Technique and the Art of Immortality, 1800–1900

Marjolijn Bol, *Utrecht University and Max Planck Institute for the History of Science*

ABSTRACT

This essay investigates how, over the course of the nineteenth and twentieth centuries, painters, art historians, and chemists fused a bond to undo the damage they believed the industrial revolution had caused the art of painting. Even though the industrial revolution produced many novelties for painters, from a whole new range of colors to pre-prepared paints, these new materials were not always stable and were sometimes even contaminated for industry's own gain. As another consequence of the industrial revolution, painters no longer produced their own supplies and thus lost the ability to assess the qualities and technical possibilities of the materials they were using; their paintings sometimes degraded in a matter of decades. The works of the old masters, on the other hand, were admired for their ability to keep their condition for centuries. It was hoped therefore that the rediscovery of the materials and techniques of the old masters would help "modern" painters to once again bring a similar "immortality" to their fame. What is more, the methods and collaborations that painters, art historians, and chemists established in light of the above constitute today the pillars of the emerging field of technical art history.

How long will our pictures last?[1]

The industrial revolution produced many new materials for the painter, from synthetic pigments such as Prussian blue, cadmium yellow, and emerald green to the paint tube, invented and patented in 1840. With an extended palette,

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1. L. Zechmeister, "'Wie lange werden unsere Bilder dauern?' (Ein Experiment in der Farbfabrikation). Mitteilung von L. Zechmeister aus der *Pall Mall Gazette*," *Technische Mitteilungen für Malerei* 11 (1894): 76–78.

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with the most brilliant hues the artist could desire, painters no longer had to meticulously find and prepare their raw materials to start working. Paint could now be bought readily prepared from the so-called colormen. As many artists embraced the new materials produced by science and industry, the period saw the rise of plein-air painting, impressionism, expressionism, and, because of painter's materials being more commonly available, even the rise of amateur painting. Some of the greatest fathers of modern art were in fact self-taught. Vincent van Gogh (1853–1890) and Paul Gauguin (1848–1903), to name but two, were both dilettante painters who never received formal training. Besides contemporary art production, advances in science also affected the study of historical works of art. By the end of the eighteenth century, the natural sciences were increasingly used to investigate the works of the old masters.[2] Surprisingly, this early bond of science with art history, which had itself just started making its first steps toward becoming an academic discipline, was not fueled by the progressiveness of the natural sciences. Instead, as I will argue in this essay, painters and art historians turned toward science to undo the damage they believed the industrial revolution had caused.

The new synthetic pigments, so fervently embraced by many painters, were not always as stable as they were made out to be, and in some cases, industry even contaminated paints with cheap fillers for their own gain. Because painters no longer produced their own supplies, they lost the ability to assess the qualities and technical possibilities of the materials they were using. As a result, some paintings started degrading before the eyes of their patrons. Looking backward rather than forward, it was thought that the remedy to this problem could be found in the materials and techniques of the old masters; surviving old master paintings were admired for their remarkable permanence. The rediscovery of the methods by which they were painted, so it was believed, would help "modern" painters bring "immortality" to their fame. Today's restorers and conservation scientists are well aware of the fact that paintings made before 1800 have their own share of problems with fugitive or otherwise degrading materials. But during the course of the nineteenth century, painters, chemists, and art historians became increasingly convinced that the key to making a durable painting could be found in the works of Jan van Eyck, Raphael, and the like. This article investigates some of these ideas to convey how, between the nineteenth and early twentieth centuries, material expertise and technical skill came to be considered crucial for the evaluation, restoration, and, most importantly, immortalization of works of art.

2. On this subject, see Jilleen Nadolny, "The First Century of Published Scientific Analyses of the Materials of Historical Painting and Polychromy, circa 1780–1880," *Reviews in Conservation* 4 (2003): 39–51.

In 1787 the painter W. Williams published a treatise on the *Mechanic of Oil Colours*, which includes one of the earliest remarks on the apparently rapid decline of modern paintings. Williams writes that he has heard that contemporary paintings may be decaying so quickly that they "die" sooner than those that they portrayed: "an evil report is gone abroad and propagated by the dealers in old paintings, I believe more through envy or interest than truth, that the modern pictures will not stand—have not stood—but departed before their models."[3] We will see that the idea that the painting should "outlive" its model returns in many later discussions in which the durability of contemporary paintings is questioned. To Williams, however, there is no real need to worry; the problem is not common and is not always found with the same master.[4] It is therefore rather remarkable that despite his lack of concern for the permanency of modern painting, Williams's tract is exclusively concerned with a description of the materials required to produce a durable work of art. After the painter "has studied to make his pictures worth preserving," Williams's treatise provides him "with the materials to give a duration to his works and his fame": "Being convinced from long experience and practice, the method here recommended will enable them [i.e., paintings] to stand the test of time, and put the moderns in this respect, upon a par with the masters of former ages."[5] Whatever Williams believed about the state of painting in his times, one contemporary English master, the portrait painter Sir Joshua Reynolds (1723–92), was known (and even considered infamous by some) for the diminished state of his paintings only shortly after they had left his workshop. Reynolds admired the achievements of the old masters and undertook various travels to examine their works. He even borrowed money to purchase a few paintings for the purpose of having important examples close at hand.[6] Reynolds is said to have remarked that the study of old master paintings was the "art of using other men's minds" so that by "this kind of contemplation and exercise we are taught to think in their way, and, sometimes, attain their excellence."[7] Besides visual examination, Reynolds tried to recreate the painting techniques of the old masters through technical experiments.[8]

3. William Williams, *An Essay on the Mechanic of Oil Colours, Considered under These Heads, Oils, Varnishes, and Pigments, By an Artist* (Bath: Hazard, 1787), 15–16.

4. Ibid.

5. Ibid., 17.

6. *The Works of Sir Joshua Reynolds, Containing His Discourses, Idlers, a Journey to Flanders and Holland (Now First Published) and His Commentary on Du Fresnoy's Art of Painting. (With His Last Corrections and Additions) in Two Volumes, To Which Is Prefixed an Account of the Life and Writings of the Author*, 3 vols. (London: Junior and Davies, 1797), 1:xxix.

7. Ibid.

8. See, e.g., the recent exhibition catalog on this subject by Lucy Davis and Mark Hallett, *Joshua Reynolds: Experiments in Paint* (London: Wallace Collection, 2015).

