1 Introduction

This book provides the first overview of the history, development, and applications of color charts with a focus on 18th-century Europe, where such charts had their first historical production peak. The core of this work is the study of 18th-century color charts, their developers and designers, and their meaning. While the book focuses on the 18th century, it necessarily includes earlier and later examples of color charts that show commonalities with 18th-century ones. Precedent attempts to chart colors are mentioned or briefly analyzed to historically contextualize the 18th-century examples. Overall, this work conducts a novel collection and discussion of a selection of 87 color charts produced during a period of roughly six centuries. The majority (66) of these charts are 18th-century products. Notably, this selection is by no means conclusive; some charts are omitted for practical reasons, while others have yet to be unearthed.

This study attempts a first delineation of categories or strands into which 18th-century color charts can be sorted. It establishes a threefold distinction, and the structure of the book reflects the three main categories of color charts: natural, pigmentary, and trichromatic. These categories emphasize lines of development that reflect their roots in specific historical traditions and clarify their later reception during and after the 18th century. At the same time, this text highlights shared and interacting influences across categories, thus revealing a long and wide network of color understandings both chronologically and geographically. Finally, this work presents the first specification of real and imagined applications of these items in many fields of knowledge and practice.

This book contains five main chapters. The introduction in Chapter 1 explains my own understanding of the various objects that constitute color charts, and it elucidates my choice of the 18th century as the focal timeframe. This chapter also reviews previous research in the field, outlines my novel approach, and provides a content overview of the book. Chapters 2, 3, and 4 then investigate the natural, pigmentary, and trichromatic color chart categories, respectively. Chapter 5 concludes with a panoramic view of the people, places, and reasons that contributed to the enhancement of 18th-century color knowledge through the development and application of color charts. Each chapter is comprised of several subsections that engage with the different disciplinary fields and contexts in which the examples were developed. For almost every color chart presented in this book, I consider six main questions: Who developed and designed the color chart? What does it look like? Which main colorants were mentioned or purportedly

Published in: Simonini, Giulia: Color Charts in 18th-century Europe: Natural, Pigmentary, and Trichromatic, Heidelberg: arthistoricum.net, 2025. DOI: https://doi.org/10.11588/arthistoricum.1483

used by the author to manufacture it? What are the imagined and real applications of this item? Which textual sources were consulted in developing this color chart? Finally, how and by whom was this object received?

1.1 Color Charts and the 18th Century

Before proceeding with the historical part of this book, I must clearly explain my own understanding of the term "color chart." I consider a color chart to be an assemblage of actual color samples consisting of pigments and dyes that are already combined with binders or media. The color samples found in color charts are made from either unmixed colorants or mixtures of two or more colorants. In many cases, they are labeled with names or symbols (e.g. numerical, alphanumerical, letters). Such symbols and names often refer to further information, such as a recipe for producing the corresponding nuance, the ratio of ingredients in a mixture, or a thorough description of the given name or equivalent names in other languages. This information is external to the color chart.

Color charts may be manufactured with various materials and techniques and a range of methods. In the 18th century, color charts were most commonly painted with pigments and dyes on a paper support. The color samples were either washed directly on the sheet that would become the color chart or painted on a separate paper that was then cut and pasted onto the color chart. In other color charts, fabric swatches were pasted onto the pages of a book or loose sheets. Color charts have also been manufactured on other substrates, such as enamels on porcelain plates or colored glass slabs.

As I demonstrate in this book, color charts were often devised and utilized as practical instruments. Physicians, natural historians, and cloth merchants employed them as reference color terminologies to associate color terms with color samples or swatches. Meanwhile, practitioners, such as painters and dyers, created color charts to record instructions to replicate their cataloged nuances. Color technologists and chemists also developed color charts to document their experiments with new colorants or mixtures. Color charts have been manufactured not only to guide experts but also to educate students of medicine and natural history, apprentices in painters' workshops, and manufacturers on their respective color knowledge. Finally, color charts served commercial functions as well, as they were deployed to sell fabrics, new artists' supplements, and valuable commodities.

