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Passivity Matters! Transience and Conservation Practices: Examples from the Eighteenth Century to Today

In 1902, a major architectural landmark in Venice, San Marco Basilica's bell tower, collapsed into a heap of rubble. Whether (and if so, how) to reconstruct the tower—which had been damaged, rebuilt, and added to several times throughout a history dating back to the ninth century—became a heated debate, revealing how the general public and experts viewed their relationship and duty to objects of cultural importance. This famous event brought to the fore questions about what the maintenance and restoration of an object should entail, both practically and conceptually; how to treat and repurpose the materials of the object; and whether evidence of restoration and conservation processes should be made visible in the restored object.

In the following, I explore several competing concepts of conservation through a series of illustrative examples from European conservation practices of the last three centuries: the preservation of wet specimens, the use of wax moulages, climate-controlled spaces, and architectural restoration. These mini case studies demonstrate a range of approaches to the treatment of cultural objects, both technical and philosophical. They highlight differing paradigms of conservation: namely, whether conservation should aim to "passivate" the substance or material of a cultural object —to protect it and freeze it in a state of suspended animation through chemical or climatic means; to restore (or recreate) the "original" or "ideal" state of an object, even if only as a simulacrum or mimetic approximation of the object itself; or to view transformation, transience, and even decay of the object as integral and as processes worthy of preservation in their own right. A critical consideration of different concepts of conservation and restoration (both historical and contemporary) can help us think through our current moment's tendency toward "over-conservation." It can suggest alternative approaches to cultural memory—to the treatment, stewardship, and preservation of artifacts—and can help us chart a middle path between the extremes of idolatry and iconoclasm.

Introducing Specimens: Friction Points between Activity and Passivity

The conservation laboratory of the Berlin Museum of Medical History at the Charité accommodates various organic materials with the aim of keeping them materially sta-

 https://doi.org/10.1515/9783110714883-017

ble for as long as possible.[1] To keep materials in such a passive state and slow down their natural transformation processes, conservators must have a comprehensive knowledge of the potential activity of the materials with which they work and, thus, must be experts in active and passive matter. In the following, I will examine the preconditions and ambivalences of passivation and its opposite, activation, and, second, their historical anchoring.

The collection of pathological-anatomical wet specimens at the Berlin Museum of Medical History was established by pathologist Rudolf Virchow and comprises around 10,000 objects.[2] One item in the collection is a sliced lung, whose structure and blackish discoloration are typical markers of tuberculosis (fig. 1). This specimen is undated, but it is known to be over one hundred years old. Its glass container was opened recently for restoration and research purposes. During conservation treatment, the specimen is stored inside a fume hood to protect humans from the vapors and gases emitted by the fluid preservative formaldehyde, which is classified as a carcinogen. This is a protective measure for both specimen and conservator: people must be protected from the vapors of the specimens, and the specimens must, in turn, be protected from people—or, more precisely, from the surrounding environment. Indeed, as soon as the glass containers are opened or are otherwise compromised, they become susceptible to the invasion of microorganisms and the development of mold. Leaking glass containers are one of the biggest problems in specimen storage, resulting in unintended molecular exchange processes and the gradual evaporation of the alcohol. For this reason, the preservative liquid must be regularly replaced. The "freezing" of an organic specimen through the use of preservative liquids requires not only regular maintenance but also enormous technical skill and specialized knowledge from the very beginning of the preservation process.

To better understand this process, it is essential to familiarize oneself with how organic specimens are created. First, organs are carefully dissected from a deceased body. Detaching the tissue from the adjacent body structures is particularly challenging. While the remains are left to the natural processes of organic decay or are cremated, the organs are subjected to an elaborate technical procedure of mechanical interventions and chemical manipulations by a trained preparator.[3] This fixation process

1 The article is based on a collaboration with the Human Remains Conservator and Museum Curator Navena Widulin, who generously opened the doors of the conservation laboratory for me, and whom I would like to thank very much. All factual information about the collection and conservation procedures that is not separately identified is obtained from communication with her.

2 In the history of knowledge techniques, anatomical specimens in natural history, medicine, and biology perhaps go back the furthest; see Hans-Jörg Rheinberger, "Epistemologica: Präparate," in *Dingwelten: Das Museum als Erkenntnisort*, ed. Anke te Heesen and Petra Lutz (Cologne: Böhlau, 2005), 67. We know of anatomical specimens from the seventeenth century on, for example, from Frederik Ruysch, one of the earliest collectors of anatomical specimens in The Hague.

3 See the description and images of this procedure in Thomas Schnalke and Isabel Atzl, "Magenschluchten und Darmrosetten: Zur Bildwerdung und Wirkmacht pathologischer Präparate," *Bildwelten des Wissens: Kunsthistorisches Jahrbuch für Bildkritik* 9, no. 1 (2012): 18–28.

Fig. 1: Lung Specimen, Berlin Museum of Medical History at the Charité (BMM).

can take between a few days and up to several months to denature the proteins and delay the decomposition of the tissue. Although the fixative and fluid preservation processes cause a chemical alteration of the specimen and can lead to discoloration, shrinking, or swelling, these collections are able to last for hundreds of years under ideal conditions. In its natural and unprepared state, an organ would very quickly undergo a process known as autolysis, the destruction or self-digestion of a cell through the action of its enzymes. With the technology of fluid preservation, one could say, we come very close to a dream of material immortality—an almost perfect stillness of the organic substance.

In the case of the collection of the Berlin Museum of Medical History, there is an interesting tension between passivation and activation. Due to close cooperation with the pathology department of the Charité, tissue samples are regularly taken from the collection's specimens for histological examinations in order to gain new insights into old diseases. Also, the tissue of older specimens with sufficient volume is sometimes recut to refresh its color and structure. Both treatments (histological examination and recutting) activate a specimen. This implies that there is no way to passivate the substance itself in its status as an epistemic entity. On the contrary, the greatest possi-

ble deactivation of the material can even be identified as an irreducible condition of its ongoing epistemic activity.[4]

The collection also contains objects that are never "activated" in this sense or never (re)cut for research—namely, the specimens made by Virchow himself. Here, we encounter a completely different concept of the specimen as object, one that is similar to that of a work of art and that draws on the mythical charge of the original. Perhaps the integrity of his specimens would have pleased Virchow, particularly since he chose the concept of a "walk-in textbook" for the presentation of his collection at the opening of his Pathological Museum in 1899.[5] The production and editing process for this "textbook" took place in rooms of the museum that were not accessible to visitors. Photographs documenting the preparation and conservation laboratory—the so-called *Kittraum*—from the beginnings of the Pathological Museum in 1902, show bustling activity (fig. 2). The men, with concentrated facial expressions, mix and pour solutions, seal glass containers, and use sharp instruments to process the organs. The staged surroundings show specimens in different phases of preparation. Unlike today, at that time both pathologists and preparators made the preparations and were involved in the further development of preparation techniques and preservation methods.

