# 5 Conclusions

In this book, I have analyzed examples of color charts in depth and traced their history, uses, and reception. In this concluding chapter, I view these detailed insights from a holistic perspective to fully visualize the overarching phenomenon of color charts. I specifically highlight five main topics that emerge from this research: first, the catalyst of the production peak of color charts in the 18th century; second, the characteristics of each group of color charts and their impacts; third, the applications of these tools, including how they reflect the domains of knowledge that chiefly engaged with them and their division into three main categories; fourth, the main professions of the developers and publishers of the color charts; and, fifth, the inventions and economy surrounding color charts. In the final section of this chapter, I deliver some conclusive remarks about general and lingering questions on the topic of color charts that could and should be addressed in future research.

## 5.1 Production Peak in the 18th Century

Three key factors explain the production peak of color charts in the 18th century. The first is the success of a new mineralogical method developed by Abraham Gottlob Werner in 1774 based on the identification of specimens through sensorial characteristics, such as color. This Wernerian method envisages the use of a color nomenclature to identify minerals (called "fossils" at the time), which was transformed into variegated color charts in the second half of the century.[2167] The second factor is the advancement of certain technologies, such as the re-discovery of hard-paste porcelain and prefabricated watercolor cakes in Germany, during the 18th century. As I show below in the section on the inventions and economy surrounding color charts, color charts were used in porcelain painting to catalog new nuances.[2168] Furthermore, prefabricated watercolor cakes were often advertised and demonstrated with color charts.[2169] The third and final

2167 See p. 59ff.
2168 On color catalogs for porcelain painting see p. 147ff.
2169 On prefabricated watercolor cakes, see Simonini 2023a. On color charts used to advertise this new product, see pp. 225–226.

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

factor is the evolution of trichromacy as a practical color mixing theory in opposition to Newton's theory of colors. Colored trichromatic color charts first appeared at the dawn of the 18th century. Between the 17th and 18th centuries, "color (order) systems" describing trichromacy progressed from uncolored diagrams to colored systems. Moreover, the intent of the later colored systems shifted from a merely illustrative purpose of visualizing color mixing theories for philosophy students to the pedagogical goal of demonstrating the mechanism of colorant mixing for practitioners.

These three factors are by no means disconnected, and they simultaneously contributed to the enhancement of 18th-century color knowledge. Yet, technological progress in color chemistry was surely the most significant driver of the increase in color charts during the 18th century. Notably, during the 18th century, many new colorants were introduced to the market, including the valuable Prussian blue as well as tin white, which was the first satisfying substitute for the toxic lead white.[2170]

Despite this technological progress, the production and use of color charts often remained tacit artisanal knowledge. For instance, the color catalogs of porcelain painters were rarely known outside of the *Farbenlaboratorium*.[2171] At the same time, during the 18th century, many color charts were printed, painted, and described in books, thereby becoming available and visible to a vaster readership. This sudden availability was achieved through cooperative partnerships that served as frameworks to devise, design, and manufacture color charts for publication. Such cooperative partnerships often resulted from natural historians and philosophers consulting practitioners, studying and perfecting their working practices with colorants or color knowledge, and publishing their findings in the form of a color chart. In many (but not all) of these endeavors, practitioners and learned men shared information about their color worlds. These exchanges gave life to more sophisticated attempts to map colors.

## 5.2 Characteristics of 18th-century Color Charts

In the previous chapters, I assess that 18th-century color charts can be divided into three main categories, which differ with respect to content, program, intent, and underlying premises. Still, it is fundamental to emphasize that this categorization must be understood as a modern one that was likely not perceived by 18th century authors, developers, or designers of color charts. It is, in this sense, a modern historiographical contribution to the study of color science. This research therefore delivers a generalized scheme for understanding the historical prerequisites and objectives of charting colors from a modern perspective. Such scheme is an instrument with which future research

2170 On Prussian blue, see Berrie 1997; Kraft 2008; 2019. On tin white, see Lamarre 2000.
2171 Klein 2014b, 597.

in this field can examine color charts as a whole corpus or as single cases. In this regard, I use the following subsections to summarize the prominent characteristics and purposes of each group, which informed the subdivision discussed in this work, while cross-referencing examples from the previous chapters.

## Natural Color Charts

In Chapter 2, I discuss 18th-century natural color charts and trace their origin to urine scales, such as those illustrated in *Fasciculus medicinae* (1491; **Fig. 2.2**). Although natural and pigmentary color charts look rather alike at first glance, there is a fundamental aspect that allows for a clear distinction: the terminology affixed to the samples. Natural color charts rarely use colorant names to describe nuances. In those that do, the descriptions usually disclose that the specified colorants were not necessarily employed to paint the samples. Pigment names are simply used as color descriptors. Color names – not the materiality of the samples – are the true focus of natural color charts. Thus, the color names are used to single out abstract hues rather than to catalog colorants or their mixtures, which is the case in pigmentary color charts.

This point can be clarified with examples of color varieties from the color nomenclature of Werner, who gave impetus to 18th-century natural color charts.[2172] Among the 54 color varieties Werner highlighted in 1774 (**Fig. 2.6**), 10 color terms are associable with colorants, such as smalt (*Schmalteblau*). Werner explains that he borrowed these terms from the corresponding colorants.[2173] Yet, all of Werner's color varieties named after pigments are described not only by the hue of the colorants but also with putative mixtures, minerals, and sometimes spectral colors. For instance, smalt "appears to consist of azure-blue mixed with a little white."[2174] Werner also claims to have identified this color variety in the spectrum, precisely "between violet and sky-blue."[2175] We can therefore deduce that Werner's color varieties are abstract or conceptual hues. It is likely for this reason that, in 1809, the trichromatist James Sowerby callously judged Werner's color varieties as "unnatural and absurd," "very indeterminate," "misleading," and "a confounded mess."[2176]

Despite Sowerby's criticism, natural color charts were much appreciated tools during the 18th century, in which the selection of meaningful hues and the naming process occurred mostly through referencing. In natural color charts, the color nomenclature was compiled by building a chromatic association between well-known

2172 See p. 59ff.
2173 A. G. Werner 1774, 108–109, 112.
2174 "mit etwas weiß gemischt zu seyn scheinet" A. G. Werner 1774, 109; 1805, 51.
2175 See p. 64 (n. 318) for the original sentence.
2176 Sowerby 1809, 46–47; Simonini 2018, § 32.

things, such as stones, animals, plants, food, metals, and even pigments, and the specific hue they resemble or display. Having an associative relation to an object with a particular hue that is expressed in the color name itself (e.g. lemon yellow) was paramount to immediately picture the abstract hue. In other cases, the supplied names were universally accepted color terms, such as black, yellow, and green, that generally did not need to be explained through an association.

