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# PRESERVATION OF MOTION PICTURE FILM

A Background Paper

for the

National Film Preservation Board

by

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Motion picture film is now 100 years old. Since Edison and Eastman collaborated through their companies to produce continuous rolls of film at a standardized width of 35mm, our visual cultural history has been recorded in theatrical, documentary and newsreel forms. The light and shadows, which later included color, have enthralled, entertained, educated and emotionally moved audiences since the beginning of the century. Tragically, half of the 21,000 films produced in the first 50 years no longer exist. They are lost, destroyed or deteriorated. Time, the greatest enemy of motion picture film, claims more victims each day. The necessity for preservation of motion picture film is a given. The need for immediate action is what we must address now.

Motion picture film was never designed to be long-lasting. Early films were produced for weekly runs at "nickelodeons" and then had no further use. While prints of some of these early productions still survive, most of the original elements that produced the screening prints have deteriorated into oblivion. To understand the need for film preservation, one must examine the physical properties of film as well as its subject matter.

Film, physically, is comprised of three main layers: emulsion, adhering binder and support base. The emulsion is a colloidal (gelatin) medium which contains dispersions of light-sensitive materials. The emulsion layer makes the image possible. The binder holds the base layer to the emulsion layer(s). The support base carries the other layers through the photographic process, including the original camera photography, laboratory processing,

editing and in some cases, projection

Until 1951, the base was cellulose-nitrate, a strong but highly unstable and particularly flammable material. Eastman Kodak Company, in its internal publications, acknowledged that nitrate base started decomposing virtually from the time it was manufactured. While some samples of 30-to-40-year-old nitrate have been found in good condition, all nitrate deteriorates with age and the degradation process is speeded up by chemical contamination and improper storage conditions. Nitrate can spontaneously combust and, since it generates its own oxygen during combustion, it can actually burn under water. In addition, the gases released during its deterioration are hazardous to humans.

The original negative was "backed up" in the photographic process by intermediate films. The negative was purposefully made to be light-sensitive in order to capture the subtleties of image, but that meant that its emulsion was softer and less able to take physical handling. The intermediate fine-grain master positives and duplicate negatives were a generation or two removed from the original, but their use extended the life of the original negative. They also helped to protect the original film by providing alternate means of reproduction.

With the introduction of cellulose-acetate safety film and the cessation of nitrate base manufacturing, motion picture film was considered to be more stable. However, two other factors continued the problems of degradation.

The first was the use of organic vegetable dyes to add color to the image. The stability of these dyes, which faded with time,

was highly questionable. Much of the negative material from the 1950s and early 1960s shows a loss of at least one of the primary color layers in the emulsion. Master separations, which were color-sensitive black and white records called YCM's (for yellow, cyan and magenta), became the archival medium of choice. The cost of these records, however, precluded their automatic use, so many titles were left unprotected..

The second problem, verified in the last several years by the Manchester Institute of Technology in England and the Image Permanence Institute in Rochester, New York, is called the "Vinegar Syndrome." This is defined as a catalytic reaction in the cellulose-acetate base: it produces acetic acid, which causes film deterioration. This problem greatly concerns the archival community because the major method of preserving the motion picture image since the first half of this century has been to transfer the image from nitrate film base to acetate safety film. What this means today is that even those films thought to be preserved by conversion are just as susceptible to loss as they were on their original base.

Such industry organizations as the American National Standards Institute (ANSI) and the Society of Motion Picture and Television Engineers (SMPTE) are finally reconsidering the standards and recommended practices for the storage of motion picture film. Previous parameters were so wide that they offered little protection to the stored media. New studies indicate that storage under low temperatures and relative humidity can **arrest** film deterioration. While this is not a cure for degradation, such

storage is a temporary solution in the relatively new and rather imprecise science of film preservation.

Futurists proclaim that digital technology will be the consummate answer to film preservation. They say that digitizing the information onto a medium with a known life expectancy of several hundred years will preserve the original image in all of its attributes and each copy produced will be a master quality clone. As a goal, this is admirable, but many questions still need to be answered.

