Dying Technology: The End of 35mm Slide Transparencies

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Abstract

This paper is written from the perspective of a museum conservator working with slide-based artworks within the context of a fine art collection. One of the challenges addressed by this research, which is centred on the imminent demise of analogue technology, is the gap between the trained practitioner rich in bench skills, the artist who has chosen to work in this medium and the language used by imaging science to describe the properties of a slide and any subsequent analogue or digital production route.

Introduction

When visiting art galleries or contemporary fine art museums, one often encounters displays of time-based media works of art that contain equipment and use media formats belonging to a technological age that has long passed its heyday. One of the formats which has almost entirely lost its commercial support in recent years is 35mm slide transparencies. This technology is an analogue hybrid which sits between analogue still photography and motion picture film and has often been chosen for its specific aesthetic qualities by artists from the 1960s or 70s to the present day.

Looking at the linguistic origin and meaning of the word, the term 'slide' is commonly used to refer to a 35mm photographic positive image made of chromogenic dyes on a transparent base which is held inside a plastic or card mount. Without this mount, the transparent film material would not be able *'to slide'* from one image to another inside a carousel or magazine when projected. In contrast to negative based film, reversal film is photo-chemically processed as a positive image. In most Latin based languages, slide is translated as *diapositive*, *dia* (through, between). Transparent breaks down into *trans* (beyond, across) and *parere* (to beget, appear, be visible, be seen, give birth to, obey). All three terms *slide, transparency* and *dia* describe an ephemeral presence, a state in which a picture is formed, lasts and disappears. [1]

Artists such as James Coleman, Nan Goldin, Robert Smithson, Giovanni Anselmo, Lothar Baumgarten, Paul McCarthy, David Lamelas, Marc Camille Chaimowicz and David Tremlett have been followed by a new generation for example Francis Älys, Phil Collins, Simon Starling, Hilary Lloyd, Ceal Floyer and Armando Andrade Tudela, amongst others, who are equally drawn and attracted to the medium of 35mm slide transparencies. For some artists, the appeal of 35mm slide as a medium was historically due to its high-resolution photographic quality, the simple capture technique, its accurate colour reproduction, the relatively low processing cost, its physical size in comparison to its achievable projection size and the possibilities to control the way in which the slides alternate. Slides can be externally controlled through dissolve or synchronising devices such as AVL, Dove, Dataton and Stumpfl. These devices store a cue tone that is an inaudible pulse of different low voltage frequencies that encode a line of precise events on a defined timeline. In its prime, slide technology harnessed external computer control to create elaborate shows involving multiple projectors, sequences, stitching techniques and synchronisation to other technologies. Many art historians still refer to slide-based artworks as *slide-tape.* This term goes back to the 1970's when magnetic audiotapes in cassette format were used to store the cue tone alongside the audio track or spoken word that would accompany the images.

For many artists the physical presence of the slide projector is significant, and often the model specified is Kodak's S-AV 2050 (fig.1), a carousel slide projector which ended production in the mid 1980's. Each projector type has a distinct soundscape or acoustic backdrop that can be associated with its mechanical 'klong' when the carousel rotates. The intensity of the sound varies depending on the types of slide mounts being used. Heavier glass mounts create a different sound to that of card mounts or glass-less mounts and subsequently influence the way in which the public's attention is drawn to the projection technique which in consequence impacts how one experiences the artwork when displayed.

Figure 1*. Installation View: Ceal Floyer "Light Switch" 1992-1999*
© Ceal Floyer, Courtesy Lisson Gallery, London

The challenge of collecting slide-based artworks

This research arises out of the practical requirement to adequately respond to the preservation needs of slide-based works from the point of acquisition through to the cycles of storage and display within a fine art museum.

Time-based media conservation at Tate has been established since 1996 and has the largest body of specialist conservators working in this area worldwide. These conservators are responsible for works that incorporate film, video, 35mm slides, performance and software. Given the fast changing technological environment upon which these works are dependent, time-based media

conservators are skilled in understanding and navigating the impact of these changes on the range of works in their care.

