Characteristics of Motion Picture Film as Aids to Identification in the Age of Digitization

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Abstract

For years it has been the practice of film stock manufacturers to impress markings on the edges of their films. The information extracted from these markings regularly reveal to the moving image archivist a film's manufacturing date, laboratory procedures, and provenance—in short, a transmissible history of the artifact itself. With moving image archives making the transition from analog to digital for access and preservation purposes, it will not be long before these new energies of conservation usurp traditional practices of archiving. The penalty for such a break-through in terms of content accessibility via the digital domain is a general sealing off of knowledge to a film artifact's original photochemical manufacture and development processes.

Introduction

The "edge information" of motion picture film has for years provided the archivist a transmissible history of the film object. These characteristics offer a series of punctual events in the film's manufacturing and development processes, and can be traced back to the origins of cinema when the earliest producers processed their own film elements for distribution and exhibition. As standardization took form, producers of film outsourced manufacturing work to specialist companies where edge information was (and still is) applied to a piece of film as it undergoes a procedure of finishing during which an emulsion-coated roll is slit, edged, printed, perforated, and finally packaged into units for sale. On the opposite end of the photochemical chain, film laboratories produce visible images on exposed film through processing, and through various methods of printing create production elements for editorial and finally, exhibition. It is here that countless evidential traces are made along the way. Typically found at a film's margins, edge information may be inscribed in both light and ink, punched, shaped, or perforated, in various degrees of frequency throughout the roll of a film.

Once limited to a handful of esoteric lab professionals and chemists, this area of knowledge has been reclaimed for archaeological methods of film identification. The art of film identification by its edge information was first pioneered by film archivist Harold Brown (1919-2008) during his career at the National Film Archive in Britain. Brown's seminal work *Physical Characteristics of Early Films as Aids to Identification* (written for the Preservation Commission of the International Federation of Film Archives in 1990), thinly veiled in this article's title, remains a definitive reference guide on the topic. In addition to the earliest producers of silent films such as Georges Méliés, Gaumont and Charles Urban Trading Company, Brown drew distinctions from the characteristics of stock manufacturers Agfa, Gevaert, Pathé and Kodak, among many others [1]. As a result, this body of work has lead to the identification of countless silent films found in the British Film Archive, but in film archives around the world.

Brown called for the study of as many manufacturers' edge information as possible, so that an area of knowledge might be produced and used by archivists as aids to identification. With institutions currently making the transition from analog to digital with regards to access and preservation, however, it will not be long before new energies usurp traditional practices of film archiving. As photochemical objects take on the uniqueness of manuscripts, institutions will be in favor of providing scholars with digital surrogates for research purposes. The penalty for such a break-through in terms of content accessibility via the digital domain is a potential sealing off of knowledge to a film's original photochemical manufacture and development processes for future custodians of our cultural heritage to attain.

This paper is structured as follows. It begins with an overview of the current film inspection process, noting various types of edge information that may be encountered. Moving from the analog to digital workflow, it demonstrates how edge information is captured upon digitization, as embedded metadata within the headers of several file and wrapper structures. Upon surveying these various methods of capture, it then seeks a changeover with the current state of digital preservation of film by proposing that outer-frame characteristics be digitally captured in conjunction with frame-only counterparts. It concludes by expressing that within this digital preservation master image field, previous cinematic technologies will be seen by their appropriate extensions, with edge information for future generations to investigate.

The Film Identification Process

According to Paul Read and Mark-Paul Meyer, the purpose for identifying a film object is two-fold: to identify a film's title, actors and events, time period and context in which the film was made, as well as to provide information to technicians about the film itself in order to produce an authentic restoration [2]. For the latter, such information can be derived from the evidential traces found on the film itself. Evidence will come from a wide range of characteristics such as gauge, perforation type and pitch, color system, among others. Many are listed below in detail.

Inspection is the single-most important way to identify a film's photochemical and reproductive origins [3]. Reviewing a film on rewinds and armed with knowledge of laboratory production, one becomes empowered to establish an element's provenance.

