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## PAST, PRESENT AND FUTURE OF ARCHIVAL MATERIAL AS (NON)PERSISTENT CHEMICAL MATERIAL - WITH SPECIAL FOCUS ON THE PROBLEM OF ACETATE DECAY OR VINEGAR SYNDROME

### ABSTRACT

**Purpose:** *The purpose of this article is to show how important it is for archives to realize that the safe storage of originals is important for the preservation of material.*

**Methodology:** *With the help of the story of the Indian Ishi from the beginning of the 20<sup>th</sup> century and the destruction of important film material, it was explained what are the consequences for the existence of cultural heritage because of irresponsible handling of film material.*

**Results:** *The story of the collapse of film material that was stored in unsuitable conditions teaches us that we must pay attention to appropriate professional education. The damage caused by ignorance or carelessness in the handling of archival material is in most cases irreparable.*

**Conclusions/findings:** *The decay of film material is not only a problem of audio-visual archives. Similar problems have been detected in all archives. Digitization enables easier access to the material and more secure storage, but there is still a need for professional, flawless storage of the original analog material in archival depots. This is the only way cultural heritage can be preserved for future generations.*

**Keywords:** *archives, digitisation, chemical deterioration, acetate decay, audio-visual archives.*

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## 1 INTRODUCTION

This article addresses the problem of permanent preservation of archival material in audio-visual and other archives. Archives and the work of archivists are discussed from the perspective of three different times: past, present, and future. We were interested in how we can connect traditional archival theory and practice with digital archival theory and practice. A book, that we found on the shelves of a local library, prompted us to try to connect the points of time where three seemingly completely opposite time periods unconsciously meet each other. We highlighted archives as institutions that ensure that the material as well as the knowledge of professionally qualified archivists are transferred through the present from the past to the future. The first, purely coincidental contact between the past, which is unknown to us, and the century we experienced, and then, at its conclusion, stepped into a new century (the date limit is otherwise imaginary) was the invention of film. The invention of film and the first film of the Lumiere brothers in 1895 (Lavedrine, Gandolfo, 2011, 1) made it possible to record moving images. The beginnings of film, which developed from the processes of photography, almost coincide with the beginning of the 20<sup>th</sup> century.

## 2 PAST, PRESENT, FUTURE

How can past, present and future meet each other? Sometimes we think about it at the transition to the new year, which is repeated every year at midnight in all time zones. Baković (2023, 40) mentions midnight „*as that moment in which a person can be in the past, present and future*“, as the only moment „*in which the end and the beginning embrace*“.

For the Tralfamadorians, people from the planet Tralfamadore, time runs differently (Vonnegut & Klavnica, 1969, 27–28), but we are not Tralfamadorians, at least for now, Earth is our only home, where time runs linearly from the past to the future and stops in the present in between. And just as the Earth is the only home, the originals are the only original copies, everything else is copies, and with the original as with the Earth we lose the only home. Billy Pilgrim, who traveled through time periods in Vonnegut's novel, could not change things like the past, present, and future. Even archivists cannot change the past (we mustn't), but we can influence the present and therefore change and improve the future.

According to film material, we can talk about three tenses: past, present, and future. The same applies to the archiving of classical documentary and archival material in archives, but this division is even more noticeable in the case of audio-visual documents, and analogies are made in relation to the archiving of digital born material, and even more so of digitized analogue material.

Audio-visual material always stands before us in the present tense. It is as it is at this moment, it carries both the material and substantive past and at the same time the future in which the material must be preserved. The present moves linearly towards the future with time, the content of the past becomes richer, the future more unpredictable and the concern for preserving the material more intense.

Many archivists agree that this work, which represents the preservation and transfer of material from the past to the future, is the most difficult task in archives. At the end of the 20<sup>th</sup> century and the beginning of the digital world, Bubenik (1999, 265) explained that the only way to save audio-visual cultural heritage is its digitization and the use of digital copies, which enable faster access and safe storage of the originals. Bubenik (1999, 257) conceived audio-visual archives as a temporal bridge between different technological sediments.

The past of the film includes all processes (Jacobsen, 2020), which led both to the material design of the film strip and to the content, to the present viewing of the film at this moment. Considering the changes that occur with the use of audio-visual material, we can say, like Heraclitus, who explained this idea by entering the river once, that we cannot watch the same film twice.

How to explain the importance of the work of archivists in the present for the preservation of the past and the future, describe the preservation of material under the required conditions, digitization of material, continuous work with originals - airing and turning over and control of chemical changes (Lavrenčič, 2005, 203–210)? We decided to try to explain this with a simple story.

