A Classical Approach to Authentically Restoring Film

Author	*Affiliation*
Julia Wallmüller	Deutsche Kinemathek Berlin

Abstract: I begin this paper by reviewing terms that ground its theoretical discussion. For example, the term 'original' is not only crucial for reproducible works like film, but it begs the question of whether an original exists or whether restored versions merely refer to some ideal. To get a handle on this dilemma, I introduce two relevant case studies, followed by a discussion of the nature of film in terms of its material and immaterial components. I then describe how each film's aesthetic values engender ethical principles for its restoration, and why these prove relevant for and adaptable to film restoration. My focus on the principle of preserving a film's authenticity shows that aesthetic considerations drive many decisions during the restoration process. The last section focuses on the question of how digital techniques contribute to the task of authentically restoring film. This essay's points are meant to be valid for both analogue and digital film restoration.

I. MOVING IMAGE RESTORATION—TERMS AND DEFINITIONS

In their daily work for film heritage institutions, film restorers regularly refer to *restoration*, *conservation*, *duplication*, and *preservation*. Not only archivists, but the general public tends to mix up these and related terms. I thus begin by defining relevant terms in order to provide a basis for further discussion. Following this review, which includes several personal interpretations offered as suggestions, I provide a general description of the technical

process of digitising film. Consider that the term *moving image* denotes images presented sequentially, but such images can originate as film, video or digitally-produced films. A moving image can be motion picture film or found footage; just a fragment or an experimental, moving-image sequence. In order to avoid a merely abstract discussion, my focus here is film—a sequence of photographic images printed on a plastic carrier that is meant for projection. Nonetheless, I encourage readers to apply my case studies and claims to other sorts of moving images, as far as possible.

During restoration, conservators identify and restore the film's numerous irregularities, whose problems warrant particular treatments.[1] The term *damage* concerns physical and chemical conditions that have occurred during the particular film's lifespan. One might find traces of age, decay, as well as material use or misuse like scratches, tears, fingerprints, or stains. Additionally, conservators distinguish between damage and *change*, the latter referring to a film's chemical condition. Change describes any appearance, resulting from material decay, like shrinking and colour loss, which typically comes from poor storage conditions or inadequate processing during production. *Error* refers to some modification of the film's content that doesn't belong to its original content and has arisen subsequently. These include errors made during the copying process like visible framelines, flickering, and unsteadiness, as well as mistakes such as inverted shots, made during the editing process.

Restoration is an intervention in the visual, acoustical, or material part of a film. It should reduce or remove damage/changes and errors, while defects inherent in the work at the time of production are preserved as part of its individual characteristics. A *defect* is either damage or an error that visually and/or acoustically causes perceptible film effects, but since they date back to its original production, they are considered part of its original characteristics. Furthermore, defects can be any imperfection stemming from the moving image's original production, for example, a problem arising from that era's technical limits. Existing since the film's origination, defects are regarded as integral parts of the original work. During restoration, a work must not suffer any new damages or errors, and its original nature cannot be changed or distorted. Theoretically, any technique that upholds this principle is regarded as appropriate within a restoration project.

Restoration projects are sometimes combined with reconstruction, which aims to bring back the film's original narrative structure by re-establishing the original edit. Reconstruction can also be described as editorial restoration that aims at a specific version of the moving image under discussion.

Conservation includes any activity that prevents or minimises the decay of archived moving image material, such as optimising the storage environment in order to slow down chemical decay. The primary goal of what's generally called passive conservation is to preserve film's two components, the original object and its original content. Duplication produces facsimiles, or exact copies of the film for preservation or distribution purposes. The most accurate

duplication procedures subtract the traces of time and use from the material under treatment without necessarily bringing the copied picture back to its original condition.[2] This can be achieved by applying wetgate printing to optically erase scratches from the image to be transferred to a new carrier.[3]

By contrast, preservation is the totality of activities that guarantee the survival of film heritage and its accessibility for further generations. It typically includes some combination of restoration, reconstruction, conservation, and duplication of moving images, and involves either the recreation or emulation of obsolete technical processes and equipment, presentation environments, and research to support these activities.[4]

The digitisation of film converts the photographic image into a digital image.[5] During this process, a fundamental change occurs: a photographic image is formed by converting an irregular, chaotic accumulation of silver grains or colour dyes into a regular pixel grid by quantising and sampling. The most important technical parameters in film digitisation are the resolution (the ability to display detail) and the bit depth (representing the number of displayable grey or colour values). Each pixel is capable of displaying one value of grey or colour. In order to preserve the original image's nuances in colour values, the digitised image's resolution must not be lower than the estimated resolution of the film to be scanned, otherwise there will be a loss of detail.