Yet, not knowing exactly what techniques these painters of the past had used, he often mixed incompatible materials or fugitive ones in trying to replicate the visual effects he admired in their works. As a result, some of Reynold's paintings formed extreme craquelure or got otherwise damaged in a relatively short time. The often dire condition of Reynold's paintings caused quite a controversy and this may have been why, in his 1815 supplement to the *Memoirs* (1813) of the great English portraitist, James Northcote tried to demonstrate that Reynolds did in fact care about the permanency of his work.[9] Unfortunately, Reynolds had not been very outspoken about his concerns with the durability of his painting method, and Northcote was able to cite only a few of his scattered remarks on the topic. Nevertheless, Northcote insisted that Reynolds should not be blamed for some of the technical flaws of his work because, unlike the painters of the past, the "moderns" did not have the advantage of having "chymical knowledge" and were therefore unable to recognize the true qualities of their materials: "It was of the advantage of the old school of Italian painters, that they were under the necessity of making most of their colours themselves, or at least under the inspection of those as possessed chymical knowledge, which excluded all possibilities of those adulterations to which the moderns are exposed."[10] Before long, however, concerns about durability would take center stage in painters' discussions about the importance of acquiring technical expertise through a deep understanding of the chemistry of the materials used. Whereas Reynolds appears to have mostly busied himself with the replication of the visual effects he admired in the works of the old masters, later painters hoped to rediscover how to make their work similarly withstand the test of time. To unravel exactly what gave the paintings of the old masters their durability, the study of examples and practical experimentation was expanded upon with research into written sources on art technology and the scientific examination of historical paintings. The results were published in numerous painting manuals designed to help contemporary artists improve their technique through a better understanding of their materials.[11]

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9. James Northcote, *Supplement to the Memoirs of the Life, Writings, Discourses, and Professional Works of Sir Joshua Reynolds, Comprising Additional Anecdotes of His Distinguished Contemporaries* (London: Printed for Henry Colburn, by J. Gillet, 1815), lxxx–lxxxii.

10. Ibid.

11. For the English situation, see Leslie Carlyle, *The Artist's Assistant: Oil Painting Instruction Manuals and Handbooks in Britain 1800–1900 with Reference to Selected Eighteenth-Century Sources* (London: Archetype, 2001); and for the case of American painting, see Lance Mayer and Gay Myers, *American Painters on Technique: 1860–1945* (Los Angeles: J. Paul Getty Museum, 2013), and *American Painters on Technique: The Colonial Period to 1860* (Los Angeles: J. Paul Getty Museum, 2011). For the German

The handbook of the French painter Léonor Mérimée (1757–1836) can be considered an exemplary source for illustrating this discourse. Mérimée was one of the first painters who not only studied examples and made practical experiments but also tried to unite his insights with the information he gleaned from sources on art technology, conversations with restorers, color theory, and chemistry. In the introduction to *De la peinture à l'huile* (1830) Mérimée praises the state of preservation of the works of the painters working in the fifteenth century, especially when compared with those painted in his own times:[12]

> The pictures of Hubert and John Van Eyck, with others of the same period, but by different artists, are now in a better state of preservation than the greater number of those painted in the last century: the processes used in their execution, having only been transmitted down by tradition, have not, it is very probable, reached our time perfectly pure; and it is reasonable to suppose that those pictures, that even now surprise us by their brilliancy after a lapse of three centuries, have not been painted with the same combination of materials, as those which we see evidently impaired, though not painted one-fourth part of that period. If it were possible to discover a manuscript of Van Eyck upon the preparation and application of colours, there can be no doubt that the announcement of it would create a considerable degree of eagerness to possess such a treasure, especially amongst those who cultivate the art of painting.[13]

Mérimée hoped that his treatise would improve contemporary painting by unveiling the tried painting materials and methods of the old masters through the study of both "the earlier treatises on that art" and "the attentive examination of those ancient paintings, which have best resisted the numerous causes of decay to which such works

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situation, and Munich in particular, I refer to Kathrin Kinseher, *Womit sollen wir malen? Farben-Streit und maltechnische Forschung in München: Ein Beitrag zum Wirken von Adolf Wilheim Keim* (Munich: Siegl, 2014).

12. Jean François Léonor Mérimée, *De la peinture à l'huile, ou des procédés matériels employés dans ce genre de peinture depuis Hubert et Jan Van Eyck jusqu'à nos jours* (Paris: Huzard, 1830). Mérimée's work was translated into English in 1839 by William Benjamin Sarsfield, see Jean François Léonor Mérimée, *The Art of Painting in Oil, and in Fresco: Being a History of the Various Processes and Materials Employed, from Its Discovery, by Hubert and John Van Eyck, to the Present Time: Translated from the Original Treatise of M. J. F. L. Mérimée*, trans. and ed. Benjamin Sarsfield (London: Whittaker, 1839). Interestingly, the translator adds some notes on the "young English school of painting" written by W. B. Sarsfield Taylor. Sarsfield Taylor includes some of Reynold's methods recorded by Northcote as exemplary to the English school (332–71) but does not neglect to point out some of the more fugitive materials and methods used by Reynolds (see esp. 342–43).

13. Mérimée, *The Art of Painting in Oil*, xvi–xvii, *De la peinture à l'huile*, ix.

are liable."[14] Following Giorgio Vasari's (1511–74) myth of the invention of oil paint, Mérimée argues that the durability of the paintings of Jan van Eyck (1390–1441) was the result of his perfection of an oil-varnish medium that the great Flemish painter had developed to "preserve the transparency and brilliancy" of his colors when dry.[15] Similar to Northcote, whom he had in fact met during his stay in London, Mérimée points out that because artists were no longer learning the nature of their colors, they became incompetent in detecting fraud, or distinguishing good materials from inferior ones. For this reason, a basic knowledge of chemistry is important to the painter and, most of all, to those who sell them their materials, the colormen.[16] Mérimée continues with a detailed discussion of a few early endeavors by chemists who hoped to write down the foundations for the use of durable materials in the art of painting. He is not entirely satisfied with their efforts, however, because, lacking a practical foundation in the arts, chemists did not experiment with the processes they thought could be successful: "Doubtless the author [Lorenzo Marcucci[17]] has not thought it requisite to bestow all the care upon it of which he was capable. He contented himself with choosing, among divers works, the processes which he thought most likely to succeed, but without trying them himself, as he ought to have done."[18]