### **3 ISHI'S STORY**

The story that we will describe here is very old, an extraordinary event in everyday life wrote it at the beginning of the last century not so far away, in America (if we ironically compare the geographical distances a hundred years ago and to-

day). I don't know why, but sometimes I get the feeling that such stories can only happen in America or in the movies. The story we are going to narrate is beautiful, sad, and instructive. It is a story that could happen to any of us can relate to each of us, at any time. It is a placeless, timeless story, but it is not an immaterial story. It teaches us how our improper handling of documentary and archival material can destroy not only centuries, but also millennia of human cultural history, back to the beginning of civilization.

“At the first light of the morning on August 29, 1911, a wretched, hunched over man was seen standing by the fence of a slaughterhouse near the town of Oronville, California. The man was almost naked, only a large piece of cloth, like the poncho of the South American Indians, was draped around his neck. The face betrayed an Indian, but of a special type, the likes of which had never been seen before. Later it turned out that Ishi, as the Indian was called, was the last American of the Stone Age. The scientists felt the importance of the event, took care of Ishi, employed him as a guard in the museum and carried out numerous investigations and documented them properly...” (Ceram, 1973, 329).

Five years later Ishi died. After his death, he was quickly forgotten. When interest in him was revived in 1957, and the boxes containing the stored wax cylinders containing recordings of Ishii's voice, singing and vocabulary were opened, they found that most of the cylinders had been broken. In addition, they could not train any of the old equipment to play music. Only one resourceful student was lucky enough to assemble a useful one from several wreckage of old devices and thus they were able to listen to part of the music recordings. Film recordings made for museum purposes by cameramen of the California Film Society fared worse. Cassettes with about 1,500 meters of film were perfectly stored in the vicinity of the heating pipes. When the cassettes were forcibly opened, they found only an unrecognizable slimy mass (Ceram, 1973, 329).

With Ishi, a part of human history disappeared forever, a part that could not be prevented in the development of human society in any way; however, about a century later after the story that unfolded in the west of the United States of America, the careless behavior of scientists with documentary records should not be repeated.

## 4 MATERIAL PROTECTION OF ARCHIVAL MATERIAL

The material protection of archival material includes the maintenance or protection of the material against damage, destruction, loss or unauthorized use or abuse. (Žumer, 2001, 267). The Act on the Protection of Documentary and Archival Material and Archives (ZVDAGA, 2006, 2014) established in 2006, regarding the protection of documentary and archival material against damage, destruction and loss, determined in general: „Archival material in physical form is permanently and professionally stored in appropriate rooms and equipment, in appropriate climatic conditions, protected against burglary, fire, water, biological, chemical, physical and other harmful influences“ (ZVDAGA, 2006, 2014, Article 36, 2. Paragraph). „Storage of archival material in digital form is permitted only as long-term storage of covered material in accordance with internal rules“ (ZVDAGA, 2006, 2014, Article 36, Paragraph 3).

The duty of public and private institutions and individuals regarding the professionally irreproachable protection of documentary and archival material is therefore a legal obligation, while damaging or destroying the material is a criminal offense according to the Criminal Code of the Republic of Slovenia. The conditions prescribing the methods of material protection of material are determined by the Decree on the protection of documentary and archive material (UVDAG, 2017). All public and private institutions must store documentary and archival material or their permanent collection of material in an archival warehouse with appropriate technical equipment (archival warehouses are equipped with metal equipment), which enables:

1. rational placement of material,
2. insurance against injuries,
3. easy accessibility of the material,
4. air circulation and
5. easy cleaning.

## 5 ACETATE DECAY – VINEGAR SYNDROME

The Report and Guide for film preservation by the California-based National Film Preservation Foundation published in 2004 explains the term acetate decay

as chemical deterioration of acetate plastic accelerated by high relative humidity and temperature. Also known as vinegar syndrome because of the odour released during the decay process (Melville, 2004, 98).

Research on the effect of acetic acid on the degradation of historic cellulose triacetate cinematographic film was begun in Great Britain at Manchester Polytechnic. A report from the Library of Congress (1993, ch.1) cited the study N. S. Allen, and others, "Degradation of Historic Cellulose Triacetate Cinematographic Film: Influence of Various Film Parameters and Prediction of Archival Life," *Journal of Photographic Science* 36 (1988). This study notes a link between the onset of vinegar syndrome and metal ion contamination, reinforcing anecdotal evidence among archivists that the most serious vinegar syndrome is occurring first in magnetic soundtracks. The Library of Congress report then cites that continued research in the United States has been conducted at the Image Permanence Institute, Rochester Institute of Technology, which was published in P.Z. Adelstein, J.M. Reilly, D.W. Nishimura, and C. J. Erbland, "Stability of Cellulose Ester Base Photographic Film," *SMPTE Journal* 101 (May 1992).