II.   TWO CASE STUDIES: SELECTING THE 'ORIGINAL' SOURCE FOR RESTORATION

Like paintings, sculptures, buildings, and gardens in need of restoration, it can be difficult for conservators to gauge a work's original material conditions, especially after decades of ageing. As we shall soon see, film introduces an additional dilemma for restorers who must also select some version to serve as a source. The relation between the original and the copy for reproducible arts like film has been discussed ever since 1936, when Walter Benjamin published an essay to address this.[6] He argues that the very notion of an original's *authenticity* is incompatible with that of its reproducibility. According to his view, the *aura*, the mark of a work's authenticity, signals a work's credibility as an original, and not a copy. Benjamin claims that reproduction causes the loss of a work's *aura*. Still, he admits that reproducibility, which is part of what it means to be a film, is derived from both its production mode and the fact that it is distributable, since it is meant to be presented to a broad audience. Ergo, films are not singular works of art that are merely reproduced like copies. Their function depends on reproducibility (during production), since they are created to be distributed. In other words, reproducibility is a feature of film's authenticity (apart from special art films, which are not meant to be reproduced).

Film production itself involves several duplication processes. The camera-original negative is a negative image that gets copied onto positive film stock, which converts it into a positive image. In order to preserve the 'camera original', one typically makes projection prints from duplications or immediate material, not from the 'camera original'. Regular film productions generate at least two intermediate elements: a duplication/intermediate positive and a duplication/intermediate negative, which typically serves as source material for the reproduction of projection prints.

Since these multiple production copies are considered essential parts of a film's production history, one might wonder which is the 'true' original? The 'camera original', which is either negative film or positive reversal film, is certainly the most original element with the highest possible image quality in terms of sharpness, resolution, and detail. Problem is, only a few people involved in the film's production have ever seen it. The first print to be projected could be considered the original, since it is usually the first version an audience sees. As far as image quality goes, a print cannot be compared to a 'camera original'.[7] In the many cases where only one print of a film has survived, it is treated as the 'camera original'.

Which version should the film restorer select as his/her restoration source? If the camera original is available, it is usually the first choice. If it hasn't been preserved, the restorer has to look for another version of some earlier generation, which should be as close to the 'camera original' as possible. Having worked on various restoration projects, especially those involving digitisation, I've learned that original elements don't necessarily provide the best source material. Let's explore two relevant case studies.

The 1994 German documentary *Balagan* by Andres Veiel was originally shot on Super 16mm film, and enlarged for distribution to 35mm.[8] In 2016, Veiel digitised the film in cooperation with Deutsche Kinemathek. The film-maker had originally selected rather light-sensitive raw film, because long parts of the film were to be shot indoors in dark rooms. Such film typically produces quite coarse-grained images, resulting in visibly grainy prints. Thanks to generation loss, the graininess actually became less disturbing with every duplication process, so the 35mm prints looked fine. Our test scan of the original Super 16mm negative revealed the differences between the source and later copy. The scanned negative was grainy and its single colours composing colour images were visibly disturbing. It looked as if the film had a layer of coloured noise that distracted the spectator's eye from the actual image content. A test scan of the 35mm blow-up duplication positive showed much better results. The grain structure was much more even and there was only a marginal loss in detail. Our not selecting *Balagan*'s original negative as the source for digitisation engendered a result that both the film director and restorer appreciated.

In addition to image quality, the film's physical and chemical condition influences which version will serve as the source material for restoration. For

example, restoring Paul Leni's 1924 silent film *Waxworks* required reconstructing the film from different prints. The most original preserved version is a tinted and toned nitrate print from 1926, held by the BFI National Archive.[9] Ordinarily, it would have served as the restoration source, but it turned out to show heavy signs of decay in almost all toned scenes. The BFI also has a duplication negative that was produced in 1979 from the nitrate print. When this one was made, the decomposition of the nitrate print's toned images was still in its very early state, so the duplication negative shows almost no sign of decay. Although this negative is of slightly poorer image quality than the print, its loss of detail is hardly noticeable, so it served as a very good substitute for all parts of the film where the nitrate print could not be used because of heavy decay.

Figure 1: *Waxworks* chemical decay.

Our having to choose between an original nitrate print and its negative duplicated a half-century later reflected the original's mechanical and chemical condition, whose decayed status would no doubt alter the film's appearance in a disturbing way. We thus opted for a slight loss in photographic quality rather than stubbornly relying on the more original.