Not evident from the photograph is the fact that their conservation liquid was a brand-new invention by Virchow's assistant, Carl Kaiserling, which had started a small revolution.[6] His novel mixtures of glycerin- and formol-based substances made specimens appear considerably truer to color, form, and structure. According to Virchow, this new invention made it possible to create specimens as "real images," in a way that was previously only known "from illustrations."[7] These would have the advantage of offering the visitor a "first-hand impression."[8] Virchow's claim was confirmed by twenty-first-century analyses of the history of scientific images, which have often described this method as an "image formation process" or even as "becoming images of themselves"—in other words, becoming images in which the represented and the means of representation are materially identical.[9]

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4 This recalls the activation of certain collections in the Museum für Naturkunde, Berlin—for example, the collection of animal skins and hides. They are considered "biodiversity storage" and similarly used in research.

5 See Schnalke and Atzl, "Magenschluchten," 27–28. For a comprehensive discussion of Virchow, his Pathological Museum, and his collection of specimens, see Angela Matyssek, *Rudolf Virchow, das Pathologische Museum: Geschichte einer wissenschaftlichen Sammlung um 1900* (Darmstadt: Steinkopff, 2002).

6 Thomas Schnalke and Isabel Atzl, *Dem Leben auf der Spur im Berliner Medizinhistorischen Museum der Charité* (Munich: Prestel, 2010), 89–90.

7 Virchow, quoted in Schnalke and Atzl, *Dem Leben*, 90.

8 Virchow, quoted in Schnalke and Atzl, "Magenschluchten," 21.

9 See Hans-Jörg Rheinberger, "Präparate—'Bilder' ihrer selbst: Eine bildtheoretische Glosse," *Bildwelten des Wissens: Kunsthistorisches Jahrbuch für Bildkritik* 1, no. 2 (2003): 9–19; Johannes Grave, "Selbst-Darstellung: Das Präparat als Bild," *Kritische Berichte* 37, no. 4 (2009): 25–34; and Schnalke and Atzl, "Magenschluchten."

Fig. 2: *Kittraum* of Virchow's Pathological Museum, 1902, Berlin Museum of Medical History at the Charité (BMM).

The Restoration Boom and the Beginning of the Museum Age

Virchow's equating of specimens with textbook illustrations—the equating of the thing with its representation—points to an understanding of museum objects that is strongly influenced by the development of the paradigm of cultural preservation. This paradigm relies on successful passivation of the material, and, historically, it went hand in hand with the formation of the museum as an institution and the elaboration of approaches to building and maintaining collections in the eighteenth and nineteenth centuries. This parallel development can be seen in two illustrative examples: the professionalization of restoration and the history of exhibitions.

The development of the profession of painting restoration (between 1750 and 1830) occurred alongside the founding of large museums, beginning in the mid-eighteenth century. Although restoration methods had, to some extent, been passed down, starting

from the Middle Ages, in art and recipe books (with such methods called "secrets"),[10] the quality and number of such transmitted texts began to change in the middle of the eighteenth century. By the end of that century, a modern understanding of restoration emerged.[11] In this context, "modern" means a preventive understanding of restoration, and thus the attempt to make interventions unnecessary through precautionary measures as well as the conviction that all procedures be based on the specific needs of the individual work.[12] In the late 1820s, the first handbooks were published, providing comprehensive insight into the restoration practices of that time.[13]

If one compares the history of the museum with the history of exhibitions, it becomes evident that the physical preservation of cultural assets was initially considered even more important than opening museums to visitors or lending works for exhibitions. In other words, the benefits of one were weighed against the risks of the other. In the nineteenth century, visitors were seen as a threat to the physical integrity of the cultural objects. In 1883, Johann Grässe, director of the Dresden Numismatic Collection, weighed the pros and cons of the plan to show art objects from public museums in exhibitions; as he wrote in the *Zeitschrift für Museologie und Antiquitätenkunde*, "Might the collection objects, especially in summer, with an unlimited admission of visitors, suffer from the dust and exhalations whirled up by those walking around?"[14] The human as breathing and sweating biological machine has long been considered an incalculable risk for the paradigm of conservation. Conservators must know not only about the intrinsic activity of objects and materials but also about the dangers posed by their proximity to visitors and by human interactions, which invariably stimulate them further. These are two different sides of a continuous transformation and material activation of museum objects that cannot be separated from each other. However, the idea of the museum as a shelter from contamination and decay, as a pure white room whose climate is continuously optimized for the perfect preservation of the objects it houses, persists to this day—despite numerous reforms and new, innovative, and experimental museum forms and formats.[15]

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10 Cornelia Wagner, *Arbeitsweisen und Anschauungen der Gemälderestaurierung um 1800* (Munich: Callwey, 1988), 7.

11 Ibid., 15, 29.

12 Ibid., 15.

13 Ibid., 7. Here, however, it must be noted that the establishment of restoration science for different genres and objects did not occur homogeneously. As Wagner also writes, the restoration of antiquities, for example, was established earlier and more quickly than the restoration of paintings, while post-antique sculpture was considered for restoration only in the late twentieth century, and objects of decorative art not before the end of the twentieth century. Wagner, *Arbeitsweisen*, 9.

14 Johann Georg Theodor Grässe, "Ist es ratsam Kunstgegenstände aus öffentlichen Museen zu Ausstellungen abzugeben?," *Zeitschrift für Museologie und Antiquitätenkunde* 12 (1883): 89. Translation by the author.

15 It would be worthwhile to compare this idea to O'Doherty's analysis of the *white cube*; see Brian O'Doherty, *Inside the White Cube: The Ideology of the Gallery Space* (Berkeley: University of California Press, 2010). However, Doherty explicitly located his *white cube* in contrast to the outside world as po-

The rise of the conservation paradigm was also closely tied to mechanisms of value creation. The art market, which expanded as a result of social restructuring in the late eighteenth century, also contributed significantly to the upswing in the restoration sector.[16] An anonymous letter to the editor of a British journal from 1764 describes this development: "No picture bought at an auction, or elsewhere, must be sent home before it is sent to the picture cleaners, and the owners will take as much pride in letting you know who cleaned it, as who painted it."[17] Here, the restorer is equated with the artist in an astonishingly clear way, anticipating twentieth- and twenty-first-century debates on the role of restorers as editors of works of art.[18]

The Material Alchemy of Wax and the Knowledge of Conservators

All these factors led to the idea, beginning around 1900, that a material's natural activity had to be managed and controlled by the techniques of restoration and preservation. The conservation paradigm was also a driving force in the development of techniques in the medical field. Over the course of the nineteenth century, in some collections—in Florence, for example—specimens started to be replaced by another material that was considered superior from the point of view of conservation: wax.[19] Wax is the second most prominent material represented in the conservation laboratory at the Berlin Museum of Medical History. An examination of the ambivalences between strategies of passivating and activating and of the intrinsic "performance" of wax is useful for understanding the importance of wax in conservation, among other passivation strategies that date back to the late eighteenth century.[20]

On close inspection of a wax moulage, the most striking feature is its overwhelming capacity to hyperrealistically depict the human body and, in particular, the structure of the skin, right down to the smallest pores and surface structures that are barely visible to the human eye (fig. 3). This effect is often enhanced by additional elements,

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litical reality. Here, by contrast, it is about the outside world as a biological influencing factor. In this shift lies a whole cultural history of the transformation of the museum as an autonomous space.

16 Wagner, *Arbeitsweisen*, 13.

17 Ibid., 13. The title of the journal, which published the anonymous letter, was *The Gentleman's Magazine*.

18 See Dušan Barok, Julia Noordegraaf, and Arjen P. de Vries, "From Collection Management to Content Management in Art Documentation: The Conservator as an Editor," *Studies in Conservation* 64, no. 8 (2019): 472–89, https://doi.org/10.1080/00393630.2019.1603921.

