10

Art Conservation and Quantum Physics: The Example of Mold Remediation

Conservación del arte y física cuántica: el ejemplo de la eliminación del moho

Scott Joseph Peck, Ph.D.[1] Nadine M. Kalin, Ph.D.[2]
[1]Museum of Biblical Art, National Center for Jewish Art, Dallas, TX, USA
[2]University of North Texas, Denton, TX, USA

Abstract
Art conservation involves the care and preservation of artwork, while art conservation curriculum attempts to formally educate art conservation students in preparation for joining the profession. This research proposes significant amendments to how both processes are conceived and practiced. We contend that the current field of art conservation fails to appreciate, explain, or speculate on the shared transformations, traumas, pieces of knowledge, intensities, or affects activated between humans and nonhumans through preservation processes. Art conservation and its education must offer new ways to think about what is happening in conservation—to the art objects and the human beings involved. The field of physics has inspired fresh insights for conservation. This chapter highlights the implications and potentialities of entanglement—a term describing the literal intertwining of meaning and matter—for art conservation and its curriculum. Mold remediation is a prime example, providing insights into the intra-agency and intra-activities involved in entangled art conservation processes. Harnessing quantum mechanics' concept of entanglement, we contend that the nonhuman art object and human are interwoven, materially altering and modifying. New materialist perspectives bring art conservation into applied physics, defined as a bridge between physics and related scientific disciplines. Conservation practice and curriculum as applied physics speculatively advances and extends the field.

Keywords: Art Conservation, Curriculum, Quantum Physics, Entanglement, New Materialism, Intra-Agency.

Suggested citation:
Peck, S.J., Kalin, N.M. (2023). Art Conservation and Quantum Physics: The Example of Mold Remediation. In Pérez-Aldeguer, S. (Ed.), *Teaching and learning projects in Arts and Humanities*. (pp. 99-112). Madrid, España: Adaya Press. https://doi.org/10.58909/ad23732604

Resumen
La conservación del arte implica el cuidado y la preservación de las obras de arte, mientras que el plan de estudios de conservación del arte intenta educar formalmente a los estudiantes de conservación del arte en preparación para unirse a la profesión. Esta investigación propone modificaciones significativas a la forma en que se conciben y practican ambos procesos. Sostenemos que el campo actual de la conservación del arte no logra apreciar, explicar o especular sobre las transformaciones, traumas, conocimientos, intensidades o afectos compartidos activados entre humanos y no humanos a través de los procesos de preservación. La conservación del arte y su educación deben ofrecer nuevas formas de pensar sobre lo que sucede en la conservación: de los objetos de arte y de los seres humanos involucrados. El campo de la física ha inspirado nuevos conocimientos para la conservación. Este capítulo destaca las implicaciones y potencialidades del entrelazamiento—un término que describe el entrelazamiento literal de significado y materia—para la conservación del arte y su plan de estudios. La remediación del moho es un excelente ejemplo, que proporciona información sobre las actividades internas y dentro de la agencia involucradas en los procesos de conservación del arte entrelazados. Aprovechando el concepto de entrelazamiento de la mecánica cuántica, sostenemos que el objeto de arte no humano y el ser humano están entrelazados, alterándose y modificándose materialmente. Las nuevas perspectivas materialistas llevan la conservación del arte a la física aplicada, definida como un puente entre la física y las disciplinas científicas relacionadas. La práctica de la conservación y el plan de estudios a medida que la física aplicada avanza y amplía especulativamente el campo.

Palabras clave: conservación de arte, plan de estudios, física cuántica, entrelazamiento, Nuevo materialismo, intra-agencia.

Introduction to Art Conservation

Art conservation involves the care and preservation of artwork. While art conservation curriculum attempts to formally educate art conservation students in preparation for joining the profession. This research proposes significant amendments to how both processes are conceived and practiced. We contend that the current field of art conservation fails to appreciate, explain, or speculate on the shared transformations, traumas, pieces of knowledge, intensities, or affects activated between humans and nonhumans through preservation processes. Art conservation must offer new ways to think about what is happening in conservation—to the art objects and the human beings involved. The field of physics has inspired fresh insights. This chapter highlights the implications and potentialities of entanglement—a term describing the literal intertwining of meaning and matter—for art conservation and its curriculum. Mold remediation is a prime example, providing insights into the intra-agency and intra-activities involved in entangled art conservation processes. Harnessing quantum mechanics' concept of entanglement, we contend that the nonhuman art object and human are interwoven, materially altering and modifying.

