



## **BOOK OF ABSTRACTS**

**3<sup>rd</sup> Edition of Colour Photography and Film: sharing knowledge of analysis, preservation, conservation, migration of analogue and digital materials**

Thursday 12 and Friday 13 September 2024  
Amsterdam (and online)

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***Tan Lip Seng's montaged colour transparency slides: A case study in unpacking intentionality and 'the decisive moment' in image-making, preservation and conservation***

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1. National Heritage board- Heritage Conservation Centre, Singapore; 2. National Heritage board- National Museum of Singapore

This project adopts a curatorial and conservation perspective to examine the creative practices of one of Singapore's most eminent modern photographers – Tan Lip Seng (b.1942-), for the purposes of preservation and for deepening knowledge on developments in photography innovations from the 1960s to 80s. His works currently resides in the collection of the National Museum of Singapore and National Gallery of Singapore, some of which are classified as high value.

Ranked as one of the top ten practitioners amongst photography salons internationally for twenty successive years from 1969 to 1988, Tan often emphasized the importance of capturing "the decisive moment", a concept influenced by Henri Cartier Bresson, which is premised on a mastery in speed and reflexes to derive an unerringly precise sense of pictorial composition. It was evident in every step of Tan's creative process: from the planning of the shot, the setting up of the scene, to the post-production workflows in the darkroom to achieve striking visual impact and poignancy. Tan was renowned globally for his consummate skills in the colour derivation photomontage technique, which involves meticulously overlaying and assembling various types of photographic films in the darkroom to achieve a manipulation of colour and aesthetic effects. This process involved an intricate combination of the Kodachrome film, Technifax diazotype film, Kodak fine-grain positive film and the Kodalith ortho film, with some of these latter films commonly used in lithographic and graphic art applications. His photographic pursuits were noted to be influenced by his fulltime profession as a medical photographer in which similar materials were utilised.

The study will report on the ongoing investigation of his technique and material of these montaged colour transparencies, lending insights into their current condition and types of degradation, with the aim of developing a conservation plan and to promote the sustainable use of his works. Artist interviews, literature research and scientific analysis form the primary methods of investigation at the current phase of characterizing the works and their condition. The project also plans to use the microfading technique to determine the light sensitivity of the Kodachrome and the diazotype images.

From the curatorial perspective, by obtaining a more comprehensive understanding of Tan's creative processes, the study aims to analyse the significance of his works in opening the chapter to a new pictorial language in Singapore's postwar art and photography history. It also posits new thought on how photographers have attempted to interpret and construct 'the decisive moment' in their own terms, reflecting an intimate connection between photography with the field of design, medicine, science and engineering.

**Keywords:** Kodachrome reversal slide, diazotype, kodalith film, montages, artist interview

***“Infinito” by Luigi Ghirri - Restoration work and diagnostic imaging: an opportunity for further reasoning***

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The restoration work carried out on the 1973 artwork “Infinito”, by Luigi Ghirri, was made possible thanks to the ministerial announcement "Strategia Fotografia", which allowed the recovery of unique pieces of the Ghirri Fund, consisting of more than 1600 artworks preserved by the CSAC of the University of Parma. "Infinito" in its totality was only exhibited for a few weeks in 1979, in the Sala delle Scuderie della Pilotta, in Parma, in the “Luigi Ghirri/Vera fotografia” anthological exhibition, and could be considered to be one of the very rare site-specific installations by the great photographer. Consisting of 365 colour photographs of the sky, taken every day, one per day, for a year from 1973, the work was assembled in 1979 and subsequently stored, disassembled into its 12 panels, in the CSAC's depot. If, on one hand, the chromogenic colour photographs are among the most unstable materials in the history of photography, on the other, those of Luigi Ghirri and of "Infinito" in particular, appear in many cases matted with inhomogeneous materials, sprays of various kinds, and then stuck in various points with double-sided tape onto unsuitable cardboard, subsequently nailed onto two plywood panels placed side by side. In order to investigate how the state of preservation of the images had changed over time, a comparison with a photographic reproduction of the individual panels, also carried out in 1992 at the CSAC, was fundamental, showing how the images had only partially altered chemically, in some cases showing very evident toning, in others much less. In order to undertake the conservation of the famous 'sky image mosaic', it was considered necessary to carry out a punctual analysis using UV fluorescence, which not only shed light on some of the methods necessary to carry out a restoration work that respects the object, but also highlighted the diversity of the materials used that contributed to the artwork's creation process and highlighted a series of considerations on the toning of the photographs taken by the author. It was indeed the comparison with the archive images, from which a progressive and rapid deterioration of the colour of the original photographs emerges, and the diagnostics imaging, that provided the occasion to define a periodic and timed monitoring of the degree of colour change of each individual photograph in order to trace back, as far as possible, the cause, inherent or external to the original materials, and to estimate any potential change in the event new placements. The proposed contribution, therefore, in addition to describing the phases of restoration, defines the importance of diagnostic imaging applied on materials that are still scarcely investigated in this sense, such as chromogenic development photographs, and in this specific case, on what is probably the best known artwork by a 'master of colour' such as Luigi Ghirri.

**Keywords:** Luigi Ghirri; chromogenic prints; toning; restoration; diagnostic imaging

**Fading memories:  
Assessing colour slide film's cultural impact in Portugal and abroad**

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The early development of colour slide film is associated with the photographic industry in North America and Europe in the 1930s. Distributed through a globalized market, such objects became a part of people's daily lives through a myriad of uses. Despite decades-long commercial success with both professional and amateur photographers, slide film has been progressively replaced by digital imaging technology since the early 2000s. In fact, even though slide film can be a memento, its memory is fading away from our lives. This entire branch of the industry has died out, and, if no action is taken, so will the recollections of its impact. To transform these materials into enduring cultural memories, it is crucial to collect and organise information related to their production context and related experiences.

This study focuses on colour slide collections in Portuguese institutions while exploring their manufacture, use, decay, values, and significance. To assess the opinion of a broad national and international audience about slide film, data was collected through Portuguese and English versions of an online questionnaire using Microsoft Forms<sup>®</sup>. Participants were asked about their personal and professional experiences related to colour slide film and their views on the photographic industry. Currently, c. 440 individuals from over 50 countries have replied from varying age groups, training backgrounds, and professional fields. Results were analysed statistically and through data visualisation tools, showing that differences in perspectives can be related to a slight generational divide, as well as a range of geographical and socio-economic backgrounds. Furthermore, the cultural impact of colour slides is often associated with the images they carry, but the significance of the scientific and technological context in which they were created seems to be underestimated. To complement standardized answers, participants were encouraged to add personal comments, many of which emphasized the power of slide film in triggering personal memories.