19 Sandra Mühlenberend, "Wachsmoulagen: Orte ihrer Etablierung," *Bildwelten des Wissens: Kunsthistorisches Jahrbuch für Bildkritik* 9, no. 1 (2012): 75–84, 78.

20 On the concept of the performance of materials see Bernadette Bensaude-Vincent, "Materials as Machines," in *Science in the Context of Application*, ed. Martin Carrier and Alfred Nordmann (Dordrecht: Springer, 2011), 101–11.

such as the incorporation of hair. The moulage achieves this mimetic proximity through a production process that relies on a direct imprint and thus on direct contact with the body. This process involves a number of steps: producing a plaster negative; coloring the melted wax in the corresponding skin tone; filtering the residues of resins and pigments through fine gauze; pouring the wax into the mold using a swivel technique; smoothing and hardening; and, finally, coloring the finished artifact with translucent oil paint.[21] This complex procedure is essential to achieving the artificial stillness of the material and to situating it in the intermediate realm between two states, thereby transcending dualisms—incidentally, this is one of the central properties attributed to wax, as often described by material theorists.[22]

Fig. 3: Navena Widulin, skin detail of wax moulage, 2010.

One of the most important indicators of the inner activity of the material is contained in the production process of a wax moulage: the initial mixing of the substance. The lead preparator of the Museum of Medical History at the Charité, Navena Widulin, uses beeswax, calcium carbonate, and dammar resin, but the combination of ingredients varies considerably in each historical moulage, posing an additional challenge for conservation—or, as Widulin puts it, "Wax is never the same."[23] In her material experi-

21 For more details on the production process, see Navena Widulin, "Der Blick auf die Haut – Die Heidelberger Scharlachmoulage und die Fertigung des klinischen Wachsabdrucks," in *Spiegel der Wirklichkeit: Anatomische und Dermatologische Modelle in der Heidelberger Anatomie*, ed. Sara Doll and Navena Widulin (Berlin: Springer, 2019), 159–63.

22 "Wax is solid but can be easily melted. . . . It can be sculpted, modeled or cast, so the traditional hierarchies of the fine arts are unknown to him from the outset. It can be worked with the hands or with all kinds of tools; it can be opaque or transparent, matte or polished, smooth or sticky; its consistency can be modified infinitely by adding various resins. It is a fragile and perishable material, but it is usually used—precisely because of its textural richness—to make objects that are meant to last. The plasticity (or performance) of wax would thus consist primarily in this range of physically ambivalent properties." Georges Didi-Huberman, "Die Ordnung des Materials: Plastizität, Unbehagen, Nachleben," in *Die Ordnung des Materials: Vorträge aus dem Warburg-Haus* 3, ed. Wolfgang Kemp et al. (Berlin: Akademie-Verlag, 1999), 10–11. Translation by the author.

23 Navena Widulin (Human Remains Conservator and Museum Curator, Berlin Museum of Medical History at the Charité), in discussion with the author, October 6, 2020. Besides beeswax, paraffin or stearin are used far more frequently today. There is a multitude of possible waxes, both organic and synthetic.

ments in her laboratory, Widulin investigates the chemical and physical response of wax to its environment (humidity, climate conditions, pollution, pressure, chemical reactions to adjacent materials such as wood, lacquer, textiles, etc.). This method is in the historical tradition of using the ingredients of wax as indicators to monitor and influence its material response to the surrounding environment. Since at least the Renaissance, various wax recipes have been known to us from the writings of artists and art theorists, who used a range of wax ingredients to determine wax's response to various climatic conditions and mechanical impacts—for example, the degree of its malleability and durability.[24] One could say that—through extensive experiments and passed-down knowledge—the material has been individually "coded" to show different intrinsic activities and to fulfill different functions. The specific ingredients of the wax used could therefore be described as an operational mechanism, in the sense of wax being an active material.[25]

The "alchemical" use of the inherent material activity of wax is rooted in its very constitution. Starting from its origin as a product of bees' metabolism, it is one of the most complex organic substances produced, and it is characterized by continuous transformation processes. Wax moulages, for instance, can be melted down as often as desired without causing damage to the material. Yet, this "fixed instability" of wax also makes it one of the most fragile materials in the museum: "It deteriorates, passes away, vanishes more easily than others."[26] Unlike water, wax always remains wax in all its different states and conditions.[27] It is this "alchemical" constitution of wax that generates a very different kind of activation of the material, done at the margins of laboratory practice and unnoticed by the public.

To grasp the significance of this kind of activation, one must understand the direct precursor of the wax moulage: the anatomical wax model, of which Florence became the center of production in the eighteenth century.[28] In contrast to the moulage, which depicted pathologies, wax models showed a healthy and idealized human body. One famous type was the so-called anatomical Venus. The sexualization and passivation of

24 Vernon J. Murrell, "Some Aspects of the Conservation of Wax Models," *Studies in Conservation* 16, no. 3 (1971): 95–109.

25 See the description of material as a "set of operational mechanisms" in Wolfgang Schäffner, "Active Matter," in *23 Manifeste zu Bildakt und Verkörperung*, ed. Marion Lauschke and Pablo Schneider (Berlin: De Gruyter, 2018), 6.

26 Georges Didi-Huberman, "Viscosities and Survivals: Art History Put to the Test by the Material," in *Ephemeral Bodies: Wax Sculpture and the Human Figure* (Los Angeles: Getty Research Institute, 2008), 155.

27 This has been called a "paradox of consistency"; see Didi-Huberman, "Die Ordnung," 13. This evaluation is consistent with other theoretical reflections on the wax, such as its "amorphous and polymorphous potential"; see Monika Wagner, Dietmar Rübel, and Sebastian Hackenschmidt, ed., *Lexikon des künstlerischen Materials: Werkstoffe der modernen Kunst von Abfall bis Zinn* (Munich: Beck, 2002), 231.

28 Mühlenberend, "Wachsmoulagen," 78.

the female subject associated with it have been extensively analyzed in the literature.[29] The figure lies supine, often with a languid gaze—a symbol of passive surrender. It can be actively opened for the study of anatomy and its organs can be removed. As it happens, Navena Widulin's laboratory is populated by another Venus, a countermodel to this Florentine version of feminine passivity: a large number of casts of a small replica of the Venus of Willendorf, dated around 30,000 BC and often identified as a mother goddess (fig. 4). They stand defiantly, seemingly ready to march; even though their arms are not visible, they appear confident and combative. Without individual facial features, they seem to symbolize empowered femininity itself, whose physicality and fertility are proudly shown, not passively exposed. Begun as a personal project for the purposes of both documentation and entertainment, the Venuses are cast from the wax residues of each new moulage that Widulin produces, thus capturing the different skin tones that had been mixed. Widulin's Venuses are an impressive testament both to the importance of museum laboratory practice beyond public visibility and to the fact that the power of transience, decomposition, and change can also be a subversive force.[30]

Besides this potential of the material to transform and to provoke, it is the capacity of wax to store or record that characterizes its cultural history: from mummification to death masks, from "memory material" (*Gedächtnisstoff*) to the first writing tablets, wax has been considered a medium of preservation since antiquity.[31] "Wax never forgets," as Widulin puts it, referring to the fact that even the smallest pressure or temperature fluctuations are stored in the deepest layers of the material, and sometimes even dust fuses with it.[32] This in-between state of activity and passivity is also noticeable when shaping a piece of wax with one's hands. Wax records the unintentional, unconscious movements of the hand of the person shaping it, and even the imprints of the fingers. For Georges Didi-Huberman, this represents a liveliness beyond passivity.[33]

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29 See Melissa Bailar, "Uncanny Anatomies/Figures of Wax," *Journal of the Midwest Modern Language Association* 49, no. 2 (2016): 29–53; Corinna Wagner, "Replicating Venus: Art, Anatomy, Wax Models, and Automata," *19: Interdisciplinary Studies in the Long Nineteenth Century* 24 (2017), https://doi.org/10.16995/ntn.783.

