A Dyeing Art:
Research and Documentation as Means of Authenticity in Applied Colour Restoration

Professional Masters Thesis

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Abstract:

Uricchio has observed an issue in film restoration and subsequent study where ‘the loop between interpretation and text’ becomes invisible. In a similar fashion Fossati elaborates this point in practical terms stating ‘preservation and restoration…act directly on the film material artefact, (re)shaping the way it will be available to archivists, scholars and users in the future’. At some point the materials used for the restoration are placed back in storage and the new restoration materials become the visible film text. The issue here, which Uricchio refers to as ‘serious conceptual dangers’, is that the historical difference between the original film text and the subsequent restoration work is lost. An audience watch the restoration of a film with little understanding of why it may look the way it looks and how this most likely is very different to how the film may once have looked. Original examples of applied colour are very difficult to accurately duplicate. This has presented a problem for the film archive field wishing to present authentic representations of these colours in film restoration work. In response to this problem the film restoration field has developed numerous alternative techniques to provide means of simulating applied colour. These have included new approaches with the use of standard chromogenic stocks, a return to original historic techniques and more recently new developments in the use of digital technology. With so many options for the restoration of applied colour now available, although the problem of accurate duplication is always present it can be argued the issue has shifted somewhat. Now the problem has become more about how the field not only creates authentic representations of applied colour but also justifies the approach taken. This thesis focusses on the problem of accurate applied colour restoration as a means to explore issues of authenticity in restoration work in general. Using Fossati’s theoretical framework for archive practice it proposes that research and documentation can act as a means to convey authenticity.
1. **Introduction**

‘I didn’t touch the original because there is no original’ - Giorgio Moroder

The above quote is by Giorgio Moroder, the famous music producer and now also infamous film restorer responding to negative comments from the film archive field regarding his work on the 1984 re-issue of *Metropolis* (dir. Fritz Lang, 1927). At the time Borde described the ‘original’ *Metropolis* as having been ‘massacred’ in Moroder’s ‘disfigured’ version which he stated, defined the ‘meaning of abusive restorations.’ Moroder’s abridged re-issue with contemporary pop soundtrack by artists such as Freddie Mercury and Bonnie Tyler certainly disregards many of the original qualities of the film. Indeed it is not hard to see how Borde saw this version as unsympathetic, even disrespectful to the ‘original’ which already has a score by Gottfried Huppertz. Yet does placing the restoration in the context of Moroder’s statement that ‘there is no original’ change its reading? It can be argued that Moroder’s statement is not only provocative but to some degree also quite pertinent.

Speaking on the relationship between an original and its restoration Gunning states ‘we must always remain aware of the gap that separates [the past] from us’ and calls the re-creation of the ‘original’ an ‘impossible ideal’. Although we can recreate many aspects of the original film such as the ‘correct’ musical accompaniment Gunning reminds us that the audience watching the film will ultimately be very different to that of the 1920s. Also of course, the process of degradation and finally restoration creates a physical film object that will always be at least slightly different in look to any ‘original’ appearance. This is not to say one should not strive for an ‘authentic’ representation of the ‘original’ as promoted by Borde. Similarly though one should not take the opposite extreme and see any attempt as an entirely futile endeavour which justifies intrusive interventions. The point here is that one approach to the restoration of *Metropolis* is not necessarily more authentic than the other. Indeed both approaches are equally dangerous if they present themselves as the ‘original’ without creating what Gunning calls a ‘dialogue’ between past and present which acknowledges the difference between the two points in time. An aspect of this ‘dialogue’ could be read as the need for

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2 Raymond Borde, “Film Restoration: Ethical Problems,” *Archives* 1, no. September / October (1986): 90

an audience to understand the difference between the past original as it may have once been and the current restoration as it can only exist. As mentioned, Gunning states that there must be recognition for multiple types of restoration work. He gives the specific example of the value in modern musical scores for silent films which he argues create a dialogue by preserving ‘our sense of distance’ between past and present.⁴ In this respect Gunning allows for a reading of Moroder’s *Metropolis* as a means of self-documentation. The now dated music acts as a demarcation that the restoration is of its time and not the ‘impossible ideal’ of the ‘original’ film as seen in the 1920s. In a more conceptual reading the use of modern music could also be read as an attempt to convey the original excitement experienced by audiences watching the images of science fiction in the 1920s whilst still simultaneously allowing this distancing effect. A similar idea was conveyed by Serge Bromberg for the justification of the use of music by the French pop group Air for the recent restoration of *Voyage Dans le Lune* (dir. Georges Méliès, 1902).⁵

Moroder’s quote and its subsequent reading via Gunning identify some key issues which this thesis wishes to explore. The key problem is the role of authenticity in film restoration work and this is important in two particular ways. The first is the definition of the original and the possibility of different interpretations of authentic original qualities. The second is the process of restoration itself and how the authenticity of these original qualities is carried, translated and ultimately maintained in the new copy via this ‘dialogue’ which Gunning identifies a need for.

Gunning’s argument for the need of a ‘dialogue’ between past and present is framed in what Uricchio refers to as ‘serious conceptual dangers’ where ‘the loop between interpretation and text’ becomes invisible.⁶ In a similar fashion Fossati elaborates this point in practical terms stating ‘preservation and restoration...act directly on the film material artefact, (re)shaping the way it will be available to archivists, scholars and users in the future’.⁷ At some point the materials used for the restoration are placed back in storage and the new restoration materials become the visible film text. The restoration and the work done on it will become the canonical text and the interpretation and interventions which took place during the restoration process risk becoming invisible. It can be argued that one means of overcoming these conceptual dangers would be to improve the means of documentation on restoration projects. This is not only the internal documentation which archives

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⁴ Ibid, 79.
⁷ Giovanna Fossati, *From Grain to Pixel: The Archival Life of Film in Transition* (Amsterdam: Amsterdam University Press, 2009),107.
use to create detailed records of interventions in a restoration but also the development of means to convey this documentation to audiences. Coherent, standardised and detailed means of creating documentation is a well acknowledged issue in moving image archive practice referenced by both Wallmüller, ⁸ and Fossati ⁹ though it often focusses on means of internal practice such as Koerber’s detailed documentation of Menschen am Sonntag (dir. Robert Siodmak, 1930). ¹⁰ Without documentation of what has occurred in the restoration process it can be argued the term ‘authenticity’ becomes meaningless as it is impossible for others to understand how the restoration is different to the original. Although this issue of documentation is not tackled directly within this thesis it is an on-going issue which underpins the main argument of the thesis in that the justification for decisions in a restoration can be seen as the process of justification for choices can be seen as twofold. The first is the means to justify the process itself which is directly tied to the concept of authenticity. The second is how the choices made in the first are explained, for example to the audience of the final work, so that the differences and limitations are understood. This second part can be defined as an aspect of documentation. Although the two are somewhat entwined in that the means of justification relies on documentation to be conveyed there is only room to adequately cover the means of justification of authenticity within the space of this thesis. The role of documentation must not be forgotten but in the context of this thesis acts more as an on-going issue which needs further research and is elaborated on in the conclusion.

Applied colour is very difficult to accurately duplicate which in turn has made it very difficult to preserve and restore. This thesis focusses on this specific issue of applied colour restoration as a means to explore the issues of Urrichio’s ‘conceptual dangers’ but also attempts to develop solutions which are relevant to film restoration practice as a whole by addressing some of the problems of authenticity as stated above. The definition, technical application, use, and general history of applied colour have been written about extensively elsewhere. ¹¹ Saying this, an extremely brief outline before developing the problem and hypothesis of the thesis will hopefully provide a somewhat useful context for the rest of the paper. Applied colour is the term used to describe

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⁹ Giovanna Fossati, From Grain to Pixel: The Archival Life of Film in Transition, 91.
numerous techniques in which colour is added to a photographic image after the moment of capture and processing. The colour is literally applied to the image in an arbitrary fashion with no reference to the colour information from the moment of exposure. Stemming from use in still photography and forms of pre-cinema such as magic lantern slides, applied colour in motion picture film was particularly popular during the silent era where four main techniques were utilised. These were hand-painting, stencilling, tinting and toning. As with glass magic lantern slides, in the first technique of hand painting, aniline dyes were literally hand-painted on to the film frames using a brush. The second technique was stencilling which developed from hand-painting but allowed some form of mechanisation as the stencils could be used multiple times. The third technique is known as tinting and involved the absorption of dyes into the gelatine layer of the film creating a uniformly coloured image. The fourth and final technique known as toning used chemical compounds to replace or alter the original silver which forms the image in black-and-white photography.