My focus on the 18th century also warrants clarification. Color charts are not an exclusively 18th-century phenomenon, but their first production peak occurred during this century. Indeed, the 18th century was the era in which actors (other than painters and other practitioners) started to regard these objects as valuable instruments for the aforementioned purposes. In the conclusion of this book, I explain the reasons for the production peak of color charts in the 18th century.

1.2 State of the Art

Historical research on color charts has been characterized by fragmentation, disjunction, and a lack of cross-disciplinarity. In the past, historians have analyzed color charts only from the perspective of their own fields of study. This approach reflects the modern subdivision of history departments and has resulted in three main frameworks of research on color charts from the 18th century or earlier: the history of color science and theory, the history of art technology, and the history of natural history.[1] However, these frameworks are not necessarily discrete. In this section, I delineate the contribution of each framework to the history of color charts.

In the history of color science and color theory, a wealth of studies have discussed color charts. Yet, few of their authors have included analyses of color charts or diagrams, which are usually called "color (order) systems" in this context.[2] The main interpretative line of these color (order) systems categorizes these diagrams according to their number of spatial dimensions (i.e. one, two, three) and, accordingly, their geometrical shape. This line was initiated by Frans Gerritsen and has been accepted by many scholars, including Narciso Silverstrini, Werner Spillman, José Luis Caivano, Robert A. Crone, Rolf G. Kuehni, and Andreas Schwarz.[3] In particular, Kuehni and Schwarz have championed and expanded on Gerritsen's work with many publications on color (order) systems, which have culminated in a historical overview entitled *Color Ordered: A Survey of Color Order Systems from Antiquity to the Present* (2008). This book remains the most comprehensive analysis of historical attempts to systematically organize colors. The color charts that are part of their research are presented in three chapters

1 Other publications, such as Patrick Baty's *The Anatomy of Colour: The Story of Heritage Paints and Pigments* (2017), take a bibliographic approach instead and do not usually fit into any of the above-mentioned branches. They are not particularly relevant in the framework of this study and therefore do not need to be discussed here.

2 Rolf G. Kuehni and Andreas Schwarz (2008, 25) have defined color systems or color order systems as "a general term used for any effort to systematically arrange color experiences." They have included both colorless diagrams and colored systems under these efforts but have not highlighted any differences.

3 Gerritsen 1975; 1979; 1984; Silvestrini 1994. This occurred in the catalog for the exhibition held at the XLII edition of the Biennale di Venezia in 1986, which was curated by Silvestrini. The catalog was printed for a later iteration of this exhibition at the Bauhaus-Archiv in Berlin. It was reprinted again in 1998, 2002, and 2005 with extensive additions. The exhibition has a dedicated, yet not updated, website with illustrations: http://www.colorsystem.com/?page_id=551 (last accessed: 10/09/2019) ; Spillmann 1991; 2009; Caivano 1995; 2023; Crone 1999; Kuehni 2003; A. Schwarz 2004.

and grouped into linear systems, bidimensional systems (color diagrams and color circles), and tridimensional systems (solids).[4]

Notably, Heinwig Lang and John Dixon Mollon have proposed a different approach. These scholars have introduced the term "trichromacy," which is a property of human color vision that is usually associated with the works of Hermann von Helmholtz, Thomas Young, and James Clerk Maxwell, to capture a color theory in early modern color science and diagrams.[5] Mollon has stated that "the basic notion of trichromacy emerged in the seventeenth century" and was used "before the true nature of trichromacy was grasped."[6] He has characterized this early understanding of trichromacy as centering on the "trichromacy of color mixtures" and identified it with the modern concept of subtractive color mixture.[7] Mollon has referred to supporters of this theory as "trichromatists."[8] I adopt this term in the present study. While Kuehni and Schwarz have acknowledged the discussion revolving around the "three painter's primaries," they have not considered earlier trichromatic theories as a parameter for the development of color (order) systems.[9] The color systems that Kuehni and Schwarz have differentiated as either linear, bidimensional, or tridimensional have been grouped by Lang and Mollon into diagrams and charts developed following this early trichromatic idea. However, Lang and Mollon have not discussed further theories used to produce color charts.

