Damage and Preservation of Ancient Egyptian Tomb Murals

The curse of the pharaoh, or "mummy's curse," entails a mummy or the spirit of a mummy chasing you through life inflicting revenge for having disturbed their final resting place. This curse is well known by both Hollywood and trick-or-treaters alike. Although widely popularized by the 1922 opening of pharaoh Tutankhamen's tomb and the subsequent death of twenty-nine people related to the opening of the tomb (Luckhurst, 2010), the idea of a mummy's curse was not a new idea. Conflicting theories have surfaced as to the origin of the curse, spanning from ancient Egyptian mythology to the overactive imagination of an European author after witnessing a perverted striptease in which real mummies were unwrapped (Handwerk, 2017). However, even after becoming popularized this curse was disproven statistically as being a bunch of sensationalized coincidences (Nelson, 2002). Additionally, the suggestion that bacteria, molds, and fungi which could have been festering in the dark, damp tomb for years made people who enter the tombs ill has been found to have no biological basis (Handwerk, 2005).

Even though bacteria and fungi found in ancient Egyptian tombs are not actively killing people, they are still causing problems, specifically to the wall murals inside of the tombs. These problems include color changes, mystery brown spots, and issues with the mural's structure (Elhagrassy, 2018) (Vasanthakumar et al., 2013). Recently there has been increased interest in research about the types of bacteria, molds, and fungi that are present in Egyptian tombs, their effect on tomb wall art, and what can be done to protect the art so it can be enjoyed by future generations. In this review, I will analyze the actual effect of these bacteria, molds, and fungi on ancient Egyptian tomb art, how we can combat these microbial free riders, and the negative effects they experience due to human interaction.

Destruction of Ancient Egyptian Tomb Wall Murals

There is a large variety of bacteria that have been found on ancient Egyptian tomb wall art. Each has its own unique effect, including but not limited to: color changes, dark spots, and the creation of structural complications within the paintings. One such bacteria, Streptomyces, is a major driver in the

color changes of wall murals and stone supports. This bacteria does so by producing a wide range of metabolites such as acids (oxalic, citric and sulphuric acids), biopigments of melanin, carotenoids, and hydrogen sulfide, which react with the original mural pigments (Abdel-Haliem, Sakr, et al., 2013). Due to the range of metabolites produced, streptomyces can create irreversible stains by creating carotenoids with red, orange, yellow, pink, and violet color as well as melanins with black and brown-olivey colors (Abdel-Haliem, Sakr, et al., 2013). Another group of researchers found that in addition to color changes, streptomyces also caused weakness in the mural paintings' structure causing pieces of paint to be more likely to flake off (Elhagrassy, 2018). This is a problem as the tomb art is being destroyed in irrevocable ways and if the tombs are not structurally sound they will be closed to visitors, secreting valuable pieces of history away from the public eye. Overall, bacteria is creating overwhelming negative effects in ancient Egyptian tombs.

Ancient Egyptian tomb wall murals have not only been harmed by bacteria, but also through human interaction. Visiting tourists increase humidity, carbon dioxide, and dust levels in the carefully monitored internal microclimate of the ancient tombs (Wong et al., 2018). This is a problem as increased moisture and humidity create the perfect growing environment for mural eating molds, fungi, and bacteria to spawn and thrive. Dust is also a major problem as it settles unevenly over everything which creates a dirty, uncomfortable environment for visitors and artifacts alike. More dust results in decreased legibility of signage and wall art, necessitating more cleaning which in turn causes further damage to the wall murals. As human beings are also known to (literally) leave a mark on their environments, graffiti has been an issue in King Tutankhamen's tomb (*Saving Tutankhamun's Tomb*, 2023). This is disappointing because the tomb is a sacred place of religious and cultural heritage that should be respected. Graffitiing a tomb is akin to writing "I was here" on a gravestone, which is just bad taste.

Conservation Efforts

There are a variety of ways scientists are attempting to protect Egyptian wall art from bacteria, molds, fungi, and human disruption. One major group bacterium that is causing damage to Egyptian wall murals are Streptomyces, which change the colors of original paintings. To combat the Streptomyces, researchers tried exposing them to antibiotics. Gentamicin, spiramycin, and doxycycline were found to be effective antibiotics against the majority of strains of streptomyces in the study (Abdel-Haliem et al., 2013). These antibiotics killed a majority of the bacteria present on the tomb murals, but due to natural variation, some streptomyces had built-in resistance to the antibiotics. This natural resistance allows them to prosper even in the presence of antibiotics created to kill them. When gamma irradiation was studied as an alternative, microbial growth was found to be completely inhibited in all strands except S. canarius (Abdel-Haliem et al., 2013). Importantly, both the antibiotics and gamma irradiation do not cause any observable changes in color or binding material of the paintings, making them very viable options for preservation work (Abdel-Haliem et al., 2013).

To combat human effects on ancient Egyptian tomb murals, researchers are trying to find ways to keep tombs open to the general public in a way that is still safe for the paintings themselves. However, this is not always possible. In the case of King Tutankhamen's tomb, the damage due to frequent visitors got so bad that the Getty Conservation Institute had to close down the tomb for almost 10 years. During that time they designed and implemented a new ventilation system in order to stabilize the internal microclimate and prevent dust from building up in the tomb (*Saving Tutankhamun's Tomb*, 2023). Another way to keep tombs safe without completely removing them from public access is to make a replica. A physical replica of King Tutankhamen's tomb was created just three kilometers away in 2014 while the real tomb was shut down for preservation work. It was made along with a digital replica using 3D digital recording technology and is said to be an exact facsimile of the original tomb (Wong & Santana Quintero, 2019). This new technology is amazing as it allows people to interact with history without

damaging the original artifacts themselves. However, concerns have been raised about expending funds to recreate historical pieces which could have instead been used to preserve the originals.