As a film restorer, it is not always obvious which of the surviving versions should be restored, let alone serve as the source. Of course, selecting the appropriate source is an individual choice, yet restorers must recognise the responsibility that goes along with such decisions. Choosing a source element should ideally be the result of an intensive research process that includes critical discussion with colleagues and professionals.[10] After restoration, the restorer must make a detailed account of which materials were restored and why, which accompanies the work's presentation. The restorer must clarify which specific element or version of the film was restored. This is often done by posting explanatory panels or restoration credits at the beginning or end of the restored film.

In addition to the difficulty of selecting source elements for restoration, there can be a question about which film version should be restored. During the original production, the film's content may have changed before reaching

its final form. Some changes are due to the usual creative process, while others are forced by extenuating circumstances that could result in a print that doesn't meet the filmmaker's original vision. Today, we are familiar with the release of director's cuts, versions favoured by the directors, yet not originally distributed. The film's fans usually also appreciate these versions, which motivates their availability, though posthumous director's cuts risk to be fakes. The decision to restore a director's cut should be considered carefully, especially when there are only vague hints about how a never-released version ought to differ from its known cut.

Because of different nation's censorship laws, there are often divergent versions, which again opens a wide field of questions that restorers routinely address, but fall outside this essay's boundaries. Whether a specific object or a specific version has to be chosen, film restorers are always confronted with questions concerning the original. And in many cases, there is no satisfying answer.

III.   FILM'S TWO COMPONENTS: IN LIGHT OF ITS CHARACTERISTIC LOOK

Initially, I defined film as 'a sequence of photographic images on a plastic carrier that is meant for projection'. In order to adapt classical restoration concepts such as authenticity, I must develop a more general or less pragmatic definition. In addition to film's material properties as an object or film reel, there is also its immaterial component, the image content. The film image represents both what the film shows (this may be a narrative, documentary, or abstract content) and its actual aesthetic appearance. From now on, I use the term 'work' to refer to a film's *immaterial* aspects.

The work is the visibly and acoustically perceptible part of a film that is readable on both narrative and aesthetic levels. Film's aesthetic value lies in its characteristic look, which is determined by material properties such as grain structure and type of colour system, but also its photographic properties such as contrast, sharpness, luminance, density, and image stability. All of these properties are inherent in the photographic image itself. Moreover, the image is embedded in a gelatine layer on a specific carrier with its own physical characteristics, which also influences how viewers grasp the work. Art historian Cesare Brandi has described this symbiosis of matter and image as the indivisibility of material structure and appearance.[11]

The image carrier (substrate) also influences the image's look. Still, one must realise that the duplication process strips the image from its substrate, which is particular to photographic mediums like film. Each of these separations involves a more or less noticeable change in the look of the image due to the change in stock material. Audiences only ever see the final *work* - the projected image. It is important to keep this fact in mind as we move on to the following discussion about principles in film restoration.

IV. CLASSICAL RESTORATION PRINCIPLES AND THEIR ADAPTABILITY FOR FILM RESTORATION

Conventional criteria in film restoration originated from classical restoration theory. The most important criteria involve the principles of authenticity, reversibility, and transparency. They form the ethical basis that drives restorers' decisions. As a film restorer, I consider the preservation of authenticity to be restoration's primary goal. Therefore, I will elaborate upon this principle more extensively than the other two, which I briefly next describe.

Unfortunately, the principle of transparency is often neglected in practice, due to a lack of time or for other reasons. Transparency implies not only documenting the restoration process, but also discussing and presenting it to others. This is of vital importance, since restoration is a continuous decision-making process and one of the best motivations for making good and well-thought out decisions is to make them public. Documentation of all phases of restoration must include information on the context of restoration (reasons, framework, and goals, as well as institutions and individuals involved), the restoration concept (planned interventions based on critical examination of the film to be restored), and the process of restoration (refers to the adopted concept of restoration and possible changes during intervention, including technical information about all phases of intervention). Documentation should be humanly readable, accessible, and published if possible. Whenever a restored film is presented, the audience must be told which version they are viewing, the source of the film's material and immaterial components, and the restoration's aim.

The second ethical criterion concerns the principle of reversibility. Restoration history shows that professional methods have changed significantly during the last decades. Established practices of one generation of restorers can be and are often considered inappropriate by later generations for either scientific or historical reasons. Such ever-changing standards concerning the way cultural heritage should be treated, have led reversibility to be one of the most important restoration principles. It requires an unrestricted recovery of an object's state prior to intervention, so that a future restoration project on a previously restored work allows access to the original work. What does reversibility mean for film restoration? Generally, film restoration is carried out on a copy of the original material and thus guarantees reversibility, since the source material is not modified and thus remains available for future restoration or other purposes, so long as it is stored under adequate conditions.