This survey documents how colour slide film's broad societal impact can be felt across generations and countries. Furthermore, the provided statements demonstrate that caring for these photographs should go beyond preserving materiality and is a process that needs to be supported by a deeper grasp of a technology's cultural impact. The presentation will elaborate on the obtained results and demonstrate how online surveys and visualization tools are useful methods for studying obsolete technologies, helping to recover and rediscover their cultural and artistic meaning.

**Keywords:** colour slide film; chromogenic photography; online survey; value; cultural memory

***Investigating solvent treatment methods on a matte pigment inkjet print.***

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Due to the increasing amount of inkjet prints found in art and museum collections the need for preservation and conservation becomes more eminent. The commercial aspect of multiple companies producing inkjet prints while constantly changing their formulae and keeping it partially secret makes it a complex undertaking. To potentially overcome this barrier and determine the impact of solvents on inkjet prints, we seek to investigate the influence of various solvent application methods on an aqueous pigment ink matte microporous Hahnemühle PhotoRag inkjet print, aiming to determine its susceptibility towards solvent treatment. For that purpose, thirteen solvents commonly employed by conservators (demineralised water, 50:50 water: ethanol, 30:70 water: ethanol, iso-propanol, acetone, methyl ethyl ketone, ethyl acetate, heptane, iso-octane, toluene, xylene, and Kodak Photo-Flo 200) were subjected to assessment through three distinct application methods: liquid drop application, damp cotton swab application with various amounts of friction applied, and a subset underwent exposure to solvent vapours. These tests were complemented by comprehensive photo documentation (normal, raking, and UV-light), spectrophotometer measurements, and HIROX microscopy to determine possible changes to the objects.

Alongside these experiments, liquid chromatography-photo diode array-mass spectrometry (LC-PDA-MS), paper-spray mass spectrometry (PS-MS), and attenuated total reflection Fourier-transform infrared spectroscopy (ATR-FTIR) were employed to identify ink components and to assess the solvent's dissolving capabilities. Samples of Epson ink directly from cartridges were used during this part of the study: yellow (Yellow T5914), cyan (Cyan T8002), light cyan (Light Cyan T8006), magenta (Vivid Magenta T5913), and light magenta (Light Vivid Magenta T8005), together with a printed sample (Hahnemühle PhotoRag). We demonstrated that ATR-FTIR is able to identify the colour pigments, in contrast LC-PDA-MS could not identify the complete set of pigments, but provided information about other ink components. The analytical method, PS-MS, was used for direct solvent testing, but also showed potential for identification.

The overall outcome emphasised that the method of solvent introduction significantly influences the impact on these inkjet prints. Application with friction resulted in the most substantial and instantaneous modifications to the surface, while frictionless application using damp swabs primarily influenced the optical brightening agents in the paper substrate for specific solvents. Moreover, this study shows that the choice of solvent has an impact, since certain solvents induced alterations in print planarity and have potential to dissolve or displace components. The effectiveness of the treatment methods regarding cleaning of inkjet prints were not assessed during this research, however, a future research should be dedicated to investigating the efficacy.

**Keywords:** inkjet photography; aqueous pigment ink; matte microporous coating; solvent treatment; chemical composition.

## ***Evaluating the stability of colour slides: 30 years of natural ageing at the National Museums of Denmark***

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In the 1990s, chromogenic reversal films (or colour slides) were still a widespread medium to document objects from museum collections. At the same time, there was a growing awareness about the poor long-term stability of these materials due to the vulnerability of the chromogenic dyes to relative humidity (RH) and temperature (T), light, as well as to other factors such as the quality of processing [1].

In this context, a study collection was produced in 1992 at The National Museum of Denmark, with the aim of evaluating the natural ageing of different brands and models of 35 mm colour slides used at that time. Six films were selected: i) Kodak Kodachrome (ISO 64); ii) Kodak Ektachrome (ISO 100); iii) Fuji Fujichrome Velvia (ISO 50); iv) Agfa Agfachrome RS 100 (ISO 100); v) Agfa Agfachrome 1000 RS (ISO 1000); vi) Polaroid Presentation Chrome (ISO 100). Nine colour patches were exposed in the test slides to allow a proper understanding of the fading of the different dyes separately and overall colour change. After processing in commercial photo labs, the films were contaminated with three concentrations of fixer to simulate improper processing. A set of films was maintained untreated for comparison. The content of thiosulfate (residual fixer) in the films was measured using the methylene blue and iodamylose methods. The films (treated and untreated) were framed, stored in plastic folders, and placed in eight different locations at room T. A reference set was kept in a freezer at -18°C. To assess the fading and production of yellow stain in the samples, density measurements were collected before ageing.

After twelve years of natural ageing, the study collection was re-assessed by repeating the density measurements. In most storage locations, the slides were not significantly affected if processed properly. Some locations did however affect the slides considerably [2].

More than thirty years after the creation of the study collection, the test slides are being assessed once again, following the same methodology. Of the originally eight sets, six could be retrieved while two sets were lost. The results of this investigation will be presented, seeking to expand knowledge about the ageing of these materials.

**Keywords:** colour slide; chromogenic reversal film, densitometry; natural ageing; fading

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## ***Migration of Color Photography to UV and Pigment Ink Processes***

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The migration of traditional photographic media to archival digital processes represents a significant evolution in the field of photographic preservation and reproduction. Central to this shift is UV-Curable printing, a cutting-edge technology that utilizes ultraviolet light to cure inks and create durable, high-quality prints. We explore the intricate processes and advantages of UV-Curable printing in the archival context, including its superior color fidelity, longevity, and resistance to environmental factors compared to traditional photographic methods.

Analyzing case studies and technological advancements, the research highlights how UV-Curable printing enables the faithful reproduction of original works while preserving the integrity and intent of the artwork. Furthermore, we address the challenges and solutions associated with digitizing and archiving photographic media, providing insights into the practices that ensure the maintenance and accessibility of our visual heritage in the digital age.