How to explain the occurrence and danger of vinegar syndrome? Richardson and Altias (2017) explained this phenomenon by relating it to living organisms that biologically age and die. Carbon-based organic living and non-living material are subject to aging, decay, or death, especially for plants and animals. However, where infection, disease, and extreme environmental conditions cause premature biological deterioration, a medical treatment may be developed to slow, stop, or reverse the process. In one sense, decay is a gradual process by which something breaks down or falls apart as a result of natural causes. Bones become brittle, skin loses its elasticity, hair gets grey. *"In another sense, decay is a natural reaction that results over time when a substance is exposed to a reactive environment and/or other substances with which the substance will chemically react."* (Richardson & Altias, 2017).

In 1993, the Library of Congress in Washington developed guidelines for the preservation of material on filmstrip. At that time, special attention was also paid to nitrate film. In the time before digitization, copies were made on polyester tape. The report (Library of Congress, 1993) stated: *"Films are ephemeral and fragile products. For the technical reasons outlined in the next section, even the*

*most durable of films can become unusable in less than a single human lifespan, although some types have proven to deteriorate more rapidly and spectacularly than others. While preservation can be thought of as any effort to keep a film in a viewable form, most archivists consider a film preserved only when it is both (1) viewable in its original format with its full visual and aural values retained, and (2) protected for the future by “preprint” material through which subsequent viewing copies can be created.”* In practice and in casual language, preservation has usually been synonymous with duplication. The archival rallying slogan for the last two decades has been “Nitrate Won’t Wait,” and the primary preservation task--still far from accomplished--has been to copy unstable, nitrate-base film without significant loss of quality onto more durable “safety” stock (Library of Congress, 1993).

Before digitization began, the preservation of film material was considered to be that “One basic archival principle is that preservation is not accomplished unless the new medium has a considerably longer life than the original from which it is copied. On the surface, continued copying onto acetate base would seem to violate that principle. But there are two reasons to qualify such a conclusion: First, the original nitrate print is older and usually well into its decomposition cycle; and second, the new acetate print can be given proper storage right from the start. Thus, vinegar syndrome has not been detected in films duplicated under archival conditions and put into ideal storage immediately. The implications of vinegar syndrome in acetate have not yet been fully assimilated into preservation practice, but scientific research into its causes has also been accompanied by compelling evidence that it can be delayed by proper storage” (Library of Congress, 1993).

Historically, motion-picture bases consisted of three main types:

- (1) cellulose nitrate (usually called simply nitrate), in commercial use through the early 1950s,
- (2) cellulose acetate (usually called acetate), available for some uses since the 1910s but widely employed only after 1950, and
- (3) polyester, available since the mid- 1950s but still in only scattered use. Both acetate and polyester are sometimes called “safety” film, in distinction from nitrate. (Library of Congress, 1993).



Water, high humidity, and heat can destroy the plastic base of acetate film. In the early stage of decay, the plastic releases acetic acid, which is chemically identical to vinegar, hence the name “vinegar syndrome.” As the decomposition advances, the chemical reaction accelerates. Typically, the decay process follows this pattern:

1. The film begins to smell like vinegar.
2. The film base begins to shrink. As the base shrinks irregularly, the film resists being laid flat. It curls and warps along both length and width.
3. The film loses flexibility.
4. The emulsion may crack and eventually flake off.
5. White powder may appear along the edges and surface of the film. The acetic acid vapor released by films with vinegar syndrome can infect other acetate base materials stored nearby, particularly in a poorly ventilated storage area. The Image Permanence Institute (IPI) at the Rochester Institute of Technology advises freezing films in advanced acetate decay. (Melville, 2004, 14).

Acetate decay cannot be reversed, but it can be slowed by improving storage conditions (see chapter 6). At the early decay stages, the film content can be rescued by transferring it to new film stock. Generally, once the film becomes too brittle, it cannot be copied in its entirety, although less damaged sections may be salvageable (Melville, 2004, 15).

In 1948, the nitrate film, which had exploded several times, was replaced by a triacetate film carrier, which was supposed to be safer and more durable, but the stench of vinegar was detected several times in the film archives already in the fifties of 20<sup>th</sup> century. They found out that there is a silent killer of films hiding among the archival shelves, which does not kill as spectacularly as those from the time of nitrate films, but destroys slowly and reliably, causes the emulsion to retreat, brittleness and curling of the film, the polymers in the film base begin to split into monomers (Lavrenčič, 2005, 207). The process of disintegration of the films was accelerated due to storage in unsuitable conditions. Decomposition was influenced by the following factors: temperature, humidity, and degree of acidity in the microenvironment. Namely, this works in a hermetically sealed film box as a micro catalyst that accelerates a chemical reaction, similar to the „snowball“ effect (Reilly, 1993).