In 1961, Charles Parkhurst commenced a long and successful line of research on color theories in both optics and art.[10] Compared to the previously mentioned studies, this research line affords a less comprehensive and in-depth analysis of color charts as a whole. Although Parkhurst's inaugural research is partly indebted to Gerritsen's work, it introduces a new criterion for the categorization and understanding of these diagrams: the aesthetic concept of color harmony in painting and art. Faber Birren was the first scholar to expand on this concept after Parkhurst.[11] Since the 1980s, there has been an increasing interest in historical understandings of color in the history of both art and science. This trend has manifested in myriad publications

4 These chapters are entitled "Linear Systems, Color Diagrams and Color Circles, From Two to Three Dimensions." The only exception is Edmé-Gilles Guyot's representation of Castel's *clavecin oculaire*, which appears in Chapter 11, "Miscellaneous Systems II: Incomplete and Unconventional Systems" Kuehni and Schwarz 2008, xi, 27–90, 288–289.

5 This line developed at the end of the 1940s (Halbertsma 1949; Weale 1957). Lang (1980a; 1983) and Mollon (2003) were the first to associate trichromacy with color systems.

6 Mollon 2003, 5–6.

7 Namely, three main colorants (red, yellow, blue) produce all other compounds; see Mollon 2003, 5.

8 Mollon 2003, 8.

9 Kuehni 2003, 37; Kuehni and Schwarz 2008, 16–24.

10 Parkhurst 1961; 1971; 1973a; 1973b; 1990. Parkhurst and Robert L. Feller (1982) also wrote an essay on the history of the color wheel.

11 Birren 1965, 15–30, 119–26.

that sometimes mention color diagrams but rarely consider these visual tools as the main subject of their investigation. Such publications include John Gage's *Colour and Culture* (1994) and *Colour and Meaning* (1999).[12] One exception is *The Science of Art* (1990), in which Martin Kemp analyzes color knowledge in art and science from the Florentine Renaissance to the advent of color photography. In this work, Kemp skillfully discusses color diagrams and charts as well.[13] Other art historians, such as George Roque and Andreas Schwarz, have combined the contributions of Parkhurst and Birren with Gerritsen's geometrical development of color charts to demonstrate how these visual tools are key to understanding concepts such as color harmony and color complementarity.[14]

Andreas Schwarz, Ulrike Boskamp, and Annik Pietsch were the first art historians to attempt the categorization of 18th-century color charts. Schwarz has discriminated between color (order) systems and color charts and subdivided the latter into three groups: *Farbsammlung* (color collection), *Farbkollektion* (color assortment), and *Farbmuster* (color samples).[15] Despite this subdivision, his categorization treats these groups almost as synonyms. His scheme maintains that all color charts are generally organized around one spatial dimension and, unlike color (order) systems, do not follow "theoretical considerations."[16] In contrast, Boskamp has adopted the term *Farbklassifikationssysteme* (color classification systems), which has been introduced by Sarah Lowengard to describe certain color charts developed by scientists and artists during the Enlightenment.[17] Meanwhile, Pietsch has referred to *Farbmischungssysteme* (color mixing systems) made with bodycolors or watercolors.[18] None of these authors seems to agree with any previously proposed grouping, and they have coined new terminology according to their specific case studies.

A slightly different situation can be observed in the second framework, the history of art and technology, where color charts have only occasionally been discussed by art conservators and historians of technology or art. Usually, the examples referenced by these authors are those that have been mostly neglected by historians of color science and related color theories. Indeed, unlike color (order) systems, these color charts typically systematize colorants instead of colors. Historians of color science have therefore been uninterested in these items in their studies. Nevertheless, these

12 Rehfus-Dechêne 1982, 15–22; Brusatin 1983; Kemp 1985; Gage 1981; 1984; 1989; 1990; 1994; 1999; Shapiro 1994; Pastoureau 2001; 2009; 2014; 2017; 2019.

13 Kemp 1990. In another article, Kemp (1985) briefly explores color theories from Cennino Cennini to Le Blon.

14 Roque 1994; 1996; 1997, 46–51; A. Schwarz 1999.

15 A. Schwarz 2004, 6.

16 "theoretischen Überlegungen" A. Schwarz 2004, 5.

17 Boskamp 2009, 217. Sarah Lowengard (2006, Number, Order, Form), whose work is analyzed below, subsumes all the color charts she discusses under this term. Karliczek (2013) uses *Farbklassifikationssysteme* as one of his categories of color orders.