Another useful method for determining hues, especially those with abstruse or uncommon names, was to subsume them under a main color, such as white, black, green, or blue. Since all 18th-century natural color charts stem from Werner's nomenclature, the number of main colors was always eight.[2177] There are two exceptions to this general tendency: Willdenow and Hayne did not group color varieties into main colors in their natural color charts for identifying fungi and lichens (**Fig. 2.18** and **Fig. 2.23**).[2178]

The division of color terms into main categories of abstract hues was quite widespread in color nomenclatures, which generally recognize the seven main color groups of white, black, red, blue, green, yellow, and purple.[2179]

In the Wernerian traditions, the relation of some color terms to pigments or dyestuffs does not necessarily imply that these colorants were used to paint the corresponding sample. In fact, the colorants employed to manufacture natural color charts were deemed insignificant. Descriptions of nuances in natural color charts intentionally omit instructions regarding the materiality of the samples, because these tools were not meant to teach color mixing and instead aspired to normalize color names and their hues.

However, we should remember that during the time period between the decline of uroscopy and the successful establishment of the Wernerian tradition of natural color charts, two authors attempted to normalize the color nomenclature for natural historians and philosophers using colorants as their starting point. These two authors, namely Waller and Scopoli, listed the colorants they used to manufacture or determine their standards for color terms. Despite the presence of these pigmentary instructions, these two attempts cannot be regarded as pigmentary color charts, as their ultimate goal was to normalize the color terminology of naturalists.[2180]

2177 In 1814, Patrick Syme extended the number of main colors to 10 by adding the purple and orange categories. Previously, these two main categories had been subsumed under blue, red, or yellow; see Simonini 2018, § 36–37.

2178 See pp. 102 and 113.

2179 See, for example, pp. 19 and 24.

2180 See pp. 34 and 49ff.

## Pigmentary Color Charts

Unlike the previous group, the pigmentary color charts analyzed in Chapter 3 present discordances concerning the number of main colors of abstract hues (e.g. brown, blue). Some authors of pigmentary color charts, such as Brenner and Prange, identify six main colors, while others, including Goeree, Boogert, Schäffer, and Schreger, list seven.[2181] The abstract hues in pigmentary color charts always feature black and white. Moreover, among principal colors, these color charts include green and brown, which are ranked as secondary or tertiary colors in trichromacy. Authors and designers of pigmentary color charts viewed main colors as umbrella terms that encompass all pigments and dyestuffs of similar hues. For instance, under the yellow category, Schäffer subsumes seven colorants: gamboge, yellow lake, saffron, orpiment, realgar, and antimony yellow (**Fig. 3.18**). In pigmentary color charts, the number of main colors rarely exceeds seven, but the number of main colorants is much higher, ranging from 10 in Brookshaw's *A New Treatise on Flower Painting* to 43 in the Sloane MS 2052 color chart.

Many other pigmentary color charts do not include main color categories because such charts were part of fragmentary working notebooks or had color samples disjointed from their recipe book, such as the Feldsberg color chart (**Fig. 3.20**) and the Vatican glass cakes for mosaic painting (**Fig. 3.9**). Because some of the information about these color samples is missing, it is unclear whether the authors and developers of these objects were interested in grouping colors according to their abstract hues.

Pigmentary color charts can also be found in manuals for teaching painting techniques to enthusiasts, such as Günther's *Praktische Anweisung zur Pastellmahlerey* (**Fig. 3.15**) and Friedrich's *Anweisung zum Zeichnen und Blumenmalen* (**Figs. 3.29–3.31**), where instructions and samples are bound together. These cases do not highlight main color categories either; in fact, neither Günther nor Friedrich even discerns main colorants from mixtures.[2182] In other cases, the authors do not discriminate between main colors and main colorants, especially in how-to books on watercolor painting. These authors single out a number of colors that they call "main colors," but these colors clearly correspond to pigments rather than abstract categories.[2183] These clues imply that the notion of main colors was a rather flexible concept and not a major concern in pigmentary color charts.

Another fundamental characteristic of pigmentary color charts is that pure colorants and the hues they represent are simply named after the corresponding colorants. The yellow color produced by gamboge is simply called gamboge. No author attempts to provide further epithets for these color appearances. This phenomenon is evident in, for example, Schäffer's *Farbenverein*, where the eight simple reds are named

2181 For an in-depth analysis of the selection of six or seven main colors, see pp. 120–122.
2182 See pp. 156 and 228.
2183 See the examples on pp. 225–258.

after their colorants.[2184] While synonyms and renderings in other languages occasionally complicate the identification, the names generally refer to their materiality.[2185]

Dyers, enamellers, and mosaicists were the first to embellish the color terminology of mixtures. Samples obtained with mixtures refer to the names of things, animals, and flowers.[2186] With some exceptions in the second half of 18th century, the names of mixtures are generally absent from or not fully addressed in pigmentary color charts. This choice is logical since it would have been a true challenge to name all possible outcomes of mixing, for instance, 30 or 43 pigments with one another. This aspect is evident in the color chart of Sloane MS 2052 and in Boogert's manuscript, where the authors are able to chart a stunning 216 and 326 mixtures, respectively. Here, mixtures are simply named *Grun mit Bla* ("green with blue") or *geelen oocher en rust geel* ("yellow ochre and red orpiment").[2187] Late 18th century color charts, such as those published by Brookshaw, Riley, Meynier, and Lück, do not name a single nuance. Instead, in a similar fashion as earlier ones, they describe the mixtures by using the names of the two ingredients that produce the color – for instance, *Karmin und Indigo* (carmine and indigo) and *Vermillioen en Gutte-gom* (vermilion and gamboge).[2188] Similarly, *Farbenlexicon* provides many composite names, such as violet-brown and blue-green for mixtures.[2189] In the absence of satisfactory solutions to register new colors used in the artisanal practice, Prange relied on older methods and sporadically collected color terms for his dictionary, such as tiger yellow (*Tiegergelb*) and coffee black (*Kaffeeschwarz*).