These days, reversibility is rightly regarded as an illusion. Certain restoration methods induce changes in the original material that might not be visible at first glance, but which actually affect the source on a chemical or physical level. Washing film material as a preparatory measure for duplication can, for example, have a negative effect on the long-term stability of the material by affecting the film base. Residues of solvents used in wetgate printing or wetgate scanning can have similar effects, leaving the film brittle and at

risk of breaking.[12] Furthermore, any film material in fragile condition passing through machinery is potentially at risk of being torn, scratched, or otherwise physically damaged. In light of these problems, a restoration's reversibility is—at least potentially - not ensured. Film restorers thus follow the principle of retreatability instead.[13] This principle insists on guaranteeing the same range of options and conceptual decisions for future restorations.

V. PRESERVING AUTHENTICITY AND A WORK'S AESTHETIC CHARACTERISTICS IN FILM RESTORATION

The restorer's primary goal is the preservation of authenticity in order to permit access to the original work. The principle of authenticity is inseparable from aesthetic considerations and this section covers how a work's aesthetic value can be restored. Classical restoration theory credits a work's authenticity to its material, structure, traces of production, individual history, function, and context, as well as its historical, art-historical, aesthetic, and artistic meanings. Preserving authenticity over time thus involves preserving both original and new characteristics, like traces of a particular work's individual history, such as signs of age and use. Over time, each work loses some of its original characteristics, while new ones constantly arise. Even so, authenticity is maintained, since each work's individual history is a crucial part of its uniqueness.[14]

As already noted, film restoration aims to eliminate, if not reverse damages and errors resulting from some source's individual history. The restorer thus finds himself/herself faced with a dilemma, since the traditional principle of authenticity typically forbids interventions that erase traces of a work's particular history, yet the principle of restoration requires the removal of such additions. Either way, authenticity must be respected. To escape the dilemma, I distinguish the restoration of the material object, or image carrier (authentic work) from the restoration of the film's immaterial components, such as its image, or characteristic look, and its content (authentic restoration).

Preserving the work's authenticity as an object is not the same as authentically restoring a work in terms of its image, though both are possible and equally important. To start with, let's consider the claims regarding the preservation of the work's authenticity, in other words, the preservation of the authentic work as an object. When one considers classical art history, one realises that the theory of monuments that 19th Century Austrian art historian Alois Riegl developed to characterise authenticity applies to historic buildings, as well as archived film.

Riegl distinguished *age value* as commemorative value.[15] Age value manifests itself in a work's lack of perfection, incompleteness, and decay of form and colour. He believed modern viewers receive aesthetic satisfaction from

monuments' dynamic, degraded states, not their stasis, owing to either preservation or restoration. In this sense, traces of physical use and decay should be preserved, as they apparently enhance a work's aesthetic value. According to his principle of age value, further decay must neither be decelerated nor prevented.

Less radical but related is Riegl's principle of *historical value*, which indicates the importance of traces owing to a monument's historic design, whose aesthetic value reflects its credibility as a witness to an era. Moreover, his principle of historical value forbids the removal of symptoms of decay. Although Riegl discouraged the restoration of original works, he encouraged the treatment of copies. Both of Riegl's principles guide ethical and aesthetic considerations in film restoration. The principle of age value provides important aspects about the appreciation of traces of time, to which I later refer. The principle of historical value can be respected by preserving the source material in its status quo under adequate conditions and performing the intervention of restoration on a copy.

To ensure future generation's access to earlier eras captured on film, today's film heritage institutions must preserve the original authentic film works. Doing so entails carefully archiving source material and regularly intervening to restore copies. It is important to note that even though film restorers work with copies, not originals, they are not free from ethical and aesthetic guidelines, as well as restoration restrictions. The restored film's image, or content, gets handed down as the authentic work to be presented to future audiences. Since copied images represent original works, the same principles for restoring originals apply to copies, leading us to the idea of authentic restorations. In addition to respecting the principle of restoration as defined above, which includes practices that remove or reduce only damage and errors, authentic restoration requires that a film's aesthetic features be preserved.

As discussed above in the fourth section, moving images have an aesthetic value that is based on their material properties, but also on photographic properties. Moreover, the projection itself contributes to its characteristic look. One must thus project the film on a cinema screen to grasp its true look. Like historical monuments, a film's characteristic look is affected by traces of its individual history, due to age, and use or misuse. The spectator's appreciation can be considerably reduced by such traces. In extreme cases, the viewing experience is disturbed such that the work's aesthetic value is in jeopardy. It might even be impossible to follow the film's narrative.