New materialist perspectives bring art conservation into applied physics, defined as a bridge between physics and related scientific disciplines. Conservation practice and curriculum as applied physics speculatively advances and extends the field.

Defining Art Conservation

A conservator is entrusted with the care of art objects. Various implied ideas and nuances exist with the use of the term conservation within the field of art conservation today (Appelbaum, 2018). One practice associated with conservation is prevention. Art objects are vulnerable as they age, and they naturally degrade and deteriorate, causing the need for preventative action (Hermen & Fiske, 2010). The decomposition and damage to art are due to the scientific law of entropy, which holds that all organized matter is moving from a place of order toward disorder. Therefore, information or meaning is potentially being lost in artwork continuously.

Art conservation may rightly be defined as managing the alterations in artwork affected by the agents of deterioration or damage (Staniforth, 2013; Ward, 1989). Conservation involves a human intermediary practicing preventative measures to slow natural aging and other deterioration processes (Appelbaum, 2007; Conti, 2007). Inevitably, conservation acknowledges that all artworks will cease to exist in their current material forms. Art conservators are also intermediaries, offering restoration and salvation for artworks damaged from catastrophes and accidents (Powell, 2016).

In recognition of the mutual atrophy and shared trauma experienced by humans and art objects, it is time to re-think and re-work art conservation and its education beyond the human-centric processes of art conservators acting upon artworks. Turning to concepts associated with applied physics has enabled a more interdisciplinary approach to art conservation theory and its learning that expands current limits of thinking and doing in the field.

Human Bias to Art Conservation

Art conservation education is human-biased, as evidenced in its reliance on a human savior to heal in a unilineal progression without appreciating the intertwined relationships between the nonhuman and human. This limited perspective stands in the way of advancements and potentialities of art conservation curriculum and practice. For example, conservators do not treat the art object as an equal; the nonhuman is subservient to the human, as the human is the only life in this equation, and the art object is incapable of knowing or acting. Speculative realism is a concept that states reality exists outside of human experience (Harman, 2010, 2018). In other words, the art object has its own life and existence that must be respected, appreciated, and valued for what we might know from the hard sciences and what we can discover about the life of the materials that make up any art object. Speculative realism demands care for the art object because the nonhuman art object has its own life and existence worthy of such care and thinking beyond our current knowledge limits.

Human beings and nonhuman art objects have their own lives and pieces of knowledge, inviting new questions for art conservation and its education. What relations might be occurring between these two beings? What if knowledge or information passes between the two beings? How does this impact art conservation education and curriculum theory?

Artwork that is being conserved acts upon the art conservator that is executing the conservation work. For instance, when performing conservation on an ancient shattered ceramic vase, the art conservator may potentially experience shared trauma with that damaged nonhuman artwork. Upon encountering the damage, human responses occur such as anxiety, fear, and grief; along with physiological changes including an increase in heart rate, rapid breathing, panic responses, increase in body weight, higher blood pressure, and altered brain cell activities, initiating what might be identified as feelings of terror and horror (Kubzansky *et al.*, 2007; Levine, 2009; van den Berk-Clark, 2018) may be triggered in the conservator. On the other hand, during the restorative processes of conserving an object, the mindful and meditative-oriented human being can partake in the shared healing, resulting in lower blood pressure, controlled breath, stress relief, and changes in brain cell activities from feelings of joy, pleasure, and ecstasy (Archer, 2004; Baer, 2003; Rosamond *et al.*, 2008).

Re-Thinking Art Conservation with Principles from Quantum Physics

The concept of entanglement from quantum physics offers further light on what could occur between the human art conservator and the nonhuman art object. Entanglement refers to a phenomenon where atomic and subatomic particles are related and connected regardless of the space between these particles (Wheeler & Zurek, 1983). Karen Barad (2007) states that entanglement encompasses human and nonhuman involvement, where meaning and matter are intertwined. Re-thinking the human conservator and the conserved nonhuman art object being through entanglements re-conceives this coupling of beings as tangled and interwoven.