In a few cases, we find generic categories for groups of mixtures, which are mostly green and purple (e.g. Sloane MS 2052, Brookshaw, Meynier, and Riley). Moreover, in *Farbenlexicon*, it is difficult to distinguish simple colorants from mixtures. As in the majority of previous cases, there is little discussion of color mixtures or their potential categorization (e.g. as secondaries or tertiaries). Prange's *Farbenlexicon* and all pigmentary color charts present mixtures as tints, shades, or nuances. Likewise, in Meynier's color chart (**Fig. 3.35**), the names of mixtures function only to group similar hues, such as violet colors (*Violette Farben*), which are nonetheless not necessarily discriminated from main colors (e.g. black, blue, brown) but described as "new nuances" (*neue Nuancen*) yielded by "simple colors" (*einfachen Farben*).[2190] Among these hues, we also find brown, red, and yellow colors.

The color chart prototype in Schäffer's *Farbenverein* (**Fig. 3.19**) represents a key turning point in the desolate status of the systematic charting and naming of color mixtures in the pictorial practice. Schäffer conceptually enhanced the idea of a

2184 See pp. 173–174.
2185 See, for instance, Brenner's chart on pp. 137–140.
2186 See pp. 145–146, 150, and 160–161.
2187 See pp. 131 and 142 (n. 681).
2188 Meynier 1799, 205; Lück 1802, 16.
2189 See p. 203.
2190 Meynier 1799, 205.

pigmentary color chart by proposing a standardization of mixtures, and supposed that they could all be named for the sake of naturalists.[2191] His idea spurred the production of Prange's *Farbenlexicon*, which was the first printed color dictionary to supply color samples and their recipes (**Figs. 3.22**, **3.24**, and **3.27**). Prange's dictionary was unique in the panorama of 18th-century pigmentary color charts given the lack of any solution or genuine interest in color terminology, with the exception of the plagiarized and improved copies published in *Wiener Farbenbakinet* (**Figs. 3.26** and **3.28**).

*Farbenlexicon* is the apex of 18th-century pigmentary color charts for systematic naming. None of the large collections of color samples assembled before or after it (e.g. the Vatican glass cakes, Meynier's color chart; **Figs. 3.9** and **3.35**) aimed to systematically name nuances. In later attempts to map simple colorants and mixtures (usually of two colorants only), the importance attributed to naming progressively waned. The few surviving names are mostly for green and purple hues, with only two cases of a gray color (*Aschgrau*) and a brown color (*Rostfarbig*), respectively.[2192] This gradual but relentless aversion to the discussion of color naming was largely due to the goal of these pigmentary color charts and occurred simultaneously with the emergence of natural color charts in more compact color guides, which assigned absolute priority to color naming and completely overlooked the materiality of the samples.

## Trichromatic Color Charts

Trichromatic color charts, which are discussed in Chapter 4, comprise a rather uniform group. The developers of these charts recognize three primary chromatic colors – red, yellow, and blue – as abstract or ideal hues, which they often compare to those in the spectrum or rainbow. Many 18th-century trichromatists seem to believe that the spectrum is composed of three primary colors next to a variable number of secondaries. This belief is evident in the works of Castel, Mayer, Lambert, Schiffermüller, and Harris. The lone discordant voice is apparently that of Le Blon, whose *Coloritto* (1725) accepts trichromacy as a paint mixing theory and Newton's theory of color as an explanation for the mixing of colored light.[2193]

While the other types of color charts do not involve systematically mixing three main pigments, supporters of trichromacy singled out a set of main secondaries (*Nebenfarben*). Most identified three main secondaries (green, purple, orange), but some considered only two (green, purple) or even four (green, purple, violet, orange). The modern concept of secondary colors was not fully developed in the 18th century. Charleton and Mayer apply the term *secundarios* to all colors produced by mixtures of

2191 See p. 174ff.
2192 See Friedrich 1786, 24–25 and p. 228 above.
2193 See p. 290.

two or three primaries, including brown, gray, olive, cinnamon, and other unnamed modern tertiary colors.[2194] The differentiation of secondaries from tertiaries is made by the anonymous author of *Traité*, Castel in *L'Optique*, and Schiffermüller in *Versuch eines Farbensystems*. These authors refer to the modern tertiaries as either *couleurs sales* or *trübe Farben*.[2195] Although there was not yet an established vocabulary for these concepts at the time, we can safely assume that our modern secondary and tertiary colors emerged from 18th-century trichromatic theory.

Trichromatic theory regards white and black as equivalents of light and darkness, respectively, as in Aristotelian color theory. Yet, they were sometimes deployed as colorants to demonstrate theory through trichromatic color charts. Like Alberti, Mayer considers black and white to be non-chromatic colors and uses them to theorize a color solid. Furthermore, Mayer rightly believes that mixing the three primaries cannot produce pure black – only a very dark color.[2196] Le Blon, Lambert, Pfannenschmid, and Harris instead perceive black as the outcome of mixing yellow, red, and blue in the right quantities.[2197] Lambert includes black among his secondaries and positions it at the center of the triangles that form his color pyramid, yet he does not apply the term "black" to any of the samples in his pyramid (**Fig. 4.32**). Meanwhile, Harris uses an illustration of three overlapping blue, yellow, and red triangles to convey that black originates from mixing of these primitives (**Fig. 4.46**).[2198]

Castel placed black outside of his chromatic cabinet with a gray tonal scale, and he used this scale to gauge the other 12 lightness scales, which are lightened with a white pigment only. Harris colored with transparent washes and engraved black lines forming concentric rings to represent lightness scales in his prismatic and compound circles (**Figs. 4.45–4.46**). Lambert notably includes white among his main colors.[2199] Yet, like Harris, instead of a white pigment he made use of transparent washes over white paper.