The range of substrates that UV inks are compatible with has been a catalyst for clients to migrate their work to this process for new work as well. The printer can manage soft materials like paper and linen up to 98 inches and rigid panels up to 80x140 inches. The inks are compatible with a wide range of materials, including but not limited to Dibond, painted aluminum, plexiglass, canvas (including conservator-grade polyester), Japanese paper, and glass.

The flexibility of the UV-Curable printing process has created a shift in how artists envision their work. Scale and range of materials are key reasons for this shift, but the inks are also inherently stronger and can withstand handling, allowing the work to be exhibited without glazing, which can interfere with the immediate experience of viewing the images.

The SwissQ printer's inclusion of white ink, in addition to the full range of CMYK inks, creates a barrier when used with process inks. This results in archival light boxes with a full tonal range, facilitating the creation of plexi prints that can be exhibited without using adhesives.

Notable clients who have migrated damaged work to the UV curable print process include Luis Gispert, Robert Polidori, and Richard Prince. Clients who have pivoted to using UV for current work, having previously been C-Print clients, include Stephen Shore and Edward Burtynsky.

**Keywords:** Archival, UV Cured, SwissQ, Photo

Keynote - Thursday 12 September, 14.00 – 14.45

**Rediscovering the colours of early cinema: a journey through Eye Filmmuseum's silent film restorations**

**Elif Rongen-Kaynakçi**

Bio

Elif Rongen-Kaynakçi is the Curator of Silent film at Eye Filmmuseum. Born in Istanbul, Turkey, she completed her BA at the Bosphorus University in English Literature, followed by MA in Film & TV Studies at the Univ. of Amsterdam. In 1998 she completed the Archimedia course organized by the EU Media Desk. Since 1999 at Eye, she has worked on the discovery, restoration and presentation of many presumed lost films, often starring forgotten actresses.

On a daily basis she is responsible for some of Eye's internationally acclaimed collections such as the Desmet Collection, the Mutoscope&Biograph Collection, the Bits&Pieces Collection. Her duties involve the preservation as well as the worldwide presentation of these films in all formats.

Rongen-Kaynakci is directly involved with the programs of international archival festivals Il Cinema Ritrovato, Le Giornate del Cinema Muto and other events dedicated to cinema heritage. She has served on the steering committee of the WFHI (Women and Film History International) from 2015 to 2022, and co-organized the 2019 Women and the Silent Screen Conference at Eye. She is also one of the three curators of 'Cinema's First Nasty Women'; a bluray-box with 99 films and a booklet, released in December 2022 by Kino Lorber.

3<sup>rd</sup> Session - Thursday 12 September, 14.45 – 15.35

***Your memory is our history: recovery, digitalisation and dissemination of vernacular video production***

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History is a complex tapestry of interwoven memories, a set of narratives that define us and connect us to the past, reinforcing the sense of belonging to a society and a territory. Carbonia (Sardinia, Italy) is a founding city, created to ensure the supply of coal in the Italy of Fascist autarchy to reduce dependence on foreign imports. Inaugurated on 18 December 1938, in the presence of Mussolini, it saw an intense economic migratory phenomenon converge on it that delineated a peculiar social characterisation and experienced changing fortunes, until the definitive end of mining era. The preservation of memory is a topic of significant interest that can be used both for the pure documentation of events and for the suturing of a sense of belonging to a legacy that is difficult to accept.

Carbonia is home to the 'Centro Servizi Culturali della Società Umanitaria', which, in 2015, activated the project 'Ex Di Memorie in Movimento - La Fabbrica del Cinema'. Among other services, the Centre deals with the preservation, collection, promotion and production of audiovisual historical memory. Since 2017, the Region of Sardinia has granted the Centre funding for the activation of a 'Cineportual hub', an attempt to develop the local cinema industry.

Of considerable interest is the 'Your memory is our history' project promoted by the three Sardinian Centres of the Società Umanitaria (Cagliari, Carbonia and Alghero). It is based on family (or vernacular) cinema, which aims to recover the audiovisual historical memory that private citizens have produced through home movies from the 1960s-70s onwards and eventually forgotten in attics and cellars, and then transform these small private stories into public testimonies of daily life and local culture. Thus, these vernacular film materials are not only valuable documentation, free from the political propaganda that characterises the enormous archive of Istituto Luce productions during Fascism, but are also fundamental pieces for scholars, historians and film enthusiasts who want to build a stronger social framework, based on sharing and mutual understanding thanks to new productions that seek to fill cultural gaps or address neglected aspects of the island's culture and history.

The Carbonia Cinema Factory stands out as an example of excellence in the integration of art, science and society. Through its commitment to memory preservation and scientific dissemination, it demonstrates the transformative power of art and culture in building a shared and conscious future.

**Keywords:** cultural heritage preservation; coal mine, documentary film, vernacular movies; color home movies

## ***Prokudin-Gorskii's technique of colour photography and contemporary exhibitions***

Nadezhda Stanulevich<sup>1</sup>

*1 Peter the Great Museum of Anthropology and Ethnography (the Kunstkamera), Saint-Petersburg, Russia*

Analog photography has been a subject of curatorial interest for more than hundred years. Nevertheless, among the early colour photographs, there are ones made in techniques that were demonstrated only from an aesthetic and cultural point of view, for example, the works of the Russian photographer Sergei Prokudin-Gorskii (1863-1944). To obtain colour projections and colour photomechanical prints, Prokudin-Gorskii used colour separation method. This method is based on the principle of preliminary separation of information about the constituent parts of the spectrum for its subsequent reproduction through light or dyes. The principle of colour separation is also at the heart of digital projectors and colour printing. Therefore, I am interested in exploring the possibilities of using Prokudin-Gorskii's historical photographs to explain the operating principles behind certain elements of immersive exhibitions. I analyse the curatorial design practices of the Prokudin-Gorskii's photography exhibitions and catalogues production. My short article demonstrates the potential of using technically unsuccessful photography in explaining additive colour synthesis. These results contribute to the history of methods and curatorial practices. Altogether, this research provides the basis for future exhibition projects.