As already stated, original examples of applied colour are very difficult to accurately duplicate. This has presented a problem for the film archive field wishing to present authentic representations of these colours in film restoration work. In response to this problem the film restoration field has developed numerous alternative techniques to provide means of simulating applied colour. These have included new approaches with the use of standard chromogenic stocks, a return to original historic techniques and more recently new developments in the use of digital technology. With so many options for the restoration of applied colour now available, although the problem of accurate duplication is always present it can be argued the issue has shifted somewhat. Now the problem has become more about how the field not only creates authentic representations of applied colour but also justifies the choices made.

As will be elaborated, it is generally accepted that the least accurate means of duplicating applied colour is to create a photochemical copy on modern chromogenic colour film stock. This is interesting in that Fossati has argued that historically photochemical duplication has been recognised by the archival field as the most authentic means of duplication. Applied colour sits in a paradox where the perceived traditional means of authentic duplication creates the least accurate representation and what can be argued to be more accurate techniques of simulation would traditionally be deemed to be the least ‘authentic’. Fossati argues that the traditional archival approach to the film object and the definition of the film original is limiting and has proposed a new theoretical framework for application in film archive practice based around multiple approaches to the film object and the definition of the original. Via Fossati’s theoretical frameworks and

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12 Giovanna Fossati, From Grain to Pixel: The Archival Life of Film in Transition (Amsterdam: Amsterdam University Press, 2009), 103-122.
subsequent concept of human mediation this thesis proposes that research and documentation can themselves be carriers of authenticity. The role of research may seem like an obvious task in any restoration; this thesis proposes that by working within Fossati’s frameworks the role of research allows for the justification of not only the particular technique but also as intended by the framework, the approach to the film object and subsequent ethical standpoint as originally elaborated by Fossati.

In terms of methodology, this notion of research as mean of authenticity is developed in the case study of the recent restoration of Die Nibelungen (dir. Fritz Lang, 1924). It is then developed further with regard to a more specific focus on the use of applied colour stability research on other photographic processes. This is done by taking an archaeological approach and comparing a specific case study on stability research of Cyanotypes by Mike Ware with existing research on iron bluetoning in motion picture film.

2. Justification and context of Fossati’s theoretical framework

Following several high profile film restorations in the early 1980s, it has been argued a debate emerged regarding ethical principles in film archive practice. In the context of motion picture film, ‘restoration’ had often referred to a notion closer to reconstruction of a complete narrative, but now began to be used to refer to attempts at reconstituting and repairing the image itself. Fossati claims ‘emphasis on restoring the pristine photographic quality of archival films started to be consciously addressed.’ With this change the emergent debate sought to define the ethical principles for how far one could go in the restoration process whilst still maintaining ‘authenticity’ of the ‘original’ film. As already mentioned there was also interest in so-called ‘non-archival restorations’ such as Moroder’s abridged re-issue of Metropolis (1927) with pop soundtrack. Indeed it has been said Patalas’ reconstruction of Metropolis was a response which took a ‘took a stand against’ Moroder’s version. The debate was also conveyed in numerous publications from both academics and archivists which Fossati has argued aspired to utilising existing fine art restoration theory. This can be seen in the adoption of Brandi’s principles of ‘documentation’ and ‘reversibility’ as means of

14 Giovanna Fossati, From Grain to Pixel: The Archival Life of Film in Transition (Amsterdam: Amsterdam University Press, 2009), 25.
16 Fossati, From Grain to Pixel: The Archival Life of Film in Transition, 106.
respecting the importance of the ‘original’ 17 which have broadly come to be represented within FIAF’s ‘Code of Ethics’.

Concepts such as documentation and reversibility are useful to the field of moving image preservation particularly in the definition of ethical principles. Despite this, Fossati argues that although ethics are essential in defining the limitations of intervention, placed within the context of the ‘original’ as assimilated from fine art restoration theory, ‘the “Code of Ethics” is not necessarily what film archivists need at this point’. 18 Fossati elaborates this point by analysing a section of the code which reads that archives ‘will not seek to change or distort the nature of the original material or the intentions of its creators.’ 19

Fossati argues this definition of ‘original’ is limiting when placed within the context of the moving image. Unlike with a painting or sculpture where there is generally no doubt what constitutes not only the original object but also the original artist, with film, multiple ‘originals’ can be defined.

Firstly, the ‘original material’ may physically survive in a single form be it a sole surviving print or the original camera negative. In this context the ‘original object’ may be simple to define but often multiple physical originals survive often constituting one particular version of a film text. For example in the silent era numerous camera negatives were shot simultaneously for different language markets. The same film may exist with slightly different takes or completely different actors or endings. Alternatively a surviving print may be one of many original regional variations with unique applied colour schemes or intertitles or there could be numerous surviving original prints all with slight historical variations. Secondly, ‘the intentions’ of the film’s ‘creators’ also needs to be qualified. A film’s creators can be defined in multiple ways, not only by the artistic intentions of the filmmakers but also the interventions of producers who paid for the films creation and may have enforced changes during production. In this context a film may exist in multiple versions based upon the intentions of different creators. A ‘Director’s cut’ may be seen as the ‘authentic’ original version of the film as intended by the creator. Simultaneously though it must also be recognised that the original theatrical release version which may have had changes forced upon it by the film studio is also an authentic historical document which deserves preservation even though it may not have been the ‘intentions of its creators’. This second definition based upon intentions is also important in defining a notion of the film text as not only physical but also conceptual. A film text such as a ‘Director’s cut’ may never have physically existed being defined solely by documentation. An example of this is Orson Welles renowned memo to the film studio pleading for the preservation of

17 Ibid, 91.
18 Ibid, 106.
his original vision for *A Touch of Evil* (dir Orson Welles, 1958) which was later used as reference for the reconstruction of his version. Essentially Fossati argues for the recognition of multiple possible definitions of an original and that this idea of an original can even exist as a conceptual object rather than a need to physically exist in this single object. It is also important to emphasise here is that the role of ethics which have informed decision in choices when seen in the light of multiple possible originals changes. As Fossati states, the ethical approach dependent upon a single original object as in fine art is ‘inevitably challenged’.

Key to this idea of the simultaneous existence of multiple originals is the role of duplication. It is duplication which allows for the creation of multiple prints with their historical differences in the first place but also the physical creation of versions which had only previously existed conceptually. The ‘directors cut’ of *Touch of Evil* now physically exists by being duplicated and built up from multiple physical original sources. Again, it has to emphasised that unlike with a painting or sculpture a moving image restoration is not carried out upon the archival elements but on new copies as ‘the original artefacts will be too fragile to be projected’. Yet, the role of duplication is not something invented for the purpose of moving image preservation as a means to protect the fragile originals; it is a fundamental, even ontological quality of motion picture film. Many source elements in an archive will be negatives, objects designed to be duplicated. The recognition of this creation of new copies via the essential process of duplication as an ontological function of the medium is fundamental to the difference between classical forms of fine art restoration and moving image restoration and in particular the role of authenticity.

In his essay ‘*The Work of Art in the Age of Mechanical Reproduction*’ Walter Benjamin argued that this ontological quality of duplication allowing for identical copies leads to the loss of authenticity. Groys and Fossati have countered Benjamin’s argument showing that copies become originals gaining their own authenticity via their individual histories. Paradoxically though this argument of authenticity still presents a problem. The multiple objects may all gain their own authenticity - indeed it is important to note that the original object(s) in a film archive are still of great importance - but as mentioned above they still need to be duplicated to be restored and presented. It is this process, the translation from authentic original objects to new copies which has caused conflict in

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20 Fossati, From Grain to Pixel: The Archival Life of Film in Transition, 107.
21 Ibid, 71.
23 Ibid, 118-119.
the argument of authenticity. The question of how authenticity of the new copy can be verified and carried over from the original source objects still remains.