18 Pietsch 2014, 161.

color charts have special significance to the study of historical pigments and dyes. For this reason, they appear in publications related to art techniques and materials. Some of these items have been addressed, for instance, in the pioneering works of Rosamond D. Harley on historical pigments and dyes in Great Britain between 1600 and 1835.[19] In addition, essays by Arie Wallert, Robert Fuchs, Doris Oltrogge, and Erma Hermens have described medieval and early modern color charts that were developed in painters' workshops in various European countries.[20] Truusje Goedings has also investigated mainly 17th-century color charts made in the Netherlands for use by *afsetters* (illuminators or hand-colorists) and *meester-afsetters* (professional illuminators or professional hand-colorists) who washed prints and maps.[21] Fuchs and Oltrogge have discussed color charts from the 18th and 19th centuries that were intended for this same purpose.[22] However, none of these publications has aimed to provide a full list of color charts used by practitioners.

In terms of comprehensiveness, the work of Lowengard eminently draws a rich picture of the color understanding and manufacturing in 18th-century Europe from the viewpoint of both practitioners and scholars. Whereas the aforementioned publications all concern color charts on a paper support, Lowengard's work takes into account color charts made of other materials, such as cloth and porcelain.[23] Her analysis of these items places them under one of two umbrella terms – "color classification systems" or "color ordering systems" – though neither term is sufficiently elucidated. Lowengard has also introduced further categories, such as color tables and color graphs.[24] In line with Gerritsen's theory, Lowengard has supported the development of these color arrangements in different spatial dimensions.[25] Still, apart from her alignment with historians of color science, Lowengard's work has the significant merit of not highlighting any trenchant discrimination between color (order) systems and other color charts.

An array of case studies on art and technological interactions during the 17th and 18th centuries is discussed in an anthology of essays edited by Magdalena Bushart and Friedrich Steinle. Here, Bushart and Steinle emphasize the need to approach color charts from the angles of art technology and science technology to understand their practical uses.[26] This work was the first to investigate the uses and applications of color (order) systems, which opened a new inquiry into historical color systems not only

19 Harley 1975; 1979; 2001.
20 Wallert 1991; Oltrogge 2009; Oltrogge and Fuchs 2011; Oltrogge 2018; Hermens 1995; 2001; 2006.
21 Goedings 1989; 1995; 2014; 2015.
22 Fuchs 2000; Oltrogge 2000.
23 Lowengard 1999; 2000; 2001; 2002; 2006.
24 Lowengard 2006, Color Tables or Color Graphs.
25 Lowengard 2006, Two Dimensions to Three.
26 Bushart and Steinle 2015.

as theoretical diagrams but also as practical tools. From this perspective, color order systems could be considered in parallel with color charts produced by practitioners. Steinle has reiterated this position in two other publications, where he attempts to identify the strands that shaped 18th-century color knowledge and, in part, had repercussions for the production of color systems and color diagrams.[27] According to his subdivision, the first strand arose in the field of natural philosophy with the rules for color mixing formulated according to the three painters' primaries and, later, with Isaac Newton's theory of colors. The second strand was triggered by Jacob Christoff Le Blon's discovery of trichromatic printing, while the third strand encompasses other attempts to chart colors for practical purposes. Nevertheless, Steinle states, "there are far more strands of colour research in the eighteenth century than just these three."[28] With this admission, he leaves the task of defining these other lines of development to the next generation of historians.

Recently, the anthropologist Anne Varichon has published the first attempt to unveil the great variety of color charts produced between the 15th and the 20th century. While the focus of her book are clearly those color charts used in textile and other color industries during the 19th and 20th centuries, very important and well-known color charts developed in the 18th and earlier centuries are here fully neglected.[29] Furthermore, the subdivision of color charts into different strands is not the aim of Varichon's book.