**Keywords:** history of photography; curatorial design practice; projectio; printing

4<sup>th</sup> Session - Thursday 12 September, 16.00 – 17.40

***The Scream (ca. 1910) through the Years: from Photographic Documentation to Digital Rejuvenation***

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Digital rejuvenation [1] is the attempt to reconstruct the appearance of an artwork as it was in the past, and it is of high interest for a wide range of stakeholders: art historians, conservators, museum curators, educators and the general public. Very often, rejuvenation approaches start from accurate color representations of the artwork based on spectrophotometric measurements of its current status [2]. This is combined with knowledge about the constituent materials and their color change behavior, which is usually assessed with accelerated aging experiments [2].

In our work, we accessed the museum's archival records and captured historic film slides (see Figure 1) with a hyperspectral imaging setup, to restore the past colors of the painting *The Scream* (ca. 1910) by Edvard Munch. The challenge is that some of these photographs were themselves subject to degradation, as it is obvious with the one from 1971, where the cyan dye heavily faded.

Our approach to digital rejuvenation starts with a first step, where we adjust the spectral densities of the cyan, magenta, and yellow dyes so that they match the original concentrations, taking the black level in the film as reference [3]. This way, we obtain an unfaded film record of the painting.

In the second step, we develop a film-to-painting transformation, where we correct the colors of the film record using the painting as reference. From prior investigations, we are aware of which areas in the painting are stable and have not changed during the last decades. These areas become anchor points to define a transformation from the colors of the slides to the actual colors of the painting. In addition, we use the color control patches in the film to supplement the range of anchor points.

Mathematically, we formalize the film-to-painting correction with least-squares regression of polynomial models (first-order, second-order, third order) and neural network fitting, respectively. We choose the best model according to the mean absolute error given a train-test split of the data. Finally, we apply the resulting transformation to each film, which ultimately enables us to peek into the painting's past with improved color accuracy.

**Keywords:** archival film records; digital unfading; painting digital rejuvenation

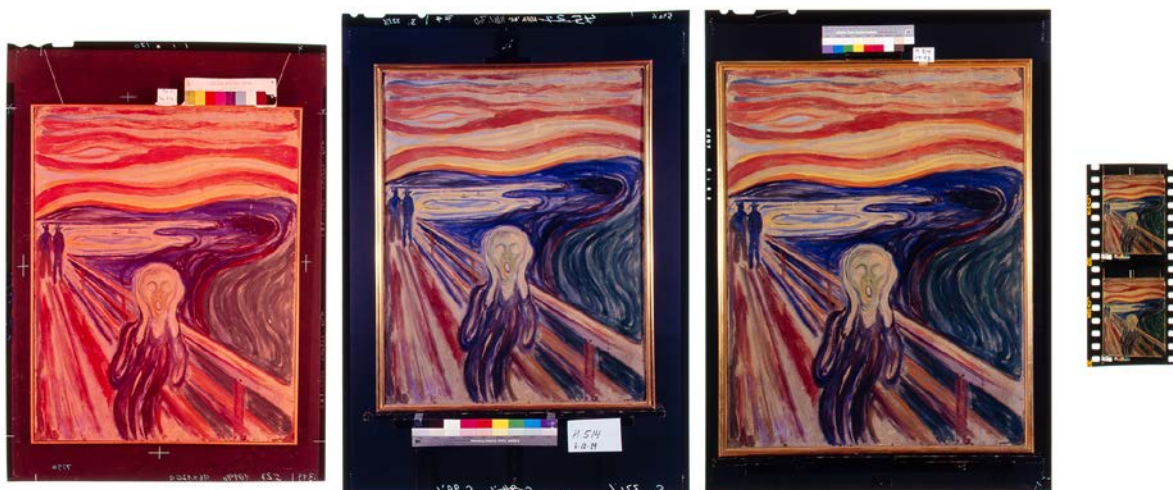


Figure 1. The analogue photographs of *The Scream* in 1971, 1989, 1993, and 2003 (in order from left to right).

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***Polaroids around the 80s. An investigation of the stability of instant film according to storage, handling, and exhibition***

Sille Juline Høgly Petersen<sup>1</sup>, Morten Ryhl-Svendsen<sup>1</sup>

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“Probably the most outstanding single advance in photographic science made during this century” was said in 1963 about the first commercial instant color film from Polaroid Corporation [1]. In 1972 Edward Land invented the integral film, a complex package with inbuilt chemicals, several layers of light-sensitive material, dyes, and several other functional layers. The instant film was perceived as a landmark in the scene of photography, but it also led to preservation concerns as they entered the museums and collections. According to research by Henry Wilhelm, five types of instant integral films stand out as the “Longest-lasting Polaroid Instant Color Prints”, but it is still not recommended for anything else than short-term usage because of their poor light-stability and of the excessive yellowish stain that occurs, even at normal, room-temperature dark storage [2].

In this study the stability of integral color instant film was researched. The study is based on test material consisting of already exposed prints from 1978-1987 bought on the internet.

This test material has undergone two types of artificial aging; 1) light aging conducted in a Weather-O-meter and 2) dark aging at three different relative humidity (RH); 27 %, 50%, and 75% RH. To have an impression of the light-stability of the test material a micro-fading test was conducted before the start of the experiments. These results were also used to see if the micro-fading tester is suitable for predicting the light-stability of the instant integral films.

The degradation of the samples was analyzed by visual observation, microscopy of the image layers and of the cross-sections of the prints, color measurements, and FT-IR.

The research shows differences between the Polaroid instant integral films from the different years, both in the structure of the layers and stability of the prints. Overall, the results show that test material artificial degraded in dark at 25 % RH and 50% RH has less sign of degradation according to test material degraded by light fading or by degradation in the dark at 75% RH. Compared to each other the micro-fading test and light aging test conducted in the Weather-O-meter lead to similar results.