With this essential role of duplication and its influence on ‘authenticity’ in mind, Read & Meyer state that when copying a film, respect must be given to the original format, ‘in particular 35mm and 16mm cinematographic’ films. Therefore there is an assumption not only of the authenticity of the physical original but that this authenticity is carried over via the utilisation of the original process too; in this context photochemical duplication. The authenticity of the original object has been entwined with the authenticity of the original process which has come about via this disjunction between a single original object and the possibility of multiple originals defined by the ontological quality of duplication. Essentially Fossati argues that in many respects fine art restoration theory has been misappropriated for film restoration which as Tybjerg also observes, ‘provides an imperfect analogue’. In contrast to the view of the original process being essential to authenticity Fossati argues that ‘maintaining the original film’s look is more important than remaining true to the original format’ proposing the need for a new theoretical approach based upon the concept of multiple frameworks. These frameworks allow for the use of multiple means of restoration best suited to the qualities of a particular film. This does not mean to say that the above approach based upon the object and the original (read photochemical) process is ‘incorrect’, but to recognise that it does not suit every need and is only one of many possible approaches all of which can be authentic to the ‘original’. An example of this is the preservation and restoration of applied colour processes popular in silent cinema which often lose most of their original qualities when ‘simply’ photochemically duplicated.

3. **Fossati’s Theory of Archive Practice**

Fossati’s theory is made up of two ‘conceptual tools’. The first is a means to connect both theory and practice by aligning them with two opposing theoretical and practical ontological approaches to the film object. The first theoretical definition of film is the indexical (or the ‘realist’ approach); film

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24 Read and Meyer, *Restoration of Motion Picture Film*, 1.
26 Fossati, *From Grain to Pixel: The Archival Life of Film in Transition*, 71.
ontology as ‘realism’. Within archive practice this aligns with a focus on film as a physical object. Fossati defines the ‘physical/realist’ approach via theorists such as Barthes, Bazin, Cavell, Sontag and Wollen. This idea of ‘reality’ is not about the concept of ‘truthful representation’ but the one-to-one reaction of light capturing and exposing a physical impression of what is in front of the lens onto the film emulsion. This is tied to the concept of indices; each point on the frame is ‘indexical’ to what existed during the process of exposure. In the classical reading of the realist/indexical ontology the process distinguishes photochemical duplication from other forms such as digital. It is this ‘indexical’ nature of the photochemical process which carries authenticity. 29

The second theoretical approach defines film by its existence in motion or performance (the ‘mind/film’ approach); within archive practice this aligns with a definition of the film artefact as conceptual. Fossati defines the conceptual mind/film approach via theorists such as Baudry, Carroll, Deleuze, Metz and Munsterburg who saw the ontology of film as being defined by its effect on the spectator. This ‘mind/film’ approach is concerned with film not as an object but as an ephemeral experience based upon the idea of both memory and the unique time-based quality of moving images. The film only exists for that moment in time when it is projected, not when seen as static individual frames on a winding bench. The ‘mind/film’ approach defines cinema’s essence as being performance based where the relationship is between film and viewer rather than film and object. 30

The second set of tools is four frameworks which further define particular approaches to the film text based upon important aspects or features. All these frameworks are informed by the approach taken toward the films ontology/artefact as outlined above and more than one framework can be used at once. The first framework is Film as Original which is based upon the concept of the importance of the original artefact. The second framework is Film as Art which focuses on the artefact as a work defined by the intentions of the creator. The third framework is Film as Dispositif which focuses on presentation environments. The fourth and final framework is Film as State of the Art which focuses on the creation and appropriation of new often niche means to show, preserve or restore film. Certain frameworks appear to suite particular approaches. For example the ‘film as original’ framework as already outlined in the introduction can be argued to often lead toward the ‘realistic’ photochemical approach as ‘it offers very strong arguments for stressing the importance of the original film artefact’ 31 as a tangible physical entity. In contrast the ‘dispositif’ framework may be seen to have a natural bias towards ‘mind/film’ and the role of performance and presentation. When combined with the other frameworks though it can be shown how a supposed bias can also

31 Ibid, 117.
be countered. For example within the ‘film as art’ framework the approach might be dictated to by the intentions of the artist. A restoration with a focus on both ‘film as original’ and ‘film as art’ may take the position that using a very different process to the original physical objects may convey the artist’s original intentions better rather than continuing to use the original process which may now be obsolete or unsatisfactory for use in its current form. In this example to meet the demands of ‘film as original’ a ‘mind/film’ approach would be necessary.32

4. The Historical Perception of Applied Colour

In light of Fossati’s proposed theoretical tools applied colour provides a rich topic for exploration, particularly within the framework of ‘film as original’. This in part is due to what could be argued to be termed the ‘duality’ of applied colour where it simultaneously overlays Fossati’s two ‘opposing poles’ of the physical ‘realistic’ approach and the conceptual ‘mind/film’ approach.

In terms of its physical quality applied colour may be the closest cinema ever gets to the concept of a single physical original as every print is unique from the point of creation. Direct comparisons between applied colour, painting and the original object have even been made.33 Yet it is not as simple as this. Fossati states, ‘in a painting the colours actually are the image while with a coloured nitrate print the photographic image is both conceptually and physically distinct from the colours applied upon it.’34 This is where the duality of applied colour emerges. The colours are at once part of the physical object but simultaneously removed from the photographic system. In this sense the colour becomes almost like a performative aspect, accompanying the images like music combining with projection to formulate the complete experience of the film ‘performance’. One of the connotations of a performance can be an idea of something which is ephemeral and temporary, it exists for a unique moment in time but is hard to capture. In this respect applied colour can be described as being ephemeral. This ephemeral nature is particularly emphasised by the difficulty to accurately capture and duplicate applied colour. As Cherchi Usai states ‘colour in the moving image is the most unstable component of an inherently ephemeral medium; anything we can say about it comes from a contradictory mediation between memory and present visual experience.’35 It can be argued that Fossati’s theoretical approach to film archive practice helps to deal with this nature of applied colour by contributing better means to accurately define these qualities and tie them to particular approaches to the film object.

35 Cherchi Usai, Silent Cinema: An Introduction, 39.
Historically this duality of applied colour has been less clearly defined and caused conflict where the original quality has been recognised as important but the ephemeral nature has not been acknowledged and dealt with. This conflict can be seen in the confusion with regard to authenticity that applied colour has historically caused. During the debate of the 1980s, applied colour came to be recognised as an intrinsic ‘original’ quality important for preservation, but this had not always been the case. In what Borde refers to as ‘the wild days of preservation’ 36 applied colour was often lost. Original colour nitrate prints were preserved in black-and-white and this was something which only slowly changed from the 1960s to the 1980s. 37 The possible reasons for this are numerous such as the extra expense in duplicating to colour but also the later emergent knowledge of the instability and therefore futility of preserving on early examples of Eastman color stock. 38 Yet there is also an underlying possibility that the colour was simply regarded by many archives as not being of value. Hertogs argues that:

‘Although [colour preservation] is a new problem, the original nitrate was always there. The older generations of archivists sorted through coloured nitrate films for black-and-white preservations, and I don’t believe this was just a case of money. My problem is that while preserving nitrate coloured film in black-and-white, they never stressed the fact that the original material was coloured.’ 39

Hertogs believes that some archives actively dismissed the colour record. Both Fossati 40 and Read 41 have highlighted that historically scientists and technicians often disregarded applied colour. They saw applied colour as inferior to so called emergent and experimental ‘natural colour’ processes. These processes were seen as superior in that the colour was a record of what had been in front of the lens. In this respect ‘natural colour’ can retroactively be said to have been perceived as having a direct connection to the indexical and therefore a level of authenticity. Culturally this perception of applied colour as inferior to the authentic record of natural colour processes may have continued to take hold on a larger scale. Indeed Borde gives examples of the general public’s misconception of the role of applied colour in the presentations of restorations in the 1980s. One example is a review of Rohauer’s restoration of Intolerance in Le Monde which sought to recreate the original applied colour scheme only for it to be described as inauthentic and ‘sick making’. 42 In some respects this

36 Borde, “Film Restoration: Ethical Problems.”, 98.
37 Read and Meyer, Restoration of Motion Picture Film, 287.
40 Giovanna Fossati, “When Cinema was Coloured,” in Tutti i colori del mondo [All the Colours of the World], ed. (Gamma-Group) (Bologna: Diabasis, 1998), 127-128.
42 Borde, “Film Restoration: Ethical Problems.”, 95.
can be seen as an inversion of Uricchio’s conceptual dangers in that the audience rather than accepting the modern film text without question rejects it instead. Either way it is a prime example of the difficulty in conveying to audiences the dialogue between past and present. Indeed it can be seen as a failure not of the audience but the restorer in not adequately explaining the role of applied colour in the restoration where arguably audience should have learnt the context and goal of the restoration of the original applied colour as part of the presentation.