Finding the ideal primary colorants to produce trichromatic color charts was a major concern of trichromatists. It seems that no ordinary 18th-century colorant could match the putative primary colors of the spectrum and rainbow, which trichromatists perceived as the natural epitomes of their theory. Although no common 18th-century red, yellow, or blue pigment was able to yield convincing secondary nuances through mixture with the other two primaries, some authors and developers of trichromatic charts found blue and yellow colorants that could approach the corresponding ideal primitives. However, opinions about the best red colorant varied wildly among

2194 See pp. 29 and 326.
2195 See pp. 273 (n. 1372), 307, and 375.
2196 See p. 326.
2197 See pp. 290, 351, 388, and Pfannenschmid 1781, 28.
2198 See p. 388.
2199 See p. 351–352.

trichromatists[2200] Seemingly, no single red could simultaneously deliver satisfying orange and purple tones. The anonymous author of *Traité*, Le Blon, and Castel mix two red colorants to overcome this technical problem.[2201] In contrast, Lambert chooses carmine as the primary red of his *Farbenpyramide*. With his color pyramid, Lambert surely set a standard as this pigment was repeatedly selected as the primary red in many later trichromatic color charts.[2202]

Harmony is another concept often addressed by trichromatists. The designers and developers of trichromatic color charts wanted to visualize the inherent connections among colors. In their colored diagrams, hues transition into each other to deliver an impression of a coherent system. For this reason, trichromatic color charts have frequently been called "color systems." Such concept of harmony is rooted in the analogy of color and music, which had already been heavily discussed by philosophers long before the appearance of trichromatic color charts. Trichromatists advanced this analogy to show that nuances, like notes and chords, followed mathematical proportions. In this view, nuances yielded by colorant mixtures could be pre-calculated, recorded, and painted in the same way as musical scores to teach harmony to painters and other practitioners. A desire to find order in the chaos and educate practitioners was the main driver of the development of early trichromatic color charts and virtually defined their primary purpose.

## 5.3 Applications of Color Charts

The assessment of real and imagined applications of color charts helps us divide the production of color charts into domains of practical and theoretical knowledge. The present study clearly highlights a division of knowledge according to the branches in which these items originated. Color charts from the 18th century (and usually earlier) have been produced mainly in and for three general domains or branches – medicine and natural history, artisanal practice, and art theory and optics – that reflect and emphasize the premises and goals of these items. The development and production of color charts in and for these domains significantly substantiate the categorization scheme of natural, pigmentary, and trichromatic color charts that I propose in this book. Indeed, natural color charts developed within the domain of medicine and natural history, pigmentary color charts were strictly within the realm of artisanal practice, and trichromatic color charts appealed to the discussion of colors that unfolded in the branch of art theory and optics. In the following sections,

2200 Simonini and Steinle 2022.
2201 See pp. 273, 292, and 309.
2202 Simonini and Steinle 2022.

I briefly illustrate how the applications of each color chart category clearly define its correspondence to a specific domain of knowledge.

## Medicine and Natural History

As I have illustrated, natural color charts stem from the traditions of color naming and color scales in uroscopy. The pursuit of a normalized color nomenclature gained momentum in the early modern period, during which Waller's *Tabula colorum* (**Fig. 2.4**) was published. Natural color charts focus on the terminology and appearance of colors. The intent of natural color charts is simply to normalize color names by way of painted samples. This aim is shared by all natural color charts discussed in this book, from Waller's attempt to Patrick Syme's field color guide (**Fig. 2.14**).

The addressees of natural color charts were experienced naturalists, who could have benefited from a common color terminology within their field of specialization, as well as students of natural history, for whom these tools had a mostly educational function. In this regard, the dissemination of these instruments was encouraged and facilitated by universities and learned societies. Some examples reveal the substantial involvement of these institutions. Waller, for instance, was a fellow of the Royal Society and created *Tabula colorum* for other fellow philosophers to describe "the *Colours* of *Natural Bodies* [...] with less ambiguity [...] than is usual."[2203] In addition, Scopoli compiled his color nomenclature while working at the Bergakademie Schemnitz for use by other entomologists. Werner's color nomenclature and related color charts originated at the Bergakademie in Freiberg as resources for both young and experienced mineralogists. Finally, two natural color charts were developed and published by Willdenow and Hayne, two pharmacists from Berlin later appointed as professors of botany at the Friedrich-Wilhelm University, who aimed for their charts to provide standard color names for the classification of lichens and fungi.

## Artisanal Practice

Pigmentary color charts were tacitly used in the artisanal practice and employed chiefly in painters' and printers' workshops, glassworks, dyehouses, enamel and porcelain *Farblaboratorien*, and colored paper manufactures. The development and circulation of these tools were mainly driven by the need to illustrate the appearance of colorants for young practitioners, document instructions for reproducing specific nuances, and record experiments carried out to create new colors. This color world publicly emerged around the mid-17th century in how-to books that partially unveil

2203 See p. 34.

the working methods of these practitioners. In 1670, Goeree published the first uncolored device of this sort in a book addressed to print colorists (**Fig. 3.4**).[2204] The first printed pigmentary color chart with actual color samples appeared in a booklet for amateur miniature painters (**Fig. 3.7**).[2205] During a brief phase in the second half of the 18th century, pigmentary color charts evolved into more complex instruments that also targeted naturalists, which opened the way to possible multidisciplinary applications of these charts (**Figs. 3.19**, **3.22**, **3.24**, **3.27**).[2206] However, such attempts failed miserably, which evidences that painters' and natural historians' approaches to color were irreconcilable. Natural historians were not interested in the bewildering variety of colors that practitioners could produce and focused instead on charting a reasonable number of them. Conversely, practitioners were mostly unconcerned with elaborating a coherent body of color terms.

Over the course of the 18th century, pigmentary color charts gained a new commercial purpose with the invention of new color technologies and the rising trade of colormakers. Colored paper and porcelain manufacturers advertised their goods through catalogs showcasing samples or specimens of their wares and the palette they could produce (**Figs. 3.12** and **3.26**).[2207] Likewise, pastel stick and watercolor cake manufacturers deployed color charts to attract the attention of potential customers (**Figs. 3.14**, **3.15**, **3.38**, **3.41**).[2208]

## Art Theory and Optics

While developers of trichromatic color charts had diverse backgrounds, their intent was the same: to demonstrate a color mixing theory supported equally by scholars and painters. Trichromatists considered their charts to be educational tools that establish rules for the coloring practice, guide practitioners in harmoniously combining colors, and validate this modification theory of color. With regard to their applications, trichromatic color charts were the most multifunctional and cross-disciplinary variety of color chart. The trichromatic approach was highly functional and utilitarian since it required only a few basic colorants to generate a substantial number of mixtures. Trichromatic charts were considered useful to avoid trial and error in the mixing of colorants, ease communication among merchants, and standardize color terms and color appearances. Trichromatic charts also demonstrated that the rules that were valid for colorants also worked for spectral and rainbow colors. They could illustrate the

2204 See pp. 132–134.
2205 See pp. 137–140.
2206 See pp. 174–177 and 209–211.
2207 See pp. 221–222 and 151–152.
2208 See pp. 155–159 and 252–258.

inherent connections of colors through their origins, positions within an organized scheme, and compatibility with other hues.