**Keywords:** Polaroid; instant film; integral film; artificial aging; stability

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***An investigation into the structure and color stability of different generations of Polaroid 20×24 materials.***

Paulina Miąsik<sup>1</sup>, Sylvie Pénichon<sup>1</sup>, Ken Sutherland<sup>1</sup>, Clara Granzotto<sup>1</sup>, Giovanni Verri<sup>1</sup>

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While Polaroid 20×24 prints are commonly encountered in fine art collections, they have received little attention from the conservation community. The research presented here is part of a wider project being conducted at the Art Institute of Chicago, which aims to provide a better understanding of the materials as well as practical guidelines for their care and preservation. This presentation will focus on the identification and structure of the different generations of Polacolor 20×24 film, their image stability, and their unique properties. The history of large format Polaroid 20×24 (50×60 cm) began in 1976 with the building of the first prototype of the camera for a special presentation at that year's Polaroid shareholders meeting. The idea for creating the large format originated from Dr. Edwin Land's desire to demonstrate the quality of the Polacolor 2 film, for the launch of the 8×10 version of the film. After that event, five more cameras were built. Equipment and films were made available to artists in the US and later in Europe, where one of the cameras is still being operated today. Polaroid 20×24 photographs belong to the peel-apart family of instant or dye diffusion prints. The image is created by exposing a negative that is then brought in contact with a chemical reagent and a sheet of image-receiving paper as it is pulled from the camera. As the reagent permeates the negative, the dyes it contains migrate towards the receiving paper where they will form a positive image. Processing takes a few minutes at the end of which negative and positive are separated (peeled apart) and the negative is discarded. Several generations of the 20×24 film was produced between 1976 and 2008, when the Polaroid Corporation was dissolved and the production of all instant films ceased. Each generation was supposed to be an upgraded version of its predecessor, with better image qualities. The collection of the Art Institute in Chicago contains Polaroid 20×24 photographs that span the three decades of the film's production. Several nondestructive methods were used to characterize the different supports, including colorimetry and spectrophotometry, along with measurements of surface gloss, support thickness, and surface texture. Data were also collected from other collections, including those of the Museum of Fine Arts in Boston and Museum of Contemporary Photography in Chicago. Using reference samples of Polaroid 20×24 in the conservation study collection, it was possible to create cross-sections and perform instrumental analyses, including SEM-EDS and FTIR. The data collected from the collection items and the identified study samples were correlated to establish identification clues for the most common generations of material.

The second part of the presentation will deal with the results of an investigation into the light stability of large Polaroids' materials using the microfading tester (MFT). The analysis of four areas with different colors (cyan, magenta, yellow and black) on each sample helped uncover differences in lightfastness between the different generations of Polaroid 20×24 film. Guidelines for the display of these materials will be proposed.

**Keywords:** Instant Prints, Polaroid 20×24, Polacolor, Microfade Testing, Light Stability



## ***Light sensitivity of contemporary photographic print materials under LED exposure***

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Digitally captured images can be output on different print materials depending on the requirements of the application for example as print in a photobook, as a calendar, a book cover or as a digital display print or work of art. The most widespread output technologies for these applications are silver halide, liquid toner electrophotography (EP), dye sublimation transfer (D2T2) and dye-based as well as pigment-based inkjet. The current study investigates the light sensitivity of six different photographic output materials under LED light exposure, as a spin-off activity from an interlaboratory test of ISO's TC42, WG5 to validate a general light stability test standard.

The design of the bespoke experimental set-up was described at the 2nd Conference on Photography and Film, 2022 [1]. Patches of medium lightness of yellow, magenta, cyan, black and a white patch of the six different test materials were exposed with eight different narrow band LED, covering the visible range of 380-620 nm. The amount of fading plotted as a function of the exposure at a certain wavelength provides the sensitivity of a colour patch as its slope. For all technologies, fading was fastest for the wavelength range 390-405 nm. While in IJ dye prints, silver halide prints and D2T2 prints, all colorants faded quite fast, in the pigment system, the overall fading was much slower, but one colorant faded much faster than the others of the set. In the case of pigment ink, this was yellow, in the case of EP it was magenta. The sensitivity as a function of wavelength, the action spectrum, was used to predict fading of a similar colour patch for the exposure with a white LED (CCT of 5000 K). This is done by adding the effects of the narrow band exposures selected to match the white light exposure. As certain patches were composed of several colorants, working with changes in density provided better results than working with Dealt E. The prediction depends on the fact that the exposure in one wavelength range is independent of the exposure in another wavelength range and that effects are additive. This is not the case when imaging materials have sacrificial protective agents incorporated into the material design, which is sometimes the case for silver halide chromogenic prints. In white LED exposure, the protective agent is degraded by shorter wavelength light which accelerates the degradation of the colorants under longer wavelength exposure. Due to the interaction of the destruction of the protective agent with the colorant fading, the effects of the narrow band exposure are no longer additive. The spectral light fading method is particularly suitable to characterize single colorants in colour print materials, in which the image matrix is a paper or a clear layer and which do not have protection layers with UV absorbers.

**Keywords:** Spectral light fading, Prediction of LED light fading, Light stability of colour print materials: silver halide, D2T2, Liquid toner electrophotography, inkjet

Keynote - Friday 13 September, 9.45 – 10.30

*Reprinting as a game-changer*

**Monica Marchesi**

The reprinting of photographic artworks can take various forms: as a conservation strategy where, discoloured photographs are replaced with pristine ones, as an artistic practice that allows photographic prints to be exhibited to the public without protective glazing, and as a collaborative mode of production between the artist and the museum. This talk will look back and share experiences from the past ten years, focusing on potential gains or losses during the reprinting process. It will also reflect on how, through reprinting, the speaker's views on conservation have evolved: from an approach aimed mainly at preventing or slowing down change to one in which documenting or curating change becomes equally relevant.

Bio:

Monica Marchesi is an art historian and a conservator at the Stedelijk Museum Amsterdam (SMA). She strongly advocates for the value of practice-driven research, where material and technical investigation, active conservation, cultural heritage management, conservation theory, and museum studies intersect. Her primary interest is in the reprinting of photographic artworks as a conservation strategy. She has delivered numerous presentations, authored peer-reviewed publications, and was awarded a PhD degree from the Leiden University (2017) on this subject.

Over the past decade, she was actively involved in several research projects the Photographs and Preservation. How to save photographic works of art for the future? within the NWO research program Science4Arts (2012 – 2016); Rineke Dijkstra: Exploring the reprinting of color photography as a conservation strategy (2019 -2021). In 2024 she was awarded a NWO Museum grant for the project Print on Demand: Printing digital-based artworks through a collaborative mode of production.