Besides attempts to improve the material and technical aspects of contemporary painting practice through painter's handbooks, another impetus for the exploration of historical sources on art technology concerned the decoration of monumental architecture. Here, without exception, durable painting techniques were sought to ensure an enduring life for important national edifices; but as contemporary artists lacked technical expertise to achieve such durability, great controversies arose over what exactly the best method for realizing the most permanent kind of painting was. This was the concern of those involved in the decoration of the new Palace of Westminster. The palace had to be rebuilt because much of the medieval structure (then the Houses of Parliament) went up in flames in 1834.[19] In 1841, the vast complex was nearly finished and the official campaign planning the decoration of the new palace started under the guidance of Prime Minister Sir Robert Peel (1788–1850). Charles Lock Eastlake (1793–

14. Ibid.

15. Mérimée, *The Art of Painting in Oil*, 6, *De la peinture à l'huile*, 7.

16. Mérimée, *The Art of Painting in Oil*, xxii–xxiii, *De la peinture à l'huile*, xix–xx

17. Mérimée here refers to Lorenzo Marcucci, a chemist active in Rome who published his analyses of painting materials and processes; see Lorenzo Marcucci, *Saggio analitico-chimico sopra i colori minerali e mezzi di procurarsi gli artefatti, gli smalti e le vernici* (Rome: Nella stamperia di L. Contendini, 1813).

18. Mérimée, *The Art of Painting in Oil*, xix–xx, *De la peinture à l'huile*, xiv–xv.

19. See also T. S. R. Boase, "The Decoration of the New Palace of Westminster, 1841–1863," *Journal of the Warburg and Courtauld Institutes* 17 (1954): 319–58.

1865), perhaps best known for being the first keeper of the National Gallery of London, became secretary of the newly instated Fine Arts Commission. One of the most pressing issues the committee had to address was whether the murals in the new palace were going to be painted in oil or in fresco.[20] Additionally, and not unimportantly, the committee hoped to inspire a new great school of painting in England.[21] In order to inform and advise the artists involved in the decoration campaign, Eastlake and Mary Philadelphia Merrifield (1804–1889), who would become one of the most prolific nineteenth-century writers on art technology, were supported by Peel to investigate the nature of the durability of the techniques of the old masters from written sources.[22] Their resulting publications—Merrifield's English translation of Cennino Cennini's *Il libro dell'arte* (1844), her work on *The Art of Fresco Painting* (1846), her *Original Treatises on the Art of Painting* (1849) and Eastlake's *Materials for a History of Oil painting* (1847)—are among the first systematic explorations of written sources on art technology. In the preface to her translation of *Il libro dell'arte*, Merrifield explains that the Fine Arts Commission "induced" her to make an English translation of Cennini's treatise because it was thought to hold the key to uncovering the process of painting in the fourteenth and fifteenth centuries. Consequently, its study could expose the nature of the remarkable permanency for which the works painted during this period were admired: "the colouring and execution of which excite our surprise and admiration even after a lapse of four centuries, and which have survived the trials of exposure to the elements, and injuries sustained from injudicious attempts to clean and restore them."[23] Merrifield insists that even though the painters of the school of Giotto were "deficient in theory," they "possessed a manual dexterity, and a certainty of producing a good and durable effect."[24] This ability to create a painting that would withstand the test of time "arose from a knowledge derived from the tradition of preceding artists," and it was "confirmed by experience, of the nature and properties

20. This question is extensively discussed in the minutes of the 1841 report of the committee; see *(Report) from the Select Committee on Fine Arts . . . Ordered, by the House of Commons, to Be Printed, 18 June 1841*, 1–92.

21. Boase, "The Decoration of the New Palace of Westminster," 319–58.

22. Besides the fact that she wrote two additional artists' handbooks—Mary Philadelphia Merrifield, *Handbook of Light and Shade, with Especial Reference to Model Drawing* (London: George Rowney & Co., 1880), and *Practical Directions for Portrait Painting in Water Colours* (London: Winsor & Newton, 1851)—Merrifield shows her versatility as a scholar when she writes a treatise on fashion, arguing that it was a topic worthy of intellectual pursuit—*Dress as a Fine Art: With Suggestions on Children's Dress* (Boston: Jewett, 1854)—and when, in later years, she becomes a published expert on seaweeds; see Mary R. S Creese and Thomas M. Creese, *Ladies in the Laboratory? American and British Women in Science, 1800–1900: A Survey of Their Contributions to Research* (Lanham, MD: Scarecrow, 1998), 31.

23. *A Treatise on Painting, by Cennino Cennini in the Year 1437*, trans. and ed. Mary Philadelphia Merrifield (London: Lumley, 1844), v–vi.

24. Ibid, viii.

of their colors and materials, to which the modern discoveries in chemistry have been able to make few additions."[25] In the introduction to *The Art of Fresco Painting*, Merrifield resumes this line of thought when she writes that "the moment it was determined to decorate the new Houses of Parliament with frescoes, it became important to ascertain the mode adopted by the great masters of the Italian and Spanish schools."[26] According to Merrifield, this "desirable object" would only be accomplished by a "return to the old treatises on the subject."[27] Eastlake explains in similar terms that his reason for undertaking the project was the search for durable techniques to permanently decorate the new Parliament: "It professes to trace the recorded practice of oil painting from its invention; and, by a comparison of authentic traditions with existing works, to point out some of the causes of that durability for which the earlier examples of the art are remarkable. It was considered that such an inquiry, if desirable on general grounds, must be especially so at a time when the best efforts of our artists are required for the permanent decoration of a national edifice."[28] Like Mérimée, whose work he refers to on various occasions, Eastlake believed that Van Eyck and his contemporaries devised much of their method with the durability of the end result in mind.[29] The conditions of their time were perfectly tailored to such an endeavor, foremost because the best kind of painting was "holy" in the eyes of the patrons commissioning these works, a fact that required the use of the best materials available. Second, the purchasers (monks) of the pictures were often also the manufacturers of the painter's materials, and if the materials were not provided by the monasteries, they came from the pharmacy.[30] Indeed, Eastlake points out, "chemistry was still the professed auxiliary of painting, as well as of medicine, from the thirteenth to the seventeenth century."[31] Eastlake addresses the same problem that, as we have seen, Northcote and Mérimée introduced; because chemistry and painting no longer developed along the same path, as was the case in the past, it was difficult for