The last framework concerns the history of natural history. Color charts were also developed for and by natural historians, and their modern historiography started in the 1930s. Aloys John Maerz and Morris Rea Paul have traced a brief history of color standardization beginning in Saxony in 1774, when Abraham Gottlob Werner published his color nomenclature for mineralogists.[30] In 1938, Hans Pander contested that date, and, in his history of color charts (called *Farbentalfen* here), he notes that "there are at least 10 older works [with color charts], in part very comprehensive," the first of which dates back to 1680.[31] Pander's contribution is a concise yet thorough chronological documentation of some early color charts. Jiři Paclt has applied a similar approach in his studies on color charts and color terms used among naturalists.[32]

In all of these surveys, the color knowledge of draftspeople plays little to no role in the development of these items. However, a shift occurred in the 1990s, when Hans Walter Lack and María Victoria Ibáñez Montoya discovered a color chart that was allegedly used by three 18th-century draftsmen to paint botanical illustrations.[33] Lack has

27 Steinle 2016; 2018.
28 Steinle 2015, 60.
29 Varichon 2023.
30 Maerz and Paul 1930, 137.
31 Pander 1938a; 1938b. "Während es wenigstens zehn zum Teil sehr umfangreiche ältere Werke gibt" Pander 1938a, 187.
32 Paclt 1958; 1983.
33 Lack and Ibáñez 1997.

suggested a connection of this color chart with contemporaneous color systems created by naturalists.[34] The impact of the naturalists' "color world"[35] on the coloring practices of draftsmen had previously been described by Kemp, who has written with regard to color that "science performs a confirmatory and amplificatory function, assisting the artist in the development and consolidation of his ideas and practice."[36] This line of investigation, which presumes that naturalists guided practitioners in the development of color systems, has been continued and reinterpreted by Kärin Nickelsen, David J. Mabberley, María Pilar de San Pío de Aladrén, Robert Mulholland, Christa Riedl-Dorn, and Markus Dominik Riedl. However, with the exception of Nickelsen's work, these studies have been devoted to contextualizing the working method of these three draftsmen rather than understanding the logic of color charts as a corpus.[37]

André Karliczek has made a more recent attempt to single out strands of color charts in use among naturalists by partly building upon the works of Lowengard and Boskamp.[38] Karliczek has coined the term *Farbreferenzsysteme* (color reference systems) chiefly to distinguish the color charts used and developed in natural history from the color (order) systems devised by natural philosophers and painters. Karliczek's distinction is based on the premises and intentions of these two items. In his view, color systems aim to establish the order, harmony, and relationship of colors by means of a determined number of primaries and philosophical, metaphysical, mathematical, or theological tenets; in contrast, color reference systems intend to capture the colors of nature with visual references. The latter have the practical goal of standardizing both color names and color appearances to describe and measure the natural world.[39] Karliczek has also supplied a complex diagram of the ramifications of these two system types. This scheme essentially subdivides color reference systems into *Farbtabellen* (color tables) and *Farbskalen* (color scales).[40] Karliczek's work is a treasure trove of color charts developed for and by naturalists during the 18th century. It is valuable for its subdivision and grouping of color charts that previously had no clear positioning in historical studies on color science, including those produced by Werner's followers and students.[41]

34 Lack and Mabberley 1999; Lack 2003a; 2006; 2015; 2016.
35 "Color world" is intended as the main category of analysis in the volume by Baker et al. (2015, 15) and consists "of practices, concepts and objects" relating to color in the broadest sense.
36 Kemp 1985, 98.
37 Nickelsen 2006a; 2006b; 2016; Mabberley and Aladrén 2011; Mabberley 2017; Mulholland 2015; 2019; 2020; Mulholland et al. 2017; Riedl-Dorn 2019, 195–200; Riedl-Dorn and Riedl 2019.
38 Karliczek 2013; 2016; 2018; Karliczek and Schwarz 2016.
39 Karliczek 2018, 36–37.
40 Karliczek 2013, 101; 2016; 2018. Other historians have used the term color scale in specific case studies For instance, Kuehni and Schwarz (2008) have used the term "color scale" for Glisson's uncolored color chart.
41 See pp. 64–72; 78ff.