Tate is actively acquiring works into its collection. At the point when the work is considered for the collection, there is an active dialogue between the artist, their gallery, the curator and the conservator. An important aspect of the dialogue at this stage is the need to establish what the artist or their gallery are offering as part of the sale to the museum and whether this is adequate. It is rare for this to include unique in-camera originals not least because these works are often sold as editions. A common scenario is that the museum will obtain a number of sets of slides that are first generation duplicates from the in-camera original, with an additional clause as part of the artist's certificate that future copies should be requested from the artist. There is often an assumption that the museum will use the duplicates provided for display, with the artist or their representative returning to their in-camera original for duplication. This however presents a risk for the museum, which may feel too great an abdication of responsibility for preservation. Slide duplication is an analogue photographic process that is subject to generational loss and deviation in quality. It is therefore always best to return to the in-camera original.

The quality of the slides that a museum receives varies. In the case of an artist such as James Coleman, he employs an archivist and his slides are kept under controlled environmental conditions. His images have all been shot on the same slide stock using the same camera and the slide duplicates that form part of the acquisition are produced as three identical sets made at the same time using the same stock and the same duplicating machine. Works by other artists may be produced in a more ad hoc fashion, created and stored under less controlled conditions. For example, sometimes slides that form the artist's master set have been used for display and have therefore faded. Duplicates taken from these for subsequent exhibitions can be produced by different labs on different stocks. It is from these slides that a selection is made and given to the museum as part of the acquisition.

***Figure 2**. Installation View: Marc Camille Chaimowicz "Partial Eclipse..." 1980-2006. © Marc Camille Chaimowicz*

These scenarios clearly indicate why it so important for the conservator to understand the previous life of the artwork and the context in which it was created as in some cases slides may have been used as a precise aesthetic visual medium, whereas in other cases they may have been used less as an aesthetic medium and more as a tool for documentation for example in the context of conceptual art practices of the 1960s and 1970s.

Conservators archive the slide sets that were part of the acquisition despite the fact that there are no masters as such and catalogue these as the best available material that the museum will have access to. In an ideal case, Tate would receive three sets of slides which are provided by the artist, the best quality set will be made an Archival Master (AM), one a Duplicating Copy (DC) from which future duplicate sets can be made and a third will function as colour reference for later productions which is catalogued as Artist Verified Proof (AVP). All three will be kept in Tate's cold store which is set at -10°C and 35% RH. When the work is displayed for the first time, there is a very good chance that the status of these three sets will change if they are superseded by sets that the artists and conservator find to be of better quality.

Slides deteriorate inside the projector due to the exposure to light from the projector lamp, rendering them unusable after a relatively short period of display. Hence, large quantities of display sets of duplicate slides are essential to the continued display of these works.

***Figure 3**. Slide-based artworks in Tate's Collection by the year of acquisition*

Artists often indicate how often the display slides in their works need to be renewed. This is based on predictions regarding the degree of fading and colour shift over a certain period of time a work is on display. This again is relative and depends on the combination of two main factors; how many slides make up the work and how quickly they alternate.

The challenges associated with acquiring slide-based works into a collection came to a head in 2007, when Tate began to

rapidly increase the number of slide based works in its collection. Until the middle of the first decade of the 21st century, Tate held six slide-based works. The earliest work to enter the collection in 1973 was David Tremlett's *Green*, 1972. From 2004 until the end of 2010, the total number of works had increased to 21. These included a wide spectrum of works including multi-channel installations consisting of more than 160 slides each and projections using a single slide. Newly acquired works encompassed those recently made, as well as older works that had only recently entered the market or works that were produced over many years. (fig.3)

This rapid expansion to Tate's collection coincided with the demise of analogue photography and its replacement by digital imaging, a development that started gradually at the end of the 20th century with the full impact being felt by 2006. Within a couple of years, Tate was faced with a backlog, needing to archive these newly acquired artworks whilst artists, galleries and museums all struggled to obtain good quality slide duplicates.

