues, chrome yellows, and zinc whites. If nothing else, the sheer vividness of pigment and paint manufacturers' displays guaranteed that these newer artificial pigments would not go unnoticed (see, for example, 367–8; and *Exhibition of the Works of Industry of All Nations* 1852: 37–50, 456–9).

Among those that caught the jury's special attention was Jean-Baptiste Guimet's artificial ultramarine, originally developed in 1828 as an alternative to the costly, brilliant blue pigment derived from lapis lazuli that had made the fame of early Italian Renaissance painters and their wealthy patrons. As Jean François Léonore Mérimée's report to the Société d'encouragement pour l'industrie nationale reveals, endorsements by well-established artists originally played an important part in ensuring the new pigment's success (Mérimée 1828: 346–9). Vauquelin's certification that artificial ultramarine was chemically identical to the natural kind allowed Mérimée to cast doubt on artists' claims that they could tell the two apart. In the end, however, it was the artists' opinions that mattered the most; it was they, not scientists, whom Guimet needed to convince to employ his product.

By the 1850s, however, the bulk of artificial ultramarine being produced—now not only in France by Guimet but also in Germany, England, and Austria—was no longer of the kind that Mérimée initially wrote about in the late 1820s. Assisted by Linton, the jury made special note in their report of how many of the specimens of artificial ultramarine Guimet had sent to the World's Fair had a "purple bloom," more suitable for calico printing than oil and watercolor painting (*Exhibition of the Works of Industry of All Nations* 1852: 41). In other words, while artists had originally played an important role in legitimating Guimet's new artificial pigment, they were no longer the company's only, or even primary, client base. Differences between purplish ultramarine and the pure blue kind notwithstanding, the production of fine artists' and industrial colors remained closely connected. But the balance of power had now shifted. For, as historian Philip Ball rightly insists, "Without the engine of commerce to drive it, the manufacture of these new pigments would simply have not been viable" (2000: 12). Indeed, it is noteworthy that, among the artificial ultramarines suitable for artists' purposes, Linton especially recommended that exhibited, not by a manufacturer specialized in artists' colors, but by Zuber & Co., an Alsatian wallpaper, textile, and paint manufacture (Linton 1852: 62).

Not everyone was happy with this blossoming partnership between profit-driven industry and the fine arts. Field's position on the matter of synthetic artists' colors was notably more cautious than Linton's, for example. Wary of cheap imitations, the modernization of artists' materials could best be achieved, Field believed, by perfecting the extraction and processing of well-known colorants derived from plants, fungi, minerals, and insects, rather than the wholesale invention of new ones. His skepticism toward "factitious ultramarine" and other chemical novelties, "[which] captivate the eye by a meretricious beauty which misleads the judgment," was not, however, the only thing that set him apart from other experts in the field (Field 1835: 52). Following his first publication entitled *Chromatics* (Field 1817), Field devoted ever-increasing portions of his time to writing and more theoretical scientific pursuits. His goal was not so much to take leave from the grubby world of pigment making as to show that the manipulation of substances was connected to broader scientific, aesthetic, philosophical, and moral issues—to show, one might say, how all aspects of nature and human experience are intertwined (Brett 1986). Indeed, as he would later write in *Chromatography*:

> A due selection and employment of colors materially is not alone sufficient—an adequate knowledge of their reciprocal, sensible, and moral influences in painting, is essential to the production of their full effects on the eye and the mind [...] [F]or colouring like every other art that has its foundation in nature, refers to a whole, and cannot be rightly comprehended, nor perfectly practised, without some attention to all its parts.
>
> (Field 1835: xii)

Seeing the world as an interconnected web of substances, forces, and metaphysical realities, Field was particularly attracted to the notion that it was possible to understand color through music and vice versa. This was hardly a new idea. For Field, however, the intervals of notes making up the notes of a major chord held a special, almost mystical, significance. Plotting primary, secondary, and tertiary hues on musical staves, he argued that, just as when the notes E, G, and C—falling at intervals of 3/8, 5/8, and 8/8—are played together, the combination of three parts yellow, five red, and eight blue automatically produced an especially harmonious effect (see Plate 2.1).

Based on what he called the "scale of chromatic equivalents," Field also tried to demonstrate his law of color harmony empirically, using an instrument of his own invention, which he dubbed the *chromometer* or *metrochrome*. Consisting of an obelisk-shaped viewer containing three adjustable colored glass wedges, the device ostensibly allowed users to accurately "measure" the proportion of red, yellow, and blue contained within secondary and tertiary colors, "so as to convey precise ideas of their hues, shades, and relations" (Field 1835: 244, 247). A method for accurately measuring and denominating colors, he acknowledged, had long "been a desideratum, not only in fine art, but also to the chemist and geologist, the botanist and anatomist, the optician and the astronomer, and in every department of natural philosophy," as well as in trade, agriculture, and manufacturing. Additionally, by assisting in precise scientific measurement and denomination of colors, the device would provide, he suggested, an empirical confirmation of "the proportional powers of colours upon which their equivalence, or faculty of harmonizing each other in every possible case depends" (244).

The fact that several well-established and influential tastemakers embraced Field's theories testifies to elites' immense faith in the ability of science to serve as a mediator between art and industry.[6] First among these was Owen Jones (1809–1874), the talented architect and theorist of ornament responsible for designing the color scheme of the Crystal Palace. Taken with Field's ideas, Jones insisted that the iron columns and girders of the transept be painted blue, red, yellow, and white, in the exact ratios related by the colorman in his scale of chromatic equivalents (Piggott 2004: 13–14). Thus, while Field himself was nowhere to be seen in the Crystal Palace, his ideas—or, at least, some simplified version of them—were visible everywhere. Moreover, thanks to Jones's highly publicized endorsement, the colorman's notion that science could and should serve as a guide for applied artists and consumers—increasingly overwhelmed by the marketplace's offerings—gained additional traction among elites, quickly making its way into the middle-brow press as well as decorative and industrial arts textbooks.

These early applications of Field's ideas by others bring to light the close connection between art, industry, and science, including in ways the colorman himself had until then generally preferred to ignore. In the 1835 edition of *Chromatography*, for example, Field mostly glossed over the practical difficulties involved in the production of his color-measuring instrument. According to his instructions, the metrochrome's three wedge-shaped color lenses were to be created by filling presumably custom-made "hollow prisms" with a transparent solution of sulfate of copper for the blue, madder for the red, and saffron or turmeric for the yellow. The precise shade of blue, red, and yellow to be created is virtually impossible to determine, however. Half admitting that the complicated troubleshooting techniques outlined in the book were unlikely to yield positive results, he mainly resorted to reassuring his readers that the calibration of the metrochrome would prove no more difficult to the "practised eye" than "the tuning of musical strings is to a musician" (Field 1835: 245).

The decorative painter and design theorist David Ramsay Hay (1798–1866) clearly remained doubtful, as evidenced by his publication roughly a decade later of *A Nomenclature of Colours*, wherein he translated Field's general insights into a series of standardized color charts "applicable to the Arts and Natural Sciences, to Manufactures, and other purposes of general utility" (Hay 1845, 1846) (see Plate 2.2). By detailing the ratio of red, yellow, and blue—and, relatedly, the "relation to light" and "relation to darkness" of secondary and tertiary hues—the nomenclature, like Field's metrochrome, purportedly made it possible to "measure" color. Citrine, a compound of orange and green, for example, was composed, Hay explained, of sixty parts yellow, thirty parts red, and thirty parts blue, or 135/240 light and 105/240 dark (Hay 1846: 23–4).[7] These, however, were not just any blue, red, and yellow. Conflating chemical and visual purity, only unadulterated ultramarine blue, carmine red, and chrome yellow deserved the label of primaries, according to the decorator. The system thus explicitly underscored how the study of the ostensibly eternal laws of color science emerged from an active engagement with contemporary visual and material culture. After all, a generation and a half earlier few people would have even heard of chrome yellow.

Further undermining traditional distinctions between the realm of color theory and the everyday, commercial materialities of art and industry was tastemakers' propensity to evaluate the validity of so-called scientific laws of color harmony using aesthetic criteria. Contemplating the many displays of colorful textiles and household items she had seen at the Great Exhibition, art and fashion writer Mary Merrifield (*c.* 1804–89), for example, declared that French manufacturers had the clear upper hand when it came to tasteful design. This, she believed, was largely due to Field's rival Michel Eugène Chevreul's widespread influence among the country's decorative and industrial artists. In England, by contrast, the proper selection and juxtaposition of colors was still "frequently looked upon merely as a matter of taste," she complained (Merrifield 1851: I‡ [p. 345]). In fact, Merrifield was so struck by the elegance of French manufacturers' wares and the beauty of their displays that she instinctively attributed the success of Jones's color scheme for the Crystal Palace to his mastery of Chevreul's law of the simultaneous contrast of color, ignoring Field's influence altogether (II‡ [p. 346]).[8]

Similarly, Thomas Delf (pseud. "Charles Martel"), the English translator of Chevreul's original 1839 treatise, remarked that the lack of scientific merit of Field's and Hay's teachings was readily evident "upon all occasions where a knowledge of principles was necessary to the successful result of great undertakings," citing "the discussions raised upon the proper colouring of the Crystal Palace, in 1851" as proof of earlier color scientists' failings (Chevreul 1855: x). In short, according to Merrifield and Delf, the questions of who deserved credit or blame for Jones's decorative scheme and who was the better scientist, Field or Chevreul, were as much matters of aesthetic judgment as universal, natural truths about color to be determined by a combination of theory and experiment. Beauty and scientific truth went firmly hand in hand.

PREDICTABLY IMPERFECT VISION AND THE ACCIDENTAL COLORS OF FASHION: MICHEL EUGÈNE CHEVREUL'S *LAW OF THE SIMULTANEOUS CONTRAST OF COLORS*

Chevreul presented his preliminary observations concerning the "influence that two colors can have on one another when viewed simultaneously" to the French Academy of Sciences in 1828 (Chevreul 1828), nine years before the publication of his voluminous treatise on the subject with Pitois-Levrault, commonly known in English under the title of *The Principles of Harmony and Contrast of Colours and their Application to the Arts*. The chemist was not the first to document and analyze phenomena related to what we now call "accidental colors." However, whereas earlier theorists typically ascribed subjective complimentary sensations to optical fatigue or some other psychophysiological abnormality, Chevreul insisted that that simultaneous contrast and the related phenomenon of colored after-images were a normal aspect of human vision. Accidental colors, in other words, were not so accidental. To the average, healthy perceiving subject, every color seems to cast a complimentary shadow of itself on the surface placed next to it. In the case of complementary colors, such as red and green, for example, the green surface casts a reddish shadow onto the already red surface next to it, and vice versa. As a result, the red and the green appear more vivid than they would if viewed separately. When two more similar colors are juxtaposed, they can sometimes seem dull or muddied. For instance, a red surface placed next to an orange one will typically appear more violet, and the orange surface more yellow.

Like Field, Chevreul believed that science held the key to understanding how to harmoniously select and combine colors. In the case of non-imitative decorative and industrial arts, such as textile and wallpaper design, interior decorating, and fashion, to name only a few of the topics addressed in his book, the chemist recommended the combination of highly contrasting, ideally complementary colors. In addition to pairings of blue and orange, yellow and purple, red and green, as well as close variations thereof, Chevreul also urged his readers to take advantage of what he termed "contrast of tone," that is, the combination of lighter and darker shades of the same hue. *Principles of Harmony and Contrast of Colour* was, in short, as much prescriptive as it was descriptive. It provided, according to its author, "a clear demonstration of what is laudable or censurable" in the hopes that "in teaching it to abandon its first impressions, [the public] will itself become capable of expressing a sound judgment" (Chevreul 1855: para. 829).

In addition to Chevreul's law of color harmony, the book also contained a detailed description of a color notation system intended to replace vague and confusing color names with precise numerical coordinates. Essential to the scientific study of color, the system, Chevreul explained, would "render the language uniform, as we are in the habit of doing in the determination of temperature by the thermometer" (Chevreul 1855: para. 172). Unlike Field, however, Chevreul did not propose measuring color by making use of a new scientific instrument, specially created for the purpose, but instead advocated for the use of a series of precisely graduated color wheels. Based on a theoretical hemispheric model of his own invention, his system would, in its fullest, most complete iteration, represent a total of 14,400 colors, organized according to hue (*nuance*) and tone (*ton*). As such, the system Chevreul imagined was much more ambitious than Hay's color charts, which counted only 228 different "colors, hues, tints, and shades" (Hay 1846: 5). Additionally, unlike the decorator's nomenclature, Chevreul entirely did away with common color names. Bolstering the sense of precise scientific measurement, the color traditionally known in French as *émeraude* received, for example, the far less poetic appellation, *2 vert 11 ton*, and the red of French soldiers' trousers that of *3 rouge 3/10 ton*.

Unlike Hay or even Field, who never received any formal university training in chemistry and was generally regarded more as a technician than a bona fide scientist, Chevreul had unassailable credentials.[9] Prior to directing the Manufacture des Gobelins' dyeworks, his research had focused on the elemental analysis of organic substances, including fats and natural dyestuffs. Many, if not most, of the latter would have been imported from abroad: so-called exotic dyewoods, such as fustic, brazilwood, and logwood, were mainly harvested in Central America; the yellow colorant known as quercitron came from black oak trees found in North America; cochineal was imported from Mexico, Guatemala, and the Canary Islands; once widely cultivated in the Southern United States and Caribbean, most indigo now came from British-controlled India; and, finally, while there was still a sizable number of farmers in France and the Netherlands growing madder, European consumers generally preferred the Turkish variety, which yielded a more vivid red. Splitting his time between the Manufacture des Gobelins and the Muséum national d'histoire naturelle, where he succeeded his mentor Vauquelin as chaired professor in the "chemical arts," Chevreul was in a perfect position to observe and analyze the global circulation of dyestuffs, technical expertise, and scientific knowledge.[10]

Yet, as Chevreul himself readily admitted, the law of the simultaneous contrast of color had nothing to do with chemistry proper. Indeed, as he made sure to emphasize in his treatise, the modification of hue and value resulting from the juxtaposition of two or more colors was only *apparent*. To refer to the color as changed was only a "manner of speaking," he wrote. "It is really only applied *to the modification that takes place before us*" or, as he put it elsewhere, "inside of us" (Chevreul 1855: xiv; emphasis in the original; 1867: 12). The law of the simultaneous contrast of color pertained, in other words, to the realm of the psychophysiological—how color is seen by the perceiving subject. Likewise, the new system he devised for scientifically classifying and naming colors, thanks to which he hoped to replace imprecise and confusing color names with precise, standardized coordinates, was only very indirectly connected to the scientist's life work. The goal was not to change the appellation of dyestuffs or pigments—madder would remain *madder*, and indigo would remain *indigo*—but to reform the classifying and naming of *colors*.

Even so, addressed first and foremost to decorative and industrial artists, Chevreul's research on color nevertheless remained deeply anchored in the technological and commercial context of the period (see Kalba 2017: ch. 1). Perhaps most obviously, it was generally individuals who possessed an advanced practical understanding of chemistry, in particular, professionals working in the French dye and textile industries, who initially expressed the greatest interest in his ideas. Writing in the 1860s, manufacturer Paul Eymard recalled how, in 1842, when Chevreul first came to Lyon to teach a course on the law of the simultaneous contrast of color:

> [The hemispheric construction] was still but a draft; the essential was missing: it was color that would make the system *tangible*, so to say. The clearest and most lucid explanation was not as valuable as a demonstration made effective by color.
>
> (Eymard 1862: 4; emphasis in the original)

The absence of a suitably illustrative prototype—whether a hemisphere or series of wheels—to demonstrate how his system for scientifically classifying and naming colors worked seems to have had little effect on Chevreul's core audience. Enthused by the chemist's presentation, a local industrialist and member of the learned society that had sponsored Chevreul's visit, Jules Bourcier, for example, excitedly described in a letter how,

> [the] table would make unnecessary the many samples that are used today to explain the manufacturers' wishes to dyers; it would prevent numerous discussions and arguments, which are the inevitable consequence of miscommunications or misunderstandings; [and] finally, it would allow for a great amount of care, which until now has been wasted, to finally be usefully applied to industry.[11]

Bourcier was not alone in believing that the chemist's system would benefit the city's silk and dye industries. Soon after Chevreul's visit, the Lyon Chamber of Commerce wrote to the Ministry of Agriculture and Commerce requesting approval for the creation of a series of porcelain color wheels, according to the chemist's exact specifications, by the national ceramics workshop for the use by local industrialists and merchants. Thanks to the chemist's color wheels, disagreements between producers and clients and time-consuming, custom color-matching would soon be a thing of the past, or so the businessmen hoped.

It was crucial, Chevreul insisted, that the color wheels be made out of an inalterable material. In practice, however, the choice of porcelain proved far less than ideal. Where would the workshop find these 14,400 colors? How would it know if they were the right ones? The response of the director of the Manufacture de Sèvres, Alexandre Brongniart, was less than encouraging. Before attempting to make Chevreul's wheels, the ceramics workshop would first need to see "samples" of the colors. They could not be created ex-nihilo, as it were. It was an easy, polite way for the director to get out of having to complete what was clearly an arduous, time-consuming project.

Several years later, however, when Chevreul was finally ready to provide such samples, the new director refused to take on the project, claiming, according to the Minister of Commerce, that:

> the assortment of colors that the Manufacture de Sèvres holds are too incomplete to allow for the creation of a scale according to a precise and rigorous system. To fill in the existing gaps, it would be necessary to embark upon investigations that would be long and most probably fruitless.[12]

This was not the response Chevreul had hoped for. Still, measurable progress had been made in the intervening years. In response to the Manufacture de Sèvres' initial request for samples, the chemist began working on making a series of ten color wheels out of wool with the help of a certain Mr. Lebois, the foreman of the Manufacture des Gobelins' dyeworks. Presented before the French Academy of Sciences in 1851, the first of these was composed of seventy-two colors, each made available in a range of nineteen additional different "tones" not included in the color wheel itself. This initial construction represented, of course, only a fraction of the total 14,400 colors represented in Chevreul's original system. Its completion, however, was hardly an easy task. As the scientist pointedly insisted in his report to the Academy, "it required all the talent and perseverance of Mr. Lebois, the foreman of the Gobelins' dyeworks, to execute the beautiful ensemble of colors that I present today to the Academy" (Chevreul 1851: 695).

Executed by Adb-el-Aziz Herraouy, an Egyptian studying dyeing at the Gobelins, the color wheel included later that same year in the workshop's display at the Great Exhibition in London was even more perfunctory, for it only included the seventy-two basic colors without the extra tonal gradations from light to dark. Its ostensible incompleteness, relative to Chevreul's original system or the color wheel back in Paris, in no way dampened, however, jury members' admiration. For, as Chevreul made sure to point out to his superiors, in their original deliberations, members of the international jury explicitly referenced the Egyptian student's color wheel among the achievements motivating their decisions to award the workshop a prestigious council medal (Chevreul 1854: 94–8). But, what was it, exactly, about this and Chevreul's other color wheels that warranted such praise?

At the time of the creation of these two initial color wheels, the Manufacture des Gobelins' dyeworks produced somewhere between 25,000 and 35,000 different colors.[13] What made their production such a challenging task was not, therefore, the sheer variety of hues. Rather, because they featured a perfectly symmetrical, precisely calibrated assortment of colors, the wheels' construction required the creation of new colors, never before produced at the dyeworks. As

Chevreul explained in his original treatise, unlike those found in analogous color notation systems, his basic color types did not correspond to specific colorants already used in art or industry. In order to create a truly scientific system, it was essential, he maintained, to first establish "invariable types of colour, either from the solar spectrum, from polarised light, from the Newtonian rings, or from colours developed in a constant manner by any method" and only then, in a second instance, "try to imitate them by means of coloured materials" (Chevreul 1855: para. 172).

Carmine, ultramarine, and chrome yellow pigments were not, therefore, accorded any special status in Chevreul's system, however pure their chemical composition. Indeed, in order to imitate pure color types, it was often necessary to use impure mixtures, the chemist explained. Therein lay the scientific novelty, technological wizardry, and visual appeal of Chevreul's color wheels. In order to imitate the standardized color types, Lebois had to create colors that had never before been made, possibly never before been seen, at the Gobelins, permanently altering both the material basis and visual experience of color in the process (Kalba 2017: ch. 1).

Equally painstaking was the reproduction of Chevreul's ten color wheels in print form. Published in 1855, the publication further contributed to the system's popularization. The chemist, meanwhile, continued to perfect its use by employing his color wheels to identify and denominate the colors of innumerable commodities and "scientific" specimens, from flowers, to fruits, to animals, to humans. In a 900-page memoir published in 1861, he observed that Catayba, a type of wood from Paraguay, corresponded to "rouge-orangé 7/10 6 ton," the forehead of a 38-year-old Egyptian man was equivalent to "2 rouge-orangé 2/10 I, 5 ton," and the gums of a Sudanese man were slightly darker than "4 violet-rouge du 2 au 3,5 ton" (Chevreul 1861: 3–938).[14] Created first from dyes and now inks originating in different parts of the world, Chevreul's scientific method of classifying and denominating colors at once stemmed from and further fortified imperialist mechanisms of global commercial exchange.

As the chemist begrudgingly conceded in this same 1861 study, there were certain colors, however, namely that of a particular synthetic blue dye derived from coal tar, for which he was unable to find any equivalent in his system. Matching the color of the African butterfly *Junonia clelia*, the aniline dye azulene, as manufactured by the French dyers Guinon, Marnas & Boddet, produced a blue brighter than any featured in his color wheels, he explained (Chevreul 1861: 922). Not all coal-tar dyes escaped Chevreul's system. Still, the perception that the chemist's color wheels, born in the era of natural dyes, were no longer useful for measuring color following William Henry Perkin's "accidental" discovery of mauve in 1856 soon gained ground among scientists. As chemist Marcellin Berthelot related in a belated tribute to Chevreul, the color wheels were useful to industrialists "up until the day when the discovery of artificial colors, prepared from coal tar and at first aniline, produced brilliant colors of an incomparable vividness and that escaped the color wheels" (Berthelot 1902: cdxxvii–cdxxviii). The system, in any case, was never widely used in industry, as numerous contemporary sources attest, such as Gaultier de Claubry (1862: 725) and Lacouture (1890) (see also the Introduction, this volume).

Chemists' enthusiasm about the first generation of coal-tar dyes verged at times on caricature in these early years.[15] "Who, indeed, would now dare to have cargoes of safflower shipped from India? This substance, which a couple years ago had a considerable value is destined to disappear from the European market as a result of the manufacturing of aniline red," a major trade journal predicted in 1861 ("Bleus Artificiels" 1861: 10). Aniline dyes' exorbitant price tag meant that they were generally only used in the making of high-end silk textiles. What's more, these new aniline dyes, Chevreul warned, were far less durable than high-quality natural ones (see Fournier 2005: 349–70). Nevertheless, according to certain chemists, a major reorganization of the worldwide supply chain was already on the horizon. By 1867, they had already begun dreaming up new business strategies: in addition to sending synthetic dyes to China, chemists would also provide the country with new solvents and mordants—"one had to, in short, reeducate the Chinese dyer" (Hofmann et al. 1867). And, indeed, despite Chevreul's enduring confidence in the value of natural dyes, it was not too long before the West ceased to be dependent on colorants imported from faraway lands and instead became the major worldwide exporter of synthetic dyes, pigments, and colorful finished products of all sorts.

But all was not lost for Chevreul. Originally devised in the 1830s, the chemist's law of color harmony became newly relevant in the second half of the nineteenth century, as tastemakers sought to bring order to the chromatic free-for-all unleashed by the introduction of synthetic dyes. From fashion magazines to home-decorating manuals, sources that introduced the wider public to the chemist's scientific law of color harmony seldom did so without first condemning readers for their gaudy, mismatched color choices and overall lack of good taste.[16] As such, it is fair to assume that only a fraction of readers actually followed Chevreul's recommendations. Indeed, looking at what was actually produced at the time, it is not hard to find textiles, ceramics, wallpaper, and other colorful household goods that forsook the chemist's precepts. Nothing, after all, could be more antithetical to the idea of fashion than the notion that there is only one right way of selecting and combining colors (Kalba 2017: ch. 1).

Unbeknownst to French tastemakers, however, for whom the law of the simultaneous contrast of colors continued to serve as an infallible guiding light, a new generation of color scientists emerged in the 1850s that would eventually undermine the chemist's theories. Attentive to color's subjective, psychophysiological dimensions, this group endeavored to distinguish themselves from previous generations of color scientists, including Field and Chevreul, whose thinking was, in their view, too muddled by the material uncertainties and commercial imperatives of the dye and pigment industries. If chemistry mattered at all, Hermann von Helmholtz and his followers posited, it was in its psychophysiological capacity, related to the functioning of photoreceptors in the human eye. Challenging not only existing color theories but also the practical experience of painters, dyers, and artists everywhere, they pushed the scientific community and everyday consumers of colorful goods to fundamentally rethink the very nature of color. Indeed, reimagined in psychophysiological terms, the three primaries, they explained, were not red, yellow, and blue, as most until then had been taught, but rather red, green, and violet (see Lenoir 1994; Turner 1994; Rossi 2019: esp. chs. 1 and 6).

"*THE EYE IS MASTER, AND PAINTS ARE BUT AGENTS TO WORK ITS WILL*": ALBERT H. MUNSELL'S COLOR SYSTEM AND THE SELLING OF SCIENCE

Influenced by the research of American physicist Ogden Rood, whose writings on the psychophysiology of color perception he first encountered while attending the Massachusetts Normal School of Art in the late 1870s, Albert H. Munsell (1858–1918) had tremendous confidence in the ability of technology to transparently exteriorize scientific theory. As he saw it, if previous scientists, such as Field and Chevreul, had been unsuccessful in their efforts to devise a standardized method for identifying and denominating colors and positive laws of color harmony, it was largely for scientific reasons as opposed to technological or economic ones. In order to make any progress on these matters, scientists first needed to cast aside the vague theories of the past, which privileged the "uncertain action of pigments" over the "essential action of the eye." "*The eye is master, and paints are but agents to work its will*," he insisted (Munsell 1912: 109; emphasis in the original).

Munsell originally laid out the basic characteristics of his system for scientifically identifying and denominating colors and related laws of color harmony in *A Color Notation* (1905). Echoing Chevreul's complaints about the lack of a precise, scientific way to identify colors, Munsell detailed how, confronted with "incongruous, irrational, and ludicrous" names, from *burnt onion* to *automobile*, people everywhere longed for a "rational way to describe color" (Munsell 1905: 7, 8, 53). Forming an irregular three-dimensional space, wherein colors are organized according to hue, value (lightness), and chroma (intensity), the system he proposed would finally make it possible—in earnest, this time—to substitute these poetic color names with precise alphanumerical coordinates. Vermilion, for example, received the designation R 5/10, with the R standing for the hue, red; the fraction's numeral, the value; and its denominator, the chroma. Unlike Chevreul, however, for whom hue and tone were objective qualities, belonging to colors themselves, Munsell based his system on the perceiving subject's visual responses, employing the awkward formulation "hue, value, and chroma *of our sensations*" to underline this point (8; my emphasis). Described as a relief globe with valleys and mountains, the irregular color space envisioned by the artist was a psychophysiological, as opposed to a geographical, one (52). It mapped subjective visual responses rather than objective physical qualities or trading routes.

The astonishing success of Munsell's color notation system—it became the first color order system to be widely accepted across different scientific disciplines and industries—would seemingly corroborate the notion that psychophysiology held the key to scientific color measurement. Submitting paint pigments to the will of the human eye was not an easy task, however, as Munsell himself quickly realized. The charts appearing in the first complete *Atlas of the Munsell Color System*, published by Wadsworth-Howland & Company in 1915 (Munsell 1915), were originally made by a certain "Mr. Lyon" in the Munsell Studio.[17] These were then reproduced in the publisher's factory under the watchful eye of Munsell himself, who rigorously verified the hues, values, as well as chromas of the Atlas's multitudinous printed colors. Orders for copies soon arrived from several private and public institutions including the Rockefeller Foundation, the Carnegie Institute, Heintz of Chicago, and Dartmouth College (Nickerson 1940: 578; Blasczyk 2012: ch. 2).

Much had changed since the early days of coal-tar dyes. To start with, the variety of synthetic dyes had dramatically expanded in the final decades of the nineteenth century—between 1870 and 1913, the number of synthetic dyes increased from around 50 to 1,300—compelling dye manufacturers and fashion writers to invent ever more fantastical color names (Blaszczyk and Spiekermann 2017: 5). More impressive still, some of these more recently introduced dyes, namely artificial alizarin, successfully synthesized by Carl Gräbe and Carl Liebermann in 1868, and indigotin, by Adolf von Baeyer in 1877, were exact chemical replicas of the main dyeing principles found in madder and indigo, respectively. In fact, contrary to Chevreul's and other synthetic-dye skeptics' predictions, these and other related coal-tar dyes were just as long-lasting or even more durable than the natural dyestuffs they were designed to mimic. But that is not all. While previously only accessible to the well-to-do, lower production costs for aniline and newer-generation azo and alizarin synthetic dyes now made the chromatic pleasures—or, as Munsell would have it, chromatic *pains*—of the color revolution accessible to virtually everyone. Finally, as a result of competition from synthetic-dye manufacturers, the prices of natural dyes decreased dramatically, forcing producers of natural dyestuffs all around the world, from cochineal raisers in the Canary Islands to madder growers in the south of France and, eventually, even to indigo farmers in eastern India, to look elsewhere for their livelihoods. By World War I, natural dyes had largely been replaced by synthetic ones (Engel 2012).

News of lake pigments made from aniline colors greatly unnerved painters, and rightly so. In his efforts to curtail the harmful effects of fugitive pigments, Pre-Raphaelite painter William Holman Hunt, for example, promoted the use of "natural" colorants, oftentimes conflating the synthetic inorganic pigments of the early part of the century with the organic synthetic pigments of more recent invention, whose durability varied much more widely (Hunt 1880). Indeed, according to Thomas W. Salter, the editor of the posthumous 1869 edition of *Chromatography,* Hunt's efforts to revive the reputation of George Field only risked confusing the public. "In his time Mr. Field was undoubtedly a boon to the art world, but in these days he would be considered more of a colour-maker than a chemist; and I am not aware of any 'secret,' so far as regards the preparation of colours, having died with him," Salter wrote in an open letter to the editor of *The Times*.

> The colours he made then can be and are made now, only better and on a larger scale; and these since his death have been supplemented by others equally beautiful and valuable. Of Mr. Field's processes in my possession some are simply worthless, while others excite a smile through his very primitive mode of proceeding.
>
> (Salter 1880)

Munsell's hostility toward bright colors and evocative color names was rooted in a deep discomfort with what he saw as the deterioration of human language, reason, and taste by the irrational, feminized forces of fashion and commerce. In comparison to Chevreul, however, whose color wheels were almost immediately relegated to the status of scientific curios, Munsell arrived on the scene at a much more propitious time. No longer preoccupied with product innovation, the German dye industry began standardizing and consolidating its offerings in the 1890s, focusing its resources, instead, on reducing costs, increasing output, and effectively marketing a more limited range of tried-and-true dyes (Engel 2012, 2017). Similar actions were taken by manufacturers of decorative, house, and artists' paints. Heeding their customer's concerns, colormen weeded out pigments that failed to meet their standards for durability (Delamare and Guineau 1999: 114). Meanwhile, marketing materials published by house and decorative paint manufacturers offered dealers advice on how to make the best selection of products for their customers, reassuring them that "in laying the stock every facility is offered to minimize the number of colors" (Harrison Brothers and Company 1893).

In the United States, the quest for color standardization dovetailed with the "scientific management" movement spearheaded by Frederick Winslow Taylor (1856–1915). With the goal of eliminating inefficiencies and increasing production, American executives eagerly embraced time-motion studies and other forms of quantification (Blaszczyk 2012: 65–6). Following the dye and pigment shortage of World War I, producers of branded packaged goods as well as a growing number of consumer durables, from cars to bathroom fixtures, looked for ways of submitting color to the same sort of production and market controls. In short, while Munsell presented his notation system as a bulwark against the chromatic chaos of the marketplace, this same marketplace had become over the years increasingly receptive to his ideas for reasons that were entirely their own.

Founded in 1918, a few months before Munsell's death, the Munsell Company initially specialized in the production of school supplies, aimed at training children's senses to appreciate balanced color harmonies. By 1923, however, the company was already out of the school supply business, focusing instead on their books, color atlases, "tree"-models, and specialized color charts, which they marketed to a range of professionals for whom the "scientific" production and consumption of color held technical, economic as well as more intangible symbolic significance (Nickerson 1940; McLeary 2013). The advantages for businesses extended beyond streamlining production. Published in 1921 by the Strathmore Paper Company, *A Grammar of Color* (Plate 2.3) functioned, for example, at one and the same time as an illustration of Munsell's theories and "a vital piece of advertising" for the paper company ("Our Latest" 1921). At the Direct Mail Convention held that same year in Springfield, Massachusetts, visitors to the Strathmore booth were treated to miniature Maxwell disks that "whirled into Gray" ("Watch the Colors Turn to Gray" 1921). Much like the contracting of innovative graphic artists to design their marketing materials, the association with Munsell allowed the company to brand itself as more refined and modern than the average paper manufacturer.

Meanwhile, halfway around the world in Tokyo, Seishi Shimoda (1890–1973), a professor of child psychology at Talma University, was moved to order a copy of the Munsell atlas after reading about the system in the pages of *School Arts Magazine* sometime in or around 1915. Dissatisfied with the state of art education in Japan, he later published an article, summarizing the basic principles of Munsell's color notation system and the laws of color harmony (Kawakami 1972; "Japan's Early Contact with Munsell" 1975).[18] To be clear, Munsell's dream of subjecting colorful materials and goods to the aesthetic, scientific, and moral discipline of the eye was never fully realized, neither in Springfield nor Tokyo. Still, the global circulation of his charts—all it took was a letter and thirty dollars, stuffed in an envelope—shows how, in certain important instances, the color scientist worked not *against* but *with* the forces of early twentieth-century technology and trade.[19]

CONCLUSION

This chapter chronicles the evolution of pigment and dye production during the nineteenth and early twentieth centuries, highlighting how technological innovations and global commercial exchanges simultaneously provided scientists with new tools for studying color and repeatedly frustrated their efforts to definitively make sense of it.[20] In the first half of the nineteenth century, advances in analytical chemistry led to the development of new methods of sourcing, extracting, and manufacturing pigments. Pigments born in the chemist's laboratory, as opposed to extracted from minerals, plants, fungi, or animals, made their way into artists' paintboxes and housepainters' buckets. The discovery and successful commercialization of organic synthetic dyes in second half of the nineteenth century, ushering in the development of exact chemical replicas of natural coloring principles, marked an even more decisive change in the technological and economic history of color.

Another, equally momentous shift arrived in the early twentieth century. The primacy of synthetic colorants and industrialists' pursuit of color standardization worked together to ensure that dyestuffs and pigments were no longer as "indefinite" as they once were. Meanwhile, so-called scientific laws of color harmony continued to proliferate, attracting attention from individuals and corporations for whom science—or, rather, the *idea* of science—was something to be conspicuously consumed. As bright colors became increasingly within the reach of the middle and eventually working classes, the ability to make visual distinctions between the colors of various commodities and moral distinctions between the consumers of those commodities went hand in hand.

CHAPTER THREE

Power and Identity

DOMINIQUE GRISARD

This chapter discusses the power of color and the gendered, racial, and classed fabric of visual and material culture. The nineteenth century is characterized by two intertwined developments: the growing production and consumption of color (Blaszczyk and Spiekermann 2017; Engel 2017) and the renunciation of color in a world that had distinguished between black and white, male and female (McClintock 1995). These changes coincided with an increasingly industrialized, rationalized means of production and an exceedingly elaborate and complex consumer culture, and—relevant to this chapter—new ways in which the bourgeoisie as the ruling class established and maintained power in European societies.

The bourgeoisie exerted power by differentiating people into discrete race, gender, sexual, and class identities. White middle-class men and their families set a standard to be emulated by all others. In fact, they created and objectified "others" in order to affirm their way of being and seeing as hegemonic. This new mode of power differentiated between productive and rational *subjects* whose gaze carried authority and truth, and reproductive and emotional *objects* (such as women) to be looked at. Color was a vital motor in establishing such a "scopic regime," that is, in linking practices of seeing and representing to systems of knowledge and power (Jay 1988: 3–12), and this led to the reordering of the social world through the senses. Seeing and not touching became the primary way of experiencing the world, the eye being considered the single most important witness (G. König 2001: 277). Recognition was intricately tied to visibility, with the opposition between bright and drab colors, as well as between black and white, playing an important role in social hierarchies and in promoting conspicuous consumption and self-fashioning, all means of maintaining or elevating a person's social status in the "modern West."

In the following, the symbolic use of color in national flags, imperial maps, menswear, and men's military uniforms are examined in order to demonstrate how color (codes) contributed to the establishment, display, and stability of the political, military, economic, and social order of the bourgeoisie. Firstly, the red, white, and blue tricolor and its symbolic meaning in the French context is examined. Secondly, the coloring of maps as a way of establishing imperial claims, most notably the late nineteenth-century implementation of pink on maps by the British and the Portuguese, is investigated. Finally, the critical role of the "uniform" of the emergent middle-class elite—the suit—is considered. It is demonstrated how a dark-colored jacket and trouser combination paired with a white-colored dress shirt helped establish bourgeois hegemony over the "blue-blooded" aristocracy and fostered gender identity, inasmuch as it served to demarcate the ostensibly rational public sphere of men in black from the emotional private sphere of women and children dressed in bright colors. The colorful ornamentation of the bourgeois home was undergirded by commodity racism's investment in the black-and-white dichotomy. This color-coded differentiation not only between men and women, but also between white Europeans and colonized others, along with technological advances, eventually also led to the replacement of the bright colors of military uniforms by khaki at the end of the century.

WITH FLYING COLORS: NATIONAL POWER AND THE TRICOLOR FLAG

The national flag associated the modern nation-state with a particular set of colors and the myths they invoked, thereby promoting national belonging. The colors on flags carried such an impressive symbolic power that *color* became a synonym for flag. Originally, the term *flying the colors* referred to a victorious warship flying its national ensign on the high seas, thereby making its military power known to other nations (Brewer 2001: 271; Breverton 2004: 143). By the eighteenth century, *color* came to refer to feelings of patriotism and national allegiance more generally, whereas the expression *showing one's true colors* underscored the nexus between the nation, its flag, and the expected honor and honesty of its citizens (Brewer 2001: 276). Indeed, by the nineteenth century, flags were no longer the banners of a powerful few. Throughout the century, national flags and their specific color arrangements helped construct national borders and foster national loyalties across Europe and the Americas (Elgenius 2011: 12).[1]

The history of the French tricolor is particularly illuminating in order to help understand the symbolic power of national "colors." Although the Constituent Assembly decreed in 1790 that the blue-red-white tricolor should become

France's official national flag, it remained contested for most of the nineteenth century.[2] Despite its official status, the tricolor was rarely used during the French Revolution. Many revolutionaries preferred the red flag of the Jacobin Club, which symbolized defiance and national emergency. However, when Napoleon Bonaparte (1769–1821) became Emperor in 1804, he adopted the tricolor. After his defeat in 1815, it was quickly replaced by the white flag of the Bourbon dynasty, which flew over France until 1830. During the July Revolution of the same year, the "citizen-king" Louis-Philippe (r.1830–48) requested that France take back its national flag, the tricolor. Accordingly, he underscored the symbolic *and* affective dimensions of national "colors." He recognized that the citizens of France identified with and felt emotionally attached to the blue, white, and red colors and the myths of nationhood, citizenship, and Republican governance that they stood for. It is for this reason that certain politicians were loath to accept the tricolor as the national symbol of *La Grande Nation*.

During the February Revolution of 1848, French rebels fought to introduce the red flag, because it was considered more radical. Dead set against such an endeavor, Foreign Minister Alphonse de Lamartine (1790–1869) defended the tricolor flag. "If you remove the tricolor, know it well, you will remove half the external force of France," he exclaimed in his address to the citizens of France on February 25, 1848 (Lamartine 1849: 402). Lamartine emphasized the military strength of the tricolor, stressing that the French nation needed its tricolor to appear fortified against and independent of the rest of Europe: "France and the tricolor is the same thought, the same prestige, even terror, if necessary, for our enemies!" (403). The Foreign Minister spoke not only about the unity between the nation and its colors, but he also underlined the global reach of the symbolic power of the colors: "the red flag has only been around the Champ-de-Mars, dragged in the people's blood in '91 and '93, but the tricolor has toured the world with the name, the glory and freedom of the fatherland" (395).[3]

Shortly afterwards, France's Second Republic under President Napoleon III restored the tricolor flag (Lamartine 1849: 410).[4] However, efforts to "overthrow" the tricolor did not stop. Once the end of the Second French Empire under Emperor Napoleon III became imminent, the throne was offered to Henri, Comte de Chambord, and the Bourbon heir-apparent. In 1870, Henri accepted but with one condition: the tricolor must be replaced by the white Bourbon ensign, featuring the fleur-de-lis. His wish was considered too outlandish to be granted. In the course of the past seventy years, the tricolor had become such a vital national signifier of unity and military strength that it trumped the mode of governance. Monarchy would not return to France. Instead, the tricolor and the republican ideals it represented ruled for the next seventy years.

The tricolor as a symbol for revolution and republican governance reached well beyond French borders. Nations that chose a tricolor ensign aligned their ideals with the French Revolution and the republican ideals of liberty, equality, and fraternity that it symbolized. Throughout the nineteenth century, popular uprisings and claims to political sovereignty were accompanied by tricolor cockades, be it in Belgium, the Netherlands, or Sicily (Maxwell 2014: 140). However, by the 1880s, radicals tended to abandon the tricolor flag, mostly due to the popularity of the black flag by the then virulent anarchist movements (Pastoureau 2009: 190).

The tricolor and the revolutionary and republican ideals that it stood for also served imperialist purposes inasmuch as France forced its client republics in Italy and the Netherlands to adopt the tricolor. Despite its involuntary implementation, the tricolor often came to "inspire genuine devotion" by the colonized, underscoring the way in which nineteenth-century biopower (power over populations) worked (Maxwell 2014: 140). Individual citizens strongly identified with the colors of their nation and its body politic, even if not all national ensigns had as turbulent a history as the French flag.

MAPPING THE BRITISH AND PORTUGUESE EMPIRES: THE COLONIZING POWER OF COLORS ON MAPS

Not just flags but also maps and atlases fostered identification and a sense of belonging to the nascent nation (Schulten 2012: 4). By the mid- to late nineteenth century, use of lithographic and photomechanical techniques in printing allowed publishers to print, copy, and circulate maps more quickly and inexpensively. Importantly, these techniques also facilitated the industrial production of colorful maps (Moser and Meyer 2019: 163–79). Although color had been present for centuries in handcrafted maps, hand-colored by "society ladies" in their spare time, such maps remained in the hands of the elite (Güttler 2013: 138; Moser and Meyer 2019: 179). In contrast, the new *brightly colored maps* were now used in European and American schools, effectively teaching children that national borders were objective, quasi-natural boundaries. Not only did the use of color promote "biased, partial, and selective" narratives about the world and international relations, but it also visualized and authorized the imperial agendas of nineteenth-century nations (Short 2003: 24; see also Fotiadis 2009).

Two examples will illustrate the intricate relationship between nineteenth-century maps and power, visual knowledge, and nationhood (Schulten 2012: 4). They underscore that maps were neither mirrors of nature nor neutral transmitters of a universal truth (Short 2003: 24). In fact, the colors on maps often served imperial purposes. In the case of the Portuguese, maps were used to stake claims to new territories in the scramble for Africa, and in the case of the British, they served to aggrandize and unify the empire (Friendly 2008).[5]

Brazil's independence in 1822 substantially reduced the Portuguese Empire (Nowell 1982: 20). In the 1830s, a colonial movement gained strength in Lisbon and culminated in an imperial project in the 1880s known as the Rose-Colored Map (124–36). It laid claim to a trans-African colonial zone stretching from Angola to Mozambique. The Portuguese government under Foreign Minister Henrique de Barros Gomes (1843–98) had a Lisbon civil servant design two slightly different versions of a map with large expanses of presumably Portuguese territory in Africa in a pink color (136). The government attached the first map to a treaty with France, which rearranged the borders with France involving Portuguese Guinea (127). The second map was attached to a treaty with Germany (129), which readjusted the boundaries between Angola and (German) South West Africa, and between Mozambique and (German) Tanganyika.

The small nation's self-assignment of key territories in the late nineteenth-century European "partition of Africa" was thwarted by the British, who in 1890 issued an ultimatum demanding the immediate withdrawal of the Portuguese from the territories claimed by the Rose-Colored Map (Nowell 1982: 189).[6] The Portuguese dared not risk their age-old peace alliance with the British (Vieira 2010: 132). The Lisbon government resigned, and the plans detailed in the Rose-Colored Map were abandoned.

The Rose-Colored Map is just one example of the ways in which the colors on maps have served to stabilize power relations and further geopolitical gains. The more mundane use of one particular color to demarcate the boundaries of a nation or an empire were just as effective. When Charlie Marlow, the young English protagonist in Joseph Conrad's late nineteenth-century novel *Heart of Darkness* (1899), admiringly gazes at a world map as he is about to travel to the Belgian Congo, the colors he uses to describe the different areas on the maps are anything but incidental:

> There was a vast amount of red—good to see at any time, because one knows that some real work is done in there, a deuce of a lot of blue, a little green, smears of orange, and, on the East Coast, a purple patch, to show where the jolly pioneers of progress drink the jolly lager-beer. However, I wasn't going into any of these. I was going into the yellow. Dead in the centre.
>
> (Conrad [1899] 2018: 10)

Yellow designated Belgian territory. Moreover, it was also associated with imminent danger, exemplified by the late nineteenth-century racializing metaphor of "Yellow Peril" to denote a menace from the East (Klein 2015; Moser and Meyer 2019: 177).

While the French traditionally used a deep blue to demarcate their empire on world maps, the British symbolized geopolitical power by coloring Commonwealth countries pink (Ryan 1997: 20; Moser and Meyer 2019: 176).

Pink was likely a printer's compromise so that overprinted letters could be clearly read. The color most closely associated with the British Empire was red, which signified war, vigor, and health (Laidlaw 2006). Significantly, red is often found in combination with the color white in the visual history of Great Britain, for example, in the union of a red and a white rose as a symbol of the Tudor monarchy or the red St. George's Cross against a white background as an emblem of England. Red and white mixed together became the pinkish hue of the swathes of the British Empire.

The use of one single color for the empire on maps and atlases served several functions. Firstly, pink concealed the territorial fragility of British imperialism by underlining its global reach. It made the empire seem connected by presenting stretches of pink territory (Colley 2007). Secondly, pink made all the lands of the British Empire look homogenous, whereas the various parts of the empire were vastly different and held with different levels of power (Colley 2003: 172).[7] Finally, the use of the same color for all Commonwealth countries detracted from the small size of the United Kingdom (Colley 2004: 4–5).

Linda Colley states that the first maps using red/pink to demarcate the British Empire are James Rennell's maps of India from the 1770s and 1780s (Colley 2007). According to Moser and Meyer, this practice only dates to the *Imperial Federation Map of the World* from 1886 (Moser and Meyer 2019: 176). What is clear is that the use of pink became more dominant/prominent in the course of the nineteenth century. Indeed, "in the second half of the nineteenth century, national tastes and traditions in the use of color in maps developed which were charged with symbolic meanings and became conventions" (Schneider 2006: 127; Moser and Meyer 2019: 164).

Maps of the British Empire featured lush Romantic and Victorian designs, often coupled with an endless variety of typefaces (Kain, forthcoming; Schneider 2006: 127). The *Imperial Federation Map of the World* is one such example. This immensely popular map was used in schools and beyond to promote imperial unity—in colorful "British" ways (Moser and Meyer 2019: 176). According to James R. Ryan the map appeared in a color supplement to *The Graphic* in 1886 to be ready for Queen Victoria's Golden Jubilee the following year (Ryan 1997: 20). The map used vivid shades of red, pink, azure, cream, and green to depict racialized peoples, colonial citizens, soldiers, animals, and plants from around the empire, draped at the map's margins and admiringly gazing at the figure of Britannia, seated centrally astride the globe (20). On one side, a redcoat (British) soldier holds a yellow tiger in chains, symbolizing European domination over nature and Asia (Vujakovic 2009: 141). Colorful maps such as the *Imperial Federation Map of the World* formed an integral part of the iconography of nineteenth-century British imperialism. They not only reflected the Victorian visual culture of the time but were also an effective way of promulgating a British imperial worldview.

CLASSING AND GENDERING THE POWER OF COLOR: BOURGEOIS MASCULINITY AND THE BLACK SUIT

The nineteenth century has often been qualified, in the words of psychoanalyst John Flügel (Flügel 1930: 110–12; 206–8), as the "great masculine renunciation," when bright colors were stripped off male attire and supplanted by black, dark grays, and blues. Indeed, the conventions of colors appropriate for menswear had changed drastically, expressing an important shift in power relations and in the very fabric of power, from the "blue-blooded" aristocracy of the ancien régime's sovereign power, ruling its people in a coercive top-down way, to the bourgeoisie's biopower disciplining their fellow "free" and "equal" brothers by differentiating them into discrete classes, genders, and races.

Inspired by the French revolutionary spirit and the expectation that an "honest citizen wears a black suit," the black suit triumphed in the Romantic period and lasted until the 1920s, if not longer (Pastoureau 2009: 169). Innovations in dye technologies in the mid- to late nineteenth century (Engel 2017: 37), made colorful fabrics available and affordable to the European middle classes. Soon, women's dresses were made in the wildest colors imaginable. A discrete children's fashion in pastel colors emerged, first in England, but with other European countries following suit. So why did men not take advantage of the new and improved availability of brightly colored dyes?

First and foremost, the black suit allowed men to visually establish bourgeois hegemony over the flamboyantly dressed aristocracy. Whereas in the eighteenth century, male elites in Europe might have worn pink, pale lemon, silver, or turquoise blue, these colors were now considered too feminine for men to wear. By deriding the nobility as a lavishly dressed, ostentatious chosen few, the bourgeoisie pitted their luxurious lifestyle against middle-class men's economical, spartan, rational mode of dress. Indeed, the dark-colored suit became the uniform of the bourgeoisie, and the dress code to which all other men were incited to aspire (Harvey 1995; Meyerrose 2016). The bourgeoisie thus relied on color codes to signify power relations: black stood for the self-governance and self-discipline of productive, efficient male citizen-merchants, while bright colors became the code for excessive, irrational, and feminine "others." The color code affirmed the revolutionary credo that all men clad in black suits were created equal, a promise made—if never realized—by the enlightened constitutions of the new nation-states, a promise predicated on the exclusion of women, poor white men, and people of color.

