

Introduction

Toutes les choses visibles se distinguent ou se rendent desirable par la couleur.

—Jean-Baptiste Colbert, *Instruction général pour la teinture...*

This is a book about the organization of science and technology in eighteenth-century Europe, about the relationships of each to the other and to the worlds in which they existed. The underlying theme is the collection and arrangement of information, and the subsequent employment of that information to create a place for its collector—a person or occasionally an institution—within the modern world of the eighteenth century. Colloquially expressed, it is a study of contemporary answers to a question—"What do you think you're doing?"—asked of institutions and governments as well as individuals.

The object of my investigation is color. That is, I turn to the range of interests and activities associated with color as an idea and with color as the outcome of technological processes (colormaking) to establish both questions and answers. To do this effectively, I join examples from different colormaking traditions and different scientific disciplines. I use this collection of data to examine the application of theories in practice and practices in theory during a long eighteenth century in Europe, particularly in Britain, France, and Germany.

The result of this agglomeration is a reassessment of eighteenth-century connections between practical techniques, philosophical ideas, and the cultures in which they resided. It exposes interdependencies that altered approaches and results, clarifies some well-known events, and reinterprets others that are, by tradition, less easily assimilated. This study of color provides a model to understand other interactions between industries and ideas in eighteenth-century Europe and their place in a larger cultural setting.

Color is a particularly appropriate topic for such a broad-based examination. By the eighteenth century, the production of dyes, pigments and glazes were well established industries. The need for color was well known. The search for new colors, or for improved methods to produce known ones, was constant throughout Europe, throughout the eighteenth century. Color was a subject of systematic experimental and theoretical investigations in the sciences. Color production techniques were subject to an equally intense market-conscious if not market-driven scrutiny. At the same time, color had a place in the world beyond the factory, the laboratory, and the study. Because it was familiar and accessible, color brought philosophical ideas close to everyday experience. In books and lectures directed at popular audiences, color was used to illustrate connections between methods and theories, emphasizing the familiarity and practicality of

colormaking techniques.

Color was an integral part of things, but it also had an existence separate from objects, playing several roles within the sciences during the eighteenth century. Colors differentiated natural-history objects and marked physical or chemical transitions in experiments. Color and colormaking presented some appealing puzzles: What were they? Were they one thing, or several? Both color and colormaking were connected in the minds of many people to optics and optical phenomena, where their philosophical and analytical problems were known to engage the best minds of the age. Theories of color were frequently incorporated into explanations of light. Color was worthy of concentrated philosophical examination because it included practices that could be made experimental—that is, that could be explained through the results of a purposeful investigation.

Eighteenth-century European culture was overflowing with color in its diverse configurations, and many people were drawn to better understanding of the subject. In an era when intellectual and practical pursuits were often combined, color was a potent site for their juncture. Beliefs about links between materials, techniques, and theories suggested that improved comprehension of color would have positive practical, commercial, and intellectual outcomes. Practical descriptions of color could be summoned to enhance theoretical explanations. The quest for new colors and for improvement to understanding more generally could look to the sciences for order and direction. The search for new colors and improvements to existing ones were ways to connect science to public advancement and politeness, ways that carried hints of potential personal gain. Throughout the eighteenth century, people from all social and economic backgrounds thought about color, experimented with color, and offered their own notions of how to explain it, how to use it, and how to improve it. In this book, I will discuss those interests, explorations, expectations, and outcomes.

The Creation of Color in Eighteenth-Century Europe is also my effort to address several long-standing personal concerns. First was a desire to integrate knowledge I have gained from handling eighteenth-century artifacts with interpretations of contemporary social and intellectual interactions based on more traditional historical sources. It has seemed to me that important clues about quality, and therefore about expectations for use and the possibilities of change, are embedded in the techniques of creation. These clues are not well understood because the significance of production processes to the resulting objects is often downplayed.