Even when slide technology was at the height of its popularity, the quality control and accuracy required to duplicate slides was a challenging task demanding patience and skill. The reasons behind this can be summarised by the following four factors:

- The deviation of colour gamut and spectral sensitivity between different slide stocks, manufacturers and type of developing process e.g. duplication of a Kodakchrome slide (K-14 process) onto Ektachrome or Fujichrome slide duplication film (both E-6 process).
- The variation in the emulsion of different production batches of the same slide stock.
- The instability of the chemicals inside the processing bath and the regularity with which this is monitored, adjusted and renewed.
- The time and knowledge required to improve colour filtration settings based on the above factors.

The challenge of analogue duplication

Due to the commercial demise of analogue photography and more so of 35mm slides, the majority of photographic laboratories are no longer producing slide duplicates nor processing 35mm slide film and those few laboratories that continue to offer these services are now dealing with just small quantities of material. Commercial factors often mean that the quality control is less stringent. In 2007, in response to this rapidly changing situation, and before a significant body of work was placed with any one laboratory, Tate's time-based media conservation set out to re-evaluate which photographic lab in London was able to produce the best analogue duplicates. We restricted our search to London in order to avoid the risk of having to ship the master slides and also because we felt that it was highly desirable to build-up a professional relationship with a local laboratory that would help us to understand how the difficulties involved could be resolved. We tested three different labs. Each was given four in-camera exposed slides on Kodak E100VS, and four first generation duplicates on Kodak slide duplication film Edupe; and asked them to make five duplicates from each slide onto Kodak Edupe using an analogue duplication machine. After we were sent the results, we waited two weeks and asked to repeat the same task again.

Our assessment was based on:

- The accuracy of the colour filtration and exposure time was chosen.
- How much clipping on the margins occurred which would show whether the set-up and focusing was rushed.
- Whether the duplicating camera was capable of transporting the film correctly using pin-registration, a method which provides a more accurate positioned duplicate.
- Whether there were any blemishes such as drying marks or micro-scratches.
- How much the results differed due to variations in the processing bath that occurred in the time span of two weeks.

The outcome of our tests was disappointing and despite multiple attempts to challenge the labs to improve on the precision of their colour accuracy, the results remained sub-standard. These were assessed working together with one of Tate's photographers who also trained and worked as a Kodak Q-Lab technician. It was as if the highly trained analogue eyes that once oversaw this process were no longer available or maybe the problem was one of motivation, as moral was low with many experienced staff being made redundant due to the demise of the demand for analogue photographic processes.

In response to this, a new approach was taken, we concluded that a time-based media conservator would need to learn how to operate a slide duplicator to better understand the challenges involved in producing accurate colour matched slide duplicates first hand, and also to regain some control of this task recognising that a photographic laboratory has to operate within greater commercial constraints. In consultation with Tate's photography department, who owned a *Firenze ChromaPro 45* slide duplicator, Tate begun to duplicate the slides in-house and then send the exposed strip of slide film to be developed by an external photographic laboratory. One of Tate's photographers with more than 40 years of experience in this area provided training on how to operate the *ChromaPro* and taught me how to judge which colour filtration to use depending on the stock the slides are held on, how colour correction filters would cancel each other out and what this means in relation to lens stops and exposure time. Within a short period of time, I felt that I better understood this process and I began to see a clear improvement in the quality of the duplicates. What we achieved with this workflow was a way to minimize variation. Variability in the results cannot be completely eliminated as the colour processing of the slide film remains a significant factor due to the change in the E-6 processing bath from week to week. In order to overcome this, we adjusted our workflow and repeated our filtration tests weekly.

It was clear at this point why the initial laboratory tests were unsatisfactory; it is extremely time-consuming to carry out these individual tests in a systematic way and this is difficult to achieve within a commercial environment. Although time-consuming, it was encouraging to have established a successful method of producing duplicate slide sets for the purposes of preservation and display.