It is estimated that a single frame of 35mm film contains the equivalent of two thousand lines of horizontal resolution and almost five million pixels of information. No digital system has yet been established to encompass these criteria. Another issue is "loss-less compression." The information contained in a single 35mm film frame would need the equivalent memory of a 20 megabyte hard disc in a personal computer. Since a feature length film runs at a rate of 24 frames per second, the film would require a football field full of personal computers to preserve all of its information. Computer scientists claim that this problem will be solved by a compression algorithm that will condense the information into a more practical storage size. Estimates range for the technology's being "just around the corner" or "five to ten years away."

The next question concerns the film stock itself. Until the discovery of the "vinegar syndrome," black-and-white safety film was thought to be the medium with the longest life expectancy. Assuming that ESTAR base (polyester) film will now be utilized

instead of acetate base, we are still talking about a chemical-optical system of photographic images. Digital bits can be stored optically on a film base as was demonstrated by Cinema Digital Sound (before the company ceased to operate) but these bits were only **sound** information. Picture or image information, even in a loss-less digitized form, would still need to be deposited and stored on a medium with a long life expectancy, such as a laser disc, a compact disc or a bubble memory chip. The life expectancy must be determined and confirmed by scientific methodology and the process and the medium will have to be accepted universally as practical standards.

Finally, assuming that the technology will exist to digitize feature-length material onto a standardized medium with an acceptable life expectancy, this solution will protect only the film produced from that point forward. The deteriorating material previously produced will have to be transferred to the new medium, and priorities would be determined by either need (deteriorating material) or economics (future revenue).

Dealing with motion picture film technology as it currently exists on a medium certain of eventual degradation emphasizes the need to formulate a practical policy of preservation **now**. The issues divide into three broad areas:

1. Technology: postponing the inevitable deterioration of the image by

    A. Converting nitrate base material to ESTAR safety base.

B. Arresting deterioration of film material by using recommended environmental storage conditions.

2. Funding: concentrating on public domain films which have no economic support.
3. Priorities: determining where efforts and funding should be directed.

The National Center for Film and Video Preservation estimated in 1989 that public archives hold some 150 million feet of nitrate material that needs to be copied to safety base. Of this total, 100 million feet were considered to be **unique** features, short subjects and newsreels that must be copied before they are irretrievably lost due to nitrate deterioration. There are also many more millions of feet of unique but uncopied nitrate material in studio archives, private collections and newsreel and stock-footage libraries.

The National Center estimated that public archives convert only two-and-one-half million feet of nitrate each year, partially due to lack of funding. Its studies show that from 1979 to 1989, Federal funding of film preservation (excluding direct funding to the Library of Congress) was less than four-and-one-half million dollars. To put this funding into perspective, the current cost of converting nitrate to safety film is between $1.50 and $2.00 per running foot. The conversion of the 100 million feet of nitrate in public archives deemed unique by the National Center's study would cost between 150 and 200 million dollars to convert today. At the

present Federal funding levels of less than 400 thousand dollars per year, it would take more than 400 years to convert the film. Realistically, there will not be much nitrate film left to convert after the next two decades. (Even a remaining twenty year lifespan is now questionable.)

Therefore, the need to act quickly and decisively is obvious, not only to set policies, but also to create and implement a cohesive and prioritized plan of film preservation, technologically and monetarily. The medium of film is fragile and time works against it relentlessly. It is significant that the United States Congress sees the need to address the issue of the preservation of our moving image. Let us hope that the research and education needed to formulate a National Preservation Plan, will begin soon enough to salvage our visual cultural heritage before it is too late.

Ray Bradbury, the noted science fiction author, wrote "Fahrenheit 451" in which the ruling dictatorship burned all books in order to keep the ideas of liberty from spreading. A small but committed group of people memorized these books before they were destroyed so that they could verbally pass them on to succeeding generations. I hope that we do not find ourselves trying to **verbally** describe the visual artistry and creativity of "Lawrence of Arabia," "Star Wars," "E.T.," "Birth of a Nation," "Casablanca" or any of the titles selected for the National Registry. We must preserve our visual cultural heritage of motion pictures now. It is our obligation to our past and to future generations.

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