Material Agency and Art Conservation

What progressions are at work between beings in art conservation? From physics, we learn that the materials of which the artwork and the human body are composed have agency or a capacity to act and produce affect (Bennett, 2010). Affects are body-to-body transferences (Gregg & Seigworth, 2010). For example, a marble sculpture damaged by a flood possesses such agency. While human beings potentially experience feelings such as grief and increased blood pressure upon encountering the damaged artwork, conservators may also breathe in mold spores from mold-damaged marble that modifies the functioning of their human lungs. Conservation involves intra-agency or shared agency between the human conservator and the art object.

The trauma/healing intra-activities can involve many material agents (Barad, 2012a). A mold-damaged sculpture's surface molecules change and reorganize via conservation treatments by placing the sculpture in a freezer to stop the mold's growth. The conservator applies solvents to the sculpture that kill the mold cells embedded in the stone, changing the patina or coloring. Affects occur on the atomic and subatomic levels (Coole & Frost, 2010) as the human body responds to changes in the art object and reactions to changes in temperature.

Multi-Directional Changes and Affect from the Intra-Activity of the Human and Nonhuman

Entanglements occur throughout the conservation processes where the nonhuman art object and human conservator are not merely interacting but intra-acting, which means that the human conservator and nonhuman art object alter each other on the deepest levels, atomically and subatomically (Barad, 2007, 2010). Intra-actions are not the simple, unidirectional human-to-art object intervention the field of art conservation has clung to since its inception as a field of practice. Many processes occur in various directions amongst materials in ongoing relations, pre-cognitive or as-yet-unknown to us as humans. Figures 1 and 2 demonstrate evidence of nonhuman beings and human being entanglement, displaying affects on the atomic and subatomic levels, continuing for five centuries and into the future.

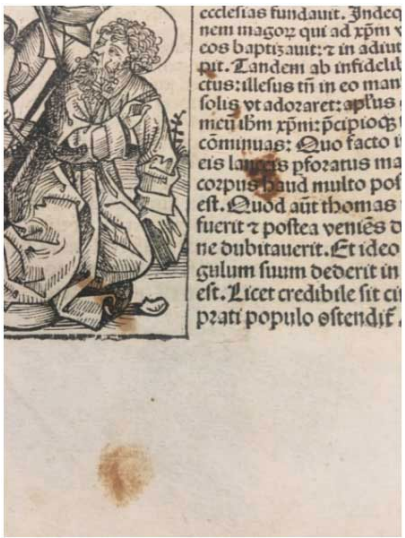

Figure 1. Peck, S. (2023). Evidence of nonhuman being and human being entanglement, displaying affects on the atomic and subatomic levels, continuing for five centuries and into the future: Example 1 Nuremberg Chronicles leaf 1493 [Digital photograph]. Courtesy of the author.

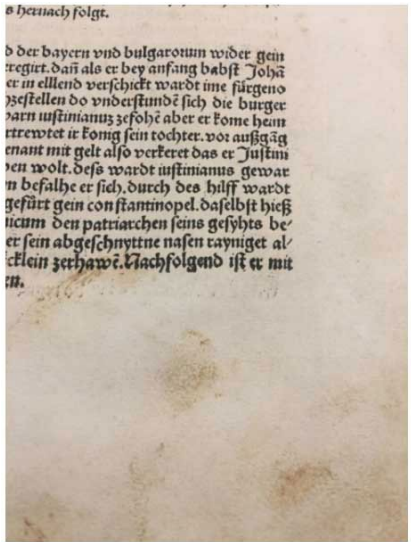

Figure 2. Peck, S. (2023). Evidence of nonhuman being and human being entanglement, displaying affects on the atomic and subatomic levels, continuing for five centuries and into the future: Example 2 Nuremberg Chronicles leaf 1493 [Digital photograph]. Courtesy of the author.

The affects and changes occurring within the human/nonhuman conservation relationship involve materials, and conservation itself is very materially oriented, demonstrated in art conservation treatment activities that are a part of the curriculum, such as using chemical solvents for cleaning a painting or applying adhesives to reassemble a cracked glass artwork (Berger & Russell, 2007). This paper proposes a materials-based or new materialist perspective (Bolt & Barrett, 2007; Coole & Froste, 2010) of art conservation and education that acknowledges and speculates on "having the other in one's skin" (Barad, 2007, p. 392) towards dissolving binary divisions between human and nonhuman through interdisciplinary innovations (Dolphijn & van der Tuin, 2012).