5<sup>th</sup> Session - Friday 13 September, 10.30 – 11.20

***Reception of film colour in the Soviet postwar cinematic community: between aesthetics and technology***

Iryna Marholina

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Full colour Soviet cinema appeared during the postwar time and became possible because of the *Agfa* technology dismantled from German Wolfen factory and brought to the USSR together with tones of film itself, and so the news all over the world appeared about the first Soviet colour pictures. *Stone flower* («Каменный цветок») by Aleksandr Ptushko participated in the Cannes film festival in the late September 1946, and won the price for the best colour. Even earlier, first week of September, international premiere of the colour newsreel *Russia on Parade* («Всесоюзный парад физкультурников») took place. Technically, they weren't the first Soviet colour movies as during 1930's each Soviet production company (Lenfilm, Mosfilm and Mezhrabpomfilm) held its own experiments with colour technologies, but neither attention nor support from the USSR State Committee for Cinematography was granted. Not for long, but situation altered just before the war, when active discussion on colour pictures and processes appeared in periodicals. Production possibilities were low at that time, but the plans were big.

After the war, vice versa, the censorship was so tough, that while the means and resources for colour movies became available, pictures production decreased drastically. Meanwhile, discussions around the colour were blooming. The cinematic community put all its enthusiasm in finding the ways of dealing with this new means of expression. Within the section of artists and cinematographers in Central House of Cinema in Moscow regular meetings were held, dedicated to the different topics concerning colour film. Claims and applications on the improvement of the working space were running between the directors and the management of the studios. Even though during the artistic councils, when pictures were discussed, small could be said about the colour as it was too specific for the usual party representatives, the ideological colour restrictions were formulated in the very beginning of the discussion during the conference on colour held in Central House of Cinema in September 1945. No doubts, the availability of colour film fully shaped the mood of the cinematic community during the postwar time.

In my presentation I offer to track down the direction of the postwar discussion on colour film within film institutions and partially in periodicals. Different sides of the colour film discussion will be taken under the consideration: colour technical demands and its aesthetical capabilities. The noteworthy context and the following epilogue will be considered as well.

**Keywords:** Soviet; reception; colour; Agfa; postwar.

***Preserving Bosnia's Cinematic Heritage: Challenges and Achievements of the Film Centre Sarajevo in the Post-War Era and Beyond***

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In the past in Bosnia and Herzegovina, film culture was reflected in the work of three important production companies: Bosna Film, Sutjeska Film, and Studio Film Sarajevo. This cinematic era began in 1947, at the conclusion of World War II, and tragically ended during the Siege of Sarajevo (1992-1995). Bosnia's cinematic heritage faced challenges due to the war and post-war neglect of film materials. In response, the Government of the Federation of Bosnia and Herzegovina established the Film Centre Sarajevo in 2008, with the aim of conserving and representing the Bosnian film heritage to the public.

In 2020, the Film Center experienced positive developments, including a new collaboration with the MIPS Lab at the University of Milan and significant economic support from the U.S. Ambassadors Fund grant. Previously, the film material had been stored in rooms that were unsuitable for its conservation. However, with new expertise and fundings, it became possible to adapt to the existing facilities. This marked the beginning of the Center's recovery and rediscovery, with the cataloging of film materials, the creation of a provisional digital archive, and the beginning of the first film digitization efforts. A significant challenge was managing the condition of the films, which had suffered from fungi, shrinkage, acetate decay, and other issues.

Cataloging and conservation efforts have resulted in significant improvements in the condition of the films and have also led to the discovery of previously thought lost negatives. This underscores the importance of preservation initiatives and the potential for recovering valuable historical materials through dedicated archival work.

This work aims to present the entire process of creation and adaptation, showcasing examples of both successful and unsuccessful practices in preserving the cinematographic collection. The authors will employ comparative and descriptive methods to evaluate the Film Centre's former state and current achievements in preserving the archive's cinematic heritage. Our concise methods enabled effective operation with minimal staff, addressing post-war challenges.

In conclusion, our case study exemplifies the improvement efforts of the Film Center and offers a model for archives facing various obstacles (financial, legal, staffing shortages, and socio-political).

**Keywords:** film restoration; film preservation; cinematic heritage; cultural heritage preservation

*Understanding colors of Dufaycolor*

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Dufaycolor, introduced for motion pictures in 1932 and still photography in 1935, represents one of the most advanced additive color processes in early color photography. It employs a color filter, known as the "reséau," which consists of small patches of red, green, and blue colors covered by a panchromatic black-and-white emulsion. This filter serves a dual purpose: recording the scene's colors during exposure and reproducing the original colors once the film emulsion is developed into a monochromatic transparency.

The dyes used in the reséau filter faced several constraints. They needed to have the appropriate spectral transmittance to function effectively with the specific type of photographic emulsion, be highly soluble to produce saturated colors in a collodion layer approximately 3 $\mu$  thick (a requirement for compatibility with standard movie cameras), and be effectively printed on the film base. Consequently, color permanence was a secondary consideration. As noted, "The fugitive character of the dyes is not of great importance, since the exposure of an individual picture frame in the projector only occupies about 1/40th of sec., and the life of an average film is about 200 projections. The actual exposure of the colors, therefore, to the light of the arc lamp is of order of 5 sec., so that the property of permanence may be ignored." [1]. Thus, Dufaycolor photographs often appear faded today. However, due to the stability of the black-and-white emulsion, it is possible to digitally reconstruct the original colors from high-resolution scans by identifying the individual color patches of the reséau screen and recoloring them accurately [3].

High-precision color reproduction necessitates a thorough understanding of the dyes used in printing the reséau filters. These dyes are documented in various sources, including [2], which specifies their xyY coordinates and transmission spectra. Unfortunately, contemporary publications contain numerous errors and contradictions. We introduce a new software tool that simulates the Dufaycolor process, enabling us to resolve some of the technical uncertainties. The goal is to reconstruct photographs into their original colors (as they looked new). However we can also apply modern digital color processing techniques to Dufaycolor images getting closer reconstructions of colors of the original scene.

**Keywords:** early color photography, dufaycolor, additive color photography

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## ***Limitations and Potentials of Hyperspectral Imaging Technique Applied to Cinematographic and Photographic Film Materials***

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Reflectance or transmittance hyperspectral imaging (HSI) is an advanced technique that enables the capture of hundreds of images in contiguous narrow spectral bands, usually in the visible and the near-infrared regions. In the cultural heritage domain, the HSI data can be used to analyze and characterize the materials of a work of art. This research explores the possibility of applying transmittance imaging spectroscopy to analyze cinematographic and photographic film materials to assess its potential and limitations [1-3].