Second was an interest in the development of production techniques during the eighteenth century and especially in the interactions among different occupations or industries as sources of innovation. With a few exceptions, historians have no basis to compare similar or analogous colormaking processes and no means to

examine inherently different kinds of colors put to comparable uses. As a result, we cannot fully assimilate the changed processes or new uses for any one technique. My curiosity about the possibilities of technologies that developed from examination of other practices in the eighteenth century led to a strategy that called for me to avoid the customary structure wherein a single subject, category of object, or technique is used to represent all others. The study of objects is often highly compartmentalized, but the study of color need not be. Here, I look at color and colormaking for textile dyeing and printing, pigmentmaking for fine-art, decorative and industrial purposes, and vitreous colormaking—colors for ceramics, glass and enamel.

Also at issue was my understanding of the transfer of ideas or objects across geographic or political boundaries. Information about color, as objects and as ideas, moved easily and often quickly despite regulations, tariffs, and other prohibitions. Trade was too important to local and national economies; colored objects and coloring materials were the artifacts traded. Conspicuous examples of these porous borders exist in the international commerce in printed works about color. Particularly important were periodicals, issued throughout Europe, in which goods were described (occasionally with samples included), techniques discussed, and reports of scientific investigations presented. Furthermore, examples of espionage and the luring of skilled workers to new factories abound in histories of eighteenth-century trade and technology. Events or concerns of one region affected or flourished in others as well.

Another personal concern was my reluctance to cede to physics the principal place in a study of color founded in workshop practices. The characterization of eighteenth-century chemistry as under-fledged in comparison to physics has often meant that understanding the former begins with the latter. Mathematics and mechanics, optics and dioptrics are present in discussions of color practices, especially those at the fine-arts academies, but chemistry was more directly a part of the daily routine of colormakers. There are good reasons to consider physics here. If eighteenth-century chemistry was not chemistry as now practiced, neither was eighteenth-century physics. References to Newton, Descartes, Gassendi, and even Aristotle were obligatory in practical writing intended for publication. But color production needed chemical operations and chemical sensibilities first, to explain and direct events in the workshop and studio, and so my emphasis lies there.

In order to address these concerns I needed to establish a model that could accommodate multipractice, multidirectional interactions among and within eighteenth-century craft and theory across national boundaries. Color was international, and it crossed social and cultural groups within and between nation-states. If we look at all enterprises, organizations, and people interested in the phenomena of color, we find a diverse group. It includes theorists and

academics, production personnel and manufacturers, colormakers and merchants, students and inventors. Efforts to learn about, make, and improve color are found in the dyehouse, the color mill, print works, and glazing rooms, and in the discourse of the scientific and fine-arts academies. They are not confined by geography or limited by social roles, or even by success. The creation of color in objects was taken up by people who wanted to understand the nature of color and methods of its reproduction. The interest of any individual might extend to one aspect of color or to several. That interest might be directed to discovering new theories, inventing new processes, investigating materials, or perhaps several of those paths simultaneously or sequentially. My model is to consider the work of many, to locate similarities and correspondences, and to consider the sources of information and inspiration for all and from all.

This approach allows me to transcend the traditional isolation of practices from theory, practitioners from theorists. Within those new groupings, people with diverse interests become less anomalous. Many people and many work sites play multiple roles simultaneously or sequentially. A factory owner develops theories about his processes in an effort to improve them; a merchant develops new colors or techniques that improve the formula of existing ones. Principals at a pottery works experiment to adapt the processes to painting. Textile printers make wallpapers. Sign painters decorate glassware. Scoundrels, always amusing to read about, attempt to exploit the artisan interests of scientists almost as often as they do the scientific interests of amateurs. The unifying criterion is an interest in color, an interest that often extended beyond the specific intellectual or occupational training of its students. Through this interest, we can consider relationships and dependencies as they existed in the eighteenth century.

I have believed, from my earliest explorations of these topics, that consideration of connections between activities in more than one nation is critical to understanding. Initially, I focused on Britain and France. Archival and anecdotal information highlight the political, economic, and social ties between these two countries during the eighteenth century. The connections play a role in the characterization of each: French practitioners, entrepreneurs, and theorists turned to their British counterparts for technical information and novelty, the British looked to France for examples of taste or style. As I worked, the firm lines drawn by those characterizations began to dissolve. In addition, the significance of activity in Germany (or German-speaking regions) became evident. This was a matter not simply of investigating the technologically-rich portions that formed the border with France in the eighteenth century, but also of direct and indirect connections to Berlin, Göttingen, Leipzig, Dresden, and elsewhere. Dissemination of information to and from all these areas occurred through overt or covert transfer of practical and intellectual data, and through a lively trade in colored objects. The high level of interest is evident in the rapid translation of texts, the

detailed reports of factory sites sent by visitors from and to all countries, and the demand for foreign-styled objects everywhere. Tracing communication that supported dissemination of information about color throughout this central portion of Europe creates a fuller and more accurate description of technology transfer and of responses to innovation in the eighteenth century.