With this assumed public perception of applied colour as inferior in mind, although applied colour came to be valued as an important quality in need of preservation, this still initially often meant the continued use of photochemical duplication. Writing at the time, Borde shows there was still an assumption of authenticity based upon the ‘realistic’ approach of photochemical duplication stating ‘today, the golden rule is to print silent movies on colour film respecting scrupulously the original colouring’,\(^{43}\) [emphasis added]. Borde gives no acknowledgment to the difficulties of accurate duplication though this assumption may also be due to the lack of research on the topic at the time. For example, Borde’s article makes other assumptions about applied colour that later research has shown to be much more complex. He states ‘the whole of the silent era worked with a colour code: blue for night scenes shot in full daylight, red for dramatic intensity’\(^{44}\) which is now known not to be as simple as Borde states. Since the 1980s on-going interest in applied colour has led to much better knowledge of its use. Cherchi Usai states ‘the utility of this approach [codified meaning] to colour is undeniable but that alone is not adequate to explain the enormous variety of options that were available to filmmakers and their audiences.’\(^{45}\) Colour had complex and varying uses from implied codified representations of reality to more complex narrative purposes. It could also act as a means of luxury and expense, an early form of rights management and as a means of pleasure in itself, the simple joy of colour. As this knowledge shows, with the development of interest in applied colour there has been an informed discussion on its role within silent film\(^ {46}\) which has also included prominent international conferences.\(^ {47}\) These publications and events have not only continued an on-going dialogue between academics and archivists on applied colour use and meaning but practical methods of restoration leading to the development and presentation of new applied

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\(^{43}\) Ibid., 95

\(^{44}\) Ibid, 95.

\(^{45}\) Cherchi Usai, Silent Cinema: An Introduction, 26-27.


\(^{47}\) ‘Disorderly Order: Colours in Silent Film’ taking place at the 1995 Filmmuseum workshop in Amsterdam and ‘Colour and the Moving Image: History, Theory, Aesthetics, Archive’ held in Bristol, UK in July 2009.
colour restoration techniques better suited to the process than standard photochemical duplication still generally accepted as best practice in the 1980s.

5. **Applied Colour Restoration Techniques**

In 1995 the Nederlands Filmmuseum’s primary technique in applied colour duplication was still photochemical, but this appears to have mainly been dictated by financial limitation. In a presentation at the 1995 workshop applied colour duplication problems not mentioned by Borde are acknowledged and explored. It is noted how ‘warmer’ magenta and pink dyes do not register without increasing exposure levels which cannot be done ‘without distorting the overall spectrum.’ It is also noted how the inaccurate reproduction often leads to tints appearing as ‘tones’. In the 1990s photochemical duplication was still utilised but its limitations were openly acknowledged and discussed and lead to the adoption of other better suited techniques.

Some attempts at new techniques to preserve applied colour were ahead of their time. In 1976 at the Royal Belgian Film Archive Jacques Ledoux asked Noel Desmet to develop a stable means to preserve applied colour. Influenced by colour separations which record colour information in black-and-white the method developed has come to be referred to as ‘Desmet’ or Desmetcolor. The process involves creating a black-and-white preservation negative which is then used in the creation of the colour positive using the ‘flashing’ of coloured light. Read & Meyer claim the technique was used at the Royal Belgian archive in the 1970s but Desmet himself has said it was not until the mid-1980s that Ledoux was satisfied with the results. A long development time may indicate why the process was not more widely known of and adopted until the 1990s. In 1995 Desmet also presented the technique at the Amsterdam workshop where it was stated it had begun to be adopted by other archives. Fossati refers to Desmet as ‘not only the best photochemical procedure to restore original tinted and toned films but [it] is also the closest simulation of the original chemical procedures of tinting and toning black-and-white films.’

Another technique is to recreate the original chemical processes of tinting and toning for modern use. Again, like the Desmet method it is known the technique was experimented with as far back as the late 1970s to early 1980s by Harold Brown at the BFI and Vladimir Opela at the National Film Archive in Prague. Read believes it may have also been experimented with by archives much earlier than these examples. The method gained prominence in the 1990s in restoration work by Paul Read

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49 Hertogs and de Klerk, *Disorderly Order: Colours in Silent Film (The 1995 Amsterdam Workshop)*, 74.
50 Read and Meyer, *Restoration of Motion Picture Film*, 288.
51 Hertogs and de Klerk, *Disorderly Order: Colours in Silent Film (The 1995 Amsterdam Workshop)*, 23.
52 Fossati, *From Grain to Pixel: The Archival Life of Film in Transition*, 90.
and Bob Mabberly at Soho Images London and João de Oliveira at the British Film Institute.\textsuperscript{53} Compared to the Desmet method and standard chromogenic duplication the technique has been utilised in very few restorations. In 2009 Paul Read conjectured possible reasons for this scarcity of use were due to the time and expense needed.\textsuperscript{54} Despite this concern though, in the same year that Read laments the passing of the process Daniela Currò and Ulrich Rüdel began to present their current research restoring applied colour which includes the use of historical techniques. In recent years there appears to have been a re-emergence of the technique. UCLA’s Stanford Theatre Film Laboratory have been working on using it on their own collection and Oliveira is now using the technique at his own PresTech lab having recently completed a restoration of \textit{Die Niebelungen}.

A final technique is the digital intermediate (DI) method where a film is scanned, digitally processed and then ‘recorded’ back to film. The DI process has also been used to appropriate the photochemical Desmet method. Developed at Digital Film Library in Copenhagen the process has been dubbed ‘digital desmet’. A black-and-white duplicate is still used but whereas in chromogenic photochemical colour systems the spectrum is linked (to change one colour requires changing the levels of all colours) digital processing allows for action on discrete sections of the frame. For applied colour restoration Fossati states ‘digital technology offers a system of simulation that can give results that are much closer to the look of the original colours compared to photochemical duplication methods.’\textsuperscript{55}

Until recent developments in DI processes photochemical duplication was still the only means to preserve hand-painted and stencilled films. At the 2010 AMIA conference as part of The Reel Thing Ulrich Rüdel and Daniela Currò gave a presentation on the use of digital intermediate techniques for stencil colour restoration. In this presentation it was interesting to note that the continued importance of chromogenic stock was highlighted as restorations currently still need to be recorded back out to film. Looking at the above processes it can be argued that often applied colour restoration also fits within the framework of ‘Film as State of the Art’ by appropriating historical knowledge and technology into other forms to create means to convey applied colour in restoration work. In a sense the restoration techniques come full circle informing and influencing each other. The DI process appropriates Desmet which appropriates the historic technique. Indeed the DI process needs to use photochemical duplication but Ulrich Rüdel and Daniela Currò still push the boundaries of the technology to best simulate the original look by experimenting with using stocks outside their original intended use. An example is the use of camera negative for projection prints.

\textsuperscript{53} Ibid, 26.
\textsuperscript{54} Ibid.
\textsuperscript{55} Fossati, \textit{From Grain to Pixel: The Archival Life of Film in Transition}, 89.
taking advantage of particular qualities useful in recording particular dyes. In some respect all of the above techniques simulate applied colour. This idea of simulation is an important one which can be argued to be the key to accurate reproduction not possible in the direct ‘realism’ approach of the photochemical alone and will be elaborated on in the next chapter.