25. Ibid.

26. Mary P. Merrifield, *The Art of Fresco Painting as Practised by the Old Italian and Spanish Masters, with a Preliminary Inquiry into the Nature of the Colours Used in Fresco Painting* (London: Gilpin & Wallis, 1846), iii. The 1841 report of the committee also included an essay by Eastlake, which advised fresco painting to be "a durable and immoveable decoration" and to be the most suitable painting technique for the decoration of a "building of permanent character"; see Charles Lock Eastlake, "Paper on Fresco Painting," in *(Report) from the Select Committee on Fine Arts . . . Ordered, by the House of Commons, to Be Printed, 18 June 1841* (1841), 74–76.

27. Ibid.

28. Charles Lock Eastlake, *Materials for a History of Oil Painting*, 2 vols. (London: Longman, Brown, Green & Longman, 1847), 1:iii.

29. "That the most scrupulous operations of the laboratory should be carried on together with the most devoted practice of art, is quite consistent with the habits of the early painters" (ibid., 1:267).

30. Ibid., 1:11.

31. Ibid.

artists and colormen to acquire the chemical knowledge necessary to achieve the much desired durability.[32]

Perhaps the most profound critique of the impact on the artistic world of the splitting of the wealth of contemporary knowledge production into different sciences or disciplines can be found in the writings of the German architect and art theoretician Gottfried Semper (1803–79). A large part of Semper's ideas on this subject were formed during his exile in London (1850–55) and were the outcome of his observations during the Great Exhibition of 1851.[33] In his essay "Wissenschaft, Industrie und Kunst" (1852), Semper sets out the theory that, in former times, science was driven by a sense of *Not* (necessity), which allowed its inventors to apply their own discoveries from a deep understanding of their nature.[34] Semper had already made a similar claim about art in an 1834 essay and now made necessity the mother of both realms.[35] He criticizes the ways in which science fuels the arts of his own times, because instead of being driven by necessity, "necessity has become the marketplace for science to sell its products."[36] Need was thus artificially created in order to sell the novel produce of science and industry. As a result, craftsmen are no longer able to artistically apply these inventions forced upon them, because they do not have an intrinsic understanding of their nature. In *Der Stil in den technischen und tektonischen Kunsten* (1860–63), written as a "Handbuch für Techniker, Künstler und Kunstfreunde," Semper transforms his ideas into a consistent theory. Despite its title, Semper points out that *Der Stil* is not "a handbook

32. In the end it was decided to decorate the new Palace with frescoes because it was the most esteemed and durable technique of all arts of painting. The project would turn out a disaster, because in order to have the murals withstand the damp atmosphere of the city of London, a new fresco technique (water glass) was used that ironically caused the rapid deterioration of the frescoes. Already in 1866 we read that the frescoes "were hardly completed when decay seized them"; see Richard Redgrave and Samuel Redgrave, *A Century of Painters of the English School, with Critical Notices of Their Works, and an Account of the Progress of Art in England*, 2 vols. (London: Smith, Elder and Co. 1866) 2:540. See also Clare A. P. Willsdon, *Mural Painting in Britain 1840–1940: Image and Meaning*, Clarendon Studies in the History of Art (Oxford: Oxford University Press, 2000), 44–59.

33. See, on this topic, David J. Diephouse, "Science, Industry and Art: Gottfried Semper's Search for the *Juste Milieu*," *Journal of the Rutgers University Library* (2012): 14–31.

34. Gottfried Semper, *Wissenschaft, Industrie und Kunst: Vorschläge zur Anregung nationalen Kunstgefühles: bei dem Schlusse der Londoner Industrie-Ausstellung, London, Den 11. October 1851* (Braunschweig: Vieweg und Sohn, 1852), 7–8.

35. For the 1834 remark on this subject, see Gottfried Semper, *Vorläufige Bemerkungen über bemalte Architectur und Plastik bei den Alten* (Altona: Hammerich, 1834), viii: "Nur einen Herrn kennt die Kunst, das Bedürfnis"; Mallgrave, *Style in the Technical and Tectonic Arts*, 75.

36. "Schon zeigt es sich, dass die Erfindungen nicht mehr, wie früher, Mittel sind zur Abwehr der Noth und zum Genusse; vielmehr sind die Noth und der Genuss Absatzmittel für die Erfindungen. Die Ordnung der Dinge hat sich umgekehrt" (Semper, *Wissenschaft, Industrie und Kunst*, 9; my translation).

for artistic practice" nor is it "merely a history of art."[37] Instead, *Der Stil* seeks to reveal how art comes into being. Semper begins his work with an analogy between the development of the solar system and art. The solar system's condition of destruction and regeneration, so Semper believes, is analogous to the phenomena of artistic decline and the "mysterious phoenixlike birth of new artistic life."[38] These phenomena are extremely relevant to Semper's own times because contemporary art was in a similar crisis to those experienced in the past. In order to help art out of its confused state, Semper sets out to explore the fundamentals of an empirical theory of art that reveals the inner law governing the world of the art form, "just as it governs nature."[39] As such, Semper hopes to explain the work of art "as a result of all the factors involved in its creation," and he thus considers technique "only insofar as it affects the principle of art's creation."[40] Semper continues his introduction to *Der Stil* with an explanation as to why the contemporary state of the arts demands such a theory: "capitalism has separated the so-called ornamental from the formal and technical aspects of art in a purely mechanical way, immediately its lack of feeling for and misunderstanding of the true relationship between the various means the artist uses to produce his work."[41] The impact of capitalism on the arts had ensured that even when artists involved in "high art," such as painters, architects, and sculptors of repute, were asked to work in craft industries to make designs, "the influence from the heights of academic art generally lacks a practical foundation."[42] Semper explains that the reason for this, "as was often the case before the academies separated the arts," is that "the skilled and highly talented designers and model-makers are not metalworkers, potters, carpet weavers, and goldsmiths."[43] In other words, the artists asked to make the designs have no experience with the materials and techniques they have to design for. Medieval artists, in contrast, knew exactly how material, technique, and style combined successfully because of their excellent craft training. Semper makes reference to three historical invention stories that further illustrate his point. He asks the reader whether "it took long for

37. For the recent (and first) English translation of this work, see Gottfried Semper, *Style in the Technical and Tectonic Arts; or, Practical Aesthetics*, ed. and trans. Harry Francis Mallgrave and Michael Robinson, Gottfried Semper Texts & Documents (Los Angeles: Getty Research Institute, 2004), 71, and *Der Stil in den technischen und tektonischen Künsten, oder praktische Aesthetik*, 2 vols. (Frankfurt: Verlag für Kunst und Wissenschaft 1860), 1:v. See also *Der Stil in den technischen und tektonischen Künsten, oder praktische Aesthetik*, vol. 2 (Munich: Bruckmann, 1863).