Tracking art conservation processes as intra-activity between conservation treatments, humans, and art object materials enlivens these undertakings as beings of materials that have agency and can cause specific affects (Bennett, 2010). Conservation processes commonly observe the vitality and dynamism of nonhuman materials and material entities, as seen in Figure 3. An example is when a fire occurs in an art museum. Smoke damage is extreme in fire tragedies, transforming the art objects' molecular structure. Paintings exposed to this kind of damage indicate intra-activity and intra-agency, where heat and smoke alter the canvas with plant cells, absorbing the particulate molecules. The canvas surfaces catch particulate material or PM that further changes the molecular structure of the painting. This example gives insights into how powerful nonhuman materials are related to material agency and intra-activities beyond art conservator interventions.

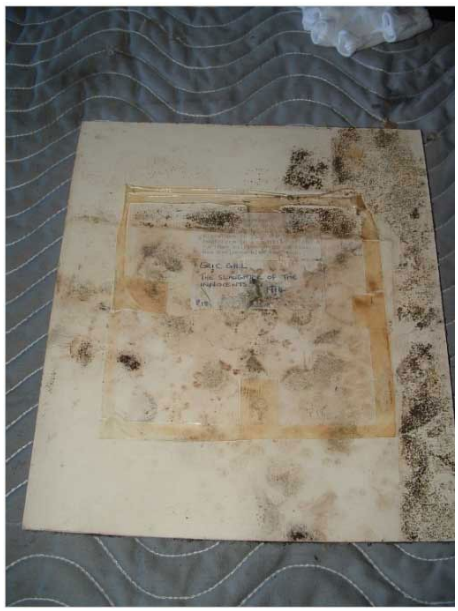

Figure 3. Peck, S. (2023). Human being intra-acting, demonstrating the entanglement of the human conservator and the nonhuman smoke damaged painting [Digital photograph]. Courtesy of the author.

Digging Deeper: Discovering Entanglement when Conserving Artwork Affected by Mold

Mold growth on art objects is a significant threat facing conservators as it can cause extensive damage to the nonhuman, demanding an immediate response (Pinzari *et al*., 2013). Mold is a fungus that grows in damp or humid environments (Mazzola *et al.*, 2017) on various surfaces, including artwork and its materials, such as paper, textiles, and wood (Ormsby, 2015). The artwork and the mold can be entangled so much so that the presence of mold can produce enzymes that break down the organic components of art objects, leading to discoloration, texturing, and physical weakening (Bulat & Lupulescu, 2019). Thus, the mold cells change and alter the molecules that make up the art object, as seen in Figure 4.

Figure 4. Peck, S. (2020). Mold demonstrating its agency upon an Eric Gill wood engraving with matting [Digital photograph]. Courtesy of the author.

Types of Mold and the Life Cycle

Several types of mold, including Aspergillus, Penicillium, and Cladosporium, are commonly found in art conservation settings (Furakawa & Hakuta, 2019), each type identified based on their unique morphological and chemical features. For example, Aspergillus has septate hyphae with conidiophores that produce unbranched conidia (spores), whereas Penicillium has branched conidiophores that make chains of closely spaced conidia. Like all fungi, mold has a life cycle that includes sexual and asexual reproduction (Bloom *et al.*, 2009). During the asexual phase, mold produces spores, which can spread quickly on surfaces, in the air, and even attach to clothing (Villegas & Abergal, 2018). Spores can remain dormant for extended periods, waiting for the proper environmental conditions to begin germination and growth.

Under favorable conditions, mold spores will germinate, developing hyphae, the small, thread-like structures that make up the fungus (Grzywacz, 2016). Hyphae can grow and multiply quickly, creating a network that enables the mold to absorb nutrients and water from its surroundings. In this way, mold can continue to grow and produce more spores, which can spread to new surfaces, resulting in further growth affecting the artwork.