In reviewing the state of the art, I noticed that some of the studies exhibit an anachronistic perspective of the understanding of color charts. Kuehni and Schwarz, for instance, have construed the development of three spatial dimensions in color (order) systems in terms of the historical discovery of three color attributes, namely hue, chroma/saturation, and lightness/brightness, that were only identified by Albert Henry Munsell in 1905.[42] This very modern understanding was not fully grasped in the 18th century. Historically, the second dimension corresponded to color mixtures, as evident in the diagrams proposed by Johannes Zahn (1685) and Richard Waller (1686).[43] The third dimension appeared once black and white were integrated into diagrams to modify not only the hues of primary colors, as in Francis Aguilón's work (1613), but also their mixtures, as in the double tetrahedron Tobias Mayer theorized in 1758.[44] It was the application of mathematical rigor to color mixing – not the discovery of modern color attributes – that allowed for the construction of tridimensional color charts in the 18th century.

Other authors have presented their findings and conclusions in a weakly systematized manner that leaves substantial room for further questions. While paramount to this study, Karliczek's subdivision into color systems and color reference systems is not fully satisfactory. Karliczek has not thoroughly investigated the reasons and purposes for which these tools were developed, and his categorization fails to consider the methods by which color charts were manufactured. For instance, it indiscriminately groups color charts made to normalize color names with others that were intended to normalize colorant mixtures and fully rooted in the painters' practice. Thus, these two items are classified as having identical premises and intentions even though, as I illustrate, the first group, which I call "natural" color charts, was not meant to normalize pigment and dye mixtures. In addition, other studies have specified category names that, in my opinion, do not fit the given examples. For instance, Pietsch has identified Georg Christoph Günther's *Verzeichnis der Pastellfarben* (1762) as a color mixing system, yet it does not supply any mixing instructions.[45] Therefore, I do not believe it can logically be considered a color mixing system.

The presented studies form a fragmentary corpus on the history of color charts. Most studies on color organization efforts have focused on only one portion of a very broad phenomenon. Too often, historians have chosen to highlight only the internal logic of these color arrangements without properly analyzing their historical context in terms of manufacturing and applications. Finally, historians have seemingly misaligned their common terminology, which renders the study of this phenomenon even more disjointed and incoherent.

42 Kuehni and Schwarz 2008, 13, 114.
43 On Zahn, see pp. 267–268. On Waller, see pp. 33–36.
44 On Aguilón, see pp. 262–263. On Mayer's tetrahedron, see pp. 325–328.
45 Pietsch 2014, 162–165. On Günther's chart, see pp. 156–159.

This corpus is fragmentary because historians of science and historians of art and art technology have studied color charts separately, and investigations of historical color charts in these disciplines have rarely overlapped. Historians of color science have largely overlooked color charts developed by painters and practitioners as guidelines for their practice because such charts do not fit into the ideal category of color (order) systems. However, modern disciplinary boundaries cannot be applied to 18th-century norms and objects; thus, I believe that all items conforming to my definition of a color chart warrant cross-disciplinary exploration to reveal a clearer picture. For this reason, both color (order) systems and other, lesser-known color charts deserve to be part of broader, interdisciplinary research on this historical phenomenon. Indeed, there has been no comprehensive study of all color charts with the aim of categorizing these items into strands to provide an overview of their historical development and deliver data that illustrate their applications and practical uses.

In summary, the deficient and disaggregated state of the art calls for a new approach. The intent of my research is not to reject the works of scholars from prior decades, who in fact spurred its conception; rather, my goal is to produce the very first comprehensive history of 18th-century European color charts as both individual case studies and a historical phenomenon. With this objective in mind, I put forth a new approach that conceptualizes various strands of color arrangements, circumvents both disciplinary subdivisions and past preconceptions, and elucidates the interdisciplinarity of different color charts.

1.3 A New Approach to the History of Color Charts: Results and Book Contents

My basic approach is to start from scratch – to forget all previous classifications and categorizations, including color order systems, color reference systems, color mixing systems, color classification systems, color collections, color assortments, color scales, and color dictionaries. Instead, I place all assemblages of color samples selected for this study on the same level and regard them all as color charts. From this fresh perspective, I inquire *ex novo* into their nature, structure, and purposes.