38. Semper, *Style*, 71, *Der Stil*, 1:v–vi.

39. Semper, *Style*, 71, *Der Stil*, 1:v–vi.

40. Semper, *Style*, 71, *Der Stil*, 1:v–vi.

41. Semper, *Style*, 75–76, *Der Stil*, 1:xii–xiii.

42. Semper, *Style*, 75–76, *Der Stil*, 1:xii–xiii.

43. Semper, *Style*, 75–76, *Der Stil*, 1:xii–xiii.

the masters of the great period toward the end of the Middle Ages to learn to use linseed oil to bind paints, to replace older processes they found too restrictive? Did it take long for the West to rediscover the secret of applying enamel to faience . . . ? Although [Jan] van Eyck [the inventor of oil paint], Luca della Robbia [1399/1400–1482, inventor of the tin glaze] and [Bernard] Palissy [ca. 1510–ca. 1589, the inventor of rustic figurines] are perhaps not exactly exemplars of Western knowledge and science, they did know how to apply their own discoveries artistically."[44] By comparison, Semper continues, "How few modern painters are masters of the means and refinements in paint offered so profusely by chemistry? We see the deformation, whitening, and cracking of paintings after only a few years, whereas those pictures by Italian and Flemish Old Masters are *unsterblich* [immortal] in these purely technical aspects. Even though they may have darkened and become thickly covered with the sediment of the centuries, they nevertheless maintain their condition and indeed may even have improved with age."[45] Semper's remark about the technical immortality of the paintings of the past in the introduction to *Der Stil* runs in accordance with what we have seen with contemporary writers. As Semper argues that the theories he sets out were meant to help relieve art of its confused state, it is interesting to see what his theory has to say about durability. Semper is interested in the driving forces behind the search for permanent materials and considers necessity the primary reason for man's pursuit of durability. He refers to durability as the material's *Erhärtungsfähigkeit*, the ability to harden. Semper believes hardening processes are a primeval technique of the plastic arts and for this reason most of his remarks on durability appear in his chapters on ceramics.[46] He argues that examples of the search for the *Erhärtungsfähigkeit* of materials can be found in man's desire to create a durable enclosure for himself and with the glazing of pots to make them impermeable to liquids.[47] A second reason for artists to search for durability has to do with aesthetics. Here Semper's example concerns the ways in which vessels and other works are given "the properties and the appearance of marble or other more precious stones, such as rock crystal, onyx and opal (porcelain, glass)."[48] Unlike what we have seen thus far, in Semper's theory the search for durability does not appear to have been driven by the desire of patron and artist to transmit their creations to a faraway future so as to ensure immortality of their fame. Instead, he believed that the artistic exploration of durability was the result of an inherent need for shelter, other necessities, and, in some cases, aesthetic considerations.

44. Semper, *Style*, 97, *Der Stil*, 1:xi n. 1.
45. Semper, *Style*, 97, *Der Stil*, 1:xi n. 1.
46. Semper, *Style*, 467, *Der Stil*, 2:1.
47. Compare Semper, *Der Stil*, 1:356–57, 2:119–21
48. Semper, *Style*, 562, *Der Stil*, 2:119–21.

We can now more fully understand Semper's critique on the contemporary state of the arts; because "necessity" and "pleasure" had become the marketplace for industry to sell its products, artists no longer "needed" to creatively search for permanent substances themselves and thus had lost the ability to give permanence to their works of art.

Despite Semper's wish to help the arts out of their confused state, his theoretical approach to style and durability did not diminish the call for artists to become material experts and masters of technique once again; it was still as strong in the first decades of the twentieth century as it was in the nineteenth. Beyond the fact that the new materials produced by science and industry were not always durable, writers of the time point out that it was mostly the lack of knowledge of the nature of these novel substances that ensured that painters were unable to adopt a technique that would allow them to create a permanent work of art. To address this problem, the focus of the debate, particularly prominent in the city of Munich, shifts from pointing out the gap between the natural sciences, industry, and contemporary art toward concrete attempts at bringing these fields closer together.[49] The notion of technique, as we will see, came to be considered the binding factor, and the reason for collaboration, between chemists, art historians, and painters.

In 1886, the Deutsche Gesellschaft zur Beförderung für rationelle Malverfahren (German Society for the Promotion of Rational Painting Techniques) was founded by the chemist and entrepreneur Adolf Wilhelm Keim (1851–1913).[50] The society's primary aim was to bring the false promises of the paint industry into the open and to publish research about the characteristics and durability of new pigments on the market in the *Technische Mitteilungen für Malerei* (1884–1941).[51] Its second aim was to reintroduce the painting techniques of the old masters to the training of students in the art academies. In the 1892 edition of the *Technische Mitteilungen*, a short article commemorating the hundredth year of Reynolds's death uses the case of his work to promote the activities of the society. After praising the English portraitist, the author points toward the dire condition of Reynolds's work. He writes that whereas the works of the great masters of the Renaissance look as if they were made yesterday, Reynolds's paintings are discolored and jump from all corners.[52] It is Reynolds's fault that time ruins his

49. For an extensive analysis of the situation in Munich, see Kinseher, *Womit sollen wir malen?*

50. Keim is best known for inventing and patenting (1878) a new method for water glass painting that was more durable than the one used to decorate the new Palace of Westminster.