6. **Duplication vs. Simulation of Applied Colour**

These techniques present multiple possible routes for applied colour restoration but the question of authenticity still stands. To step away from the role of the photochemical as a means of authenticity it can be argued that all the above forms of restoration technique in fact offer a means of simulation. It may seem obvious that these processes are means of simulation but imaging techniques can be used to convey this with objective means. Primary research which informs this thesis was conducted by the author as part of two internships. The first took place at Haghefilm and the second at the Image Permanence Institute (IPI) in 2010. At Haghefilm Ulrich Rüdel and Daniela Currò have been conducting small applied colour tests. These are simply scaled down recreations of historic formulations for tinting and toning as published by Kodak, Agfa and Pathé in the late 1910s and 20s. The internship work at Haghefilm involved continued research on how much variation in tints and tones could be achieved through variables such as time and the concentration of chemicals in formations. In 2009 IPI produced a poster to help characterise different colour processes, and one of the visual tools was the use of cross-sections of motion picture film.\footnote{“Knowing and Protecting Motion Picture Film Poster”, Image Permanence Institute, accessed May 24th, 2012, https://www.imagepermanenceinstitute.org/imaging/film-poster} These cross-sections can be observed under a microscope and used to objectively compare different colour processes. Whilst at IPI in 2010 a new set of cross-sections were produced from applied colour samples created at Haghefilm and looking at these images helps to convey the role of simulation in all the processes.

Fig 1.1 shows a cross-section of an original nitrate based tint. The orange dye permeates the emulsion within which the silver creating the black-and-white photochemical image is suspended. Fig 1.2 shows a polyester tint using a dye called ‘Orange G’ created at Haghefilm. This tint is also on a black-and-white stock and again it is notable how the dye permeates the emulsion. Despite superficial differences such as the polyester base being thinner than the nitrate, the two samples are very similar. In contrast Fig 1.4 shows a cross-section of a Desmet tint. Although top-down it looks like a black-and-white tinted image the cross-section appears very different. It shows how the image is made up of the chromogenic layers of emulsion and that there are no black-and-white silver salts remaining in the image having been bleached out during the chemical development process. These images show how the diffusion of dye into the gelatine of both original nitrate and modern polyester
bases are essentially the same but also how the chemistry of a chromogenic desmet print is very different to the nitrate original.

As already stated by both Fossati and Read the cross-sections show how the Desmet process is a ‘simulation’ of applied colour. It also shows though how it could be argued any historic colour process - even ‘natural colour’ systems - would also be simulations when created using a technically different photochemical chromogenic process. The boundary between simulation and duplication - and the relationship between authenticity and the ‘indexical’ - becomes blurred. For example would the duplication of a two-colour system on an integral tripack system be classed as simulation? What constitutes authentic indexical duplication? They react point-by-point but is this enough when as shown the chemistry and therefore final look is so different? The point here is an attempt to show the limitations of an assumption of authenticity based upon ‘indexical’ photochemical duplication. Indeed if using an analogue tripack system to duplicate applied colour (or any other non tripack chromogenic process) can be classed as simulation then in what way is digitisation any different or less authentic? It is also important to note that even though historical tinting and toning techniques result in a copy with structurally similar chemistry it is also by its nature not a ‘duplicate’ in the strict sense but simply a very good simulation of the original object. Again, the point is that the use of cross-sections highlights how all means of preserving applied colour rely on a sense of accurate simulation of the original object and that in this context the concept of authenticity by its nature relies on something other than the indexical. As Cherchi Usai observes colour is ‘loosely translated in the duplicates struck by preservation laboratories in to systems radically different from the original techniques.’

Cherchi Usai sees this as a problem which cannot be overcome - see ‘the death of cinema’ where he states duplication transforms film ‘into another entity’ whereas already stated Fossati argues that ‘maintaining the original film’s look is more important than remaining true to the original format’. The most authentic process is not the original but one which is best suited to the job at hand be it Standard Chromogenic duplication, the Desmet process, the recreation of Historic techniques, Digital intermediate, or even a blending of different aspects of each of these techniques. There is still the issue of how this authenticity, if not carried by the indexical will be conveyed though. A new means of carrying authenticity must be conceptualised. According to Fossati one method may be the role of human mediation. In the next chapter this role of human mediation as a means of authenticity will be explored by the specific process of Research.

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57 Cherchi Usai, Silent Cinema: An Introduction, 39.
58 Paolo Cherchi Usai, The Death of Cinema: History, Cultural Memory and the Digital Dark Age (London, UK: British Film Institute, 2001), 89.
59 Fossati, From Grain to Pixel: The Archival Life of Film in Transition, 71.
7. Research as means of Authenticity

Fossati’s theoretical frameworks and specifically the opposing ontological approaches to film are originally defined in the context of the transition from analogue to digital. Despite the ‘classical’ argument of authenticity being carried solely by the indexical qualities of the analogue photochemical process, via theorists such as Punt, Marks and Soderman it is shown there is an ongoing discourse on not only how the indexical is still applicable to digital but more importantly how it may be irrelevant to authenticity.

Punt argues that both photochemical and digital technologies are similar in that they rely on human mediation to verify the creation of images with accurate representations of reality. He states, ‘in the same way that the photo-chemical procedures of the nineteenth and twentieth centuries depended on prior views of reality to inform chemical engineers and lens grinders, so computer programmes emulate a prior view of what that image should look like.’ It is this human mediation which not only creates the technology but more importantly tailors the variables of it - be it a chemical emulsion or software algorithm – to create a human influenced and verified perception of reality. Fossati counters that Punt’s argument although bringing in a new approach to authenticity with human mediation does not overcome what many claim to be a fundamental distinction between the photochemical and digital imaging processes with regard to the actual technology because the act of human mediation in his examples create the technology not the image itself. In the photochemical system there is a ‘transcription’ between reality and representation whereas with digital imaging there is ‘transcoding’ between reality and representation. With photochemical film the emulsion reacts directly with the light and ‘transcribes’ the image before the lens. Indeed this is the classical definition of the indexical. In contrast the light which hits the CCD behind the lens of the digital camera or scanner has to be ‘transcoded’, or interpreted from light to bits and back to light seen as pixels on a user’s visual display unit. Although Punt introduces the concept of human mediation the relationship is between the human and different machines which create representations in different ways. In this respect Punt does not overcome the the barrier of the different technologies and their different means of creating representations.

Fossati argues this disjunction between human, machine and representation can be overcome via Soderman who moves the focus from the object which creates an image representation to the process itself which creates the representation. Soderman states ‘digital images are produced

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61 Fossati, From Grain to Pixel: The Archival Life of Film in Transition, 119-120.
62 Ibid, 120.
under such circumstances that they are physically compelled to correspond point-by-point to a symbolic algorithm." Soderman deliberately references historic definitions of the indexical by taking the stance that digital images are ‘forced’ or ‘compelled’ in to existence by human mediation. In doing so he shifts the importance from the role of technology to the role of ‘human mediation’. That is to say the process of the representation is ‘forced’ by humans. Indeed Fossati goes on to say ‘the fact that the analog photographic film reproduces reality becomes less important than the fact that it is designed and made to do so by someone’. It is this human mediation which Fossati argues can be the ‘carrier of authenticity’ stating:

Restoring a film implies making a copy of an authentic film artifact: the authenticity of the new restored copy depends completely on how this copy is made, and the way the copy is made depends, in turn, on how the restorer instructs the process, whatever the process. Whether it is a photographic, analog duplication or a digitization, in this perspective is irrelevant for the authenticity of the result.

With this quote and the elaboration of argument via Soderman, Fossati moves authenticity from the indexical process to ‘human mediation’ and in this context the actual film restorer(s). The role of ‘human mediation’ can be used to argue for authenticity in the use of a particular applied colour restoration technique because that technique has been chosen by the restorer as the best means to represent – or simulate - the qualities of the original object by the said restorer. The role of the restorer in this context is also conveyed by Fossati who states:

‘the biggest obstacle in color restoration...is usually the lack of reference for restoring the original colors...film restorers often need to guess (this should of course be a well educated guess) what colors are to be restored. The restorer’s work is based on their knowledge of the historical context from which the work to be restored originates, of the technology used to produce it, as well as knowledge of the work itself and of its maker(s). Based on this knowledge, the restorer will finally resort to an interpretation to restore the original look of the work.