However, circumstances changed once again when Kodak announced the discontinuation of its slide duplication film stock Edupe in March 2010. This was not completely unforeseen as the price of the duplicating stock had steadily increased and its

availability had become increasingly scarce. Tate had therefore begun to create a small stockpile of Edupe slide film. The workflow that had been established needed to be reconsidered, as far too much duplicating stock was used in this repeated weekly testing to be viable given the finite amount of duplicating stock now available. What followed was a year where slide duplication came to a halt. This meant that there were no slide-based artworks available for display at Tate whilst alternative methods of slide duplication were sought.

The chart below (fig.4) shows the pressures on analogue production that impact the options available to the museum for the continued display of slide-based works. There are five associated activities; the availability to purchase slide stock (red), the feasibility of duplicating slides after slide stock has discontinued (orange), the option to show slide-based artworks using slide projectors (yellow), digitally scanning slides for preservation purposes (light green) and the preservation of analogue slides as such (green). Essentially, the constituent with the shortest life expectation limits the availability of the associated activity. Whereas stockpiling slide film and slide projector lamps is recommended, it must be seen in context with the other factors involved. If a digital scan is available it is also possible to use film recorders (LVT or CRT) to create slides from the digital scan onto slide film as long as the E-6 developing process remains available. The predictions in Figure 4 are simply my own best estimations regarding the life expectancy of any particular constituent of the technologies upon which the display of these works depends. Whilst much is uncertain in these predictions, this remains a useful exercise in helping to identify where best to prioritise effort.

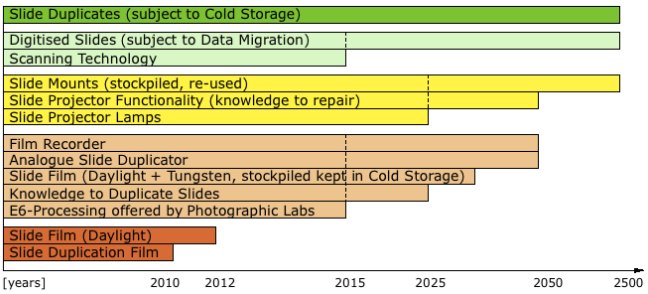

***Figure 4**. Expected availability of slide technology related activities*

The Move to the Digital

In March 2012, Kodak announced that it would discontinue the production of all its remaining slide films by the end of 2012. The chart presented (fig.4) clearly outlines the need for action now in order to create slides that can be placed in cold storage for the future. In response to the end of the production of Kodak Edupe in 2011, Tate established a new collaboration with a small slide laboratory in southwest Germany [2] which was able to control the production processes much more tightly, and understood the needs of accurate duplication when working with artworks.

In tandem with exploring the analogue production of duplicate slides, we have also been investigating the creation of accurate digital scans. Whereas in the past, scanning may have been postponed whilst the technology was still developing, at this point it is unlikely that digital scanning technology for analogue transparent material will be developed further and in addition these scanners are now on the verge of becoming obsolete themselves if the commercial support by the industry stops.


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Due to a steady decrease in sales and customer usage, combined with highly complex product formulation and manufacturing processes, Kodak is discontinuing three EKTACHROME (color reversal) Films:

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We estimate that, based on current sales pace, supplies of these films are expected to be available in the market for the next six to nine months; however, inventories may run out before then, depending on demand.

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***Figure 5**. Discontinuation Notice of all remaining slide stocks by Kodak [3]*

While digital intermediates make it possible to use film recorders in the production of duplicates, these are not of better quality than an analogue duplicate. Any solution linked to storing a large number of slides will be finite, either because any stored slides will eventually be used for display or the projector lamps needed for their display will not longer be available. The hope is that digital scans made now may open up other options for the display of these works in the future and therefore form part of the long-time preservation strategy for these works. .