The broadened combination of regions and objects strengthens yet another aspect of my interpretation. We cannot use late-nineteenth- and twentieth-century western European structures to describe the social and intellectual worlds of this earlier era and, in particular, to define their junctures. Although the seeds of modern expectations may have been planted in the eighteenth century, nineteenth-century precepts for the use of science in technology, and for the use of technology by science, cannot be met. Recent interpretations of eighteenth-century communities of science and technology have identified overlapping social organizations that bear little resemblance to those of the later nineteenth century. Financial and other organizational relationships between industry and scientific institutions were also substantially different. Significant developments within both the study of nature and its exploitation during the eighteenth century demand an interpretive structure that recognizes their place at that time and respects their fundamental differences from the enterprises of later periods. I wished to engage those interpretations in my own.

An experimental history of the capital ingredients and materials hitherto employed in arts, with an exact description of such as are less known, is an essential part of our work, and we hope will prove no less entertaining than useful: this we shall endeavour to improve by several new experiments, from whence the goodness, qualities and properties of many substances may be determined, and consequently new uses found.

William Lewis, *Proposals for Printing... Commercium Philosophico-Technicum* ([London, 1748])
n.p.

Historians and sociologists call on a few general models to categorize the diffusion of technology.¹ Technological change may be described as evolutionary in nature, spreading out and adapting to new situations and new requirements. Another characterization suggests a feedback system in which innovations are sent out, change, return to their starting place, and are perhaps then retransmitted and changed again. Although suggestive, neither model fully explains the eighteenth-century situation. Diffusion did not always follow the patterns of a single system but often included several, sometimes functioning together. Therefore, explanations for science and technology of the eighteenth century must have an orientation that accepts that exchanges were not purely evolutionary and that feedback might be returned several thousand miles away, some decades later. The nature of change in eighteenth-century practices and theories of color was not essentially linear, and it could affect several regions at once. It was neither so rigid and hierarchical as feedback nor so haphazard as evolutionary models might suggest. The spread of ideas and practices in the

eighteenth century more closely follows a model now recognized as informal systems of diffusion in industry, particularly systems that show that data can move out in several directions at once and then reappear elsewhere, later, sometimes with no direct links to the original source. Ideas may be combined at different times and in a number of ways. They may reach other places and be returned (or not) changed (or not). They may move off in a different path entirely.²

Methodological Considerations

I once made a great deal of trouble for myself by commenting that methodological approach is how historians personalize their objectivity. We consider the interpretations available and chose and adjust to fit our own tastes. We have an obligation to recognize the prejudices in our work, however. These are mine.

I used to have what I believed was a wonderful way to explain my methodology, involving the equation of a graph ($y=mx+b$), independent and dependent variables, circles, and sine waves. This made some of my scientist friends laugh but irritated most of the historians who listened, and I no longer call on it. It is enough to say that, when you study something, you choose the things you wish to hold constant and examine what happens to other things as they revolve around your constants. My work crosses many different fields in which the assumption held constant is that the pursuit of an ultimate truth comes from its scientific basis. Instead of perfect sciences, I use perfect practices—here, the search for ways to make things brightly and beautifully and permanently colored—as my constant. I formulate answers to the basic questions of this book by placing practitioners and practice first.

Fifteen years ago, the art historian John Gage reported the complaint, of a student twenty years earlier, that the study of color lacked a methodology.³ Infrequently considered in the past, color has been a subject for which no focused narrative can be framed. It is always a superficial, even anecdotal aspect of something else. Color might be part of a developing art, or of a trade, or something tangential to science. These analyses yield to the fluid nature of color and so reject certain types of exploration. When objects are isolated for study the congruities between colors and coloring methods cannot be located. Color may be acknowledged as important, but it is then set aside as peripheral.