Notably, the darkly-colored suit must also be seen as a marker of male power in the color-coded gender binary foundation of bourgeois social order. It clearly demarcated the drab and serious public life of men from the carefully cordoned off private realm of women and children in the home. The colorful adornment of the home served to construct an emotionally bright and safe space, far away from the dangerous and dark streets reserved for men. This color-coded spatial and material construction of the gender binary became a pillar of Western societies' power structures.

Within the confines of the home and areas deemed appropriate for women and children (such as shopping in the new department stores), white middle-class women learned to exert power by developing appropriate taste (Nead 2013). Thus, despite the availability of hundreds of different colors and shades, bourgeois women learnt to exercise restraint in order to show class (Finlay 2007) (see Plates 5.1, 5.2, and 5.3). The color of a woman's dress had to harmonize with her complexion and hair color, as prescribed, for example, by the prominent French color theorist Michel Eugène Chevreul from the 1830s onward and by British color researcher Mary Merrifield in the 1850s (Merrifield 1854: 127–73). Soft pinks supposedly suited blondes best, and only the most fair-skinned women were believed to be able to pull off certain color combinations without risking ridicule (Perrot 1994: 102). This performance of restraint was firmly rooted in class, racial, and gender biases, all of which were buttressed by fashion periodicals such as *Godey's Lady's Book and Magazine* in the United States, the *Englishwoman's Domestic Magazine* in Britain, and similar publications in France, Germany, and elsewhere in Europe. Victorian era cartoons, such as the "Society War Game" panels drawn by Arthur Hopkins in 1884, were quick to ridicule women who dressed confidently and conspicuously and depicted them as compulsive shoppers and promiscuous flirts (Fongeallaz 2017). Even medical journals mocked women who fell prey to frivolous fashion trends, namely "gaudy" green dresses known to carry arsenic, and maintained that they should be called "killing creatures" ("The Week" 1862: 177), for a woman "carries in her skirts poison enough to slay the whole of the admirers she may meet with in half a dozen ballrooms." In the mid- to late 1800s, caricatures and humorous claims like these put women in their place, while it was rarely publicized that fashion used dyes that contained arsenic known to cause serious—at times fatal—health issues (Whorton 2010: 181–3).

Color codes also served to affirm national and class-specific standards of style and good taste (Grisard 2017). The French literary critic Hippolyte Taine's scathing comments on the bright dresses of wealthy English middle-class women in the 1860s left no room for doubt (Taine 1872: 23). He proclaimed that bright colors were the domain of prostitutes and the wives of parvenus. Any woman who dressed too shrilly was suspected of being one or the other (42). Not only did the unrestrained use of bright colors disqualify English middle-class women and their fashion sense in the eyes of this Frenchman, but it also invalidated the social ambitions of the British bourgeoisie more generally. By arguing that the collective cultural disposition of a nation's middle class correlated with its aesthetic sense, Taine used fabric colors to propagate class and national distinctions. Thus, when the management of bright colors became the domain of bourgeois women, it was their responsibility to use color responsibly so as to uphold sociocultural differences and white bourgeois beauty standards.

Wearing suits in black and other subdued shades set middle-class men apart from the colorful apparel of their middle-class wives and children. In turn, they learned to use restraint in order to distinguish themselves from the dingily dressed working class, as discussed in the next section, the unfamiliar world of the colonial "Other."

RACIALIZING THE POWER OF COLOR: CONSUMER CULTURE'S MISSION TO "CIVILIZE" AND "DOMESTICATE" THE COLONAL OTHER

The disappearance of color in Euro-American men's attire also served to establish superiority over ostensibly brightly dressed colonial subjects (Mirzoeff 2009: 51; Grisard 2017: 80). In the bourgeois cultural imagination, indigenous people were believed to be naturally drawn to bright hues. In line with colonial thinking of the time, this was seen as a testament to their "passionate" and "carefree" as well as "savage" and "sanguinary" nature (Grisard 2019: 220). The color of dress not only allowed the bourgeoisie to objectify and feminize ostensibly "unproductive," "idle," and "excessive" colonial bodies, but also served to affirm the idea that white men were inherently productive, rationally functioning masculine subjects (Grisard 2017, 2019).

White middle-class women were no impartial bystanders. Indeed, "the mass-marketing of empire as a global system was intimately wedded to the Western reinvention of domesticity, so that imperialism cannot be understood without a theory of domestic space" (McClintock 1995: 17). The bourgeois home became the site for middle-class women to tastefully display their brightly colored ornaments brought back from the colonies, essentially domesticating the ostensibly "untamed" and "uncivilized" colonial other. It was their seemingly "refined" taste and the innocence and purity ascribed to their children that authorized women—be it through advertising or missionary and philanthropical work in the colonies—to "civilize" colonial subjects with Western consumer practices and goods. Dubbed "Mrs Consumers," women were the main target audience of racist advertisements for colonial goods such as cocoa, coffee, refined white sugar, or soap (Quilley and Kriz 2003: 1–12).

The late nineteenth century was profoundly shaped by mass consumption and a fast-growing advertising industry. Brand design, elaborate window displays in department stores, and larger-than-life, brightly colored billboards were all characterized by the distinctly seductive sexualizing and racializing power of color. The increasing implementation of color lithography technology in advertising oddly coincided with starkly black and white commodity racism (see Plate 10.1). The commodity racism of soap advertisements was particularly extreme. Many advertisements promised to wash black skin white, propagating bourgeois ideals of hygiene, tidiness, and whiteness as civilizational gains. For example, "Why doesn't your mamma wash you with Fairy Soap," was the title of an advertising card by N.K. Fairbank Company of Chicago in 1893. Similar advertisements were used in England, France, and Germany. Advertisements such as these reaffirmed the idea that white skin was not only clean and innocent, but also that it was desirable (McClintock 1995; Wolter 2004). They thereby cemented the hierarchies between "white" Europeans' moral and hygienic purity and "black" people's morally corrupt nature. Ironically, brightly colored billboard advertisements were the ones that constructed the blackness of these exoticized others, while commodifying and essentially whitewashing the hierarchies among white Europeans and between Europeans and colonized others (Quilley and Kriz 2003: 1). In the course of the nineteenth century, dirtiness, dishonesty, laziness, and hypersexuality were metonymically linked to blackness, whereas innocence, cleanliness, and moral purity were intimately connected to the color white. The bourgeoisie elevated these "white" virtues to indicating the fundamental conditions for civilization, using the presumed lack of innocence or hygiene to justify commodity racism and colonialism as "civilizing" missions.

MILITARY POWER OF COLOR: FROM ORNAMENTAL RED COATS TO CAMOUFLAGE KHAKI

It was delineated above how white bourgeois men abandoned brightly colored attire in the early nineteenth century.[8] Military uniforms are often considered one of the last bastions where men were incited to adorn themselves with bright colors and ornaments without being decried as effeminate or gay (Matthews David 2015: 5–7). Under the influence of French army fashion, nineteenth-century military uniforms emphatically embraced bright colors, particularly during the reign of Napoleon III from 1852 to 1870. By the end of the century, however, colonial experience, technological changes, and larger sociocultural shifts in the perception of war, nation, gender, and color led most European armies to adopt drab, clay, gray, or khaki colors (Guillaume et al. 2016). Whereas the brightly colored uniforms of soldiers expressed the identity of the male citizen-soldier, the khaki uniform of the end of the nineteenth century symbolized the advent of the soldier-as-professional (Tynan 2013: 19). The former was intended to create a military spectacle at the home front and to daunt the enemy on the battlefield, whereas the latter expressed the new need for efficient performance of countersurveillance on the battlefield (3–4, 7).

With the establishment of modern national armies, a development that started in the seventeenth century and gained ground in the nineteenth century, colors in uniforms developed strategic importance. They served to distinguish the identity of soldiers from civilians within individual nation-states, and to demonstrate national unity, solidarity, and strength in the international system of nation-states (Maxwell 2014: 69–70): "docile," "disciplined" bodies invested in one body politic (Foucault 1977). Notably, while the dark suit worn by civilian men in nineteenth-century everyday life confounded established hierarchies, leading to anxieties about social disorder, at least among those unschooled in discerning the finer differences in cut and material, uniforms served to exhibit rank, discipline, and allegiance (Maxwell 2014: 69). Moreover, at a time when consumer culture was believed to seduce women into spending money beyond their means, uniforms were perceived as a way to economize on state expenses (69).

The history of how the color red became the signatory color of the British imperial army is instructive here. The first references to English infantry soldiers wearing a "red coat" have been traced back to the early sixteenth century (Arch 2007: 100). It was not until Britain's imperial century, however, that the "Redcoats" became veritable icons of the British nation and empire. A growing popular sense that red was the sign of the nation, pride in the conspicuous nature of the color red dovetailed with the relatively cheap production of red dyes, countless military ceremonies and rituals of the redcoats, and a far-ranging circulation of toy soldiers, photographs, postcards, and prints of redcoats (Matthews David 2003: 7; Arch 2007: 99, 102).[9] The anecdote of Lieutenant Macpherson, who in the North American War of 1812 "could not find a British flag for the flagpole [...] ran up his own red jacket" (Holmes 2002: 184), underscores how by the early nineteenth century the red coat had come to express national pride and belonging.

The red coat was also a signifier of class. If one is to take seriously the words of the Duke of Wellington, whose claim to fame is that he led the British army to victory at Waterloo in 1815, the red coat had the power to elevate poverty-stricken "scum" into "fine fellows" and respected representatives of the British Empire (Linch and McCormack 2015: 289). King William IV (r.1830–7) increased the use of red in British military uniforms by replacing the dark blue jackets of the light dragoons and lancers with scarlet ones, introducing red pelisses (short, fur-trimmed jackets) for the hussars, and red facings in the Royal Navy. Queen Victoria (r.1837–1901) reversed many of those changes, which suggests a more ambivalent relationship to the red uniforms. Indeed, by the end of the century, the red coats, once "convenient objects of adoration," became "more often than not targets of 'symbolic degradation' as the nineteenth century drew to a close" (Maxwell 2014: 67). Still, the abandonment of the British red of "our national uniforms" and the adoption of the "Indian 'khakee'" was at first an unpopular decision ("The Colour of Military Uniforms" 1883: 730). Rendering the troops less noticeable was also perceived as making them appear less British and less masculine in the eyes of both the enemy and British civil society. This may explain why it took the British Army until 1885 to give up its signatory scarlet tunics on the battlefield, even though the impracticality of traditional, bright colors had been acknowledged early in the nineteenth century (Barnes 1950: 197). In turn, the introduction of less conspicuously colored military uniforms was accompanied by voices now disqualifying red as both "unmanly" and "un-British." A shift in the perception of bright colors in general—and the color red in particular—made a soldier dressed up in scarlet appear like an ostentatious, even deceptive "canary bird" as opposed to the desired "British warrior going forth to fight the battles of his country" ("The Army" 1846: 144). "Scarlet is unmilitary, first, because it is tawdry; and secondly, as rendering the soldier, when isolated, an easier mark than a less glaring colour" (144).

While colorful French military fashion had been the yardstick for British army garments, by the mid-nineteenth century the scarlet of the British uniform began to be seen as inferior to the Prussians' "sober blue" ("The Army" 1846: 144). The shift from brightly colored uniforms to more subdued and drab colors coincided with the introduction of aerial surveillance and smokeless gunpowder in warfare in the second half of the nineteenth century, which led to the need for soldiers to hide (St. Clair 2016: 240–1). The change was also aided by the defeat of France in the Franco-Prussian War in 1871 (Matthews David 2003: 31). This said, "the identity of the nineteenth-century military man" remained wedded to the use of bright colors up to World War I (Matthews David 2003: 5; Guillaume et al. 2016).

The advantages of drab-colored uniforms were first tested in the hot climate of British India. In the mid- to late 1840s, the Corps of Guides, a regiment of the British Army that patrolled the northwestern border of India, outfitted its white officers and Indian soldiers with uniforms made out of khaki fabric shipped from England (Hodson-Pressinger 2004: 341, 346). Red did not vanish completely, however. Some regiments sported scarlet facings on the collars and cuffs, others wore a scarlet sash and turban, which earned them the nickname "the Flamingos" (343). Soon thereafter, all regiments, whether British or Indian, serving in the region had begun dressing in drab or khaki uniforms for active service and summer dress (Maerz and Paul 1930: 157; St. Clair 2016: 240–1). The first official adoption of khaki by British troops followed in 1868 with the Ethiopian Expedition. Subsequently, *khaki drill* became the official color of colonial campaign dress. The victories in the Mahdist War (1884–9) and the Second Boer War (1899–1902) were decisive in leading the public to embrace their troops and in no longer referring to them as *Redcoats* but as *Khakis*. The British government seized the moment of postwar national pride in its armed forces to call a "khaki election," a term used ever since for elections called to exploit public approval of governments immediately after military victories (St. Clair 2016: 241). By World War I, khaki represented a new British masculinity to the extent that those who could not wear the khaki uniform, due to a shortage of khaki cloth, were perceived as less soldierly (Tynan 2013: 47–53).

By the end of the nineteenth century, other nations had begun to favor khaki, *olive-drab*, *clay*, or *dust* colors for service dress. These earthy hues were believed to be more resilient and—most importantly—less visible than previously worn bright colors (Bühlmann 1909: 105). The introduction of more subdued earth tones was not only because of technological changes in arms and observation tools, which made bright colors too conspicuous for the safety of the soldiers. The turn to drab colors also symbolized a new way of constructing the nation and masculine identity as rational, professional, and economical (Guillaume et al. 2016). Indeed, khaki was believed to have particular, seductive powers. During World War I, there was much concern about the sexual morality of young women who had caught "khaki fever," that is, frequenting public places such as cinemas with khaki-clad soldiers home from the war (St. Clair 2016: 241). The French Army was the last major European army to hold on to its brightly colored military dress in World War I (Matthews David 2003: 32). Bright colors were not completely abandoned, however. Traditional scarlet, blue, and green uniforms were still worn for full dress and off-duty "walking out dress."

CONCLUSION

In the nineteenth century, "at precisely the moment when the social, economic and political institutions of the modern west were coming into form" (Quilley and Kriz 2003: 9), the opposition between bright colors and subdued, dark shades as well as the opposition between black and white became powerful instruments in hierarchizing society and affirming bourgeois identity in the West. Indeed, the bourgeoisie of the industrial age exerted power through a scopic regime that worked with specific color codes to foster national identity through flags, atlases, and maps. The colors on maps and atlases also allowed the establishment of imperial claims and legitimacy. In addition, racist caricatures in "exotically" colorful advertisements of commodities and the colonial ornamentation of the bourgeois home served to maintain white supremacy. The scopic regime also differentiated between the black-suited rational masculinity of bourgeois men and the brightly colored world of women and children. The departure from colorful to somber menswear as well as the decline of the ornamental uniforms of the Napoleonic Wars and the spread of khaki gray and green military dress corresponded with changing perceptions of nationhood, masculinity, and the role of warfare and the military (Olàh [2011] 2016: 453–63). What had restricted the attire of bourgeois men throughout the nineteenth century now also defined the image of soldiers: machine-like rationality, functionality, professionalism, and economic efficiency. Not only had the gender binary finally conquered one of the last bastions of white male ornamentation, but the military, submitting to the gender binary and its dress code, had also become a survival strategy for military men. Ironically, both the feminization and exoticization of bright colors and the introduction of drab colors are intricately tied to nineteenth-century colonialism and imperialism.

CHAPTER FOUR

Religion and Ritual

CHARLOTTE RIBEYROL

Throughout most of the nineteenth century, Britain appeared at the vanguard of industrial progress. Although the Industrial Revolution transformed color thanks to a number of key scientific innovations, such as the discovery in 1856 of aniline "mauve," the Victorian period (1837–1901) is still often perceived through a colorless filter—as the age of coal pollution and bleak, working-class slums. In his 1884 essay "The Storm Cloud of the Nineteenth Century," the critic John Ruskin interpreted this pervasive darkness as the symptom of a diseased, faithless world. Drawing on his diary entries of 1879, he noted:

> Sunday, 17th August, 1879
>
> Raining in foul drizzle, slow and steady; sky pitch-dark, and I just get a little light by sitting in the bow-window; diabolic clouds over everything: and looking over my kitchen garden yesterday, I found it one miserable mass of weeds gone to seed, the roses in the higher garden putrefied into brown sponges, feeling like dead snails; and the half-ripe strawberries all rotten at the stalks. And now I come to the most important sign of the plague-wind and the plague-cloud: that in bringing on their peculiar darkness, they *blanch* the sun instead of reddening it […]. But in plague-wind, the sun is choked out of the whole heaven, all day long, by a cloud which may be a thousand miles square and five miles deep. And yet observe: that thin, scraggy, filthy, mangy, miserable cloud, for all the depth of it, can't turn the sun red, as a good, business-like fog does with a hundred feet or so of itself. By the plague-wind every breath of air you draw is polluted, half round the world; in a London fog the air itself is pure, though you choose to mix up dirt with it, and choke yourself with your own nastiness.
>
> (Ruskin 1903–1912: 34:38–9; emphasis in the original)

In this passage fraught with apocalyptic imagery, Ruskin denounces the evils of modern industrialism and materialism, which not only corrupt the soul of man but also discolor God's most beautiful creations, from sun to rose.

For Ruskin, color was indeed "sacred"—a paradoxical statement for one brought up by a strict Evangelical mother, who had taught him to cherish the Word over the lure of the colorful ornaments favored by Roman Catholics. And yet, in spite of the multiple religious and aesthetic "revirements" he experienced throughout his life—and notably his 1858 "unconversion" in Turin in front of the *Queen of Sheba* by Venetian colorist Veronese—Ruskin never wavered in his celebration of "the sanctity of colour," which he strove to reconcile with his love of both nature and art in *Modern Painters*:

> Take a wider view of nature, and compare generally rainbows, sunrises, roses, violets, butterflies, birds, goldfish, rubies, opals, and corals, with alligators, hippopotami, lions, wolves, bears, swine, sharks, slugs, bones, fungi, fogs, and corrupting, stinging, destroying things in general, and you will feel then how the question stands between the colourists and chiaroscurists,—which of them have nature and life on their side, and which have sin and death.
>
> Finally: the ascertainment of the sanctity of colour is not left to human sagacity. It is distinctly stated in Scripture. I have before alluded to the sacred chord of colour (blue, purple, and scarlet, with white and gold) as appointed in the tabernacle; this chord is the fixed base of all colouring with the workmen of every great age; the purple and scarlet will be found constantly employed by noble painters, in various unison, to the exclusion in general of pure crimson.
>
> (Ruskin 1903–1912: 6:69)

Drawing on the Scriptures, Ruskin here attempts to moralize color, which the Reformation had targeted as dangerously sensuous, material, opaque, feminine, and superficial. In the preface to his 1904 translation of Ruskin's *Bible of Amiens*—a eulogy of the French Gothic cathedral as a Bible in stone—Marcel Proust quotes Ruskin's opposition between "colourists and chiaroscurists" (Proust 1987: 32), to suggest that the Victorian critic should be remembered not only as a major prose writer but also as a great chromophile. This "sacred chord of colour" was indeed central to Ruskin's "religion of beauty" explored by Robert de la Sizeranne in his eponymous essay *Ruskin et la religion de la beauté* (1897). Echoing de la Sizeranne, Proust claims that the source of Ruskin's talent as word painter was due to a form of "idolatry," a term smacking of both paganism and Catholicism, which he provocatively repeats throughout his *post-scriptum* (Proust 1987: 50–8). But fifty years before Proust, a Catholic reviewer, commenting on the first two volumes of *Modern Painters*, had already underlined the contradiction in Ruskin's aesthetic celebration of the Gothic and the works of the Italian Primitives:

> There is something so transcendently ludicrous in the notion that the Church of Rome is *idolatrous*, and yet that the early medieval architecture was the result of the purest Christian faith and feeling.
>
> (quoted in Cheeke 2016: 21; emphasis in the original)

Such conflicting responses to Ruskin's art-writing, as Stephen Cheeke notes, reveal that,

> the question of the theological significance of the supposedly aesthetic appeal of certain aspects of Church ritual, architecture, and decoration is part of a long struggle in British culture which foreshadows the emergence of art-writing that is sometimes nostalgic for Christian forms of worship later in the century.
>
> (2016: 21)

Because Ruskin, as a major cultural commentator on his own age, frequently engaged with the controversies relating to these "aspects of Church ritual, architecture, and decoration," which intensified in the wake of the Oxford movement of the 1830s—his wide-ranging writings on color will serve as the *fil rouge* to this chapter. It will be divided into two sections devoted, first, to the nineteenth-century revival of the colors of the pre-Reformation Church of England and then to discussions of color production and perception in the overlapping contexts of scientific materialism and industrialism, which challenged established religious orthodoxies throughout Europe. If the colors of the medieval past were praised by Tractarians, ritualists, or ecclesiologists in their polemical plea for liturgical reform, the invention of aniline dyes for the needs of an expanding textile industry, as well as the new approaches to chromatic perception propounded by Darwinist "free-thinkers," brought about alternative interpretations of the colorful beauty of nature, which Ruskin celebrated as a divine gift.

"OLD CHURCH OF ENGLAND" COLORS: CHROMATIC NOSTALGIA AND THE GOTHIC REVIVAL

Ruskin's bleak statement on the soulless "materialism" of the industrial world was echoed by many of his contemporaries, who shared the critic's belief that theirs was a funereal age. As noted by John Harvey, the fact that men from all classes in western Europe, as well as the Queen herself following the death of Prince Albert in 1861, were uniformally dressed in black reinforced this gloomy impression (Harvey 1995: 23–39). In contrast to the colors of female dress, perceived as superficial ornamentation, black was the preferred noncolor worn by Anglican clerics:

> Anglicanism under Victoria's reign, bearing the imprint of the eighteenth century's evangelical revival, was characterized by its rejection of adornment and its taste for simplicity. Ministers of the Church of England for instance wore a plain black habit, with sometimes a white collar or cravat, and during services the emphasis was placed not so much on the liturgy as on the reading the Scriptures and on predication, the focus being on the idea that faith primarily derives from what is heard (the word) rather than what is seen (the spectacle of religious rites, with their deployment of colour).
>
> (Murray 2016: 240)

In order to escape this pervasive darkness and uniformity, several artists and thinkers, including Ruskin himself, turned to the past in search of more dazzling hues, which they often longed to revive. The craze for revivals, whether Greek or Gothic, which affected both France and Britain at the time, had a strong chromophile dimension. In 1856, Ruskin thus praised the Middle Ages as the true "ages of gold":

> And first, it is evident that the title "Dark Ages," given to the mediæval centuries, is, respecting art, wholly inapplicable […]. They were the ages of gold: ours are the ages of umber […]. The Middle Ages had their wars and agonies, but also intense delights. Their gold was dashed with blood; but ours is sprinkled with dust. Their life was interwoven with white and purple; ours is one seamless stuff of brown.
>
> (Ruskin 1903–1912: 5:321–2)

Ruskin's reading of the darkness and opacity of modernity reflects his ambivalent engagement with the body of color—the blood of the past anachronistically jarring with the dust of the present. Drawing on a Carlylean sartorial metaphor, he contrasts the costly, sacred golds and purples of medieval fabrics with the common "seamless stuff of brown" of modernity, which he describes as "umber," an earth pigment he certainly understood in its etymological, theologically charged sense, derived from the Latin *ombra* (shadow).

COLOR AND LIGHT: THE "TREASURES OF THE NEW JERUSALEM"

Ruskin or Carlyle embraced the colors of a medieval past united in faith and fervor to question, as well as escape, the bleakness of the industrial present. A similar contrasting approach was adopted in High Church and Catholic circles as praise of the Middle Ages became increasingly equated with a nostalgia for the pre-Reformation Church. A strong historicizing strain indeed characterized Tractarianism, ecclesiology, and ritualism—three overlapping religious currents within the Church of England, which called for a revival of ancient liturgical practices to uphold the waning faith of their contemporaries, increasingly challenged by the agnostic positivism of modern science. As noted by Nigel Yates, there was "a good deal of cross-fertilization" among these three movements, in particular in discussions of church decoration and ecclesiastical vestments (Yates 2000: 49). As a consequence, Tractarians, ecclesiologists, and ritualists were indistinctly viewed by their detractors as suspiciously "popish"—especially following the conversion in 1845 of the leading figure of the Oxford movement, John Henry Newman, who had initially envisaged a "'via media' between Catholic idolatry and puritan-evangelical iconoclasm" (Allitt 1997: 52). But since the Roman Catholic Relief Act of 1829, and the pope's 1850 reestablishment of a national hierarchy for Roman Catholics in England and Wales (perceived as a form of "Papal aggression"), fear of the growing influence of the Church of Rome in Anglican circles had become widespread. Anti-Catholic rhetoric often focused on the dangerous taste for seductive colors supposedly favored by advocates of liturgical reform, as Roman Catholicism appeared as a theatrical religion of surfaces, which valued the lure of material splendor—and notably of dazzlingly colored fabrics, over the Word of God (Pastoureau 1994: 40).

In the 1840s, Francis Close of Cheltenham, author of *The Restoration of Churches is the Restoration of Popery,* thus ironized: "Romanism is taught *Analytically* at Oxford, it is taught *Artistically* at Cambridge […] it is inculcated theoretically in tracts at the one University and it is *sculptured, painted* and *graven* at the other" (quoted in Yates 2000: 51; emphasis in the original). If Oxford was the home of the Tractarian Newman, it was in Cambridge that the Cambridge Camden Society, later known as the Ecclesiological Society, was born. Ecclesiology was defined by its proponents as "the science of church architecture" as well as "the science of Christian Aesthetics" ("Schools" 1847: 2). Its journal, *The Ecclesiologist*, explicitly advocated the use of "Decorative Colour":

> We are surely not called upon to prove that colour is beautiful. If it be not, why employ stained glass at all? […] We are consistent; we would have every inch glowing. Puritans are consistent; they would have every inch colourless.
> ("On Decorative Colour" 1845: 200–1)

Because it openly broke away from "this grey Protestantism of hue" ("On Flowers as Employed in the Adornment of Churches" 1846: 215), inherited from what Michel Pastoureau has defined as the "chromoclasm" of the Reformation (Pastoureau 1994: 36), William Butterfield's All Saints' Church on Margaret Street in London became the model church of the ecclesiologists (Muthesius 1972: 59). Begun in 1849 and consecrated in 1859, this church, built with alternating bright red and black bricks is a glowing tribute to the Victorian rediscovery of medieval polychromy, in keeping with Ruskin's recommendations in *The Seven Lamps of Architecture* (1849). A natural theologian, Ruskin had indeed praised "the true colors of architecture" as "those of natural stone":

> I cannot, therefore, consider architecture as in anywise perfect without colour […]. Our building, if it is well composed, is one thing, and is to be coloured as Nature would colour one thing—a shell, a flower, or an animal.
> (Ruskin 1903–1912: 8:176–7)

At All Saints, both the exterior and the interior glow with color, as the usual whitewash was banned in favor of brilliantly colored geometrical mosaics, stained glass, and gilding (Muthesius 1972: 63–4). Unsurprisingly, this polychrome church soon became one of the most active ritualistic centers in England. But because it betrayed the influence of *foreign* Catholic countries such as France or Italy, the question of liturgical colors in both vestments and church decoration was a highly sensitive one in Victorian England. As early as 1840, that is to say, five years before his conversion, Newman had felt the need to respond to accusations from his detractors on the subject of the controversial "rich embellishments" of medieval churches:

> The other point commonly insisted on is the Medieval Church's wealth and splendour, the rich embellishment of her temples, the jewelled dress of her ministers, the offerings, shrines, pageants, and processions, which were part of her religious service. All these are supposed to be denoted by "the purple and scarlet colour, and gold, and precious stones, and pearls," with which the sorceress in the Apocalypse is arrayed; where mention is also made of the merchandize of gold and silver, precious stones, and of pearls and fine linen, and purple, and silk, and scarlet, and all thyine wood, and all manner of vessels of ivory, and precious wood, and brass, and iron, and marble, and cinnamon, and odours, and ointment, and frankincense, and wine, and oil, and fine flour, and wheat, and beasts, and horses, and chariots, and slaves, and souls of men, and the voice of harpers and musicians, and of pipers and trumpeters. All such magnificence would of course, in itself, as little prove that the Church is Antichrist, as that any king's court is Antichrist, where it is also found […]. Passages such as these, at least show that precious stones are no peculiar mark of Antichrist; which is sufficiently clear even from a later chapter of the Apocalypse, in which jasper, sapphires, and other jewels are mentioned among the treasures of the New Jerusalem.
> (Newman [1840] 1872: 184–5)

In this text, entitled "The Protestant Idea of the Antichrist," Newman replaces the anti-Catholic assimilation of the pre-Reformation Church to the Scarlet Whore of Babylon with a reference to Saint John's vision of the New Jerusalem. The passage from Revelation (Rev. 21:9–23)—certainly one of the most colorful in the New Testament, otherwise somewhat lacking in chromatic terms—appears as a particularly apt one as the colorful revelation had already served as a liturgical and theological justification for the use of colored materials in the decoration of Gothic cathedrals in twelfth- and thirteenth-century France. As Otto von Simson observes:

> The Christian sanctuary is, liturgically and mystically, an image of the Heavenly Jerusalem […]. The medieval dedication rite establishes this relationship in explicit terms and the twelfth and thirteenth centuries appear singularly preoccupied with this symbolic significance of sacred architecture.
> (Von Simson, quoted in Stookey 1969: 35)

Echoing Neoplatonic discussions of divine light in St. Augustine, Abbot Suger believed that color was akin to light, that is to say, both visible and immaterial, which enabled him to use luminous materials (notably jewels and stained glass) in the construction and decoration of his new abbey at Saint Denis, the first Gothic church, completed in 1144. Not only did Suger conceive a whole new spatial order to let more light into the edifice, he also drew on the Old and New Testaments to justify its luxurious ornamentation, advocating an anagogical shift "from the material to the immaterial":

> Thus, when—out of my delight in the beauty of the house of God—the loveliness of the many-colored gems has called me away from external cares, and worthy meditation has induced me to reflect, transferring that which is material to that which is immaterial, on the diversity of the sacred virtues.
> (Panofsky [1946] 1979: 21)

The Victorians may not have been as familiar with the writings of Abbot Suger as with those of Theophilus, discussed by Mary Merrifield in her 1849 translation of *Original Treatises Dating from the XIIth to the XVIIIth Centuries, on the Arts of Painting* (Loske 2016), or of William Durandus, translated in 1843 by the ecclesiologists J.M. Neale and B. Webb (Durandus 1843). Yet, Ruskin's discussion of the relationship between architecture and theology in his 1870 *Lectures on Art* appears quite close to Suger's conception of the sacredness of Gothic cathedrals:

> Let us take an instance—the most noble with which I am acquainted, the Cathedral of Chartres. You have there the most splendid coloured glass, and the richest sculpture, and the grandest proportions of building, united to produce a sensation of pleasure and awe. We profess that this is to honour

> the Deity; or, in other words, that it is pleasing to Him that we should delight our eyes with blue and golden colours, and solemnize our spirits by the sight of large stones laid one on another, and ingeniously carved.
>
> (Ruskin 1903–1912: 20:69)

This passage clearly "solemnizes" the colors of the Gothic past, reflected in its most sacred, costly blues and golds. Ruskin draws on the example of the sublime stained glass windows of Chartres to articulate the visual and the visionary, reminiscent of the luminous "large stones laid one on another" of the New Jerusalem.

Ruskin's aesthetic and ideological reappraisal of the colors of a medieval past proved also extremely influential throughout the second half of the nineteenth century, especially with artists such as William Morris and Edward Burne-Jones, who had initially envisaged a career as High Church clergymen in the wake of the Oxford movement. Following a tour of the Gothic cathedrals of northern France in 1855, they finally opted for the artistic path—nonetheless benefiting from the increase in commissions for the decoration of newly built or restored churches fostered by the Gothic Revival and pleas for liturgical reform. Morris, Marshall, Faulkner & Co. notably became very active in reviving the ancient stained glass techniques in which the painting of details of line and shadow in brown or black oxides are fired onto translucent colored glass (Winston 1847). This enabled artists to achieve a transparency—anagogically transmuting color into light, the metaphor for God (Raguin 2003: 10–13)—which eighteenth-century windows painted in enamels on large pieces of glass lacked. The second half of the nineteenth century thus became the most active period in the production of stained glass since the Middle Ages, in Britain, France, and Germany.

Close to the Morris circle, and a keen reader of Ruskin, the Pre-Raphaelite architect William Burges, who designed the Medieval Court of the International Exhibition of 1862 for the Ecclesiological Society, equally defended the use of color in church decoration—from stained glass to ecclesiastical ornaments and vestments, mural and even missal painting. The image of the New Jerusalem, chosen by Burges to illustrate the colorful origins of sacred architecture (see Plate 4.1) on his Great Bookcase (1859–62)—displayed as the centerpiece of the Medieval Court—was also a favorite in *The Ecclesiologist*, a journal to which Burges regularly contributed:

> Mere naked form, however graceful in itself is cold and unaffecting; may we not add unnatural? For whether we look at the inanimate works of creation, at the sky or the earth, at the setting sun, the glowing cloud; at the fields, mountains, trees, flowers, or at living objects, animals, reptiles, the glittering fish, the painted bird, the gaudy fly; or again at the description of the Tabernacle, the Temple, or the New Jerusalem; we see that every work

> of God—and from what other source has man any perception of beauty?—is adorned with colour.
>
> ("[Review of] *Glossary* …" 1844: 142)

From "glittering fish" to glowing stained glass, advocates of liturgical reform drew on the dappled beauty of nature to celebrate the sacredness of color—strikingly absent from the *Book of Common Prayer*.

PUGIN AND ECCLESIASTICAL ORNAMENTS

Following a discussion of the writings on coloring and gilding techniques of the medieval monk Theophilus, *The Builder* of June 23, 1860, reported that:

> Mr Burges […] saw no reason why the service books in our abbey churches should not be illuminated. It seemed to him that if a memorial of a good and distinguished person were required, it would be far better to produce a magnificient illuminated volume than an ugly bronze statue, which in a few years would become as black as a sweep. Just fancy what a magnificent Book of Common Prayer might be produced for Westminster Abbey if Mr Dyce and Mr Herbert were commissioned to illustrate it.
>
> ("Royal Institute of British Architects" 1860: 395)

Burges's proposal to illuminate in medieval fashion the Book of Common Prayer—that is, the central text of the English Reformation—was most certainly meant as provocation, especially as one of the suggested illustrators, the medievalist painter John Rogers Herbert, had converted to Roman Catholicism in 1840 and was a close friend of the Roman Catholic architect A.W.N. Pugin.

Pugin was one of the most vocal proponents of the Gothic Revival in Victorian England. Although Ruskin denied Pugin's influence (Ruskin 1903–1912: 5:428–9), accusing him of having converted mainly for aesthetic reasons—"blown into a change of religion by the whine of an organ pipe; stitched into a new creed by the gold threads on priests' petticoats" (quoted in Allitt 1997: 46)—it is evident that the two writers shared a common belief in the chromatic superiority of early Christian art over the modern. However theologically apart, their conception of the Gothic past as "the school of colour" (Ruskin 1903–1912: 20:140) evidently shaped nineteenth-century liturgical debates and architectural practice.

Pugin may have converted at the time when the Oxford movement was in full swing, but his apostasy had more to do with what was happening in ecclesiastical Cambridge at the time. This may seem surprising as Cambridge had a more Puritan-Evangelical tradition than High Church Oxford. However, between 1825 and 1830 three Cambridge students, Kenelm Digby, George Spencer, and Ambrose Philipps, were received into the Roman Catholic Church. Ambrose

Philipps was a close friend of Pugin's, and both shared a deep fascination with the beautiful ceremonials of the Middle Ages defined as "ages of the highest grace to men; ages of faith; ages when all Europe was Catholic" (quoted in Allitt 1997: 44).

If Pugin's *Contrasts*, published in 1836, two years after his conversion to Roman Catholicism, is devoid of color illustrations, his *Glossary of Ecclesiastical Ornament and Costume* (1844) paradoxically draws on the new technique of chromolithography to celebrate the rich rituals of the medieval church (see Plate 4.2). In the introduction, Pugin insists on the importance of colored ornaments to celebrate the glory of God:

> But if the exterior of the temple be so soul-stirring, what a burst of glory meets the eye, on entering a long majestic line of pillars rising into lofty and fretted vaulting! The eye is lost in the intricacies of the aisles and lateral chapels; each window beams with sacred instructions, and sparkles with glowing and sacred tints; the pavement is a rich enamel, interspersed with brass memorials of departed souls. Every capital and base are fashioned to represent some holy mystery; the great rood loft, with its lights and images, through the centre arch of which, in distant perspective, may be seen the high altar blazing with gold and jewels, surmounted by a golden dove, the earthly tabernacle of the Highest [...]. It is indeed a sacred place; the modulated light, the gleaming tapers, the tombs of the faithul, the various altars, the venerable images of the just,—all conspire to fill the mind with veneration, and to impress it with the sublimity of Christian worship.
>
> (Pugin [1844] 1868: 4–5)

The glossary itself is also full of references to color as a means to retrieve the ritualistic practices of the past. Red—the most popish of hues, connoting both luxury and sin according to Protestants (Pastoureau 2016: 111)—is, for instance, given a particularly long entry (Pugin [1844] 1868: 198–200).

But Pugin's defence of Gothic colors against what he perceived as the dullness of post-Reformation architecture was far from just an antiquarian hobby. Like the ritualists—whom he deeply influenced—his discussion of liturgical practice in the medieval Christian church was aimed at reviving the waning faith of his contemporaries. Pugin believed in particular that the visual dimension of ritual was central to the religious experience. The reception of his second wife, Mrs. Louisa Pugin, into the Catholic faith, celebrated in the chapel at Alton Towers, illustrates the powerful "impression" produced by a beautiful ceremony, literally high in colors:

> The ceremony was grand, and awfully impressive. Agreeably to ancient Catholic custom in this island and to the present practice of the Church in Catholic countries, the aisle of the sacred edifice was bestrewed with

> odiferous flowers and evergreens, emblematic of the sweetness and never-fading beauty of the Heavenly Zion. From either extremity of the side galleries was extended across the chapel a handsome and tasty festoon of flowerets, from the centre of which was suspended a crown of the same materials directly over the head of the convert. At the appointed hour [...] the Rev. Dr. Rock as priest, attended by the Rev. Messrs. Morgan and Fairfax as deacon and sub-deacon, walked in solemn procession from the sacristy to the sanctuary, preceded by the thurifers, acolytes, and torch-bearers. Their vestments were of the richest gold brocade. A grand High Mass was then sung [...]. Immediately after the Gospel, Dr. Rock exchanged his superb chasuble for a splendid cope [...] with which he [...] intoned the first words of the [...] Veni Creator Spiritus, in the old Salisbury chant, which the choir continued with impressive effect.
>
> (*Catholic Magazine*, July 1839, quoted in Adams 2010: 34–5)

Although in keeping with “the present practice of the Church in Catholic countries,” the reference to “old Salisbury” at the end of the passage is also a clear evocation of the “Sarum Rite,” or “Use of Salisbury,” established in the eleventh century and originally used in Salisbury Cathedral. Abandoned after the Protestant Reformation, it was only partly retained in successive versions of the Book of Common Prayer. In the mid-nineteenth century, attempts were made to revive this traditional form of liturgy, believed to be authentically English rather than Roman—in keeping with the “Ornaments Rubric” of 1559. In his 1879 essay on *The Ancient Use of Liturgical Colours*, C.C. Rolfe thus includes a table of colors according to the Sarum rite as they should be revived to “mark” specific liturgical seasons (Rolfe 1879: 208–9). In the Catholic liturgy, color symbolism equally signaled the feast of the day. As noted by Murray:

> White, which is associated to purity, is worn on Marian feasts as well as for the celebration of virgins, confessors and angels, and also on Holy Thursday, Easter Sunday, the Ascension and All Saints. Red, which suggests the shedding of blood and the fire of the Holy Spirit, is used on the feasts of martyrs and apostles and on Whit Sunday. Black, symbolizing mourning and penance was used for funeral masses, for Advent, Lent and the feast of the Holy Innocents—and green for all the other days.
>
> (Murray 2016: 243; see also Pastoureau 1989: 219)

The Rev. Daniel Rock (1799–1871), the English Roman Catholic priest and ecclesiologist who celebrated Pugin’s second wife’s reception into the Church of Rome, was an authority both on the old Sarum rite as well as on ecclesiastical vestments, to which he later devoted a volume entitled *Textile Fabrics: A Descriptive Catalogue of the Collection of Church-vestments, Dresses, Silk Stuffs, Needle-work and Tapestries* (Rock 1870) based on the textile collections of the South Kensington Museum. This catalog was illustrated with colored plates—which contrast with Rolfe's purely scholarly, unadorned text on ancient liturgical colors, which is nonetheless indebted to Rock:

> Almost from the beginning there appears to have been a difference between the usage of Rome and that of England; most certainly there was throughout the Middle Ages. Dr. Rock says:—"Rome herself never uses sky-blue, England in Catholic times did; Rome enjoins black for Good-Friday, England prescribed red."—[*Church of our Fathers*: 2:259] [...]. Probably no one has expressed more deep regret for the change that has passed over the Church of Rome, with regard to the sacerdotal dress, than the late Dr. Rock. As he was a Roman Catholic Priest, and remained in communion with Rome until the day of his death, his writings are especially valuable upon this subject, and cannot be said to be dictated by any sectarian bias, as might have been the case had he been a member of the Church of England. He clearly shews that a change has been brought about in the very shape of the Roman vestments, exactly corresponding in degree to that which we note with reference to their colour.
>
> (Rolfe 1879: 193–4)

Following the Public Worship Regulation Act of 1874 which had been introduced to limit ritualistic excesses denounced as "masquerade" (Benjamin Disraeli, quoted in White 1962: 205), the color of ecclesiastical vestments was evidently still a much vexed question, one which could only be broached with utmost rhetorical precaution. Having noted the "disorganised" use of colored vestments (Rolfe 1879: 6–7), Rolfe thus paradoxically quotes Rock to *discredit* the "unorthodox" colors of modern Roman Catholic vestments on the one hand and to advocate a return to true "old Church of England" colors on the other:

> Enough harm has already been done to the Church of England in past centuries, through the introduction of foreign influences and schools of thought, external to her own true system. It would be wise to take warning from the past, and, in this matter, for English Churchmen to stick to their old Church of England colours.
>
> Then again, the modern Church of Rome, in her sequence of colours, is not orthodox. If we apply the triple crucial test of reason, authority, and revelation to that use, it fails as regards the latter. The use of the five Roman colours—red, white, green, violet, and black—is consistent enough, as regards reason or common sense; it is also based upon as good authority, as aught that is comparatively modern can be; but there the matter rests. It is not supported by revelation: the ancient use of the Church of England was.
>
> (Rolfe 1879: 3)

Rolfe's central claim here is that the use of color in liturgical matters should be sanctioned by the biblical text rather than by "foreign" practice:

> The twenty-eighth chapter of the Book of Exodus contains the one Revelation from God to man of the colours of the sacrificial vestments to be worn in His Church upon earth. In every pure age of the Church this one Revelation, made once for all, has materially influenced her holy ritual worship.
>
> In the fifth verse of this chapter, the Divine command is clearly given: "And they shall take gold, and blue, and purple, and scarlet, and fine linen," wherewith to make the vestments for those about to minister in the sacerdotal office. No doubt has ever yet been expressed by any commentator, that the "fine linen" implies other than a white material. Thus it is manifest that materials of these five colours were to be used in making the sacrificial vestments, viz. gold, blue, purple, scarlet, and white,—and of these five colours only.
>
> (Rolfe 1879: 9)

Like Ruskin, Rolfe believed that "the sanctity of colour [...] is distinctly stated in Scripture." Rolfe even quotes the Victorian critic twice in both his introduction and conclusion—possibly because Ruskin had succeeded in making the material splendor of the pre-Reformation past palatable to a Protestant readership.

"GAY AND GAUDY COLORS": THE LURE OF MODERN HUES

If changes in ritualistic practice were perceived as a "popish" threat by many Anglicans—religious orthodoxies were also being challenged on other fronts, and in particular, by industrialism and the rise of scientific materialism.

"Unweaving" the rainbow: Darwin and the colors of nature

Following the controversial publications of Darwin's *On the Origin of Species* and *The Descent of Man*, color became increasingly involved in discussions of animal as well as human perceptions of the beauty of nature. Ruskin, in particular, strongly dissented from both Darwin's sexualization of nature's colors as well as from the "naturalization" of the aesthetic sense that the Darwinian physiologist Grant Allen equally believed to be the "necessary result of natural selection" (Allen 1877: vii–viii). Baffled by Darwin's assertion that:

> Flowers and fruits have been rendered conspicuous by gaudy colors in contrast with green foliage, in order that the flowers might be easily seen, visited, and fertilized by insects, and the fruit have their seeds disseminated by birds.
>
> (Darwin, quoted in Smith 2006: 163)

Ruskin felt the need to defend his moral vision of nature and art. *Proserpina* was his response to Darwin's emphasis on the utilitarian role of deceitful color to lure insects into the sexual act of cross-pollination:

> What the colours of flowers, or of birds, or of precious stones, or of the sea and air, and the blue mountains, and the evening and the morning, and the clouds of Heaven, were given for—they only know who can see them and can feel, and who pray that the sight and the love of them may be prolonged, where cheeks will not fade, nor sunsets die.
>
> (Ruskin 1903–1912: 25:414)

In the conclusion to his essay on liturgical colors, Rolfe explicitly draws on the opposition between Ruskin and Darwinian "free-thinkers" to support the Ruskinian claim that nature "teaches us something with reference to the mystic colours of the Law" (Rolfe 1879: 222):

> That there is some occult secret sympathy between the outer world of Nature and our most holy Faith there can be no doubt. It is in a measure proved by the fact that he who has most faith in God, has also the most love for Nature. Mr. Ruskin has alluded to this. He says:—"We shall find that the love of nature, wherever it has existed, has been a faithful and sacred element of human feeling; that is to say, supposing all the circumstances otherwise the same with respect to two individuals, the one who loves nature most will be always found to have more capacity for faith in God than the other" [*Frondes Agrestes*: 141].
>
> Now it is a most remarkable fact that in these wild flowers of Nature we perceive the same mystic colours which are prescribed in the Law for the sacerdotal dress. And it can only be accounted for by considering that in Nature, as in the Church, the influences of God's Spirit are ever at work, and that these holy influences, save when checked by man, produce one and the same result.
>
> There are free-thinkers nowadays who tell us that there is no God; and that Nature is guided and directed by certain occult laws of its own. We Churchmen think otherwise. We believe that God is in Nature, moulding and developing it:—sending the beautiful wild flowers to teach us one great lesson: the green leaves and green grass, another: the clouds, another: the foaming ocean, another: and so on. If these modern sceptics could point out to us in our English hedge-rows wild flowers growing with black petals, instead of with those mystic coloured petals of golden yellow, and blue, and purple, and red, and white, which we now find, we might then perhaps be

> tempted to doubt whether the influences of God's Spirit were indeed still working within Nature, as of yore. But Nature is true, and we do not doubt.
> (Rolfe 1879: 223)

Ruskin's praise of the beauty of nature as a Divine gift, had evidently both a Romantic and a religious dimension, which may recall John Keats's fury against Newton's "unweaving" of the rainbow in his poem "Lamia" (Keats 1956: line 237). If Ruskin did at times feel a form of unease when confronted with the lure of material color, in particular, with the sensual colors of Catholic Venice (Bullen 2005: 130–1), he often celebrated the rainbow as the prismatic epitome of God's covenant with Man, reflected in the harmonious transparency of Gothic stained glass (Ruskin 1903–1912: 10:457). Therefore, more often than not, his rainbow was pre-Newtonian—that is, holy and ternary—rather than sevenfold:

> In that heavenly circle which binds the statutes of colour upon the front of the sky, when it became the sign of the covenant of peace, the pure hues of divided light were sanctified to the human heart forever; nor this, it would seem, by mere arbitrary appointment, but in consequence of the fore-ordained and marvellous constitution of those hues into a sevenfold, or, more strictly still, a threefold order, typical of the Divine nature itself.
> (Ruskin 1903–1912: 10:174–5)

Aniline dyes: From factory to church

Ruskin was, therefore, not prepared to welcome the new dazzling gamut of coal-tar based, aniline dyes devised by the chemical industry (Travis 1993), which in Thomas Salter's terms of 1869, had managed to "produce the colours of the rainbow from a lump of coal" (Salter and Field 1869: 162, see also Ribeyrol 2016b). For Ruskin, the aniline revolution brought about by William Perkin in 1856 desacralized color by severing it from nature. The anthropologist Michael Taussig has commented upon this "killing off" of the natural body of color in the mid-nineteenth century:

> Then there are the name choices for what are generally thought of as the first synthetic, meaning aniline, dyes discovered in the mid-nineteenth century, the best known of which is mauve, the French name of the common mallow plant […]. Such names are fake, allusions to what paints used to be before the industrial production of paints […]. The fakeness of these bodies conjured up by market hype is a fakeness brought about because the body was killed off by mid-nineteenth century. What took its place were these names as substitutes for what had gone, and the names were marvelous.
> (Taussig 2009: 43)

Ruskin was more skeptical as to these “marvelous” names devised by nineteenth-century chemists whose “mauves” or “magentas” would never match the poetic “purple sea” of Homer:

> We moderns, who have preferred to rule over coal-mines instead of the sea [and] have actually got our purple out of coal instead of the sea! And thus, grotesquely, we have had enforced on us the doubt that held the old word between blackness and fire, and have completed the shadow, and the fear of it, by giving it a name from battle, “Magenta.”
>
> (Ruskin 1903–1912: 19:379–80, see also Ribeyrol 2016a)

Following his religious crisis, Ruskin became increasingly interested in pagan myths as well as in the Greek color sense. In his 1870 Oxford lecture on color, he discussed:

> the Greek conviction, that all nature, especially human nature, is not entirely melodious nor luminous; but a barred and broken thing: that saints have their foibles, sinners their forces; that the most luminous virtue is often only a flash, and the blackest-looking fault is sometimes only a stain: and, without confusing in the least black with white, they can forgive, or even take delight in things that are like the *nebris*, dappled.
>
> (Ruskin 1903–1912: 20:71)

Linda Dowling identifies this dappledness with the Greek *poikilia*, a term referring to the multicolored and changing textures favored by the Hellenes, notably of the Archaic age (Dowling 1989). This *poikilia* was also explored by another Oxford don, Walter Pater, whose approach to pagan art drew on E.B. Tylor’s anthropological analysis of “primitive” religions.