This study used an adapted version of the hyperspectral imaging scanner made in IFAC-CNR laboratories. The hyperspectral system has a mechanical component that allows the movement of films, while a projector uniformly illuminates a diffusing screen in contact with the film materials. The system operates in the range 400-900 nm, with a step of 1.2 nm, and has a spatial resolution of 37 microns (i.e., 27 points per millimeter - 700 PPI) [3].

The processing of HSI is usually based on multivariate techniques, and when analyzing cinematographic and photographic films, a decomposition of transmittance data into a collection of constituent spectra could be particularly convenient since transmittance measurements often blend the absorption of the chromogenic film's three dyes (Cyan, Magenta, and Yellow) [4]. Here, we present an analysis of the different strategies applied to decompose the transmittance data and to match and validate the results.

In this work, we have tested the hyperspectral system on different cinematographic and photographic film negatives. Results and outcomes have been evaluated in order to assess the applicability of hyperspectral imaging techniques to film materials and to evaluate the most appropriate multivariate technique to identify film dyes.

**Keywords:** hyperspectral imaging; photography; cinema; motion picture film; film dyes.

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***Colour change tools to assess the preservation state of motion picture films***

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Motion picture films with support in cellulose triacetate (after 1948) and cellulose nitrate (before the fifties) are extremely vulnerable today. Their degradation is mainly attained to the depolymerization of cellulose polymers, leading to the emission of gaseous acidic compounds i.e., acetic acid and nitric or nitrous acid, respectively. In chemistry, the acid-base properties, including the strength of acidity and basicity, of any compound (whether it is in liquid, solid, or gaseous state) can be friendly and readily detected using pH indicators. Among these indicators, the most employed is litmus paper, which changes colour following a known chromatic scale in accordance with the pH level. In literature, there are various attempts to use tailored litmus papers for detecting acidic emission from depolymerizing motion picture films. In the case of acetic acid emitted by cellulose acetate motion picture films subjected to Vinegar Syndrome, the Acid Detection (AD) Strips<sup>®</sup> produced by the Image Permanence Institute (IPI) at the Rochester Institute of Technology (RIT), Danchek AD Strips<sup>®</sup> and Danchek Control Eye<sup>®</sup> manufactured by Dancan Cine Film Service S.L., and Gastec Detector Tubes<sup>®</sup> from Gastec Corporation are the most widely used. These tools are well known to the community of professionals in cinematographic archives. Conversely, less known are the efforts to develop similar tools (e.g., paper strips imbued with cresol red or cresol purple) for the early detection of Honey Syndrome affecting cellulose nitrate motion picture films. Since the degradation of both acetate and nitrate films is influenced by thermo-hygrometric conditions, in the past traditional colour-changing tools were used to qualitatively investigate the level of relative humidity in the storage environment (e.g., humidity-indicator cards manufactured by SCS - Static Control Solutions). This approach is certainly not accurate and *ad hoc* instruments must be used.

Assessing the state of preservation of a motion picture film based on the simple colour change of an indicator can be user-friendly, cost-effective, and employable on large scale. Attempts in the literature to objectify the mere subjective interpretation of the colour change have also been addressed and discussed by the authors of this contribution.

**Keywords:** cellulose acetate film; cellulose nitrate film; colour change; early warning tool; archive management



## ***Color and original soundtrack restoration of experimental films by Italian artist Roberto Lucca Taroni***

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This paper presents the restoration work carried out on several experimental color films by Italian artist Roberto Lucca Taroni, all of which were originally shot on small gauge films in the 1970s and presented serious color fading issues. The artist boasts an extensive body of experimental film production [1], often delving into Expanded Cinema, emphasizing the cinematic experience as a total event by pushing the boundaries of the medium through innovative use of screening, sound, and space. Taroni's work includes films shot in 8 mm, Super8, and 16 mm, along with numerous audio sources recorded on various sound formats, mostly magnetic. Some of these works were originally conceived as multimedia art installations, comprising both films and external sound elements, the latter of which were generally controlled live by the artist or by a tape-loop system. This posed a major challenge during the restoration process, as some of these works needed to be adapted into a single-channel version suitable for screening. Other materials also saw the re-activation of the original installations after their digital restoration by exploring the usage of modern technologies such as Virtual Reality (VR) in recreating the original environment. The films materials were previously digitized by the Camera Ottica Lab of the University of Udine in 2022, when the first author of this paper was part of the intervention team. Due to the significant color fading issues and deterioration, the digitized film materials required an extensive color correction intervention to reestablish their original color palette. The color correction intervention was also carried out based on the indications provided by the artist, who participated in the restoration process by supervising the operational decisions. The original soundtracks, which were digitized by the Centro di Sonologia Computazionale (CSC) of the University of Padua [2] from ¼" open-reel tapes and audiocassettes, underwent a considerable digital restoration intervention as well, due to the numerous audio signal issues, such as a significant amount of noise, harmonic saturations, signal dropouts, and generally poor-quality audio. In this contribution, the materials by Taroni are investigated by means of concerns and techniques employed for the restoration of both soundtrack elements and film materials, underlining the choices made during the color correction and the digital audio restoration in revitalizing the original artworks.

**Keywords:** color correction; film preservation; audio restoration; experimental film; art installations

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## ***The Role of Subjectivity in Color Film Restoration***

Lucia Becatti<sup>1</sup>, Enea Ahmedhodzic<sup>1</sup>, Beatrice Sarti<sup>1</sup>, Alessandro Rizzi<sup>1</sup>

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Color film restoration is a complex process that requires multidisciplinary knowledge aimed at bringing back old films to their original appearance through film digitization and color correction. The reconstruction of the original appearance would become easier if it were possible to gather more comprehensive information. This includes details about the film itself (i.e. storage circumstances, severity of dye fading or tone shading, etc.) as well as shooting details (such as lighting, camera settings, filters, etc.). Moreover, during the digitization process, the transition from analog to digital introduces additional complexities. Factors like scanner settings, characteristic curves, standards, gamuts, devices, and dynamic range become crucial, each playing a role in affecting color accuracy. Due to that, an “infinite” gamut of colors can be possible, so with limited clues about the original appearance, the operators restore the film based on historical research, their experience, and subjectivity. The decisions made during the restoration process are indeed often influenced by the personal preferences and biases of the restorers, even being experts in the field.