Trichromacy surfaced during the 16th century in optical and – to a lesser extent – printed art theory literature.[2209] For two centuries, this widely acknowledged color theory circulated and garnered support among philosophers around the University of Padua, the Royal Society in London, many Jesuit colleges across Europe, Académie des Sciences in Paris, and Göttingen Akademie der Wissenschaften. Some practitioners valued trichromacy as well. However, a large share of these artists supported trichromacy mainly as an optical theory and did not recognize any use for it in painting. Only a few practitioners actually found the theory implementable in practice. It was employed, for instance, by Le Blon to print colored mezzotints and by Quémizet to simplify the dyers' practice at the Gobelins.[2210]

## 5.4 Professions and Color Charts

It is interesting to consider the professions of the authors, developers, and designers of the color charts produced between the late 17th and early 19th centuries. Based on my research, I delineate four main groups of professionals who needed or desired a standard color terminology to identify and normalize well-established and newly developed nuances and to organize colors in a meaningful way. These professions are practitioners, mathematicians, mineralogists, and entomologists. I highlight these professions in my categorization of the color charts as well as the structure of this book. This delineation further illustrates how different color chart strategies were followed within the same group of professionals (e.g. entomologists). With respect to professions, another significant inference concerns the extent to which each group was interested and actively involved in the conception of color charts. For instance, practitioners were commissioned to design color charts, yet their participation in such projects was merely one of their many tasks. In the following sections, I explain why this is a significant result of the study.

### Practitioners

Previous publications on the topic of color charts have noticeably neglected one category of developers: practitioners. In this context, "practitioners" is an umbrella term that predominantly represents painters who used various techniques as well as

2209 See p. 259ff.
2210 See pp. 293 and 320–321.

dyers. Practitioners produced all types of color charts with every possible material; thus, they can be regarded as the most prolific and versatile developers of color charts. In their working routine, they mainly employed pigmentary color charts, which they manufactured with enamel cakes, vitreous pigments painted on metal plates, porcelain tablets or fragments, watercolors, bodycolors, oil, wax, and pastel colors painted on paper or other supports, dyed swatches, and colored paper cards pasted on a paper leaf.

Many color charts would have never been manufactured if not for these practitioners. For myriad reasons – though mainly because of the shift from an economy of goods handcrafted by guilds and small workshops to one dominated by royal and national manufactures – practitioners started showing their working methods to learned men around the 17th century.[2211] For instance, enamel and porcelain painters and dyer journeymen brought their know-how and working methods to new places. As employees of porcelain manufactures and dyehouses, these practitioners were subordinate to administrators and learned men, who supervised them and gained the authorization to observe and appropriate their secrets for the first time. In this way, working methods and practices were institutionalized and passed down to future generations of practitioners hired by these manufactures. Consequently, during the 18th century, color charts were no longer the tacit knowledge of small private workshops or single practitioners; in Ursula Klein's words, these charts were, like other artisanal secrets, finally depersonalized.[2212]

Because of this depersonalization process, no specific authors are known for certain pigmentary color charts. For instance, the collection of colored glass cakes at the Vatican mosaic studio (**Fig. 3.9**) was created through collective efforts by a number of anonymous or lesser-known *fornaciari*, mosaic artists, color technologists, and people working in the administration of the studio. Only the name of the "arcanist" Alessio Mattioli is acknowledged for this achievement.[2213] A similar collective endeavor occurred in the first European porcelain manufacture of Meissen between 1710 and 1740, where many employees claimed to have invented a new under- or overglazing color and reported carrying out color experiments that contributed to the Meissen color palette.[2214]

The know-how of practitioners was the real driver of the emergence of such a wealth of color charts during the 18th century. Practitioners used these tools in their daily practice and were consulted and hired by learned men to develop, design, and manufacture color charts. Thereby, learned men were able to adopt these methods in their own inventions and popularize these visual tools in pursuit of scientific

2211 S.C. Ogilvie 2000, 109–121; Hilaire-Perez 2008, 242–245; Epstein 2008, 70–78.
2212 Klein 2014b.
2213 Pogliani and Seccaroni 2010, 65. On the history of the Studio Vaticano del Mosaico, see p. 144ff.
2214 On this, see Rückert 1990, 48–54, 80, 81.

and societal advancement. Schäffer, for instance, maintained that the color charts published in *Farbenverein* (1769) were his brainchild, but this method was inspired by his Loibel, a miniature painter who draw the watercolor originals for many of Schäffer's publications.[2215] Schäffer relied on the know-how of practitioners for all sorts of projects but, like many other scholars, believed that these men and women had to be guided by learned men. According to Gabriella Szalay, "Schäffer considered such men to be little more than 'invisible assistants'" and had them depicted as putti in the frontispiece of his book on paper trials.[2216]

Practitioners were not only the acknowledged or unacknowledged designers of pigmentary color charts but also responsible for the development of natural and trichromatic color charts. Waller, a draftsman and fellow of the Royal Society, authored the first 17th-century natural color chart (**Fig. 2.4**), while it was perhaps an anonymous practitioner (or maybe Le Blon) who published the first colored trichromatic chart in 1708 (**Figs. 4.6–4.7**). Other practitioners were often consulted or commissioned to design natural or trichromatic color charts. Calau, whose name is clearly headlined on the title page of *Farbenpyramide*, advised Lambert on his choice of three basic colorants that could yield satisfactory secondary and tertiary colors in his pyramid (**Fig. 4.32**).[2217] Additionally, Quémizet generated and carefully recorded the formulae for an alleged 25,000 nuances for the Gobelins by means of the trichromatic theory (**Figs. 4.18** and **4.19**).[2218] In the creation of his natural color chart, Estner was helped by the painter Unterberger and then by Ecker, a successful cartographer, whom he credited with "the entire execution of these tables" (**Fig. 2.15**).[2219]

## Mathematicians

Mathematics seems to have played little to no role in the development and manufacturing of color charts. However, basic usage of weight and proportions is evident in certain color charts, namely those in Boogert's *Klaer lightende spiegel der verfkonst* (1692), Prange's *Farbenlexicon* (1782), and Waller's *Tabula colorum* (1686). Waller used two colorants in the same weight to produce their mixture, whereas Boogert produced five different shades of the same mixture by changing the ratio of the two ingredients of the color mixture. Likewise, Prange provided the numerical proportions of the ingredients for each of the 4,608 tints and shades in his *Farbenlexicon* (**Figs. 3.22–3.25**). Yet, none of these authors explained how to measure each ingredient.