By relegating color to the debased status of industrial refuse, the aniline revolution desacralized the “pied beauty” of nature, which the poet Gerard Manley Hopkins—a pupil of both Ruskin and Pater, who was received into the Roman Catholic Church by Newman himself on October 21, 1866—lauded in Ruskinian terms in 1877 (Hopkins [1918] 1967: 69). Coal-tar colors thus became an apt metaphor to designate the ills of a modern, materialistic, society, including in debates about ritualistic practice. Although the first aniline dye was patented by an English chemist, *Punch* saw the “mauve measles” as an epidemic originating from France, where the new color “mauve” happened to be Empress Eugénie’s favorite (Garfield 2000: 59–61). This perception of aniline dyes as potentially alien and feminine may equally shed light on why the satirical magazine *Punch*, described the new “mauve” as a “Puseyite” (in reference to the Tractarian E.B. Pusey), effeminate color, associated with ritualistic excesses typical of Catholic ceremonials (“Clerical Slips and Skirts” 1859: 115): “Clergymen […] officiate in the height of Puseyite fashion, wearing vestments of gay and gaudy colors; green, for example, and for aught we know, *mauve*" ("The Disturbances in the Eastern Church" 1859, 37: 122). It is true, as noted by J.G. Davies, that,

> to meet the growing demand of the high-churchmen of the Church of England and of the clergy of the Roman Catholic Church, Victorian commercial interests were mobilized to supply full sets of vestments and hangings in the "correct" liturgical colours.
>
> (Davies 1972: 141)

This, in turn, led anti-ritualists to hint that the call for liturgical reform, generally perceived as deeply anachronistic on the basis of its nostalgic praise of the "primitive"—if not pagan—usages of the pre-Reformation church, also had a hidden "modern" and materialistic agenda. A broadsheet published on December 11th following a ritualistic crisis at St. Sidwell's, Exeter, thus ironized about the High Church Bishop, Henry Phillpotts:

> Henry Fillpotts [*sic*], formerly head Pot Boy of the Bell Inn, Gloucester, but lately in the *sole* trade, Exeter, begs to inform the Clergy of the Diocese, that he hath been appointed *Sole* Agent, by Mr Gregory Pope, 16, Rome, an eminent manufacturer, for the Sale of Surplices, of the most approved cut and spotless colour … His next consignment will consist of a few choice lots of Copes and Albs, bearing the true Papal Stamp.
>
> (quoted in Yates 2000: 182–3; emphasis in the original)

By describing Pope Gregory as a textile "manufacturer" motivated by greed rather than faith, the broadsheet targeted colorful Anglo-Catholic liturgy as not only superficial and theatrical, but also as materialistic and hence sinful—however "spotless" the new colorful surplices in question. Moreover, as avid "consumers" of new colors and new vestments, High Churchmen were frequently feminized as narcissistic. In a country where clerical costume, like male costume, was uniformly black, delight in bright colors was indeed perceived as dangerously effeminate. In another cartoon by *Punch* published on December 22, 1866, an "Ardent Ritualist" is thus depicted complimenting his colleague on his new costume: "O Athanasius, it's charmingly becoming!" (see Figure 4.1). Even if the cartoon is in black and white, the elaborate motifs suggest that the praised vestment is richly decorated in diverse hues. The comment appears as a purely aesthetic one, disconnected from any form of theological or liturgical concerns. What is more, the archaic name Athanasius—deliberately *not* English-sounding—was certainly meant as a thinly veiled allusion to Newman's translation of treatises by Athanasius of Alexandria (296–373)—in order to lend an anti-Tractarian touch to the satirical charge.

FIGURE 4.1 "Height of Fashion," cartoon from *Punch* (vol. 51, London, 1866). Copyright free edition. Digitized by the University of Minnesota.

Chromatic spectacles in Catholic decadent literature

The taste for the "gay and gaudy" colors of the pre-Reformation past may also be found in the Catholic literature of the *fin de siècle*. Oscar Wilde—who was received into the Roman Catholic faith just before his death in Paris in 1900, after having been "in the toils of the Scarlet Woman" for many years (Wilde 2000: 15)—was certainly a nostalgic chromophile. His praise of color for color's sake dissociated from any form of "ethical sympathies"—"even a colour-sense is more important […] than a sense of right or wrong," he claimed (Wilde [1948] 2003: 1154)—may have set him apart from the moralism of Ruskin, but he certainly shared with the Victorian critic an unconditional love for the more dazzling colors of the past, especially of the Italian past. It is thus evident that his conversion had more to do with his aesthetic—and notably chromatic—fascination with Rome than with the practice of modern Catholics in his native Dublin.

To a certain extent, Wilde's ambiguous relation to Ruskin is partly reflected in his ambivalent response to color and notably to the changes that affected chromatic materiality in the second half of the nineteenth century. He embraced the aniline revolution, which heralded the superiority of art and artifice over natural beauty. Wilde and his acolytes thus flaunted an artificially green-dyed carnation at the premiere of *Lady Windermere's Fan* in 1892. The artificial color of this flower was obtained by plunging its stem into aniline malachite green. Robert Hichens then turned this aniline green carnation into a symbol of decadent aesthetics in his eponymous novel published in 1894, a *roman à clef* featuring Esmé Amarinth as the witty Oscar Wilde figure. In the following passage, Hichens satirizes the decadents' sensual rather than spiritual attraction to the Roman-Catholic Gregorian plain-chant:

> The average Anglican chant is one of the most unimaginative, unpoetical things in the world. It always reminds me of the cart-horse parade on Whit-Monday. A brown Gregorian is so much more devotional [...]. All combinations of sounds convey a sense of colour to the mind. Gregorians are obviously a rich and sombre brown, just as a Salvation Army hymn is a violent magenta.
>
> (Hichens 1894: 77; also quoted in Murray 2016: 255)

The synaesthetic association of music and color, much favored in aesthetic and decadent circles from Swinburne to Wilde, could evoke the "multisensory context" of pagan as well as medieval rituals (Classen 1998: 7; Morgan 2016: 97). The association between paganism and Roman Catholicism was indeed a common anti-Catholic topos at the time (Murray 2011). In a lecture entitled "Ritualism Traced to its Pagan Origins," the Rev. H.C. Leonard defined ritualism as "not the practising of rites, but the overestimation of them" (Leonard 1879: 3). His contention was that ritualism originated in the sensuous rites of "Pagan Rome" quoting the use of liturgical colors as evidence:

> The worship of the Pagan temples was highly ritualistic and imposing to the senses. Music charmed the ear, and the sweet perfume of incense filled the atmosphere. The priests wore vestments of gorgeous colors, those who offered sacrifice to Vesta only being clothed in white (*alba*). One of the orders instituted by Numa Pompilius wore a scarlet cassock (the *salii*). Another as ancient (the flamines) wore caps with a tuft on the top.
>
> (7)

In the passage from *The Green Carnation*, however, the colors chosen are deliberately *not* liturgical colors. By contrasting the "rich and sombre brown" of the Gregorians with the "violent magenta" of the Evangelical Salvation Army hymn, Hichens may have simply wished to subvert the Anglican scorn for the Catholics' delight in bright and supposedly artificial (that is, aniline) colors.

And yet, Wilde himself denounced the chromatic vulgarity of his contemporaries, who adopted the fashion for mauve or magenta, as opposed to the superior hues of bygone times. This chromatic antiquarianism is well illustrated in the following passage on ecclesiastic colors in chapter 11 of *The Picture of Dorian Gray*, which owes much to the accumulative style adopted in the decadent novel *À Rebours* (Huysmans [1884] 1920) by contemporary French novelist Joris-Karl Huysmans, who also converted to Catholicism:

> He had a special passion, also, for ecclesiastical vestments, as indeed he had for everything connected with the service of the Church. In the long cedar chests that lined the west gallery of his house he had stored away many rare and beautiful specimens of what is really the raiment of the Bride of Christ, who must wear purple and jewels and fine linen that she may hide the pallid, macerated body that is worn by the suffering that she seeks for, and wounded by self-inflicted pain. He possessed a gorgeous cope of crimson silk and gold-thread damask, figured with a repeating pattern of golden pomegranates set in six-petalled formal blossoms, beyond which on either side was the pineapple device wrought in seed pearls. The orphreys were divided into panels representing scenes from the life of the Virgin, and the Coronation of the Virgin was figured in the coloured silks upon the hood. This was Italian work of the fifteenth century. Another cope was of green velvet, embroidered with heart-shaped groups of acanthus leaves, from which spread long-stemmed white blossoms, the details of which were picked out with silver thread and coloured crystals. The morse bore a seraph's head in gold-thread raised work. The orphreys were woven in a diaper of red and gold silk, and were starred with medallions of many saints and martyrs, among whom was Saint Sebastian. He had chasubles, also, of amber-coloured silk, and blue silk and gold brocade, and yellow silk damask and cloth of gold, figured with representations of the Passion and Crucifixion of Christ, and embroidered with lions and peacocks and other emblems; dalmatics of white satin and pink silk damask, decorated with tulips and dolphins and fleurs de lys; altar frontals of crimson velvet and blue linen; and many corporals, chalice veils, and sudaria. In the mystic offices to which such things were put, there was something that quickened his imagination.
>
> (Wilde [1948] 2003: 105)

The eponymous hero here contemplates embracing the Roman Catholic faith—but as this purple passage suggests, it is for aesthetic rather than religious reasons. Dorian's attraction to colorful vestments has no spiritual dimension: the focus is on rich patterns, textures and materials, and colors with no liturgical function. Moreover, this appears as a fleeting craze (only "for a season") as he also "inclined to the materialistic doctrines of the *Darwinismus* movement in Germany" (Wilde [1948] 2003: 101). In both instances, the attraction is to the material rather than to the spiritual.

As noted by Murray in her analysis of this chapter, "the passage is filled with passive past participles that underline the artificial and elaborate nature of the colors ('wrought', 'embroidered', 'woven', 'raised', 'figured', 'decorated') – which ostentatiously turn the vestments into 'collectibles', rather than devotional objects" (Murray 2016: 244). The ecclesiastical costumes, here reduced to their spectacular dimension, are praised for their material properties rather than as vehicles of faith. This passage strangely echoes *Punch*'s stigmatization of "Ardent Ritualists" as lured by the beauty of textures and colors for their own sake.

Ruskin's praise of the "sanctity of colour," deeply rooted in both the biblical text and the holy book of nature, translated into many of the liturgical debates that agitated the Church of England in the wake of the Oxford movement. Although he never himself contemplated embracing the Catholic faith, Ruskin's complex engagement with the colored materials central to the ornamentation of Gothic cathedrals as well as his praise of the dappled beauty of nature epitomized by the prismatic hues of the rainbow found an unexpected echo in ritualistic circles calling for an increased use of color in liturgical practice. Partly under Ruskin's impulsion as well as that of Pugin, color, both old and new, material and translucent, thus played a crucial role in discussions of religion and ritual in Victorian England. But Ruskin's apocalyptic rhythms, so indebted to his Evangelical upbringing, equally shaped the literature of the Catholic decadents, who paradoxically drew on anti-Catholic rhetoric to foster a new religion of art giving pride of place to the dazzling hues and textures of the past, in contrast to the bleakness of industrial modernity.

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CHAPTER FIVE

Body and Clothing

CHARLOTTE C. NICKLAS

During the nineteenth and early twentieth centuries, industrialization fundamentally changed how men and women in Europe and North America engaged with and experienced color in clothing. As well as increasing mechanization, science and technology facilitated many developments in the making and coloring of textiles and garments. High-quality, long-lasting colored textiles continued to be expensive, so elite consumers had more access to a broader range of colored clothing than those further down the social scale. Even before the advent of synthetic textile dyes, however, most consumers enjoyed some choice in the colors of their clothing.

The dramatic growth of the popular press made descriptions and images of fashion and clothing more accessible, particularly from the second half of the nineteenth century (Best 2017: 28). Contemporaries pointed to France, particularly Paris, as the wellspring of women's fashion, usually chronicling "Paris Fashions" with regularity (Steele 1998) (Figure 5.1). As part of this journalism, reporters often used sophisticated language and terms, sometimes drawing on color theory, to discuss fashionable color. The fashion press also underscored that wearing appropriate, flattering colors, particularly for middle-class and elite women, was an important part of fashionable knowledge and decorum. Dressing in colors perceived to be unsuitable could lead to accusations of impropriety or vulgarity.

Cultural attitudes toward color affected people's reception of and use in fashion. John Gage has explored how in the West, from antiquity to the twentieth century, the "'Orient'" was considered "an exciting and dangerous repository of colored materials and attitudes" (Gage 1993: 10). In a related line of inquiry,

FIGURE 5.1 James Gillray, “Les Invisibles,” 1810. Etching and stipple engraving. Courtesy of the Royal Pavilion & Museums, Brighton & Hove.

David Batchelor has traced the chromophobia that runs through Western attitudes toward art and design since antiquity, stressing how the enjoyment of bright colors was often associated with women, children, or non-Western cultures (Batchelor 2000). This fear of color manifested itself in dramatic ways during the nineteenth century, particularly in discussion of men’s and women’s clothing. As the century progressed, men’s garments became generally darker and less colorful. In women’s fashion, however, color retained an important role. The pronounced orientalism of this period also meant that vivid colors were often associated with the East.

Although men and women wore garments in a great variety of colors during the nineteenth and early twentieth centuries, certain colors were especially popular. This chapter moves chronologically through the period and discusses some of these key examples of fashionable color and its use in Britain, France, and the United States.

CIRCA 1800–1840

In the early nineteenth century, both male and female elite fashions challenged the luxury and display that had characterized the dress of the ancien régime. Multicolored, complexly woven silks, sometimes embroidered and often trimmed with valuable lace, had been the favorite dress textiles during the eighteenth century (Chrisman-Campbell 2010: 17). As political turbulence and industrialization produced unprecedented social changes in the century's final decades, followers of fashion came to prefer less decoration and embellishment. Women looked to the dress of classical antiquity, and men adopted the clothing worn by English country gentlemen (Ribeiro 1995: 29).

Information about fashionable colors appeared in early nineteenth-century fashion reports, most of which were published in newspapers and periodicals that covered a range of topics. From the eighteenth century, fashion plates had sometimes accompanied fashion news. While popular, these images increased publication prices, especially if they were hand-colored (Best 2017: 20). Fashion reports, descriptions of fashion plates, and the colored plates themselves all provided information about fashionable colors to readers. Periodicals also contained longer articles that addressed the appropriate use of color in clothing. This advice often drew upon theories of color, particularly concerning harmony and contrast, reflecting a growing artistic and cultural interest (Gage 1993: 172–3; Ball 2000: 40–1, 175; Burchett 2005: 18–20). Much of this counsel centered around the appropriate colors for a woman's complexion, which was almost always assumed to be white. For example, an 1808 article in the *Belle Assemblée* warned: "It can scarcely be conceived how much the colour of a robe, or of a shawl, may heighten or destroy the beauty of a complexion" ("The Ladies' Toilette" 1808: 157). After discussing examples of color choices, this author went on to assert: "It is this perfect adaptation of all the parts of dress, this harmonious choice of well assorted colours, that are the peculiar characteristics of women of refined taste" (158). This alliance of a well-developed color sense and good taste remained strong throughout the century.

During the first half of the nineteenth century, fashion reports in periodicals frequently ended with a summary of current or future fashionable colors. These reports were often simple declarations, but sometimes an author expressed uncertainty, as when the May 1806 report in the *Belle Assemblée* concluded that "The variety of colours worn at this moment renders it impossible to say which are the most fashionable, but the most prevailing are straw, pink, lemon, and lavender" ("General Observations on the Fashions for June" 1806: 226). Presumably, readers could choose from these most commonly seen colors or (if hesitant) wait until the periodical's next issue for an update. Fashions for specific colors could come and go swiftly. In December 1806, the *Belle Assemblée* approvingly observed of "fawn-colour": "nor do we recollect ever to have seen a colour so justly entitled to public suffrage; it is unobtrusively elegant, and attracts by its simplicity" ("A General Delineation of the Fashions for December" 1806: 612). The very next month, however, the same journal reported that fawn-color "is now too common to be chosen by our first order of females" ("Observations on the Fashions for February" 1807: 50) and in February 1807 "though still much worn by the multitude, [it] is not now considered as genteel" ("General Observations on the Most Prevailing Fashions Carefully Selected" 1807: 107). The rapid rise and fall of this color's currency reflected the quick pace of elite fashion, at least as represented in an expensive, exclusive journal. Regularly describing dress at court occasions, the *Belle Assemblée* represented fashion as an elite practice in which specific colors could play an important role of inclusion and exclusion.

Although contemporary journals reported the wearing of a wide range of fashionable colors, white was probably the most fashionable color for elite and middle-class women's dress in the first decades of the nineteenth century. In the postrevolutionary world, white cotton stood in aesthetic opposition to the colorful, highly decorated silks of the previous century (Fukai 2004: 212). White was considered appropriate for all ages and "without exception the most becoming garb for women of all complexions" ("Remarks on the Judicious Arrangement of Apparel Particularly Addressed to the Ladies" 1806: 281) (Figure 5.2). The fashion for the color had grown during the late eighteenth century, particularly for fine muslin from Bengal. The fineness of the highest quality muslins, woven in Dhaka, made them semitransparent. Embroidered white flowers and other patterns often decorated these valuable textiles (Ghuznavi 2006: 303–8). Contemporaries particularly appreciated muslin, because it fell into soft folds, creating dresses that reflected the contemporary fashion for classical styles (Johnston et al. 2005: 40).

Fashion leaders dressed in white muslin gowns in the late eighteenth century and well into the nineteenth century. In 1795, the daughters of King George III (r.1760–1820) wore fine "clear muslin" to Ascot, demonstrating the fabric's fashionability at a prominent social occasion (Lemire 1991: 110). The portraits of French fashion leaders such as Juliette Récamier highlighted the delicacy of the material (Ribeiro 1995: 114). The newly independent United States had no court society, but women followed Europe's lead in fashion, wearing neoclassical gowns of white embroidered muslin. This material was one of the most desired American imports from Bengal (Bean 2006: 226–7). The increasing production of lightweight cottons in Lancashire also allowed more women to wear these fashionable fabrics (Levitt 1996: 159).[1] White remained one of the most fashionable colors for several decades. An 1822 fashion report in Rudolph Ackermann's *Repository of Arts, Literature, Fashions* claimed that "white […] is universally the mode" and if not for the variety of scarves and shawls "the eye would be fatigued with the uniformity of white robes" ("Eudocia" 1822: 183–4).

As the report in the *Repository of Arts* indicated, fashionable women wore shawls with their snowy white dresses. Such shawls had the added benefit of keeping women in colder climates warm. Although the best and most desirable

FIGURE 5.2 "Brighton Walking Dress," fashion plate from Rudolph Ackermann's *Repository of Arts, Literature, Commerce, Manufactures, Fashions and Politics* (London, 1817). Courtesy of the Royal Pavilion & Museums, Brighton & Hove.

shawls were made in Kashmir, rich European women wore them because they thought their graceful folds looked "Grecian" (Ribeiro 1995: 115; Chrisman-Campbell 2010: 20). The Empress Josephine loved shawls and possessed many fine examples. Aileen Ribeiro notes that an 1809 inventory of Josephine's clothes lists the shawls by color, observing that "red, amarante (a purplish color), yellow and white are the most popular—and then mixed colors" (1995: 118). Surviving examples of high-quality Kashmir shawls retain deep, rich colors, such as red, blue, and mustard yellow, highlighting dyeing skills passed down over centuries (Ames 1986: 67).

By the end of the eighteenth century, elite men's styles had also moved from ornamentation toward simplicity. Fashionable men valued English tailoring skills and wool cloth, usually in neutral or dark colors. For coats, dark blue and black enjoyed particular popularity, especially in England. This sartorial Anglomania also emphasized clean, good-quality linen, which provided an effective contrast to these sober colors (Ribeiro 1995: 48–50, 100–1; Levitt 1996: 159). The frequent wars in early nineteenth-century North America and Europe also affected men's dress and representations of masculinity, as military uniforms became increasingly standardized. Perhaps the most notable and characteristic uniform color, for friend and foe, was the British red coat. Napoleon himself appreciated that attractive uniforms played an important role in creating professional pride and honor in soldiers and thus established a new uniform in blue, white, and gray (Kay-Williams 2013: 127–8). Some French uniforms were also red, and this color came to represent the military in the nineteenth-century cultural imagination. Black symbolized the clergy, as Stendhal's 1830 novel, *The Red and the Black*, about an ambitious young man exemplified. The almost constant warfare in the first decades of this century meant that military uniforms, in silhouette, decoration, and color, influenced women's clothing as well (Fukai 2004: 208).

By the second decade of the nineteenth century, the vogue for classical antiquity in women's fashion was waning, and other historical periods, from the Middle Ages to the seventeenth century, began to inspire female clothing. In France, when the monarchy was restored in 1814, King Louis XVIII (r.1814–24) consciously looked back to the days of King Henry IV (r.1589–1610) in an effort to recover French royal glory. Elite women in France, as well as those looking to Paris for fashion leadership, adopted historicist features of dress, such as puffed sleeves, and decorative details, such as ruffs and plumes (Chrisman-Campbell 2010: 20). Fashionable materials included rich satins and luxurious velvets, often in jewel tones such as red and blue. The luster and textures of these fabrics highlighted the richness of these fashionable colors, as an 1822 "Carriage Morning Dress" of "mulberry-coloured velvet" described in Ackermann's *Repository of Arts* would have demonstrated ("London Fashions" 1822b: 362). Although historical names most frequently described aspects of dress such as sleeves and headdresses, they also appeared in fashionable color names. In July 1832, the *Court Magazine* placed *Althea* first in its list of "colours most in favour" for the month ("General Observations on Fashion and Dress" 1832: 44). The report did not indicate what color this was, but the name probably refers to Cavalier poet Richard Lovelace's 1642 poem "To

Althea, from Prison," reflecting contemporary interest in the fashions of the seventeenth century.

Another aspect of historicism in fashion was the nineteenth-century enthusiasm for tartan, stimulated by the success of Walter Scott's "Waverley" novels about a romanticized Scotland, published from 1814 to 1832. King George IV's (r.1820–30) pomp-filled 1822 visit to Edinburgh, in which tartan was highly visible, quickly influenced fashion (Faiers 2008: 151–5). A fashion plate from that year in the *Repository of Arts* showed an evening dress of "very rich silk" in "the Mackenzie tartan." The accompanying description explained that "the families of the ancient Scotch nobility were distinguished by their different plaids" ("London Fashions" 1822a: 239). In fact, as Hugh Trevor-Roper discussed, specific patterns were not connected to individual families until the nineteenth century, making clan tartans the paradigmatic "invented tradition" (Trevor-Roper 1983: 23–32). These spurious mists of history, however, made tartan appealing to the contemporary historical imagination, and it decorated everything from ribbons to waistcoats throughout the century. The "setts" (patterns) often incorporated bright colors arranged in effective contrast (Johnston et al. 2005: 70–1; Faiers 2008: 14–16, 24) (see Plate 5.1).

Colorful, printed cottons had been a mainstay in eighteenth-century wardrobes across the social spectrum, and this popularity continued into the nineteenth century (Styles 2007: 109–27). Using rare surviving examples, Alison Toplis shows that working-class women in Herefordshire often used printed cotton for their wedding dresses in the first half of the century (Toplis 2011: 140–4). In the 1930s, the formerly enslaved Della Mun Bibles remembered that, in the antebellum southern United States, "If a person, white or black, had a calico dress in them days, they was dressed up" (quoted in Foster 1997: 111). Cotton mills in Lancashire increased their output exponentially during the early nineteenth century, generating calicos for markets around the world (Sykas 2005: 120). Manufacturers in New England and France also produced printed cottons, although not on the scale of North West England (Schoeser and Dejardin 1991: 108; Lemire 2011: 96). Spots, stripes, and geometric patterns decorated cotton textiles, but botanical and floral motifs were considered the most appropriate source of designs for women's clothing (Sykas 2005: 54). Advances in bleaching, dyeing, and printing in the late eighteenth and early nineteenth centuries enabled cotton manufacturers to produce complicated designs that incorporated multiple colors. To showcase their technical skills, Lancashire printers created designs on grounds of colors such as blue, brown, and red (Schoeser 1996: 192–3). Consumers in Europe and North America particularly valued the printed cottons of Alsace for their superior quality and design throughout the century (Schoeser and Dejardin 1991: 108–11). At the top end of production, elaborate patterns featured realistic, shaded designs of flowers and leaves executed with great skill.

"Turkey red" (*rouge d'Andrinople* in French) was one of the most vivid colors in clothing of the first decades of the nineteenth century (see Plate 5.2). Printers employed a complicated process, refined over decades or centuries, to produce this bright, colorfast red on cotton (Kay-Williams 2013: 116–17; Nenadic and Tuckett 2013: 25–30). Turkey-red dress textiles often featured bright red grounds ornamented with colorful floral designs. The manufacturers of Mulhouse, Alsace, produced the best-quality Turkey-red printed cottons, often using several other colors as well (Kay-Williams 2013: 130). In the 1820s and 1830s, dresses made entirely from these textiles would have been costly, but by mid-century Turkey-red printed accessories such as shawls and aprons were widely available (Johnston et al. 2005: 194–5; Nenadic and Tuckett 2013: 124–5). In their study of Scotland's Turkey-red printed cotton industry, Stana Nenadic and Sally Tuckett particularly emphasize the ubiquity of Turkey-red handkerchiefs among the working classes in Scotland. Men and women wore these useful and decorative accessories around their necks, over their shoulders, and on their heads. The industry also produced celebratory and commemorative handkerchiefs to mark local, national, and international events (Nenadic and Tuckett 2013: 127–8). American textile companies in Lowell, Massachusetts, also manufactured Turkey-red printed cottons, including dress textiles and shawls (Kay-Williams 2013: 131).

CIRCA 1840–80

Throughout the nineteenth century, the lightness and sheen of silk made it a valuable textile for fashionable women's clothing. In the 1840s, shot or "changeable" silks (in which the warp and weft were different colors) became fashionable for day and evening dresses (Buck 1984: 22). The American women's magazine *Godey's Lady's Book* listed "changeable satins" among the fashionable "new materials for dresses" in January 1843 (Leslie 1843: 60). Later that year, the British *Ladies' Cabinet* reported that "the mixture of hues in the changeable silk called *cameléon* is as much in vogue as ever" ("London Fashions for the Month" 1843: 201). In some descriptions, fashion writers noted specific colors used, but these textiles appealed mainly because of the mutable character of their surfaces. The appreciation of this constant shifting of colors reflected a growing cultural interest in vision and perception (Nicklas 2013: 113).

By the 1840s, printed cottons were less fashionable for women's clothing than they had been earlier in the century, but patterned wool and mixed fabrics (such as combinations of silk and wool or silk and cotton) enjoyed popularity. Intricate, multicolored printed wool dress textiles echoed the contemporary enthusiasm for shawls (Buck 1984: 23). European shawl production had begun in the 1780s, growing exponentially during the first half of the nineteenth century in Lyon, Edinburgh, Norwich, and Paisley (near Glasgow). Patterns were produced through both weaving and printing, allowing women across the social spectrum to participate in the mania for shawls (Geczy 2013: 104–5). The rich tones of the original shawls from Kashmir strongly influenced the color palette of the European imitations. Deep oranges and reds are perhaps most characteristic of surviving examples, but shawls were made in a wide variety of color combinations. Patterns woven or printed *à disposition* (specifically designed to be made into tiered skirts) became fashionable in the 1850s. Manufacturers often produced these designs, along with other printed cotton dress textiles, in different shades of the same color, such as pink, lavender, or blue (Buck 1984: 36).

As colorful textiles and clothing became available to a greater number of consumers, concerns about the proper use of color also grew. Bright colors, especially when worn together, garnered particular censure, as when the editors of the American women's magazine *Godey's Lady's Book* pronounced in 1843: "It is absolutely vulgar to walk abroad flaunting in gay colours" ("Editors' Table" 1843a: 154). Later that year, the same editors asserted that "the cultivation of the mind has a tendency to correct the barbarian admiration for ornaments and glaring colours, which is always found in savage nations," making clear the period's association between the enjoyment of color and the lack of "civilization" ("Editors' Table" 1843b: 190). In this increasingly confusing world of color, contemporaries sought color advice, and one of the most influential guides was the French chemist Michel Eugène Chevreul. Laura Kalba emphasizes that among French "tastemakers writing on fashion and interior decoration" Chevreul's theories of color contrast and harmony "were most widely diffused and arguably best known," even if they were not always applied (Kalba 2017: 17). By the 1860s, Chevreul's advice had also permeated Anglophone fashion advice on both sides of the Atlantic Ocean (Nicklas 2014).

The mid-nineteenth century development of synthetic textile dyes led to the production of vivid colors that quickly entered the fashionable palette and further complicated contemporary attitudes to color. In 1856, the English chemist William Perkin accidentally made a purple dye from coal-tar aniline, and consumers could purchase dress textiles colored with aniline purple by 1859 (see Plate 5.3). Shades of purple were already fashionable in the mid- to late 1850s, so the market was receptive. In the fashion press, the pinkish-purple color produced by aniline purple became known by the French term *mauve* (Travis 1993: 46). The color became so popular in England that the satirical magazine *Punch* declared in 1859 that London was suffering from a bad case of "Mauve Measles" (Garfield 2000: 65; Blaszczyk 2012: 26–7). Aniline purple opened the door to a rainbow of other bright colors derived from coal tar, including magenta, a bright blue called *azurline*, and a series of purples ranging from "blue purple" to "red purple" (Travis 1993: 67–79).

References to these brilliant colors flooded the fashion press in the late 1850s and continued into the next decade with periodicals, such as *Godey's Lady's Book*, assuring readers that both "azurline blue" and "new shades of mauve" would be among the "most popular" colors for spring in 1862 ("Fashion Items from Various Sources" 1862: 309). While bright colors, such as Turkey red, had certainly been available before aniline dyes, colors such as mauve and magenta caught popular attention in a distinctive way. With these dyes and colors, as Christopher Breward asserts, contemporaries appreciated "the immediate connotations of heightened fashionability and a sense of 'modernity' they were able to command" (1995: 162). The scientific advances that led to the creation of these dyes, along with their industrial origins, played a key role in these contemporary perceptions of novelty (Nicklas 2010).

Surviving garments, including some produced at the highest levels of Parisian fashionable dressmaking, reveal that women did wear full dresses in these bright hues, particularly in silk satins and taffetas that accentuated the colors (Johnston et al. 2005: 122–7). Chemists and dyers, including William Perkin, also worked hard to adapt these dyes to cotton printing, as this was the most profitable part of the textile market (Blaszczyk 2012: 26). By the 1860s, mauve, magenta, and other aniline colors decorated cotton dress textiles in flowered, geometric, and striped patterns. Ribbon manufacturers also embraced aniline dyes: some of the earliest references to magenta and azureline in *Godey's Lady's Book* noted the appearance of these colors on ribbons for trimming and millinery ("Description of Steel Fashion-Plate for April" 1860: 383; "Chitchat upon New York and Philadelphia Fashions for September" 1861: 263) (see Plate 5.4). For women who could not afford full silk dresses in one of these bright hues, printed cottons and ribbons afforded opportunities for colorful experimentation (Wass with Anderson 2000: 162).

Women's dress provided the most obvious evidence of midcentury enthusiasm for the bright colors created with aniline dyes. In contrast, as John Harvey has discussed in detail, "color die[d] in menswear in the nineteenth century" (1995: 195). The darkening of men's clothing was one of the most significant aspects of contemporary male appearance in Europe and the United States. By the 1860s, the plaids and checks of previous decades were disappearing (Breward 1999: 29). The visible distinction between "black men and bright women" certainly reflected the strong ideological division of middle-class gender roles (196). Black, in particular, became the ultimate color of "smartness, decency and respectability" for men (Harvey 1995: 193). Middle-class professionals, such as doctors and lawyers, had long worn black, and men in these careers grew in prominence during the course of the century (140–2). The sober appearance of these men justified their bourgeois ascendency (Perrot 1994: 32). All over Europe, black also became the default uniform color for official and civic workers, such as policemen, firemen, and postmen (Pastoureau 2009: 174).

Although bright aniline dyes were the most remarkable aspect of mid-nineteenth-century fashionable color, women also habitually wore black during this period. Fashion writers extolled the economy and usefulness of black, especially compared to colors that might go out of fashion quickly. In 1860, for example, "Mrs. M.L." advised in *Godey's Lady's Book* that black mantles, "being so generally serviceable, should be a standard article in a lady's wardrobe" (L., M. (Mrs) 1860: 429). The practicality of the color meant that for women with limited clothing budgets, black was essential. It was also a color of female service, worn by governesses (Harvey 1995: 199). Black grew in popularity in the second half of the century and, by 1875, the *Englishwoman's Domestic Magazine* commented that "Now the most general habit is to have at least one complete costume of black in one's wardrobe" ("Humming-Bird" 1875b: 146). Later that year, the same periodical quoted the *Saturday Review*'s opinion on the increase of women wearing black: "as it suits almost every one, and looks well out of doors, it is at least unobjectionable" ("Humming-Bird" 1875a: 147). These discussions of the sober suitability of black support Harvey's argument that the color, when worn by women, possessed "some of the assertive values it had when worn by men" (Harvey 1995: 198).

Nineteenth-century mourning dress most clearly displayed black as the color of female propriety. Elite and official practices surrounding death and mourning had incorporated black long before 1800 for both men and women. The visible signs of male mourning, however, decreased during this period, and by the end of the century most men wore only a black crape armband (Taylor 1983: 134). In contrast, full wardrobes of black mourning garments became common among women from all social classes during the nineteenth century. Queen Victoria wore mourning dress for forty years after the 1861 death of her beloved husband, Prince Albert, and her example provided a powerful influence, even beyond Great Britain (120–2). Complicated rules developed, particularly for middle-class and elite women, dictating types of mourning textiles and the time periods that they needed to be worn. The first period of mourning (a year and a day for a widow) required dull black fabrics, covered with black crape. Matte black textiles distinguished the second period of mourning, followed by a range of black textiles considered appropriate for the period of "ordinary mourning" (Goldthorpe 1988: 69).

Mourning clothes increasingly followed fashion during the nineteenth century, while black also became a fashionable color (Taylor 1983: 131; Harvey 1995: 200–1) (Figure 5.3). Fashion writers made fine distinctions, as when the *Englishwoman's Domestic Magazine* described a "woman dressed in stylish black, not mourning" in 1872 ("Spinnings in Town" 1872: 163). Three years later, the same magazine commented on the fashionability of black and then described dresses that could "be worn either in slight mourning or out of mourning altogether" ("The December Fashions" 1875: 314). The fashionable changes in

FIGURE 5.3 Detail of jacket collar, *c*. 1900, silk satin, silk velvet, feathers, glass beads. Courtesy of the Lovett Turner Collection, Dress History Teaching Collection, University of Brighton, UK.

women's styles meant that it was difficult, if not impossible, to keep and reuse clothes from the early stages of mourning. Particularly for widows, adhering to fashion in mourning was socially necessary, but financially demanding. As Lou Taylor explains, "impecunious widows often sold their weeds at the end of their period of mourning to other, newly widowed women, who in their turn, sold off the colored clothes that they could no longer wear" (1983: 132).

Ensuring the quality of black textiles presented another mourning-related challenge. These garments had to be worn for months, if not years, and black fabrics had always been prone to fading. The increased use of logwood as a dyestuff meant that the quality of black textiles did improve over the course of the century, but long-lasting varieties were still expensive (Nenadic and Tuckett 2013: 24–5). In 1854, *Godey's Lady's Book* offered advice about choosing textiles for mourning, stressing that "the first essential, *even before quality*, is a good shade of black, neither blue nor rusty." The author went on to warn readers: "Never get a cheap material in black; it will be sure to fade or grow rusty" ("Chitchat upon New York and Philadelphia Fashions for February" 1854: 190; emphasis in the original). Recipes and instructions for dyeing with black appeared in women's magazines, revealing the domestic strategies undertaken to adhere to social imperatives (Nicklas 2010: 227).

After women (particularly widows) observed the mourning periods indicated by black clothing, they went into "half mourning." During this stage, they wore fashionable clothes made in half mourning colors, which included white, gray, and dull shades of lavender and violet (Taylor 1983: 146–8; Goldthorpe 1988: 69). An 1854 fashion report in *Godey's Lady's Book* noted the "delicate shades of lavender silk, the cheques, bars, and stripes of lavender and black, black and white" seen in a "fashionable *maison de deuil*, or 'mourning store,'" indicating that manufacturers produced a wide range of textiles for half mourning ("Chitchat upon New York and Philadelphia Fashions for September" 1854: 288). It also seems that, as with stylish black and mourning black, the distinction between fashion and mild grief was not always clear. Commenting on the fashion for shades of lavender and violet in 1868, a fashion writer for the *Englishwoman's Domestic Magazine* wrote that "one would think two-thirds of the ladies one meets in the streets were in half-mourning" ("Fashions" 1868: 261).

Although darkness was the primary feature of nineteenth-century male clothing, men did have some opportunities to add color into their wardrobes. Anne Buck observes that "most of the color and ornament of men's dress was concentrated in the waistcoat," also noting that these objects survive in "larger quantities than any other man's garment of this period" (1984: 188–9). Museum collections certainly hold many splendid, colorful waistcoats made from a wide range of plain and patterned textiles. Most of these examples would have been owned and worn by middle-class and elite men, but working-class men also wore colorful waistcoats, as demonstrated by the descriptions in newspapers of men who absconded from their jobs (Toplis 2011: 130). Until the 1860s, many of these fabrics bore close resemblance to the materials used for women's dresses (Buck 1984: 189). Woven, printed, and embroidered floral patterns were especially fashionable in the 1840s and 1850s, the heyday of the fancy waistcoat (Ehrman 2004: 34: Johnston et al. 2005: 198–9). Men's outfitters also stocked neckties, handkerchiefs, pajamas, and dressing gowns in wide ranges of patterns and colors

(Breward 1999: 113). Printed shirting fabrics, frequently featuring multicolored patterns, also grew in popularity for informal menswear (Sykas 2005: 82). By the 1840s, however, brightly colored accessories sometimes marked men as "gents" or "swells," displaying a flamboyance that some contemporaries found unsettling (Ehrman 2004: 36). Manufacturers also produced vividly striped socks for men, particularly in shades of red, using aniline dyes. Unfortunately, as Alison Matthews David reveals, some of these dyes used for socks proved to be toxic, leading to painful rashes and swelling. New, brilliant colors could be dangerous, even deadly (Matthews David 2015: 106).

While the bright, new colors of the 1860s appealed to many consumers, Regina Lee Blaszczyk notes that a vocal minority objected to these hues because of their dazzling intensity. She mentions the French historian and critic Hippolyte Taine (1828–93) who, writing about an 1860–1 visit to England, decried the women's clothes he saw, disparaging the "outrageously crude" colors and the "loud, excessively numerous colors each swearing at the others." Blaszczyk also cites the 1874 *Gazette des Beaux-Arts*'s condemnation of a purple-scarlet combination as "un scandale optique" (Blaszczyk 2012: 40). English designer and reformer William Morris objected to the "hideous but bright aniline colours," but he also censured the dyes because of their industrial manufacture, which he felt was leading "towards destroying all beauty in the art" of dyeing (Morris [1914] 2012: 257). For some contemporaries, both the origin and appearance of these industrially produced colors were repellant.

CIRCA 1880–1920

One of the most visible reactions to fashionable clothing in bright, aniline colors appeared in the Aesthetic movement. By the late 1870s, key artists and designers devoted to this "cult of beauty" were becoming more widely known (Calloway 2011: 18). Color was a crucial, immediately identifiable element of aesthetic design and clothing for men and women. As Matthews David explains, supporters of Aestheticism such as Mrs. Haweis emphasized that "artistic colors" were "so far indescribable that you question whether it is blue or green, green or brown, red or yellow," very different from the "staring […] dazzling" colors associated with aniline dyes (1879, quoted in Matthews David 1999: 180). The most famous (and notorious) aesthete, Oscar Wilde (1854–1900), declared that "all beautiful colors are graduated colors while glaring colors are the essence of vulgarity" (1895, quoted in Buruma 2007: 105). The mid-nineteenth-century advances in dye chemistry that allowed a larger number of consumers to buy and wear brightly colored clothing led to contempt for these colors, particularly when worn together in ways considered inharmonious among aesthetes and tastemakers. Matthews David shows how British novelists and critics deplored the "wild" colors worn by working-class women, linking them to excessive, unconsidered consumption habits (1999: 177). Making the same point, the prison reformer Alexander Paterson (1884–1947) criticized the "tight green trousers" and "the waistcoat with fancy buttons" worn by young men in southeast London (1911, quoted in Breward 1999: 202). Laura Kalba highlights how French taste leaders condemned the *bariolage*—"the multiple and jarring colors of the marketplace"—that appeared in women's fashion, even in the ensembles of usually praised Parisiennes (Kalba 2017: 33).

Liberty & Co., the London department store established in 1875, catered to aesthetically minded consumers and consequently played a key role in disseminating aesthetic styles. As Kimberly Wahl notes, artistically inclined contemporaries particularly appreciated "the texture and appearance of the gauzy and lustrous silks imported from and inspired by countries in the Far East, primarily India, China, and Japan" (Wahl 2013: 41). The company's promotional materials, such as an 1881 advertisement in the *Artist and Journal of Home Culture*, reveal the distinctive language used to describe aesthetic colors, listing fabrics available in "Persian Pink, Venetian Red, Terra Cotta, Ochre Yellow, Sapphire and Peacock Blue, Sage, Olive, and Willow Green, Soft Brown, Warm Grey, Drab, Old Gold. &c." (quoted in Wahl 2013: 137). Wahl affirms that advertisements for aesthetic wares often emphasized "color and its use for the expression of mood and emotion" (137).

Aesthetic styles also enjoyed some popularity in the United States, with fashion writers adding to the chorus of praise for Liberty's fabrics and colors (Cunningham 2003: 148). In their 1892 book *Beauty of Form and Grace of Vesture*, the American authors Frances Mary Steele and Elizabeth Livingston Steele Adams discussed "artistic" clothing and emphasized the importance of color. Rather than strictly recommend aesthetic colors, Steele and Adams continued the long tradition of urging readers to pay attention to color harmony and select shades that suited them individually: "It is the harmony of colour, grace of form, and fitness to the personality of the wearer that makes a gown beautiful [...]. The most beautiful quality of a dress is its colour" (quoted in Cunningham 2003: 152).

The elaborate language used to describe aesthetic colors also figured in some of the criticisms and parodies of the movement and its adherents. Referring both to color and artistic taste, the satirical magazine *Punch* chronicled the doings of the "Cimabue Browns," a family devoted to the aesthetic life (Wilson and Taylor 1989: 32). While the society magazine *The Queen* did not explicitly ridicule aesthetic colors, their descriptions were not quite as fulsome as those of more devoted followers. A fashion reporter, describing fabrics available at Liberty, noted: "There are tints that call to mind French and English mustards, sage-greens, willow-greens, greens that look like curry, and greens that are remarkable on lichen-coloured walls, and also on marshy vegetation—all of which will be warmly welcomed by those who indulge in artistic dress" (Adburgham 1975: 31). With this list in mind, W.S. Gilbert and Arthur Sullivan's famous mockery of Aestheticism as "greenery-yallery" in *Patience* (1881) certainly has some foundation.

Edwina Ehrman and Kimberly Wahl underscore that surviving examples of dress influenced by Aestheticism often diverge from the ideals of the movement, featuring fashionable bustles or containing boned bodices (Ehrman 2011: 206; Wahl 2013: 118–21; 2015: 108–10). Colors and textiles associated with the Aesthetic movement were also used to make dresses in fashionable styles (Buruma 2007: 109). By the 1880s, "artistic" colors had become fashionable beyond the bohemian elite with which they originated. The aesthetic tendency to use different shades of the same color in an ensemble also entered mainstream fashion (Newton 1974: 84; Wahl 2013: 121, 140). Liberty played an important role in shifting attitudes toward color, as "Olivia" the (possibly American) author of a 1906 guide to shopping in London underscored. She lamented the "maroon and navy-blue stage" of the 1870s, going on to pronounce: "Then came Liberty, and can anybody ever be grateful enough for that relief? With the refinement in colouring appeared refinement in texture […]. Nothing Eastern or Oriental can show more delicious things than our own modern crepôns, chiffons and silks" ("Olivia" [1906] 2009: 51). The colors and fabrics that Liberty had done so much to promote had entered the fashion mainstream, but still retained orientalist associations.

In her discussion of color in dress at Liberty & Co., Anna Buruma refers to E.M. Forster's opposition of "a clinging Liberty tea-gown" to "a magenta satin" in his 1910 novel *Howards End* (Buruma 2007: 105) to represent cultural differences among contemporary elites. Adherents of the Aesthetic movement constituted an important cultural influence in the late nineteenth century, but the majority of women in the upper social and economic classes would have been far more likely to wear fashionably cut dresses, often in vibrant colors and heavy silks. The "father of haute couture," Charles Frederick Worth (1825–95), designed such clothes for rich women around the world. Before opening his salon in Paris in 1857, Worth had worked for the distinguished London silk mercers Lewis & Allenby, and he retained a keen interest in high-quality textiles for his dress designs throughout his career (Coleman 1989: 9–10, 68).

Worth established strong relationships with several prominent Lyon silk manufacturers, who created exclusive textiles for his use. Elizabeth Ann Coleman highlights the distinctive color combinations used in these fabrics and ensembles, pointing to an 1883 dress in which Worth "melded brocaded satin of 'pepita yellow' with shrimp pink ottoman silk, trimming it with bows of chaudron (antique red) velvet ribbon" (Coleman 1989: 74). Indeed, as Marie Simon observes, heavy materials in "clashing colors (salmon and dark khaki, pale pink and tobacco-color)" and "deep colors," such as heliotrope, garnet, and dark blue, were a hallmark of high fashion for the final decades of the nineteenth century (Simon 1995: 68). While Aestheticism may have encouraged some of these colors and color combinations, the substantial, textured fabrics would have revealed the influence of high fashion.

In a more restrained palette, color was also a significant aspect of nineteenth-century women's tailored garments, which grew in importance during this period. Male tailors had been making riding habits for rich women for centuries, but in the second half of the nineteenth century more women began to participate in physical activities such as archery, boating, and walking. To satisfy this demand from women, tailors began to make a wider variety of practical garments, which became known as "tailor-mades" (Taylor 1999: 31–2; North 2008: 146–7). For sports, men wore wool tweeds and serges in dark colors and manufacturers developed similar textiles for women's garments, usually in lighter weights. Some of these were in dull, drab colors, but others were in rather bright colors and large patterns (Taylor 1999: 38–40).

Lou Taylor has shown that by the 1870s and 1880s retailers were promoting fabrics to women using fashionable color language, quoting an 1874 catalog from the London department store, Debenham & Freebody, that listed textiles "for that autumn's tailored garments [that were] mostly dark in tone, including Marron, Choco, the new Damson Blue, five shades of Claret, two of Heliotrope and fashionable Fraises Ecrasées'" (Taylor 1999: 41). In the top echelon of society, Redfern & Sons supplied tailored garments in Cowes (Isle of Wight), London, Paris, Saratoga Springs, and Newport (Rhode Island) (North 2008: 152). Particularly known for their yachting costumes in a range of nautical blues, Redfern & Sons also made sporting garments in other colors such as red, purple, and black. By the end of the nineteenth century, the tailor-made had evolved into a jacket-and-skirt suit, of a hard-wearing fabric in a practical color, worn with a blouse. As Susan North notes, this versatile ensemble "became the universal daywear for all but the poorest women" (North 2008: 156).

Women across the social spectrum continued to wear sober, tailored clothes in the first decades of the twentieth century (Wilson and Taylor 1989: 46). The styles and colors of less practical garments, however, changed around the turn of the century. Lace and lightweight fabrics in cream, white, and pastel shades replaced the deep colors and substantial fabrics of late nineteenth-century women's dress (Mendes and de la Haye 1999: 24). The title of Mrs. Eric Pritchard's 1902 advice book, *The Cult of Chiffon*, captured the contemporary enthusiasm for "frou-frou." The designs of the English fashion designer Lucile (Lady Duff Gordon) also epitomized the temper of the times. Valerie Mendes explains that the designer did create dresses in bright colors, but notes that the "gentle harmonies in pastel hydrangea and sweet pea shades [...] in conjunction with fluid layers of laces, chiffons and embroideries, became a Lucile hallmark" (Mendes 2009: 22). In its June 1905 praise of Lucile's designs, the society magazine *The Lady* particularly admired colors, noting a tea gown of "special beauty … of 'maiden's blush' rose satin, very soft indeed" (quoted in Mendes 2009: 23). The language of color helped to explain the delicate femininity of contemporary fashions.

In the years immediately preceding World War I, many fashionable women embraced a novel palette in their clothing. Bright colors became à la mode once again, influenced by artistic innovations emanating from Paris. The Ballets Russes, overseen by the Russian impresario Serge Diaghilev, exercised a strong influence, particularly through the work of costume and set designer Léon Bakst. The company first performed in Paris in 1909 and then in London in 1911, exciting audiences with exotic, colorful productions such as *Schéhérazade* (Mendes and de la Haye 1999: 32). These orientalist fantasies inspired artists and designers working in many media, from jewelry to perfume (Davis 2010: 127–8). In the world of high fashion, the Parisian couturier Paul Poiret designed orientalist ensembles that incorporated jeweled turbans and luxurious fabrics. In his 1930 autobiography, Paul Poiret emphasized his bold use of color. He lamented the "soft, washed-out, and insipid" popular colors at the turn of the century, the "nuances of nymph's thigh, lilacs, swooning mauves," and claimed that he "threw into this sheepcote a few rough wolves; reds, greens, violets, royal blues, that made all the rest sing loud" (Poiret [1930] 2009: 45). For contemporaries, color was certainly one of the most remarkable aspects of Poiret's designs. M.E. Clarke, the fashion writer for the weekly society magazine *The Queen*, wrote about a trip to Poiret's workrooms: "the dazzling colours of the lovely materials lying all over the floor, chairs and tables literally made me rub my eyes to be sure that I was not dreaming a story of Arabian splendour" (Clarke 1911: 288). Poiret's use of color certainly drew upon the Western cultural associations of color with the feminine and the Other, but, as Adam Geczy argues, Poiret's chromatic exuberance "injected [color] into fashion's substance." This moment represented a significant diminution in the derogatory "gender and exotic associations" (Geczy 2013: 143).