By moving color—not art, not pigments, not dyes, or textiles, or pots or glazes, or scientific theories, or special techniques—into the center, we can look at the way all these components functioned together. By making peripheral what is often at the forefront, whether objects or ideas, and considering this one aspect that is engaged by all, we can begin to break through the problems that have hindered

the development of a narrative that places color within technology, science, history, art, or consumer patterns. But success here demands a joining of different kinds of color and a recognition of the combinations of intellectual and commercial goals. Without any sense of the entire universe in which color was important, it is not possible to locate the subsets, let alone examine or explain them.

In books and in several articles, Alan E. Shapiro has used Newton's optics as a springboard from which to examine presentation, acceptance, and refutation of theories about color in the eighteenth century.⁴ He explores the relationship between artists' and scientists' colors in order to understand the chemical and mechanical explanations of color. Shapiro found that "a heated battle between chemists and physicists was waged over Newton's theory," and concluded that the disagreement did not ever spill over into artists' practices.⁵ Still, when he writes of artists' colors, his focus is on eighteenth-century science, not production or technological improvement. A discussion of textile dyeing highlights the discipline as an outlet to display chemical theories about color. The objectives of his presentation rest in the theories and not in their conjunction with practice.

Historians will detect some obvious influences on my thinking and writing: social-history models first outlined for the history of science by Steven Shapin and Arnold Thackray; institutional studies such as those by Margaret C. Jacob, Karl Hufbauer, and others; and studies of consumption, especially those related to the decorative arts, cultural history, print culture, and communication.⁶ Some recent histories of technology also address the issues I attempt here, creating a more solid historiography for the cultural issues surrounding the sciences and moving economic considerations away from the countinghouse.⁷

Again, my methodologies were influenced by personal experience. During a technical apprenticeship among anthropologists I learned much about the cautious use of artifacts to explain cultures with no easily accessed record system. The importance of accepting that I am an outsider to eighteenth-century society, that no amount of enthusiasm or belated participation will ever make me into an eighteenth-century colorist, is one lesson I have learned from this discipline. How to observe and understand from this position is another. In my attempt to determine the form of this study, I have been engaged by a characterization of culture attributed to Clifford Geertz: inconstant or inconsistent, stratigraphic, full of symbolic actions on personal and larger plains—an organism with its own logic.⁸ I have adopted an analytical approach, however, that incorporates both a search for laws that Geertz rejects as more appropriate to experimental science and a search for meanings that is the interpretation of cultures.

To understand the practices that are the constants of this study, I have turned to

sources that put me, as a historian, on unusual ground. These are my interest in chemistry and my background as a colormaker. I did conduct colormaking experiments and occasionally you will see their results here. Had there been time, I would have continued experiments with the more than two thousand recipes I collected; I know that work provides insights unattainable any other way. For the most part however I relied on close reading and informed imagination to improve my sense of process changes and color differences. This was possible only because of the confidence gained by my own experience.

My struggle to understand recipes, processes, and the way that colors were used in the eighteenth century was abetted by the technical literature about art and artifacts, an information source that has only recently begun to receive regular attention from historians of science and technology. A characteristic of publications for art conservators or restorers has been their emphasis on determining materials and techniques used in past centuries. Thus, this literature can provide useful suggestions about theoretical recommendations and practical applications in the eighteenth century.⁹ Frequency of recommendation in contemporary literature, descriptions of acceptance (then or now), and actual use may diverge: Technical examinations document the way materials were used. These sources were not methodological influences for me however, as the goal for publication is often to establish a record of use for a material or the preferences of an artist or atelier independent of further historical interpretation.