30 On the subversive and epistemic power of museum remains in a broader context, see Nina Samuel and Felix Sattler, ed., *Bildwelten des Wissens: Kunsthistorisches Jahrbuch für Bildkritik*, vol. 18, *Museale Reste* (Berlin, De Gruyter, 2022).

31 Didi-Huberman, "Die Ordnung," 5. On wax and memory, see also Pliny's report on the "imagines"—portrait busts and death masks made of wax, which record the remembrance of ancestors. In the presence of the lifelike depiction, the absence of the deceased is transcended. Wax effigies have been associated with the cult of the dead since antiquity (see Wagner et al., *Lexikon*, 233). On wax as a writing medium, see Andrea Jördens, Michael R. Ott, and Rodney Ast, "Wachs," in *Materiale Textkulturen: Konzepte – Materialien – Praktiken*, ed. Thomas Meier, Michael R. Ott, and Rebecca Sauer (Berlin: De Gruyter, 2015).

32 Widulin, discussion.

33 He calls this the "power of the material" of wax, which is related to its "viscosity." Didi-Huberman, "Die Ordnung," 13.

Fig. 4: Navena Widulin, wax copies of Venus of Willendorf, ongoing.

If one considers museum objects and their unintentional material activities, this intermediate state between transformation and preservation also proves to be a practical problem.[34] This is evident, for example, in the phenomenon of "efflorescence" or "blooming" of wax: an organic, internal process (or "auto-activity") of the material that is accelerated by its environment (fig. 5). Chemical reactions are triggered within the wax's constituents, and fatty acids come to the surface and form a white crystalline

34 Monika Wagner has concisely summarized these two aspects: in wax, "metamorphosis merges with conservation." Wagner et al., *Lexikon*, 235.

coating.[35] This is a normal transformation process of the material over time, which cannot be suspended or stopped but can be accelerated by climatic fluctuations and humidity.[36] Hence, impermanence and transience can lead to growth. However, in conservation, this auto-activity poses a major challenge because it can distort the appearance of the documented disease and raise questions about how to distinguish between the evolution of the material and the pathological condition. But wax reacts extremely sensitively not only to climatic fluctuations; in the history of conservation, moisture has been identified as one of wax's archenemies. This can be seen in the prehistory of today's struggle against the effects of water in conservation.

Fig. 5: Microscopic photography of wax surface with efflorescence and crystalline coating induced by climatic fluctuations, 1955. Moulage from the collection of Deutsches Hygiene Museum Dresden.

The science of conservation was heavily informed by scientific knowledge about the activity of substances and, in particular, by the rapidly growing knowledge of modern chemistry in the nineteenth century.[37] However, there is clear evidence of expert knowledge about materials and their activation already a century earlier. Water, in particular, was identified as one of the greatest challenges in artifact conservation from the late eighteenth century on, coinciding with the growing professionalization of the field. It is unsurprising that this discussion was initiated by a commission of experts in Venice—a place known for its fluctuating climatic conditions and high humidity. From their detailed report in 1777, it can be deduced that the experts' advice on conservation was based on a comprehensive knowledge of the activity of materials, especially of wood and dyes.[38] Moreover, the first-known discussions about creating

35 Widulin, discussion.

36 See Widulin, "Der Blick," 151; Patrick Dietemann, Ursula Baumer, and Christoph Herm, "Wachse und Wachsmoulagen: Materialien, Eigenschaften, Alterung," in *Körper in Wachs: Moulagen in Forschung und Restaurierung*, ed. Johanna Lang et al. (Dresden: Sandstein Verlag, 2010): 61–81, 76. For a different perspective on the influence of humidity on wax, see Alicia Sánchez Ortiz and Sandra Micó Boró, "Preventive Conservation Strategies for Wax Bodies in Scientific University Collections," *Conservation Science in Cultural Heritage* (2012): 219.

37 Wagner, *Arbeitsweisen*, 25.

38 "Picture supports made of canvas or wood work under the influence of fluctuating humidity, salts damage some pigments, and the adhesive power of the binder weakens when exposed to humidity,

a microclimate for storing works of art can also be dated to around the same time. Art-technological treatises of the time, for instance, recommend achieving this by paneling or wallpapering rooms to regulate humidity.[39] Thus, as early as the end of the eighteenth century, the foundation was laid for the conservation paradigm of dryness as the supreme condition for the stagnation of material activity.[40]

The demand for artificial cold was soon added to the paradigm of dryness in order to successfully passivate the material—a development that gained momentum as industrialization progressed in the second half of the nineteenth century: from the first patent for mechanical cooling, in 1851, in the United States to the founding of the first big firms for the large-scale production of artificial cold in Europe, around 1900.[41] The first air-conditioning systems installed in British museums in the 1920s were the result of an well-established debate about the ideal "museum climate"—a debate that was conducted at a high level in specialist journals already decades before.[42]

From the examples of the preparation of specimens and of the use of wax in conservation, we can conclude the following: fluids with different chemical compositions play an important role in passivation technologies in museums. For the creation of specimens, alcohol, as a highly manipulative liquid, ensures that the natural process of the decomposition of human organs is suspended; moulages, meanwhile, must be protected from humidity in order to slow down their material transformation processes. This realization by conservators marked the beginning of a long process that led to the establishment of a completely new concept of indoor air, in the museum and else-

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which also endangers the adhesion of the painting layers." Wagner, *Arbeitsweisen*, 14. Translation by the author.

39 M. Mauclerc, *Traité des couleurs et vernis* (Paris: Ruault: L'auteur, 1773), 116; Wagner, *Arbeitsweisen*, 14.

40 This finding is also confirmed by research on textile restoration in the nineteenth century: "Contrary to possible general assumptions, many current conservation and restoration practices have their roots in the nineteenth century, or earlier. The negative effects of moisture and humid indoor climates on artifacts were known. . . . Some materials for maintenance and preventive conservation used more than a century ago, such as water repellents, have remained almost the same." Maria Brunskog and Johanna Nielsson, "Restoration of Flat Textiles: Ideological Framework, Ideas and Treatment Methods in Sweden before 1900," in *Conservation in the Nineteenth Century*, ed. Isabelle Brajer (London: Archetype, 2013), 178.

41 Kostas Gavroglu, "Historiographical Issues in the History of the Cold," in *History of Artificial Cold, Scientific, Technological and Cultural Issues*, ed. Kostas Gavroglu (Dordrecht: Springer, 2014), 3.