In the early twentieth century, some women used color to signal their wish for political representation. In 1867, women's suffrage supporters in Kansas had campaigned using the state's symbol of the sunflower, which led to the wider use of the color yellow among the movement's followers ("Woman Suffrage" n.d.) By the second decade of the twentieth century, women's suffrage groups in the United States were holding large-scale, successful parades attended by women from across the social spectrum. The emblematic color yellow visually unified participants, leading one reporter to describe the appearance of one of these events as "yellow sunshine" (Bzowski 1995: 74, 79). In Britain, the leading militant women's suffrage group, the Women's Social and Political Union (WSPU) adopted purple, white, and green in 1908. Emmeline Pethick-Lawrence, the coeditor of the WSPU publication *Votes for Women*, in which she proposed the color scheme, wrote soon after:

> The colours have now become to those who belong to this Movement a new language of which the words are so simple that their meaning can be understood by the most uninstructed and most idle of passers-by in the street.
> (1909, quoted in Parkins 2002: 97)

Hats, jewelry, and particularly sashes (often emblazoned with "Votes for Women") were some of the ways in which politically minded women incorporated these colors into their wardrobes (Figure 5.4). Wendy Parkins

FIGURE 5.4 Postcard, produced in support of the suffragette movement in Britain, before 1909. Courtesy of the Royal Pavilion & Museums, Brighton & Hove.

highlights that women involved with the suffrage movement deliberately "conform[ed] to middle-class prescriptions of fashionable femininity" in their clothing, as a conscious challenge to the perception of women as "decorative but apolitical" (2002: 105). Their use of identifiable colors, however, immediately proclaimed their political leanings.

CONCLUSION

The nineteenth-century transformations of dyeing and printing made a broader range of colors in clothing less expensive and more widely available to many consumers in North America and Europe. Almost everyone could wear cotton printed with one or two colors, at least for special occasions. For middle-class and elite consumers, colors shifted every season (if not more quickly), becoming one of the most important, quickly changing elements of design in women's and men's fashion (Kalba 2017: 30). This great variety of color choices could be bewildering, so critics and fashion writers stepped in to offer advice. They inveighed against wearing many bright colors together and sometimes against wearing bright colors at all, linking this with vulgar, undeveloped taste. These complaints, however, along with many surviving objects, reveal that many men and women either did not read or ignored this counsel.

Dominique Cardon stresses that synthetic dyes "produced a major cultural revolution that has irreversibly changed the world" (2004: 232). Paradoxically, the increasing number of colors available for clothing and growing concerns about the appropriate use of color eventually "accustomed people to take colors for granted, to be surrounded by them in most circumstances of their lives, without giving them conscious attention" (232). This explosion of color, particularly in the years preceding World War I, also meant that the correlations of color with feminine and oriental Others, at least in fashion, began to diminish (Geczy 2013: 143). The contentious associations and historical values of colors changed when vividly colored clothing became available to all.

CHAPTER SIX

Language and Psychology

NICHOLAS GASKILL

INTRODUCTION

Modern color required modern perceivers, and psychology and philology did more than any other disciplines to shape what such perceivers looked like and how they should be studied. Where other chapters in this volume detail how industrial dyes integrated chromatic materials into scientific, artistic, and commercial pursuits, this chapter examines two essential conditions of this larger history of modern color: first, the accounts of color perception as embodied and relational that emerged from empirical psychology; second, the investigations into the meaning and origins of color words initiated by philologists but extended by ethnographers, physiologists, and literary critics. Together, these entwined threads of nineteenth-century chromatic history reveal how the modernization of color required not just new colors to be seen, or new places to see them, but also new accounts of what seeing is and what is involved in the seeing.

The psychology and philology of color overlapped significantly in the age of industry. Colors are by nature fugitive—materials fade and memories deceive—therefore researchers studying color perception relied on standardized systems of color nomenclature to stabilize chromatic quality and make it communicable. They required, in other words, a scientific vocabulary of color to specify the exact shade, tint, tone, or saturation of, for example, a red used in an experiment (Lewis 2012; Gaskill 2018; Rossi 2019). Similarly, philologists investigating the origins and development of color terms regularly jumped from linguistic evidence to psychological conclusions. Not to have a word for blueness was thought to indicate an inability to see blue, such that the philological record came to double as a document of the history of visual sensation. Such assumptions then fed back into psychology, where researchers investigated the developing color sensitivity of children and argued over whether verbal identification tasks accurately reflected perceptual acuity. In the nineteenth century, thinking about color sensations involved thinking about color words.

The following sections elaborate on the accounts of color perception that resulted from this entanglement. The first two survey the major trends that shaped the psychological study of color over the course of the nineteenth century, from Johann Wolfgang von Goethe's anti-Newtonian emphasis on "physiological colors" through the color studies produced in Harvard's psychology laboratory in the 1890s. The understanding of color perception that emerged over the century saw color as a *relational* and *embodied* phenomenon, something inextricably tied to the viewer. This account entailed dangerous epistemological consequences. For if color, and all that it allows us to observe of the natural world, is hopelessly connected to the perceiving subject, how could researchers make claims about the "objective" world itself? Was color even "real" in the sense sought by scientists? For some, the psychological character of color disqualified it from the realm of things-as-they-are. Yet for others, color demanded an expanded definition of reality, one that dispensed with the category of the world-in-itself.

The third section turns to the historical episode that best showcases the links between psychology and philology: the late nineteenth-century debates about the historical development of the color sense. Beginning with William Gladstone's suggestion that the ancient Greeks saw colors differently than modern Europeans, philologists sought to read in the development of color terms the evolution of human sensory capacities. As a result, they transformed color perception into something that could be deemed either "primitive" or "modern" or somewhere in between. Yet even as this theory migrated from scientific journals to popular magazines, it met with significant opposition from those who argued that color terms did not transparently reflect color experience but instead responded to the pragmatic needs of linguistic communities. The ensuing arguments sharpened the inquiry into the relationship between language and psychology, and set the stage for the major trends of twentieth-century linguistics, from the Sapir-Whorf thesis to Berlin and Kay's *Basic Color Terms* and its critics.

FROM LIGHT TO EYE AND MIND

The study of color was crucial to the formation of psychology as a discipline. It provided a distinct and delimited domain for testing a specific quality of sensory perception and its relation to other mental phenomena, for instance memory and hearing. Wilhelm Wundt's laboratory in Leipzig—generally considered the first laboratory dedicated expressly to experimental psychology—generated several reports on color vision in its heyday during the 1890s (Boring 1950: 341). Even more studies came out of Harvard's psychology laboratory, the American equivalent of Leipzig, especially once it came under the direction of Hugo Münsterberg in 1892 (428). Indeed, the Harvard laboratory's exhibit at the 1893 World's Columbian Exposition in Chicago showcased the prominence of color research in the images of its instruments—including color wheels with variously hued disks, contraptions for filling the visual field with a single luminous color, colored gels, and apparatuses for testing color blindness, the "color-sense of the eccentric parts of the retina," and the "appreciation of color"—and through descriptions of studies of the influence of color sensation on attention and the perception of time (Münsterberg 1893: 9–10; Nichols 1893: 400–2) (Figure 6.1).

In short, during the decades in which psychology became an established science, color provided researchers with a domain for working through the fundamental questions of their field: questions about the mind and its connection to the body, the relation between consciousness and the external world, and the

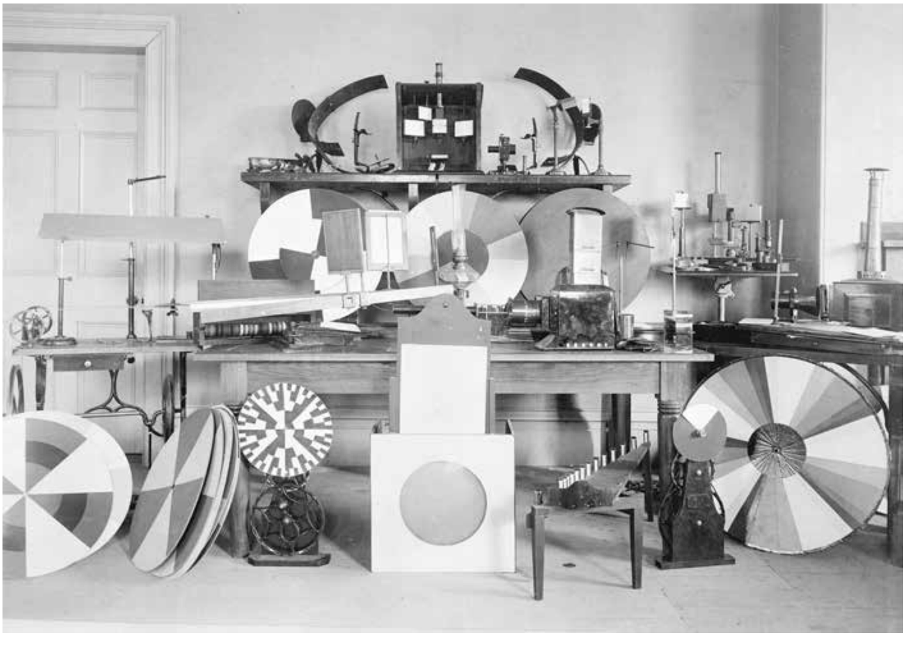


FIGURE 6.1 "Instruments for Experiments on Sight," from Hugo Münsterberg, *Psychological Laboratory of Harvard University* (Cambridge, MA: Harvard University Press, 1893). Courtesy of Trans-Technology Research.

mix of physiological, psychological, and even linguistic factors involved in the seemingly simple act of seeing red.

As important as color was for the history of psychology, psychology was even more important for the history of color. For if Newton's famous experiments in optics had made color a matter of light, nineteenth-century researchers insisted that it was rather a matter of minds and bodies—specifically rods, cones, and nerves. The yellow that adorns the daffodil, on this account, is less a property of the light reflected by the flower and more about how that light is interpreted by the sensory organs, such that the proper study of color belongs to physiology and psychology rather than physics. Of course, earlier philosophers, such as Locke and Descartes, had also treated chromatic sensations as psychic additions to the world. Locke would have agreed that the daffodil was not itself yellow but instead had a power to produce a yellow sensation in observers. The difference is in how scientists such as Hermann von Helmholtz (1821–94), Ewald Hering (1834–1918), and Ogden Rood (1831–1902) turned to experimental methods rather than introspection, and to physiology rather than philosophy, to explain the nature and components of color perception. As the critic, Karl Scheffler, wrote in 1901, "never before was the sense of color such a matter of nerves" (quoted in Gage 1999: 192).

The nervous explanation of color perception only emerged in the second half of the nineteenth century, alongside the experimental methods of physiological psychology or "psychophysics." Before that, as historian R. Steven Turner notes, scientific accounts of color vision pulled from three main traditions: Newtonian optics, craft knowledge grounded in the work of creating and mixing pigments and dyes, and the observation of subjective visual experiences, such as after-images, color contrasts, or the effects of illness or drugs on chromatic perception (Turner 1994: 27–8). This was an era of color wheels, visual representations of the relationships among the various hues, and aids in the creation and analysis of *harmony*, the keyword in early nineteenth-century investigations of color perception. Indeed, much of this work aimed at formulating a scientific and quantifiable account of why certain chromatic combinations pleased some and annoyed others. For instance, George Field (*c*. 1777–1854), the chemist and paint merchant whose pigments gave Pre-Raphaelite paintings their distinctive brilliance, wrote *Chromatics* and *Chromatography*, published in several editions (1817, 1835, 1841) to demonstrate how the secret to beautiful color combinations lay in the analogy of color and music (Morgan 2017: 38). The two editions of *Chromatics* detail how harmonious arrangements depend on the presence of all three primary colors (red, yellow, blue), combined in ratios that correspond to those of a major chord in Western music (Field 1817: 23; Rossi 2019: ch. 1).[1]

Field felt that the analogy between music and color bespoke a deeper and more cosmological harmony that underwrote both the project of *Chromatics* and the early nineteenth-century science of color more broadly. He assumed that the universe was governed by a divine order, and that this order made the "principle of analogy" a technique for learning about nature (Field 1817: 36). As Michael Rossi tells it in his brilliant history of color science, this belief in the ultimate harmony between viewer and object constitutes a foundational belief of the *common sense* tradition that characterized early nineteenth-century scientific accounts of color vision. Grounded in the thought of Scottish Enlightenment thinkers such as Thomas Reid (1710–96) and Dugald Stewart (1753–1828), common sense philosophy held that the senses formed a reliable bridge between the mind and the world. It explained "why scientific observation worked" by insisting on the intelligibility of nature to the observing eye (Rossi 2019: ch. 1).

In the course of the nineteenth century, this confidence that color sensations provided direct access to the material world gave way to an increased attention to the mechanisms of seeing itself, with the result that color came to point more to the eye than to the world. The pioneering figure here is the poet Johann Wolfgang von Goethe. In his massive *Zur Farbenlehre* (1810), Goethe argued that Newton and his followers had hastily limited the study of color to the behavior of light, when in fact a whole host of color experiences resulted from the activities of the eye. He called such colors "physiological" and illustrated them with examples of simultaneous contrast, after-images, and colored shadows. Such colors, he explained, arose "from an image which belongs to the eye" (Goethe [1840] 2006: 12–13). Here is where Goethe put a Romantic spin on the idea of nature's unity. He saw nature as a dialectical process that involved the unification of polarities, and he understood color as a particular instance of this dance, one that united subject and object, seer and seen.

The details of Goethe's theory failed to hold up under subsequent scientific scrutiny. The Newtonians balked at the idea that colors were mixtures of light and darkness, with the latter considered an active force (Meulders 2010: 119–26). And while artists found Goethe's detailed and compendious descriptions of color phenomena useful, the theories did not have predictive power (Sepper 1988).

Nonetheless, Goethe's insistence on the physiology of vision caught on. The Czech physiologist Jan Purkinje (1787–1869)—who gave his name to the effect whereby the relative luminosity of colors changes as the eye adapts to darkness—dedicated the second volume of *Beobachtungen und Versuche zur Physiologie der Sinne* (Observations and Experiments on the Physiology of the Senses; 1825) to Goethe, and he saw all of his important work on after-images, blind spots, and relative brightness as a continuation of the phenomenological tradition of color science exemplified by *Zur Farbenlehre* (Boring 1950: 20, 99; Wade and Brožek 2001). By the 1840s, one-third of the scientific research published on color and color vision focused on the kinds of subjective effects emphasized by Goethe and his readers (Turner 1994: 28). And it is this general shift toward the subjective and physiological aspects of color vision that, for historians as diverse as John Gage and Jonathan Crary, establishes Goethe as a paradigmatic figure in the formation of a modern mode of color perception and the art practices associated with it (Crary 1990: ch. 3; Gage 1993: ch. 11).

One pivotal figure in this history is the French chemist Michel Eugène Chevreul (1786–1889). Best known for the influence it had on Impressionist painters, Chevreul's *De la loi du contraste simultané des couleurs* was published in 1839, and translated as *The Principles of Harmony and Contrast of Colors* in 1855. His fame arose during his directorship at the Gobelins tapestry works in Paris. After fielding several complaints from angry customers, who claimed that the colors they had chosen for their wall hangings were not the ones used in the final product, Chevreul realized that the problem was not with the dyes but with the way the appearance of the colors changed when set alongside others in the finished work. Like Goethe, Chevreul turned his attention to subjective effects; but as art historian Laura Kalba points out, he differed from previous researchers by asserting that "the illusion was a feature of normal human vision" rather than the product of optical fatigue or distress (Kalba 2017: 19).

These studies show that, during the first half of the nineteenth century, color came to be understood as a relational phenomenon in two senses. First, chromatic experience emerged from a relationship between a stimulus and a perceiver and, since the study of color was the study of color phenomena rather than of the physical properties of light, researchers had to account for both poles. Second, colors always exist in relation to one another. There is no experience of pure blue, only of blue alongside other hues, and the relations thus formed modify the quality of each color involved. Yet even amid all the attention to "subjective" color effects, color itself was not treated as *merely* subjective, because it involved perceptual relations that connected the seeing subject to the wider world.

EXPERIMENTS IN COLOR: TO HELMHOLTZ AND BEYOND

At mid-century, the drift of color science decisively shifted as experimental procedures challenged the introspective methods of Goethe, Chevreul, and their supporters. New techniques for isolating and mixing differently hued rays of light enabled more focused stimulation of experimental subjects, and elaborate instruments such as the ophthalmotrope and the spectral colorimeter allowed researchers to measure the physiological responses to such stimuli with unprecedented precision (Turner 1994: 30, 240–3) (Figure 6.2).

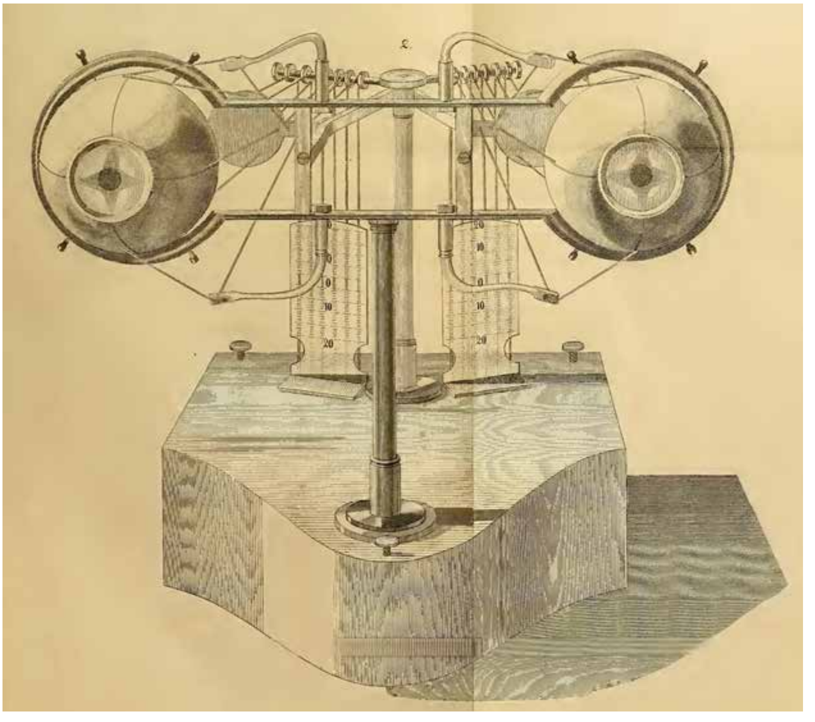


FIGURE 6.2 Ruete's ophthalmotrope second model of 1857. Illlustrated in C.G.T. Ruete's *Ein neues Ophthalmotrop, zur Erläuterung der Functionen der Muskeln und brechenden Medien des menschlichen Auges* (Leipzig: Druck und Verlag von B. G. Teubner, 1857).

Purkinje's self-reporting began to seem flimsy in light of the rigorous methods pioneered by Gustav Fechner (1801–1887), Hermann von Helmholtz, and Wilhelm Wundt (1832–1920). This was the age of physiological psychology, which aimed at elevating the study of the mind to the level of the experimental sciences. Especially in Helmholtz's hands, this research modified the relational understanding of color by complicating the connection between stimulus and sensation, and ultimately defined "color" as pertaining only to the latter.

The experiments in color sensation in the second half of the century relied on several insights attained in the first. Most important was Johannnes Müller's (1801–1858) doctrine of specific nerve energies. Müller held that humans have five kinds of nerves, and that sensory experience is determined not by the nature of the stimulus but by the type of nerve excited. When a person feels red, on this account, what he or she is actually feeling is a nervous response, which could in principle be prompted by a variety of stimuli—light of a particular wavelength, for instance, but also a poke in the eye or a knock on the head. As Boring summarizes it, Müller's doctrine held that "we are directly aware, not of objects, but of our nerves themselves," since the nerves come between the mind and what it perceives. It is effectively an anatomization of Kant, one that made the proper domain of color science the goings-on beneath the skin, not the objects of the material world (Boring 1950: 80–2; see also Rossi 2019: ch. 1).

Other important developments included the acceptance of the wavelength theory of light and the concentration of physiological optics on the rods and cones of the retina as the sensitive elements involved in vision (Turner 1994: 12, 30). In 1801 to 1802, for example, Thomas Young (1773–1829) combined these two factors to explain the effects of color mixing. He was of the opinon that color perception depended on three retinal receptors that were sensitive to different wavelengths of light, and thus that what mattered in color experience was how the net effect of the luminous stimulus activated the receptors. Several different combinations of wavelengths could trigger similar responses. This fits nicely with Müller's doctrine about nerve energies (Turner 1994: 29; Meulders 2010: 131). Young hypothesized that the receptors responded to red, green, and violet light, respectively.

Though not focused on the physiology of the retina, Gustav Fechner played a pivotal role in initiating the experimental program that, in Helmholtz's hands, would establish a modified version of Young's hypothesis as scientific doxa. Fechner is best known as the founder of *psychophysics*, which he described as "an exact science of the functional relations or the relations of dependency between body and mind" (quoted in Boring 1950: 286). Fechner believed in the ultimate unity of the physical and the mental, not simply as entwined or as parallel processes but as different ways of apprehending the same basic phenomena, and the techniques he developed for measuring and quantifying cognitive experiences were all aimed at arriving at a mathematical expression of this underlying identity. His major insight was to replace introspective observation of sensation with the quantification of *sensitivity*. Fechner recognized that you cannot measure sensation itself—you either see red or you do not. Instead, he sought to measure the *just noticeable difference* between two sensations or the thresholds at which a subject's qualitative experience changes—when a red becomes redder, or a light becomes brighter, or even when a color can be seen at all (Boring 1950: 286–7). For, as Fechner noted, several conditions must be met in order for someone to detect "those modifications we call color": the stimulus must "cover a sufficient area" and reach a certain amplitude and degree of refraction. If a chromatic stimulus does not meet these requirements, it will not technically be sensed as color (Fechner 1966: 200). In *The Elements of Psychophysics* (1966; original German edition published in 1860), Fechner built on these premises to formulate two related laws, known jointly as the Weber-Fechner Law, which mathematically expressed the relation between a change in stimulus and a change in human sensation—between matter and mind—as logarithmic.

Even more than Fechner, Helmholtz devised experimental methods and devices for measuring the physiological mechanisms of vision. As Richard L. Kremer notes, the second part of Helmholtz's *Treatise on Physiological Optics* (1924–5; original German edition published 1856–67 in three parts), "consolidated, organized, and directed research in color vision until early in the twentieth century." Yet unlike his contributions to the fields of spatial perception or sensations of tone, Helmholtz's color research consisted less in building new apparatuses or making important laboratory discoveries, and focused more on synthesizing and clarifying disparate ideas into a coherent program (Kremer 1993: 206).

Helmholtz's first major contribution to color psychology was his distinction between *additive* and *subtractive* color mixing. Against those, such as David Brewster, who claimed that the three "primaries" of physical color also held for the eye, Helmholtz proposed that two different processes were at work in these domains. When colors combine on the painter's palette, for instance, the resulting hue absorbs more wavelengths of light than either of the original colors on its own. The mixing thus *subtracts* from the light that reflects off the material and defines its observed color. But when colored light rays of different wavelengths combine (as with a light projector), their sum includes a greater variety of light, since the wavelengths are *added* together when they hit the retina. Subtractive mixing was a physical effect based in the materials; additive mixing was a physiological or psychological process, based in the eye and mind. And in the latter case, more than simply wavelength was at issue. Helmholtz also demonstrated how *intensity* factored into the subjective calculation of color. His visualization of this effect squished the venerable color wheel of Newton and the artists into a barycentric curve (see Plate 6.1), showing how, for instance, one would need more blue than yellow to create a neutral white sensation (see Isaac 2013: 216–21).

In the *Handbuch* of 1856–67, Helmholtz built on this earlier research, as well as the work of Fechner, Müller, and James Clerk Maxwell (1831–79), to formulate a modified version of Young's hypothesis about color vision, now known as the Young-Helmholtz theory.[2] Against those who might posit a physical definition of "primary" colors, he insisted that "it makes no sense whatsoever to speak in objective terms of three fundamental colors." Rather, "a reduction of colors to three fundamental colors can only have a subjective meaning, can only concern a derivation of color sensations from three fundamental sensations" (quoted in Kremer 1993: 237). Helmholtz read Young through Müller and proposed that three types of "nerve fibers" exist in the eye and respond to specific types of stimuli to produce specific qualities of sensation: red, green, and violet. As light of varying wavelengths and intensities hits the retina, the excitations of these three nervous receptors combine to produce the whole range of human color experience. The incorporation of Young's ideas into Helmholtz's *Handbuch* made the understanding of color as a subjective and, therefore, physiological and psychological phenomenon an uncontested part of color science.

Helmholtz not only grounded Young's hypothesis in the mid-century understanding of the nerves but also extended Young's insight to account for a range of phenomena, including color blindness, chromatic contrasts, and other subjective color effects (Kremer 1993: 247; Turner 1994: 113). Furthermore, in accounting for these subjective effects, Helmholtz made a decisive leap from physiology to psychology that set the terms for subsequent controversies in the study of color vision. Where most of the *Handbuch* focuses on the physiological mechanisms of vision, the sections on color contrast in part two of the work argue that phenomena of the sort that Chevreul and Goethe had both documented were due not to the nervous fibers of the retina but to "the psychic activities by which visual perceptions were formed" (quoted in Kremer 1993: 254). In particular, Helmholtz argued that these visual effects resulted from "unconscious judgments" made in the act of perception, and in doing so he announced the empiricist program that he elaborated in his account of spatial perception in part three of his *Handbuch* (1867). In broad terms, Helmholtz believed that the objects we perceive result from inferences, based on previous experiences, made about the sensations caused by the nerves. What we see results largely from how we have learned to engage with visual stimuli. For colors, this means that some chromatic experiences could not be explained solely through Young's three receptors, which were physiological and fixed rather than psychological and adaptive.

Helmholtz's trichromatic theory gained broad support after the publication of the *Handbuch*, but with this broad support came increased criticism, especially from Hering and the adherents of his "opponent" colors theory. Many of Hering's objections updated Goethe's phenomenological approach to color. First, Hering argued that Helmholtz's theory flew in the face of introspection and everyday color experience. Take yellow, for instance. We see it not as a shade of "greenish-red," as the trichromatic theory would suggest, but as its own primary hue (Rossi 2019: ch. 5). Similarly, the idea that simultaneous color contrast resulted from false judgments made without viewers realizing it struck Hering as a hasty and unnecessary interpretation of what was more likely a local instance of the general principle that sensory experience depends as much on the state of the organism as on the nature of the stimulus (Turner 1994: 121–5).

To address these problems, Hering proposed replacing the three-fiber theory with an account based on three types of "visual substance," each linked to two opposed colors: red–green, yellow–blue, and white–black. These substances, which, contra Helmholtz, were said to have a physiological rather than psychological basis, acted the role of the organism whose state influenced sensation. When red light hit the red-green substance, it entered an "assimilated" state; when green light hit, it shifted to a "disassimilated" state. If neither type of light is affecting it, the red-green substance remains at rest, producing no sensations at all. Hering's theory thus explained why we cannot experience a "reddish green" or a "bluish yellow," since the physiological substrate of vision was organized such that red sensations came at the expense of green, and vice versa, and so on. And by making yellow one of the opponent colors, the theory accounted for our experience of that hue as a unitary rather than mixed color. Hering further held that the effects of the red-green and blue-yellow substances always combined with those of the white-black substance, which responded to all luminous stimulation and determined the intensity of the color sensations (Turner 1994: 128–35; Rossi 2019: ch. 5). If Helmholtz's theory aimed primarily to set the study of color vision on an experimental basis, Hering's opponent colors sought to use introspection to provide a more comprehensive account of chromatic perception.

Adherents of the Young-Helmholtz and opponent color theories attacked one another for the better part of the next three decades (Turner 1994). At stake were not only the implications of specific experimental findings but also the underlying assumptions guiding the psychology of vision. Yet the common ground continued to be the idea that the scientific investigation of color should focus on sensations—their various causes and material bases as well as their qualities and development—rather than light alone.

In the United States, this basic reorientation of the science of color was first effected by Ogden Rood. As Rossi details, Rood studied psychophysics at Berlin University. He then brought these ideas back to Troy University, where he conducted "some of the earliest experimental work in physiological psychology in the United States" (Rossi 2019: ch. 1). In *Modern Chromatics* (1879), the book that followed from these studies, Rood declared colors to be subjective and set out, as the title suggests, to update the common-sense program of Field's *Chromatics*. "Outside of ourselves," Rood wrote, "there is no such thing as colour, which is a mere sensation that varies with the length of wave producing it" (quoted in Rossi 2019: ch. 1). Rood's book spread the modern approach to color psychology to a wider anglophone audience—and beyond. Perhaps the best-known readers of Rood were the French Impressionist painters who, much to the author's chagrin, adopted *Modern Chromatics* as their "Bible" (Rossi 2019: ch. 1).

Yet while Rood championed the German line on color psychology, the polymath pragmatist Charles Sanders Peirce (1839–1914) charged that Helmholtz and his ilk had based their theories on an untenable materialism. For Peirce, the initial promise of psychophysics, as articulated by Fechner, was that it aimed to abolish the separation of mind from matter. *Elements of Psychophysics*, after all, was the scientific side of Fechner's broader campaign for a metaphysical panpsychism that saw the physical and the mental as two sides of the same existential coin. But Helmholtz and Wundt separated Fechner's experimental program from his metaphysical brief against materialism, with the result that physiological psychology came to be identified with the division between mind and matter that it had been launched to oppose. Peirce considered this a grave mistake (Rossi 2019: ch. 2). The evidence was in the arbitrary relation that Helmholtz and Rood postulated between stimulus and sensation. Peirce believed that when emphasis was placed on the workings of the visual system alone, which interpreted several different stimulations as the self-same color sensation, the question of how sensory experience related to its physical determinants inevitably got muddled, or fell out of view altogether. As Peirce disparagingly remarked of Helmholtz's color theory, the conclusion "is that the sense-qualities distinguish the things in themselves about as well and about as arbitrarily as the names Henry, Charles, and John parcel out human kind" (quoted in Rossi 2019: ch. 2). The threat of the broader program of nineteenth-century color psychology, according to Peirce, was that it left us unable to account for how, why, or whether color sensations tell us anything about the world, or if they are shared from one human observer to the next.

For Peirce, then, the study of color psychology had implications beyond the specification of the physiological basis of color vision or the psychological factors of perception; it involved fundamental questions about the nature of reality. In short, theories of color constituted theories of experience in miniature. And psychological accounts of chromatic perception carried with them the metaphysical assumptions of the researchers who formulated them. Peirce formulated his philosophy of signs (which he called "semiotic") as part of an ambitious project overhaul the materialist metaphysics informing nineteenth-century science. Rather than treat thoughts as uniquely mental and therefore separate from the physical, Peirce approached them as *actions* and defined ideas in terms of the embodied beliefs and activities they motivated. Likewise, he understood colors not as mere sensations tied only to the observing subject but as *signs* that pulled together the stimulus, observer, and process of perception into a single dynamic activity. As such, the question was not whether a sensation represented the world accurately, in the sense of giving a clear and distinct image of it, but how the interpretation of a chromatic sign was situated as an activity within a complex and unfolding environment, one in which the distinctions of mind and matter were ones of degree rather than kind (see Rossi 2019: ch. 2). Peirce's work, esoteric though it often is, thus provides a distinctive take on the philosophical implications of nineteenth-century color psychology. Whereas scholars such as Jonathan Crary (b.1951), Peter Gallison (b.1955), and Lorraine Daston (b.1951) have emphasized the epistemological implications of physiological psychology—focusing primarily on the problem of subjectivism posed by the idea that sensory experience refers only to the visual system and varies slightly from person to person—Peirce saw the study of color as an occasion for reformulating the ontological picture that shaped Western thought, including the developing discipline of psychology (Crary 1990; Daston and Gallison 2007; Gaskill 2018).[3]

Christine Ladd-Franklin (1847–1930), who studied logic with Peirce at Johns Hopkins University, shared Peirce's misgivings about the hard divisions between the material and the mental in color science, a division she saw as exemplified in the debates between Helmholtz and Hering. The trichromatic theory of the former tied color sensations to retinal receptors sensitive to three bandwidths of light, and so it favored the physical aspects of color perception even in the face of criticisms, including the point about the psychological unity of yellow. In contrast, opponent color theory privileged the lived experience of color, and so offered four "primary" colors, but by dogmatically adhering to this doctrine, Hering threw out results from the Helmholtz camp that had been verified many times over. Ladd-Franklin worked with Helmholtz and Hering, as well as their followers, during her years in Germany, and so she had an intimate understanding of both the insights and the shortcomings of each side (Kargon 2014: 153; Rossi 2019: ch. 5). Their positions seemed incommensurable; yet both were clearly right about certain things. How to square them?

Ladd-Franklin's "development theory of color sensations," presented to the International Congress of Experimental Psychology in London in 1892, solved this riddle by introducing evolutionary time into accounts of human color vision. She hypothesized that color sensitivity had developed through the evolution of a single, light-sensitive molecule that over millennia had been broken down by light waves to produce three distinct molecules with unique ranges of responsiveness. Achromatic vision emerged in prehistoric animals equipped with the single light-sensitive chemical. Over time this molecule differentiated into one type responsive to "warm" frequencies (yellow) and another responsive to "cold" ones (blue). This dichromatic vision, enjoyed by bees and dated to the Cretaceous period, then morphed again, as the "warm" molecule split into red-sensitive and green-sensitive molecules. The result was the trichromatic human vision (Plate 6.2). By approaching color-sensitivity as an evolved feature of human experience rooted in the interactions between light and the photochemical components of the retina, Ladd-Franklin explained how the four primary colors seen by humans (including yellow) were part of the same developmental story as the trichromatic theory. Between light and the mind were chemical processes and their evolution (Kargon 2014: 153–5; Rossi 2019: ch. 5).

Though it has fallen out of favor, Ladd-Franklin's developmental theory received widespread acclaim at the end of the nineteenth century, and its attention to evolution is a reminder that a significant portion of color psychology in the period encompassed animals as well as humans, and developing infants and children as well as adults. Indeed, the findings about the physiological components of vision that emerged in the laboratories of Helmholtz, Wundt, Hering, and their students stimulated research into the color sensitivity of insects, reptiles, birds, and mammals. During the same decades, psychologists such as James Sully (1842–1923), James Mark Baldwin (1861–1934), and G. Stanley Hall (1846–1924) turned to the color perceptions of children as a possible portal onto the historical processes by which the human race moved from "primitive" to "civilized" states (Gaskill 2018). If color was a sensation rather than a property of the physical world, then the task for color researchers, from psychophysicists to child psychologists, was to determine how to record and compare the chromatic experiences of different people or even different species. Helmholtz and Hering devised experimental apparatuses to quantify sensations in the laboratory; but for studying the *development* of color sensitivity, many turned instead to language.

LANGUAGE AND THE COLOR SENSE

The philological investigation of words for color achieved a surprisingly widespread influence in the second half of the nineteenth century, touching not only the study of literature and history but also that of physiology and psychology. For many, the linguistic record of color descriptions, from ancient epics to modern novels, offered a record of the growth of human sensation. Others disagreed, and their objections both spurred and drew from the psychological studies described above. The controversies around the use of philological evidence in the postulation of so-called "primitive color vision"—understood as a rudimentary stage of color sensitivity exhibited by societies at a lower state of "civilization" —doubled as debates took place about the relationship between language, on the one hand, and thought, perception, and social practice, on the other. At the same time that the lexicon for describing colors was expanding more explosively than ever, the historical development of color terms became a contested site through which the enduring questions of subsequent linguistic research were posed.

The story starts with British Prime Minister William Gladstone (1809–1898), who in his spare time was a Homer scholar. Gladstone devoted a chapter of his three-volume *Studies in Homer and the Homeric Age* (1858) to "Homer's Perception and Uses of Colour," in which he detailed several apparent anomalies in the chromatic descriptions in the *Iliad* and the *Odyssey*. Single objects often received multiple and conflicting color appellations. Other things, manifestly different in hue, were described with the same color term. And, overall, the epics showed a shortage of words for hue and paid a preponderance of attention to lightness and dark—so much so that even the blue sky was denoted using the same word that, elsewhere, was applied to dark or even black objects. To the modern mind, Gladstone explained, there was no idea "more definite [...] than that of colour" (Gladstone 1858: 457). But these strange descriptive patterns suggested that this had not always been the case. Since Gladstone revered Homer as a gifted poet in a great society, he interpreted these irregularities not as descriptive mistakes but as precise evocations of the perceptual experiences of the ancient Greeks. Where nineteenth-century Europeans saw color, Gladstone reasoned, Homer's contemporaries saw modalities of light and dark (489).[4]

A decade after *Studies in Homer and the Homeric Age*, the German philologist Lazarus Geiger (1829–70) strengthened Gladstone's thesis by demonstrating that the same oddities found in the *Odyssey* were also present in the Vedic poems, Norse myths, ancient Chinese texts, and the oldest Hebrew scriptures. What is more, the color terms in all of these different languages progressed through the same stages. After a primitive phase in which the only colors described are pale and dark, terms for red appear, followed by words for yellow, green, blue, and violet. Geiger pointed out that this pattern neatly aligned with the solar spectrum; it appeared that humans had gradually became sensitive to shorter and shorter wavelengths of light. And he insisted that this seemingly universal progression "must have a common cause," likely a physiological one (Geiger 1880: 60–1).

In 1877, Hugo Magnus (1842–1907), an ophthalmologist at the University of Breslau (present-day Wrocław, Poland), gave Geiger's sequence a Lamarckian interpretation. In *Die geschichtliche Entwickelung des Farbensinnes* ("On the Historical Evolution of the Color Sense"; 1877), he argued that the human retina developed its sensitivity to color gradually, in response to the "stimulus produced by the unremitting pounding of the ether particles" (Magnus 1877: 19; quoted in Deutscher 2010: 48). By this account, various colors had different levels of "internally generated kinetic energy," with red being the most energetic, followed by orange and so on to violet (quoted in Bellmer 1999: 30). The most energetic colors "stirred the first signs of color perception" through their superior force, and as centuries passed, and the particles kept pounding, the eye gradually became able to respond to the less energetic hues (Magnus 1877: 19; quoted in Deutscher 2010: 48). Magnus's theory was textbook Lamarckian: it held that traits acquired during the lifetime of an organism could be passed on to its offspring. And since at the time Lamarck's view of evolution was more widely accepted than Darwin's, the idea that some populations had acquired full-spectrum vision through the work of many generations found a ready audience (Deutscher 2010: ch. 2).

Magnus's theory offered a way of countering ethnographical reports that set the visual acuity of non-Western tribes above that of modern Europeans.

Drawing on his travels in Latin America, Alexander von Humboldt (1769–1859) had reported that so-called "primitive" people could see better and farther than their "civilized" peers. Increased data on color blindness, another product of nineteenth-century research into the physiology of color vision, confirmed that white men were more likely to be "deficient" in color perception than nonwhites or women (Musselman 2006: ch. 3; Rossi 2019: ch. 3). Herbert Spencer (1820–1903) explained the former issue away by claiming that the greater perceptual ability of so-called "savages" came at the expense of the more advanced mental functions that characterized the modern mind. Just as children fixate on particular things rather than abstract categories, Spencer explained, so too did less advanced races exert the bulk of their finite mental resources to the crude operations of sense perception, while Europeans—especially European males—diverted their energy toward abstract reasoning and generalizations (Spencer 1876).

But what about color perception? The trick here, which Magnus provided, was to recast the sensory hierarchy in terms of organization and complexity rather than strength. Ever since colonization got underway, Europeans had reported a proclivity for strong, bright colors in the non-modern cultures. Goethe's remark that "Men in a state of nature, uncivilized nations, children, have a great fondness for colours in their utmost brightness," is representative (Goethe 1810: 179). Magnus's theory suggested that human evolution unfolded through a process of increased sensory responsiveness that made such crude colors intolerable. Francis Galton (1822–1911), the English polymath famous for his theory of eugenics, laid out the general logic in his *Inquiries into Human Faculty and Its Development* (1883), a book that included the first studies of color-sound synesthesia. Remarking on the supposed perceptual superiority of non-Europeans, Galton invoked the psychophysical concept of "just perceptible differences" to distinguish between higher and lower orders of sensitivity. In short, he was of the opinion that civilization increased the "grades of sensation" in its members and that, contrary to those who thought that modernization wrought havoc on the nerves, "a delicate power of sense discrimination is an attribute of a high race" (Galton 1883: 19–21, 23).[5] Magnus applied this reasoning to the color sense.

Gladstone read Magnus's work with enthusiasm and repackaged his original theory in the Lamarckian terms of "the laws of hereditary growth" (Gladstone 1877: 366). In "The Colour-Sense" (1877), Gladstone wrote that the "sharpness of sense" exhibited by "savages" is in fact "wholly distinct from a high development of special aptitudes" in perception. He illustrated with an analogy: the relation of savage to civilized sense perception is like that between "muscular strength and muscular pliability" (Gladstone 1877: 368; see Schuller 2017). With this physiological account in mind, Gladstone returned to Homer and insisted that the only way to make sense of his color terminology is to assume that the ancient Greeks saw the world through materially different eyes (Gladstone 1877: 371).

Almost immediately people objected. Charles Darwin (1809–1882) and Alfred Russel Wallace (1823–1913) argued that color perception had played a role in natural and sexual selection and that it therefore almost certainly had not developed in humans only in the past few millennia (Bellmer 1999: 34). Others pointed to the use of blue stones in the statuary of ancient Egyptians and the anatomical basis of color vision across species. Especially damning counterevidence came from the Victorian science writer Grant Allen (1848–99), who tested Gladstone's thesis by sending ethnological surveys about indigenous color sensitivity to "missionaries, government officials, and other persons working amongst the most uncivilised races" (Allen 1879: 205). The questionnaires included questions about the color perception of the informants ("Can they distinguish blue and green?" "Can they distinguish mixes of intermediate shades, such as mauve, lilac, orange, and purple?"), followed by questions about language ("Have they separate names for blue and green?" "How many colours do they discriminate in the rainbow?") (205). Allen received "a large number of courteous answers, from Europe, Asia, Africa, America, and the Pacific Islands," to which he added his own "observations on negroes" and his father's reports on North American Indians, and all of them proved the same thing: "the colour-sense is, as a whole, absolutely identical throughout all branches of the human race" (205, 207, 209).[6]

Some ideas prove too useful to disappear, even when refuted. Despite criticism that Gladstone's argument rested on the fallacious assumptions that if a language group is capable of seeing blue then they will have a word for it, the belief that color sensitivity had emerged within historical time, and that it became more nuanced with increased cultivation, nonetheless persisted. For one, the argument about the color sense coincided with an international concern about color blindness, sparked by a high-profile train wreck supposedly caused by a color-blind engineer (Deutscher 2010: 46–8). But even more significantly, the late nineteenth century witnessed an explosion of colorful goods that made color design and color sensitivity hot topics. Some genteel observers in the USA and UK worried that the increased range of affordable colors, not to mention their chromatic intensity, threatened to dull the perceptual capacities of modern citizens. As the English artist Alexander Wallace Rimington (1854–1918) put it, "not only has there been neglect of the colour faculty, but […] there has been an evident decay of it in most Western nations," as evidenced by "the tendency for good colour to disappear from our surroundings, from costume, and from fabrics, from architecture, and from other decorative arts" (Rimington 1912: 9). The idea of the color sense helped late nineteenth-century commentators to discuss the impingements of commercial color.

Many of these modifications to Magnus's initial idea transformed the color sense from a physiological phenomenon to a psychological one—from a feature of the eye to a quality of thought. Where Gladstone erred, explained Henry T. Finck in 1880, was in failing to distinguish "between the physical and the aesthetic development of the color-sense." The former has to do with anatomical structure, but the latter "is a matter of intellectual training" (Finck 1880: 26). Color sensitivity became a matter of experiential quality: hard to quantify but easier to deploy against the mounting evidence that all humans saw color in fundamentally the same way. Where Helmholtz and Hering sparked scientific debate over whether the perception of color contrasts was a bodily or mental phenomenon, contributors to the Gladstone debate pushed people outside of professional science to consider where color perception occurs, and how it might change.

Even as the controversy over the historical evolution of the color sense died down, giving way to the less technical or more nebulous invocations of color sensitivity just described, the mystery of Geiger's sequence of color terms remained. Why did human languages acquire separate color words for hues in a near-regular manner? For the Cambridge ethnographer and neurologist W.H.R. Rivers (1864–1922), the philological evidence was too strong to dismiss, and he used the opportunity of an anthropological expedition to the Torres Straits and New Guinea in 1898 to "reopen" the debate (Rivers 1901c: 58). He packed a set of Holmgren wools—variously colored samples used to test color blindness—and the color-mixing wheels designed by Maxwell, and set out to test "the relation between language and thought" as evidenced in the delimited domain of "the color sense of primitive races" (44). And though many of his findings supported the objections from Allen, Rivers found enough evidence to give new life to the discredited hypothesis. "One of the chief interests of [this] work," he announced, "is that it shows that a defect in nomenclature for colour may be associated with defective sensibility for that colour and so far lends some support to the views of Gladstone and Geiger" (Rivers 1901b: 49).[7]

Rivers's research both reinvigorated the color-sense debates and refocused them around the relation between language and mental character. His examinations of the color vision and vocabularies of tribes from different regions of Papua New Guinea, Kiwai Island, and Australia, yielded results that, on his account, paralleled the patterns and peculiarities of ancient color vision, as postulated by philologists. The question, though, was whether these linguistic "deficiencies" pointed to corresponding visual defects. Rivers thought they did, at least in the case of Murray Islanders. Members of this group made odd comparisons of, for instance, bright blue with dirty water. And although Rivers did not think that they suffered from "blue blindness," he did conclude that they displayed a "relative insensitiveness to blue" compared to Europeans, which he attributed to the darker pigmentation of the *macula lutea* in their retinas (Rivers 1901c: 51–2). Rivers offered his interpretations hesitantly, without Magnus's brio, but nonetheless he succeeded in putting the idea of an evolving color sense back on the table.

Rivers also studied the color language of a group of "Eskimo" (that is, Inuit) men and women, and although his findings complicated the easy correlation between civilization and color he postulated elsewhere, they strengthened his case for the link between language and thought. Unlike the people of the Torres Strait, the Inuit individuals, who had been brought to London's Exhibition Hall at Kensington as a curiosity, spoke about color with remarkable precision, despite their "primitive" culture. Whereas Murray Islanders had few terms for abstract colors, using instead words that designated specific objects (similar to *olive* and *chestnut* in English), these Labrador natives had six basic color words corresponding to English *red*, *yellow*, *green*, *blue*, *white*, and *black*. They then combined these words and, when needed, added affixes meaning "light" and "dark" to name whatever color they needed (Rivers 1901a: 143–5). When asked to describe a sample of magenta, for instance, several individuals responded, *aupaluktaktungalangaijuk*, meaning "bluish red," and when given the same task with violet, they replied with *tungajuktakaupalangaijuk*, meaning "reddish blue." Rivers wrote that, psychologically, this manner of designating color stood "much higher" since it exhibited the facility with abstract generalizations that Spencer had reserved for people at a more advanced stage of civilization (148). Indeed, the most striking thing about these names is that they imply a chromatic system in which all color sensations result from combinations of six basic colors—the six postulated by Hering's opponent theory. In other words, as Ladd-Franklin wrote in an excited review of Rivers's findings, "Eskimo" color vocabulary was "a perfect reflection of the facts of consciousness" (Ladd-Franklin 1901: 399). It was, indeed, "absolutely scientific" (Ladd-Franklin 1929: 121).[8]

Around the same time, the anthropologist Franz Boas (1858–1942) and his students advocated for an alternative approach to the ethnographic interpretation of linguistic peculiarities. Whereas Rivers believed that all human groups could be plotted along a single continuum from savage to civilized, Boas proposed that each culture had its own internal ways of acting, sensing, and thinking that should not be judged better or worse, only different. Instead of Rivers's single civilization, Boas promoted the idea of *cultures*. He came to this idea in part as a reaction against the psychophysical project in which he was trained. His 1881 PhD dissertation at the University of Kiel, Germany, had drawn on Fechner's methods to study the perception of the color of water—but, in the course of his research, he abandoned the idea that sensations could be quantified using the tools of physiological psychology. Something always seemed to get between the stimuli and the chromatic experiences, making it impossible to standardize measurements across perceivers (Cole 1999: 52–4).

In “On Alternating Sounds” (1889), Boas presented this mediating something as “culture.” “It is well known that many languages lack a term for green,” he noted, and speakers of such languages may well describe “a series of green worsteds” as yellow or blue, and may hesitate about these designations, or even switch them up from day to day. The issue, Boas continued, was not that they were incorrectly seeing the green but that they were seeing it through the lens of their particular culture (Boas 1889: 50).

Throughout the subsequent century, the pendulum swung from one extreme to the other: from the idea that language acted as a “mirror” for mental experience to the idea that language determined what could be thought or sensed, and then back again (Rivers 1901c: 44; Deutscher 2010). The twentieth-century fallout of this back and forth, including the Sapir-Whorf hypothesis and Brent Berlin and Paul Kay’s *Basic Color Terms* (1969), occurs in a later period than that covered by this volume. What is interesting about the period at the turn of the twentieth century is that a slightly different position emerged, one based on the *pragmatics* of color terms. The question became “What are color words for?”

As many of Gladstone’s critics pointed out, words are forged to fit specific needs. In the case of color, the activities of dyeing and painting, and the practical work of distinguishing colors in farming, horse trading, or navigation, provided the need, and language groups developed the terms necessary to abet their activities. As a writer for *Nature* put it, “Language does not keep pace with perception unless a practical or aesthetic necessity arises for expressing what is perceived to other people” (Smith 1877: 100). Gladstone had suggested as much in his original chapter on Homer’s colors, when he speculated that the deficiencies of ancient color vision had to do with the relative underdevelopment of the arts dealing in color, such as painting and “the culture of flowers” (Gladstone 1858: 487–8). But this suggestion was buried in the broader reception of Gladstone’s work in the 1870s, and so when Rivers rekindled the debate, the point was reformulated, this time within anthropology. Robert S. Woodworth, for example, in “The Puzzle of Color Vocabularies” (1910) dismissed Rivers’s conclusions by insisting that what requires explanation is not the *absence* of a color term but its *presence*. Drawing on his own interviews with “more or less primitive peoples” assembled at the Louisiana Purchase Exposition in St. Louis in 1904, Woodworth argued that “it is where color serves as the mark of an important object, or condition of an object, that a color name would be most likely to develop.” If cows and horses had been green and blue, he conjectured, “the history of color vocabularies would probably have been quite different” (Woodworth 1910: 333–4).