Damaging Entanglement of Mold and Art Objects

Mold growth on cultural heritage objects can cause irreversible material alterations, deteriorating the object's physical and structural integrity, as shown in Figures 5, 6, and 7. Mold affects different materials in various ways, so understanding the effect of mold on different cultural heritage objects is essential for art conservation professionals.

Mold growth on wood objects can cause both aesthetic and physical damage. Surface mold growth causes discoloration, staining, and unpleasant odors. The hyphae of the mold can penetrate the wood, leading to structural damages such as cracking, deformation, and, ultimately, the loss of integrity of the object. Wood degradation caused by mold can weaken the object, making it more susceptible to further damage from other sources.

Paper is highly susceptible to mold growth since it provides a favorable surface for mold to grow and reproduce. Mold growth on paper can cause discoloration, staining, and deformation. The hyphae of mold can break down the paper's fibers, causing weakness, brittleness, and, ultimately, deterioration of the object. Mold growth on paper can lead to the loss of written or printed material, losing the information held on the object forever.

Mold growth on textiles can cause discoloration, staining, and a musty smell. While the textile itself may not have significant structural damage from mold growth, mold can weaken or ruin the threads used to sew the textile together, causing unraveling or loss of the object's original form and shape. Mold growth on textiles can also increase the risk of insect infestation.

Figure 5. Peck, S. (2023). Mold causing material alterations to a Max Liebermann etching, demonstrating its agency [Digital photograph]. Courtesy of the author.

Figure 6. Peck, S. (2023). Affect or body-to-body changes in the structural integrity of the etching [Digital photograph]. Courtesy of the author.

Figure 7. Peck, S. (2023). Permanent alterations to the art object from the vibrant life of mold spores [Digital photograph]. Courtesy of the author.

Mold growth in paintings can cause extensive damage, including changes to color, bulges, blisters, and cracking in the paint layer. Mold can also cause canvas degradation, weakening the structure and, in extreme cases, causing holes in the paintings. The artwork's value and historical significance are severely diminished by mold growth, losing the object's originality and authenticity because of these affects, as evidenced in Figure 8. In summary, mold has its own agency that is demonstrated by the intra-acting agents that result in alterations of the nonhuman art object. Thus, demonstrating the intra-activity and intra-agency of mold and art objects is a viable means in which to incorporate physics' concept of entanglement into art conservation curriculum and pedagogy.

Figure 8. Peck, S. (2023). Demonstration of artwork's value and historical significance severely impacted by mold growth, losing the object's originality and authenticity due to these affects [Digital photograph]. Courtesy of the author.

Destructive Intra-Agency between Mold and Human Conservators

In contrast to mold's effects on artwork, for humans, mold growth can produce a variety of intra-activities from the harmful aerosols that can be inhaled or come into contact with the skin. These aerosols can contain spores, cell fragments, microbial volatile organic compounds (MVOCs), and allergens that can cause adverse health effects (Sterflinger & Piñar, 2013). Exposure to these aerosols can cause short-term and long-term health problems, depending on the duration and intensity of exposure. Common health intra-agency associated with mold exposure include allergic reactions, asthma, headaches, skin irritation, and respiratory infections (Hong *et al.*, 2018).

Allergic reactions are a common health concern associated with the agency of mold on artwork. Symptoms may include sneezing, runny nose, nasal congestion, watery eyes, and skin rashes. Allergic reactions can be particularly severe in humans with pre-existing allergies and asthma. In some cases, an allergic response to mold can trigger more permanent and severe respiratory symptoms, such as difficulty breathing, chest tightness, and wheezing, forever altering the atomic structure of the human conservator.

Exposure to mold's agency on artwork can cause respiratory problems in conservators, especially in individuals with a history of respiratory illness. Inhalation of mold spores can lead to permanent respiratory symptoms such as coughing, shortness of breath, and chest pain. Chronic mold exposure can lead to the development of pulmonary fibrosis, a lung disease that results in scarring of lung tissue and impaired breathing ability, affecting the life of the human with the direst of intra-action.

Neurological symptoms in humans come from exposure to mold in indoor environments. High levels of mycotoxins, toxic compounds produced by certain types of molds, have been associated with neurological symptoms such as memory loss, confusion, and cognitive dysfunction. In addition, mold exposure creates affects such as an increased risk of depression, anxiety, and other mental health problems.