Many film restorers not only appreciate signs of decay, but preserve them to enhance a work's aesthetic value.[16] Their arguments recall Riegl's principle of age value, which attributes aesthetic satisfaction to imperfections and traces of some monument's unique history, as guarantors of its credibility. Like patina, such marks convey time's presence and are sometimes appreciated aesthetically for their inseparability from time. Brandi mostly agrees

with this idea, since for him an artwork's historical significance makes it independent from constantly evolving aesthetic values, caused by changes in taste and fashion.[17] In this sense, restoration that aims to make a work spotless risks the loss of authenticity in favour of modern taste. A 1900 film with some historical traces seems more credible. In fact, we almost expect it to be damaged, scratched, and dirty. However, a work cannot be reduced to its being an historical document. Its aesthetic value and its content must remain perceptible. If conspicuous traces interfere, then the work's readability must be regained in order to re-establish the balance between its original characteristics and its history. The image must not be overpowered by subsequent marks.

This argument recalls Brandi's principle of *lacunae*, whose focus is the way extraneous properties such as holes or chips deleteriously affect a work's aesthetic value, when they take precedence over the work.[18] When retouching painted surfaces dotted with lacunae (gaps), he suggests the *tratteggio* technique as the most suitable retouching strategy. He imagines that observers standing at a short viewing distance can distinguish between original and retouched lacunae, yet when they step back, they experience the original work without the *lacunae*'s distraction.

It is not so easy, however, to adopt Brandi's principles of *lacunae* and *tratteggio* to film restoration, since a viewer doesn't observe each film frame as one does a painting. Thus the film's images and any subsequent changes, like *lacunae*, don't simply disappear with distance. Accessing and appreciating a film requires projecting a sequence of single frames with a speed of 24 frames per second or slower. Thus, if the physical damage only occurs to one single frame, it is only visible for a 24th of a second. Some kinds of damage, however, like scratches appear repeatedly on successive frames. Even for cases where spectators cannot identify the exact nature of the damage, the sense of interruption, which disturbs the viewing experience, remains. How then should we deal with damage or *lacunae* in moving images?

With analogue film restoration, something like *tratteggio* is not only impossible, but it would be impractical to attempt retouching damaged single frames, since a 90-minutes film consists of 130.000 single frames that would require manually retouching one by one. Moreover, the manual retouching of such a vast number of photographic images meant to be projected is virtually impossible and doesn't make any sense. With digital film restoration, however, there are systems that allow semi-automatic intervention on image sequences, as well as the manual retouching of single frames. The retouching of a single damaged frame generally requires interpolating image content from adjacent frames into the area of the *lacuna*, thus creating a new image content to replace the damaged one. Instead of Brandi's approach of making the *lacunae* less visible by adjusting the viewer's observing position, viewers experience the fully retouched *lacunae*.

Although the *tratteggio* principle of making *lacunae* less visible is not suitable for film, it remains a useful principle for understanding authenticity, since aspects of the *lacunae* and *tratteggio* principles are applicable for entire works, though not singular frames. In the end, a film is a series of continuous moving images as seen on a screen, not its singular frames. If one uses the term *lacunae* to refer to the entity of damage in an original film element, *tratteggio* can mean making *lacunae* less visible or reducing their damage so that they don't dominate the final work. This possible approach to authentic restoration leaves some damage as a trace of the individual history of a film, but removes the most disturbing and distracting *lacunae*, which had inhibited viewers from experiencing the work's aesthetic value. Still, not all film restorers support this approach. There is widespread opinion that all signs of age and use—and especially misuse - contribute nothing to the aesthetic value of a film and disturb what we refer to as the original characteristic look.

Whether or not traces of a film's individual history are considered part of its aesthetic value for a particular restoration project, one can imagine the principle of restoration and aesthetic considerations either supporting or contradicting one another. Restorers must make decisions. And most decisions are based on individual judgement and taste. It is therefore crucial that the decision making process be documented and comprehensible to colleagues and the public. In complicated cases, restorers rarely arrive at definitive answers, which isn't necessarily a problem. The essential point is that the restorer asks and discusses those questions and keeps them in mind throughout the whole process. Articulating and documenting all principle methodological decisions is of vital importance. This is especially necessary for restorers making subjective decisions, such as the amount of damage and errors they find acceptable.

VI. WHAT CHANGES WITH DIGITISATION AND DIGITAL RESTORATION?

With analogue film, it is easy to grasp why a moving image's reproducibility is part of its authenticity, which is why separating the image from its carrier engenders changes, such as when nitrate films are copied to safety film stock. Although the carrier contributes to the look of the film's image, the film's characteristic look is primarily derived from its photographic properties. Digitisation also separates the image from its carrier; only this time, the image undergoes fundamental changes, as described above in the second section. So long as the technical parameters (resolution and bit depth) are adequately chosen and a high quality film scanner is used, the digitised version has the potential to preserve the original work's characteristic look.