Evidence for this view was everywhere at the end of the nineteenth century. The business of dyeing had been greatly expanded by the success of aniline dyes, and more and more commercial endeavors sought to incorporate color into their products (Blaszczyk 2012). Color terms proliferated in turn. On the one hand, the fashion industry created fanciful names to give added allure to the new chemical colors: elephant's breath, ashes of roses, Nile green, chrome yellow (Salisbury 2015). On the other, people such as Albert Munsell (1858–1918), Robert Ridgway (1850–1929), and Milton Bradley (1836–1911) devised standardized nomenclatures for use in business and scientific research. In these systems, color names doubled as formulas for recreating the sensations indicated: for example, in Bradley's nomenclature, a light bluish green might be written "W.40, B.20, G.40," meaning that it comprises forty parts white, twenty parts blue, and forty parts green. Using a color wheel and a set of colored papers from the Milton Bradley Company (of the same sort used in many of the psychological and ethnographic studies cited above), one could reproduce this color, and so—in theory at least—know exactly what the designated color looked like (Gaskill 2018). In short, then, the increased *business* of color required, and produced, an expanded *vocabulary* of colors. And the psychology of color both stimulated and benefited from the language of color.

Several literary scholars working within this tradition commented on the imbrication of science and language in the development of English color terms. Even outside of the broader debates about color sensitivity, the late nineteenth century was a high point for the philology of color. Alice Edwards Pratt's extensive study *The Use of Color in the Verse of English Romantic Poets* (1898) not only offered detailed accounts of the chromatic styles of Wordsworth, Keats, and Shelley, but also provided a deep history of the development of color descriptions. The Elizabethans, for instance, favored poetic descriptions of colors in terms of objects—*linen faced*, *raven black*, and so on—but the Romantics relied on a more abstract vocabulary, similar to what Rivers had found among the Inuit. They use hybrid color terms, such as *pinky silver* or *dun red*, often qualified with prefixes such as *pale*, *dark*, *light*, or *deep*, the better to render a nuanced image (Pratt 1898). The critic George Stewart, Jr. (1895–1980) made the case that this mode of description owed much to the techniques developed by eighteenth-century naturalists in their studies of flora and fauna. Without the scientific effort to "describe and distinguish 133 varieties of parrot," Stewart reasoned, the Romantics would not have had at their disposal the elaborate color language that they used to their own unique effect (Stewart 1930: 74). Even after the initial idea that the philological record revealed the sensory history of the race faltered, literary scholars continued to treat the chromatic descriptions of poets and novelists as windows into a complex cultural history (see Skard 1946; Gaskill 2020).

The twists and turns of the Gladstone controversy illustrate how the actors working in a range of disciplines approached color as a site for investigating the relation of language to thought and material culture. Psychologists and philologists cited one another's work and built on one another's conclusions. Sometimes they even dipped into the other's territory: the British psychologist

Havelock Ellis, for instance, published an extensive study of “The Colour-Sense in Literature” in 1896, in which he claimed that color imagery in imaginative writing offers direct insight into authors’ “personal psychology” (Ellis 1896: 729). He then wrote essays on the psychology of red and yellow (Ellis 1900a, 1900b, 1906). Anthropologists testing “primitive color vision” used the same tools as psychophysicists measuring the color sensitivity of Westerners, and both relied on a stabilized and standardized language of abstract color to record and share their results. In the end, this tight collaboration had much to do with the creation not only of a modern notion of color (as an autonomous system with its own rules and logic) but also of the subjects who responded to it and the discourses that supported it.

CHAPTER SEVEN

Literature and the Performing Arts: A Poetic Case Study

MARGRIT VOGT

INTRODUCTION: THE INDUSTRIAL BACKGROUND

This chapter concentrates on the literature of Germany, as an example of nineteenth- and early twentieth-century work in that field. It begins with an overview of colorant production and use in Germany, because that industry acted as an inspiration to writers who included color terms and phrases in their texts, evoking colorful images and atmospheres. An overview is presented here, therefore, of the role of colorants, especially dyes, in German industry and this is followed by a consideration of the consequences of this development for color perception in German literature, comparing the preindustrial age with the beginning of the twentieth century.

Since the late nineteenth century, dyes had been seen to have considerable market value. The German dyestuff industry became engaged in worldwide markets, in North and South America, China, Japan, Korea, and Russia, as well as parts of Europe and Africa. In the first few years of the twentieth century, several German chemical manufacturers formed a conglomerate or *Interessengemeinschaft* (IG) ("interest group") and eight of them then amalgamated into a single company called IG-Farben ("IG Dyes") in 1925, based in Frankfurt-am-Main ("Der deutsche Farbentrust" 1925–6).[1] At its height, IG-Farben was the biggest chemical and pharmaceutical company in the world, and it dominated the world market for synthetic dyes. The production of dyes and varnishes was promoted, patents were registered for new color recipes, and color standardizations were implemented.

The journal *Farben-Zeitung* (1905–1943) stresses that dye manufacture was considered to be of great economic importance to the company. Discussions on dyes, which included debates about the improvement of their manufacture and of dyeing techniques, were dominated by economic considerations. In terms of sales and income for the company, dyes were esteemed as the new German "gold." In specialized publications, dyes are differentiated according to their function and designated use (for example, see "Altes und Neues über Buchdruckerfarben" 1905).

In the eighteenth and nineteenth centuries, factory owners had struggled to produce new synthetic dyes.[2] The competition became more intense with the establishment of the Patent Office in 1877 in Berlin. Patents were awarded for the first chemical formulae of new dyes and varnishes. In 1906, an inspection commission was founded to deal with fraud in the dye industry; from then on, the dye market was controlled, and the practice of selling cheap imitations was forbidden and subject to fines. New patented products included fluorescent colors, celebrated in Berlin as an exciting innovation ("Trifft Substanzen, bei denen das absorbierte Licht eine neues Phosphoreszenz nennt" 1925: 401).

The importance of synthetic dyes to the German economy is shown by the measures taken to protect the industry and individual dye formulae. To control color standards, specialists first used color tables, but, in 1929, the spectrophotometer, an American color-test machine, was developed and soon sold in Germany. As a result, the quality of the dyes on the color market could be tested and their prices fixed ("Kreditfrage, Preisabbau und Praxis" 1925). However, apart from governmental regulation, including the imposition of high customs tariffs on imported finished color products, prices also depended on the costs of imported raw materials for German manufactures. Germany frequently imported raw materials from Third World countries and produced and exported the final product more expensively to the rest of the world.

The German colorant industry and the textile dyeing factories conquered the world market with their dyes, varnishes, and paints, and made massive profits, especially between 1920 and 1930, and after the amalgamation of IG-Farben with the Swiss company IG-Chemie (M. König 2001: 43).

From around 1900, the newly produced chemical colorants were omnipresent in German cities with innovative color experiments on the façades and in the interiors of buildings. At this time, Germany's income from colorants doubled as the color market burgeoned, and Germany also imported colorants from the United States ("Vom Weltmarkt" 1925). Advertisements in Germany and abroad promoted color production and the German color market. In order to overcome the depression following World War I, Germany promoted its colors with an appeal to use more colors in the cities to brighten both interiors and exteriors. Not only did this initiative provide many jobs, but it also served to create a colorful and more joyful atmosphere. As a result of this development, the phenomenon of color also became a matter of interest in contemporary literature

COLOR PRESENTATION IN GERMAN LITERATURE

The following is an analysis of color presentation in German literature from the eighteenth to the twentieth century with a focus on the impact that the development of chemical colors and the color market had on the use of color in German poems.

During the lifetime of the versatile writer Johann Wolfgang von Goethe (1749–1832), natural products were still being used to fabricate colors, and scientific experiments concentrated on the *nature* of color. Goethe mentions color in his *Römischen Elegien* (Roman Elegies), written in 1788 to 1790, but he only used the general words for "color" or "colors" and did not specify the appearances of red, blue, yellow, and so forth. The seventh *Römische Elegie* frames the warm south as an artistic inspiration, where the special light is contrasted with the darkness of the north, and light versus dark is presented metaphorically as a difference between artistic creation and dullness. At this point, one might expect Goethe or the articulated "I" (first-person singular) in the poem to portray the different colors perceived in Rome and the brightly colored lifestyle in Italy in the love poems in the *Römischen Elegien*, but, interestingly, colors are rarely mentioned. For example, the articulated "I" in Elegy VII presents a stereotypical north–south axis of the cold and cheerless north versus the bright and sunny south:

> O how well I feel in Rome! When I remember the times,
> When a grey day in the north surrounded me,
> When the sky weighed down, dreary and heavy on my soul,
> The world was colorless and formless around the exhausted soul,
> And I above myself, was immersed in silent contemplation,
> Desiring to see down the gloomy paths of my unsatisfied spirit.
>
> (Goethe 1985: 409)

The cultural experience of the articulated "I" in Elegy VII in a new and strange world in the south culminates in the praise of colors and forms, which set them apart from the grayish northern areas. Not once, however, does Goethe's articulated "I" name the newly discovered colors, and he only makes a general statement about their beauty:

> Phoebus evokes God, forms, and colors.
> The night bright like stars, sounds from songs
> And the moon gleams brighter than the northern day.
> What blessedness did I, a mortal soul, receive? Do I dream?

Does your ambrosial residence receive, Father Jupiter, the guest?
Ah! Here I lie and reach imploringly out with my hands
To your knees.

(Goethe 1985: 409–11)

Despite the lack of reference to color, the articulated "I" mediates the fact that color and forms are essential for our spatial perception. Elegy VII, however, rejects the illustration or concretization of specific colors. In the warm south, the experience of new colors becomes an introduction to unknown forms,[3] and in the *Römischen Elegien* it is always a sensual perception that provides the articulated "I" with new cognition. The poem explains the differences between the colors of the north and south from a climatic perspective as well as from an art-theoretical and artistic viewpoint. Accordingly, it is not only the warm south but also the art metropolis, Rome, that serves as an educational introduction for the articulated "I" to aesthetic color and form.

In Elegy VIII, the articulated "I" uses the strategy of color evocation while avoiding naming the perceived colors:

If you tell me, my beloved, that you did not appeal to people as a child,
And that your mother therefore despised you,
Until you were grown and until you silently evolved into a woman—
    I believe it:
Happily I imagine you as a special child.
In this way, the blossom of the vine lacks color and form.
As soon as the berry has ripened, it delights both humans and gods.

(Goethe 1985: 411)

The beloved woman is compared to a ripening grape, which evolves from an inconspicuous bloom into a beautiful grape. Its color is not named, but the poem indicates that the proper state of growth is reached when the grape attains the right color. The poem transfers this model of development in color to the human process of ripening and indicates that with each new color gained, a new phase in life is reached. It is clear that Goethe does not associate colors in a love-magical formula with a sensually perceivable effect in his *Römischen Elegien*, but that he renounces the presentation of different shades and hues while only mentioning the general word for "colors."

In contrast to his minimal use of color terms in the *Römischen Elegien,* Goethe is generous with color adjectives in other poems, in which he provides minute criticisms of Newton's theory of colors (Newton 1704). It is as if suddenly the color imagination of this color-restrained author was kindled when he put the results of his "Color Theory" (*Farbenlehre*) (Goethe 1810) into poetic expression:

There around the spring
The oscillating dragonfly,

Delighting me;
Now dark and now bright,
Like a chameleon;
Now red and blue,
Now blue and green.
Oh that I nearby
Could see its colors!
There, the little one flies in front of me
And it seats itself on the quiescent meadows.
There, I got it!
And now, I examine it exactly
And I see a sad dark blue.
Just this experience you too will get, you, who dissect all of your joys!

(Goethe 1985: 89)

The poem *Die Freuden* ("Joys"), which was published in the first edition of Goethe's *Neue Lieder* (New Songs; 1770), presents the color-coordinated variety of the world to the eyes of the beholder according to the rules and principles of his *Farbenlehre*. And yet, the flying butterfly changes its color according to the light or the shadow. This chameleon-like oscillation between colors shows its ephemeral character. This is confirmed by the comment on its dissection, because the incarceration of the colorful butterfly in the cosmos of an analytical examination is punished by the deprivation of the color and artful hues of its wings, which now seem to be just dark blue. Goethe's interest in color is much stronger in his *Farbenlehre* than in his aesthetically ill-performing poems defending his color theory. When concentrating on his poems as literary works of art, he shifts his attention from color naming to color evocation.

Goethe paid full attention to specific colors, when he utilized them to poetically defend his color research in the *Farbenlehre*. In this sense, Goethe transfered the last fight against Newton's "heresy"—as he called the color theory of his opponent—to the literary field. Quite a few Newtonian fans had tried—with or without success—to shape the results of Newton's *Opticks* into the literary form of a poem with the aim of mediating the complicated theory through a light presentation with easy rhymes for the salons of the time (Schöne 1987: 169).

The *Farbenlehre*—which was intended to polemicize in the form of a poem against Newton's theory—names the perceived colors and schematically shows the development of color impressions from light and shadows.[4] Goethe evidently sensed the poor literary and aesthetic quality of his poems, and along with his somewhat embarrassing attack on Newton's color theory, this may be another reason for his decision not to publish these poems.

In contrast, is the art work of the poet Eduard Mörike (1804–1875), which has typically been assigned to the Biedermeier period (an era in central Europe between 1815 and 1848, during which the middle class grew and arts appealed to common sensibilites), but sometimes also to realism (an art movement beginning with mid-century French and Russian literature and extending to the late nineteenth century). Mörike uses—in accordance with the realistic representation of the world—an object-related color scheme and paints in his poem *Septembermorgen* ("September Morning") the typical colors of autumn. The sky is blue, and the yellow-tinted leaves shine like gold in the autumn light. The poem celebrates the beauty of the season and its fading charm:

> The world still is in a fog,
> The forest and the meadows still dream:
> Soon you will see the blue sky undisguised
> When the veil falls,
> You will see the world in the power of the hushed autumn
> Flow in warm gold.
>
> (Mörike 1910: 60–1)

Theodor Storm (1817–88), a realist poet, used color in a similar vein. In his poem *März* ("March"), he paints a picture of a snowdrop blooming on a cold winter day, indicating the end of winter and the beginning of spring:

> And out of the earth is looking
> A snowdrop all alone;
> So cold, so cold is the meadow still,
> It is cold in its white small skirt.
>
> (Storm n.d.)

Storm uses nature to describe colors: the snowdrop got the name from its color and from its appearance as one of the first flowers to bloom after the winter. Not only does Storm paint the flower in its white "skirt" but also mentions that it is the first flower to appear after winter. When Storm mentions that the snowdrop freezes in its white skirt, he alludes to the colors of winter and emphasizes that this flower is a testimony to the transition from winter to spring.

Storm uses the same strategy of painting a season in realistic colors in his poem *Ein grünes Blatt* ("A Green Leaf"):

> A leaf from summer days
> I took it when I was wandering
> That it may tell me one day
> How loud the nightingale sang
> How green the forest was, through which I was walking.
>
> (Storm n.d.)

The wanderer picks up a green leaf while walking through the woods in order to remember signs of spring and summer. However, when Storm describes nature in its realistic colors, they metaphorically allude to life. As the seasons change, situations in life change, and the green leaf serves as an indicator of the fact that plants and trees had been in full bloom.

In the poem *Oktoberlied* ("October Song"), Storm (much like Mörike in his "September Morning") uses colors in both a realistic and metaphorical manner:

The fog rises, the leaves fall;
Pour this dainty wine!
We intend to color this grey day
To gild it, yes to gild it!

And even if outside rough times are indicated,
Unchristian times or christian ones,
The world itself, this beautiful world
Is entirely indestructible!

And even if the heart whines once in a while—
Clink glasses and let it clink!
We always know, a right heart
Will never die.

The fog rises, the leaves fall;
Pour this dainty wine!
We intend to color this grey day
To gild it, yes to gild it!

Yes, it is autumn; but only wait,
Only wait for a little while!
The spring arrives, heaven laughs,
The world presents itself in violets.

The blue days begin
And before they pass,
We want to enjoy them, my good friend,
Yes, enjoy them!

(Storm n.d.)

October suggests autumn, when wine is produced from ripe grapes and the leaves change color. Storm alludes to the color gold in order to create a contrast to the gray days preceding winter. The exhortation to enjoy the wine and gild our days matches the intent to live the autumn season of life to its fullest. Even if times are unsteady or if there is rivalry between ideologies, the world itself and kind hearts are indestructible. Accordingly, Storm not only makes use of colors as they appear in nature but also employs them metaphorically to indicate the aspired life's journey.

At the end of the nineteenth century, Stefan George (1868–1933) adopted a different approach with regard to depicting colors, probably as a result of industrial developments and the emergence and formation of a German color market in the second half of the nineteenth century. He viewed all colors through the lens of their materiality and was attentive to chemically produced colors. In his poem *Ein Angelico* ("An Angelico"), the narrator of the poem uses color as a means of artistic creation. The Italian painter in the poem, Fra Angelico (b. *c*. 1386–1400, d.1455, Rome), strove for the almost impossible "glorious deed" through the innovative meanings of color (Schäfer 2005: 188).

He took the color gold from sacred trophies,
For blond hair the ripe wheat straw,
The rose of children, who paint with slate,
The washerwoman on the creek, the indigo.
The master in the gloss of an absolute kingdom
At his side gentle singer of his glory
And victors of the Graces and Medusas
The bride with ever-silent children's breast
Full of humbleness but pleased with her reward
Receives from his hand the first crown.

(George n.d.: "Hymnen")

Stefan George celebrates in his poem "An Angelico" geniality and productivity, and he does so without intending—as Rainer Nägele points out—to create a *Gesamtkunstwerk* (a work of art that makes use of many art forms) in the sense of a verbal mimesis to Fra Angelico's pictures. George alludes to Fra Angelico's picture *Mary's Crowning* without comparing the strength of artistic expression in a *paragone* (comparison) between his poetry and Fra Angelico's painting (Nägele 1975; Schäfer 2005). Although George's poem focuses on Fra Angelico's picture, it is not an ekphrasis (a verbal description of a work of art) in the common sense; rather, the poem unfolds as a search for the proper color or as a discussion of the best color choice. The poet reproduces in words the struggle of the painter for the appropriate hue and color shape. Hereby, nature, as it presents itself to the painter's eye, is his inspiration. In the colors of the surroundings, in the colors of the different materials, the painter finds the source for his choice of pigments. The common wheat straw is the inspiration for the yellow-blonde shade of the Virgin Mary's hair. The gold color of sacred trophies is the color template of the Madonna's halo, the rose color of the children indicates the color of the Virgin's gown, and the color of her blue coat has its origin in the indigo-blue dress of a washerwoman at the stream.

Fra Angelico, then, uses the materials, fabrics, and textiles of his surroundings as color-approving “authority.” His strategy mimics the representation of color in nature, and his use of color is secondary in his art. The wheat straw becomes an indication of color or a color dispenser and loses in this context its form and function. Accordingly, it is transformed into a color *instrumentarium* (set of instruments) during the creative process in George’s new world of art. The search for pigments, in particular, for the painting of the Madonna is a reminder of the baroque manner of comparing colors to objects as, for instance, in the poetic conventions of female beauty in which the lips of the beloved are like corals and the skin is snow white. The painter and the poet succeed in their artistic endeavor when they find the color-dispensing object and the matching pigment on their palette: the Virgin Mary’s hair is yellow like the wheat straw.

This apparent color playfulness meets the specific and literary processes of creative art at its heart and offers a portal into deeper layers of meaning: every epoch and era must find the proper color, the matching word, and the right expression for the chosen artistic subject.

Even though the four colors—gold, yellow-blonde, rose, and indigo—of “An Angelico” are taken from four different phases of reality, they provide a color hierarchy from the sacral sphere to the working-class milieu (Nägele 1975: 102). In the poem, all the colors embrace the same color-dispensing function, which indicates that they do the same in the development of the painting, even though the pigment and its price varies. Despite this leveling of the color material to their function in the painting, the chosen colors perform meaningful roles.

In contrast to this strategy of leveling the importance of colors, the artists of especially the Middle Ages and the Renaissance liked to introduce expensive color pigments in order to emphasize the quality of their artwork and the painted subject (often members of the holy family). Painters used a pure ultramarine blue and a bright gold for their paintings (see, for example, Gombrich 2002: 326). Ultramarine blue was the most expensive pigment. This is why ultramarine was very often chosen for the topic of the Virgin Mary of Mercy protecting humankind with her outstretched coat. However, when depicted in one painting with God, it did not seem appropriate to use ultramarine for Mary’s coat, because her garment could not, in the logic of the Middle Ages and the Renaissance, be painted with more precious materials than those of God. When letting the painter in the picture choose to paint the Virgin Mary dressed in a simple dark blue coat of the cheap pigment indigo, George distinguishes himself both as a medievalist and a connoisseur of the subject matter, and as a poet during the age of industry. Indigo—one of the first dyes to be chemically produced during the age of industry—allowed him to characterize the Virgin Mary. The dye, which was used in Germany in the late nineteenth century for working clothes, portrays the Madonna as a working-class woman. George, therefore, used colors as indicators of his ideas in his poem, and did not focus solely on their symbolic meanings.

The use of color in George's *Komm in den totgesagten Park* ("Come into the Park which is Said to be Dead") reveals the same strategy, namely to bristle with intensive chromaticity contrary to the self-evident autumnal expection of the observer and in spite of the coming decoloration:

Come into the soon dying park and observe
The shimmer of the distant smiling shores.
The unexpected blue of the pure clouds
Lightens up the ponds and the colorful paths.
There, the deep yellow takes the soft grey
Of birches and of box trees, the wind is mild.
The late roses not entirely faded yet.
Pick, kiss, and braid them into a wreath.
And don't forget these last asters.
As well as the purple around the twines of wild vine.
And also what is left from the green life
Weave easily in the autumn face.

(George n.d.: "Das Jahr der Seele: Nach der Lese")

"Come into the Park" is the first poem in George's anthology *Das Jahr der Seele* (The Year of the Soul; 1897) and belongs to the so-called "spoken" poems—according to George's own words—after the songlike poems in the anthology *Hymnen, Pilgerfahrten, Algabal* (Hymns, Pilgrimages, Algabal) along with the "painted" poems in the anthology *Hirten- und Preisgedichte, Sänge und Hängende Gärten* (Pastoral and Glorifying Poems, Chants, and Hanging Gardens). In these poems, the blazing colors serve as substitutes for the color-dispensing objects in the earliest poems, and so the denotative color-object relation is inverted. While the circumfluent material provided "An Angelico" with chromaticity, color serves in this poem to describe objects, such as the birch tree in the park, the box tree, the rose tree, or the aster, which are only mentioned after the effect of their color has been praised.

George's second literary strategy in terms of color orchestration was to focus on color and to overcome its materiality. The colors act as semantic mediums, though George introduces them not in an allegorical or symbolic manner, but like atmospheric color stains on an artist's palette. Just as a painter uses the color mixes on his palette as materials for his creation, George applied them to give color to his poems. Although the plants in the park will all fade in a short time, they still show intense chromaticity. The articulated "I" advises the addressee in the poem to assemble the yellow, gray, red, green, and purple hues into a beautiful bouquet. Thereby, the articulated "I" demands its readers *take* the colors and wrestle a sign of life from them.

Another autumn poem by George, *Beträufelt an Baum und Zaun* ("Drizzled on Tree and Fence"), uses a combination of seasonal colors as a sign of the last chances for life and love:

Has a balm drizzled on the brittle wood
On the tree and the fence?
The autumn colors brown,
Red-yellow, dappled brown,
Scarlet, and a strange green.

Who approaches the nameless?
Who grieves far away from the crowd?
In the matt-blue clothes of a child.
As a shy wind rustles
As dying roses scent
Warmed-up by departing sunbeams.

At the border of the iridescent hedge
At the rustle of drying leaves
And at chants of the bright tree top
We guide each other by the hand
Like fairytale siblings
Enchanted and with hesitating walk.

(George n.d.: "Pilgerfahrten")

The matt blue clothes of a child are in response to the intensive red-yellow, brown, green, and scarlet hues. Scarlet suggests that the fragrance of dying roses is warmed by departing sunbeams. Hesitantly and affectionately, the gesture is carried out. Again, George uses colors very differently from Goethe and the poets of the Biedermeier and the realism periods. While Goethe's poetry evokes the beautiful colors in Italy without naming them and defends his *Farbenlehre*, the poets of the Biedermeier and realism periods portray nature using the expected color terminology. Under the influence of the industrial age and due especially to developments in chemical color production at the turning point of the nineteenth and the twentieth centuries, the poets of the *fin de siècle* focused on the color product itself and its effect on artwork.

CHAPTER EIGHT

Art

JOYCE H. TOWNSEND

This chapter deals with the materiality of paintings: the colored pigments used by artists, the ways in which they created surface color, and their reason for choosing these materials.[1] When considering the colors they used rather than their intention, subject, or inspiration, great artists might seem to have little in common except greatness. Individual attitudes varied from the use of traditional materials of proven worth to the employment of new ones of great potential whose durability was not guaranteed. The extent to which a low income might constrain access to new and/or high-quality paints was considerable and could last a lifetime. Some artists might use a narrow range of colors, while others might try everything and anything that proved useful without abandoning previously used colors. There was a substantial difference in attitude between those who used paint as it was supplied, and those who modified paint and experimented with new formulations in order to express their vision.

This chapter focuses on artists' attitudes toward color in their materials by discussing a selection of great artists or well-known artistic groups who were active in Britain and France. It draws on published studies of individual paintings and, on occasion, on unpublished technical studies by the author, which may be consulted in the Tate Conservation Department, UK. It recounts the ever-expanding possibilities that emerged for fine artists during the period 1800–1920, as industrial production of pigments, dyes, paints, commercial printing materials, and house paints surged in a time of transition from a niche market for art to a consumer-driven market for mood-enhancing color in every aspect of Western life.

INTRODUCTION

The nineteenth century in Britain was an industrial period. By the end of the century, most countries in mainland Europe had embraced industrial manufacture of the materials used by artists and craftsman, although in some countries it took decades before the impact was felt; the Scandinavian countries, for example, were late to industrialize. This period of expansion in terms of manufacture and export made British goods of all kinds important on a global level, though Britain would lose its importance as the twentieth century progressed, as two world wars largely destroyed the economy but later triggered new growth in the economies of other countries. It is well known that, in the nineteenth century, the British Empire exported household goods, clothing, locomotives, and the newspapers and submarine cables that facilitated global communication on a scale never seen before. In the middle of the century, British artists' materials were used on all continents, not only because natural scientists, explorers, and artists took them with them as they explored, documented, and drew inspiration from new countries, but also because these materials could be ordered by people who had never set foot in London, and shipped to them via a network of trade routes.

During the nineteenth century, the symbolism and religious meanings associated with color in previous centuries were suppressed. Much of the value and meaning projected onto key colors of Christian iconography, such as gold and ultramarine blue, had to do with the scarcity of these colors, the effort made by merchant adventurers to import the materials from distant countries, and the labor-intensive work needed in order to create just a handful of precious, richly colored dust to make a paint. Neither the artists and craftsmen, most of whom employed traditional colorants in 1800, nor their patrons knew exactly where the essential materials for their craft came from, nor how they were fabricated from minerals, vegetables, and animals. Similarly, the factory worker, who made new synthetic dyes and pigments, the printer of colorful consumer goods, and the artist, who had seen his/her importance to society diminish steadily over the period, all had no clue. All of them now worked for an expanding middle class with a combined purchasing power that rivaled the wealthy few.

New discoveries in chemistry and industrial manufacture ensured that by the 1860s and later it was possible to paint both high and commercial art, print colored images, develop new photographic processes that lent themselves to artistic use as well as scientific documentation, and print textiles for clothing and home furnishings in colors as bright as they are today, but using predominantly materials and processes not dreamed of around 1800. The Industrial Revolution led to a revolution in materials. It brought those living through it from a world that was limited in colors to a garishly bright world where every color imaginable could be manufactured on goods and images that were affordable even to the poor. The nineteenth century witnessed the democratization of color.

At the beginning of the nineteenth century, innovative British artists and designers embraced new possibilities and created new ways of seeing and interpreting the world. The substitution of new industrial products for traditional ones happened faster than art historians and conservation professionals often realize, because romantic creation myths tend to outlive reality. The Great Exhibition of 1851 in London must have been the first intimation of a new and more colorful consumer-driven age and drew tens of thousands of visitors (Figure 8.1). Manufacturers linked new products to old ones by creating cunning and even misleading names for them, so that artists and other users gradually turned into passive consumers, ill-equipped to understand the occasional health hazards and poor quality of the new materials until the products had been improved.

Innovation in the chemical industry and the development of synthetic colorants shifted from Britain to Germany in the second half of the nineteenth century. At the end of the nineteenth century, many artisan and craft paint products could be adapted for use by artists, of which a notable type was paint for domestic decoration. The final, permanent replacement of almost all traditional artists' materials with the ones found nowadays occurred after World War II when the infrastructure for manufacturing had to be replaced wholesale, but it was the

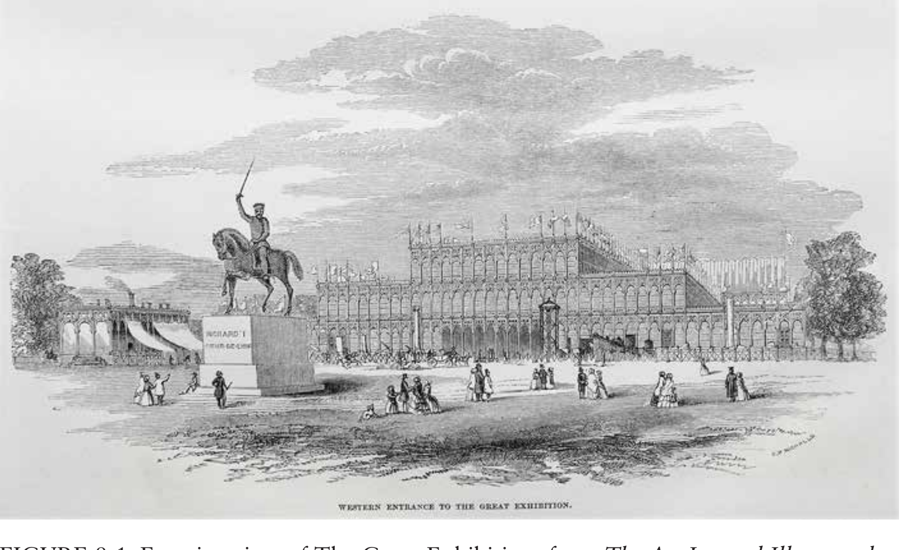


FIGURE 8.1 Exterior view of The Great Exhibition, from *The Art Journal Illustrated Catalogue* (London, 1851). Courtesy of Alexandra Loske.

second half of the nineteenth century that witnessed the greatest changes in the materials used to create color in all artistic fields.

DIVERSITY AND CREATIVITY: THE COLOR PRINTING METHODS OF WILLIAM BLAKE

Time has not been kind to the most colorful components of the oeuvre of William Blake (1757–1827). His distinctive painting techniques were not understood by early restorers, which led to poorly targeted treatments that affect the appearance of his paintings to this day. Blake was not an oil painter; indeed, in 1780, he wrote that oil was “a cloggy medium.” His paint medium for both color printing and the temperas that generally survive in poor condition today (the ones he called “fresco paintings,” such as *The Ghost of a Flea* [*c*. 1819–20, Tate]) was a judicious mixture of gum arabic, gum tragacanth, and cane sugar or honey, chosen for its working qualities. He modified the proportions once he could assess its survival in earlier works, with its layers interspersed with animal glue used warm, and with the same finally applied as an unconventional varnish. He would not have realized at first that these materials tend to darken over time to a greater extent than oil paint, which has affected the appreciation of his temperas. One tempera in excellent condition is *The Body of Christ Borne to the Tomb* (*c*. 1799–1800, Tate) which includes extensive use of white (garments) set against blue (sky) and red (garments), with areas of yellowish green (the grass in the foreground) but no pure green.

Blake considered drawing to be the soul, or in his words the “lineament,” of an image rather than color. As a lifelong art printer, he thought in terms of the balance of colors within an image, rather than the full gamut of tones and the gradations from gloss to matte surfaces, which he could have achieved by using the reviled medium of oil. He limited himself to a small range of colors (about a dozen), which he used repeatedly throughout his life. They include the artist’s primary colors of red (vermilion), blue (Prussian blue and indigo, both greenish blues and somewhat similar in tone when applied to paper), yellow (gamboge), and toners such as black (lamp black) and brown (brown ochre), with a few rarely used crimson lakes for specific details. In other words, he employed a printer’s palette across all media. These pigments were all readily available in both towns and the countryside, which made it unnecessary to invest in large and expensive stock (as he had to for paper and copper plates). Many of his watercolors employ only a few of the colors from his maximum range of twelve, the bulk of the image being produced on off-white woven paper of high quality, the least textured type of paper available to him, which produced a flat color (Townsend 2003).

His innovative color prints, which he made by creating a monotype in paint on a flexible support to generate three or even four impressions from a unique design, gave scope for several versions of each image. The first impression, having the greatest thickness of paint and depth of color, as well as the best gradation of continuous tone, was the one he finished most richly and covered most completely with color, using a greater variety of colors and sometimes applying fine details in shell gold paint (powdered gold leaf in a liquid medium), which he also used in many of the temperas. The later impressions have fewer and weaker colors transferred and more white or pale-colored areas in order to create a harmonious whole with no sharp contrasts in intensity. His combination on one page of text printed in more than one color with an image in several colors was inventive too, but it was impossible to scale up his printing process to a large print run.

Born in a preindustrial age, Blake personifies the working methods of the craftsman and artisan even in his pragmatic and standardized choice of colors, which were, nonetheless, applied with the instinct of a creative artist.

EARLY ADOPTERS OF COLORS DROVE CHANGE: TURNER VS. CONSTABLE

The training and development of Joseph Mallord William Turner (1775–1851), whose generation was the one that followed the founders of the Royal Academy of Arts in London, included the Royal Academy schools, the private "academy" of Dr. Thomas Munro, the architectural company of Thomas Malton, and a great deal of observation from nature (Shanes 2015). It did not include tuition in the process of painting, nor in the handling properties of artists' materials. Such skills, previously transferred through apprenticeship, had been taught to the founder generation of the Royal Academy, who tended, however, to view them as merely mechanical tools for the achievement of high art, where ideas mattered more than materials—hence they did not pass them on. In mainland Europe, these skills were taught in national academies throughout the nineteenth century. British artists were thus freer to experiment and were motivated to do so, since there were neither manuals nor product literature to answer questions about the durability of colors or the long-term prospects for the survival of their best works. Turner achieved greatness through dogged hard work, constant practice at drawing and watercolor, confidence, and astute commercial strategies throughout his life. This included his decisions to work in oil medium, which had a higher status than watercolor, to position his works in all media in emerging markets, to sell reproduction rights in new black-and-white printing technologies (Piggott 2013), and to find buyers for the colored originals.

Turner's interest in—and clear enjoyment of—adding a lively sky even to the commissioned image of a gentleman's country house (for example, *Radley Hall from the North-West* [1789, Tate]) and deploying telling spots of color in fairly conventional landscapes (for example, *Dolbadarn Castle, North Wales* [1800, Royal Academy of Arts, London]) is evident some years before the appearance of new and colorful pigments (yellows in particular). He used these products of the Industrial Revolution to the full, beginning with Scheele's green in the 1790s, cobalt blue (invented *c*. 1802 in France but not used by him until *c*. 1806–1807, the Napoleonic Wars having likely hindered export), chrome yellow (patented in Britain in 1814 and used by Turner in the same year), emerald green (used by him by the 1830s following its discovery in 1814), viridian (first made in France during the 1830s, and used by him by 1842), barium yellow (made in France in the 1840s, and used by him by 1843), a more orange shade of vermilion also used by 1843, and new shades of chrome-based pigments that ranged from pale lemon through deep orange yellow to scarlet, used by the late 1840s (Townsend 2007, 2019). With the exception of barium yellow and chrome scarlet, all these colors can be seen in the foreground figures in *The Opening of the Wallhalla 1842* (exhibited 1843, Tate), which is a well-preserved work on panel. A huge range of Turner's signature colors for depicting a dramatic sunset (plus some unstable and rarely observed pigments such as iodine scarlet) have been identified in *The Fighting Temeraire* (exhibited 1839, National Gallery, London; Egerton 1997) (see Plate 8.1).

No other British artist has been found to be such an early and enthusiastic adopter of new pigments. John Constable (1776–1837), for example, did not use chrome yellow until the end of the 1820s, that is, ten years later than Turner. Moreover, Constable continued throughout his life to mix the greens that are so extensive and so necessary in his landscape subjects from a blue and a yellow pigment (Cove 1991; see, for example, *Flatford Mill: Scene on a Navigable River* [1816–17, Tate]), whereas Turner was much criticized for instead painting small details with the blue-toned, new pure green pigments. Many press critics perceived Turner's greens, which tend to cover a tiny proportion of the image compared to Constable's greens, as being as inharmonious as the newly manufactured yellow pigments, which in his middle years he used abundantly in every painting and in many watercolors as well. He sometimes covered roughly a quarter or a third of the image with a yellow-toned sunset or sunrise, as in *The Arch of Constantine, Rome* (*c*. 1835, Tate).

Turner was both commended and criticized for his use of a multiplicity of tones and textures of white paint, the critic John Ruskin being his greatest champion in this respect. Turner was also criticized for contrasting white with blue to an unfortunate degree (Gage 2013). As much as he is admired today, Constable, in contrast, was mostly criticized for his innovative use of dazzling pure white highlights to depict sunlight in a rural landscape or an urban scene, as in *The Opening of Waterloo Bridge ("Whitehall Stairs, June 18, 1817")* (exhibited 1832, Tate). In contrast to later colorists, both artists used pure black pigment for dark elements in their compositions. Both used optical mixtures of grays, reds, and (less often) blues to paint cloudy skies, just as watercolorists have always done to achieve infinite gradations of hue from gray through slate and toward purple.

Turner used modified paint media and transparent brown pigments to create glossy deep brown shadows within landscapes, glossier than the use of pure oil medium would ever permit. For oil paintings, he used a white or very slightly warm-toned ground, lighter than was typical in his era or had been used by earlier generations. This is the method of a watercolorist, and Turner's painting processes in oil medium owe everything to his early proficiency and innovation in watercolor as an expressive medium. His compositions in both media were created with transparent washes of warm then cool colors that let the paper or off-white ground show through, not line, as he grew in skill and experience (Smibert and Townsend 2014; Townsend 2019). The areas that would become the brightest lights (in many cases, the yellow sun itself) were left bare as the composition evolved, so that a late application of brilliantly colored paint would lie over a white underlayer to create maximum impact, as can be seen in the yellow sky of the abovementioned *The Arch of Constantine, Rome*. His unfinished oil paintings, especially when viewed in color reproduction, could easily be mistaken for his watercolors, which later in life he always created using the same processes. An example is *Sketch for "Ulysses Deriding Polyphemus"* (*c*. 1827–8, Tate).

When he worked in watercolor on paper, Turner was far more experimental with the background color, although a majority of his watercolors are on white/off-white paper. During the middle of his career and later, he often used mid-blue papers, which were particularly effective when the applied paint included both transparent cool washes to modulate the blue of water and sky, and opaque white, red, and yellow paint for buildings. He used these for many of his views of French towns, of architectural features as seen in his sketches of fellow guests at Petworth House in the 1830s, and Venetian scenes in the same decade (for example, *The Scarlet Sunset* [*c*.1830–40, Tate]). In his youth, Turner had experimented more widely with gray-washed papers, naturally buff-colored papers, and with color-washed paper in red, lilac, and green. During all periods, he often use a warm yellow wash over much of the paper to establish a mood of serenity as well as a time of day.

There is no doubt that Constable exceeded Turner's uses of colored grounds. He experimented continuously with mushroom, blue, and lilac tones of colored ground on smaller supports used for sketching, and it is possible to date his smaller sketches and paintings to within a few years by assessing the color of the ground, the pigment combinations used to create it, and the range of pigments used for the overlying paint (Cove 2017).

During Turner's lifetime and in the following decades when the demand for public access to art lengthened the opening hours of public galleries, it was observed by those who had seen Turner's paintings, when they had first been painted, that many of them, and also his watercolors, had lost color. With regard to the paintings, the loss of reds from sunsets, and the loss of "reds and golds" were often mentioned, but there was rarely mention of the color loss from cool tones (Townsend 2007). Some watercolors that were displayed under mounts for long periods have lost the red component from mixed gray in the skies, while others have lost the blue component. This illustrates the argument against the early adoption of new pigments before there was information about their durability. A more detailed study of his materials and the state of knowledge when he used them implies that some of his choices, such as the chrome-based yellows and oranges, survived better than was expected in his lifetime. It is the traditional blue indigo in watercolors and newly manufactured red lakes in a beguiling range of shades from brown red through crimson to blue red, which were used by him in both oil and watercolor, that performed the worst. Indigo came to be superseded by a number of new and more permanent blue pigments as the century progressed, and eventually there would be fewer shades of red lake available, but of better durability.

COMMERCIAL SUCCESS OVER INNOVATION: THE VICTORIAN GENRE PAINTERS

Portraiture was the principal source of income for artists who had not yet, or never did, achieve commercial success. The steady market for low-cost likenesses put food on the table, just as taking pupils did in the early years of more successful professional artists, but the key to a good middle-class income was to capture the public's imagination. This is the ground occupied by genre painters, of whom William Powell Frith (1819–1909) is a good example. He financed large-scale exhibited works, such as *The Derby Day* (1856–8, Tate), by painting and selling numerous canvases on a more domestic scale (Woodcock 2018). *Dolly Varden* (*c*. 1842–9, Tate) is a character from Charles Dickens's *Barnaby Rudge* (1841), while *Many Happy Returns of the Day* (1856, Mercer Art Gallery, Harrogate) is, perhaps, the pictorial equivalent of a chapter in Dickens's *The Pickwick Papers* (1836), which portrays a scene from normal middle-class life with a slight archness that provoked either warm recognition or a rueful smile in the viewer/reader, but no disquiet. The genre painters exercized a high degree of well-practiced artistic skill, at its best the equal of an academically trained portraitist from mainland Europe, using durable paints and pigments that reflect the increasing range of colors available in domestic furnishings. Frith's talent for depicting glossy brown hair in *Sherry, Sir?* (1853, Mercer Art Gallery, Harrogate) is comparable to the ability of Edwin Henry Landseer (1802–1873) to depict fur on dogs, lions, and even polar bears, as can be seen in *Dignity and Impudence* (1839, Tate), *Study of a Lion* (*c*. 1832, Tate), and in the less comfortable viewing offered by the scavenging polar bears in *Man Proposes, God Disposes* (1864, Royal Holloway, London).

Generally, however, no innovation in colorants is found here. Traditional artists' pigments, such as madder-based crimson lakes and greens mixed from stable combinations of Prussian blue and chrome yellow, have been found in the works of Landseer, William Etty (1787–1849), William Mulready (1786–1863), and Edward Matthew Ward (1816–79). Their use of rose madder, a pale yet intense pink shade, is striking and reflects the prevalence of this color in women's costumes. The maid in *Sherry, Sir?* wears many bright pink ribbons, despite the fact that her income must have been very modest. Both the rose madder pigment he would have chosen, durable compared to the red lakes available to previous generations of artists, and the textile dyes that created this luscious color, were fairly new industrial products that had already been developed and improved. These artists did not use experimental painting techniques either. One good outcome is that loss of color is very rarely a feature of genre paintings. Accordingly, they testify to the astonishing depth and range of colors that the mid-century artist witnessed in society and used with confidence.

PURE COLORS AND PURE SUBJECTS: THE PRE-RAPHAELITE BROTHERHOOD

This group of artists formed a "brotherhood" of seven in the period 1847–53. The best-known painters in the group were John Everett Millais (1829–96), William Holman Hunt (1827–1910), and Dante Gabriel Rossetti (1828–82). Their subject matter of biblical or literary scenes, their commitment to painting in front of the motif in all weather and lighting conditions in order to create an intensely colored, faithful, and minutely observed copy of reality, was very different from the realism of the genre painters. Their colors were startlingly bright and pure, and they employed bright yellow-green paint to imitate strong sunlight on grass. Millais's *Mariana* (1851, Tate) includes the vermilion, emerald green, and natural ultramarine, which they used regularly. Even in their stylized "PRB" signature, usually applied in scarlet vermilion, they made use of strong color contrasts and complementary colors. Rose madder features in their works as well; by this date it was durable. The paintings of the early Pre-Raphaelites are composed of stable pigments, and color loss is not a feature of their early works.

Hugely influenced by one another's use of materials as well as subjects, this group of artists used copal-based paint media, which enabled the unmixed reds, yellows, green, and blue pigments they favored to be applied as a single thick layer of unmixed color that would dry with a glossy surface and a startling intensity of color. Since they often depicted the yellowish green of grass and foliage in sunlight, they had to mix a yellow into their regularly used emerald-green pigment, which has a bluish cast, and they also mixed purple tones from ultramarine and rose madder. It is rare to find black or brown pigments mixed in to create darks, and it is the lack of mixing of colors as well as the optical property of the high refractive index that copal-based media tend to have, which are two of the three factors responsible for the brilliance of their colors. They also wrote about using a thin varnish made from the same type of copal-based material to preserve the glossy appearance.

Hunt and Millais also developed ways of working on a very white ground—the third contributor to the brilliant and high-key appearance of their paintings—in thick but transparent blocks of pure colors applied with painstaking detail to a light but detailed underdrawing. During the short period of the brotherhood, they adopted grounds made from zinc white (also often marketed as Chinese white) (Figure 8.2), which when freshly applied has a

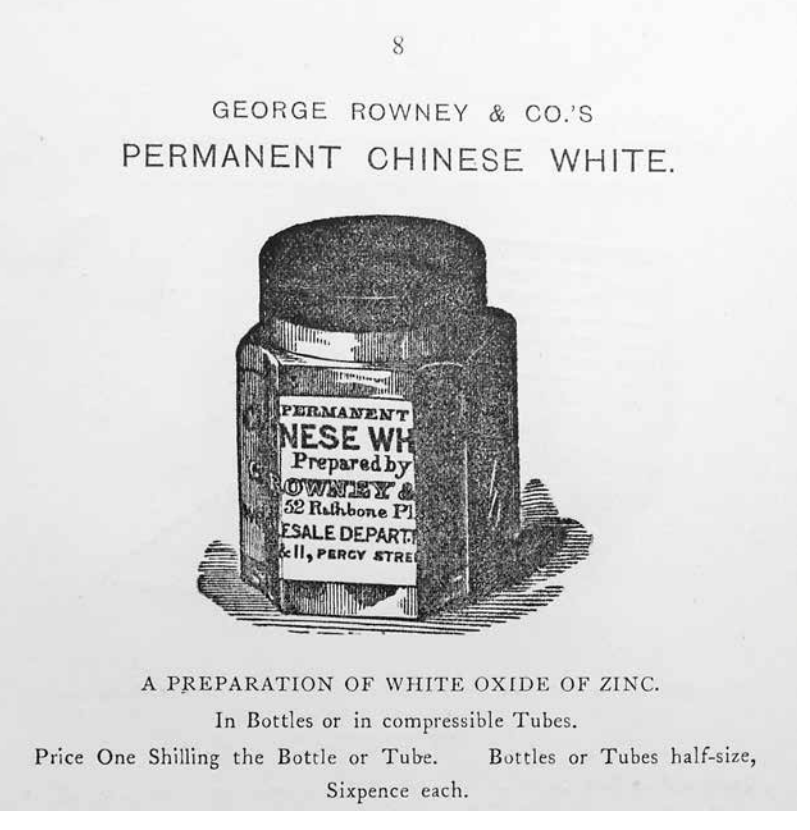


FIGURE 8.2 An advertisement for George Rowne & Co.'s "Permanent Chinese White" (Zinc White), *c*. 1885. Courtesy of Alexandra Loske.

very blue-white appearance, but contrary to popular belief they did not use it all the time. Their earlier paintings had conventional lead white grounds. They also developed skill in applying paint on top of a white ground while it was not quite dry and before it picked up smuts and grime from the air of London. This technique was used locally and beneath areas of especially brilliant color rather than over entire canvases. This is the often-mentioned "wet white ground," whose effects can be seen beneath the purple loosestrife flowers at the extreme right of Millais's *Ophelia* (1852, Tate) and beneath some areas of the backlit sheep in Hunt's *Our English Coasts* (1852, Tate), but *not* in the sky of the latter painting. That sky is an example of what happens when paint is applied wet-in-wet: the white ground beneath is picked up and dilutes the colors. In fact, that sky illustrates why the use of pure zinc-white paints was not copied from the brotherhood, or at least not for long. Used in this way, the cracking of the zinc-white paint was a serious issue, which probably made these early users return to yellower-looking lead-white grounds (Townsend et al. 2004).

TONALITY AND PRACTICALITY: J.S. SARGENT

John Singer Sargent (1856–1925) grew up in Italy and other countries in mainland Europe, and was trained as a portraitist in the French academic tradition, where he chose a master well known for his emphasis on tone and for painting *au premier coup*, which is to say, in a single painting session rather than in two or three sittings for the subject. Sargent worked this way throughout his life: from observation in front of the motif whether it was a sitter indoors, an Alpine view, or even a randomly chosen view easily accessible from the house of a friend painted just for practice. Numerous descriptions make it clear that he could work in any conditions except the absence of the motif. Accordingly, his tonal working methods can be readily examined in the few unfortunate cases when the sitter died before the work had been completed, which caused him to abandon it. In his own studio, he used curtains to adjust the fall of the light, then painted what he saw, scraping down small areas and reworking as necessary, perhaps a dozen times. This way of working means that the shadowed area round a figure had to be painted in right from the start to capture the fall of the light across the whole background. It appears that Sargent used leftover mixed paint on his palette, or quite possibly the pot of oil in which he cleaned used brushes, for this purpose. The multicolored mixture of pigments that can be detected in the backgrounds and in the unfinished portraits always ended up as a warm tone, more brown than gray and quite transparent, because simultaneously thinned with turpentine and with oil added, which made it semi-glossy when dry (Hellen and Townsend 2016).

Later in life, Sargent worked in Boston and other cities in the United States as well as London, and many of his palettes, well covered with paint, have survived.