Skin irritation is another possible health concern associated with exposure to mold-entangled art objects. Direct contact with moldy surfaces can cause skin rashes, itching, and redness, permanently changing human cells. Art conservators with pre-existing skin conditions, such as eczema, are particularly susceptible to skin irritation and changes caused by human cells intra-acting with the mold spores.

Mold Conservation that Acknowledges Entanglement

Acknowledging mold's entanglement with the human being and the nonhuman art object provides the basis for lessons that preserve these lives throughout the conservation processes. The human conservator can learn to identify mold growth and its signs to develop appropriate remediation strategies in order to save the life of the nonhuman art object. Entanglement teaches that the conservator must also care for their being, intertwined with the treated mold-ridden art object. Students can speculate in the classroom on how they may become affected by mold as human beings. Demonstrating that quantum-based art conservation is interdisciplinary, they can apply these discoveries of how to protect their brain, skin, lungs and other areas that can be incorporated into their behavior and practice.

Research and development are crucial in advancing the understanding of mold growth, its mechanisms, and effective control strategies as manifestations of entanglement in conservation education. Agential-related studies can provide valuable insights into the prevalence of molds in different environments and address the changing nature of microbial communities in storage and exhibition spaces. Quantum-based research in developing environmentally friendly biocides can help improve the effectiveness of mold management while reducing the potential adverse effects associated with traditional fungicides. Additionally, Physics research may offer innovative tools and technologies such as microclimate enclosures, air filtration systems, and humidifiers that can improve the effectiveness of mold management strategies preserving and caring for entangled human and nonhuman beings.

New Understandings of Mold Remediation from Quantum Physics

Ultimately, physics' concept of entanglement offers new understandings of how art objects, mold, and humans are intra-connected and intra-acting upon one another throughout conservation processes, sharing in trauma and healing. In mold remediation, the conservator's goal is to prevent the birth of mold spores from coming into existence and to destroy or kill mold spores that exist upon the nonhuman art object, all the while protecting and preserving the conservator's life. Entanglement in mold remediation processes involves three life forms: the human conservator, nonhuman art object, and nonhuman mold spores.

Along with the mitigation of mold's effects on the nonhuman art object, entanglement teaches that mitigation needs to occur regarding mold's entangled effects and affects upon the human art conservator. The mold spores are alive and have material agency to affect the artwork and the conservator in multiple ways, forever altering them on the deepest atomic and subatomic levels through intra-active relationships.

Teaching students of conservation the basics of entanglement is crucial for developing effective strategies to manage mold growth in art and in humans. Mold growth and its agency reveal themselves through temperature, moisture, light, and humidity changes. Entangled knowledge of the life cycle and different types of mold, including their unique morphological and chemical features, further enhances the ability of art conservation professionals to manage the intra-activities of mold and its materials effectively, controlling the aspects of mold's material agency upon the nonhuman art object and the human conservator.

Teaching Quantum Physics-Based Conservation through Narrativized Speculation

Art conservation curriculum may access quantum physics concepts of entanglement, intra-activity, and intra-agency through narrativized speculation. For example, students can speculate on how conserving the art object also conserves themselves through reflective writing while caring for a damaged artwork as shown in Figure 9. One treatment method for removing mold from a sculpture is applying distilled water using Q-tips. Applying water to the Q-tip, the conservator lightly applies pressure in circular patterns, removing the mold spores, as shown in Figure 10. The student can use these repetitive actions to consider how their body is entangling and intra-acting with the sculpture they are cleaning and the mold spores being removed, as shown in Figure 11. Narrative revelations could include how the repetitive mindful strokes of cleaning are a meditative series of actions like prayers or other forms of devotion, resulting in shared healing with the art object being restored and cleaned.

Figure 9. Peck, S. (2019). Humans respectfully intra-acting with nonhuman materials while paying attention to the materials that make up their own human bodies [Digital photograph]. Courtesy of the author.

Figure 10. Peck, S. (2023). Conserving mold damaged sculpture, offering interdisciplinary opportunities for narritivized speculation on human/nonhuman entanglement, intra-activity, and intra-agency I [Digital photograph]. Courtesy of the author.