However, it is not only audio-visual archives that store large quantities of film tape that have problems with the decay of film material. The scent of vinegar around photographic negatives and film reels points to a form of decay aptly named vinegar syndrome. (Carey, 2023). Classical archives are not safe from vinegar syndrome, as the events at the Reference Library in Toronto confirmed. In these archives, there has been severe damage to the original material on the photographic negatives. The deterioration of the originals probably occurred because the cabinets were closed during the epidemic, which reminds us that we must constantly ventilate the material. Some other archives have taken a different approach to rescue, digitizing the material and publishing it online. The Canadian National Exhibition (CNE) Archives started digitizing its collection of more than 109,000 acetate film photo negatives in the early 2010s because they were starting to succumb to vinegar syndrome. Similar problems were detected in The Arnprior & McNab/Braeside Archives (Ontario, Canada, 2019) which holds approximately 400 fonds/collections. As it was written, the best solution is to keep film cold to buy time: *“The best thing that we can do for films like that is to cool or freeze them because the lower temperatures significantly diminish the processes of degradation ... and it really buys us a lot of time,”* said David Daley, conservation advisor at the University of Calgary Archives and Special Collections (Brockbank, 2023).

Chemical changes are not only fatal for archival material; the changes are also dangerous for the personnel who handle the material. The use of appropriate protective equipment and procedures can mitigate the potential hazards of handling severely damaged films (Soleymani and Russ, 2021, pp. 154). Vinegar syndrome causes contact burns as well as nasal and lung irritation (Brockbank, 2023).

## 6 CONCLUSIONS

As we enter the new millennium and the digitization and digitalization of archival collections, many have forgotten that workers in film and other audiovisual archives around the world have long been fighting against time to secure their collections. Digitalization of archives provides many advantages, which ensure quality and cheaper transmission, regeneration and archiving of signals, easier access to digitized material also enables better material protection of the original

archival material, but we must be aware that we must first preserve the material and only then digitize it.

The story of Ishii, the Indian, teaches that the damage caused by the mishandling of cultural heritage cannot be measured in any monetary currency. However, we must also be aware that both digitization and digitization do not bring any sustainable solution if we discard the originals. The motto should remain: „First preserve, then digitize and enable safe access to the material and improve its material security.“ The story of the collapse of film material that was stored in unsuitable conditions teaches us that we must pay attention to appropriate professional education. The damage caused by ignorance or carelessness in the handling of archival material is in most cases irreparable. The decay of film material is not only a problem of audiovisual archives; problems have been detected in all archives. Digitization enables easier access to the material and more secure storage, but there is still a need for professional, flawless storage of the original analog material in archival depots. This is the only way cultural heritage can be preserved for future generations.

The Slovenian translation of the book *The First Americans* (C. W. Ceram) was published in 1973. In 2005, the story was used at the archival consultation “Technical and field related problems of traditional and electronic archiving” organized by the Regional Archives Maribor. At that time, it was difficult to find other information about the Indian Ishi in the libraries.

Today, his story is also available on the Internet. Ishi has his own entry in Wikipedia. Anyone who wants to know more about Ishi can also read the book by Theodora Kroeber (1961, 2002): *Ishi in Two Worlds: a biography of the last wild Indian in North America*. We used Ishi’s story as an example of inappropriate handling of film material by scientists and pointed out what happens to material that is kept under inappropriate conditions, in this case at too high temperatures. The material begins to disintegrate quickly; chemical reactions occur that lead to the disintegration of the polymers in the acetate base of the film. This causes the release of acetic acid and the appearance of acetic syndrome, which accelerates the breakdown of the film. Moreover, we must point out that the mentioned films were nitrate, i.e., explosive, and more dangerous.

The whole story of Ishi, however, is much darker and more terrifying. Ishi was the last member of the Yahi tribe of California, because that tribe suffered genocide in the 19<sup>th</sup> century (Rockafellar, 2018). The gold rush brought tens of thousands of miners and settlers to northern California, putting pressure on native populations. Gold mining damaged water supplies and killed fish; deer became scarcer. The settlers brought new infectious diseases such as smallpox and measles. Anthropologists at the University of California, Berkeley wrote a letter in 1999 apologizing for Ishi's treatment (Jimenez, 2017).

Ishi, his tribe, and the neighboring Yana tribe were wiped out by evil. The evil called greed. This greed led to the industrialization of human society in the 19<sup>th</sup> century. If history is the teacher of life, and archives are the textbooks of life, we must also consider the consequences that will be brought by digitalization. Or is life a teacher of history? *Historia magistra vitae? Vita magistra historiae est?*

And if we end up going back to midnight again. Baković wrote that „the essence of midnight is that it leaves us with a choice: shall we believe that something has ended with it or that something is just beginning with it?“ (Baković, 2023, 40). This wonderful sentence leads us to think whether digitization is ending something for us or whether it is beginning a new era.

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