A distinctive feature of these palettes is that they were sufficiently large to leave room in the middle for mixing, and by and large the colors were arranged in the same order every time, always round the outside. A recent analysis of their contents reveals an extremely wide but well-considered choice of high-quality artists' materials, little changed over a professional lifetime, with a core set of pigments that he used regularly (Townsend and Rayner 2018). There is no indication that he adopted new materials or abandoned older ones, except for greens and purples, which show more trends in use during the century. As a painter of sitters wearing glamorous and expensive evening clothing or sometimes elaborate pastiche costumes, Sargent deployed a very wide range of red lake pigments that served him well for ladies' costumes, and a wider range of blue and yellow pigments than his contemporaries, adding in the greenish cerulean blue and the clear yellows provided by zinc chromate or cobalt yellow on occasion.

Like every artist with a traditional training, Sargent employed lead white, but some of his later work includes a small proportion of zinc white mixed in. This is likely an industrial product, which he had not anticipated using. The opaque cadmium yellows and oranges were developed just when he began to paint. He used them regularly, but employed the longer-established industrial products chrome yellow and orange, and strontium yellow, when their color was just right for the subject in hand. He used the new cobalt violet if a sitter's costume called for it, and since his sitters were fashion-conscious trendsetters in many cases, his portraits capture the predilection to wear pinkish mauve and purple first seen in the late 1850s, which from then on extended from fabrics and accessories to cosmetics (Ribeyrol 2018). Since he worked tonally, he always mixed as few colors as possible during the later stages of painting, but he used a great deal of added white, mixing with bone black or earth colors to obtain stepwise gradations of tone.

HARMONY IN ART IF NOT IN LIFE: J.A.M. WHISTLER

The American-born James Abbott McNeill Whistler (1834–1903) was trained in the French academic tradition. He attended the Paris studio of a well-respected artist but established himself in London for most of his career, where his wit and insults became legendary. Many of his painting materials—presumably from the end of his life—are preserved in the Whistler Study Centre, University of Glasgow, and some have been analyzed (Townsend 1994). These and others have been listed in detail (McCarthy 2019). The materials in some of his paintings have been analyzed too, the harmonies and nocturnes in particular (MacDonald and Petri 2018). (Although not a highly skilled amateur musician like Sargent, Whistler titled many of his works by analogy with musical forms and included color descriptions of the "impression" [his phrase] they gave the viewer.) Whistler traveled between London and Paris regularly, and the over-labeling of many of his paint tubes makes it clear that the reputable suppliers of artists' materials in London, Paris, and Düsseldorf all imported and sold each other's products, thus facilitating this kind of lifestyle.

Whistler's harmonies were painted using a carefully selected, restricted palette, usually comprising one yellow and one blue pigment, or in a few cases two pigments, for each of these colors, and then mixing these pigments with lead white, bone black chosen for its neutral tone, and sienna, to create both lights and darks. The flesh tones consist of vermilion and lead white, and the costumes of his fashionable female sitters, if pink or crimson, include a single red lake. The paintings seen today are the successful survivors of ruthless scraping and reworking, but it is clear that Whistler preserved his customized palette (under water) and used the same range of pigments at each sitting, until the portrait of an individual was completed to his satisfaction. It is even possible to infer when he made later additions to a canvas, using a different and more restricted palette, as he did for some of the butterflies near *Miss Cicely Alexander* (1872, Tate), whose portrait famously took some seventy sittings, because Whistler effaced all the unsuccessful likenesses. In this case, the accents of yellow in her costume are as close to using a single pigment as he would ever go, though they do contain a few particles of the same ones used elsewhere to create the harmonious whole. His extensive collected correspondence makes it clear that he was not an organized individual, who recorded materials for each painting. Indeed, he rarely mentioned his materials at all. His range of pigments was not radically different from Sargent, but certainly more limited in total and very narrow for any single painting.

The same principle of color mixing was applied to nocturnes, which depict lights on the banks of the River Thames at night viewed across the water (see Plate 8.2). The shadowy depths of these works depend utterly on the application of much-thinned blue paint over a darker ground color, usually a warm dark gray for the nocturnes. His more numerous portraits often have a physically thinner and less intensely colored ground applied straight over the canvas and not over the white ground selected by most artists, even those who intended to apply a colored ground. It is the relative lack of opaque white pigments and the application of medium-rich paint that gives the *sfumato* quality to Whistler's work (Townsend 1994). This appearance, but in most cases not Whistler's technique, was emulated by many artists beginning in the 1870s when Whistler first displayed such works.

Whistler's carefully planned color harmonies have suffered more than other works by artists discussed in this chapter, because the natural resin-based varnishes favored by Whistler and by most dealers and collectors grew yellow within a few decades.

THOROUGHLY MODERN PRODUCTS: BURNE-JONES

Edward Coley Burne-Jones (1833–98) was just as enthusiastic about adopting new artists' materials as Turner. However, he was more fortunate in the sense that he encountered more new products for artists, illustrators, missal painters, hand-colorists of photographs, and products for craftsmen than Turner. During Burne-Jones's lifetime, watercolor paints were further developed: tube watercolors were thick and intensely colored and could be applied as a single thick layer, while new metallic paints provided many more metallic shades than simple shell gold had. Paints based on platinum and aluminium were also developed and gave a whitish metallic appearance without the rapid darkening that bedeviled those who worked with applied silver foil. The combination of gilding, white and red gold (the color was varied by adding silver and/or copper), and applied silver leaf (which he used before the new metallic paints were produced), all followed by over-glazing in watercolor, must have proved irresistible to him. Moreover, he made good use of textured and bodied paints in order to provide depth of color. The results are not only very colorful, with the same three-dimensional qualities and contrasts of gloss and matteness that Turner had favored, but also very difficult to classify accurately by appearance alone, since they were based on oil, watercolor, tempera, or mixed media.

For someone as innovative as Burne-Jones, it is surprising that he has been little investigated (Townsend 2004). Only his writings and the writings of fellow late Pre-Raphaelites and symbolists, such as Gabriel Dante Rossetti, where his materials are discussed, have been analyzed (Mann 2014). Burne-Jones worked closely with Rossetti, and they appear to have had many pigments in common, but Rossetti's paintings have also not been much investigated from a technical perspective. Their contemporaries noted that Rossetti's works discolored and darkened, and that some of Burne-Jones's larger works painted in watercolor suffered damage from having been treated like oil paintings by restorers.

COLORED GROUNDS AND COLORED SHADOWS: THE FRENCH IMPRESSIONISTS

In any gallery, it is easy to observe a feature common to the works of a considerable number of first-generation French Impressionists: a wide range of pale, colored grounds that vary from off-white or warm cream through to pale pink, flesh color, mushroom pink, pale sky blue, and pale lilac (though pale green and pale acid yellows seem absent). The same can be said of pointillist artists such as Georges Seurat (1859–91), who was active in the 1880s, a decade later, though his grounds are typically paler than those of other artists. It is easy to detect what color of ground was used for each work, which is the same tone all over the canvas, fully opaque, and completely concealing the white ground that was likely applied first during canvas preparation. It is the essence of Impressionism that the canvases have a fresh quality where every brushstroke can be readily observed, but many tail off before reaching the edge of the support, leaving the ground visible.

Genuinely black brushstrokes, unless they mirror a motif seen in real life, are rare in Impressionist paintings, and shadows are not graduated in the manner employed by academically trained artists, but have abrupt boundaries and stand out as rounded elements of strong or dark color. The depiction of shadows and darks in complementary colors, not a darkened version of the object casting the shadow, nor black paint, is another feature of both early and late French Impressionists.

Numerous technical studies have been carried out on French Impressionist works in the collection of the National Gallery, London, the great majority of them published (for example, Roy 1985, 2007; Roy et al. 2010), and on Seurat (Kirby et al. 2003), all illustrated with strikingly colorful images of paint cross-sections, which indicate that these artists used mixtures of many pigments within each brushstroke, most notably to create a wide range of greens and darks, browns, or purples. Black is absent from the lists of colorants, and the white pigment employed by this group of artists is always opaque lead white both in the paint and in the colored grounds. That the Impressionists mixed black rather than painting with a black pigment is frequently stated and borne out by these studies.

It is also stated regularly of the Impressionists that they employed newly discovered pigments, the products of the Industrial Revolution, and were the first to do so. The less-often stated corollary of this is true as well in that they typically avoided earth colors (ochres, siennas, and umbers, ranging in tone and opacity from opaque yellow to both opaque and translucent brick reds, through transparent browns that can be used to depict deep and glossy shadows), which had been the staple pigments of traditional academically trained European artists and British artists until the end of the nineteenth century and beyond, and were again the first artists to do so. What is not conveyed fully in this story is the implication from such statements, namely, that the Impressionists were the first artists ever to employ the manufactured, modern pigments. Among French artists, they may probably be considered early adopters, because academic training in Paris was far from innovative. Yet in comparison to British artists, such as Turner and Constable, the French Impressionists might be better described as mainstream users of these colorants than early adopters.

In the later decades of the nineteenth century, Claude Monet (1844–1926) used a list of pigments similar to that of Turner but excluded earth colors in his *The Gare St Lazare* (1877, National Gallery, London). His use of color comprises vermilion, red lake, emerald green, viridian, cobalt blue, Prussian blue, ultramarine, lead white, with only a trace of bone black, and the addition of cerulean blue, which was genuinely new (Roy 1985). Pierre-Auguste Renoir's (1841–1919) pigments in *The Seine at Asnières* (*c*. 1879) also mirrored Turner's newly manufactured ones: chrome orange, chrome yellow, strontium yellow, viridian, cobalt blue, plus vermilion and crimson lake, which were employed by virtually every nineteenth-century artist in most of their paintings. Renoir soon abandoned chrome yellow in favor of cadmium yellow (Roy 1985), which had been introduced in the 1870s, and so did Claude Monet (1840–1926) by the end of the century, who around the same time finally abandoned the earth color yellow ochre (Roy 2007). Cadmium yellow was as opaque as chrome yellow, but unlike chrome yellow, it was hardly ever accused of darkening. The new cadmium-based pigment was soon available in an orange shade that could also replace chrome orange, although the red version that might be used instead of vermilion or iodine scarlet was not available until the early twentieth century. It was possibly introduced over different years in different countries, since few early users have been reported. Not all the Impressionists lived long enough to make use of it, when soon after it became as popular a red pigment as vermilion.

Seurat's palette from around 1880 to 1890 has also been investigated (Kirby et al. 2003). The results show that his surviving paint tubes contained manganese violet, vermilion, madder lake, cochineal lake, chrome yellow, zinc yellow, chrome orange, emerald green, viridian, French ultramarine, cobalt blue, lead white, with no blacks mentioned. In his paintings were found in addition: cadmium yellow, cadmium orange, mixed greens, cobalt violet, and mixed purples and browns, but no pure black. The only very newly available pigments are thus manganese violet and cobalt violet, which are opaque pinkish-purple colors obtainable without mixing. They are rarely reported in late nineteenth-century French and English painting, which seems surprising at first, given their prevalence in fashionable costumes. It appears that the older artists of the time, well used to the huge range of shades of purple, gray, and green that could be mixed from colored pigments, seemed to regard such new products as a solution looking for a problem. Monet used cobalt violet from 1897 (Muir et al. 2014) and again in 1914 to 1916, along with vermilion, red lake, cadmium orange, cadmium yellow, zinc/barium yellow, viridian, French ultramarine, cobalt blue, and again no black pigments (Roy 2007).

As a group, the Impressionists used similar colors until a better replacement became available and did not adopt any of the cheaper dye-based colorants that were being developed by the German chemical industry, but that were at first found in industrial products rather than artists' materials. Both early and late French Impressionists used lead white as artists always had, zinc white being notably absent from the list of their materials found by analysis. Their pigment ranges imply that they never deviated from working with artists' quality paints of excellent permanence.

The material choices of the Impressionists mean that color loss is never reported in their early paintings, and for most of them it is never reported at all. The same is not true of Seurat, who adopted zinc yellow in some of his major pointillist works such as *A Sunday Afternoon on the Island of la Grande Jatte* (1884–5, Art Institute of Chicago), where most of the brushstrokes of this clear yellow, used as a pure color, have turned brown, which lead to sunlit grass far less brilliant than he intended (Casadio et al. 2008) and the destruction of a carefully devised color balance across the entire canvas.

AN ARTIST CONSTRAINED BY FINANCIAL CIRCUMSTANCES: VINCENT VAN GOGH

Although Vincent van Gogh (1853–90) was Dutch, his painting materials were for much of his life sourced from French suppliers through his brother Theo van Gogh, who was an art dealer based in Paris. Van Gogh's short life was beset with financial difficulties, and the cost of his paintings materials was always a problem. Color change in his work is the subject of much contemporary research (Hendriks et al. 2016 and references therein), which includes digital visualizations of the original colors, widely reported and illustrated on the internet, using images from the original publications.

This artist is forever associated with the use of bright yellow, notably in the paintings he made in the south of France toward the end of his life, when he lived in the yellow house that formed the subject of so many late works. He depicted sunshine on the house, and he chose the same pigment that Turner did for the same purpose: chrome yellow. Its manufacturing process had changed since Turner's lifetime, and van Gogh's chrome yellow darkened, much as Seurat's zinc yellow had, but not so severely (as yet) in some works, the two pigments being related chemically.

Loss of color in crimson and pink areas and in purples mixed from crimson and blue pigments are strongly associated with the artist's known use of the oil tube color "geranium lake," which contained a modern synthetic pigment known as eosin lake. This was not considered a high-quality artists' color and might well have been sold for commercial and student use. Van Gogh's *The Bedroom* (1888/9, one version is in the van Gogh Museum, Amsterdam, and the other in the Art Institute of Chicago) is a widely known example of the color change associated with such pigments. In the Amsterdam version (see Plate 8.3), originally mixed lilac walls look blue today, the mixture of pigments used to depict the wooden floor has lost color from at least one component, and bright yellow elements in the composition (the furniture) have darkened with loss of details. Van Gogh's gouaches suffer from the same loss of pink brushstrokes, for example *The Oise at Auvers* (1890, Tate) a sketch in gouache whose online image, when examined carefully, shows that the whitish brushstrokes in the sky were, in fact, a deep pink color. The paper has clearly darkened from a pale pink to buff, and the now off-white strokes of once-pink paint contrast poorly with it. Any mixed purples now have a pale blue appearance, and there are many blue brushstrokes present, possibly not all intended. In the twenty-first century gouache is perceived as a material for short-term use and is, accordingly, often a cheap product of low permanence, as proved to be the case when van Gogh used it.

PARIS *IS* THE WORLD: NEW MATERIALS IN A NEW CENTURY

In the youth of Whistler and Sargent, Paris was the favorite city for ambitious artists to study. This was still the case when in the 1890s Whistler taught a later generation of students in his Académie Carmen in the city. By the early twentieth century, Paris had become the center of the art world, eclipsing London, where every aspiring European and American artist longed to have a studio. Pablo Picasso (1881–1973) moved there from Barcelona, Spain, during his Blue Period (1901–1904), and so did many others from southern Europe and some from the north. He and most of the other artists had been classically trained within the academic style taught on the European mainland, before they moved to Paris. They became known as the first artists to adopt commercial rather than artists' materials for paintings, and they repurposed objects of no intrinsic value for their sculptures as a political and philosophical statement. This was not always because they lacked the means to buy good-quality materials, though some did, at least until the next work was sold. The stereotypical life working and living in a cheap and ramshackle studio in seedy but exciting Montmartre and socializing over absinthe in an even seedier bar, portrayed already by the late Impressionists, was lived by many who became dominant figures in international twentieth-century art.

The rejection of academic technique and acceptable materials led to the wide use of house paints by the early 1910s by Picasso himself (1881–1973), one of the proven early users. His *Still Life* (1914, Tate) includes previously painted scrap wood, zinc-white-containing house paint, some artists' paints, and a piece of upholstery trimming, a luxury product when new but old and faded by the time he repurposed it (Heuman 2009). This object, a sculpture made from found materials assembled by the artist, then partially painted and decorated, typifies their processes and materials. By 1920, Picasso and his Montmartre friends and rivals became Cubists or proto-surrealists, their materials and their ability to paint not drastically compromised by World War I.

Not surprisingly, they were early and avid adopters of new pigments, house paints, industrial paints, and metallic paints, which introduces such complexity into their works that they have to be investigated individually in order to understand the choices of materials, the sophisticated and imaginative ways in which these iconoclastic artists used them, and the visual changes to be found when all these products were used together. They eagerly used cadmium red, viridian, emerald green, cobalt violet, and all of the newer industrial products, because they were present in the artists' tube paint they also purchased. They wrote manifestos and magazine articles on the artistic aims of their fellow artists, but they almost never published their thoughts on materials.

RECOGNIZING COLOR CHANGE AS A GALLERY VISITOR

While van Gogh has the dubious distinction of being the one whose fading colors are most widely publicized—and probably better known for this reason to the general public as well as the conservation professional and the art historian—not all museum labels and websites refer to the changed appearance of individual nineteenth-century paintings. A visit to the van Gogh Museum in Amsterdam is very instructive, because van Gogh hand painted many of the frames around his paintings, often with a multicolored design in Tachist brushstrokes like those in the painting but likely in different paints. It certainly appears that some works have a frame whose colors include red, yellow, and blue, while in the painting itself only two of these colors are dominant, usually yellow and blue. The absence of a whole portion of the visible spectrum is a clear signal that drastic color loss is likely to have occurred: the visual mismatch between frame and painting makes it particularly easy to recognize in this artist's work.

The same clue presented by a largely two-toned painting or watercolor, only without the frame as additional comparison, can be picked up in some watercolors by Turner, and some watercolors and color prints by Blake. In portraits or genre paintings, it is far more difficult to pick up on color changes, since costumes and domestic scenes still look convincing when they have lost a little color. Yet in the nineteenth century, some of the greatest colorists were betrayed by their materials. Some were complicit, because they ignored knowledge that could easy have been accessed, and some were unwitting.

CHAPTER NINE

Architecture and Interiors

MEGAN ALDRICH

INTRODUCTION

During the nineteenth century, strong and complex color schemes became a characteristic feature of architecture and interior design. By the middle of the nineteenth century, fashionable interiors displayed a wide range of rich effects in color, texture, form, and pattern. This was a period known for its pluralistic approaches to architectural style as well as its emphasis on historicism and complexity in design. At the same time, new technologies not only brought rapid change to the production of pigments and dyes, but also led to the development of processes for executing stenciled interior decoration and the decorative use of industrial materials such as cast iron. The application of innovative and industrial technologies to historical referencing of past styles of design produced a uniquely nineteenth-century phenomenon.

In the nineteenth century, as different styles became prominent at different periods, so the distinctive color palettes associated with these respective styles changed. Accordingly, it is essential to have some knowledge of the sequence of fashionable architectural styles in order to understand the rich and changing palette of colors used in architecture and interiors of this period. The use of distinctive groups of colors during the nineteenth century was to a great extent determined by the internal logic of each revived style and its requirements.

The classicism prevalent during the early part of the nineteenth century favored bold, unrelieved contrasts in primary colors, especially yellows and reds, while the study of Pompeian wall decoration introduced terra-cotta tones and black accents. In contrast, the subtler and more sophisticated palette of the eighteenth-century revival of the 1820s to 1840s (which encompassed the rococo and neoclassical revivals) promoted the use of lighter pastel colors such as mauve and olive green mixed with tertiary colors and gilt accents in its interiors and related decorative art.

By the 1840s something of a revolution in color took place within the framework of the Gothic Revival, which had overlapped chronologically with neoclassicism and the eighteenth-century revivals. From the beginning of the century, Gothic interiors used strong color schemes often dominated by reds; however, by the middle of the century, Gothic Revival interiors were colored with accents of blue, green, brown, gilt, and black, resulting in a powerful overall effect. The design theory of Augustus Welby Pugin (1812–52), which is discussed below, was particularly important in advocating the rejection of illusionistic perspective in favor of flat, unrelieved areas of color. Slightly later, John Ruskin (1819–1900), the influential art critic and lecturer, drew attention to the architectural polychromy of buildings in Venice, which he made famous through his site drawings and many published books. Polychromatic architecture was characteristic of the Gothic Revival in the 1850s and 1860s, and its international influence affected the coloring of exteriors as well as interiors.

The last quarter of the nineteenth century witnessed a mix of styles that might be characterized as Orientalism and the related Aesthetic movement, sometimes known as the Anglo-Japanese style, although other design traditions such as that of Paris also displayed strong evidence of Japanese influence in a phenomenon known as *japonisme*. Colors in such interiors—and, occasionally, exteriors—revealed a consistent use of rich tertiary colors, with olive green and ochre yellow along with turquoise blue and accents of gilt being characteristic. Black was used for emphasis and contrast. Finally, at the close of the nineteenth century and in the early twentieth century, the Arts and Crafts movement arose in the English-speaking world and Art Nouveau in Belgium and France. Much of Continental Europe introduced a fresh palette of white and more naturalistic colors such as shades of green in keeping with the decorative emphasis on stylized plant forms at this time. It could be argued that color became subsidiary to form during the final years of the nineteenth century, heralding the paradigm shift to Modernism in the twentieth century. The remainder of this chapter examines in greater detail this progression of styles and associated coloring.

COLOR AND CLASSICISM: NEW DISCOVERIES

The revived classical tradition in European design had, of course, been established during the Renaissance and regained momentum during the neoclassical movement of the eighteenth century. However, that tradition began to change as a result of new archaeological discoveries in combination with a taste for bolder shapes and effects around 1800, resulting in a shifting emphasis for classical design, which coincided quite neatly with the dawn of the nineteenth century.

One traveler, collector, designer, and patron was the Dutch-born Thomas Hope (1769–1831). A member of a wealthy family of bankers and art collectors, Hope made an extended Grand Tour through Greece, the Balkans, Egypt, and the more usual destinations in France and Italy. He settled in London in 1799 and began work remodeling a neoclassical townhouse on Duchess Street by Robert Adam according to his very different vision of classicism. Hope described his interiors in a detailed publication entitled *Household Furniture and Interior Decoration* (1807) (Figure 9.1).

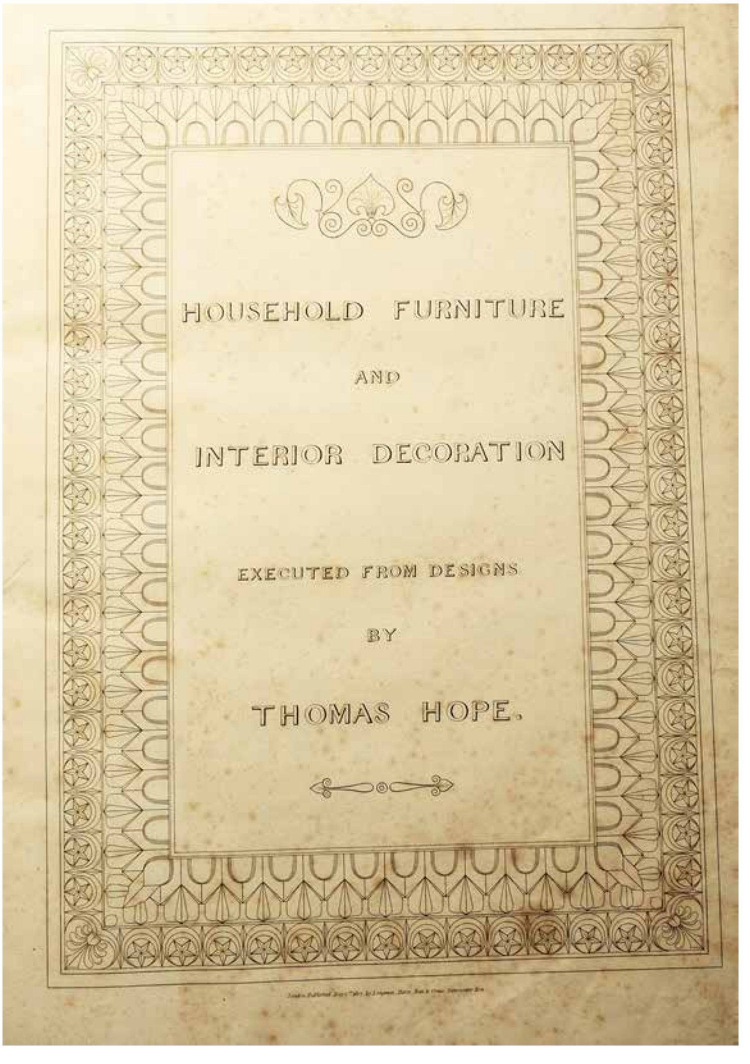


FIGURE 9.1 Title page from Thomas Hope's *Household Furniture and Interior Decoration* (London, 1807). Courtesy of the Royal Pavilion & Museums, Brighton & Hove.

The images in the publication followed the black-and-white linear style used by Charles Percier (1764–1838) and Pierre-François-Léonard Fontaine (1762–1853) in their influential work on *Recueil de décorations intérieures* (A Collection on Interior Decoration; 1801 and 1812), which captured the imperial style of the Napoleonic court in France. However, a reading of Hope's descriptions of his highly original interiors makes it possible to gain a sense of the unprecedented degree to which he used intense colors such as orange, turquoise, and emerald green, alongside accents of gilt and black. To some extent, Hope's brilliantly colored interiors were used as a foil to set off the mostly lighter stone colors of his sizeable collection of antique sculpture and objects such as Egyptian alabaster jars. The colored interior effects were achieved principally by using expensive textile hangings on the walls of his interiors along with upholstery on the antiquarian furniture he designed and had made (Figure 9.2).

The discovery that Greek and Roman sculpture may not have possessed the white "purity" much admired by eighteenth-century critics and writers shocked

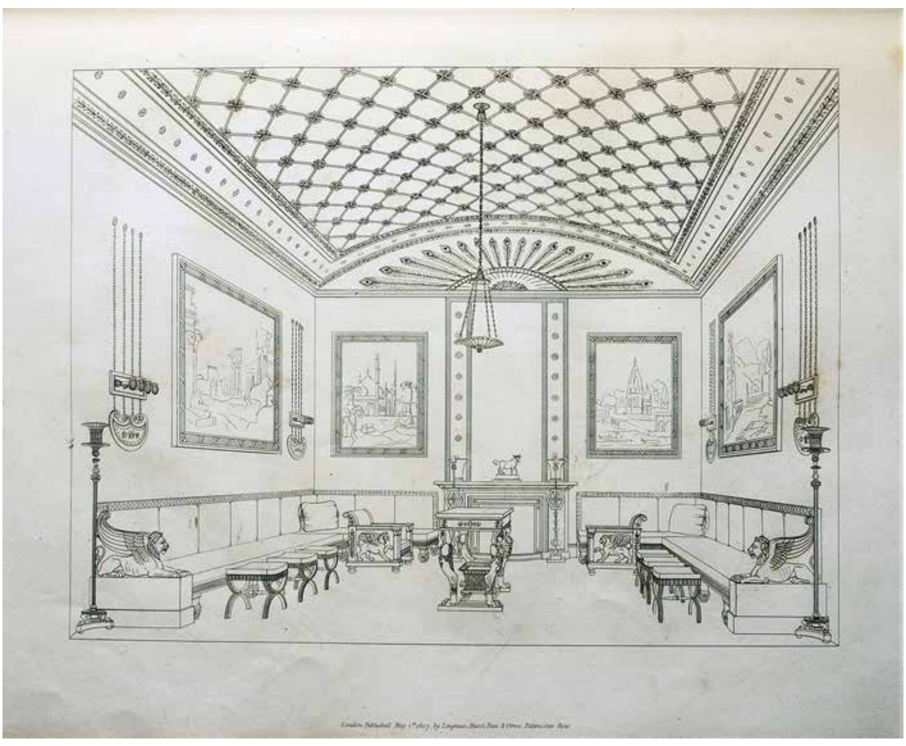


FIGURE 9.2 A plate from Thomas Hope's *Household Furniture and Interior Decoration* (London, 1807). Courtesy of the Royal Pavilion & Museums, Brighton & Hove.

and excited artists, architects, and collectors in this period. One contributor to these discoveries was Jacques Ignace Hittorff (1792–1867), a German-born architect, who had trained in Paris with François-Joseph Bélanger and practiced alongside Charles Percier, chief designer at the Napoleonic court (whose publication inspired that of Thomas Hope). Hittorff's discovery—considered astonishing at the time—was that traces of colored decoration could be observed on the exterior of classical buildings such as the temples he saw during his travels in Italy and Sicily. He first published the results of his study of Sicilian architecture in three volumes entitled *Architecture antique de la Sicile* (1826–30). The publication was followed by one of the most important books of the nineteenth-century architectural world: its subtitle was *Architecture polychrome chez les Grecs* (1851). In this work, Hittorff proposed reconstructions of colored decoration on classical temples in bold schemes of primary colors with some subsidiary decoration. It required a rethinking of the classical tradition among architects, designers, and the interested public. Architectural color also featured prominently in Hittorff's own work executed during the 1840s and 1850s in Paris, where architects and designers assumed a lead position in terms of influencing nineteenth-century classicism and its use of color—especially small amounts of primary colors—for emphasizing moldings and defining form in architecture.

In Britain, classicism during the first thirty years of the nineteenth century developed out of the eighteenth-century tradition of neoclassicism by designers such as the Scot Robert Adam (1728–92), which had left deep roots. While the exteriors of classical buildings remained largely uncolored stone or stucco, interiors began to shift away from the cooler crimson and warmer scarlet of the eighteenth-century tradition toward terra-cotta reds observed from excavations at Pompeii and Herculaneum. The renowned architect John Soane (1753–1837), architect of the Bank of England (London, now demolished) spent two years on a Grand Tour of Italy and Sicily studying classical monuments. Soane visited Pompeii in 1780 and was greatly taken with the warm, terra-cotta red found on the walls of the well-preserved houses there. He brought back to England a fragment of red-painted plaster from a site in Herculaneum, which provided a source for the "Pompeian Red" color he used to decorate the dining room of his own house in Lincoln's Inn Fields in London. This is certainly one of the earliest uses of Pompeian red, which became a fashionable color in the first half of the nineteenth century. Colored prints of ancient wall decoration were available for purchase, and Soane used prints he bought in Rome of ancient Roman wall decoration in sites such as the Villa Negroni as a source for interiors in his country house at Pitzhanger Manor in Middlesex, England.

Recent research suggests that at least some of the red walls so admired in the houses of Pompeii and Herculaneum were originally ochre yellow that had reacted with the gases emitted during the eruption of Vesuvius. However, this warm red color, as seen in the decoration of the alcove of the Villa Farnesina in Rome, painted in 19 BCE, was considered to be authentically antique during the nineteenth century, and consequently it became a standard color for overtly classical interiors.

One of the distinctive new colors to appear in early nineteenth-century interiors illustrates the interrelationship of aesthetics with technology during the so-called Victorian period. The development of chromium yellow by the French chemist Louis Nicolas Vauquelin (1763–1829) took place shortly before 1800 and may have helped spark a taste for bright yellow interiors not found in earlier periods. By the second decade of the nineteenth century, chrome yellow was used as a pigment for brilliant yellow colors, although it tended to fade and darken; the later invention of cadmium yellow solved this problem. One prominent pioneer of yellow interiors was Thomas Jefferson (1743–1826), who from 1801 to 1809 served as the third president of the United States after a long and distinguished career as a diplomat for the new American republic. Toward the end of the eighteenth century, Jefferson spent five years in Paris and would have been well aware of scientific developments; he may even have known of Vauquelin's work. During the first quarter of the nineteenth century, Jefferson used the new chrome-yellow pigment for the dining room walls at Monticello, his famous Palladian-style country house in Virginia, which he himself had designed (Dowling 2013: 88). This is possibly the earliest use of this new yellow pigment in the house of a high-profile individual. Jefferson remained interested in scientific research, and the novelty of the new color would most certainly have appealed to him.

Chrome yellow was also used in the startling interiors created for the future George IV (1762–1830) at his "Hindoo style" Royal Pavilion at Brighton on the sea coast of Sussex. Not classical in design, as at Monticello, but Chinese in inspiration, the Royal Pavilion interiors underwent a twenty-year period of decoration in the Chinese style in a variety of brilliant yellow and red schemes carried out by John Crace (1754–1819) and his son Frederick Crace (1779–1859). The process of decoration began in 1802 and culminated with the Music Room, which was designed in 1815 by Frederick Crace (see Plate 9.1). This interior was renowned for its sparkling gilt dome covered with plaster cockleshells that had the appearance of dragon scales. It has been restored after a fire in the 1970s and subsequent damage during the hurricane of 1987. Frederick Crace contributed some designs to the slightly later Banqueting Room (see Plate 9.2), which was finished in the early 1820s by his former assistant, the artist Robert Jones, about whom little is known. As in the Music Room, the Banqueting Room scheme used saturated reds and yellow/gold tones, moderated by deep blue. The use of blue was more pronounced in the wallpaper, the dome, some ornaments, and in deep cobalt-blue ceramic torchères, where they were used to illuminate this glittering and exotic interior.

According to traditional Chinese ideas about the significance of color, red was associated with prosperity and good fortune, while golden yellow was the color of the Chinese emperors and therefore the most prestigious color. These ideas were known to the Craces, as John Crace was a collector of books on China and of Chinese decorative objects. Such schemes dominated the chinoiserie interiors at the Royal Pavilion, which were more authentically Chinese in character and coloring than the chinoiserie of the eighteenth century. Bold yellows and reds could be seen in Chinese prints and painted mirrors—popular imported items that often depicted interiors.

By the 1820s the architect John Soane had two yellow drawing rooms in his London house. Another prominent champion of yellow interiors, even against the advice of his friends, was the first Duke of Wellington (1769–1852), a hero of the Battle of Waterloo (1815) and a cosmopolitan British aristocrat born in Ireland, raised in Brussels, and educated at Eton and at a military academy in France. Wellington's taste in collecting was that of an aristocratic Frenchman of the ancien régime—that is, before the Revolution. He collected old master paintings, hardstone objects, glamorous black-and-gold Boulle marquetry furniture, and giltwood furniture for the public rooms of his London townhouse, Apsley House, and for his country house, Stratfield Saye in Hampshire (Aldrich 1998). Apsley was the site of much important diplomatic entertaining, as the Duke had been the lead British negotiator at the Congress of Vienna of 1815, British ambassador to France during the period 1816–18, and in 1828 he became Prime Minister of Great Britain. Perhaps he felt that the bright yellow silks used to hang his drawing room and the Waterloo Gallery of Apsley House set off the objects and furniture he collected, but mainstream taste at the time demanded strong red walls for the hanging of old master pictures with their darkened colors and gilt frames. With some justification, it was felt that strong yellow walls clashed with mellowing, aging gilt frames and the darkening varnish of the paintings.

During the remainder of his long life, the Duke of Wellington hosted annual banquets to honor his officers at the Battle of Waterloo. The decor of Apsley was, therefore, on regular public display during the first half of the nineteenth century, and there were few more public interiors in Europe at this time. In terms of their colors and design, the interiors at Apsley House were surprisingly unconventional for an establishment figure like the Duke. In addition to the use of yellow, the Waterloo Gallery created for the Duke by Benjamin Dean Wyatt (1775–1852) in the later 1820s also led the way in terms of design. It was among the very first interiors in Europe to be executed in a pastiche of ideas termed "Louis XIV" or the "Old French Style." Decorative elements from the designs current during the reigns of Louis XIV (1638–1715), Louis XV (1710–74), and occasionally Louis XVI (1754–93) found their way into this hybrid style based on glamorous eighteenth-century models, especially the Palace of Versailles. It contributed to the rising popularity of the eighteenth-century revival as part of a wider conservatism in design, politics, and culture in the post-revolutionary era and became marked after the Congress of Vienna in 1815.

A PALETTE OF PASTELS: THE EIGHTEENTH-CENTURY REVIVAL

Beginning in the 1820s, the revival of eighteenth-century designs initially referenced the distinctive rococo style during the first half of the nineteenth century and culminated in the Paris Exposition Universelle of 1855, while the revival of eighteenth-century neoclassicism became marked after the Paris Exposition Universelle of 1867. One of the leading practitioners of this Old French style was John Gregory Crace (1809–1889), the son of Frederick Crace, designer of the Brighton Pavilion interiors. From 1834 the Crace decorators were based in fashionable Wigmore Street in the West End of London, the center of the decorating trades during the nineteenth century. They maintained a showroom in the latest French styles. The Old French style was initially popular with the eighteenth-century London theaters, for example, Covent Garden, Drury Lane, and St. James's Theatre, all of which were rebuilt in the early nineteenth century after damage by fire. This formed an important and public part of the work of the Crace firm after the work on the Royal Pavilion wound down in the early 1820s; St. James's was redecorated by Frederick Crace and his eldest son, John Gregory Crace, who became a partner in the business in 1833. The scheme relies upon a white ground with accents of gilt, which became synonymous with the rococo revival of the nineteenth century, as in the remarkable ballroom in the Lichtenstein City Palace in Vienna. Although the palace itself is an example of classical baroque architecture of the late seventeenth century, the ballroom was one of a series of rooms redone principally in the revived rococo style for the Prince of Lichtenstein as part of the new European order after the defeat of Napoleon and the Congress of Vienna. It was almost an exact contemporary of the St. James's Theatre design by the Craces, but instead of pastel painted decoration, lavish gilt work picked out the moldings and decorative features, and emphasized the architecture, while spandrels under the central dome were painted with classical figures in light colors over a light blue ground. It was a demonstration of how architects and designers in the nineteenth century looked back—perhaps with nostalgia—at the "grand manner" of the previous century.

It comes as no surprise, perhaps, that French designers were at the forefront of recasting their eighteenth-century design traditions after the political conservatism of the restored Bourbon monarchy made these traditions fashionable again. Due to the political turmoil in the aftermath of the French Revolution, followed by the accession of Napoleon to power, many of them worked in London during the early nineteenth century. An early painting from around 1835 by the young French architect and designer Eugène Viollet-le-Duc (1814–79) illustrates the revived rococo tradition in Paris for the Ladies' Banquet at the Tuileries Palace. Although Viollet-le-Duc later became a leading light of the French Gothic Revival, this early scheme shows strong similarities to the St. James's Theatre design. Viollet-le-Duc was raised in the restoration court of Paris, where his uncle, Etienne-Jean Delécluz, was a well-known painter, and his father was responsible for the governance of the French royal palaces. Viollet-le-Duc's family had apartments in the Tuileries Palace at the time he painted the Ladies' Banquet, which illustrates pale blue walls and soft, pastel colors with gilt that were typical of the Old French style. It was a far cry from the dramatic Pompeian reds and chrome yellows and the simple forms of the classical interiors discussed above. Perhaps the greater intricacy of rococo scrolls and foliate ornament demanded subtler modulations of color.

Early in the 1840s the Craces continued to execute refined interiors in the Old French style, including the Lower Library of Chatsworth House in Derbyshire, which John Gregory Crace remodeled around 1844 for the sixth Duke of Devonshire, a major collector and patron of art at this time. Further work was carried out in the Saloon of Devonshire House in London, a Palladian stateroom damaged by fire around 1840 (Aldrich 1990: 62–3). The colors used in the Devonshire schemes were a muted pastel palette of mauve and soft blue with accents of tertiary colors such as olive green. French influences in decorative art and interiors were very strong in Britain during the nineteenth century. For the Devonshire commission, during one of his frequent trips to Paris, Crace hired painters to execute the new style of French decoration. One of these specialist painters, a native of Alsace named Henri Scholtz, remained with the firm for many years.

During the 1830s and 1840s, the Craces were practicing modulation of color—that is, creating harmonious interior schemes by means of delineating forms in complementary colors. John Gregory Crace wrote about this in various notes and memoranda which are now in the Victoria and Albert Museum, London, Archive of Art and Design. He must also have absorbed a rich stream of literature about color and its use during the first half of the nineteenth century. In particular, David Ramsay Hay (1798–1866), a painter and writer about color from Edinburgh, published *The Laws of Harmonious Colouring, Adapted to House-Painting* (1828, 1845), in which he suggested that the effect of harmony could be achieved through the use of complementary colors. This sounds very similar to Crace's later writings on his own decorating practice. Hay was no doubt developing the work of Johann Wolfgang von Goethe (1749–1832) on the perception of color in his *Zur Farbenlehre* (On the Doctrine of Colors; 1810) (Baty 2017: 122).

The color blue, which had been subservient to the strong classical reds and yellows in the first part of the nineteenth century, began to appear more frequently during the second half of the century, particularly in Continental Europe under the influence of the court designers working for Napoleon III (1808–1873) of France. This second Emperor Napoleon, the nephew of the first emperor, used a variety of revived historical styles for his various residences, and instead of the traditional gilt furniture for staterooms, he increasingly used black ebony or ebonized furniture to contrast with the strong wall colors, alongside the lavish use of gilding. One of the more innovative interiors in Napoleon III's apartments in the Louvre was in the Boulle-inspired dining room, where enormous doors were painted black and gold in imitation of the ebony and brass marquetry designed by André-Charles Boulle (1642–1732), the most famous cabinetmaker at the court of Louis XIV. Not only the baroque style but also the rococo and even neoclassical styles were revived. The apartments of Napoleon in the New Louvre were used for diplomatic entertaining during the Second Empire. Banking became a major national industry during Napoleon III's reign. The suite of lavishly decorated white-and-gilt rooms with rich crimson upholstery in the revived rococo or Louis XV style at the Ministry of Finance were created under the direction of Napoleon III's architects, Louis Visconti (1791–1853) and Hector-Martin Lefuel (1810—80), principally during the period 1856–61. The rest of the world, especially designers in Europe and America, watched closely.

During the 1860s, the style of the French Second Empire directly inspired a number of interiors in the neoclassical Palace of Ajuda in Lisbon. This enormous building became a permanent residence of the Portuguese royal family in 1862 under the supervision of the architect Joachim Possodónio Narciso da Silva (1806–1896). In preparation for his marriage in 1862 to Maria Pia of the Savoy, King Luís I of Portugal (1838–89) prepared a new bedroom suite for his bride based on the latest ideas from Paris and the court of Napoleon III. The walls were hung in deep blue silk damask, and the very glamorous furniture of the room was predominantly made of black ebony with metal marquetry and mother-of-pearl, creating a strong contrast to the blue ground and upholstery. This black-and-blue color scheme demonstrated how far interior color had traveled from the reliance on reds and yellows seen during the period of classical influence at the beginning of the century. There were other rooms decorated at this time with strong colors, including green and blue, and the indoor winter garden combined painted and gilded decoration with colorful patterned stones, even on the walls of the room. Such an approach to the coloring of interiors stood in direct contrast to the soft pastels of the Old French style of twenty years earlier.

Blue tones also began to infiltrate the early Gothic Revival interiors of the Crace firm shortly before Augustus Welby Pugin joined forces with John Gregory Crace to found a Gothic house-decorating business in 1844. At Taymouth Castle, Perthshire, in Scotland, the Craces received a prestigious commission from a Scottish nobleman, the Marquess of Breadalbane. Taymouth, which stood on the site of a much earlier castle, was an early nineteenth-century version of a Scottish baronial castle, which had received Gothic improvements and alterations in the 1830s by the Scottish architect James Gillespie Graham (1776–1855), assisted by the then precocious young architect Augustus Pugin. In 1842–3, the Craces were brought in to decorate a suite of rooms for the reception of the young Queen Victoria (1819–1901) and her new husband, Prince Albert of Saxe-Coburg-Gotha (1819–61). Designs in the Victoria and Albert Museum in London and the Metropolitan Museum of Art in New York by Frederick and John Gregory Crace for the ceiling of the State Drawing Room at Taymouth Castle demonstrate the soft blue and pastel coloring of the Craces' work in the Old French style transferred to an interior with pendant vaults, Gothic tracery, and coats of arms. In their invoices to Lord Breadalbane, they described the style as "gothic arabesque," an accurate description of this sumptuous, hybrid style of painted decoration, which looks back to the Old French style and forward to the Gothic Revival.

The color blue, often used as a background for gilt stars and cosmological motifs, also dominated 1840s restoration work of Gothic monuments in France. La Sainte Chapelle in Paris, an exquisite later thirteenth-century royal chapel built to house the supposed Crown of Thorns, had been richly decorated in the medieval period, but much of this decoration had been lost; it was given a new scheme of interior polychromy during the 1840s and 1850s under a team that included the noted French architects Félix Duban (1797–1870) and Eugène Viollet-le-Duc, working under the direction of Jean-Baptiste Lassus (1807–1857), who also restored the Cathedral of Notre Dame in Paris in the 1840s. Blue was the most precious (and expensive) color available to the medieval artist, and it is most unlikely that a medieval interior ever had quite so much blue used in it. Instead, it was the Gothic Revival of the nineteenth century that created the blue Gothic interior. The stained glass of the chapel was perhaps its most important decorative element, however, and here the contrast of deep blue with deep red glass was evident. Like John Gregory Crace, Viollet-le-Duc had noticed that the colors were kept distinct in medieval glass by bands of white glass as well as by the leads (*cames*) used to hold the pieces in position. This prevented the mixing of red and blue in the eye to form violet and preserved the power of their contrast to one another.

A REVOLUTION IN COLOR: THE IMPACT OF THE GOTHIC REVIVAL

Interiors of the early nineteenth-century Gothic Revival in Britain were dominated by reds, with the exception of terra-cotta or Pompeian red, which was strongly associated with classical design. At Fonthill Abbey in Wiltshire, England, the world's richest man at the time, the collector and author William Beckford (1760–1844), used shades of strong red for his principal interiors, which have vanished but are recorded by eyewitness accounts and colored prints. Four names for shades of red are used in the contemporary accounts of Fonthill: crimson, vermilion, scarlet, and red, sometimes for the same interior, indicating that there was broad but not necessarily exact agreement as to the terminology for colors. According to the color expert, the late John Gage, an educated man or woman of the eighteenth century would understand *crimson* to mean a warm red, whilst scarlet, originally the name of a cloth, would signify a cooler red (Aldrich 2001: 129). There was likewise in the accounts of the Fonthill interiors some confusion between the use of the term *purple* (originally also the name of a cloth) and *blue*, where the latter signified a deep tone that today might be described as "French Navy Blue." Such blue-purple tones were used for accents in British Gothic interiors, which were dominated by the color red.

The Gothic Revival interior also developed in Germany during the first third of the nineteenth century. An early and important example can be found at Hohenschwangau Castle in the foothills of the Bavarian Alps. Originally a medieval hunting lodge with important historical associations, in the 1830s the much altered Hohenschwangau was further remodeled in the Gothic style for Maximilian II of Bavaria (1811–64) with a program of historical wall painting that told some of the key stories of the Bavarian medieval past—particularly the history of the Knights of the Swan. The colors were influenced by the naturalistic, Renaissance-inspired palette of the Nazarene painters led by Julius Schnorr von Carolsfeld (1794–1872).

The mural cycles at Hohenschwangau are painted against a light ground, with green foliage and blue skies setting off the jewel-like tones of the garments of the figures. The Gothic architectural details were picked out in white and gilt. Although striking, it was a very different tradition of interior color to the powerful contrasts of British Gothic interiors, which were dominated by large areas of red until the advent of Augustus Pugin and his ideas of medieval polychromy.

Augustus Welby Northmore Pugin, usually known as Augustus Welby Pugin, was a passionate Gothic Revival architect and designer. The son of a French architectural draughtsman and an English writer, Pugin grew up in the architectural publishing world of London in the period of the English

Regency and the reign of George IV (1762–1830). He also traveled frequently to France with his father and was closely in touch with developments there. After an early career as a set designer at Covent Garden for historical operas including *Kenilworth* (Hill 2007), Pugin converted to his father's Catholicism and became a champion of "Catholic architecture" beginning in the 1830s. In 1841, Pugin began two projects that marked his mature style of architecture and use of architectural color. The Roman Catholic Cathedral of St. Barnabas, Nottingham (1841–4), and St. Giles Catholic Church in Cheadle, Staffordshire (1841–6), both display a powerful use of polychromy in their interiors. The nave of Cheadle, which Pugin considered to be his masterpiece, has powerful octagonal piers with stenciled chevron patterns in gilt on alternating red-and-green grounds with a lighter motif overlaid on the ground. Every architectural molding has been picked out in contrasting colors with repeating abstract motifs, and the north and south aisle walls have been colored in blue and red, respectively, with stenciled star-like motifs in gilt. The stenciled decoration continues on the principal timbers of the ceiling in combination with stained glass, encaustic tiled floors, and fittings. The richness of the ensemble, with its use of abstract geometrical decoration, anticipates the polychromatic "restorations" carried out during the 1840s and 1850s in Paris, including Notre Dame and La Sainte Chapelle.