The Creation of Color in Eighteenth-Century Europe has proved to be a data-heavy project, in part because of widely scattered and incomplete records, in part because some facets of the subject have not been treated in detail while a few others have received a great deal of consideration. My work casts a wide net over subjects and geographies, but it must also compensate for the lack of introspection by others before me about what color is and how it is created. As a result, I have called on archival records of institutions, guilds or trade communities, government agencies, business and personal papers. The nature of the combination of theories and practices can be difficult to trace. In many cases potentially significant information disappears at a critical point. The notebooks of John Sadler, the Liverpool printer, hint at his relationship with the liberal and dissenting social circles in that city, they contain instructions to prepare red and purple cloth, and the address of William Peckitt, a glass painter-stainer based in York.¹⁰ Did these notations relate to Sadler's experiments with transfer printing onto ceramics and their later manufacture? Each can be given a circumstantial connection, but only in the first case is there a definite link. In 1801, William Dyer, a drysalter, colorman, and correspondent of Joseph Priestley and other scientists in Britain, reduced fifty years of diary-keeping to two volumes of tantalizing abstracts about his work and interests.¹¹ As a result, we have only hints about his venture to produce and sell the pigment known as Spanish brown.

Often I could build longer narrative threads from national and municipal records in France than from the archives of less administratively oriented Britain or the more fragmented German ones. Therefore, French examples frequently take the lead in my description of color, its processes and ideas, and their development. Whenever possible I have supplemented that information with corroborating examples from Britain and Germany, and I have tried hard to make no general assertion about the nature of the interactions without strong evidence from several regions.

The Order of This Book

Every performance which requests the attention of the public ought to give all requisite information respecting its object, materials, and plan, that its purchasers may form their expectations accordingly; lest, in one hand, the work should seem to promise what is not meant; or, on the other, its readers should blame it for omitting what was not the Editor's design to insert.

The Artist's Repository and Drawing Magazine (London, [1784-]94), 3:i.

I have two goals for this book as product of my own scholarship and as an electronic publication. I hope that my study will appeal to many different readers, and not only my colleagues who are historians or historians of technology and science. I also wished to produce a book that is not value-enhanced by the possibilities an electronic medium offers, but one that clearly loses value when it is removed from that medium. A few words about the form of this electronic book will make clear to you how I have joined those two goals.

Imagine this work as layers where the sections that comprise each layer are separable and able to be recombined as you, the reader, wish. Begin where you please and read as much or as little as you wish in an order you choose. I assume that parts will appeal to some readers more than others, that some may need explanations of basic ideas but others may not.

If you read all the ground layer ("Technological Tasks and Philosophical Ideas"), you will find a reasonably straightforward essay about practices and theories and the eighteenth-century European world of their interactions. This group consists of three sections, "Cultures of Technologies, Cultures of Sciences," "Number, Order, Form: Color Systems and Systematization" and "Expertise and Experience; or, What Is Science, to an Artisan?" In the first (but there is no reason that you must read in this order), I discuss several basic themes of eighteenth-century, enlightened cultures: improvement, progress, community. The second section looks at the use of art by scientists or natural philosophers, especially the integration of artisan techniques into theoretical devices. The centerpiece of the third section is a dispute between two Parisian color merchants, the life of a treatise written by one of them and their different interpretations of the relevance of science to art. The three sections allow me to consider the desire to be

scientific as a manifestation of work and life and to look at the ways all those engaged in the study of color hoped to exploit available resources.

The second layer, "Interactions Between Techniques and Ideas," is in many respects the heart of the book. In these sections I address operational details, but they are also about understanding the relationships between techniques and ideas. One section is about quality and production standards. What do you want from a color—or, for that matter, from an object or an idea—and how do you know when you have it? I look at the theoretical criteria for "good" color in the eighteenth century and at the testing practices adopted to show or guarantee that a process would produce a viable result. I also discuss how the testing programs could change in response to new ideas as well as to new materials. The process-based definition of quality did not inhibit changes to existing techniques or the introduction of new ones. In another section, I describe the chemical interpretations of coloration during the eighteenth century. The underlying philosophical question here is not what color is but rather how it gets onto objects and what makes it stay there. Color was a chemical as well as a physical and physiological problem in the eighteenth century. As a discipline, chemistry is often categorized as undergoing changes in the eighteenth century comparable to those that occurred in physics, astronomy, and mathematics during the seventeenth. These events and their consequences often obscure the lively discussions about chemical subjects before and during this reorganization. The new style of chemistry makes only a brief appearance here, however. In the early stages of its acceptance it proved to divide color in ways that did not stifle innovation but did make it more difficult for practitioners and theorists to talk to each other.