2215 Simonini 2025a.
2216 Szalay 2019, 69.
2217 Simonini 2023a and p. 352.
2218 Simonini 2023b.
2219 "die ganze Ausführung dieser Tabellen" Estner 1794, 41.

Traditional colorant containers, such as shells, gallipots, and ceramic vessels, were utilized to obtain equal measures or proportions of colorants in a mixture. Since such procedure was progressively mastered through experience, visual judgements were preferred over mathematical rigor.

Most natural color charts seem devoid of even a basic usage of weight and proportions to quantify the main colorants in a mixture, as the manufacturing of samples was ancillary to the final function of the color chart. For this reason, color swatches in natural color charts were often colored quite haphazardly, which resulted in very discrepant exemplars of the same chart.

The opposite scenario can be observed in some trichromatic color charts, where mathematics was a key factor in their development and vital to the design of color charts that had not been seen before. For example, in his stepped color scale of skin nuances, Le Blon based the proportion of white to other colored inks on the integer sequence known as the Mersenne numbers. This sequence is visible in the draft of his *Carten-Tabelletjes*, which was presumably a trichromatic color chart for pre-calculating skin tones in his printing technique (**Fig. 4.11**).[2220] The Jesuit father and mathematician Castel also theorized and described scales of primaries, secondary, and tertiary colors using proportions. His *L'Optique* even includes a table of numbers showing the color proportions in each mixture. Before him, only Glisson had suggested a similar scheme, though for primary colors only (**Fig. 4.3**).

Two other mathematicians, Mayer and Lambert, realized that mathematics was fundamental to a harmonious and coherent system, and they constructed the first three-dimensional trichromatic charts in the mid-18th century. Although Mayer theorized the arithmetic to produce his *scala colorum* (**Fig. 4.21**) and a double tetrahedron, he did not specify how to precisely measure the primitive colorants in each mixture. Thus, Mayer's triangle would be difficult to replicate, as the accompanying text explains the quantities of pigments only in terms of parts, not weights (e.g. six parts of yellow and six parts of red in the nuance $g^6r^6$). Lambert was the first and last figure in the 18th century to calculate and state precise weights for the three basic colorants used to wash his *Farbenpyramide* (**Fig. 4.32**), which distinguishes his color pyramid as an even more unique effort to mathematize colors.

## Mineralogists

Mineralogists were the main recipients and publishers of natural color charts produced during the 18th century. However, it is necessary to stress that most mineralogists did not develop their color charts themselves but instead relied on the help of a practitioner. Nonetheless, mineralogists following Werner's method brought about

2220 See p. 290.

the publication of a stunning number of natural color charts between the second half of the 18th century and the beginning of the 19th century. Although mineralogists did not surpass practitioners as the most prolific authors or designers of color charts, in the period of less than 40 years between circa 1774 and 1821, eight natural color charts went to press for the first time.

The number of natural color charts manufactured for personal use by Werner, his students, and his disciples has yet to be fully uncovered. In his manuscripts alone, Werner painted 10 color charts for various purposes. These charts included drafts (**Fig. 2.10–2.11**) for a natural color chart that he intended to publish in a manual on oryctognosy, though this project never came to fruition.[2221] In addition, Estner asked three people to develop the natural color chart that he published in his mineralogy manual, but it is not known how many trials were sketched for this project or whether any of them are extant.[2222] A particularly interesting consideration is that the natural color charts employed or assembled by mineralogists were presumably created with a wide range of materials, including textile swatches, porcelain or ceramic tablets, various colored objects, mineral samples and lithotheques, and color charts painted on paper. At the same time, natural color charts were always constructed through a method of comparison with the color of the mineral specimens indicated by Werner in *Von den äußerlichen Kennzeichen der Foßilien* (1774).

## Entomologists

Unlike mineralogists, who adopted the Wernerian way of charting colors almost *en bloc*, entomologists were incredibly inventive and explored all possible methods to develop color charts. They aimed to not only standardize color terminology for descriptions of insect specimens but also catalog colorant mixtures to wash illustrations of insects. Indeed, the bewildering variety of colors on the wings of lepidopterans and other insects troubled entomologists, who searched for the correct words to describe them but were often met with inconsistencies and countless name variations. A similar problem persisted on their book plates, where the iridescent wing scales and metallic exoskeletons could hardly be rendered in watercolor.[2223]

It soon became clear to entomologists that color samples were instrumental to define and normalize both color terminology and colorants. Therefore, they attempted to obtain color catalogs with four-color prints, color tops, and pigmentary and trichromatic color charts. In 1749, the French entomologist Réaumur encouraged the engraver Gautier-Dagoty to use his four-color printing technique to produce color

2221 See pp. 69–71.
2222 See pp. 86–87.
2223 Mandrij and Simonini 2025, 16–18.

charts for cataloging colorants, but Gautier-Dagoty never published such a catalog.[2224] In 1763, Poda and Scopoli elaborated a standard color nomenclature using rotating disks and implored other entomologists to adhere to it.[2225] Schäffer adopted and popularized a different approach in 1769: pigmentary color charts combined with a normalized color nomenclature (**Fig. 3.19**). In 1771, Schiffermüller replaced Schäffer's pigmentary color charts with Castel's chromatic cabinet but retained Schäffer's idea to label the samples with standard color terms (**Figs. 4.41–4.42**).[2226]

Later, the entomologist and miniature painter Moses Harris bent Castel's chromatic cabinet into three circles: the Scheme of Colours (**Fig. 4.44**), a prismatic circle (**Fig. 4.45**), and a compound circle (**Fig. 4.46**). Harris named the nuances in his circles but removed the instructions for mixing the nuances, which were of vital importance to Schäffer.[2227]

Schäffer's idea of a universal cabinet of colors was realized, with amendments, by Prange, who provides each color sample in *Farbenlexicon* with a name and a recipe (**Figs. 3.22–3.25**). Prange recommended using *Farbenlexicon* to wash images of insects or notate them with sample number of his color charts. In this way, Prange documented the descriptive form of the paint-by-number technique for the first time.

In this context, it is significant that many entomologists in the late 17$^{th}$ and early 18$^{th}$ centuries were also skilled draftspeople, including Maria Sibylla Merian, Jacob L'Admiral, August Johann Rösel von Rosenhof, and Harris. Even Schiffermüller was trained in miniature painting.