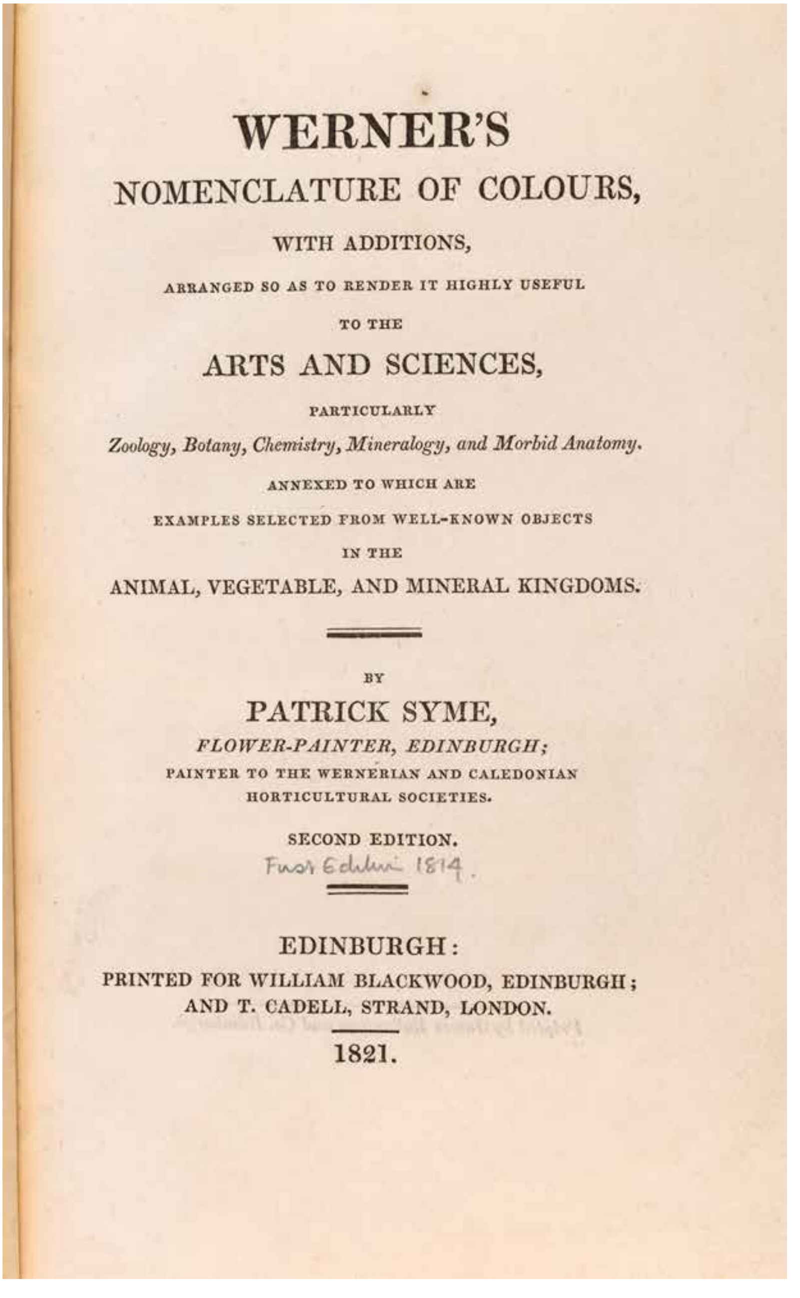
Pugin was pursuing a re-creation of the richest period of Gothic architecture and design—that of the fourteenth and fifteenth centuries. His Church of St. Giles established a new paradigm for the coloring of Gothic interiors that was taken up and developed by the next generation of Gothic Revivalists in Britain, including William Butterfield (1814–1900), George Edmund Street (1824–81), and George Gilbert Scott (1811–78). Scott was a prolific architect of the British Empire and a strong admirer of Pugin; he used powerful polychromy in the interiors of his later nineteenth-century buildings, but his polychromy drew on different and more far-ranging sources such as Greek and Byzantine art, rather than Pugin's purer Gothic vision. Also, in 1841 Pugin published his highly important manifesto of design entitled *The True Principles of Pointed or Christian Architecture*. In this work, Pugin argued for the use of flat pattern instead of illusionistic perspective in the treatment of interior decoration. So, not only was colored stenciling used for wall decoration but flat patterns, achieved by means of bold color contrasts and outlining, were recommended in the strongest terms by Pugin for floor tiles, carpets, wallpapers, and even textiles. Pugin noted, for example, that floors and walls were flat surfaces and, in order to achieve "honest" design, should be treated as such, praising medieval textiles and ceramic floor tiles for their flatness, which, he wrote, was achieved via the use of patterns delineated by contrasting colors (Pugin 1841: 26). This approach to design is illustrated in a series of ceramic bread plates which display Pugin's approach to the application of contrasting colors. Working with a limited palette of medium blue contrasting with mid-brown, the ceramic plates have been decorated with simple shapes of ears of wheat, Gothic tracery, and the motto "Waste Not Want Not," all executed in a soft cream color, which is overlaid against the darker, complementary ground colors.

This approach to design, with stylized motifs taken from nature in strong colors, for instance green and brown, is seen in Pugin's final publication of beautiful colored designs entitled *Floriated Ornament* (1849). In some of its designs, the volume anticipates the stylized natural designs of William Morris and his associates later in the nineteenth century. Moreover, the linking of color to nature was an influential idea circulating in the nineteenth century. The first author to make this connection was the German mineralogist Abraham Gottlob Werner (1749–1817), whose 1774 work, *Von den äusserlichen Kennzeichen der Fossilien* (Of the External Characteristics of Minerals), was first published in adapted form in English in 1814 as *Werner's Nomenclature of Colours*, and followed up by a second, posthumous edition published in Edinburgh in 1821, both edited and translated by the Scottish flower painter Patrick Syme (1774–1845) (Figures 9.3 and 9.4).

This was one of the books that Charles Darwin took with him on his 1830s voyage on HMS *Beagle*—so significant was it as a contribution to understanding and describing colors in the natural world.

In 1844 Pugin had formed a house-decorating partnership with John Gregory Crace, by then a leading London house decorator who felt that polychromy was an essential tool for defining interior architecture. Their partnership was directed toward producing Gothic interiors and furnishings, principally for country house owners who could afford Crace's prices. Building on his ecclesiastical work at Nottingham and Cheadle, Pugin made hundreds of decorative designs for Crace to use in interiors, beginning with Eastnor Castle in Herefordshire, a commission of 1849–50 to remodel and update the interiors of a Regency Gothic castle of an earlier generation. Crace's drawing for the Saloon shows how he retained the early nineteenth-century pendants, vaults, and plasterwork, in keeping with the wishes of the client, and repainted them in blue with accents of gilt and red, and heraldic shields. Pugin disliked this more commercial approach and had instead recommended that the plasterwork in the Eastnor Saloon be replaced by stenciled wooden beams. Certainly, the design lacks the power of the interiors at Cheadle, for example, although the interiors Crace completed at Abney Hall in Cheshire (1852–7), after Pugin's premature death in 1852, display many characteristics of the bold colorings and abstract stenciled designs he learned from Pugin.

The work of the Pugin-Crace partnership reached its zenith in the interiors they produced under Pugin's direction for the Palace of Westminster, culminating



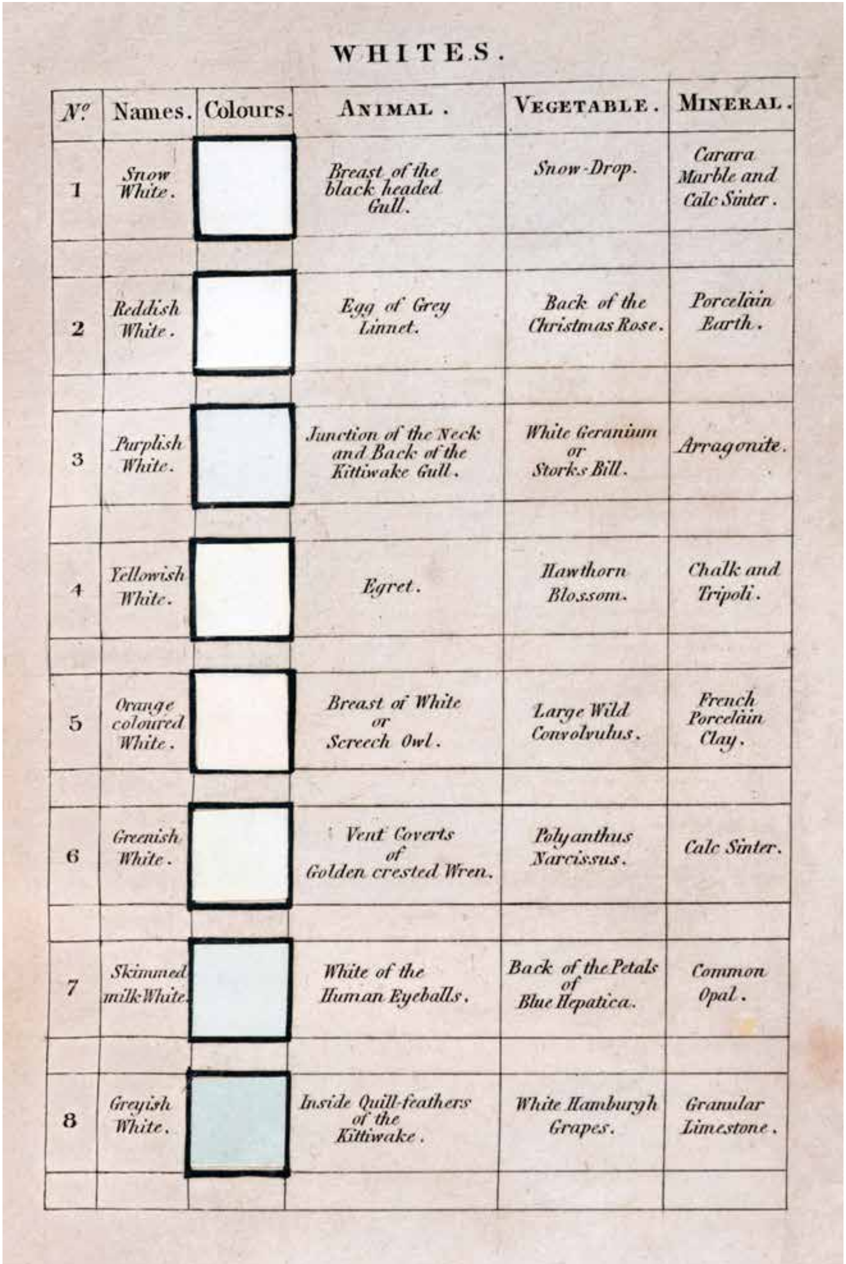
WERNER'S
NOMENCLATURE OF COLOURS,
WITH ADDITIONS,
ARRANGED SO AS TO RENDER IT HIGHLY USEFUL
TO THE
ARTS AND SCIENCES,
PARTICULARLY
Zoology, Botany, Chemistry, Mineralogy, and Morbid Anatomy.
ANNEXED TO WHICH ARE
EXAMPLES SELECTED FROM WELL-KNOWN OBJECTS
IN THE
ANIMAL, VEGETABLE, AND MINERAL KINGDOMS.

BY
PATRICK SYME,
FLOWER-PAINTER, EDINBURGH;
PAINTER TO THE WERNERIAN AND CALEDONIAN
HORTICULTURAL SOCIETIES.

SECOND EDITION.
First Edition 1814.

EDINBURGH:
PRINTED FOR WILLIAM BLACKWOOD, EDINBURGH;
AND T. CADELL, STRAND, LONDON.
1821.

FIGURE 9.3 Title page from the Patrick Syme's *Werner's Nomenclature of Colours*, 2nd edition (London and Edinburgh, 1821). Photograph by Clive Boursnell. Courtesy of Alexandra Loske.



WHITES.

No.	Names.	Colours.	Animal.	Vegetable.	Mineral.
1	Snow White.		Breast of the black headed Gull.	Snow-Drop.	Carara Marble and Calc Sinter.
2	Reddish White.		Egg of Grey Linnet.	Back of the Christmas Rose.	Porcelain Earth.
3	Purplish White.		Junction of the Neck and Back of the Kittiwake Gull.	White Geranium or Storks Bill.	Arragonite.
4	Yellowish White.		Egret.	Hawthorn Blossom.	Chalk and Tripoli.
5	Orange coloured White.		Breast of White or Screech Owl.	Large Wild Convolvulus.	French Porcelain Clay.
6	Greenish White.		Vent Coverts of Golden crested Wren.	Polyanthus Narcissus.	Calc Sinter.
7	Skimmed milk White.		White of the Human Eyeballs.	Back of the Petals of Blue Hepatica.	Common Opal.
8	Greyish White.		Inside Quill-feathers of the Kittiwake.	White Hamburgh Grapes.	Granular Limestone.

FIGURE 9.4 A list of whites, from the Patrick Syme's *Werner's Nomenclature of Colours*, 2nd edition (London and Edinburgh, 1821). Photograph by Clive Boursnell. Courtesy of Alexandra Loske.

in the November 1847 opening of the House of Lords. At Westminster, Pugin used complementary colors interposed with outlining in black or white for stenciled architectural features. Walls were covered in his wallpaper designs based upon late medieval and Renaissance textiles with stylized plant forms. The extensive use of oak paneling and furniture in the palace provided a warm brown foil to all the painted decoration, and Herbert Minton (1793–1858), the great ceramics manufacturer, produced miles of paving tiles based upon Pugin's *True Principles* and executed in a limited palette of terra-cotta and earth colors. With the stenciling, gilt, and use of strong, flat colors, the result at the Palace of Westminster was nothing less than a radical shift in approach to the colorings of interiors, and the interiors were widely seen, discussed, and illustrated during the nineteenth century.

Thus far, this chapter has concentrated on the colorings of interior architecture during the nineteenth century, but exciting developments were underway regarding the treatment of exteriors as well. Exteriors were generally plain in color until the advent of another imposing figure in the Gothic Revival—a lecturer at Oxford named John Ruskin (1819–1900), whose impact on the later Revival was considerable. As a young man, Ruskin traveled widely. Perhaps his favorite site was Venice, where he studied the architecture and executed a number of sketches of Venetian Gothic buildings with their distinctive bands of contrasting colored stones and brickwork. His resulting publication on Venetian architecture, *The Stones of Venice* (1851–3), which was widely influential, spurred an entire generation of architects to add color to the exterior of their buildings, beginning with William Butterfield, Ruskin's contemporary, at the famously polychromatic Church of All Saints, Margaret Street, London (1850–9). A decade later, Butterfield designed the remarkable and much criticized Keble College, Oxford (1868–70), which owed much to Butterfield's reading of *The Stones of Venice*. As opposed to Pugin's use of color in the Palace of Westminster, Butterfield gave color to his buildings by means of materials more than via painted decoration or rich textiles. Despite its tendency to be expensive, polychromatic design was also used to decorate fashionable residences for the middle classes. In France, Jean Lacroux was the author of a work with the subtitle *La brique ordinaire de vue décoratif* (Ordinary Brick from a Decorative Point of View) published in two volumes in Paris in 1878 and 1886. Here, the geometrical patterns in *La brique ordinaire* were less obviously Venetian than Butterfield's work and demonstrated less reliance on strongly contrasting bands of colored materials. Instead, zigzag patterns and diagonals were used in the patterning of the bricks, which particularly influenced suburban French villas built in the northern industrial cities during the last quarter of the nineteenth century, although the volume was also influential in the English-speaking world, including the United States.

ORIENTALISM, AESTHETICISM, AND HYBRID STYLES

While the phenomenon of Orientalism in art and design—that is, the referencing of Arab and other non-Western visual culture in Western visual art—is associated particularly with the final quarter of the nineteenth century, it has, in fact, its roots earlier in the century. Napoleon's 1799 campaign in Egypt and the subsequent volume by his official draughtsman, Baron Denon, and the Egyptian Room created by Thomas Hope and illustrated in his *Household Furniture and Interior Design* (1807) both sparked an interest in cultures outside of the European tradition of classicism.

However, it was Owen Jones (1809–74), the talented son of a Welsh antiquary, who became famous for his studies of Islamic decoration, using the Alhambra in Granada, Spain, as his focus. Jones also made a breakthrough in the accurate depiction of strong colors on the printed page through technical experimentation with chromolithography. The result was the first of his highly influential books, *Plans, Sections, Elevations and Details of the Alhambra* (Goury and Jones 1842–5). Nonetheless, Jones was not the first important figure to study the Alhambra, for the American writer Washington Irving published his highly successful *The Alhambra: A Series of Tales and Sketches of the Moors and Spaniards* (later known as *Tales of the Alhambra*) in 1832, as well as a later biography of the prophet Mohammed. The leading British decorator, John Gregory Crace, was an early photographer of the Alhambra and other Hispano-Moresque structures in Spain during the winter of 1854–5, demonstrating that—by the middle of the nineteenth century—there was an increasing stream of information reaching Europe and the United States about the architecture and design of the Islamic world. Jones followed his work on the Alhambra with his most important publication, *The Grammar of Ornament* (1856), which contained plates of beautifully colored ornament from many cultures, and even ended with a section on ornament taken from nature. In terms of color, Jones helped to popularize a golden-brown palette of tertiary colors that was quite new in the history of interiors. For example, in the 1868 folio volume of the *Grammar*, the plate entitled "Arabian No. 5" (see Plate 9.3) demonstrates the bold new palette with geometrical forms and black-and-white accents. Hints of this approach had appeared in Pugin's architectural decoration at the Palace of Westminster, but Jones's bold designs went far further down the path of a limited, earthy palette in abstract designs.

Jones's much-visited Alhambra Court for the second iteration of the Crystal Palace—that is, after it was relocated to Sydenham, South London, following the close of the 1851 Exhibition in Hyde Park—was controversial. It was decorated with strong contrasts of primary colors in small amounts on the elaborate Hispano-Moresque architectural features; the colors were supposed to blend in the eye to form brown tones. Not everyone was enthusiastic, however, and John

Gregory Crace was one of Jones's severest critics when he took over from Jones the decoration of the interior of the "Brompton Boiler," the cast iron and glass structure housing the 1862 International Exhibition in London. John Ruskin's writing on Venetian Gothic architecture had added to the growing interest in Islamic design, as Venetian design had looked to the East and the West for many centuries. Later Gothic Revival architects such as William Burges (1827–81) began to include overt references to Islamic architecture and design into their work, citing the work of the great French Gothic revivalist, Eugène Viollet-le-Duc, with his interest in Sicilian architecture and its Islamic references. Burges was also interested in Japanese decorative art, which he collected, and he incorporated references to Japanese ornament into his highly original, hybrid style of Gothic design which he practiced at his own house, Tower House, in London (begun 1875). Perhaps his most eclectic commission and his most famous monument was Cardiff Castle in Wales (1866–1928) for the Marquess of Bute. Here, Burges created a dazzling "Arab Hall" with the liberal use of golden tones as well as gilt decoration and outlining of his characteristic "jelly mold" shapes in the ceiling with bands of crimson red.

Burges had begun experimenting with the contrast of metallic gold and dark green colors. This pairing of colors became more widely used in the 1870s when one of the truly striking interiors was created in London—another "Arab Hall" of 1877 to 1881 for the painter Frederic Leighton (1830–96). Leighton's Arab Hall was part of an extension to his house, which contained his studio and was situated close to Burges's Gothic-style Tower House. Leighton had traveled to Egypt and Syria in the winter of 1868–9, partly in the company of John Dibblee Crace (1838–1919), the eldest son of John Gregory Crace. He had purchased an important collection of antique Iznik (Turkish) ceramic tiles with their distinctive turquoise tones (the word *turquoise* derives from the French, meaning "Turkish blue"). These tiles played a role in determining the finished decor of the Arab Hall and staircase of Leighton House in conjunction with the polychromatic use of stones and glittering gold mosaics derived from the architect George Aitchinson's observation of Sicilian and Venetian architectural decoration. It was an important landmark in Orientalism in interiors in that it combined multiple non-Western influences.

The coloring seen in the Arab Hall of blue green, gold, and accents of black, however, was not exclusive to Islamic-inspired design, for it was picked up in Aesthetic movement and Anglo-Japanese interiors such as the famous Peacock Room, now in the Freer Art Gallery in Washington, DC, designed in 1877 by the architect Thomas Jeckyll (1827–81). The painter James Whistler (1834–1903) infuriated the industrialist owner of the house, who was away at the time, by painting over his expensive antique leather wall hangings with spectacular gold metallic designs of strutting peacocks in a stylized manner inspired by Japanese prints. Whistler felt that he was creating a complementary setting for his *Princess* *in the Land of Porcelain* (1877), a Japan-inspired painting that hung over the chimneypiece of the room. Other distinctive designers of the Anglo-Japanese movement included figures such as Edward William Godwin (1833–86), who published *Art Furniture* (1877). Godwin's style manual illustrated Japanese-inspired interiors where ebonized, black furniture with simplified forms was contrasted against richly colored walls.

THE RENAISSANCE REVIVAL

At the same moment that the Aesthetic movement, with its Anglo-Japanese style, was underway, another group of architects, decorators, and designers was looking to the past for inspiration. The Renaissance Revival was a phenomenon that began intermittently during the 1860s but became prominent as a style for grand interiors during the final quarter of the nineteenth century. Notable examples were the remarkable series of interiors created for the fourth Marquess of Bath at Longleat House in Wiltshire by John Dibblee Crace, who had traveled with Leighton in the Middle East. However, J.D. Crace's great passion was for Italy and monuments of the Italian Renaissance period, which he studied for many years. The inspiration for the Longleat interiors was found in Venetian sixteenth-century architecture, which was seen to be appropriate for an English sixteenth-century house. J.D. Crace set out his ideas about house decorating in *The Art of Colour Decoration* (1912) (see Plate 9.4), in which he discussed the historic interiors that had inspired him, as well as his practice of outlining forms in white with liberal use of contrasting gold. Overlaid against his background colors were fine, Raphaelesque-type ornaments derived from his travels to places such as the Palazzo del Té in Mantua, the acknowledged masterpiece of the great architect Giulio Romano, a pupil of Raphael. Crace was particularly struck not by the grand, figurative programs of the frescoes, but by the decorative architectural painting in interiors such as the Hall of the Giants.

The revived Renaissance style suited old money and possessors of historic country houses who wanted to refurbish them in a sympathetic style. However, the Renaissance Revival reached further. After the Hotel de Ville of Paris was burnt down along with its archives in 1871, the result of a political revolution that saw the ousting of Napoleon III from power, a new town hall was built during the period 1873–92 by the architects Théodore Ballu (1817–85) and Édouard Deperthes (1833–98). The new Hotel de Ville was created in the late Renaissance style to honor the sixteenth-century origins of the lost building and decorated with a cycle of mural and ceiling paintings by a team of artists. The color scheme emphasized the same golden tones that were found in J.D. Crace's contemporary interiors at Longleat.

Finally, for the more sophisticated and discerning possessors of new money, the revived Renaissance style could signify their commitment to culture and learning. This is well illustrated by the Morgan Library in New York, begun in 1906 by the architect Charles McKim (1847–1909) for the very wealthy financier J.P. Morgan as an adjunct to his Manhattan residence. The library is made up of three interconnecting rooms with a central rotunda decorated in the style of Raphael. Again, the liberal use of gilt and golden tones created a sympathic setting not only for yellowed manuscripts but for the darkening varnish and faded gilding of Morgan's art collections, enlivened by bright accents of color in ceramics and other decorative objects. The Renaissance Revival offered an elegant style for interiors that was laden with cultural and historical references and, in the eyes of some, easier to live with than the richly eclectic and more challenging interiors of the later Gothic Revival and Orientalism.

NATURALISM: ARTS AND CRAFTS TO ART NOUVEAU

The last quarter of the nineteenth century witnessed a continued and augmented interest in the use of plant forms and more naturalistic colors in design. In the English-speaking world, this came to fullest expression through the work of William Morris (1834–96) and his widely influential architectural and interior design firm situated on Oxford Street in London. Morris's roots lay in the Gothic Revival, and the lectures of John Ruskin he attended while at Oxford were a key influence. In the 1860s, while collaborating with the architect Philip Webb (1831–1915) and the painter Edward Burne-Jones (1833–98), he began to evolve his designs for textiles and wallpapers toward stylized depictions of natural forms. At the same time, Morris collected medieval and early modern manuscripts and objects and experimented with archaic techniques such as indigo dyeing. The result was one of his iconic textile designs, "Strawberry Thief" of 1878, which represents thrushes stealing strawberries against a ground of intense indigo blue with contrasting motifs in white, soft red, and brown.

Morris investigated traditional, organically based dyes, especially madder reds, in reaction to what he saw as the inferiority of industrially produced aniline dyes invented earlier in the nineteenth century. In his commitment to traditional methods of production in combination with his writings and lectures about the "beautiful and the useful," his work provided an impetus for the founding of the Arts and Crafts Exhibition Society in London, of which he served as president for three years toward the end of his life. Color in many Arts and Crafts interiors was provided by Morris-inspired soft furnishings and, occasionally, wallpapers. Otherwise, Arts and Crafts interiors tended to display oak beams, wooden furniture, and fairly rough white plasterwork in a deliberately rustic, pseudo-vernacular style. By the end of the nineteenth century, colors tended to lighten, moving toward a palette of very light tertiary colors, as in a late Morris & Co. design, "Hyacinth" (1915–17) designed long after Morris's death. In this design, very light colors are juxtaposed against a background of pale, muddy mauve. Such coloring can also be found in the Art Nouveau movement in Continental Europe.

Although it was a curvilinear style of design, as opposed to the mostly straight lines of Arts and Crafts interiors, and although it did not share the Arts and Crafts preoccupation with the rustic and the vernacular, Art Nouveau interiors nonetheless shared some common traits with the Arts and Crafts movement. The contrast of light-colored walls with brown wooden features was also found in Art Nouveau, and where there was interior color it was generally achieved via the use of textiles or decorative panels which used lighter, more naturalistic colors such as a variety of greens with accents from the yellow-gold spectrum as well as mauve tones.

One of the pioneers of the Art Nouveau style was the Belgian architect Victor Pierre Horta (1861–1947), who built a distinctive and original townhouse in Brussels in 1893–4 for a scientist named Émile Tassel. The Tassel House, which is often considered to be the first house in the Art Nouveau style, has remarkable painted decoration in its entrance hall, where many layers of paint imperceptibly move from earthy terra-cotta tones at the bottom of the wall up through gold tones into very light colors at the top, suggesting the pouring of sunlight down the wall from the skylight up above. Superimposed on this cloud-like color scheme are scrolling vines showing the distinctive "whiplash" curves of the Art Nouveau style, moving from stenciled wall decoration to metalwork in the stair railings and the cast iron support of the staircase, and even over the mosaic tiles on the floor. It is highly imaginative, and form was at least as important as color in the design of the Art Nouveau interior.

Graphic design was extremely important during the era of Art Nouveau architecture in Continental Europe. The French Swiss designer Eugène Samuel Grasset (1845–1917) studied the art of Egypt and Japan in the 1860s before moving to Paris in 1871, where he established his practice. As with his near contemporary in Paris, the Czech designer Alphonse Mucha (1860–1939), Grasset became known for his graphic designs and posters, in particular, as well as his publications of designs such as *La plante et ses applications ornementales* (1896), published in English in the same year as *Plants and their Application to Ornament*. Some of these plates use the tertiary colors seen in the 1870s and 1880s, but most designs move toward a lighter palette. His 1893 poster for an exhibition of French decorative art at the Grafton Gallery in London shows the bright pastel colors, especially in the blue and gold ranges, with accents of peach and light mauve gray, in addition to the use of black outlining that was fairly characteristic of Art Nouveau design. Grasset was an influential figure who taught Paul Follot (1877–1941), a designer who began in the Art Nouveau style but helped to develop the Art Deco style. Like

Viollet-le-Duc, Grasset's impact on the decorative arts extended well into the twentieth century.

Accordingly, it can be seen that the use of color in architecture was a complex phenomenon during the nineteenth century. Early in the century, architectural color grew out of the classical tradition of the late eighteenth century, while picking up more exotic influences from Egypt, India, and China. The conservative political backlash after the Napoleonic Wars and the Congress of Vienna spurred conservatism in high-end design, with the revival of French eighteenth-century styles all over Europe, and perhaps leading to the refined interiors of the Renaissance Revival during the final quarter of the nineteenth century. Under Augustus Welby Pugin, however, not only did the Gothic Revival become a phenomenon of middle-class design, but it also sparked a revolution in the use of bold architectural polychromy in contrasting colors which took hold both inside and out of buildings. Gothic became the dominant design tradition of the nineteenth century until it was eclipsed by the deceptively modest interiors of the British Arts and Crafts movement and by Art Nouveau on the continent of Europe, with an emphasis on light-colored walls, wooden elements, and plant-based forms in light colors that dominated European interiors up until World War I.

CHAPTER TEN

Artifacts

KELLY F. WRIGHT

For most of human history, decorative color came only from what nature had provided. But in the nineteenth century, this situation changed dramatically. The Industrial Revolution that had begun in Great Britain not only changed how goods had been manufactured historically but also how colors could be made. In the United States, a market revolution took place in the first half of the century, which revised the ways in which Americans did business, inaugurating not only a much improved system of factory production but also advances in transportation, the wider extensions of credit and wage labor, as well as an increase in the number of immigrants, including workers trained in England and Europe, all of which enhanced the Americans' technical knowledge and better connected industry to consumers.[1] In the midst of this maelstrom of modernization were the colorful products that consumers craved, and if color had been made more accessible to more people over the centuries, it was in the nineteenth century that it became fully democratized. By century's end, what was once for most people only aspirational had finally become obtainable for almost anyone, satisfying an ancient and integral human need for color and ornament.

Portable decorative objects offered a cost-effective way to add color to one's life. The most utilitarian and mundane items could provide a lot of color relatively cheaply. Simple plates and mugs, hair receivers (small pots used to collect loose hairs) and chamber pots, blankets and quilts, document boxes, and even paper were among the objects that became wildly colorful and widely accessible in the nineteenth century.

This diffusion and expansion of color took place in stages in the United States, a development that can be examined through the lens of these artifacts. In the first stage, from 1800 to 1840, kaleidoscopic cheap and cheerful wares first brought color into the homes of the middling sort. By 1870, most companies had begun industrializing production, and some were actively engaged in inventing new colors as consumers invented new ways of using them. After 1870, mass production took what had once been a prerequisite of the wealthy—color—and made it a populist entitlement. Consumers filled their homes with both manufactured and homemade objects that showcased the full spectrum of colors and media now available to them.

KALEIDOSCOPIC COLOR, 1800–1840

In the first decade of the nineteenth century, Thomas Hope (1769–1831), the Dutch-British banker, world traveler, and designer, turned his London home into what he called a museum of "gorgeous decoration," inviting his peers to visit so they could testify to its splendor, thereby building his clientele. Hope's rich interiors drew inspiration from around the globe and classical antiquity. Like other tastemakers of the period, he reinterpreted the Greek and Roman designs that had emerged from the Herculaneum and Pompeii excavations, blended them with references to ancient Egypt, and published his ideas in an expensive volume entitled *Household Furniture and Interior Decoration* (1807). His rarified concept of an "elegant salon" included Persian carpets below a lattice-work ceiling, a deep crimson sofa set against walls of sky blue, and "foliage, flowers, peacock's feathers, and other ornaments of a rich hue, and of a delicate texture"—vivid, exquisite colors "in compliance with the oriental taste." The allure of another Hope design depended upon the contrast between pure white statuary and curtains trimmed in black velvet, with various golden urns and cassolettes (small bowls) scattered around the room. One space he described featured "masses of black and gold ornaments" strewn around walls decorated with scrolls of papyrus and mummy cases in yellow and "blueish green," colors which held, according to Hope, a "conspicuous […] rank among Egyptian pigments" (Hope 1807: 24–7). As catholic as Hope's tastes were, his work barely hinted at the eclecticism that was to come in furnishings later in the century.

Possessions as sublime as those described by Hope remained in this period an aspirational fantasy for all but the wealthiest people. Inside the homes of the fashionable set on both sides of the Atlantic, the designs of Thomas Chippendale (1718–79) and George Hepplewhite (1727–86) segued into the early nineteenth century and were frequently "japanned" with bright, finely ground pigments that were polished to a gleam, then varnished for even more shine, and often further embellished with striping, scenic cartouches, and gilding. More modest furniture received colorful surface finishes, and these cheerfully painted furnishings found in the homes of the middle classes were commonly called "chintz," in reference to the glazed printed fabric popularly used for upholstery and quilting during this period. Paint not only brightened surfaces, it also concealed and homogenized the different varieties of wood often used in a single article. "Fancy" goods of high coloration and patterning took their place alongside those displaying the restrained notes of the Federal and Adamesque palettes in the first part of the nineteenth century, creating a kaleidoscopic effect in their owners' homes. Although this concept evolved from the mid-eighteenth century during which "Fancy" referred to "imagination and creativity," by the early nineteenth century in the Anglo-American world, "Fancy" had come to refer to "a growing receptivity to virtually every form of creativity rooted in the imagination," a now mainstream style that had no single definition but whose "colorful and boldly patterned" objects were designed to please visually and to elicit viscerally emotional responses in their viewers (Priddy 2004: xxv, 43).[2]

Paints and pigments

The mineral chromium and its compounds helped to create these colorful objects by offering a new palette of bright yellows, oranges, reds, and greens to the pigment and textile industries at a price greatly reduced from the colorants available in the eighteenth century. In 1797, Louis-Nicholas Vauquelin (1763–1829), a student of the chemist Antoine L. Lavoisier, was experimenting in Paris with the mineral *crocoite*, a rare, naturally occurring red form of lead chromate that investigators had misidentified as red lead. Vauquelin isolated a specific metallic component naming it chromium after the Greek word *chroma* or "hue." Vauquelin had added a solution of a soluble lead salt to a solution of an alkali chromate to create lead chromate—the stunningly beautiful pigment known as chrome yellow. He then synthesized other compounds of lead and chromium, including chromium orange, and a chromium oxide green. All were brilliantly colored. Vauquelin established that chrome yellow takes on various shades according to how it is precipitated, from lemon to orange, and that when mixed with certain organic elements it can take on a green tint. In fact, chrome yellow quickly became "the most important of the commercial yellow pigments" (Gettens and Stout 1966: 106). Chromium works most satisfactorily in an oil medium, where it produces bright and fairly permanent colors. Its use extended beyond paints to ceramics and the textile industry, where chromium compounds served as both mordants and colorants. The chromium deposits discovered near Baltimore in the early nineteenth century guaranteed the world an abundant supply, and the family who discovered it a lucrative near monopoly on the element for the next half century.

In some utopian religious societies in the United States, figurative ornament was shunned, but color was warmly welcomed. The Zoarites, an Ohio-based utopian community of German origin, and the Shakers, a millenialist religious group whose formal name is the United Society of Believers in

Christ's Second Appearing, both indulged their love of decorative color in the liberal use of chromium pigments. Most of the legacy of the Shakers' use of these colors has been lost due to their own regular cleaning of these objects, the attrition of their membership, the influence of mainstream Victorian tastes, and the intentional stripping of these colors by collectors in the late nineteenth and early twentieth centuries.[3] But in the nineteenth century, blue (usually Prussian blue) was the liturgically prescribed color for woodwork in Shaker meeting houses, and chrome red, yellow, orange, and green appeared on cabinets, walls, and floors in public buildings and dormitories.

Decorative arts

Bold base colors such as the chrome colors were often elaborated with more decoration. Lettering, heraldry, and ciphering were combined with scrolls, garlands, acanthus leaves, *Rosemåling* (the decorative painting of flowers and flourishes long associated with Scandinavian folk art), and further motifs from the classical world, creating a popular iconography of "ornamental painting." In the early part of the century, limners (decorative painters) ground their pigments and mixed their paints on site, decorating carriages, trade signs, architecture, interior walls, and objects alike (Priddy 2004: 47).

A good limner knew how to stencil, a technique that enlivened many household articles. Toleware, or japanned objects, were sheet-metal products, usually for domestic use. Both were decorated in freehand work or with stenciling in bright colors, generally on a dark ground. Toleware remained popular throughout the nineteenth century. Theorems were stenciled artworks or motifs applied to a number of surfaces, including silk, velvet, board, furniture, walls, and other objects. Artists laid one stencil over another to create a motif of some depth, such as the period's artistic trope of a lush basket of fruit surrounded by garlands of flowers in bloom. The best theorems approximated three-dimensional space, but compositions were generally formulaic. As the period progressed, crafters could purchase manufactured stencils in a wide variety of patterns, allowing even the untrained to create art for their homes. Stenciling was a popular treatment for the oilcloth tablecovers that came into use after 1820, particularly as the locus of the household more and more became the family's parlor table. Related to painted floor cloths, oilcloths could also be block-printed by professionals, and most surviving examples feature four or five bright colors applied to black fabric. Stenciling appeared on coverlets, too, requiring only a simple process in which the design was traced on an oiled paper and then cut out with scissors or a knife, one stencil for each color. The coverlet maker stretched out the fabric and then used a tampon—a ball of cotton held in place by a coarse cotton cover—to stamp either thickened dyes or paint pigments ground in oil through the stencils.

Such bedcovers offered even the poorer classes the opportunity for creative expression, since they required only plain and cheaply produced cloth.

Like theorem painting, watercolor painting and embroidery were avocations deemed acceptable for nineteenth-century women. Female academies instructed their pupils in working samplers, and these buff-colored linen pieces worked in colored silk thread, showed off the range of needle skills and pictorial abilities of their makers in homes throughout the United States and Great Britain. “Berlin work” was a popular kind of fancywork in which the maker used woolen thread to follow a pattern printed on squared paper, like needlepoint, that decorated couches, cushions, draperies, pictures, fire screens, and many other pieces of domestic furnishing for the next half century.

Much of the color of the early nineteenth-century world was visible on its city streets. In winter, fancy-painted sleighs in bright yellow, orange, and red provided a vivid contrast to the season’s dreariness. The expensive finishes were considered a worthwhile investment because snow was gentler on the sleighs’ frames than the pebbles that battered wheeled vehicles. Nevertheless, many of these were also treated to a colorful protective finish. In the United States, blue-bodied Conestoga wagons with yellow wheels, a common color scheme, passed westward, while bright yellow stage wagons for hire ferried people around towns and cities. In New England, thousands of young country women who had been recruited to work at the textile factories dotting the region’s riverbanks descended from these wagons in the 1820s and 1830s, carrying bandboxes filled with their worldly possessions. The bandbox began its existence as a gloriously colored wallpaper that was then applied to a thin box of paper construction, like a modern hatbox. Practical, cheerful, and uniquely American, no article of the material world was more colorful, or republican, in spirit. These objects no doubt brightened up the dormitory rooms to which the girls retreated after their long days at the mills, but bandboxes were popular everywhere, and the surprisingly large number of these ephemeral objects extant shows the wide spectrum of colors and patterns in which they were made.

Many of these boxes, like the other artifacts of this early period, displayed a color effect known as *irisé* in France and rainbow or fondu in Great Britain and the United States. Rainbow patterning relied on the new method of cylinder printing. In fondu printing, an engraved cylinder picked up multiple colors of paint, ink, or dye from pans arranged side by side, and then rolled parallel bands of colors onto the surface of the manufactured good, the colors merging into one another in a melted effect. Patterns and other colors would then be printed over this striated background. Rainbow-printed papers appeared on wallpapers and window shades and in fabrics that were stitched into quilts. The same effect was achieved in woven coverlets of the period by broad bands of colored weft threads.

Fabrics

The greatest impact of color in early nineteenth-century homes most likely came from their bedrooms. Though bedsteads were commonly painted green to discourage bedbugs (arsenical green paints were as lethal to bugs as people), the greater visual impact in domestic settings probably came from bed curtains, quilts, and coverlets, especially in this early part of the century when many couples' bedrooms were still first-floor public spaces. The calamanco quilt style of the eighteenth century survived into the first quarter of the next century, but faced competition from the lively prints made with Prussian blue, chrome yellow, and antimony orange from manufacturers in Great Britain and France until it eventually fell out of fashion.

Colorful and sophisticated chintz fabrics (from the Hindi word *chint* meaning "variegated") swept across Europe and the United States. Chintzes were fast-dyed in a number of colors and either printed or painted with dyes, and then usually finished with a shiny glaze, typically polished beeswax. The many varieties of chintz were based on color; the most colorful was the most expensive. The other important fabric changing the textile world was calico, a simple cotton cloth of various grades and varieties, usually highly colored and patterned. These were the contested cottons of Indian, English, and French origin, highly desired for their many colors and fastness, that found their most lasting use in quilts. "Bizarre, fantastic, and exotic" describes the subjects and colors of many of the block-printed cottons still being made in the first half of the 1800s, a time in which cost-cutting, methodological innovation, and new dyes combined gave consumers an unprecedented selection of colorful fabrics (Montgomery 1970: 141).

The very earliest quilts of this period were usually more decorative than utilitarian, made for the "best" or guest room by women who had both means and leisure. The most popular forms were center medallion quilts in which a central motif was framed by one or more different patterns, and *broderie perse*, in which the quilter simply cut around figures already printed on cloth and applied the cutouts to another piece of fabric. Cylinder printing lent itself to vertical patterns, and the quilters who used these fabrics tended to employ construction methods that took advantage of the fabric's scale and verticality. American quilters especially sought out patterns depicting pillars or columns with capitals sometimes encircled with vining flowers, called pillar prints. These vertical prints often flanked fabrics depicting a tree of life, or provided a sort of fence around a chintz garden of blooming flowers. Many quilters chose to seam several pieces of these fabrics together in a wholecloth quilt to show off one particularly well-made or fashionable pattern. Popular after 1800 was a style referred to as drab, its yellow, orange, buff, and brown colorways made by a yellow produced by the bark of the American quercitron oak tree whose patent, owned by American chemist Edward Bancroft, had expired in 1799 (Montgomery 1970: 156).

Woven coverlets, typically of cotton and wool, were sometimes still made on looms in large private houses, but after 1800 they were often the products of professional weavers, many of them German immigrants. The most popular construction of these coverlets in the first decades of the nineteenth century was overshot, in which the weft could be caused to “float” or “skip” or “overshoot” the ground, making the pattern even more elaborate. These coverlets were generally geometric, consisting typically of a natural-color linen thread and a single-colored wool weft, combining most often blue or red and white, but warp thread colors changed as time went on and more weft colors became part of the pattern.

Joseph Marie Jacquard’s invention of a loom attachment in France just after the turn of the century revolutionized weaving. The Jacquard used punched cards to create patterns, and the device freed a single weaver, with no assistants, to create very complicated curvilinear forms in multiple colors. Weavers who invested in this attachment made sure to let customers know they had expanded their aesthetic capacity to create “figured and fancy” coverlets, with compositions of naturalistic flowers, trees, game animals, and birds, among others, highlighted by contrast banding in a rainbow of colors, commonly including red, yellow, moss green, black, brown, emerald, and indigo.

Ceramics

The exuberant colors and patterns of some of the most popular ceramics added to the kaleidoscopic style of the decorative arts in the period before 1840. Both convincing copyists of Asian ceramics and brilliant innovators for new-world markets, England’s potters continued to produce diverse wares for domestic markets and their growing customer base in North America. Affluent clents everywhere could still purchase highly colorful hand-painted ceramics from both China and Europe, as well as pearlware, creamware, jaspers, basalts, and printed china through which many British manufacturers had established their reputations in the eighteenth century. But it was in the cheaper commercial ceramics, produced through equal technological and aesthetic ingenuity, that color first came to a wide constituency of consumers. Mochaware, a slip-glazed earthenware, materialized in the liminal space between handcraft and factory production. Pressed into service in the most mundane functions as tavern cups, pitchers, and mixing bowls, the colorful swirls, flecks, checks, and worms of mochaware proved that even utilitarian objects could decorate and fascinate. Multicolored glazes and watered-down clay, or slip, allowed the creation of the stripes, drips, dendrites, seaweed, sgraffito, marble, cats-eyes, checkerboards, and vermiform patterns in the wide array of colors for which mochaware is easily recognized.

Mochaware manufacturers battled one another to increase market share to satisfy the tastes of consumers throughout Europe and North America. To that end they availed themselves, when they could afford it, of British ceramics innovator Josiah Wedgwood's rose-and-crown engine-turning lathe to incise straight lines that colored slip then flowed into to create basketweaves, reeds, flutes, and checkerboards or rounded, wave-like patterns. Vertical members were often still applied by hand, and in less capitalized potteries craftsmen continued to use the older technology of the rouletting wheel whose edges impressed patterns into the ware when rolled across its surface.

The three-chambered slip cup was another innovation that allowed decorators to create patterns such as cats-eye, common cable (or earthworm), and twig. The dendritic inclusions of moss agate, a stone imported in great quantities into Europe from Arabia through the port of Mocha (in present-day Yemen), inspired some of the most curious and haunting of mochaware's many patterns, particularly one pattern that resembled a lone tree (colored by tobacco juice or printer's ink applied to the slip), set in a haunting open landscape. Dendritic patterns remained popular in decoration across many media throughout the century, helping to solidify the Victorians' reputation for visual excess.[4] While mochaware owes its patterns to technology, it owes its long-lasting charm to its bold coloring and to some extent to the errors, or "slip-ups," made by its human decorators in applying the slip that, once applied, was very hard to correct (Rogers 2005: 96–103).

Domestically produced ceramics in the United States and Canada in the earliest part of the nineteenth century consisted primarily of slip-decorated redware, whose red body color came naturally from its clay. White lead and metallic glazes—an emerald green from copper, black from manganese, brown from iron—were typically casually if not sloppily applied on these pieces, and the patterning of this decoration reflects many regional differences in redware production. Stoneware, the utilitarian workhorse ceramic in Europe and America, was a natural gray color sometimes glazed a light brown through the addition of salt to the firing. Characteristically brush or stencil-decorated with cobalt, stoneware crocks, jugs, and mugs remained popular and useful throughout the century.

Patterned, printed china made perhaps the most lasting impression on the ceramics industry. Invented in the mid-eighteenth century, the process involved engraving a design on copper and then transferring the motif through prepared paints to tissue paper. The paper was then carefully applied to the piece of pottery. Transferware, as it came to be called, could be detailed and delicate, its patterns mimicking the prevailing styles of the day from the restrained classicism of the Georgian, to the "picturesque" celebrated by the Romantic movement, to the asymmetrical Orientalist styles popular in the later nineteenth century. Some of the most profitable designs narrated important historical events in the country into which they were imported. American victories in the War of 1812 were quickly recorded on china by Staffordshire potteries and exported to England's late enemy, fostering a kind of consumer-driven détente. Originally produced in black and blue, by the first quarter of the nineteenth century transferware could be acquired in several colors, and by the end of the century almost every color was possible.

INDUSTRIAL COLOR, 1840–70

Nowhere was the effect of industrial capitalism on Western society more obvious than in the sheer numbers of people who, by the mid-nineteenth century, could now afford color. This development transformed the way goods were invented, manufactured, packaged, shipped, and used. Paints, for instance, could now be prepared in factories, dispensed in cans, and transported by rail. Mass production's economies of scale brought the cost of colorful objects well within the means of the middle classes. Fierce competition between British and Continental manufacturers to create new colors spurred the professionalization of chemistry and further drove down prices. The acclaim heaped on *mauvine*, a bright clear purple aniline dye discovered in 1856, led to the synthesis of reds and greens and other colors in rapid succession by 1870, giving consumers a heretofore unimaginable selection of colorful goods from which to choose. On city sidewalks, the new laboratory-born colors drew attention, but they often disappointed in their fugacity. More appropriate for the soot-filled streets of mid-nineteenth-century cities were the drabs and browns that concealed dirt and were reliably fast. Yet the new clear, unmuddied, even electric, colors held an allure for consumers that their practicality could not resist.

In the 1850s, an American coach manufacturer introduced a flashy purple Rockaway carriage, though the trend among buyers in the North leaned toward more respectable, sedate shades of forest green and black. Bright shades of red, green, and gold attracted Southern buyers, and American coachmakers began to pay close attention to regional variations in taste. Omnibuses everywhere used exciting chrome colors to attract customers; hoteliers parked beautifully decorated carriages with lush, pastoral cartouches at train stations to entice vacationers away from their competitors. Firemen competed too, decorating their helmets, hose reel carriages, pumpers, and even their buckets in cheerful colors, fancy lettering, and gold, in an effort to outshine other brigades. Parents who were wealthy enough gave their children enameled-tin toy versions of pumpers with moving wheels. A domestic advice manual of 1840 advised aprons for "common use" to be made of serviceable "white, brown, blue, black, or checked" linen, and carpetbags, displaying the deep reds and greens of the floral floorcoverings issuing from British carpet mills, replaced bandboxes ("A Lady" 1840: 76).

Textiles

Millions of yards of fabric rolled out of British and American textile mills in the mid-nineteenth century. Cylinder printing continued to coexist with block printing in the textile industry just as it did in wallpaper manufacturing, and dye recipes were often written for both methods. By 1840, industrial production had lowered the price of fabrics enough for the middle classes to afford to indulge in everything bed curtains had to offer: beautiful colors and patterns, freedom from drafts, safe harbor for insects and dust, and the exciting potential to be burned alive in a house fire. One advice manual recommended bed curtains "for common use" in checks, stripes, and prints, and "for better purposes," dimity, fine stuff, moreen, damask, chintz, or Turkey twill, lined with glazed calico or muslin "of various colors." For state rooms, fine silk, satin, or velvet were to be used ("A Lady" 1840: 192).[5] Surviving materials and literary records suggest that bed curtains traveled with families and sometimes, as was the case in 1876 during Americans' celebration of their centennial, were cut down to make period costumes with fabric that had witnessed the American Revolution. Bed curtains were all but abandoned in the second half of the century when central heating became more affordable, and they had lost their cachet as a status symbol.

Though some traditions of quilt and coverlet fabrication carried over from the early part of the century, for the most part bedcovers of this period make several marked transitions, some structural, some aesthetic. The first involved the invention of the sewing machine in the 1840s and its subsequent mass marketing. Sewing machines especially facilitated piecing very small fabric sections together, and "The Queen of Inventions" allowed its users to speed up the "handsome and substantial" straight stitching that piecework quilts required ("The Queen of Inventions" 1860: 77). Gleaming in black and gold enamel, early sewing machines occupied coveted space in the parlor.[6] The sewing machine fostered the "block" method of construction, a uniquely American innovation that replaced the wholecloth and center medallion styles of the first forty years of the nineteenth century. The quilter fabricated blocks that were then pieced together to form the entire quilt, and the lines between blocks were covered with "sashing" usually in a bright contrast color. These blocks were much easier to push through the small spaces of the sewing machine, and they allowed quiltmakers to carry portions of their work around with them instead of entire quilts, a real advantage for peripatetic Americans (Brackman and Hanson 2009: 19–88). The block style lent itself to the development of "album" and "signature" quilts, also known as "friendship" quilts, in which individual quilters created personalized blocks that were then sewn into a single quilt at the end.

Another innovation in quilt construction of the early 1840s changed both how quilts would be made and how they would look. A then new style of appliqué, now conventional, encouraged quilters to cut figures from any fabric and stitch them to the quilt's ground fabric. The method's greatest contribution was freeing quilters from merely tracing the outlines of color on printed fabric, namely chintzes, by encouraging them to experiment with the limitless range of possibilities of both color and pattern afforded to them by industrial textile production. A reflection of that liberty was the boldly colored "red and green" appliqué quilt, the most significant aesthetic development in quilting in this period. The style combined so-called "Turkey" reds, a fast, vibrant tomato red still made according to a complicated ancient formula incorporating blood and dung, as many as twenty steps, and months to render on cotton. By the mid-nineteenth century, Europeans had been able to industrialize the color's production, making the fabric available but still expensive to middle-class consumers.

At the same time, mineral colors and advances in dye technology produced what appeared to be the first colorfast, reliable greens, solving the problem of twice-dyed greens where the yellow typically fled the field, leaving blue leaves and stems behind. The visual impact of these quilts relied on the contrast between the strong reds and greens against the white background, sometimes with "cheddar" yellows, oranges, and bright blues thrown into the mix. The white also highlighted tour-force quilting, and in the view of many historians the stitching of the period 1840–70 has never been surpassed. Some quilters chose a different background color to great effect, but they were much in the minority. The Baltimore Album quilt was one iteration of the red-and-green style that spread across the entire breadth of the North American continent. Its blocks drew from the popular American iconographic repertoire that greatly overlapped the British—conventionalized baskets of flowers, cabbage roses, grapes and other vining plants, floral wreaths and sprays, cornucopias, musical instruments—but added patriotic squares celebrating military victories such as in the Mexican–American War (1846–8)—eagles and stars, and symbols of membership in Masonic and other fraternal organizations (Hornback 1993: 87).[7] The huge number of quilts made with this color combination suggests that quilters considered Turkey red worth the price, and these reds, in the long run, have merited their faith. The greens were not so loyal. Many of them have faded or turned to what one might charitably call tan, if they did not disappear entirely, leaving unthethered flowers to float indiscriminately through posterity on quilted white seas.