Moving from extra-frame to intra-frame examination, there are several classifications of edge information, including but not limited to the following types:

1.Manufacturer's logos/identifications. As early as the beginnings of cinema, producers who made their own prints for

exhibition embossed their own names or trademarks either on the fronts or the margins of their films. [See: Figure 1]

2. Language or characteristics expressing the material of the film object's base. Films with acetate bases, for example, have the latent image word "SAFETY" with frequent parallel lines [Also, perpendicular lines intermittent between perforations for NITRATE].

3. Perforations. Pre-standardized (such as Vitagraph), BH (Bell & Howell), KS (Kodak Standard), DH (Dubray-Howell), CS (CinemaScope), Pathé. Type S and Type R for small-gauge formats. Perforations help indicate camera originals, intermediates, sounds recording and color print films, as well as release prints.

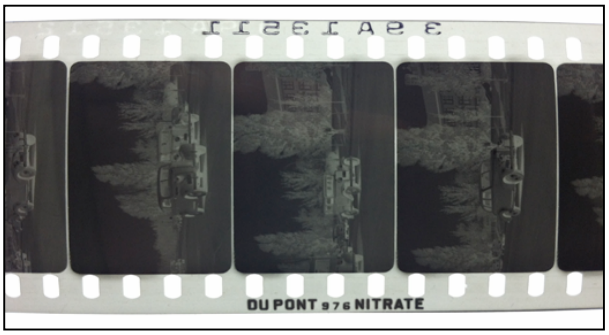

***Figure 1**. Example of 35mm motion picture film with manufacturer's logo and key numbering (bottom center), inked-in footage numbers (top center).*

4. Edge Numbers. Latent-image numbers printed into raw stock during manufacturing, and printed ink numbers for identification during the editing process. Representing the scale of footage on the print, the frequency of edge numbers is often approximately 20-40 frames for 16mm, and 16 for 35mm. These edge numbers were either printed through from 35mm negatives, or inked from 16mm original elements.

5. Letter symbols, dates and date codes indicating the approximate year the film was manufactured. In the case of Eastman Kodak, these dates are represented as a combination of circles, squares, triangles and crosses in the US; half-circles, crosses, rectangles and "L"s in England; and circles, rectangles, "L"s and diamonds in Canada. Letter symbols for Kodak stock are used to identify the film and other manufacturing operations [See: Figure 2].

6. Evidence of photographic and magnetic sound systems such as variable-density and variable-area tracks, as well as Dolby SDDS-type systems; made typically of magnetic oxide, silver or silver-plus-dye materials.

7. Physical characteristics of redeveloping, such as light piping.

8. Frame characteristics and aspect ratios.

9. Intra-frame characteristics such as trademarks.

Note that while the edge information of a film object in-and-of-itself provides a possible starting point for identification, an archivist can further narrow the range of date possibilities by corroborating with intra-frame visual clues such as surrounding architecture, common points of fashion and technology such as hats, lampposts, and the makes and models of automobiles.

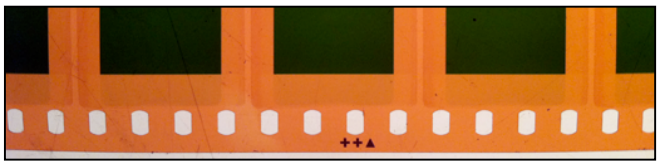

***Figure 2.** Due to the ubiquity of their product, the most commonplace type of edge information is Eastman Kodak's so-called "edge-codes," initiated by the manufacturer in 1916, in which a variation of circles, squares, rectangles and crosses indicate a particular film's year of finishing.*

1987	□ △ △
1988	+ + △
1989	× + △

Machine-Readable Representation of Edge Information and Embedded Metadata

With digital technologies embedded in the everyday production of cinema, current practices have assimilated with traditional patterns of photochemical film preservation in a variety of ways. Where the traditional workflow entails photosensitive substances and chemical reactions, the new digital model encodes light intensities into binary traces, or a hybrid thereof.

This shift towards machine-readable representation of image data can be also be seen on the edges of most modern films. As early as 1989 Eastman Kodak began printing linear USS-128 bar codes on color negative and color intermediate stocks, in conjunction with human-readable key numbering. Known as Eastman Keycode, this method of edge information delivery improved electronic editing, and was ultimately standardized in 1996. By 2002, the keycode included 8 points of information, including a 10-digit key number, manufacturer identification code, film type, and offset in perforations.