42 For the UK context, see J. P. Brown, and William B. Rose, "Humidity and Moisture in Historic Buildings: The Origins of Building and Object Conservation," *APT Bulletin: The Journal of Preservation Technology* 27, no. 3 (1996): 12–23, 14. In Germany, this development started only in 1955; see Martina Griesser-Stermscheg, *Tabu Depot: das Museumsdepot in Geschichte und Gegenwart* (Vienna: Böhlau, 2013), 86–88. See also Mattias Legnér, "On the Early History of Museum Environment Control Control, Nationalmuseum and Gripsholm Castle in Sweden, c. 1866–1932," *Studies in Conservation* 56 (2011): 125–37; Andrea Luciani, "Historical Climates and Conservation Environments: Historical Perspectives on Climate Control Strategies within Museums and Heritage Buildings." PhD diss. (Politecnico di Milano, 2013), https://www.academia.edu/3505879/Historical_climates_and_conservation_environments_Historical_perspectives_on_climate_control_strategies_within_museums_and_heritage_buildings.

where: the idea of "synthetic air."[43] Temperature control and manufactured microclimates have played a central role in perfecting the passivation of materials in museum interiors.

The Paradigm of Conservation and Architectural Discourse: From Broken Wax to Cultural Heritage

Drying and cooling are important control parameters for preventive conservation, which has a purely precautionary character. Just as central to daily museum work, however, are issues arising from active conservation and restoration, which involve either substance-preserving or reconstructive measures.[44] In the case of significant damage to or destruction of an object, what is to be done is decided on an individual basis. That very different approaches can be taken is evident from comparing the treatment of two moulages from the collection of the Berlin Museum of Medical History at the Charité, both of which had been largely destroyed (figs. 6, 7). Figure 6 shows a woman with an eye tumor, from around 1909. We know from the records that the patient, "an old woman from the infirmary [Siechenanstalt]," refused surgery and instead covered her face with a damp cloth.[45] Thanks to the fortunate find of an illustration in the *Atlas der äußeren Augenkrankheiten* (1909) that shows the moulage before its destruction, it was decided, in 2007, to restore it completely, in such a way that the traces of the reconstruction would not be visible—a rather unusual decision in view of today's *Code of Ethics for Museums* (fig. 8).[46] This was accomplished by one of the most renowned experts in wax moulages, Elfriede Walther of the Hygiene-Museum Dresden. She glued the existing wax fragments together, added missing parts, applied new paint, and inserted a new linen binding. The moulage in figure 7, however, could not be assigned a medical diagnosis and is undated. In this case, experts decided not to reconstruct it, other than to stabilize it, leaving it in this condition and thus respecting its deteriorated state.[47]

In these two decisions, two different concepts of an object (and thus its treatment) crystallize—both of which emerged in the history of conservation over the course of the nineteenth century. The first concept holds that an object was "complete" at a clear-

43 Wulf Böer, "Synthetic Air," *Future Anterior: Journal of Historic Preservation, History, Theory, and Criticism* 13, no. 2 (2016): 77–101.

44 On the priority of active and preventive conservation over restoration, see Ute Hack, "Wachsmoulagen: Restauratorische Grundsätze," in *Körper in Wachs: Moulagen in Forschung und Restaurierung*, ed. Johanna Lang et al. (Dresden: Sandstein Verlag, 2010); see especially pages 43–44.

45 This description is from the label text for the moulage at the Berlin Museum of Medical History at the Charité. Widulin, discussion.

46 International Council of Museums, *Code of Ethics for Museums* (Paris: 2017), 15; also available online at https://icom.museum/wp-content/uploads/2018/07/ICOM-code-En-web.pdf.

47 Widulin, discussion.

Fig. 6: Destroyed moulage, ca. 1919, Berlin Museum of Medical History at the Charité (BMM).

ly defined point in time in the past, and thus this completeness should be achieved again, even after total destruction, or the completeness of its past state should be frozen. This can be called the path of reconstruction and the imitation of a known or imagined style. The second concept of an object views it from the standpoint of the course of time: all the effects of material change are seen as worthy of preservation, considered "complete" in their states of transience, impermanence, and change. This can be

Fig. 7: Destroyed moulage, *Carcinoma epitheliale palpebrarum* (reconstructed findings), ca. 1910, Berlin Museum of Medical History at the Charité (BMM).

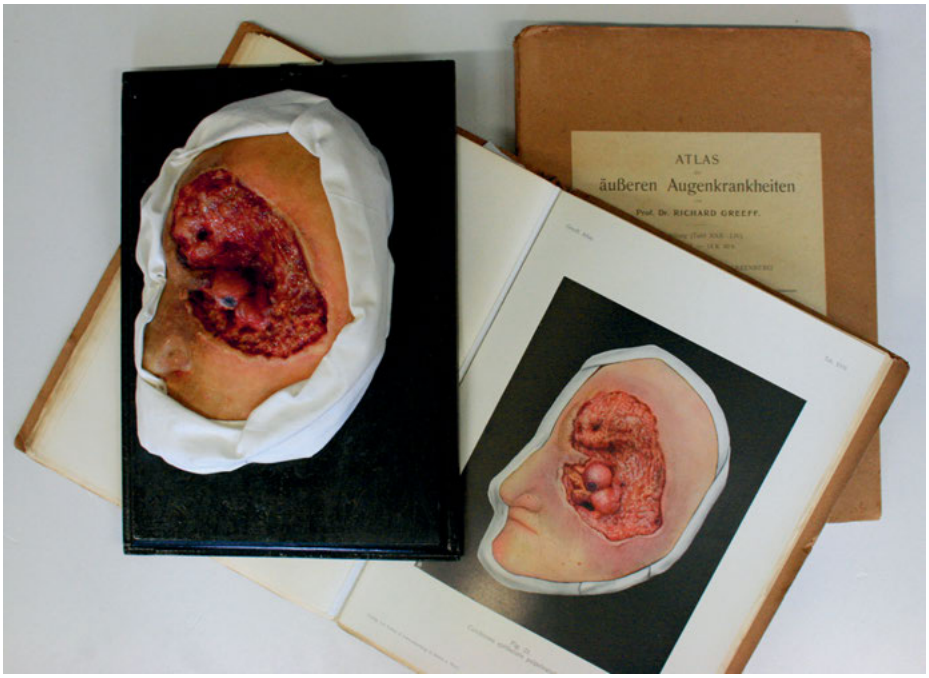

Fig. 8: Restored moulage by Elfriede Walter (1919–2018) based on an illustration in the Atlas of External Eye Diseases, Dr Richard Greeff, 1909, Fig. 21. Berlin Museum of Medical History at the Charité (BMM).

called the path of maintenance or of freezing the status quo—to preserve the physical side of the object, its historical substance. This second notion of the object was particularly influential in the theories of conservation in the twentieth century and led to an understanding of materiality as information. This involved the principle that "every restoration . . . implies a modification of cultural heritage and means a loss of information"[48]—and hence restoration should remain an exception.

Perhaps the best-known and most influential clash of these two concepts of the object—and, by extension, two different ways of grappling with the past and with remembrance—occurred over theories of the preservation of cultural heritage in the nineteenth and early twentieth centuries, as exemplified by the controversy between two of the most prominent architectural theorists of their time, Eugène-Emmanuel Viollet-le-Duc and John Ruskin.[49] When San Marco Basilica's bell tower collapsed in Venice in 1902, the contrast between these two concepts became more pronounced, sparking a public debate that continued the previously established dialectic but that reduced it to mere polar oppositions. Although both Viollet-le-Duc and Ruskin were

48 Katrin Janis, *Restaurierungsethik im Kontext von Wissenschaft und Praxis* (Munich: Martin Meidenbauer, 2005), 139. Translation by the author.