In this quote Fossati explains how decisions are informed by knowledge. It may seem obvious but this quote emphasises that a restorer does not automatically acquire ‘authenticity’, the authenticity they provide comes from the knowledge they have which is informed by research and study of film history and technology. This knowledge is then used to mediate conflict and inform decisions. Fossati argues it is ‘human mediation’ which carries authenticity but this can be taken a step further to highlight research itself as the tool to which restorers carry authenticity. Research is not just necessary for future reference but for a direct better understanding of processes and the preservation of material. Research is what is responsible for changing a ‘guess’ into an informed

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64 Fossati, From Grain to Pixel: The Archival Life of Film in Transition, 120.
65 Ibid, 120.
66 Ibid, 91.
decision but going even a step further, it is research which directly informs the ethics and framework of a restoration when placed within Fossati’s theory of archive practice. This point can be conveyed by an analysis of the recent restoration of *Die Nibelungen*.

8. **Case Study: The Restoration of Die Nibelungen**

Fritz Lang’s *Die Nibelungen* - produced in two parts, *Siegfried* and *Kremhild’s Rache* - has recently been restored using historic tinting techniques. This restoration case study is of interest on numerous levels all of which are relevant to the perception of authenticity and applied colour but also the role of research in this argument.

Firstly it can be argued that the restoration history of the film provides an example of the general changing perception of authenticity in film restoration. This is not the debut restoration of the film; thirty years prior *Die Nibelungen* was restored with a focus on narrative length - the inclusion of all surviving content - even though the existence of camera negatives ‘always offered hope of improving the picture quality’ too.\(^{67}\) Utilising these said camera negatives the current restoration has a very different focus to its predecessor and can be placed within the framework of ‘film as original’; in this case the restoration of *Die Nibelungen* to the original German theatrical release. This includes a focus on improved image quality - how the film would have once looked - but also a change in narrative length informed by the focus on this particular version which included the removal of flashback scenes and the inclusion of recently found content which conforms to the original censorship file.\(^{68}\) The first restoration was completed in black-and-white despite the majority of surviving prints being tinted. The new restoration, with its focus on image quality, restores the applied colour but this is also interesting with regard to the approach to film as object versus film as concept within the framework of ‘Film as Original’.

The restoration of *Die Nibelungen* sits within the framework of ‘Film as original’ but it cannot take the traditional route of authenticity via physical object alone. This is because the goal of the restoration is to restore the original theatrical release version, but this version no longer exists as a single physical object. There is no complete surviving original print or camera negative to be used as a reference. Despite this, multiple relevant elements do survive and were discovered in archives throughout Europe. These surviving elements were used to define the genealogy of camera negatives and later many of the elements were also used as duplication sources. In total eighteen archival elements came to light for Part 1 and 2 which were then traced back to seven camera

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\(^{68}\) Ibid, 86.
negatives. Four from Part 1 and three from Part 2, only three of which survive today and all of which are incomplete. Wilkening states, ‘despite the existence of so many original elements, it is not possible to restore the film with takes from the same negative. This means that with the restoration, a new version approaching a German version in improved picture quality will be created,’ [emphasis added].

In light of both the wish to restore the original German release and lack of a single object to do so research played a crucial role in authenticity. This is a restoration which seems to ideally fit the concept of authenticity via human mediation which can be argued to be carried with the research and knowledge of those making decisions. Of the surviving original elements it was unclear which were used in the original German distribution version. Identifying what would have constituted a theatrical German distribution print involved decision from knowledge based upon research of production and distribution practice, all of which informed the formation of a genealogy of materials. This included the study of sources such as production stills and contemporary articles and documents. As already mentioned the study of a censorship record and the original score informed the removal and introduction of content. Also, in a kind of archaeology, the elements themselves were studied. This included not just edge markings but the study of intertitles and outtakes. Dating was even informed via the shape of sprocket holes on original objects (but also as printed through) which changed with the historical shift from positive to negative cutting.

It can be argued that this kind of research work is not new. Research during a restoration seems like an obvious task. This can be countered though due to the creation a new version and how the research directly informs justification for decisions. These decisions also only become obvious once placed within the context of Fossati’s theoretical frameworks. In this restoration the lack of a single object and the approach taken in creating a new version are argued to be authentic via tying its relevance to a link with the film’s own production history. The research allowed for the creation of a genealogy of the surviving elements which in turn allowed for a subsequent analysis of their use. The research showed that four camera negatives were produced for Part 1 and that the effort to produce up to four takes of each shot ‘in almost identical quality render the historical relevance of the “one” camera negative [for use in the domestic market] a doubtful category to some degree.’ The conclusion was that the first three negatives could be assumed to have been of equal importance with the fourth emerging as a result of demand, utilising many dupes from the other

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69 Ibid, 89-95.
70 Ibid, 96.
71 Ibid, 95.
72 Ibid, 87-89.
73 Ibid, 93.
negatives. It is argued that the authenticity of multiplicity is at once part of the essence of what would have been the original object(s). That is to say it is argued that the creation of a new version informed by aspects of all surviving elements is in itself authentic. Hence, this case study is clearly an example of film as original based upon a conceptual rather than physical approach and this was directly informed by the role of human mediation via research. This conceptual approach can also be argued to have justified the choices taken in the restoration of colour.

Wilkening makes clear, ‘almost all prints, originating from different countries and showing differences in editing, titling and length, have one thing in common: they are tinted orange throughout.’ This tinting is physically consistent. Physical evidence for tinting also exists on two of the three surviving original camera negative leaders instructing ‘orange’ as the tinting colour for the subsequent prints. Although the instruction exists on the physical object these are still conceptual in that they inform something rather than show it. Similarly, although the tinting is physically consistent in surviving prints there are slight variations. ‘Kriemhild’s dream’ is often tinted Lavender, some intertitles are left black-and-white, and occasionally there are anomalies such as a surviving print which includes blue and red tinting for night and fire scenes respectively. As is typical of the duality of applied colour its consistency emerges as simultaneously entirely inconsistent. In this context Wilkening attempts to apply a sense of consistency by following ‘the concept of an overall orange tint’. In practice this meant applying a general single form of orange influenced by the others and applying it (and Lavender) wherever it appears to have existed on the original elements. Rather than worrying about a particular kind of orange pertaining to some form of acute physical accuracy a general ‘concept’ of an orange tinting scheme was adopted which fits in line with the general conceptual framework as outlined in the earlier research. It was the use of ‘orange’ as a ‘concept’ which was argued to be important rather than a particular kind of orange.

In practice the restoration produced a black-and-white master negative and from this, black-and-white prints which were then tinted using ‘the original tinting technique’. Wilkening does not elaborate on the decision to use the ‘original tinting technique’ other than the explanation that ‘the photochemical possibilities for a reproduction of a tint’s original characteristics are restricted’. It is not self-evident why the Desmet method was not used. It would have certainly fit with the general ‘conceptual’ approach. When referring to the ‘original characteristics’ of a tint Wilkening is referring to the general look rather than the specific reproduction of particular elements sourced in the restoration and therefore could also be dismissing the use of the Desmet technique too. As already

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74 Ibid, 96.
75 Ibid, 91-92.
76 Ibid, 98.
argued the original characteristics of tinting can be best simulated with the original technique due to the maintaining of the black-and-white chemistry. In the context of the restoration and the simplicity and consistency of the use of colour this technique would have also been much less complex to implement.

In a sense the *Die Nibelungen* restoration case study argues that a conceptual means of applied colour application can be authentic. This conceptual approach to applied colour seems almost symptomatic of applied colour process and its ephemerality. Fossati quotes contemporary technical literature to emphasise that applied colour was always ‘vague’ and continues:

“Maybe the instability of colours is already inscribed in their genesis and we are stumbling over the myth of the original which can be reproduced over and over again while remaining the same. But if that is not the case with preservation today...and was not the case yesterday when the colours were applied – as we see from the technical manuals, there may indeed be some use knowing about the old technologies of applying colour, even if it is doomed to be an incomplete, limited knowledge. We can use it as a theoretical base for the application of a contemporary technology of colour preservation, even though technologies, old and new, produce results that are vague and unstable, and both have to be inscribed in the history of film.”