51. This important source is available online at http://www.technischemitteilungen.com.

52. "Während die Werke der Italienischen Meister der Renaissance noch so gut erhalten sind, als ob sie gestern geschaffen worden wären, sind die Reynolds'schen Bilder schon stark verblasst und springen an allen Ecken. . . . Reynolds trägt freilich selbst Schuld daran, dass der Zahn der Zeit seinen Werken so übel

works, because, "like so many painters, he wanted to research the painting secrets of the Old Masters, using ingredients that were so detrimental for his paints, that some of his paintings died before the person portrayed did. This is another indication that proves how justified and urgent our efforts are. Reynolds is not the only painter whom this happened to. Even today there are many painters whose fame will outlast his work."[53] Two years later, a certain L. Zechmeister publishes a similar observation in a short announcement in the *Technische Mitteilungen*. In its title, he asks the reader "Wie lange werden unsere Bilderen dauern?" (How long will our pictures last?). Zechmeister insists that if one believes that a good painting should be preserved for as long as possible, concern with the durability of the materials used to make it should be priority: "Those who believe that a good painting is a lasting gain for humanity, should at all times take a deep interest in the durability of paints. The genius of the artist will be, even though *unsterblich* [immortal] in its essence, easily be the sacrifice of bad paint. Some of the most beautiful eighteenth century works of art are only lost to us now because of the unskillful palettes of their painters."[54] In 1907, the chemist Alexander Eibner (1862–1935) became leader of the society after it had become part of Munich's Technical University as the Versuchsanstalt und Auskunftsstelle für Maltechnik (Research Institute and Information Office for Painting Techniques, since 1902). Eibner was a strong advocate for closer collaborations between various disciplines to solve the problem of painterly technique and the durability of painter's materials. In his publications, he outlines a history of chemistry and painting to show why the art of painting should be interested in chemistry, especially as "from Van Eyck until Rubens, painters were not assisted by chemistry, but nevertheless knew perfectly well how to paint."[55] According to Eibner, the traditions of painter's workshops have been lost, because they were mostly transmitted orally. Unlike his predecessors, Eibner believes that the surviving painter's handbooks (he mentions Cennino Cennini's

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mitspielt" (Anon., "Joshua Reynolds," *Technische Mitteilungen für Malerei* 9 [1892]: 69–70; my translation). No published translations of this work into English exist.

53. "Wie so viele Maler wollte er die Farbengeheimnisse der Alten erforschen. Dabei benutzte er Ingredienzien, welche so zersetzend auf die Farben einwirkten, dass es schon bei Lebzeiten hiess, dass seine Bilder eher stürben, als derAbgsbildete. (M.NN.) Es ist dies ein neuer Hinweis, wie sehr berechtigt und wie dringend nötig unsere Bestrebungen sind. Reynolds ist nicht der einzige Maler, dem es so ergeht. Auch heute giebt es manchen, dessen Ruhm seine Bilder überdauern wird. C. S." (ibid.).

54. "Wer ein gutes Gemälde für einen dauernden Gewinn der Menschheit hält, wird zu jeder Zeit ein tiefes Interesse an der Dauerhaftigkeit der Farben nehmen. Der Genius des Künstlers wird, obgleich unsterblich in seiner Wesenheit leicht das Opfer einer schlechten Farbe; einige der schönsten Werke der Kunst des achtzehnten Jahrhunderts sind nun in Folge der thörichten Paletten ihrer Maler für uns verloren" (Zechmeister, "Wie lange werden unsere Bildern dauern?," 76).

55. Alexander Eibner, "Bericht über die Versuchsanstalt und Auskunftstelle für Maltechnik," *Technische Mitteilungen für Malerei* (1903–4): 142–43.

Il libro dell'Arte, Theophilus's *Schedula Diversarum Artium*, and the sources disclosed by Merrifield) "have not helped to reconstruct the lost methods of the old masters and painters had to start from the beginning once more."[56] Besides the loss of tradition, Eibner considers two other major problems of contemporary painters; their materials are not of the same high quality as they used to be and industry sometimes contaminates paint materials for their own gain.[57] It did not escape Eibner that earlier authors who wrote about artistic materials and techniques had pointed out similar issues. He introduces his *Malmateralienkunde als Grundlage der Maltechnik* (1909) with Pliny the Elder's (23–79 CE) comments about the disgraceful state of ancient painting—the result of the introduction of new pigments that did not last. According to Pliny, the paintings from ancient Greece, which were made with only four colors, did not have problems with durability.[58] With Pliny's remarks in mind, Eibner concludes that the problem with permanency was not a phenomenon limited to the twentieth century.[59] The expensive materials of the artisan had always been adulterated with fillers and cheaper substitutes. However, what differs, so Eibner points out, is that the medieval painter was at the same time material scientist and the producer of his own materials. This made him skilled at discovering fraudulent products, allowing him to create durable works that could survive the test of time.[60] In Eibner's own times, the readily available materials of the paint industry had caused artists to lose the skill and knowledge they needed to assess the quality of the materials they were using, and it is here, so Eibner proposes, that chemistry could be of assistance.[61] He insists that although it may not have been the fault of chemists that painters used their inventions, it should be the chemist's responsibility to ensure the painter has the right information about their nature and purity when he sets out to work.[62] Unfor-

56. "Die methoden derjenigen Künstler, die sich mit ihrer Bilder mit Erfolg bemühten, gingen mit ihrem Tode verloren und die Epigonen mussten wieder von vorne anfangen" (ibid.).

57. Something that Eibner attributes, among other things, to the invention of coal tar dyes.

58. "Der Römische Schriftsteller Plinius d. J. beklagte es in seinen naturgeschichtlichen Schriften, daß die Malerei durch die Einführung unhaltbarer Farben im Laufe der Zeit Einbuße erlitt, während man in der Ägyptischen Kunst, die nur die vier Grundfarben verwendete, unhaltbare Gemälde nicht gekannt habe" (A. Eibner, *Malmaterialienkunde als Grundlage der Maltechnik: Für Kunststudierende, Künstler, Maler, Lackierer, Fabrikantern und Händler* [Berlin: Springer, 1909], preface, not paginated).