49 See David Spurr, *Architecture and Modern Literature* (Ann Arbor: University of Michigan Press, 2012), 142–61.

no longer alive at the time of this specific debate (the former died in 1879, the latter in 1900), their ideas remained vital. Those subscribing to Viollet-le-Duc's theory advocated the need to restore such a symbolic feature of the city's skyline, whereas those siding with Ruskin's opposed its reconstruction because this action would amount to a falsification of history.[50]

Viollet-le-Duc was famous for his definition of restoration as "reconstruction of an originally intended and perfect state, as it had possibly never existed before."[51] He had demonstrated this approach, beginning in the 1830s, through his numerous creative restorations of medieval buildings in France.[52] Ruskin spoke out against this in his collection *The Seven Lamps of Architecture* (1849): "Neither by the public, nor by those who have the care of public monuments, is the true meaning of the word *restoration* understood. It means the most total destruction which a building can suffer: a destruction out of which no remnants can be gathered: a destruction accompanied with false description of the thing destroyed."[53] Ruskin protested what he understood as a loss of truthfulness, which he thought Viollet-le-Duc's theory and practice entailed. This was the beginning of a discourse on "truth" in preservation and restoration science that persisted until the 1980s.[54]

The school of thought inspired by Viollet-le-Duc won in the case of the bell tower, whose reconstruction was finished in 1912.[55] In the long run, however, it was Ruskin's idea of prioritizing conservation over reconstruction that prevailed as the guiding principle in the protection of cultural assets.[56] Systematized and further developed by

50 Quoted in Natalia Escobar Castrillón, "Introduction," *OBL/QUE* 1 (2016): 4.

51 Violett-le-Duc in 1866, quoted in Gerald Unterberger, "Restaurierung – Restauration: Eine moderne Begriffsdifferenzierung und die ursprüngliche Bedeutung eines Wortes im mythisch-kultischen Kontext," *Muttersprache: Vierteljahresschrift für deutsche Sprache* 122, no. 3 (2012): 203–14, 204. Peter Kurmann has pointed out the ambivalences and contradictions of this definition; see Peter Kurmann, "Viollet-le-Duc und die ironisierte Kunstgeschichte," *Geschichte der Restaurierung in Europa* 2 (1993): 54–56.

52 The attitude of imitation and creation embodied by Viollet-le-Duc was not only discussed in the preservation of historical monuments. This development can also be clearly traced in the history of the restoration of mural paintings. Again, the change occurred around 1900: conservation before restoration was now the guiding principle. See Markus Santner, "Erhaltung, nicht Restaurierung – Der Paradigmenwechsel um 1900," in *Bild versus Substanz: Die Restaurierung mittelalterlicher Wandmalerei im Spannungsfeld zwischen Theorie und Praxis (1850–1970)* (Vienna: Böhlau, 2016).

53 John Ruskin, *The Complete Works of John Ruskin*, ed. E. T. Cook and Alexander Wedderburn, vol. 7, *The Seven Lamps of Architecture* (New York: Longmans, Green, and Co, 1903), 242.

54 Natascha Bäschlin, *Fragile Werte: Diskurs und Praxis der Restaurierungswissenschaften 1913–2014* (Bielefeld: transcript, 2020), 86.

55 This case continues to shape how we think about conservation even now, according to Natalia Castrillón: "The idea that history could be studied as empirical science and that historic truth and authenticity could be retrieved through rigorous restorations." Castrillón, "Introduction," 4.

56 The paradigm shift of "conservation before restoration" began around 1900. See, for example, Santner, "Erhaltung" (see note 52). Santner refers mainly to historical wall painting. The development of the debate in architecture should be distinguished from debates over cultural assets (see Castrillón, "Introduction," 50]). However, all these debates have their origins in the discourses on the preservation of

Georg Dehio and Alois Riegl, it became a foundation of the influential Venice Charter for the Conservation and Restoration of Monuments and Sites in 1964.[57] It was in this context that the still-valid principles of preservation and acceptance of changes—caused by natural aging, minimal intervention, reversibility, and making the restoration process visible—were formed.[58] One of the key consequences of this development was the demand by the International Council of Museums, in their 1986 Code of Professional Ethics, that museum collections only include works of art that the museum is also able to preserve.[59] The prevailing paradigm of conservation and perfect passivation also affected collection development and strategies. The possibility of objects' material preservation thus acted as a filter for which objects were allowed to enter museums at all.

Three main elements of a history of material passivation can be identified in the examples provided above, and all of them share a legacy stretching from the late eighteenth to early twentieth century: first, the correlation with the beginning of the age of the modern museum; second, the increase in discussions about water as a threat to conservation and the role of climatic influences and intrinsic material activities for conservation strategies (of a material such as wax); and, third, the introduction of a new discourse in the field of architectural preservation through Ruskin, from which the principles of contemporary conservation have developed. The various approaches to conservation and preservation have contributed to a historical moment that now makes it possible, from both academic and practical perspectives, to reflect on what preservation actually means: either reconstructing the past or maintaining the status quo. From today's perspective, it seems safe to add that these historical developments and constellations have significantly contributed to our current situation: living in an age that, in the words of archaeologist Cornelius Holtorf, is "obsessed with preservation."[60] Urgent questions arise for the present.

Notes on the Future of Conservation

To paraphrase Rem Koolhaas's proclamation in his 2004 manifesto, while preservation was an invention of modernity, we currently find ourselves in a moment in which pres-

monuments (or heritage preservation), which was influential in the nineteenth century (see Janis, *Restaurierungsethik*, 19).

57 Janis, *Restaurierungsethik*, 18–24.

58 See Hack, "Wachsmoulagen." At this point, a new understanding of the preservation of "authenticity" was emerging, which encompassed the entire materiality of a work of art (e. g., in the case of paintings, preservation included the frame, the reverse side, etc.); see Bäschlin, *Fragile Werte*, 86–96.

59 Bäschlin, *Fragile Werte*, 85. It was not until around 1998 that the debate began about whether this requirement was outdated.

60 Cornelius Holtorf, "The Heritage of Heritage," *Heritage & Society* 5, no. 2 (2012): 153–74.

ervation appears to be "overtaking us."[61] He illustrates this development with two diagrams (fig. 9). Since the end of the eighteenth century, the length of time between the construction of a building and it being classified as worthy of preservation has steadily decreased; in fact, buildings are now often classified as worthy of preservation even before their completion.[62] This development has long since reached museums where, for example, in the British Museum, only 1 percent of preserved items are on display, and the rest are stored in cool and dry places.[63] In addition to this danger of *over-conservation*, there is also the other extreme in our relationship with the past and cultural heritage, which might be called *under-conservation.* Consider, for example, the natural history displays of Charles Willson Peale in the United States (fig. 10). In his displays from around 1800, his interest in taxidermy and zoological specimens merged with his enthusiasm for two-dimensional pictorial spaces: he placed taxidermy animals in the foreground, against a landscape painting in the background, in order to bring the habitat of the animals to life in a new way.[64] Unfortunately, in the late twentieth century, all his displays were destroyed—through neglect and a lack of awareness of their historical value—and, with them, the opportunity to study the displays as precursors to the dioramas that became popular in nineteenth-century natural history museums.[65]

The question of how to engage with the paradigm of conservation is crucial for the present because it determines our notion of remembrance. An example from around 1800 underlines this: when Alexander von Humboldt visited Latin America, two fundamentally different concepts of memory culture collided. He was disturbed when he learned how old monuments were used to construct new buildings, and he set about ending this practice, which he saw as sacrilege, in order to preserve the monuments.[66] The central question is thus as follows: Do we incorporate objects and make something new out of them, or do we freeze and immobilize them?