This observation is interesting in light of modern restoration work attempting to use the historic technique where it is often observed that the application of applied colour can be inconsistent and patchy from print to print.

This issue of accuracy has been noted by modern restoration labs such as UCLA’s Stanford Theatre Film Laboratory and others yet Fossati has highlighted how research shows that inconsistency was a contemporary issue too. If perceived in the correct light the issue of inaccuracy may actually be a very accurate representation of what Wilkening has called a tint’s ‘original characteristics’. In the context of an early tinting procedure Read & Meyer also state ‘the colours were never perfectly consistent because, depending on what level the section of film was on the wooden frame, and depending on the solution concentration and the time of treatment, the colour could be more or less intense.’ Read goes on to references a contemporary recipe from the National Aniline and Chemicals Co. in the USA which gave an indication the solution would last for between 20000 to 40000 feet of film concluding ‘presumably the first racks of film came out more deeply dyed than the last.’

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77 Fossati, “Session 1: Programme Notes.”, 16-17.
78 Discussion during the Q&A of the session Applied Color: Restored, Revived, Revisited, Thursday November 4th 2010 at the Association for Moving Image Archivists Conference held in Philadelphia, PA.
As has already been mentioned the use of applied colour is now known to be complex but similarly it needs to be remembered the silent era lasted from the 1890s into the early 1930s. There was approximately thirty five years of applied colour with its own developing fashions and trends. Although applied colour is certainly unstable and ‘vague’ it has been argued that the publication of manuals by Kodak, Agfa and Pathé was a means to add a form of stability and standardisation to some aspects. In this context it can also be argued that as Fossati states above research on applied colour can also provide a better understanding of its stability despite its ‘vague’ nature. Again at the Amsterdam Workshop in 1995 Mark-Paul Meyer noted that ‘more knowledge of the techniques of the teens and twenties would be a great help in restoring colour’. 

This application of the use of research can be conveyed further by returning to the Die Nibelungen restoration. A print originating from ‘Negative I’ is tinted a ‘pale orange’ and Wilkening notes ‘whether the tint’s character is original or faded is uncertain.’ In the article no comparison between the tinted prints is mentioned. The article also includes an image of the leader from the second negative of part one which clearly reads ‘Orange II. Negativ II.’ Read & Meyer show images of leaders from original nitrate negatives and mention numbers can also indicate positive cutting order. Clearly these numbers could simply indicate this but there is a possibility that the ‘II’ after the ‘Orange’ is actually giving instruction of the particular dye. Orange II or “Orange 2” is listed as an historic dye in Paul Read’s spreadsheet.

The restoration of Die Nibelungen shows that research can be used to authenticate the approaches taken. It can also be argued to show that further research, for example with regard to applied colour stability, could take the justification and evidence and therefore authenticity of decisions even further. Even if this was simply a means to justify the decisions it made on the particular use of colour and why it was not necessary (in this context) to reference a particular colour. In the words of Fossati it could have provided an even more accurate ‘educated guess’.


Applied colour as a field of study has many often repeated statistics which usually appear with little if any reference to evidence or source. Some examples include that 80-90% of all silent film was originally coloured in some form; that the mainstream adoption of synchronised sound technology

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80 Read, “‘Unnatural Colours’: An introduction to colouring techniques in silent era movies.”
81 Hertogs and de Klerk, Disorderly Order: Colours in Silent Film (The 1995 Amsterdam Workshop). 18
83 Read and Meyer, Restoration of Motion Picture Film. Plate 2.2-2.4
84 Read, “‘Unnatural Colours’: An introduction to colouring techniques in silent era movies.” 33
in the late 1920s caused the decline in the use of applied colour and that all uses of applied colour were codified to narrative meaning. This is not to say that any of these claims are incorrect but that they are often much more complex than the statements imply (as already shown with the claim of ‘codified meaning’) and that they are often stated without reference. In 1995 Tom Gunning noted this claim of 85% becoming almost ‘canonical’ and in doing so also questioned the notion that synchronised sound technology single-handedly caused the disappearance of applied colour. Gunning is not claiming they are incorrect, indeed he believes they are in large probably truthful but that more rigorous research is needed. A quick look at the 80-90% claim shows it is stated by Cherchi Usai, Fossati and Read & Meyer without any reference. Where does the claim come from? In the 1980s Borde stated ‘the Cinémathèque de Toulouse holds 700 period copies of silent full-length movies’ and that ‘90% of them are on tinted film.’ In a separate reference from 1991 Cherchi Usai attributes the claim to Richard Koszarski who in turn attributes the claim to a general survey estimate in a contemporary SMPTE journal. These references make it clear just how difficult a study would be, Borde’s claim is made from the analysis of only one collection of hundreds existing in the world’s archives and Koszarski’s from an unclear survey. Mazzanti also makes the point that it is often very difficult to study applied colour due to so little surviving and that when it does it will often be a black-and-white copy. This does not mean attempts at research studies are not possible and not useful though.

This idea of a generality can also be placed within many other aspects and assumptions of film preservation. Students are often told modern prints be they digital, photochemically derived on acetate or polyester based stocks will never compare to the visual brilliance of nitrate with little discussion or explanation as to why. This is particularly unfortunate when there is little chance to make an independent subjective comparison. This is not to say the claim is not true but that objective data should back up such a claim. This line of thought is interesting when comparing the archival film field to fine art restoration field. Read & Meyer write:

‘it will be to the advantage of film restoration itself, and to the benefit of historical research of film, that film restoration becomes the subject of a more scientific approach...Lack of such a scientific approach constitutes the big difference between film restoration today and restoration practice in other arts. For instance, the Mauritshuis in The Hague recently restored two Vermeer paintings. These restorations were not only done in a dialogue with a committee of internationally renowned restorers...”

85 Hertogs and de Klerk, Disorderly Order: Colours in Silent Film (The 1995 Amsterdam Workshop). 41
86 Cherchi Usai, Silent Cinema: An Introduction. 23
87 Hertogs and de Klerk, Disorderly Order: Colours in Silent Film (The 1995 Amsterdam Workshop). 12
88 Read and Meyer, Restoration of Motion Picture Film. 180
89 Borde, “Film Restoration: Ethical Problems.” 95
91 Nicola Mazzanti, “Colours, audiences, and (dis)continuity in the ‘cinema of the second period’,” Film History 21, no. 1 (2009): 68
and art historians, but also with institutes for atomic and molecular physics, with chemical research laboratories and with institutes for X-ray photography. In fact X-ray diffraction analysis, ultraviolet light photographs, beta-radiography etc. are quite common in fine art restoration.

In recent years two proponents of this use of science as research in restoration have been Ulrich Rüdel and Daniela Currò of Haghefilm who have used experimental data to not only inform their restoration work but have then shared it with the community through presentations at international conferences and film festivals. Their presentations have included research on the analysis of toning samples to identify chemicals using X-ray Fluorescence; comparisons of applied colour restoration techniques using densitometry analysis of Laboratory Aim Density (LAD) strips, but also explorations on human perception based on colour, film grain and digital pixels.

Two of their recent presentations have centred upon film restoration projects. The first, a restoration of the Pathécolor production La Dette (Pathé, 1910) allowed Rüdel to elaborate on why photochemical duplication does not accurately replicate the dyes of applied colour due to the underlying black-and-white chemistry. Often shrinkage of nitrate originals means duplicates have to be optically rather than contact printed. The dyes themselves are ‘optically transparent’ so the light source can pass directly through but the silver grains of the black-and-white image causes the ‘collimated light’ from the optical printer to ‘scatter’. This is known as the ‘Callier’ effect. The scattering causes an increase in contrast of the black-and-white image but not the dye ‘suppressing’ their appearance.

The most recent restoration, an excerpt from the lost film Das Rätsel von Bangalor (dir. Paul Leni, 1918) was restored with every technique currently used at Haghefilm but with a strong focus on the use of historic chemical method. This restoration was screened at the 2011 Pordenone Silent Film Festival with all six variations being looped twice in the main auditorium allowing the audience to directly compare the subtle variations of all the different techniques after which a presentation on the work was given. After the presentation Martin Koerber noted the importance of the research but in the context of the original applied colour process and the unclear future for the survival for photochemical stock asked the audience how do we take this work forward. In many respects this was of course a rhetorical question designed not for a simple answer but to encourage thought and discussion. Taking the question forward though at least one aspect to take from the work of Rüdel and Currò is to recognise it as research. The historical technique is not only a restoration tool in its own right but also a research tool that can inform all other techniques. Indeed in terms of control and accuracy both Rüdel and Currò claimed the DI process is probably the most accurate when compared to the original nitrate but all this work including the DI was informed by their research on the original dyes.