Digitised films usually run through many of the same post-production processes as newly produced analogue films. When restoring films, many film heritage institutions have to subcontract digitisation to external post-

production companies or other specialised service providers. Being focused on the image, the main steps to be done are editing (in the case of a reconstruction), image restoration, and colour grading. All of these steps have the potential to impact the final product's look. Colour grading or colour correction is the process of altering and adjusting the image's photographic properties in terms of lights, colours or grey values, and contrast.[19]

During post-production, digital techniques offer clear advantages over analogue possibilities. One can digitally-reconstruct a film from different source elements, thus allowing one to edit without losing frames, which has always been a problematic issue during analogue reconstruction.[20] Furthermore, digital image restoration systems offer a variety of tools to be applied on image sequences and single frames. The most common corrections can be summed up as stabilisation of unsteady images, de-flickering of images with flickering changes in light and colour, and retouching visible damage. Each of these steps risks creating digital artefacts, such as unwanted image changes that are just the side-effects of using digital tools, newly created errors, or digital damage. Some artefacts are obvious and easy to detect, while others require very experienced eyes or are noticeable only when watching a still frame, instead of a sequence in motion. Such issues are increasingly accepted, especially when there is a lack of money, time or interest to authentically restore or digitise a film. One might think that such artefacts don't matter, since no one will ever notice them, but they do.

Not only are unwanted artefacts a danger to authentic restoration, but changes that intentionally applied to scanned film can alter a work such that it takes on a look that it didn't have before. Digital colour grading, for example, often seduces people, especially filmmakers present in the process, to 'improve' their original works, eliminating defects that were inherent in the original production. When working with digital techniques that allow seemingly limitless changes to the image, film restorers and film heritage institutions have a duty to limit the restoration process and to defend the original work. When working with outside vendors, they must maintain control over all interventions undertaken. Detailed instructions, good communication, personal observation, and intensive quality control prove indispensable.

As already noted, digital restoration allows for results that could never have been achieved using analogue techniques. Consider the Deutsche Kinemathek's restoration of Ula Stöckl's 1968 Technicolor film *The Cat Has Nine Lives* (original German title: *Neun Leben hat die Katze*). Carried out in 2014, this restoration demonstrates how digital techniques make an authentic restoration possible, as compared to earlier analogue methods. The film was shot in Techniscope and printed by dye transfer in Rome's Italian Technicolor Laboratories.[21] The Technicolor process used for this film is classified as Technicolor No V, for which an Eastmancolor negative was used to produce three colour separations elements (three b/w positives each representing one of the colours red, green and blue). These elements were developed, bleached

and washed to form gelatine reliefs, the colour matrices, that could absorbe the dyes for the three different colours. The dyes were then applied on the matrices and transferred, one by one, onto the projection print. The reliefs exhibited on the print are typical for Technicolor film.

Technicolor images have a very specific look, which reflects the particular Technicolor process that was used to produce the film.[22] The aesthetic characteristics of *The Cat Has Nine Lives* are as follows: There is an overall rather pastel colour impression that creates pale skin tones. Also, less saturated colours appear subdued, while more saturated colours appear intense and stand out besides the rest of the image. Additionally, there are the typical Technicolor red, yellow and green tones; especially the natural green tones of plants, trees, and lawns, which have a high amount of red. (See Figure 2, p. 157.)

The camera original negative for *The Cat Has Nine Lives* is preserved at the Deutsche Kinemathek in Berlin. Unfortunately, the three matrices used for the dye transfer process at Technicolor in Rome are lost. In 1996, the film was restored using a vintage Technicolor print from the Munich Film Museum. At that time, it was decided that it would be too problematic to employ analogue restoration methods using the original negative as the source element. The reason is that using the Eastmancolor negative without the original colour matrices would produce a totally different type of colour reproduction than a Technicolor print, and wouldn't evoke the 'Technicolor look'.

Simply copying the negative onto new film stock could never recreate the characteristic look of the film, especially the pastel colour impression and the relation between the less saturated and more saturated colours described above. The better option was to use the vintage Technicolor print as the source material for analogue restoration, although this too had some disadvantages. Regarding the dye transfer, the print wasn't of the best quality. It showed light blotches, irregularities in the single colour layers and lots of coloured stains as a result of the matrices not having been adequately pressed to the print during the dye transfer process. In the analogue restoration, all of these defects, as well as physical damage of the vintage print, were photographically transferred to the new print, including damage and defects that were not part of the camera negative, but of one print that happened to be available at the time. (See Figure 3, p. 158)

Moreover, the 1996 print was not produced using the dye transfer process, but printed regularly onto new Eastman colour material, which has its own specific way of reproducing colours. So the original colour impression could only be approximated.