There is a third possible answer to this question, which stems, once again, from architecture. Starting in the 1950s, new constellations between conservation and resto-

61 Rem Koolhaas, "Preservation Is Overtaking Us," *Future Anterior, Journal of Historic Preservation: History, Theory, and Criticism* 1, no. 2 (2004): 1–3. See also Rem Koolhaas and Jorge Otero-Pailos, *Preservation Is Overtaking Us* (New York: Columbia University Press, 2014).

62 Koolhaas, "Preservation," 2.

63 Griesser-Stermscheg, *Tabu Depot*, 90. On the "expansive evolution" of the concept of objects which are now judged to be worthy of preservation, see Salvador Muñoz Viñas, "Contemporary Theory of Conservation," supplement, *Studies in Conservation* 47, S1 (2002): 27–28.

64 I thank Claudia Blümle for mentioning Peale to me. See Claudia Blümle, "Hier – Schau hin: Überzeugungsfiguren im Bild," in *Überzeugen: Szenarien von Zeugenschaft und ihre Akteure*, ed. Matthias Däumer, Aurélia Kalisky, and Heike Schlie (Paderborn: Wilhelm Fink, 2017), 167–93, especially 181–87.

65 See Stephen Christopher Quinn, *Windows on Nature: The Great Habitat Dioramas of the American Museum of Natural History* (New York: Abrams, 2006), 13–14.

66 I thank Wolfgang Schäffner for this reference. For more details on Alexander von Humboldt's journeys, see Vera M. Kutzinski, Ottmar Ette, and Laura Dassow Walls, ed., *Alexander von Humboldt and the America* (Berlin: Verlag Walter Frey, 2012).

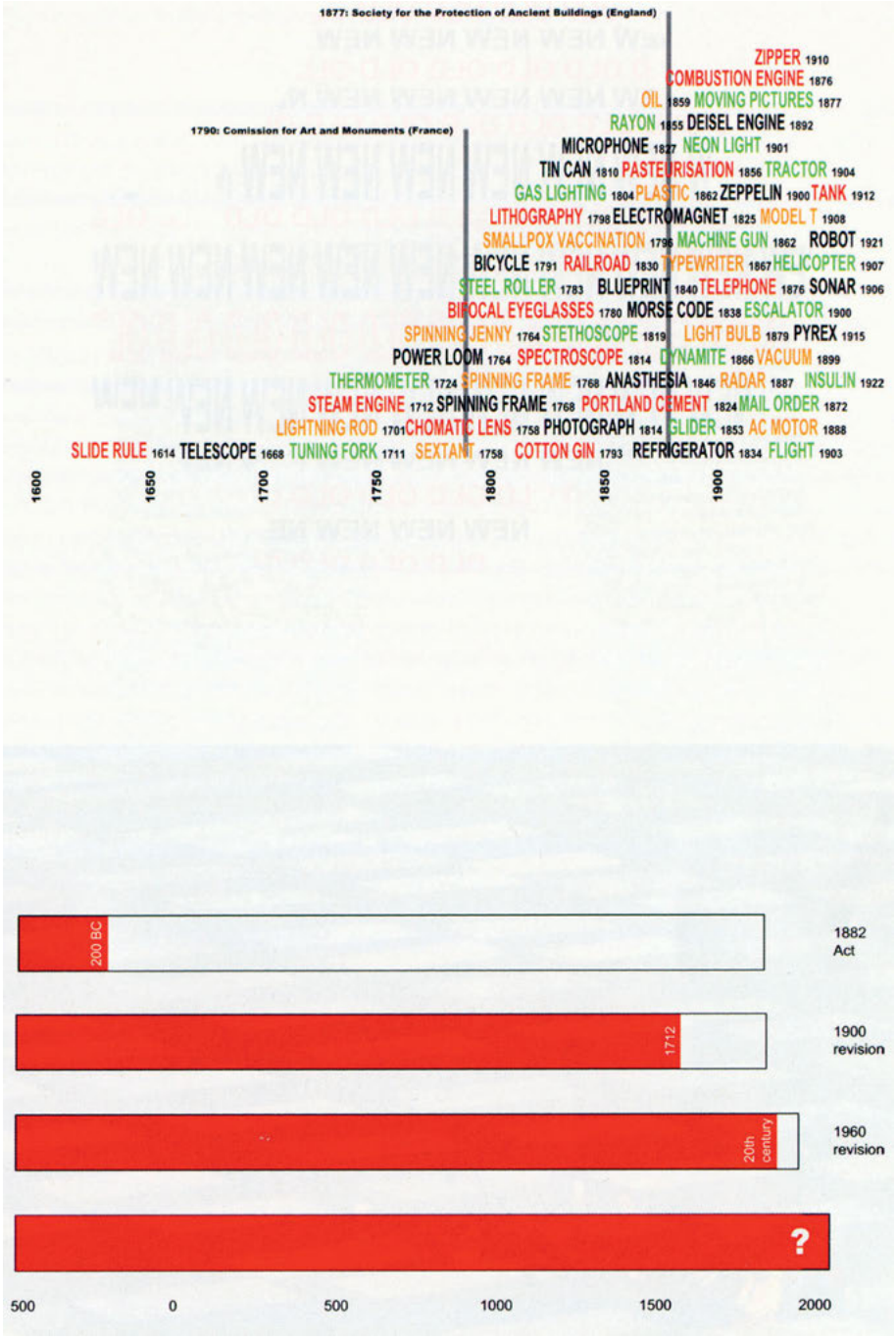

Fig. 9: Rem Koolhaas, *Preservation Is Overtaking Us* (New York: Columbia University Press, 2014), 45.

Fig. 10: Charles Willson Peale and Titian Ramsay Peale, *The Long Room, Interior of Front Room in Peale's Museum*, 1822, watercolor over graphite pencil on paper. Detroit Institute of Arts.

ration emerged. A groundbreaking early example of this development is Carlo Scarpa's transformation of Castelvecchio in Verona into a museum (fig. 11).[67] The preservation of the historical substance triggered innovative solutions in the field of architecture, transforming the entire site into a display; meanwhile, the medieval objects on view acquired a new visibility through the *dispositif* of modernity—Scarpa's use of materials and forms and their contrast to the older historical substance. Figure 11 shows the famous equestrian statue of Cangrande della Scala, which Scarpa positioned prominently against the backdrop of both the historical and the recently restored architecture, and which he embedded in a path system through the site that enabled the viewer to see the statue from various angles and thus also in multiple historical constellations.