The last section in this group is about production, and here I describe the creation both of coloring materials from color sources and of colored objects from coloring materials. I discuss objects as the tangible outcome of a process—the result of a substrate and a process of embellishment. The minutiae of production processes, often glossed over by historians, provide clues to understanding the ways that eighteenth-century inventors, experimenters, manufacturers and others thought about their efforts and, occasionally, to understanding why they acted as they did. In the eighteenth century, the most reliable way to differentiate among novelties was through the processes used to create that innovation and not through the "look" of the result. Color, one of several variables that set the ultimate appearance of an object, was technique-dependent. I believe it is important, especially in a presentation about understanding the interaction of changes in technologies and in organized understanding, to consider the materials and techniques of preparation. That information is here.

The third layer, "Details of Products and Production," has layers within it and perhaps should be considered "color about color." In general, these sections are short pieces: case studies and descriptions focused on a person or a few people,

an idea or a few related concepts, the history of a color or color-production technique. In some of these, notably a series of artifact studies and the sections on information and inspiration, I offer details that bring together the production and social aspects of some eighteenth-century objects.

Zwey Dinge muß ein Färber an sich haben, wenn er vor einen rechten und wahrhaften Färber paßiren soll, nämlich die Weisheit oder Wissenschaft, und dann die Praxis oder Erfahrung. Eines muß fleißig getrieben; und das andere sorgfältig und bedächtlich geübet werden. Aus diesen zweyen folget ohnfehlbar das dritte, die vernünftige Klugheit; diese ist gleichsam der andern König, und werden von ihr richtig und wohl regieret.

J. F. G., "Vorrede," *Die rechte und wahrhafte Färbe-Kunst* (Erfurt, 1751), n.p.

All the sections are connected by internal links where I refer to explanations or evidence I provide elsewhere. Turn to that portion to read more, ignore the lead, or use the features at the top and side of the screen to make your own path through the book. There is, in addition, a glossary of data about people, places, or things that need more than minimal information but not so much as to require a separate section. It includes definitions and relevant biographical and bibliographical information (when available) about the actors I mention here. The many similar names for eighteenth-century institutions (and occasionally people) can be confusing; throughout this book I have relied on some abbreviations to eliminate some of that confusion. Those abbreviations are listed as part of the bibliography.

Color is an exceptional model for eighteenth-century styles of inquiry because it is a part of so many different categories, and so many of those categories were important to other eighteenth-century ideas, practices, and culture. In my concluding section, I summarize the different concepts I have promised to discuss here and I describe how this study extends beyond what may initially appear as a narrowly defined topic into a more general milieu.

Notes:

Note 1: For a description of evolutionary models, see George Basalla, *The Evolution of Technology*, (Cambridge 1988). A classic characterization of feedback systems in technology is Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore, 1983).

Note 2: For a description of this style of transfer, see John A. Czepiel, "Word-of-Mouth Processes in the Diffusion of a Major Technological Innovation," *Journal of Marketing Research* 11, no. 2 (May 1974): 172–80; and Håkan Häkkanson, *Industrial Technological Development: A Networked Approach* (London, 1986). The focus of both these works is twentieth-century examples, and so their analysis is not always appropriate here.

Note 3: John Gage, "Color in Western Art: An Issue?" *The Art Bulletin* 72, no. 4 (December 1990): 518–41.

Note 4: Alan E. Shapiro, "Artists' Colors and Newton's Colors," *Isis* 85 (1994): 600–30; Alan E. Shapiro, "The Gradual Acceptance of Newton's Theory of Light and Color,

1672–1727," *Perspectives on Science* 4 (1996): 59–140; Alan E. Shapiro, *Fits, Passions and Paroxysms: Physics, Method and Chemistry and Newton's Theories of Colored Bodies and Fits of Easy Reflection* (Cambridge, 1993).

Note 5: Shapiro, *Fits, Passions and Paroxysms*, ix.