In looking for the most appropriate method of scanning 35mm slide transparencies, I have been seeking to fully comprehend the advantages and disadvantages of digital scanning technology. To this end I have been working to identify and understand the scanning equipment, colour spaces, file formats, colour management software, workflows and decisions that might achieve the best results. This in principle may sound simpler than learning the art of how to produce good quality analogue duplicate slides but I have found the opposite to be the case. In my experience, many photographic laboratories do not trust or are still unfamiliar with the science behind colour management and find their own ways to compensate for this, which leads to a lack of clarity. I have found that the theory of colour science and its implementation by practitioners remains a world apart. Working with analogue photochemical processes is a craft. It involves understanding how to translate visual difference into adjustments of a device to nudge results in a direction that creates a closer match to the original. Moving into a digital space involves a different type of abstraction, moving away from chemical to mathematical alchemy. I can see the beauty in this different world and feel the urge to methodically correct Lab values, noting differences and creating look-up-tables. However, some basic information to help me make this transition remains strangely elusive. For example, where are the colour-gamut maps that would help to visualize the difference in colour of the chromogenic dyes that are used in different slide films such as

Kodakchrome, Ektachrome or Fujichrome? I can look at spectral curves of various lamps and know what light source they are using or identify pigments in artist paints but there are no standards or comparative charts available to visualize the colour matrix of slide films. Without these basic tools how am I to make concrete the task of mapping the difference in the colour spaces involved in the process of producing a digital scan.

Recently in discussing this project, a scientist confirmed: *"that colour management does work but it creates errors."* As I reflect on this statement, I realise that there was a misconception on my part, in that I naively assumed that by scanning my slide transparencies, I could achieve greater exactness than it would be possible by using analogue duplication. Within an analogue process, I have learnt to understand the parameters and accept the inaccuracies involved in the process but I was only able to do this by looking at a physical slide that would provide me with the empirical evidence. In moving to the digital realm, it is not possible to make similar direct judgements. As part of this research project, I continue to draw on the expertise of many in the field in pursuing an understanding of the defining parameters of a digital scan.

In the case of slide-based artworks many artists, curators and conservators resist imagining the end of this technology and a future when we will have to display these works without using the iconic carousel slide projectors and analogue images. For many there is a strong link between the visual aesthetics of a photographic slide and the sculptural presence of the display equipment in the gallery; with the projector positioned on a pedestal and the sound created when the slides alternate providing a backdrop to the piece. The experience is different from a digital projector displaying digital images. One might also consider it as part of the responsibility of the museum to allow future generations to experience these works of art in their authentic form as analogue slide projections in order to understand the legacy of this medium.

Whilst recognising the extraordinary beauty of the analogue it also demands great dedication to learn a craft that requires time in order to become a master practitioner. It carries with it a very human tradition of learning from the previous generation, passing knowledge and skill on through apprenticeships.

When applying conservation ethics, we have learnt that there is value in ensuring that we can compare the impact of shifts in technology for specific works in Tate's collection by being able to see the analogue next to the digital allowing us to move back and forth between these worlds for a little while.

Transferring these analogue slides into the digital sphere under defined parameters will allow future conservators to fully understand the decisions that we have made but will also enable them to preserve these artworks in future. Clearly to be successful in this, these conservators need to understand both the analogue processes and those associated with the digital. It is also possible that some artists will decide that their works will no longer be shown when analogue display is no longer possible.

Whilst digital technology may match the veracity of analogue images, in a fine art context it is not simply a matter of preserving data; the value to the artist and the museum of the medium remains a significant consideration. Our challenge is not simply in learning a new language but in translating between the two.

References

[1] Stéphane Bauer, *Dia, Slide, Transparency: Materialien zur Projektionskunst*. (NGBK, Berlin, 2000) pg. 6.

[2] Activity, Esslingen, Germany, http://www.slidelab.de/

[3] http://www.kodak.com/global/en/professional/products/colorReversalIndex.jhtml (accessed 23 March 2012)

Author Biography

Tina Weidner received her MA in restoration, art technology and conservation science from the Technical University of Munich (2004). Since 2005 she has worked in Time-based Media Conservation at the Tate Gallery in London where she is currently conducting an 18-month project on this subject supported by the Esmée Fairbairn Foundation.

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