In 2014, Deutsche Kinemathek decided to digitise and re-restore *The Cat Has Nine Lives*, since it has attained cult status in German film history for being exemplary of female filmmaking. One of the first films to directly explore the life of women in the German Federal Republic, it strangely disappeared

Figure 2: *The Cat Has Nine Lives*

Figure 3: Film still of analogue copy with coloured stains and damage

after its premiere at the 1968 International Film Festival in Mannheim, but was later rediscovered as West Germany's 'first feminist film'.

Since the 2014 restoration project employed digitisation and digital restoration techniques, the camera original negative could be used as the source element. The challenging task was to figure out how to recreate the Technicolor print look using a scanned Eastmancolor negative. The restorers used modern digital grading techniques in a manner that most restoration projects avoid. The Technicolor vintage print from Munich Film Museum, that had been the source for the 1996 analogue restoration, served as a reference for colour grading. The print was used to create a reference file, to which the new colour grading of the digitised camera original negative could be compared scene-by-scene. The possibilities in digital cinema colour grading are extremely versatile. Basic colour correction, which usually affects the entire image and mainly controls RGB colour balance, contrast, general saturation, shadows and highlights, comes closest to analogue colour timing techniques. The photographic properties were adjusted for each and every scene in order to recreate the desired look, which usually happens when scanned negatives or duplication materials are graded.

For *The Cat Has Nine Lives*, however, basic colour correction was just the beginning of the grading process, since the look of the vintage print could not be met by sticking to conventional methods. What led to the desired look was secondary colour correction, which is based on chroma keying, which means selecting and adjusting the isolated colour tones. This allows one to alter the saturation, luminance and hue of single colours: the reds, blues, greens, yellows, magentas and cyans. Secondary colour correction is usually applied only to selected parts of an image, working with masks, while the rest of the image remains unchanged. Of course the restorers were aware of the fact that they were entering an ethically quite problematic space here; Altering the original negative image in a way that would never have been possible

using an analogue duplication process. Nevertheless, there is this important characteristic of the relation of colours to each other in a Technicolor image as described above. More saturated colours have a very strong presence, while the less saturated colours have a rather pastel appearance. This relation of the colours to each other could only be achieved by means of chroma keying and lead to the colour impression of the projected vintage print, recreating the characteristic look of Ula Stöckl's film.

a. *Result of basic grading*

b. *Result of final grading after secondary colour correction*

Figure 4

In the case of *The Cat Has Nine Lives*, only digital techniques could have facilitated this film's authentic restoration. However, it should be noted that a new, digital version was created. Most important, the film's original characteristic look is restored, making it accessible aesthetically for contemporary and future audiences.

VII. CONCLUSION

The most important ethical principles for both analogue and digital film restoration are transparency, reversibility (or repeatability), and authenticity. One respects a film's authenticity by preserving its characteristic look and its aesthetic features, as well as its original film elements. Digital techniques can be seen as handy tools for improving upon analogue restoration techniques. Applied appropriately, they enrich restorers' abilities and help them to preserve authenticity. Given these new tools' seemingly endless range of possibilities, however, ethical principles and aesthetic considerations play an even more important role for film restorers and archivists. They provide essential guidelines and help them to make decisions that directly impact how film heritage is experienced for future generations.

wallmueller@gmx.net

NOTES

1. Definitions reviewed here come from Canosa 2001, 1094-1097; Farinelli and Mazzanti 2001, 1171-1172; and Mazzanti 2001, 17-18.

2. Cherchi Usai 2001, 1037-1038.

3. For wetgate printing, the printing machine is equipped with a gate filled with a solvent that has the same refraction index as film. The scratched material passes through that gate while being printed and the solvent fills the scratches, preventing a differing refraction of light, so scratches are not optically reproduced in the new copy. In film digitisation, one achieves the same results by equipping film scanners with wetgates.

4. Edmondson 2004, 20, Article 3.2.6.3. See also: Cherchi Usai 2001, 1037.

5. This essay addresses digitisation, which produces single digital frames (like dpx or tiff files), not processes that result in video files, since they are not relevant to this discussion. They may be suitable for a quick, but low-quality access to film material, but not within restoration.

6. Benjamin 1992, 214-217.

7. Every time film material is copied onto a new carrier, there is a slight loss of definition, sharpness, and detail in the photographic image. If the duplication process is done well, this difference is barely noticeable, but in many cases the difference between a camera negative and a later generation is very obvious. *Generation* refers to one duplication process, so later generations mean more duplication processes have been carried out to make new prints. Generation loss is the loss of photographic quality due to duplication.