Note 6: Steven Shapin and Arnold Thackray, "Prosopography as a Research Tool in the History of Science: The British Scientific Community 1700–1900," *History of Science* 12, no.1 (1974): 1–28; Margaret C. Jacob, "Scientific Culture in the Early English Enlightenment: Mechanisms, Industry, and Gentlemanly Facts," in *Anticipations of the Enlightenment in England, France, and Germany*, eds. Alan Charles Kors and Paul J. Korshin (Philadelphia, 1987), 134–64; Karl Huffbauer, *The Formation of the German Chemical Community, 1720–1795* (Berkeley, Calif., 1982). Among "others," I include Henry Lowood, *Patriotism, Profit, and the Promotion of Science in the German Enlightenment: The Economic and Scientific Societies, 1760–1815* (New York, 1991); J. B. Morrell, "Bourgeois Scientific Societies and Industrial Innovation in Britain, 1780–1850," *Journal of European Economic History* 24 (1995): 311–32; Agustí Nieto-Galan, "Un Projet Régional de Chimie Appliquée à la Fin du XVIIIe siècle: Montpellier et Son Influence sur l'école de Barcelone: Jean-Antoine Chaptal et Francesco Carbonell," *Archives internationales d'histoire des sciences* 44, no.132 (1994): 38–62; Peter Hanns Reill, "Science and the Construction of the Cultural Sciences in Late Enlightenment Germany: The Case of Wilhelm von Humboldt," *History and Theory* 33 (October 1994): 345–66; *Le deuxième centenaire de l'Académie nationale des Sciences, Belles-Lettres et Arts de Lyon 1700–1900* (Lyon, 1900); Maxine Berg and Kristine Bruland, eds., *Technological Revolutions in Europe: Historical Perspectives* (Cheltenham, England, 1998); P. Fontes da Costa, "The Culture of Curiosity at the Royal Society in the First Half of the Eighteenth Century," *Notes and Records of the Royal Society of London* 56, no. 2 (2002): 147–66. Roger Chartier, *Cultural History: Between Practices and Representations*, trans. Lydia G. Cochrane (Ithaca, 1988); Robert Darnton, "Communication Networks," in *The Forbidden Best-Sellers of Pre-revolutionary France* (New York, 1996); Robert Darnton, "What Is the History of Books?" in *The Kiss of Lamourette: Reflections in Cultural History* (New York, 1990), 107–35; Richard Yeo, "Encyclopaedic Knowledge," in *Books and the Sciences in History*, ed. Marina Frasca-Spada and Nick Jardine (Cambridge, 2000): 207–24.

Note 7: Agustí Nieto-Galan, *Colouring Textiles: A History of Natural Dyestuffs in Industrial Europe* (Dordrecht, Netherlands, 2001); Patrick McCray, *Glassmaking in Renaissance Venice: The Fragile Craft* (Aldershot, Hants., England, 1999); Luca Molà, *The Silk Industry of Renaissance Venice* (Baltimore, 2000).

Note 8: Clifford Geertz, *Interpretation of Cultures* (New York, 1973); Clifford Geertz, *Works and Lives: The Anthropologist as Author* (Stanford, Calif., 1988). Other works in material culture that have influenced my thinking and writing include, E. McClung Fleming, "Artifact Study: A Proposed Model," *Winterthur Portfolio* 9 (1974): 153–73; W. David Kingery, ed., *Learning from Things: Method and Theory of Material Culture Studies* (Washington, D.C., 1996).

Note 9: Among the general works I regularly consulted were Robert L. Feller, ed., *Artists' Pigments: A Handbook of Their History and Characteristics*, vol. 1 (Washington, D.C., 1986); Ashok Roy, ed., *Artists' Pigments: A Handbook of Their History and Characteristics*, vol. 2 (Washington, D.C., 1993); Elizabeth West Fitzhugh, ed., *Artists' Pigments: A Handbook of Their History and Characteristics*, vol. 3 (Washington, D.C., 1997); Ralph Mayer, *The Artist's Handbook of Materials and Techniques* rev. ed. (New York, 1957); W. David Kingery and Pamela B. Vandiver, *Ceramic Masterpieces: Art, Structure, and Technology* (New York, 1986); Helmut Schweppe, *Handbuch der Naturfarbstoffe: Vorkommen, Verwendung, Nachweis* (Landsberg / Lech, Germany, 1992).

Note 10: John Sadler, Notebook (n.d.), Liverpool Local History Service, 238/SAD/1, page 25; related information appears on pages 22 and 16.

Note 11: William Dyer, *Diary Extracts, 1752–[1800]*, 2 vols. (1801), Bristol Public Library B20095-SR4.