Figure 11. Peck, S. (2019). Conserving mold damaged sculpture, offering interdisciplinary opportunities for narritivized speculation on human/nonhuman entanglement, intra-activity, and intra-agency II [Digital photograph]. Courtesy of the author.

Students could consider an object traumatized by mold, such as the damaged Max Liebermann etching in Figures 5 and 6. The students can make speculations by considering how they can experience shared trauma and/or shared healing with the artwork. From seeing the mold damage on the artwork of Max Lieberman, who created this etching over 100 years ago, they may guess how they are interwoven in relation to the art object and the mold, materially altering and modifying each other. Students could wonder how the damaged object might imprint on their body if they are grieved by the mold damage or pleasured by the mold treatment processes. Narrativized speculations such as these actualize conservator/art object entanglement and intra-agency teaching art conservation as applied physics.

Conclusion and Ramifications

Including human and nonhuman object narrative documentation and storytelling of shared transformations could be essential to reforming art conservation education from being so human-oriented. Interdisciplinary and fresh in its approach, speculating on the hidden narratives of human/nonhuman entangled lives requires the art conservation curriculum to be re-visioned as never-finished, finite, or fixed knowledge. Uniquely positioned and interdisciplinary, art conservation education can re-think material phenomena occurring in its practices through its extensive time with objects, resulting in speculative advancement and extension throughout art-related fields.

The materiality of thinking or meditating *with* nonhuman objects could transform art conservation into a more reflective and affective undertaking by embracing the ‘what ifs’ of our relations with the nonhuman. Art conservation is a compelling way to reach across

all disciplines to teach about human/nonhuman entangled and intra-active care. Responsibility and ethical accountability to art objects result in holistic relationships with nonhumans through an interdisciplinary art conservation education utilizing concepts from quantum physics. A more balanced curriculum featuring mutual co-curative co-conservative human/nonhuman relationships might evolve through new quantum-based attention toward nonhuman objects and their materials.

Quantum entanglement, intra-activity, and intra-agency applications are interdisciplinary approaches, marrying physics and art conservation shared damage/healing relations. As brought out through the mold case study, applying intra-agency and intra-actions from the world of physics (Barad, 2012b), quantum mechanics hypothetically reconsiders and re-practices art conservation along with its curriculum, away from uni-directional human-centeredness and towards a new multi-directional materialist position embracing speculative realism, respecting the existence of both the human and nonhuman, along with the materials that make up those entities. By incorporating curricular applications from quantum arenas (Barad, 1995), conservation's perspective on practice transforms into a relationship where the preservation, treatment, and restoration processes turn into mutual nonhuman/human intra-activities of entangled meaning and matter.

References

Appelbaum, B. (2007). *Conservation treatment methodology*. Butterworth-Heinemann.

Appelbaum, B. (2018). *Preserve, protect, and defend: A practical guide to the care of collections.* Barbara Appelbaum Books.

Archer, S. (2004). Mindfulness meditation produces positive changes in brain and immune function. *IDEA Fitness Journal, 1*(4), 98.

Baer, R. A. (2003). Mindfulness training as a clinical intervention: a conceptual and empirical review. *Clinical Psychology: Science and Practice, 10*(2), 125.

Barad, K. (1995). A feminist approach to teaching quantum physics. In S. V. Rosser (Ed.) *Teaching the majority: Breaking the gender barrier in science, mathematics and engineering* (pp. 43-75). Teachers College.

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Duke University.

Barad, K. (2010). Quantum entanglements and hauntological relations of inheritance: Dis/continuities, spacetime enfoldings, and justice-to-come. *Derrida Today, 3*(2), 240-68.

Barad, K. (2012a). Intra-actions. *Mousse, 34*, 76-81.

Barad, K. (2012b). Interview with Karan Barad. In R. Dolphijn & I. Van der Tuin (Eds.), *New materialism: Interviews and cartographies* (pp. 48-71). Open Humanities

Barrett, E. & Bolt, B. (Eds.). (2012). *Carnal knowledge: Towards a "new materialism" through the arts.* I. B. Taurus.

Bennett, J. (2010). *Vibrant matter: A political ecology of things*. Duke University.

Berger, G. & Russell, W. (2007). *Conservation of paintings: Research and innovations.* Archetype Books.