These impulses from architecture can be used to further reflect on alternative approaches to conservation, approaches that focus more on processes and practices—or, as cultural heritage researcher David Lowenthal summarized: "Preferring fragments to wholes; written, painted or mental images to physical objects; and processes to material entities."[68] If one also considers practices and processes as worthy of preservation, different conservation approaches are possible. One approach is based on repetition

67 See Manuel J. Martín-Hernández, "Architecture from Architecture: Encounters between Conservation and Restoration," *Future Anterior: Journal of Historic Preservation, History, Theory, and Criticism* 4, no. 2 (2007): 62–69.

68 David Lowenthal, "Material Preservation and its Alternatives," *Perspecta* 25 (1989): 66–77, 77.

Fig. 11: Carlo Scarpa (architect), Castelvecchio Museum, Verona, 1956 – 74.

instead of perpetuation and is exemplified by the well-known Ise Grand Shrine in Japan. Cyclical destruction and reconstruction are used to conserve both practices of worship and practices of the architectural construction associated with it, as opposed to preserving the actual substance of the shrine.[69] Another approach can be derived from one of Ruskin's terms: "voicefulness."[70] If voices of the past are stored in the objects, they cannot be made audible by material preservation, but rather through an ethics of extended usage, as discussed today in the field of ethnographic conservation.[71]

Following the thinking of Bruno Latour, what is needed is an intermediate path between the two extremes of idolatry and iconoclasm—that is, between the uncritical attention to images (the attitude of over-conservation) on the one hand, and the destructive neglect of images (the attitude of under-conservation) on the other.[72] To use Latour's term, this third way would be one of "iconophilia," in the sense of "respect, but not for the image itself, but for the movement of the image . . . for the passage, the transition from one pictorial form to another."[73] Applied to conservation science in a way that takes into account its developments over the last two decades, this approach of no longer focusing exclusively on protection could be described as "careful management of change."[74] As much as this challenges core conservation values, it also opens up new perspectives, one of the most important being the "shift from protection towards creation . . . and embracing communities' associations."[75] The contemporary theory of conservation, which is critically reflecting on the preservation paradigm, is being called upon to incorporate this question into the development of new strategies for the present.[76] This involves, as the research of Hanna Hölling has shown, "recogniz-

69 Lowenthal, "Material Preservation," 73.

70 Bäschlin, *Fragile Werte*, 88.

71 Because "the objects themselves are not important, what matters is what the objects represent." Miriam Clavir, "Preserving the Physical Object in Changing Cultural Contexts," in *The International Handbook of Museum Studies: Museum Transformations*, ed. Sharon Macdonald and Helen Rees Leahy (West Sussex: John Wiley and Sons, 2015), 389.

72 Bruno Latour, "Wie wird man ikonophil in Kunst, Wissenschaft und Religion?" *Zeitschrift für Ästhetik und Allgemeine Kunstwissenschaft* 57, no. 1 (2012): 19–44. It must be noted here that the attitude of under-conservation cannot be equated across the board with the iconoclastic destruction of images or objects, as is known from the history of art; see Dario Gamboni, *The Destruction of Art: Iconoclasm and Vandalism since the French Revolution* (London: Reaktion Books, 1997). That said, indifference and historical oblivion, which can be described as attitudes driving under-conservation, can also lead to material destruction, as in the example of Charles Willson Peale's displays. I thank Claudia Blümle for the reference to Latour.

73 "We should pay respect to the series of transformations for which each individual image is only a provisional one," Latour, "Wie wird man," 21. Translation by the author.

74 See Bäschlin, *Fragile Werte*, 140.

75 Ioannis Poulios, "Moving beyond a Values-Based Approach to Heritage Conservation," *Conservation and Management of Archaeological Sites* 12, no. 2 (2010): 170–85, 182.

76 On the change in preservation science in progress, see Bäschlin, *Fragile Werte*, 141. See also Jorge Otero-Pailos, Erik Langdalen, Thordis Arrhenius, ed., *Experimental Preservation* (Zurich: Lars Müller, 2016).

ing larger goals related to the intangible: the transmission of tradition, memory, skill, technique, and tacit knowledge."[77]

As we have seen from Scarpa, each conservation method also produces new visibilities. Yet this raises the question of what we in fact want to make visible, and how. More specifically, we might ask: What kind of new visibility can be created that frames "processes of decay . . . as . . . productive,"[78] and how can this influence contemporary artifact design? And, to take this further, what might happen if the activity or performance of the material were not understood as a disturbance or dysfunction but were instead viewed in a positive light?

To touch upon this question briefly, it is worth returning to one of the materials discussed above—wax—and its uses in applied sciences that deal with processes of decay, as opposed to its use in conservation. It is precisely the aforementioned intrinsic activity of wax that has recently been researched in the field of transient electronics. Tailored wax-based materials are currently being coded in such a way that they can operate in a stable fashion over extended periods of time in aqueous environments before dissolving completely. For example, researchers studied the functional use of a partially biodegradable wireless LED (fig. 12). There are highly promising applications of these waxes, such as in biomedical implants that are able to self-destruct after a predetermined lifespan, thereby avoiding surgical extraction and the waste management of electronics.[79] One could call this a "coded decay of the material."[80]

While this would not be a sustainable approach for museum objects such as specimens or wax moulages, since they would lose their function as educational material, it opens up perspectives beyond questions of museum conservation. For the future, it remains to be seen whether part of our ecological responsibility will be to primarily produce artifacts that dissolve without residue on a fixed date. If materials were truly understood in terms of their "performance" rather than merely as an accumulation of properties,[81] the age of cooling and drying, which this article has explored, could soon give way to a new era in which the various states and process qualities of materials are not fought, mitigated, or suspended, but are made more productive.

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77 Hanna Hölling, Francesca G. Bewer, and Katharina Ammann, *The Explicit Material: Inquiries on the Intersection of Curatorial and Conservation Cultures* (Leiden, Boston: Brill, 2019), 4. See also Hanna Hölling, "The Technique of Conservation: On Realms of Theory and Cultures of Practice," *Journal of the Institute of Conservation* 40, no. 2 (2017): 87–96.

78 Caitlin DeSilvey, *Curated Decay: Heritage Beyond Saving* (Minneapolis: University of Minnesota Press, 2017), 5.

79 Sang Min Won et al., "Natural Wax for Transient Electronics," *Advanced Functional Materials* 28, no. 32 (2018): 1801819, https://doi.org/10.1002/adfm.201801819.

80 Another historical example of the intrinsic activity of wax could be one of the oldest molding processes for metal and glass casting known since antiquity: the lost-wax casting in which the wax form is lost (i. e., melts) in order to obtain a metal sculpture. During the process, both the model and the mold are destroyed.

81 Bensaude-Vincent, "Materials as Machines," 20.

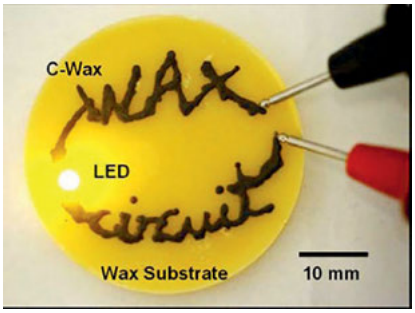

Fig. 12: Sang Min Won et al., "Natural Wax for Transient Electronics," *Advanced Functional Materials* 28, no. 32 (2018): 1.