This study investigates the subjectivity in film restoration during the color grading phase. We selected the film *Slike iz života udarnika* (1972) directed by Bato Čengić, recently restored under the supervision of its original director of photography Karpo Aćimović Godina and presented in 2023 at the 80th Venice International Film Festival.

To test how color grading is performed, we gave a digitized color original negative film and the positive reference copy to several professional restorers, and we asked them to produce a restored color copy. The results demonstrate and quantify the extent of variance among the versions produced by the different professionals. We report the measure of the comparison among each other and with the officially restored version. This analysis confirms how the colorist's choices affect the final color correction.

**Keywords:** Color grading; Color correction; Film restoration; Chromogenic films; Color films

## ***Style Transfer in Advanced Film Digitization and Rendering Workflows***

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The present paper introduces *Multi-sourced Aesthetic Transfer* (MAT), a crucial feature in advanced film digitization and rendering workflows. It is essential when integrating various film elements—whether negatives or positives—and matching their differing material characteristics to produce an aesthetically coherent result.

Multispectral film scanning enhances film digitization by measuring the transmittance values of the film across each spectral band within the selected set. This technique ensures either the accurate reproduction of color values, ideal for well-preserved projection prints, or the enhancement of color information, which is particularly useful for negatives or films that have faded.

Camera negatives contain the primary information of filmmaking, retaining the full dynamic range of captured scenes and preserving superior sharpness. Additionally, since they have never run through a projector, negatives are typically more complete and not worn down. Positives, on the other hand, provide a better color reference since they incorporate adjustments made during color correction for aesthetic or narrative reasons. However, if the film has faded, prior dye unfading would be necessary. In such scenarios, MAT becomes invaluable, combining the structural features of the negative with the color palette of the positive.

The relationship between negatives and positives is just one application of MAT. This tool is also applicable to other film element sets, such as black-and-white color separations used in two-color and three-color processes, most famously in Technicolor dye-transfer. These processes often use arbitrary and idiosyncratic color components for printing and produce image textures distinct from the graininess of the black-and-white separations.

The proper integration of different film elements has to transmit all available color and spatial characteristics captured through multispectral scanning and processing. This enables the recreation of a film's appearance as it would be seen in a cinema using analog projection technologies, ensuring that the digital renderings retain the visual integrity and historical authenticity of the original screenings.

**Keywords:** Film scanning; Multispectral imaging; Style transfer; Movie aesthetic coherence

***Training the eye, an exploration of hand-coloured daguerreotypes and their examination***

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The daguerreotype was the first commercial photographic technique in the world. Objects made by the daguerreotype technique are negative and positive simultaneously. Made on a metal plate with a silver surface polished to a mirror finish, they are amazing and unique pieces with a rich history. But, since their very beginning, they were berated for lacking colour. Attempts to add colour thus ensued and many experiments were performed. Manuals were written and patents were registered, however, as often happened within the photographic field, little documentation of the precise practices was recorded.

This research focuses on the instructions for documenting the negative and positive views as well as the value of visual inspection when examining daguerreotypes. Furthermore, a concise guide to inspecting the surface of daguerreotypes will be provided based on the knowledge obtained by examining daguerreotypes in the Museum Ludwig in Cologne when it comes to the identification of traces from colouring techniques. Furthermore, a reconstruction of historical hand-coloured techniques will be presented. The guide indicates how to spot hand-colouring techniques, as fading or tarnishing can obscure the recognition of additions of colours and some tell-tale signs of the different materials and techniques with the help of visual aids.

**Keywords:** hand-coloured, daguerreotype, identification, techniques, visual examination.

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***Insensitive to red. The hand-colored daguerreotype and its sociopolitical value in the Río de la Plata.***

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From the moment of its invention it was criticized that the daguerreotype did not register the natural colors, comparing it with an engraving or a drawing because of its monochromatic image. The lack of color was the beginning of the coexistence of pictorial and photographic materiality in the same object thanks to the hand-coloring of the daguerreotype. In some cases, only the blush of the cheeks was highlighted with pink and in others the image was completely hand-colored. The color was part of a significant aspect that could not be represented in a monochromatic image and, therefore, was carefully added. In this research we propose to analyze the practice of coloring daguerreotypes during the last decade of *Rosismo* (1840-1852) in the Argentine Confederation, where the hand-coloring of daguerreotypes played a very relevant socio-political role.

With the arrival of the daguerreotype in the Río de la Plata, Argentina, the most important families began to visit the photographic studios to have their portraits taken. The photographic portrait was an opportunity to establish social status through the use of the best clothes, jewelry and decorations, and, during the *Rosismo*, it was also necessary to prove one's political affiliation. A decade earlier, a decree had sanctioned the obligatory use of a red badge on clothing, the *divisa federal*, by means of which people demonstrated loyalty to the political cause of federalism. At the same time, these accessories functioned as a control mechanism where their absence meant being against the Rosista regime and, therefore, running the risk of being persecuted for it. For this reason, in the daguerreotypes of the period, we find men and women wearing the federal insignia as well as vests and other accessories hand-colored in red. The red coloring of the *federal* insignia could be considered more important than the gilding of the jewelry.

Nevertheless, the daguerreotype, in addition to offering a monochromatic representation, also had a limited spectral sensitivity. This means that it did not register all colors equally on a gray scale but was more sensitive to certain colors and less sensitive to others. Having a low sensitivity to red, the registration of the *divisa federal* and red clothing on a daguerreotype appears black and is therefore not very visible and difficult for the necessary hand-coloring. For this reason, the photographer had to have knowledge of this issue and recommend his clients the color and type of clothing they should wear in order to be able to correctly colorize them. At the same time, it is important to note the existence of a few examples of white *divisas federales*, which may have been used for this reason in photographic studios. Therefore, the purpose of this research is to analyze how the photographic practice was adapted to the socio-political needs of the time, solving the technical difficulties inherent to its materiality.

**Keywords:** 19<sup>th</sup> Century; hand-colored daguerreotypes; photographic materiality