Closing tombs to visitors is an easy answer, but it is not always what is best for the tombs. In the case of the Snu- Sert-Ankh tomb, researchers closed the tomb for the purpose of preservation without killing all the active molds and bacteria. This led to significant damage being done while the tomb was closed (Elhagrassy, 2018). From this, we can learn it is best to check up on closed tombs periodically and not just assume that all microbacterial problems will be magically fixed by sealing tombs up.

Why is Conservation Important?

Conservation of physical manifestations of history is incredibly important due to the ability they have to allow us to look into the past, learn from and enjoy them in the present, and preserve cultural tradition for future generations. In regards to ancient Egyptian tomb wall art, all three of these reasons hold true. People travel from all over the world to visit ancient Egyptian tombs. King Tutankhamen's tomb alone was previously seen by over 6,000 people a day but has since been limited to 1,000 for the purpose of preservation (Saving Tutankhamun's Tomb, 2023). You do not even have to go to Egypt to look at Egyptian wall art as it has been made available to the general public through showings in museums around the world and virtually via the internet. These wall paintings are incredibly valuable not only because they are art and inherently aesthetically beautiful, but also because of what they tell us about ancient Egyptian history and civilization (Bianchi et al., 1992). For example, they allow us to see the unique artistic styles and imagine the processes ancient Egyptians used to create art. They also give us a glimpse into the complicated religious and cultural traditions of ancient Egyptians. Indeed, a majority of the wall art discovered to date relates to the afterlife, scarcely showing the above ground life of the tomb owner at all (Corzo & Afshar, 1993). In preserving this art, we protect Egypt's rich cultural heritage and ancient knowledge so they can be passed onto future generations.

Conclusion

Ancient Egyptian tomb wall art is easily damaged by a variety of causes, and although there have been major discoveries in the field of preservation, further strides need to be taken to keep these unique artifacts in good condition for future generations.

Works Cited

Abdel-Haliem, M. E. F., Ali, M. F., Ghaly, M. F., & Sakr, A. A. (2013). Efficiency of antibiotics and gamma irradiation in eliminating Streptomyces strains isolated from paintings of ancient Egyptian tombs. *Journal of Cultural Heritage*, *14*(1), 45–50. https://doi.org/10.1016/j.culher.2012.03.009

Abdel-Haliem, M. E. F., Sakr, A. A., Ali, M. F., Ghaly, M. F., & Sohlenkamp, C. (2013). Characterization of Streptomyces isolates causing colour changes of mural paintings in ancient Egyptian tombs. *Microbiological Research*, *168*(7), 428–437. https://doi.org/10.1016/j.micres.2013.02.004

Bianchi, R. S., McDonald, J. K., Bakr, M. I., & Corzo, M. A. (1992). *In the tomb of nefertari: Conservation of the wall paintings*. Getty Conservation Institute.

Corzo, M. A., & Afshar, M. (1993). *Art and eternity: The nefertari wall paintings conservation project 1986–1992*. Getty Publications.

Elhagrassy, A. F. (2018). Isolation and characterization of actinomycetes from Mural paintings of Snu-Sert-Ankh tomb, their antimicrobial activity, and their biodeterioration. *Microbiological Research*, *216*, 47–55. https://doi.org/10.1016/j.micres.2018.08.005

Handwerk, B. (2005, May 6). Egypt's "king tut curse" caused by tomb toxins? *Science*. https://www.nationalgeographic.com/science/article/news-tutankhamun-carnarvon-mold-bacteria-toxins

Handwerk, B. (2017, January 21). Curse of the Mummy. *History*. https://www.nationalgeographic.com/history/article/curse-of-the-mummy?loggedin=true&rnd=1708293704564

Luckhurst, R. (2010). The mummy's curse: A study in rumour. *Critical Quarterly*, *52*(3), 6–22. https://doi.org/10.1111/j.1467-8705.2010.01948.x

Nelson, M. R. (2002). The mummy’s curse: Historical cohort study. *BMJ*, *325*(7378), 1482–1484. https://doi.org/10.1136/bmj.325.7378.1482

Saving Tutankhamun's Tomb. (2023, July 20). Getty News. https://www.getty.edu/news/video-saving-tutankhamen-tomb/#transcriptblt05ef9b53a73ec977

Vasanthakumar, A., DeAraujo, A., Mazurek, J., Schilling, M., & Mitchell, R. (2013). Microbiological survey for analysis of the brown spots on the walls of the tomb of King Tutankhamun. *International Biodeterioration & Biodegradation*, *79*, 56–63. https://doi.org/10.1016/j.ibiod.2013.01.014

Wong, L., Beltran, V., Yang, C., Maekawa, S., Lardinois, S., Hussein, H., & Agnew, N. (2018). Improving environmental conditions in the tomb of tutankhamen. *Studies in Conservation*, *63*(sup1), 307–315. https://doi.org/10.1080/00393630.2018.1504517

Wong, L., & Santana Quintero, M. (2019). TUTANKHAMEN’S TWO TOMBS: REPLICA CREATION AND THE PRESERVATION OF OUR CULTURAL HERITAGE IN THE DIGITAL AGE. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *XLII-2/W11*, 1145–1150. https://doi.org/10.5194/isprs-archives-xlii-2-w11-1145-2019