Bulat, K. & Lupulescu, A. (2019). Mold remediation on cultural heritage objects and surfaces. *Reviews in Conservation, 20,* 21-30.

Conti, A. (2007). *History of restoration and conservation of works of art* (H. Glanville, Trans.). Routledge.

Coole, D. & Frost, S. (Eds.). (2010a). *New materialisms: Ontology, agency, and politics*. Duke University.

Dolphijn, R. & van der Tuin, I. (2012). *New materialism: Interviews & cartographies*. University of Michigan.

Furakawa, K. & Hakuta, N. (2019). Mold and fungal contamination on cultural property and their remediation: A review. *Applied Microbiology and Biotechnology, 103*, 87-98.

Gregg, M. & Seigworth, G. (Eds.). (2010). *The affect theory reader*. Durham University Press.

Grzywacz, C. M. (2016). An overview of mold remediation in museum collections and exhibitions. *Collections: A Journal for Museum and Archives Professionals, 12*(2), 101-15.

Harman, G. (2010). *Towards speculative realism: Essays and lectures*. Zero Books.

Harman, G. (2018). *Speculative realism: An introduction*. Polity Press.

Hermen, E. & Fiske, T. (Eds.). (2010). *Art, conservation and authenticities: Material, concept, context.* Archetype Books.

Hong, D., Greenberg, J. A., & Tinkleman, D. (2018). The health effects of mold exposure in vulnerable populations. *Current Allergy and Asthma Reports, 18*(8), 43.

Kubzansky, L. D., Koenen, K. C., Spiro, A., Vokonas, P. S., & Sparrow, D. (2007). Prospective study of posttraumatic stress disorder symptoms and coronary heart disease in the Normative Aging Study. *Archives of General Psychiatry, 64*(1), 109-16.

Levine, S. (2009). *Trauma, tragedy, therapy: The arts and human suffering*. Jessica Kingsley Publishers.

Masotti, A. (2016). Mold growth on works of art: prevention, evaluation, and remediation. *Reviews in Conservation*, *17*, 49-58.

Mazzola, G., Patianna, D., & Rapisarda, L. (2017). The occurrence of fungi in cultural heritage: A review. *Journal of Cultural Heritage, 28*, 1-9.

Ormsby, B. A. & Baldini, M. (2015). Art conservation and mold remediation: A case study of the conservation of a mold-damaged paper artwork. *Journal of the American Institute for Conservation, 54*(1), 1-10.

Pinzari, F., Caneva, G., & Nugari, M. P. (2013). The impact of indoor environmental quality on museums and their visitors: A review of literature. *Microchemical Journal, 110*, 207-14.

Powell, B. (2016). *Collection care: An illustrated handbook for the care and handling of cultural objects.* Rowan & Littlefield.

Rosamond, W., Flegal, K., Furie, K., Go, A., Greenlund, K., Haase, N., & Hong, Y. (2008). American Heart Association Statistics Committee and Stroke Statistics Subcommittee: Heart disease and stroke statistics-2008 update: A report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation, 117*(4), e25-e146.

Sheldrake, M. (2021). *Entangled life: How fungi make our worlds change our minds & shape our future.* Random House.

Staniforth, S. (Ed.). (2013). *Historical perspectives on preventive conservation.* Getty Conservation Institute.

Sterflinger, K. (2010). Fungi: Their significance for conservation of cultural heritage. *Microbial Ecology, 60*(3), 539-48.

van den Berk-Clark, C., Secrest, S., Walls, J., Hallberg, E., Lustman, P. J., Schneider, F. D., & Scherrer, J. F. (2018). Association between posttraumatic stress disorder and lack of exercise, poor diet, obesity, and co-occurring smoking: A systematic review and meta-analysis. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association, 37*(5), 407-16.

Villegas, M. F. & Abergel, M. (2018). Mold remediation on modern and contemporary art collections and surfaces: A review of techniques and materials used. *Reviews in Conservation, 19*, 85-95.

Ward, P. (1989). *The nature of conservation: A race against time*. The Getty Conservation Institute.

Wheeler, J. A. & Zurek, W. H. (Eds.). (1983). *Quantum theory and measurement*. Princeton University.