## 5.5 Inventions and Economy Related to Color Charts

The use and development of color charts are clearly linked to some outstanding 18$^{th}$-century inventions that led to an economy of objects produced with color charts and even a market for color charts themselves, which were generally intended as educational or instructional instruments. The first example is the use of trichromatic color charts in the invention of trichromatic printing. Le Blon's *Coloritto* contains no trace of an actual color chart apart from the painters' palette (**Fig. 4.12**). Yet, *Coloritto* was a marketing tool with which Le Blon informed all of Europe about the usefulness of trichromacy. It also indirectly showcased his invention of trichromatic printing by presenting two plates depicting the head of a woman progressively colored with this

2224 See p. 368.
2225 See pp. 46–47 and 52.
2226 See pp. 370–373.
2227 See p. 394.

technique.[2228] Thus, *Coloritto* was intended to generate further interest in Le Blon's invention and entice new clientele with his printed pictures. Le Blon heavily advertised his product and even sent his prints to Accademia di San Luca in Rome in the hope of finding patrons and new buyers.[2229]

Some historians have ascribed to Le Blon an "incommunicable ability to mentally decompose every image in three colors."[2230] However, I argue that this ability was communicable and learnable, as his pupils were clearly able to acquire it. I believe that the secret to Le Blon's ability was his use of an enhanced form of his *Carten-Tabelletjes* to regulate and calculate the quantity of primary colorants in his trichromatic prints. In the *Carten-Tabelletjes*, Le Blon may have harmoniously organized colors tonally and by degree of lightness. His deployment of such an instrument, even in later years, is evident from Castel's development of a very similar color chart: the chromatic cabinet.[2231] Based on other earlier examples illustrated in this study, the use of color charts as painting and mixing guidelines was quite common among practitioners. For instance, De Gheyn developed a color chart while transitioning from engraving to oil painting. Like Le Blon, De Gheyn had a background as a miniature painter and illuminator.[2232] Therefore, we can assume that color charts played a role even in the invention of trichromatic printing, although, to preserve secrecy, Le Blon decided not to tout this instrument.

Besides trichromatic prints, other reinvented techniques fundamentally relied on color charts. Here, the charts served as tools to systematize, arrange, record, and test colors. In particular, the adoption of color charts resulted partly from the revival of mosaic painting between the 16th and 17th centuries in Venice – and, slightly later, in Rome – as well as the discovery of the *arcanum* of Chinese porcelain in Meißen in the 18th century. These charts were either painted samples on fragments of porcelain (**Fig. 3.11**) or blocks of vitreous colors kept in cabinets (**Fig. 3.9**). Each sample was given a number or alphanumerical code associated with the box in which the same color was stored, and its formula was logged in a recipe book. In the 18th century, the economy surrounding these vitreous colors was massive. Numerous colors were discovered during this century, though they have unfortunately been studied only cursorily. Inventors of new porcelain glazes and glass colors also mushroomed since such inventions were finally recognized and encouraged by monetary rewards.

Another invention that seems to be linked to color charts is that of prefabricated watercolor cakes. This invention emerged in 1773 or 1774 from the combination of Lambert's trichromatic pyramid and Calau's discovery of a new waxy binder. Lambert

2228 Scott 2003; 2018, 253.
2229 Stijnman 2020, xxx, xl.
2230 "faculté intransmissible qu'il possède de décomposer mentalement toute image en trois couleurs" Rodari 1996, 62–63.
2231 See pp. 307–308.
2232 See p. 129.

convinced Calau to fabricate watercolor cakes of 28 of the mixtures he devised for his pyramid, which were sold in a well-organized color box.[2233] Traveling painters and amateurs could purchase and use these cakes instead of having to fabricate their own. Plagiarists immediately sensed a profitable market, and the following decades witnessed increasing sales of prefabricated watercolor cakes in elegant mahogany boxes by many more suppliers in other cities, especially in Germany and Great Britain. Interestingly, many of these suppliers, such as Pfannenschmid and Riley, published books on color mixing or landscape and flower painting that include color charts.[2234] In Riley's case, the color chart served to teach his (mostly female) readership which colors in the box were suitable to, for instance, wash the leaves or petals of a flower (**Fig. 3.41**). More importantly, such color charts served as visual representations of the color boxes that were for sale to lure new buyers, as the earlier example of the pastel stick manufacturer Günther documents (**Fig. 3.15**).

After Lambert and Calau's invention, other color charts appeared in manuals on botanical painting to instruct *dilettanti* in the use of watercolors. These charts were created by painters to supplement their income and closely resemble the color charts used in private illumination studios or porcelain *Farbenlaboratorien*. Such painter-authors included professional flower painters of both watercolors and porcelain, including Friedrich and Lück.[2235] Furthermore, these color charts had a commercial function, as professional painters could advertise color cakes sold by a particular colormaker with whom they might have worked or been a business partner.[2236] Hence, color charts were the starting point of the flourishing prefabricated watercolor cake industry of the late 18th and early 19th centuries.

## 5.6 Open Questions

This comprehensive study on color charts provides a fresh perspective of 18th-century efforts to chart and normalize colors in terms of hues, colorants, and names. Nevertheless, there are still several lines of inquiry that must be investigated. A significant problem that I encountered excessively during my research concerns the materiality of the colors used to produce the color charts. In this regard, an open question persists: which colorants were actually used to manufacture color charts?

For the natural color charts, we do not have the faintest idea of which colorants were employed to wash them. Yet, in many other cases, these details are clearly and

2233 Simonini 2023a.
2234 On Pfannenschmid, see p. 345. On Riley, see pp. 252–258.
2235 See pp. 226 and 246.
2236 See from pp. 235, 241–242, 247–248, 251–252.

even meticulously noted down for the benefit of contemporaries and posterity. While many of these cases are apparently ideal, especially in color charts published in printed books, the distressing reality is that the authors' information about how the samples were painted are not always true. This very problem is particularly evident with trichromatic color charts. Mayer, for instance, compares the mixtures in his *scala colorum* (**Fig. 4.21**) with colorants.[2237] However, it is unclear if these paper clippings were actually painted with simple pigments or if the resulting colors just resembled them. Likewise, Harris claims that the primitive blue of his prismatic color circle is ultramarine blue (**Fig. 4.45**), which is hard to believe given that it was the most expensive blue on the market in the 18$^{th}$ century.[2238]

Some pigmentary color charts show a similar problem. For instance, Schäffer fails to name one of the blue colorants used in *Farbenmuster* (**Fig. 3.18**).[2239] Meanwhile, Friedrich maintains that *Dunkelrosenroth* (dark rose red) is his "arcanum," thus shrouding its nature in mystery.[2240] Other cases include porcelain *inventaires*, such as the fragments belonging to the Wegely porcelain manufacture in Berlin (**Fig. 3.11**), which can no longer be decoded because the registers listing their formulae may have been lost.