To this end, I first gathered exemplars of color charts that could contribute significantly to an overview of this historical phenomenon. This research material consists of 66 color charts produced during the 18th century and 21 color charts manufactured before or after that century that align with the description given in the introduction above. Some of these 87 color charts have never been previously analyzed or published. In the second stage, I aimed to identify basic characteristics that can facilitate a general yet meaningful categorization of color charts. This new grouping of color charts should be useful not only to clarify the internal logic of each exemplar but also to highlight lines of development within the broader phenomenon. In this stage, I also had to consider how these characteristics could be underscored and which approach to adopt to find and define them. Neither the spatial organization of colors within the color charts nor the premise of these objects is meaningful enough to sort all of the color charts into large groups, as the spatial arrangement was often not taken into consideration by developers, and the premise is not known in some cases. My determination of the categories of color charts is ultimately supported by two factors: the context of their development and the purpose(s) for which they were created.

With these two factors in mind, I effectively subdivided the color charts into the three categories – natural, pigmentary, and trichromatic – which differ in their content, intent, and underlying purpose. Natural color charts feature hues that are displayed by things and bodies in nature, such as the red color of fire or the blue color of the sky. These charts were created by and for naturalists, who wanted to implement a standard color terminology to describe the objects of their investigations. Meanwhile, pigmentary color charts map the hues of colorants and their mixtures – for example, the yellow produced by the pigment gamboge[46] or the color(s) obtained by mixing the colorants red lead and azurite.[47] These charts were manufactured by practitioners to learn, test, and replicate the appearances of pigments and dyes. Finally, trichromatic color charts describe and visualize the color mixing theory of trichromacy, or *Dreifarbenlehre*, according to the notion that the primaries of red, yellow, and blue can yield a given set of secondaries when mixed. These charts were produced to validate this theory, mostly in opposition to Newton's theory of colors but sometimes to facilitate applications of trichromacy. In this book, how and to what extent these categories differ or overlap with each other is discussed in each dedicated chapter, where I analyze the color charts as single cases and highlight aspects of their content, intent, structure, and underlying purposes to reveal similarities with previous and subsequent exemplars.

This book, as the outcome of my investigation, is divided into three main chapters (Chapters 2, 3, and 4), each of which is dedicated to one of the three categories of color charts, and a concluding chapter (Chapter 5), which offers a holistic overview of the people, places, and reasons that illustrate how color charts contributed to the enhancement of 18th-century color knowledge. The chapters contain several subsections that engage with the different disciplinary fields and contexts in which the examples were developed. For almost every color chart, I sketch a biography of its author or developer, describe how it looked, identify the main colors or colorants mentioned or purportedly used by the author to manufacture it, specify its imagined

46 A vegetable pigment produced from the gum resin of the bark of several trees of the genus *Garcinia*; see Winter 1997.

47 Red lead is lead tetroxide, also called *minium* in historical sources; see Fitzhugh 1986. Azurite is a blue copper carbonate mineral; see Gettens and Fitzhugh 1993a, 23–24; Eastaugh 2008, 33.

and real applications, explore the textual sources that were possibly consulted in its development, and establish how and by whom the object was received.

Following the present introduction, Chapter 2 explores natural color charts. I first conduct a historical survey of earlier natural color charts, most of which were employed in the practice of uroscopy that became obsolete during the 17th century (Ch. 2.1). Then, I investigate how the color terminology of uroscopy was partly adopted by early modern learned men to develop color nomenclatures as instruments for studying nature (Ch. 2.2). Here, I delve into the color nomenclatures elaborated by the natural historians Philipp Jacob Sachs von Lewenhaimb and Walter Charleton during the 17th century. Some of the color terms in these nomenclatures appear in Richard Waller's *Tabula colorum*, the only known baroque natural color chart, which is analyzed in the third section (Ch. 2.3). I then examine another 18th-century approach to normalizing color terms among entomologists in the example of a catalog of names that the naturalist Giovanni Antonio Scopoli, under the advice of Nicolaus Poda, obtained in part by using color tops (Ch. 2.4). The subsequent section documents the successful development of modern natural color charts following the color nomenclature assembled by Werner for the classification of minerals (Ch. 2.5). Here, two subsections discuss the color charts of Franz Joseph Anton Estner and Johann Friedrich Wilhelm Widenmann as case studies of the reception of the Wernerian strategy of charting colors. The last section of this chapter explores the use of similar items in mycology, which was still a branch of botany in the 18th century, in the cases of Carl Ludwig Willdenow and his admirer, Friedrich Gottlob Hayne (Ch. 2.6).