The fact that both direct-dye greens and Turkey reds were available in Britain but that English quilters did not begin to make red and green quilts until after 1850 begs the question of whether the availability of these colors alone explains this quilting phenomenon. The predominant color scheme in Anglo-American homes at mid-century was red and green; it was the preferred color pairing on many of the decorative arts of the mid-nineteenth century, and red and green were favored colors of many religious and immigrant groups coming to the United States after 1840.[8] In the end, the most convincing argument stems from the Americans' originality with color in this period, and the fact that, for the first time in the antebellum era, cultural influence was starting to flow east across the Atlantic.

Coverlets woven between 1840 and 1870 illustrate the same vocabulary of ornament. Some patterns celebrated architectural or mechanical innovations, such as the Georgian and Greek Revival building styles, or locomotives. The Masonic pillar, square, and compass figure prominently in some examples, just as they do on American quilts of this period. Many coverlets featured a woven-in guarantee of color fastness, an assertion made in every permutation of the textile industry over the course of the second half of the nineteenth century as consumers became more exacting and more suspicious about the dyes used in their yard goods. Many weavers advertised themselves as red or blue dye specialists, which suggests just how important it was to get the color right.

Aniline dyes did manage to color the woolen wefts of figured and fancy coverlets in the 1860s, but their liveliness did little to keep this industry alive. By 1870, most small-scale weavers had already lost their incomes to factories with steam-powered looms. The coverlets themselves died an ignominious death, lining army cots and serving as privacy curtains between beds in field hospitals during the American Civil War, and as tie-down tarps on tobacco and produce wagons well into the twentieth century. Despite this abuse, thousands of these artifacts survive today, attesting to the quality of their weaving and, typically, the promised fastness of their colors.

Ceramics

In the ceramics industry business was booming between 1840 and 1870 on both sides of the Atlantic. A US domestic pottery industry developed in East Liverpool, Ohio, and Trenton, New Jersey, that grew quickly but still struggled to compete with Staffordshire, in large part because American firms could not produce the quality of decoration required to attract customers. These potteries spent most of this period producing fineware in cream-colored and yellow bodies, Rockingham-glazed, and white, sometimes with simple transfers (Myers 1992: 27–8).[9] Rockingham pottery took its name from an eighteenth-century British maker; American-made pieces were a yellow or buff color with either a mottled or uniform brown glaze over, typically, relief decoration. Pitchers and washbowls, chamber pots, and other practical sanitary wares made in these colors poured out of kilns in both countries in this period. By 1870, some American manufacturers were able to make colorful hand-painted, undulating china in the rococo revival style that tended to be less "fussy" than its European counterparts (Bishop and Coblentz 1982: 193).

In 1840, British pottery owner Herbert Minton (1793–1858) bought the patent for machine-pressing clay into tiles, and the furniture industry responded by adhering these mass-produced tiles, often transfer printed, to the backs of washstands and servers, hall trees, coat racks, chairs, and umbrella stands. In the 1840s, too, British potters developed a way of printing multiple colors on a ceramic body. Chemists working in the British potteries were able to refine colored on-glazes or enamels (colors applied over the fired glaze) that made them competitive with European and Asian potteries. Enameled Staffordshire figurines—dogs and other animals, scenes from fables and literature, Toby jugs and tobacco jars, commemorative medallions, and statuary tributes to such causes as abolitionism—all took their places on mantles and tables, and in curio cases throughout the Western world. Some of the most beloved on-glaze colors came from Purple of Cassius, a preparation first discovered in Germany, which converted gold into gold trichoride and could render a wide range of beautiful shades from pink to purple. These gorgeous enamel colors helped rank English floral painted wares among the best chinas, and together with beautiful new underglaze colors—yellow from titanic oxide and the chrome tin pinks, among others—English potters expanded their share of the market on the Continent.[10]

Most of the ceramics producers exhibiting at the Great Exhibition in the Crystal Palace, London, in 1851 brought outrageously oversized versions of their wares with them, their scale fitted only to great estates, and their decorating expected to attest to the exhibiting country's international stature and industrial might. The point of the fair was, after all, as much assertively patriotic as commercial. Some lines of goods, however, did catch on with mainstream consumers, and their exposure at the Crystal Palace expanded their customer base. The English pottery firm of Minton introduced a new line called "Palissy," an earthenware homage to the French ceramicist, Bernard Palissy, of the sixteenth century, designed to compete with similar products—for example maiolica, faience, and Delftware—produced throughout Europe for hundreds of years. Minton's Palissy, a line of pottery with realistically modeled and colored animals and plants, inspired similarly naturalistic and colorful lines from other manufacturers that typically sculpted the forms of plants and animals in earthenware and glazed each element in a somewhat realistic color. Collectively, Palissy ware formed one category of the vast corpus of polychrome maiolica being sold throughout Europe and America in the second half of the century. An unflattering but reasonably accurate description of its qualities comes from a twentieth-century critic, who argued that even when it was "excellently modelled, [it] presented a curiously tasteless effect" as it was "streaked with color and glistened unpleasantly because of a too brilliant glaze which […] gathered in pools of strong color in every hollow" (Lichten 1950: 256).

It was the combination of blue and white, however, that truly seduced American consumers. Cobalt oxide had been expensive in the eighteenth century until a domestic British refinery industry was established. Cobalt's popularity worldwide may stem from the lack of such deep blue shades in nature, but there is no ambiguity in how much Americans liked it. They were the singular consumers of patterns together known as *flow blue*, produced by Staffordshire from the early part of the nineteenth century, which, similar to other transferware designs, drew from nature, geometry, and history for its subject matter. The distinguishing characteristic of this type was a deep blue that "flowed" outside its proper lines and more or less smeared the image. Flow blue may have been, technically, flawed china, but it was dumped unapologetically on the American market to the delight of Americans. Flow blue's popularity surged after 1840, but by the late nineteenth century some collectors were inclined to disparage it, at least one commenting that it had "nothing whatever of beauty or interest to recommend it" (Moore 1936: 13). In the meantime, Americans purchased everything produced in this style, from gigantic serving platters to flow-blue toilets.

Varying in color from "the fine old blue, to a tint so reddish as to be almost purple" was *Willow*, also known as *blue willow*, a chinoiserie pattern featuring an imaginary amalgam of landscape elements that rivaled flow blue in ubiquity in North America, but was also favored by consumers throughout the Western world (Moore 1936: 13). Many potteries produced Willow in other single colors and polychrome versions. The testament to Willow's success is the fact that varieties of this pattern are still in production today.

CRAZED COLOR, 1870–93

The Western world shimmered with color in the late nineteenth century. The brick walls of city buildings became blank canvases for colorful painted advertisements, posters, and handbills. The vitrines of huge department stores exhibited the millions of consumer goods now available to shoppers, and catalogs helped guarantee access to colorful objects to buyers in rural areas. International fairs continued to exhibit an unprecedented number of finished goods, some practical, some pompous and purely decorative.

By 1870, cylinder printing had emerged as a technology vigorous enough to meet the needs of mass textile production. The synthesizing of colors—a rare and almost miraculous event in the eighteenth century—became commonplace by the end of the nineteenth. The successful synthesis of alizarin by both German and British chemists in 1868 led to the laboratory production of every possible iteration of red: deep pink, crimson, scarlet, puce, fuchsia, maroon, and magenta. By 1890, these colors had found applications in a huge range of manufactures, and the textile industry was hot on the heels of its most elusive target, a synthetic indigo. It is a strange irony that the new synthetics guaranteeing people of all economic classes a never-ending supply of fast, deep, glowing red fabrics came along just at the time when most quilters had tired of red-and-green appliqué. Though a popular style of red-and-white quilt would pop up for a short time in the last decade of the nineteenth century, after 1870 quilters focused their efforts on displaying the entire range of colors, textures, and patterns now available to them through industrialized textile production.

The silk industry that had limped along in the United States through most of the century was large and sophisticated enough now to engage in niche marketing, advising retailers on which colors should be pitched to which classes of consumer. European and American silks created the lustrous effect in many of the optically dazzling quilt styles of the day that played color against color and light against dark. "Tumbling blocks" and the "log cabin" patterns, constructed of blocks of concentrically arranged bars of fabric around, typically, a brightly colored center, had been made in the United States since the middle of the century, but the reduced cost of the traditionally more expensive fabrics—silks, velvets, brocades, and so forth—inspired an optical quilting redux. The quilt style that summarized and showcased the huge numbers of colors, textures, and varieties of fabrics available to consumers in the late nineteenth century was, however, the "crazy" quilt.

Far from insane, the fabrication of a well-rendered crazy quilt, similar to the other visually sumptuous quilts of the period, required a great deal of planning and access to myriad textile samples in a wide variety of colors and textures. Such complex quilts became possible only as the world's mills churned out the cornucopia of fabrics and colors required to create the quilt's stained glass appearance, and enough women found the leisure to embellish each shard of color with the fancy embroidery in a contrasting color required of a high-style crazy. Textile manufacturers began to bag scraps from their production line, mix them up, and advertise that their sampling might have "300 or more colorings" (McMorris 1984: 16). Companies sold both embroidered fabric patches and patterns for those inclined to do the needlework themselves. Entire families participated in the piecing together of the bits of fabric, embroidered panels, award ribbons from military service or fairs, and membership badges from political parties, each contributor hoping that the effect of the pattern overall would be complex, balanced, and beautiful. Crazies were foundation-pieced quilts in which the colors were directly attached to a backing without batting (wadding) and without quilting. Most performed their decorative duty on pianos and sofa backs in a public display of their makers' artistry. Their fractured compositions perfectly fit the aesthetics of the late nineteenth-century parlor. Crazy quilts became a national obsession in the United States, and quickly thereafter in Great Britain. Both cultures celebrated the style in popular culture through poems and stories and frequently referenced them in advertising. Companies promoting products entirely unrelated to crazies or quilting in general handed out trade cards filled with puns on the "crazy" part of the style and printed with patchwork graphics to cash in on the craze.

Crazy quilts invited improvisation. An example in the collections of a Shaker community in New England most likely made around 1900 incorporates hot pinks and purples.[11] Two hot pink swatches were in fact tipped into the Sears, Roebuck & Co. catalog in 1901, demonstrating just how mainstream such acid colors had become, and how effectively, or insidiously, the world had intruded on the Shaker aesthetic.[12] So-called "country crazies" were simpler, more abstracted, often woolen versions of the highly embellished crazy quilt. They took less time to make and more often served a utilitarian purpose. Because this style made use of smaller odds and ends of fabric and could be block-pieced, crazy quilts' economies of time and material ensured that they would be made well into the twentieth century. They were no longer fashionable, however, after the 1890s.

Crazy quilts had much in common with factory-produced finished goods in the last quarter of the nineteenth century. The crazed pattern of the quilts mimicked the crackling of ceramic glazes, or crazing, and some saw the irregularity of the pieces of these quilts as a reference to the asymmetrical, Orientalist designs so much in vogue after the opening of the Japanese Pavilion at the Centennial Exhibition in Philadelphia in 1876. This exhibition strongly influenced the direction of decorative arts in the United States. Design influences from antiquity, the Middle Ages, the Near and Far East, the aesthetic movement, and the ersatz styles collectively known as "Eastlake" all collided violently but often beautifully in this period.

The Anglo-American world's obsession with pottery led to what has been described as a "china mania" that included home production. In the 1870s women throughout the United States picked up pottery blanks (undecorated fired wares) and enamels and began painting their own pieces. Home- and factory-made ornate china, glass, and earthenware appeared in palettes ranging from the more somber, saturated colors of house exteriors in this period to glorious shades that anticipated the vibrancy of dyes that chemists were still in the process of inventing in European laboratories. In 1886, the *Decorator and Furnisher* complimented the Faience Manufacturing Company, an American firm, for their "remarkable evidences of the advancement of art pottery making in this country," especially praising their wares for their "fine jewels thickly set in intricate pattern, rich gold decorations, exquisite color and perfect designs" (Veith 2001: 87). Millions of objects produced in this heterogeneous environment, to the horror of critics such as Thorstein Veblen (1857–1929)[13] and William Morris (1834–96), shared a tendency toward inducing sensory overload.

The volume of colorful statuary, china sets, jardinières, umbrella stands, urns, tiles, vases, and sentimental scenes cut in marble, cast in iron, or thrown from clay in the late nineteenth century is too broad a topic to be adequately discussed here. As Lichten commented, in ceramics alone “the desire for novelty resulted in endless variety […]. No style was too bizarre to copy, no idea too preposterous to attempt” (Lichten 1950: 256). But the proof of how colorful the industrialized world had become by the late nineteenth century is on paper. Printed ephemera—in the form of labels, programs, catalogs, greeting and show cards, posters, calendars, calling cards, rewards of merit, certificates, art prints, premiums, handbills, and billboards—covered boxes, tables, store displays, fences, walls, and buildings everywhere. These were the paper progeny of chromolithography, which even today can evoke the age of Victoria like no other objects. Trade cards were unassuming little pieces of printed advertising about the size of an adult hand, typically featuring a lushly colorful picture with promotional copy on one side and sometimes the verso. Saturated with color, bad puns, idealized domestic scenes, ethnic and gender stereotypes, unsubstantiated health claims, and self-serving advice, chromolithographed trade cards replaced the black-and-white broadsides printed by most advertisers before 1876, the year that the colored cards were handed out at the Centennial Exhibition in Philadelphia. No other single artifact could be as bizarre, preposterous, and indeed offensive to twenty-first-century sensibilities as the trade card. And yet no single object democratized decorative color so fully. Vendors handed out the cards for free, often causing a sensation. After the fair, shops continued to give them out free, and the trade card quickly became the dominant medium of communication between industry and consumers. People began to collect them, tucking them into corners of vanity mirrors and doorframes and pasting them into scrapbooks, where their lustrous layered colors have survived. Most advertisers did not even concern themselves with the relevance of the picture on the card to the good or service being sold, because it was the deep and mesmerizing colors produced by the chromolithographic process that sold consumers on these cards. Too commercial or too small, the trade card escaped the censure of the many critics who dismissed the art of chromolithography as just so much schmaltz.

Chromolithography transfigured the industrial world. Pottery decorators, for instance, stuck multicolored decals (a design on paper to be transferred to another medium), the best from Germany and France, to ceramic pieces in Britain and America, and carriage makers everywhere used decals to make decoration affordable.[14] Decalcomania, as it was known in that time, made the application of mass-produced color to virtually any surface relatively easy. But the technology had a didactic quality that has rarely been noticed by historians. Chromolithographed books and plates allowed professional and amateur biologists to identify species and learn how the processes of sexual selection played out in the plant and animal kingdoms. Physicians’ and chemists’ texts obviously benefited greatly from color printing, and businesses finally had an affordable way to communicate decorative options visually to their clients. Color printing also served national interests. A spate of children's books published at the end of the nineteenth century used colorful covers and plates to excite young boys, primarily, with the glamor of world travel, a fitting subject for a generation being raised in increasingly imperialistic nations. Color-printed letter blocks taught children the alphabet, and chromolithographed game boards and pieces educated them about exotic animals and geography (see Plate 10.1). Chromolithography also assisted in the dissemination of spurious theories insidiously supporting concepts of racial hierarchies. Even otherwise legitimate scientific organizations published ethnographic treatises with pyramidal color charts illustrating "the races of man" in which white Anglo-Americans and the "Teutonic races" appeared at the top and the darkest-skinned Africans occupied the bottom levels.

In the Western world, the nineteenth century began in black and white, but it ended in the seductively layered colors of Victorian printers' inks. It began in homespun, linen, and linsey-woolsey, but the curtain that closed on this age of industry was made of hot-pink silk. The material evidence of much of this color has disappeared over time, as the objects bearing it became victims of accidental breakage, fire, and use. But no other force has been quite as destructive to color as changing tastes. At the dawn of the twentieth century, cultural critics found much to disparage in that most industrious of centuries. Subscribers to the philosophies of the Arts and Crafts movement aimed their invective at mass production and the garish, artificial palette that they argued it set loose upon the world. Less ideological Colonial Revivalists in the United States whitewashed historic homes and abandoned the saturated colors of chromolithography for the restrained notes of delicately tinted black-and-white photographs of comely "colonial" maidens quietly seated at their humble spinning wheels. In so doing, these publishers implied that the American Revolution was fought against a backdrop of pale braided rugs and whitework quilts, and further, that modern patriotism all but required living in the same milky interiors. In the end it was elites, with Candace Wheeler (1827–1923) and Edith Wharton (1862–1937) among others to speak for them, who were now bored with the color that so saturated society. They turned away from it with their usual sangfroid to embrace instead a new palette of whites and pastels. For them, color had lost its cachet. But for the masses, color was forevermore an entitlement.[15]

NOTES

Introduction

1. This time frame was estimated recently by researchers at the Royal College of Art, London, who noted that since the book's dedication is to *Sir* Joshua Reynolds, President of the Royal Academy, the publication date cannot be earlier than May 1769, when Reynolds received his knighthood. The latest possible date of 1776 is based on the fact that Harris references his color circle in a later publication, *Expositions*, from that year (Royal Academy of Arts Collections, record no. 03/5967). Summary available online, see Royal Academy n.d.
2. Turner also owned copies of Harris's *Natural System of Colours* (1811), Field's *Chromatography* (1835), Charles Hayter's *Introduction to Perspective, Drawing and Painting* (1815), and a number of other relevant publications on color and color theory. For a complete list of books owned or quoted by Turner in relation to the topic of color, see Gage 1969: 215–20.
3. For a critical analysis of Turner's paintings relating to Goethe's *Farbenlehre*, see Finley 1997.
4. In the 1870s, Hunt states that "The labours of Mr George Field, a chemist, who applied himself with great assiduity to his task, much improved the range and the beauty of the colours to choose from. His madders were far superior in strength than those which preceded them […]. His preparations of genuine ultramarine were so valuable that, after his death, the little store left in the hands of the colourmen went up to a premium in price, as did also his vermilion to a still greater extent" (quoted in Gage 2001: 14).
5. This work first appeared in 1851 as *L'Aquarelle sans maître: méthode pour apprendre l'harmonie des couleurs*, which was part two of Cavé's *Dessin sans maître*. An English translation, entitled *Color*, appeared in 1869.
6. For a detailed analysis of Gartside's writings on color, see Loske 2014. Some extracts from this essay are included here in shortened and adapted form.
7. Incidentally, the second translation of Cennini's *Libro dell' Arte* was also by a woman. Christiana J. Herringham (1852–1929) published her new translation in 1899, under the title *The Book of the Art by Cennino Cennini*, in which she references Merrifield in the introduction.

Chapter 1

1. This translation, sometimes slightly modified, is used in this chapter.
2. For a review of the early reception of Goethe's ideas on color, see Faivre 1862: 222–34.
3. For an updated definition of colored shadows, see Lanthony 1997.
4. For a detailed account of Goethe's color theory in the light of modern optics, see Bussemer 2016: 245–81.
5. The French translation of Schopenhauer's correspondence with Goethe, published as an appendix to Schopenhauer (1986), is used here. For Schopenhauer's original letter of November 11, 1815, to Goethe, see Schopenhauer 1986: 122–30.
6. For further readings on this book, see Roque 2009; for a summary in English, see Roque 2011, 2016.
7. Helmholtz is an exception in that he maintains the idea of "accidental" colors, since he accepts the suggestion made by Buffon, that is, that the phenomena are due to the "fatigue" of the eye (Helmholtz 1924–5: 2:235, para. 23).

Chapter 2

1. On the relationship between science and material culture, see Galison 2000: 355–89; and Smith 2013: 210–25.
2. For a broad overview of the topic, see Harris 1990: 318–36; Batchelor 2000; Blaszczyk 2012; Blaszczyk and Spiekermann 2017: 1–34; Kalba 2017; and Rossi 2019. This essay draws heavily on these scholars' research.
3. For an overview, see, for example, Mintz 1986; Ahluwalia et al.1999; Beckert 2014; and McClintock 1995.
4. This section relies heavily on Gage's research, including that presented in Gage 1989. Other key sources on the British colorman include Morgan 2017: 38–42; Hamilton 2015: 179–98; Keyser 1996: 169–79; and Brett 1986: 336–50.
5. The connection between early nineteenth-century French chemistry and the pigment industry is expertly summarized in Delamare and Guineau 1999.
6. For information about the concerns of the organizers of the Great Exhibition as to a deterioration of the norms of taste brought about by industrial production, see Dutta 2007.
7. Contrary to Field, who believed that three parts yellow, five parts red, and eight parts blue combined to create white, Hay used the proportions of one part yellow, two parts red, and three parts blue. Furthermore, according to Hay, these did not create white when combined but rather a neutral gray.
8. Merrifield referenced Field's scale of chromatic equivalents. But, failing to mention Field by name, her article is misleading, as it creates the impression that Field's scale of chromatic equivalents and Chevreul's law of color harmony are related to one another, if not one and the same.
9. According to John Gage, "Field later claimed that Davy had been one of his teachers, and it is very likely that he made contact with the chemist at [an] early point in his career" (Gage 2001: 4).
10. For information about the technological and commercial history of natural dyes, see Fox and Nieto-Galan 1999; and Nieto-Galan 2001.
11. Jules Bourcier to the Société d'Agriculture, August 12, 1842. In Michel Eugène Chevreul (MEC), *Correspondence*, Muséum National d'Histoire Naturelle (MNHN), Paris.

12. Chambre de Commerce de Lyon to Monsieur Bineau, Professeur de chimie à la Faculté des Sciences et l'École de la Martinière (Lyon), August 2, 1855. In MEC, *Correspondence*, MNHN, Paris.
13. These are conservative estimates, based on eighteenth-century inventories. See Lowengard 2006: ch. 16; and Gastinel-Coural 1997: 70.
14. For a more detailed account, see Kalba 2017: ch. 1.
15. Key sources on the early history of synthetic dyes include Travis (1993) and Garfield (2000).
16. For information about Anglo-American fashion writers' diffusion of Chevreul's law of color harmony, see Nicklas 2014: 218–36.
17. Earlier editions of the Atlas were published in 1907 and 1913.
18. I am grateful for Aiko Dzikowski's assistance with translating this article.
19. Focusing on Ogden Rood and Charles Pierce, Michael Rossi (2017) develops a closely related argument.
20. As Michael Rossi rightly notes, "so much color science depended on the scientist's own use of manufactured color goods such as mass-produced pigments, papers, and textiles" (2017: 121).

Chapter 3

1. On the history and national symbolism of other flags such as the Union Jack, see Elgenius 2011.
2. The tricolor was first seen on cockades—not flags—worn by revolutionaries in the French Revolution. In fact, the Paris militia initially wore blue and red cockades on their hats. In July 1789, the Marquis de Lafayette, a prominent representative of the nobility to the Estates General, made sure that the royalist white was added, whereby he effectively created the tricolor cockade. The tricolor with vertical red, white, and blue stripes thus stood for the alliance and compromise between the monarchy and the people. Since the National Assembly approved a reversal of the flag's color arrangement in 1794, there have been no notable changes to the French tricolor flag (Maxwell 2014).
3. On the red flag and the fact that red did not come to be associated with radical politics and socialism until the uprisings of 1848, see Dommanget [1967] 2006.
4. Napoleon I (the nephew of Napoleon Bonaparte), born in 1808, was elected President of the Second Republic in 1848. In 1851, however, he seized power, founded the Second Empire in 1852, and became Emperor of the French, a position he held until the end of the Franco-Prussian War in 1870. He died in England in 1873.
5. Mapmaker Rufus Blanchard used color in historical maps of the United States to "convey the fluidity of imperial control" (Schulten 2012: 57).
6. The Rose-Colored Map was not made as a challenge to Cecil Rhodes's vision of a "Cape to Cairo Red Line" (that is, British territory). Rhodes only came to oppose Portugal's claims after founding the British South Africa Company in 1888. He subsequently made no secret of his desire to take over part of Mozambique to gain access to the Indian Ocean.
7. On the Indian subcontinent alone, a third of its territory remained under the control of quasi-independent, sometimes considerably independent, Indian princes.
8. "Though the uniform is the most vivid example, color persisted in other forms of nineteenth-century male dress, not simply in the bright silk waistcoat and tie, but

in the saturated hues of the orientalist silk bathrobe and hunting pinks" (Matthews David 2003: 6).

9. Admittedly, the exact shade of red of the "red coat" varied with the trends in military fashion and the demands of service, which explains references to *madder red*, *russet*, *crimson*, and *scarlet* uniforms (Holmes 2002: 184).

Chapter 5

1. The British political control of India and their increased manufacture of mechanically spun cotton thread led to the decline of muslin production in Bengal, with unfortunate consequences for the local economy and the weavers' livelihoods (Ghuznavi 2006: 308–11).

Chapter 6

1. The belief in the analogy between color and music stretches back to Pythagoras and up through early twentieth-century abstract art. See Gage 1993: ch. 13; 2006: ch. 7; and Gaskill 2017.
2. For an account of how Helmholtz moved from his initial rejection of Young's thesis, in the early 1850s, to being its most important proponent, see Kremer 1993. For a more general discussion of this theory, see Gregory 1997: ch. 7.
3. For a detailed account of Peirce's research on color and how it informed his broader pragmatism, see Rossi 2019: ch. 2.
4. For a discussion of the social and intellectual contexts of Gladstone's work, see Hickerson 1983; and Bellmer 1999.
5. For a brilliant account of the nineteenth-century discourse of sensitivity and impressibility (the ability to receive impressions), see Schuller 2017.
6. Magnus sent out surveys of his own and corresponded with ethnographers in North America and elsewhere (Deutscher 2010: 60; Rossi 2019: ch. 4).
7. For a reading of Rivers's work in the context of the empire and nineteenth-century theories of racial difference, see Eaton 2013: ch. 3.
8. Ladd-Franklin's "development" theory of color vision (also called the "evolutionary" theory) was akin to the accounts offered by Gladstone and Magnus, but the model of evolution was Darwinian rather than Lamarckian. For more on her response to Rivers, see Rossi 2019: ch. 5.

Chapter 7

1. The full name of the company was *Interessengemeinschaft Farbenindustrie Aktiengesellschaft* (Syndicate of Dyestuff-Industry Companies).
2. Johann Jacob Diesbach is credited with the first chemical production of *Prussian blue*, also known as *Berlin blue*, between 1704 and 1707, and, in 1814, the highly toxic *Schweinfurt green*, also known as *Paris green*, was first manufactured. In 1834, Carl Leverkus opened the first German factory for the production of *ultramarine blue* in the town that was later to be renamed Leverkusen. These and other activities inspired the competition in Germany to research and produce other color products.
3. Anton Krättli highlights that the colors of the south are always connected with objects and forms (Krättli 1949).
4. "To split the unity of eternal light, / We have to take offense, / If your error is enough. / Light and darkness, light and shadow / If one knows how to wisely marry, / Then one conquers the world of color" (Goethe 1887–1919: pt. 2, vol. 1).

Chapter 8

1. The author is grateful to numerous colleagues at Tate, especially present and past members of the Conservation Department and to curatorial colleagues, and to conservation professionals and art historians in many galleries worldwide, for their enthusiasm and sharing of knowledge when discussing a great number of paintings in the course of their technical examination.

Chapter 10

1. The most detailed source for a description of how the American economy and society were transfigured in this period is still Charles Sellers's 1994 publication, *The Market Revolution: Jacksonian America, 1815–1846*.
2. In his work on the Fancy movement in the United States, Sumpter Priddy traced the evolution of this concept and argued that, in the case of japanned objects, "polished" was a pun; Americans' perception was that those who owned polished objects were themselves polished.
3. For a useful analysis of the Shakers' aesthetic and palette, see Rieman and Burks 2003: 49–67.
4. It should be remembered, however, that patterning hid dirt and flyspecks, an important attribute in the time before metal window screens.
5. In *A Christmas Carol*, Charles Dickens's 1843 indictment of the social disparities created by England's industrialized economy, Ebenezer Scrooge's horrifying vision of a future Christmas sees his maid trying to pawn his bedcurtains, a most intimate symbol of her employer's comfortable status, before his body is even in the ground.
6. Diane Douglas has called the advent of home machine sewing a "collision" between the industrialized world outside and the inner sanctum of the home, and as a means of smoothing over the violence of this encounter "the machine was adapted to its new domestic setting," by being styled and presented as a piece of parlor furniture (Douglas 1982).
7. One-third of the nearly 150 red-and-green quilts studied in the Kansas Quilt Survey came from Ohio, followed by quilts with histories originating in Indiana, Illinois, Pennsylvania, Kentucky, and Kansas. In the United States, most of these quilts were produced by rural, middle-class Protestant women of German, English, Scotch-Irish, and Welsh heritage. "Middle-class" was defined by the occupation of the husband of the quiltmaker.
8. Both red mohair upholstery fabric and green baize, a course woolen fabric used for everything from carpets to tablecloths to carriage curtains, were staples in the Anglo-American home in this period.
9. Fineware is higher-quality, usually decorated pottery.
10. Gladstone Pottery Museum, Stoke-on-Trent, Staffordshire: labels, on-glazes and underglazes.
11. This quilt is in the collections of Hancock Shaker Village, Pittsfield, Massachusetts.
12. The catalog featured two swatches of hot pink on the same page, one in Jersey flannel and a lighter version in "albatross" cloth.
13. For more information on this, see, for example, Veblen [1899] 1912.
14. Gladstone Pottery Museum, Stoke-on-Trent, Staffordshire display: "Chromolithographic Transfers (Decalcomania)."
15. For more information on this cultural phenomenon, see Wright 2011.

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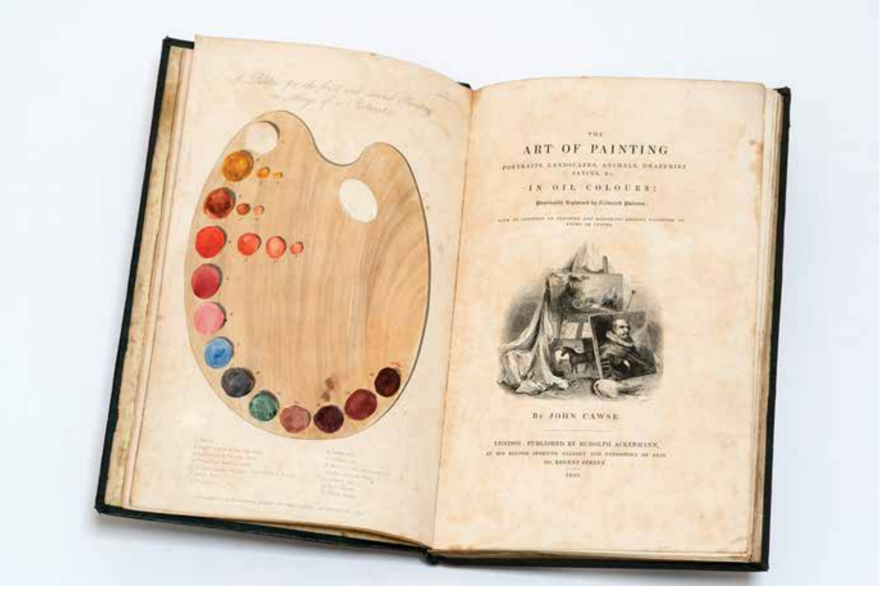

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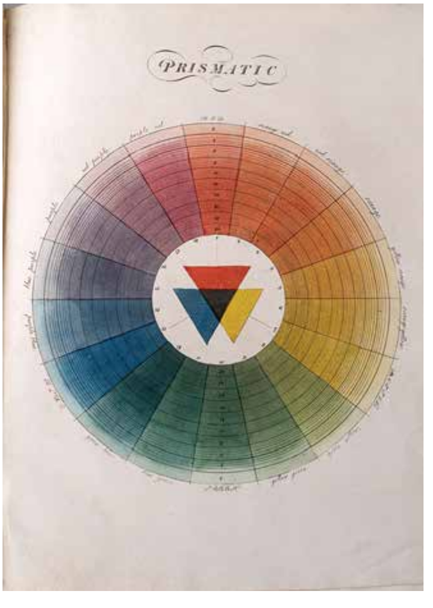

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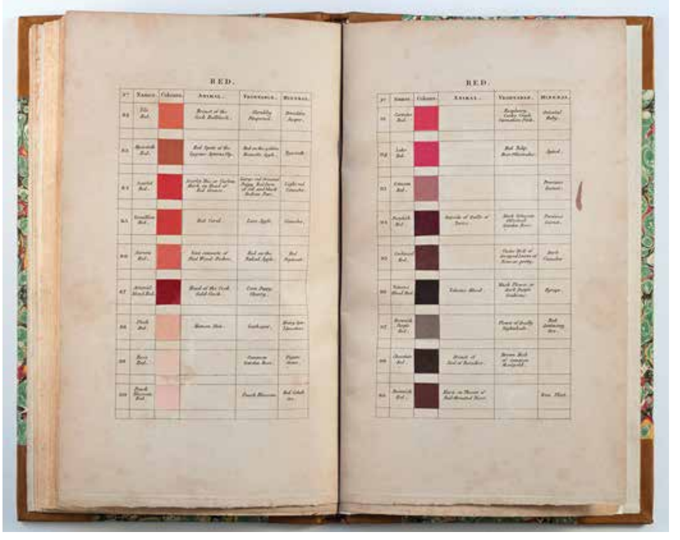

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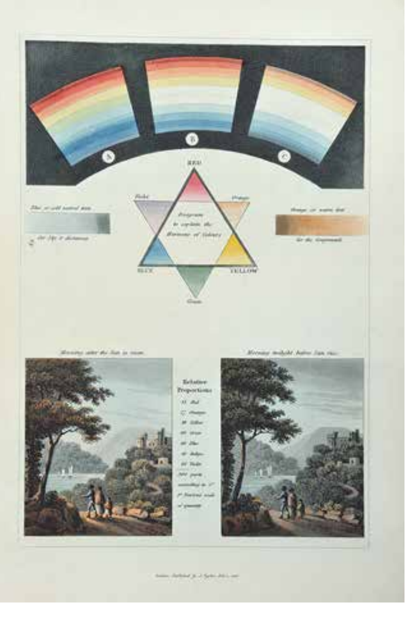

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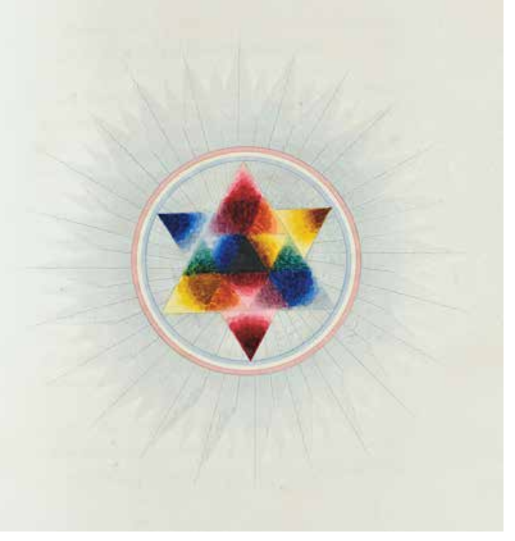

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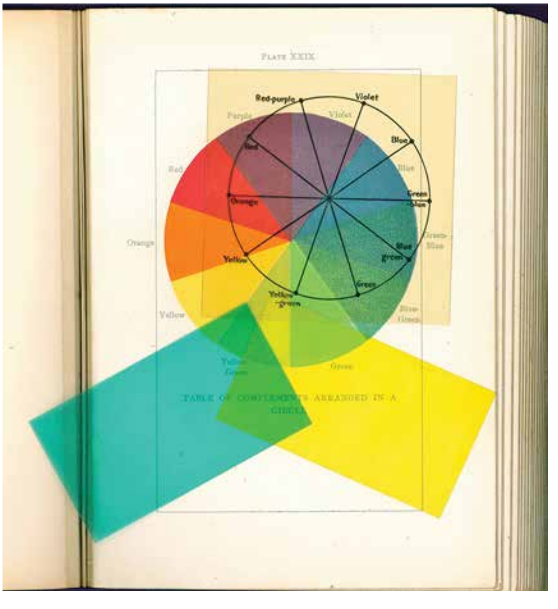

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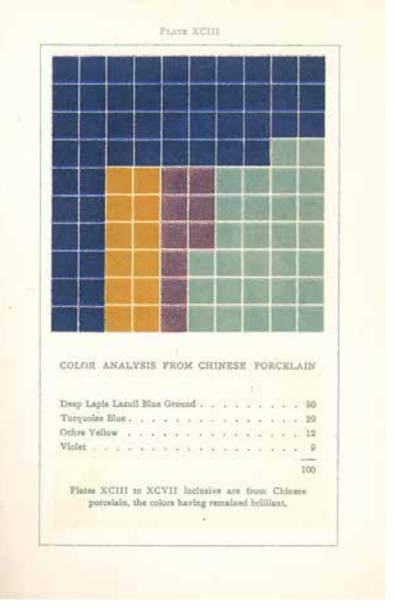

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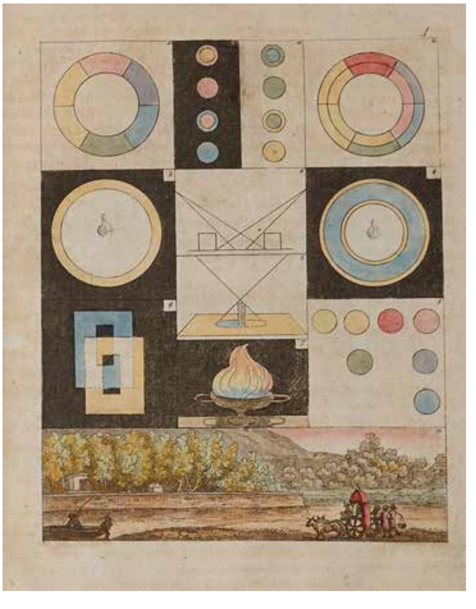

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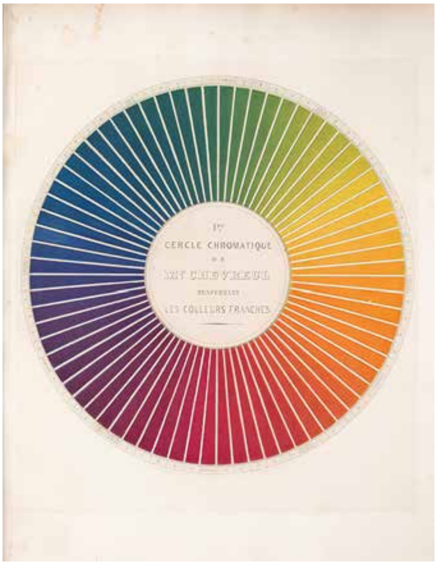

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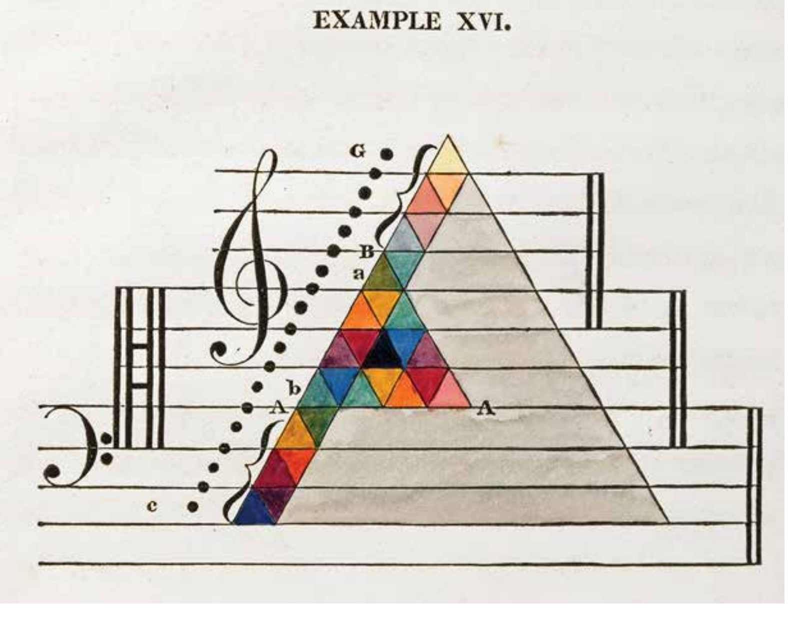

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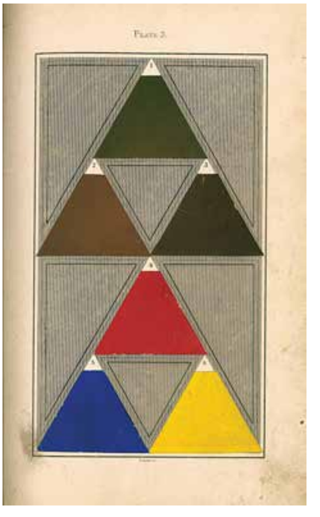

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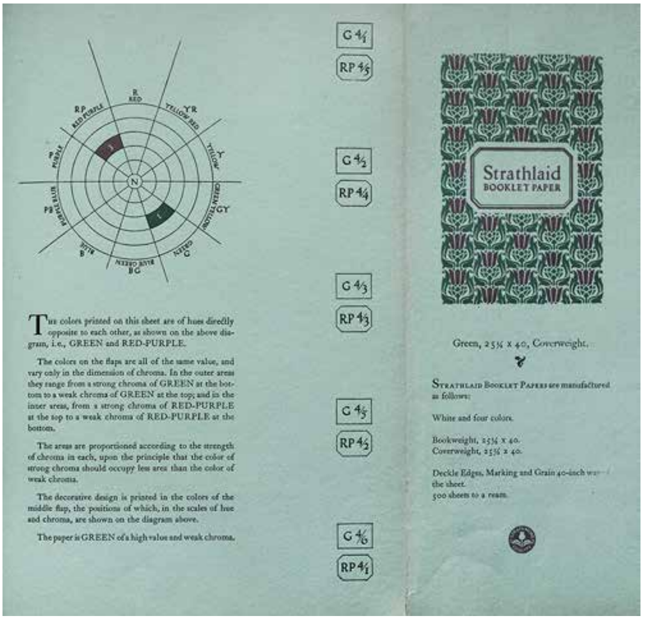

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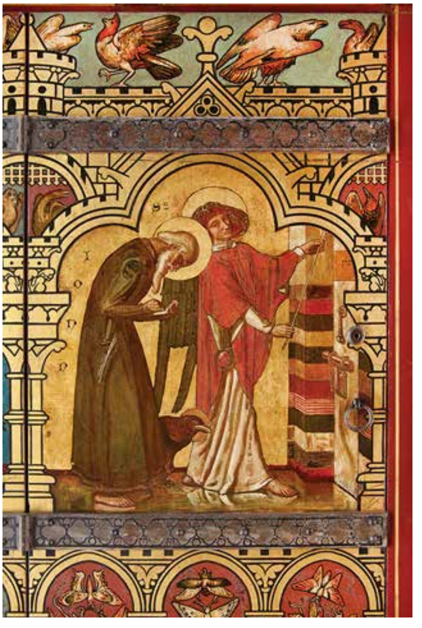

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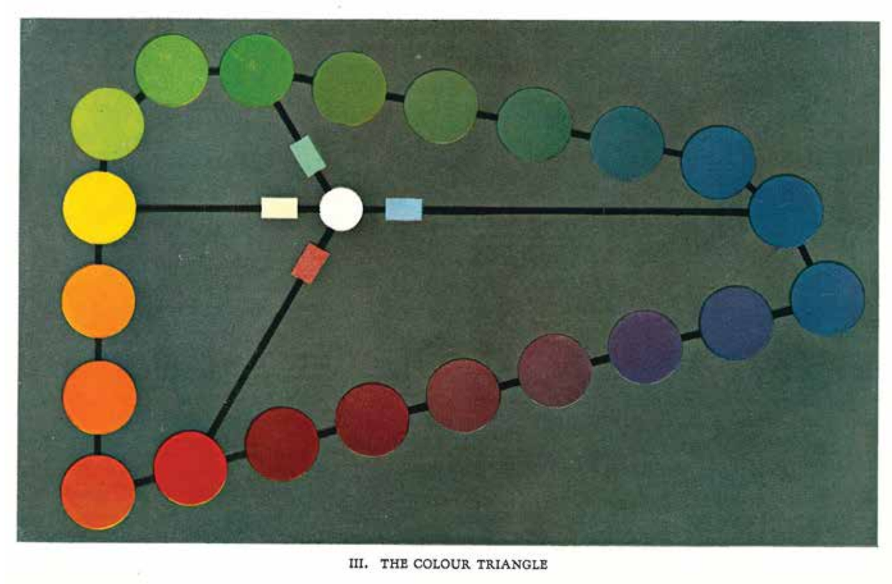

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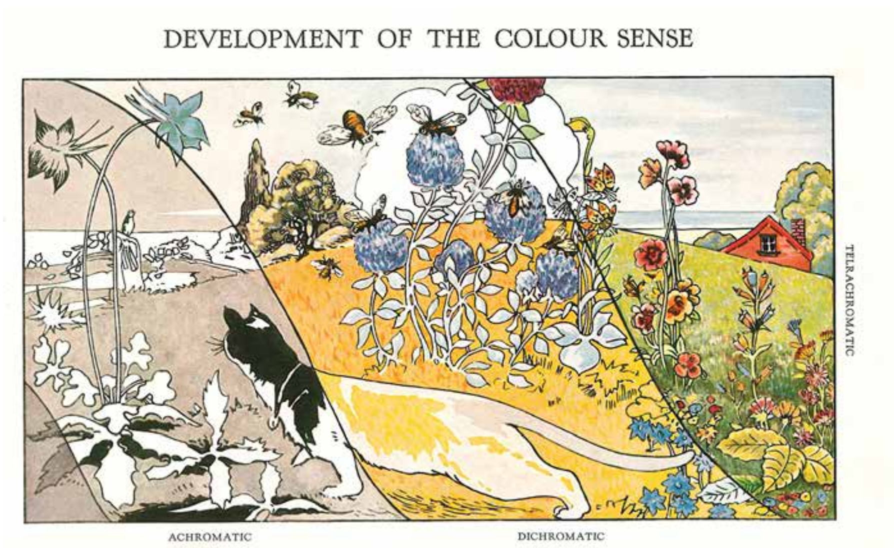

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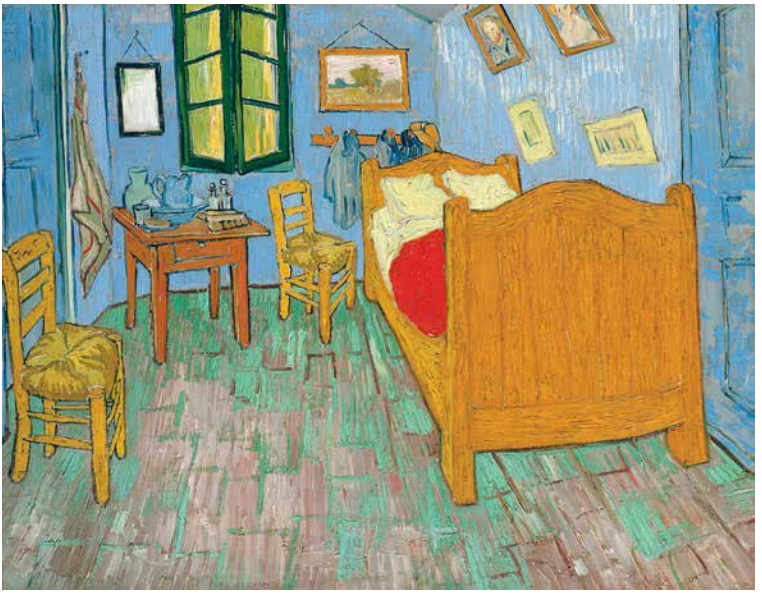

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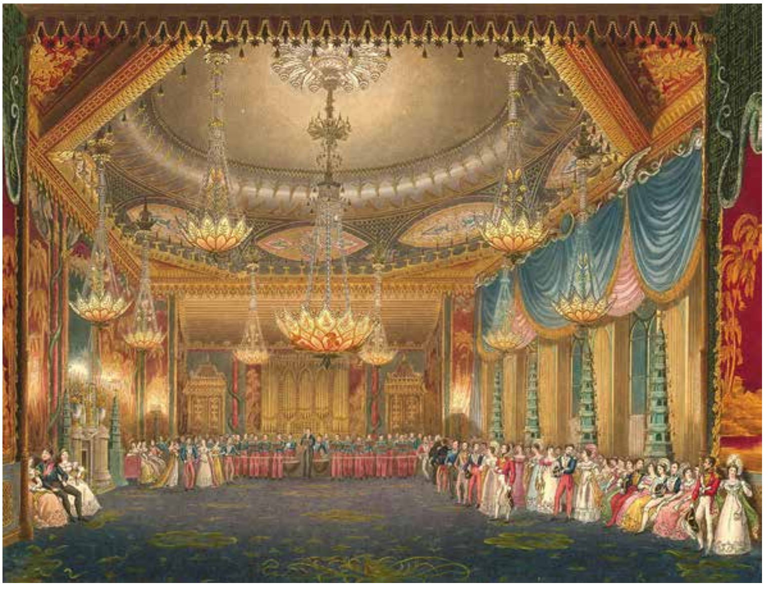

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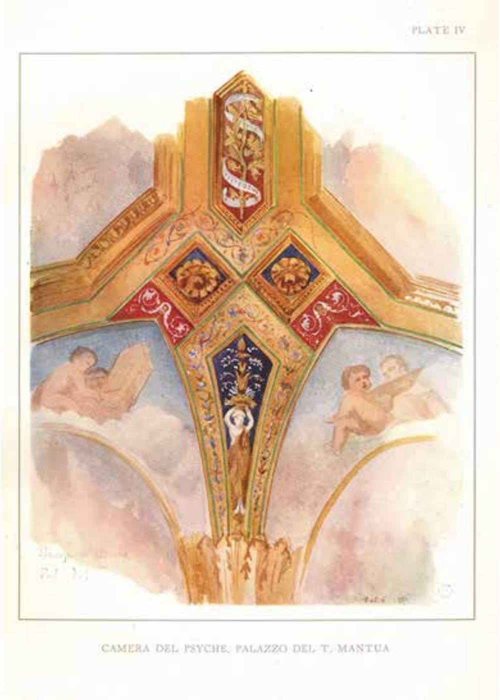

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