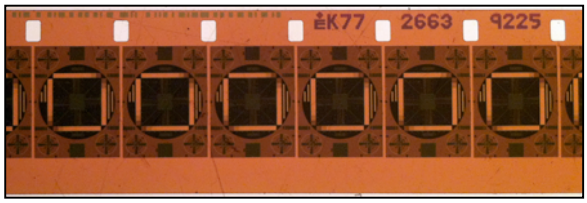

***Figure 3**. Example of 16mm Eastman key code (top left), latent image numbers (top right).*

Once extracted from its barcode, this machine-readable edge information can be stored within the header of several digital intermediate file types. Standardized in 1994, SMPTE's 268M specification listed five text fields in a specially designed header of the Digital Picture Exchange (DPX) file format used exclusively for edge code metadata. Fields for edge information are found in the header of the DPX file entitled "Motion-picture and television industry-specific information" [3]. Such fields are listed as follows:

Field	/Offset	Length	Type	Content
43	1664	2	ASCII	Film manufacturing code
44	1666	2	ASCII	Film type
45	1668	2	ASCII	Offset in perfs
46	1670	6	ASCII	Count
48	1676	4	ASCII	Count

Descended from Eastman Kodak's Cineon file format used in its original digital intermediate film system, the DPX header is heavily skewed for Kodak-only film stocks. Moreover, many stocks with earlier two-digit film manufacturing codes and film types cannot be incorporated into Fields 43 and 44. DPX files do however include a block of user-defined data, 32 to 1,048,608 bytes long (approximately 1 MB in length), in which the user can store additional documentation [5].

Container formats acting as "wrappers" such as the Material eXchange Format (MXF) offer similar types of extensibility and manipulation. While the origins of MXF date back to the mid 1990s, the format was ratified as SMPTE S377M in 2004 with the main purpose to capture program material and related information [6]. A generic data scheme for adding descriptive metadata (DM) was also defined with the broadcasting industry in mind [7]. Adding custom user-defined descriptive metadata, however, may run the risk of loss across system platforms through out-of-band management, where in-band semantics and ontology are not usually accounted for.

If edge information cannot be embedded within a given file structure, ancillary schemas written in Extensible Markup Language (XML) can be used to encode such metadata of analog and digital objects. The Metadata Encoding & Transmission Standard (METS) schema, maintained by the Library of Congress and developed as an initiative of the Digital Library Federation, allows a user to encode administrative, descriptive and structural metadata for digital objects [8]. Both the source metadata ("sourceMD") and digital provenance metadata elements ("digiprovMD") within METS can be used to express information ascertained from edge markings. In the same vein, the BagIt digital file-packaging format specification offers the archivist a structure to enclose descriptive metadata on edge information. Within a BagIT base directory, a payload may contain a digital still photo of edge information contained on the film object's margins. The BagIt specification is currently being used by the Library of Congress, as well as Stanford Digital Libraries and Archivématica in conjunction with the Open Archive Information System (OAIS) model.

Although file-based systems for recording analog metadata are showing signs of improvement through various working groups in the field, many important factors remain unknown. The risk of losing metadata through different operational patterns remains high, as does the effects of overall data corruption from IT storage technology. Moreover, the methods described above accommodate edge information derived from Kodak-only stocks manufactured subsequent to the year 1989. Such information derived from contemporary stock manufacturers such as ORWO and other analog film elements made prior to this date is not accounted for in the current file structures of their digital surrogates.

Edge Information as Visually Embedded Metadata

What response then, given this information, is left the moving image archivist absorbed in the efforts of film-to-digital preservation? I believe that this body of edge knowledge pioneered by Harold Brown provides the archivist and archive with an argument for creating edge-to-edge scanned image fields, an attainable practice that may stand in opposition to what Philip Rosen calls an inherently malleable digital utopia [9]. By scanning film as digital data, the moving image archive can move beyond aspect ratios of traditional standard and high definition video distribution channels as methods for scholarly research and access, and begin to move towards creating tiers that incorporate the entirety of the physical object in a single layout for digital storage.