59. Eibner, *Malmaterialienkunde*, iii.

60. Ibid., iv.

61. Ibid., iv–vi, and Eibner, "Bericht," 145–46.

62. "Pigmente, Bindemittel und Malmittel werden vielfach durch Zusätze entwertet und uns Chemiker trifft ungerechter Weise der Vorwurf, die Veranlassung dazu gegeben zu haben. Der verdienstvolle Maler und Schriftsteller Ludwig nahm in der Tat an, dass wir an allem Verderb der Bilder schuld seien. Seien wir gerecht! Wer möchte dem Erfinder des Dynamits machen, weil seine segensreiche Erfindung auch missbraucht wurde. . . . Wir sind ja allein imstande, diese Zusätze nachzuweisen und dadurch den Maler, den Gewerbetreibenden vor ihrer Schädlichkeit zu schützen" (Eibner, "Bericht," 142–46).

tunately—and here Eibner appears to echo Mérimée's remarks—books about painting technique are written either by chemists or by painters, and, as a result, none of them successfully establish the necessary connections between "Wissenschaft, Technik und Kunst."[63] Eibner concludes that one discipline alone cannot solve the problem of artistic technique. Painters need to have their own individual *Spielraum*, and art history has to find a basis for the assessment of the chemist's findings.[64]

Eibner's concerns about the lack of collaboration between painters, the natural sciences, and art history were also shared by the painter Max Doerner (1870–1939). Since 1911 Doerner had been a teacher at the renowned Munich Academy of Fine Arts, become a professor there in 1921, and, from 1937, was the director of the institute now known by his name. In the introduction to his highly influential *Malmaterial und seine Verwendung im Bilde* (1921), Doerner writes that his lectures at the Academy of Fine Arts formed the basis of his book. In the introduction to this work, Doerner describes his handbook as an attempt to "communicate the dependable knowledge in the field of technique to the practicing artist. It is not intended as a course on instruction in painting, because it is no more possible to learn to paint from books than to learn to swim on a sofa."[65] Critically reflecting on the usefulness of text to the practicing painter, the guiding thoughts behind Doerner's lectures had "always been the closest relation to practice and the greatest possible agreement with the results of scientific research."[66] Indeed, as well as other scientists, Doerner refers to Eibner's work over twenty times. He similarly points out that this collaboration between "science" and "art" still needs a solid basis: "The problems of the techniques of painting can be solved only by the cooperation of science with practice, but for such cooperation many of the basic conditions are today still lacking. . . . Only a complete mastery of the materials will give that firm foundation in which the artist may develop an individual style and which at the same time will insure durability and permanency of his creations. . . . Craftsmanship must again be made the solid foundation of art."[67] Discussing pigments, Doerner writes that the objection of many painters to using chemically manufactured pigments is not justified; they just need to develop the right skills and become experts at using their materials,

63. Eibner, *Malmaterialienkunde*, v.

64. "Es ist verständlich, daß hierbei den Forderungen künstlerischer Eigenart weiter Spielraum zu lassen ist und ebenso sehr, daß die Kunsthistorie als Grundlage zur Beurteilung des Ge- wordenen entsprechende Berücksichtigung zu finden hat" (ibid.).

65. Max Doerner, *The Materials of the Artist and Their Use in Painting with Notes on the Techniques of the Old Masters*, trans. Eugen Neuhaus (London: Hart-Davis, 1969), v–vii, and *Malmaterial und seine Verwendung im Bilde: Nach den Vorträgen an der Akademie der Bildenden Künste in München* (Munich: Enke, 1921, vii–viii.

66. Ibid.

67. Ibid.

and then they will be able to assess their quality.[68] In contrast to Eibner's list of chemically stable pigments, presented in 1915 in a lecture titled "Die Normalfarbenskala," Doerner provides a list of the handling properties that painters can use to assess a pigment's nature, quality, and behavior. For Doerner, once more, style, durability, and permanency are closely intertwined with the mastery of materials and technique.

It is difficult to imagine a history where material and technique are not seen as crucial to understanding the history and art of painting and where artists are no longer concerned with the durability of the materials of their creations. But only a few decades after Semper wrote *Der Stil*, such a history began when Alois Riegl (1858–1904) published *Stilfragen* in 1893. Riegl's *Stilfragen* was a reaction to Semper's work or, to be more precise, a critique on the followers who took the latter's ideas too literally.[69] In the introduction to *Stilfragen*, Riegl points out that *Technik* had become the catchword of the day, one that became identical to *Kunst* and was heard almost more often than *Kunst*.[70] Riegl continues that the *Gelehrten*, being art historians and archaeologists, would edge away from the discussion and leave it to the artists to speak about *Technik*, as the *Gelehrten* themselves knew nothing about it; but, according to Riegl, these same scholars had become smarter and realized that technique is not fundamental to understanding art.[71] Riegl wrote *Stilfragen* to criticize the impact of the scientific method on the study of history. He points out that in "our scientific age" everything has to be material and "a more psychological explanation would never be considered a solution."[72]

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68. Ibid.

69. Recent scholarship has revealed that Riegl was probably not as strongly opposed to Semper as was often thought; see Diana Reynolds, "Semperianismus und *Stilfragen*: Riegls *Kunstwollen* und die 'Wiener Mitte,'" in *Gottfried Semper und Wien: Die Wirkung des Architekten auf "Wissenschaft, Industrie und Kunst,"* ed. Rainald Franz (Vienna: Böhlau, 2007), 85–96; and Ann-Sophie Lehmann, "The Matter of the Medium: Some Tools for an Art Theoretical Interpretation of Materials," in *The Matter of Art: Materials, Technologies, Meanings, 1200–1700*, ed. Christy Anderson, Anne Dunlop, and Pamela H. Smith (Manchester: Manchester University Press, 2015), esp. 21–26.

70. "Die "Technik" wurde rasch zum beliebtesten Schlagwort; im Sprachgebrauch erschien es bald gleichwertig mit "Kunst" und Schliesslich hörte man es sogar öfter als das Wort Kunst" (Alois Riegl, *Stilfragen: Grundlegungen zu einer Geschichte der Ornamentik* [Berlin: Siemens, 1893], vii).

71. "Aber das Missverständnis, als handelte es sich hierbei um die reine Idee des großen Künstler-Gelehrten Semper, war einmal vorhanden, und die natürliche Autorität, welche ausübende Künstler in Sachen der 'Technik' genossen, brachte es ganz wesentlich mit sich, das die Gelehrten, die Archäologen und Kunsthistoriker, klein beigaben und Jenen das Feld überließen, wo nur irgendwie die 'Technik' in Frage kommen konnte, von der sie—die Gelehrten—selbst entweder gar nichts oder nur wenig verstanden. Erst im Laufe der letzteren Jahre wurden auch die Gelehrten kühner" (ibid., vii).