As historians, we analyze written material and extrapolate historical data from it. If the sources are not trustworthy, the results of our research become fragmentary or even unreliable by extension. New insight into the materiality of some charts could be obtained by chemical or optical analysis, or other technologies. The expertise of conservators and restorers should be enlisted to tackle this issue. This work has already been done on some color charts – such as Waller's *tabula colorum*, Werner's collection of porcelain tiles, and the Feldsberg color chart – and has proven, for instance, that the author used different colorants from one copy to the next.[2241] This approach could resolve the problematic lack of information about the materiality of color samples in color charts.

Another open question concerns the naming of colors and their material realization. During this research, I repeatedly encountered uncommon color naming, such as nacarat, *Haarfarbe* (hair color), or *fleur de pecher* (peach blossom). In some cases, the names do not simply describe a nuance but seem to instead relate to a precise pigment or procedure for extracting that color. An ongoing research project explores precisely the meaning of such color terms.[2242]

2237 See p. 329.
2238 See p. 392. On the cost of ultramarine, see Plesters 1993, 38.
2239 See p. 173.
2240 See p. 228.
2241 Baraldi, Fagnano, and Bensi 2006; Kusukawa 2015; Paskoff and Baldauf 2016; Mulholland 2020.
2242 Simonini 2022b; 2023b.

Besides specific names, the historical naming method for grouping and discriminating between colors raises further questions. I noticed that scholars have largely ignored how variegated these groupings are and how modern readers might perceive them as confusing and even illogical. This diversification is paradigmatic in the trichromatic tradition, where the epithets for main colors indicate a shift away from trichromacy heavily influenced by Aristotelian philosophy in favor of 18th-century trichromacy. In this process, the three colors red, yellow, and blue, which were initially regarded as intermediates (*medios*) of the extremes, white and black (*extremos*), were reframed as simple colors (*simplices*) for the first time in 1669.[2243] Subsequent works apply the labels prime colors (*première*), main colors (*Hooftverwen*), and primitive colors (*primitives*) to these colors.[2244]

While Alan E. Shapiro has maintained that "in the early eighteenth century primitive was becoming the standard French term for primary, both in the painters' and Newton's sense,"[2245] this epithet can be located in 17th-century English texts describing the basic colorants of practitioners. It is plausible that the epithet "primitive" was later popularized by trichromatists such as the anonymous author of *Traité* and Le Blon –, who appropriated the English color vocabulary to formulate their theory of color mixing. The precise origin of this term remains to be uncovered, but such information could surely shed new light on the history of trichromacy and color mixing in general.

Secondaries or mixtures can also be understood by means of generic terms. In this book, I have clarified how authors of color mixing manuals and theories deal with the idea of mixtures as well as which umbrella terms they provide for them. Rudimentary categories of mixtures and their modern terminology emerged from renaissance color theory and were further advanced by trichromacy. In 1584, Raffaello Borghini used the terms *misti* (mixed), *mezani* (intermediate), and *secondi colori* (second colors) to identify mixtures.[2246] In 1669, Scheffer was likely the first to name green, purple, and orange as *mixti secundarij*, a term rendered as *secundarios* by Mayer. No clear terminology for mixtures exists in pigmentary color charts. Prange uses the term *Nebenfarben* (ancillary colors), while Maynier discusses *Mischungen*, in which he also includes color groups such as *blaue Farben* (blue colors) and *schöngelbe Farben* (beautiful yellow colors). In natural color charts and color nomenclatures, mixtures are not a discrete topic but are described as varieties or modifications subsumed under the relevant main color categories. Further research should investigate how we can construe these different understandings of color mixing and color hierarchy.

My final open question concerns the role of publishers and publishing houses in the production of color charts: Were color charts produced and manufactured

2243 Scheffer 1669, 158.
2244 Félibien 1679, 28–29; Beurs 1692, 4; Anonymous 1708, 152.
2245 Shapiro 1994, 614–615, 624, n. 57.
2246 Borghini 1584, 206, 230.

by printers and booksellers or by the authors themselves? The scant information in books with color charts suggests that either scenario is possible. For instance, Estner instructed the publishing house on how to bind the plates correctly to avoid damaging them.[2247] This example implies that the color charts were produced without the help of the colorists working at the printing shop and were manufactured at the workshop of the cartographer and miniature painter Johann Anton Ecker (**Fig. 2.15**). On the other hand, for the production of the printed color charts in his publication, Widenmann commissioned the Leipzig publishing house of Siegfried Lebrecht Crusius, and the project was supervised by the renowned scientific illustrator Jean Etienne Capieux (**Fig. 2.17**).[2248] Crusius kept the copper plate and used it again in 1803 for a similar publication authored by Christian Friedrich Ludwig. Between 1772 and 1833, the Berlin publishing house Haude und Spener was responsible for printing Lambert's *Farbenpyramide* and seven editions of Willdenow's *Grundriss der Kräuterkunde*. All of these books included a color chart: the famous color pyramid in Lambert's publication (**Fig. 4.32**) and a differently colored version of the same natural color chart in all editions of Willdenow's textbook on botany (**Fig. 2.18**).

Unfortunately, there is virtually no knowledge of how these plates were produced or to what extent the publishing house was involved in the process. The plate displaying the color pyramid is unsigned, and Lambert only states at the end of the book, "one can finally easily keep in mind that one and the same mixture was not applied in all specimens completely with the same strength."[2249] Thus, it is not clear who colored it or whether the drawing for the plate was sketched by Lambert, Calau, or somebody else. To clarify issues such as the inconsistency between exemplars of the same color chart, scholars can explore how the coloring process was stipulated between the actors involved, how colorists were hired and instructed, and how colorants were selected, especially for natural color charts.

In conclusion, color charts are a complex research topic, and there is still much to be uncovered about them. The subject of color charts is deserving of further cross-disciplinary scholarly interest and warrants additional investigation to be fully appreciated and comprehended.

2247 Estner 1794, n.p.
2248 See p. 95.
2249 "Mann kann sich endlich auch leicht gedenken, dass eine und eben dieselbe mischung nicht in allen Exemplarien, vollkommen mit gleicher Stärke aufgetragen worden" Lambert 1772, 126. Compare with Rolf. G. Kühni's translation in Kuehni 2011, 79–80.