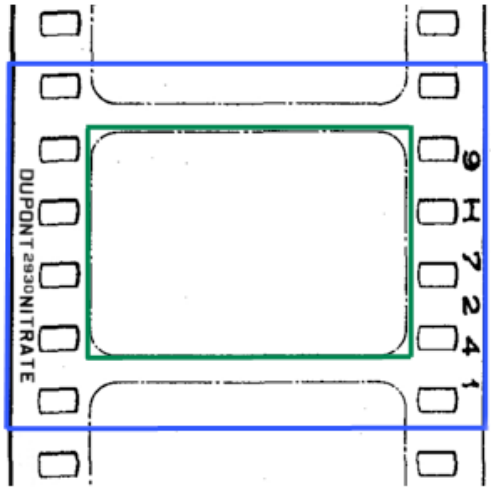

***Figure 4**. Illustration of suggested dimensions for edge-to-edge digital preservation master (in blue), and frame-only access copy (in green).*

Conclusion

This paper presents several studies for incorporating edge information as both visually and file-based embedded metadata. Alexander Horwath has argued that institutions such as museums must preserve a working system of cinema; what is inside the timeframe of the screen as well as what is inside the visual and aural space created by the joint performance of strip, machine, and operator [10]. Thus the terms artifact and object fall short when introducing to museums the concept and practice of film, insofar that they only refer to the fixed element, the filmstrip itself. Edge information in this context is therefore an 'artefactual' element indirectly related to the film system, and yet an essential element for recreating the film experience in future time. Preservation surrogates can and will be constructed in a way so that film objects may be evidenced by indexical traces, which will act as a bulwark against what Rosen again calls a practically infinitely manipulability of the film image [11].

Our collective knowledge of the material characteristics of motion picture film is also in need of additional research. As an

inherently malleable digital utopia (or regime) confronts moving image archives, archivists should not feel subordinate to such an authority. Whether one regards edge information here as antiquated or pragmatic knowledge, coming to grips with the surrogate film object will enable a continued practice of moving image archiving in the digital age. In addition to the current testing of formats for digital preservation with regards to contrast and dynamic range, research on digital cinema should include methods on how to preserve this body of knowledge intrinsic to our cinematic heritage.

References

[1] Harold Brown, Physical Characteristics of Early Films as Aids to Identification. Written for the FIAF Preservation Commission, 1990.

[2] Meyer, Mark-Paul and Read, Paul (eds.) *Restoration of Motion Picture Film*, Oxford: Butterworth-Heinemann, 2000. Pg 53.

[3] The Film Preservation Guide: Basics for Archives, Libraries and Museums. National Film Preservation Foundation, 2004.

[4] ANSI/SMPTE 268M-1994, SMPTE Standard for File Format for Digital Moving-Picture Exchange (DPX), 18 February 1994

[5] The block for user-defined data appears as follows:

```
typedef struct _UserDefinedData { char  UserId[32];    /* User-defined identification
string */
BYTE *Data;        /* User-defined data */ } USERDEFINEDDATA;
```

[6] P. Ferreira, "MXF: A Progress Report." Available at http://tech.ebu.ch/docs/techreview/trev_2010-Q3_MXF-1.pdf

[7] SMPTE 380M-2004: Material Exchange Format (MXF) – Descriptive Metadata Scheme-1 (Standard, Dynamic).

[8] "Metadata Encoding and Transmission Standard (METS) Official Web Site." Web. 2 Feb. 2012. <http://www.loc.gov/standards/mets/>.

[9] Rosen, Philip. *Change Mummified: Cinema, Historicity, Theory*. University of Minnesota Press. Minneapolis and London, 2001: 319

[10] Usai, Paolo Cherchi. "'Film As Artefact And Museum Object'" *Film Curatorship: Archives, Museums, and the Digital Marketplace*, edited by Paolo Cherchi Usai, David Francis, Alexander Horwath, and Michael Loebenstein. Wien: Osterrechisches Filmmuseum, 2008. Pg. 85.

[11] Rosen, Philip. *Change Mummified: Cinema, Historicity, Theory*. University of Minnesota Press. Minneapolis and London, 2001: 319

Author Biography

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