8. Super 16mm is a small gauge format with an aspect ratio of 1:1,66, which is 25% larger than that of regular 16mm, since it uses the space typically reserved for the sound track. A Super 16mm camera negative is usually 'blown up' to 35mm during post production, which means that the photographic image is enlarged to fit 35mm film by optical printing.

9. Nitrate film has a base containing cellulose nitrate, a highly inflammable material used until 1950.

10. Research is one of the basic points of the *Venice Charter*: 'The restoration in any case must be preceded and followed by an archaeological and historical study of the monument'. Venice International Council on Monuments and Sites 1964, chapter 9.

11. Brandi 2005, 231.

12. Read and Meyer 2000, 134.

13. As suggested by Paul Read and Mark-Paul Meyer in Read and Meyer 2000, 71. The German term *Wiederbehandelbarkeit* (retreatability) refers to a fine arts approach

proposed by Odermatt 2003, 127.

14. Janis 2005, 137.
15. Riegl 1996, 72-78.
16. Meyer 1996, 13.
17. Brandi 2005, 233.
18. Brandi 2005, 341.
19. Colour correction or colour timing is also part of a regular film's production. In analogue production, this is done when the negative is copied. The printing machine can light each scene to achieve the desired light and colour values. In addition to printer lights, the film's look can be influenced by the choice of film stock, the use of filters, and the processing methods.

20. Whenever one splices film, one or two frames have to be sacrificed, since a physical splice needs overlapping film flaps to cement the film.
21. Techniscope, also known as 2-perf, is a 35mm format introduced by Technicolor in Italy in 1960 with an aspect ratio of 1:2,32. The film is shot with normal (not anamorphic) lenses, resulting in negative images with a height of only 2 perforation holes.
22. A good website for studying Technicolor and many other colour processes is the *Timeline of Historical Film Colors* developed and hosted by Barbara Flückiger: http://zauberklang.ch/filmcolors/

REFERENCES

Benjamin, Walter. 1992. "The Work of Art in the Age of Mechanical Reproduction." In *Illuminations*. London: Fontana Press.

Brandi, Cesare. 2005. *Theory of restoration*. Rome: Nardini Editore.

Canosa, Michele. 2001. "Per una teoria del restauro cinematografico." In *Storia del cinema mondiale*, edited by Gian Piero Brunetta, Volume Vol. V, Teorie, strumenti, memorie, 1069–1118. Torino: Giulio Einaudi editore s.p.a.

Cherchi Usai, Paolo. 2001. "La cineteca di Babele." In *Storia del cinema mondiale*, edited by Gian Piero Brunetta, Volume Vol. V, Teorie, strumenti, memorie, 965–1067. Torino: Giulio Einaudi editore s.p.a.

Edmondson, Ray. 2004. *Audiovisual Archiving: Philosophy and Principles*. Paris: United Nations Educational, Scientific and Cultural Organization.

Farinelli, Gian Luca, and Nicola Mazzanti. 2001. "Il restauro: metodo e tecnica." In *Storia del cinema mondiale*, edited by Gian Piero Brunetta, Volume Vol. V, Teorie, strumenti, memorie, 1119–1174. Torino: Giulio Einaudi editore s.p.a.

Janis, Katrin. 2005. *Restaurierungsethik*. Munich: Martin Meidenbauer Verlagsbuchhandlung.

Mazzanti, Nicola. 2001. "Footnotes (For a glossary of film restoration)." In *Restauro, conservazione e distruzione dei film*, edited by Luisa Comencini and Matteo Pavesi, 23–31. Milan: Editrice Il Castoro.

Meyer, Mark-Paul. 1996. "Work in Progress: Ethics of Film Restoration and New Technologies." In *The Use of New Technologies Applied to Film Restoration: Technical and Ethical Problems*, edited by Gamma Group, 13–19. Bologna: Gamma.

Odermatt, Wendelin. 2003. "Reversibilität: eine nachhaltige Strategie, Beispiele restauratorischer Umsetzung." In *Nachhaltigkeit und Denkmalpflege, Beiträge zu einer Kultur der Umsicht*, edited by Marion Wohlleben and Hans-Rudolf Meier. Zurich: ETH-Zürich.

Read, Paul, and Mark-Paul Meyer. 2000. *Restoration of Motion Picture Film.* Oxford: Butterworth-Heinemann.

Riegl, Alois. 1996. "The modern cult of monuments." In *Historical and Philosophical Issues in the Conservation of Cultural Heritage*, edited by Nicholas Stanley Price, Mansfield Kirbey Talley, and Alessandra Melucco Vaccaro, 72–78. Los Angeles: The Getty Conservation Institute.

Venice International Council on Monuments and Sites. 1964. ICOMOS Venice Charta. `https://www.icomos.org/charters/venice_e.pdf`.