Chapter 3 focuses on the realm of pigmentary color charts. This category has the highest number of examples. More importantly, the manufacture of these charts involved the widest variety of coloring supports and techniques, including glass, enameled porcelain, and dyed fabrics. Following a historical introduction (Ch. 3.1), eight color charts from before the 18th century are discussed, including both widely known color charts (e.g. that in the so-called Mayerne manuscript) and less famous ones (Ch. 3.2). These examples are fundamental to my argument that the manufacture and circulation of pigmentary color charts were well rooted in the artisanal practice, which was not the case for trichromatic ones. The subsequent three sections examine different 18th-century pigmentary color charts and their fields of application: manufacturing (Ch. 3.3), scientific illustration (Ch. 3.4), and the production of watercolor cakes and how-to books for amateur watercolor painters (Ch. 3.5). Some of the examples, such as the pigmentary color chart used by the Bauer brothers (**Fig. 3.20**), are well known, while others, such as the chart of Johann Heinrich Meynier (**Fig. 3.35**), have never been published before. The examples of color charts used in manufacturing are representative of a broad spectrum of painting techniques, including mosaic, enamel, and pastel painting as well as textile dyeing (Ch. 3.3), in which color charts were tools of the trade. I explain how one scholar, Jacob Christian Schäffer, urged the conflation of these tools of the trade with color nomenclatures deployed by naturalists in an attempt to normalize the coloring of natural history illustrations. Furthermore, I analyze the first color dictionary ever published, which was authored by Christian Friedrich Prange in 1782 and based heavily on Schäffer's ideas (Ch. 3.4).

Chapter 4 considers trichromatic color charts through six sections corresponding to the fields of development of the illustrated examples. This chapter, like the previous two, begins with a historical introduction to trichromatic diagrams before the 18th century (Ch. 4.1). I then describe the color circles in both Newton's theory of colors and trichromacy as well as the first trichromatic color chart ever published, which appeared in an anonymous pastel painting manual (Ch. 4.2). The third section focuses on the topic of the color of human skin and Le Blon's invention of trichromatic printing (Ch. 4.3). Subsequently, I explicate the fundamental effort to popularize trichromatic color charts by the Jesuit Louis Bertrand Castel, who was known for his anti-Newtonian position and *de facto* proposal of trichromacy as an anti-Newtonian color science (Ch. 4.4). I argue that Castel's work is deeply indebted to the contributions of the anonymous author of the first trichromatic color circle as well as to Le Blon's invention, though Castel never credits them. The fifth section considers the examples of Tobias Mayer and Johann Heinrich Lambert to investigate how trichromacy allowed mathematicians to develop color charts with new shapes and organize colors to an unprecedented degree (Ch. 4.5). In the final section, I explore the development of trichromatic color charts for use by entomologists based on the examples of Ignaz Schiffermüller and Moses Harris (Ch. 4.6). Here, I demonstrate how these two color charts are essentially reinterpretations of the color charts theorized and employed by both the anonymous author of the first trichromatic circle and Castel.

In Chapter 5, I systematically synthesize all of the findings and conclusions from the previous chapters. My analysis illustrates how the proposed subdivision of color charts enables a systematic organization that, while incomplete, is sensitive to historical constellations. Here, I harvest the detailed results of the three main chapters and re-present them in a broader overview. I first explain the reasons for the production peak of color charts in the 18th century (Ch. 5.1) and specify the general characteristics and purposes of trichromatic, pigmentary, and natural color charts (Ch. 5.2). Then, I discuss the applications for which color charts were devised and substantiate my proposed subdivision into the three types (Ch. 5.3). I subsequently highlight the main professions of the authors of each color chart type and propose a slightly different framing of the phenomenon of color charts to clarify the solutions that were chosen by various actors (Ch. 5.4). I also consider the inventions that followed from color charts, to which color charts partly or indirectly contributed, and for which color charts were used, and I summarize the previously neglected topic of the economy revolving around color charts. I conclude by formulating unanswered questions that exceed the scope of this work but nonetheless deserve further investigation.