72. "Der rastlos nach Causalzusammenhängen forschende Sinn unseres naturwissenschaftlichen Zeitalters war als bald bemüht, dieses Etwas zu ergründen, das den geometrischen Stil an so vielen Punkten spontan hat ins Leben treten lassen. Und zwar mußte es etwas Greifbares, Materielles gewesen sein; der bloße Hinweis auf unfassbare psychische Vorgänge hätte nicht als Lösung gegolten" (ibid., 5).

Riegl particularly condemns *Kunstmaterialismus*, which took as its premise that art is shaped by materials and tools only, "just as the Darwinists think that humans are shaped by nature alone." However, Riegl insists that both movements are equally far away from the ideas of Semper and Darwin.[73] Even though Riegl therefore may not have intended the strong dichotomy between his work and that of Semper, his ideas, and especially the notion of *Kunstwollen*, were embraced by modernist art theory to show that art was something conceptual, far beyond the dirt of materials and the workshop.[74]

Riegl's work was fundamental for art history's founding in academia as a largely intellectual pursuit that did not necessarily have to engage with the physical substance of its object of study. For a long time, the historical study of art's materials and processes was indeed most systematically practiced in museums and conservation institutes. Since the 1970s, it started gaining momentum at universities, first as a form of a more "scientific" connoisseurship and eventually in the writing of more encompassing art histories of materials and making. Today, this type of research is known as "technical art history."[75] In 1998, David Bomford, then director of the National Gallery of London, first defined the field of technical art history as follows: "a wide-ranging, inclusive evocation of the making of art and the means by which we throw light on that process. It is generally—but not exclusively—concerned with the physical materials of works of art and how they are prepared, used and manipulated. But it goes far beyond the material into questions of artists' methods and intentions and how concepts are translated into substance—how *invenzione* becomes *disegno* and *colore*."[76] The meth-

73. "Wenn Semper sagte: beim Werden einer Kunstform kämen auch Stoff und Technik in Betracht, so meinten die Semperianer sofort schlechtweg: die Kunstform wäre eine Produkt aus Stoff und Technik" (ibid., vi–vii).

74. Compare Margeret Iversen, *Alois Riegl: Art History and Theory* (Cambridge, MA: MIT Press, 1993); and Mike Gubser, *Time's Visible Surface: Alois Riegl and the Discourse on History and Temporality in Fin-de-Siècle Vienna* (Detroit: Wayne State University Press, 2006); Peter Noever, Artur Rosenauer, and Georg Vasold, eds., *Alois Riegl Revisited: Contributions to the Opus and Its Reception* (Vienna: Austrian Academy of Sciences 2010); and Lehmann, "The Matter of the Medium," 21–41.

75. On the idea of technical art history as a form of more scientific connoisseurship, see Maryan W. Ainsworth, "From Connoisseurship to Technical Art History: The Evolution of the Interdisciplinary Study of Art," *Getty Conservation Institute Newsletter* 20, no. 1 (2005), http://www.getty.edu/conservation/publications_resources/newsletters/20_1/feature.html (accessed November 13, 2016). For a view that conceives of technical art history more broadly, I refer to Erma Hermens's excellent overview of the development of this field of study in "Technical Art History: The Synergy of Art Conservation and Science; Transnational Discourses and National Frameworks," in *Art History and Visual Studies in Europe*, ed. Matthew Rampley et al. (Leiden: Brill, 2012), 151–65.

76. David Bomford, "Introduction," in *Looking through Paintings: The Study of Painting Techniques and Materials in Support of Art Historical Research*, ed. Erma Hermens (London: Archetype; Baarn: de Prom, 1998), 9–12.

ods that were originally explored in order to help painters give durability to their work and immortality to their fame now form the pillars of the methodology used to study technical art history; insights from historical reconstructions of past materials and techniques are integrated with the study of sources on art technology and the scientific examination of works of art. It is perhaps ironic, therefore, that one of the most physical and material aspects of art history today—namely, its collaboration with the natural sciences to probe into the physical make-up of art objects—came out of a revolt against the same science, against the chemical decay of the new materials produced by chemistry, against the gap between painter and paint industry. Alexander Eibner was certainly quite ahead of his time when he suggested that the problem of artistic technique could only be solved through the close collaboration between different disciplines. Because of its special method, the exchange between conservation scientists, art historians, and restorers is now considered fundamental to technical art history research.[77] But collaboration should not stop there; the history of science, for instance, has recently shown that the creative exploration of artistic materials is also fundamental for the history of knowing nature.[78] Various other fields have similarly embraced the importance of materials, so much so in fact that some are speaking of a "material turn" in the humanities.[79] As a result, technical art history is in the process of extending its object of study more broadly into the "decorative arts" and "material culture." Hopefully, this will allow for new art histories of materials and making that reach far beyond those of the "high arts" as the academies once defined them.

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77. Hermens, "Technical Art History," 155–59.

78. I refer to Pamela Smith's groundbreaking work on "artisanal epistemology," which investigates the ways in which craft involved a way of knowing nature that was largely tacit; see Pamela H. Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago: University of Chicago Press, 2004). Recently, various edited volumes have come out that address how making can constitute the knowing of nature. See, e.g., Ursula Klein and Emma C. Spary, eds., *Materials and Expertise in Early Modern Europe: Between Market and Laboratory* (Chicago: University of Chicago Press, 2010); Sven Dupré, ed., *Laboratories of Art: Alchemy and Art Technology from Antiquity to the 18th Century*, Archimedes: New Studies in the History and Philosophy of Science and Technology 37 (Cham: Springer, 2014); and Pamela H. Smith, Amy R. W. Meyers, and Harold J. Cook, eds., *Ways of Making and Knowing: The Material Culture of Empirical Knowledge* (Ann Arbor, Michigan: University of Michigan Press, 2014).

79. For an edited volume that tries to capture this "material turn" in the humanities in a variety of different fields, see Peter N. Miller, ed., *Cultural Histories of the Material World* (Ann Arbor: University of Michigan Press, 2013).

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