This role of the historic technique as a means of research to inform all other applied colour restoration work could be argued to be particularly useful for understanding the stability of applied colour. Meyer notes that during the restoration of *Quo Vadis* (dir. Enrico Guazzoni, 1912) the last reel clearly showed colour decay. The blue tone had begun to turn brown and the pink tone had become yellow. To make more informed decisions and provide confident detailed instructions to the lab he states he ‘really needed more information about how films decay’. Read also mentions ‘most toning is quite difficult to identify after all these years and not enough is known about some original colours to predict the changes that have occurred’. Both Read and Meyer note how a closer study of the ‘stability’ of applied colour processes would be useful in restoration work and as argued via Fossati this research can act as a means to convey authenticity of the decisions taken in a restoration.

There are a number of specific uses from the research on stability of applied colour. As already noted a better knowledge of applied processes can lead to a better understanding of how a film element may have originally looked, a key aspect of film restoration. This benefit is in part two-fold though as it also allows for better understanding of how a colour came to look the way it does now and from this hopefully judge better whether the colour has faded. When Currò and Rüdel showed the results of some of their tinting tests using historic techniques to staff as EYE Film Institute Netherlands they were shocked at how vibrant the results were yet these vibrant colours corresponded to surviving samples published in the historic Agfa handbook. Although the historic technique in itself can be used as a means of research if and when it is used again in the future as a restoration technique stability research would also allow for a prediction on the long term stability of the new elements.

One means of research in to the stability of applied colour could be to take an ‘archaeological’ approach to the processes and the chemicals used. Applied colour must not be seen as an isolated phenomenon unique to motion picture film in the silent period. The applied colour techniques of this era not only have antecedents in still photography and pre-cinema but via the dyes and chemicals used precedents in other natural colour processes within both later still and moving image history. Elsaesser states, with media archaeology, ‘concerns pressing on the present formulate the

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92 Hertogs and de Klerk, *Disorderly Order: Colours in Silent Film (The 1995 Amsterdam Workshop)*, 77.
93 Read and Meyer, *Restoration of Motion Picture Film*, 98-99.
94 Ulrich Rüdel, “COLLEGIUM SESSION ON RESTORING COLOR, LE GIORNATE DEL CINEMA MUTO, PORDENONE, OCTOBER 3-10, 2009”
questions one puts to the past, as a way of coping with the future.' In this sense by following and questioning applied colour’s placement and relationship with other techniques through history one can possibly draw conclusions on the stability of applied colour for use as a research and restoration technique going forwards.

Both Oliveira and Read have noted toning processes used in silent film have their origins in still photography. In 1849 Henry Fox Talbot discovered that hydrogen sulphide could be used to convert black-and-white images to sepia brown. The use of iron salts was first written about by John Herschel in 1842 and became known as the cyanotype process. This is the same chemistry used to create not only blueprints but also iron-blue toning as used in motion picture film. In 1876 Victor Toth also documented the use of Copper Ferrocyanide to create red toned images. Read & Meyer observe that copper toning was recommended in the early editions of the silent film colouring manuals but by the 1922 edition was replaced by uranium toning stating that ‘copper toning seems to leave the emulsion...more pliable to damage.’ At Haghefilm experiments with copper toning also caused issues such as solarisation. This issue of stability is important to note. Read & Meyer have proposed that the manuals, particularly Kodak’s, were a result of wishing to conform and stabilise the use of particular techniques most appropriate for moving image use. The fact that Kodak was still updating the recommended formulations for techniques acknowledges this as a possibility. This in itself can be a useful means of learning about the stability of applied colour processes. It provides knowledge of the possible stability issues of copper toning in motion picture film. If Read & Meyer’s argument is correct though it could also indicate that applied colour produced following the introduction of the technical manuals could show greater stability than earlier techniques which may have simply appropriated formulations from still photography. As the deletion of copper toning highlights techniques in earlier forms do not always directly translate despite their apparent similarity.

This disjunction between other media processes and technologies is also apparent in tinting which Read has claimed is a process unique to silent film. This could be argued as incorrect as even in the 1860s prints often had a blue, pink or yellow tint added to the albumen binding. But these earlier

97 Paul Read and Mark-Paul Meyer, Restoration of Motion Picture Film (Oxford: Butterworth-Heinemann, 2000), 188.

[30]
processes were also before roll-film and used printing-out-paper systems; a key difference between these two kinds of tinting is the role of transparency. With a film tint the light is shone through the film whereas with a paper print it is reflected. Although links can be made, their relationships also have to be questioned. It is doubtful that the dyes or pigments used in albumen prints are the same as those used for motion pictures. This issue of transparency may also be related to the earlier issues of copper toning. Copper toned samples produced at Haghefilm were difficult to differentiate from black-and-white when projected though clearly had changed colour when perceived with reflective light and the unaided eye.

Although processes may sometimes be different it does not mean we cannot concentrate on the ‘inherent’ stability of the chemicals used if they themselves can be identified as being the same as is the case with cyanotypes, blueprints and iron-blue toning. Similar dyes as used in the hand-painting of magic lantern slides but also other early ‘natural’ colour systems such as Autochromes have also been identified as the same as those used in motion picture film. Stability studies have been conducted on these processes and by looking at the inherent stability of them could provide possible benefits to the stability knowledge for the archival moving image field too.

There are two key components to photographic colour stability. The first is when in storage known as 'dark fade' stability. This is mainly dependent on factors such as temperature and humidity but also long-term interaction between the emulsion, base and any other influences such as the reactive metal of a rusty can. The second is 'light fade' stability. This is the colour stability when exposed to a light source.


Read has focused on stability of applied colour processes particularly iron blue tone, making observations on both its light and dark fade stability. Although mentioning both tints and tones are susceptible to fade from projection light, even stating ‘this is the most common cause of fading of coloured films from the silent era,’ 99 he notes that iron-blue tone is particularly susceptible. Read provides two sources of evidence. New samples created in the lab are much more vibrant than surviving elements and many of these nitrate originals exhibit a pattern of colour fading from the centre of the film out indicating irradiation from the projection arc. In terms of dark fade Read also observes that iron-blue toning ‘appears to darken considerably with age’. 100 Read also makes general observations about the process of iron-blue toning and its critical aspects such as the washing

99 Ibid, 98.
100 Ibid, 187.
process. If the tone is not washed enough a yellow staining is left, too much and the tone leaches from the emulsion. Read also notes that blue tone over time can change to the aforementioned yellow brown colour and sometimes eventually pink. What is sometimes perceived as a blue tone on a pink tint could simply be a deteriorated blue tone.101

These observations on iron blue toning by Read can be compared to research published by Ware on the stability of Cyanotypes which share the same basic chemistry. Ware’s research is interesting as similar patterns to Read’s are observed but with detailed scientifically based explanation. Like Read, Ware states the chemistry of Prussian blue is complicated by the fact that its composition depends on its method of preparation as there are varying possible formulations to begin with. In his research Ware uses five different formulations of the toning recipe from the original Herschel formulation to modern custom made forms all of which have different levels of stability to light and dark fade.102 Although as already observed by the use and mis-use of copper toning not all formulations will necessarily work in motion picture film. Indeed it seems just as Kodak adapted copper toning to uranium they also continually developed the stability of their recommended formulation for iron blue toning noting in the 1922 edition of the technical manual that ‘the Iron (blue) formula has been improved. Previous blue toning formulae had a tendency to destroy highlight detail during toning but this objection has been entirely overcome.'103 This indicates Kodak probably tested numerous formulations but does not mean that some of Ware’s formulations could not be adapted and tested for use in motion picture film.

In terms of the science behind the iron blue toning, Ware provides a table of the basic chemical processes (see Fig 2.0). Soluble ferric ferricyanide, also known as Prussian yellow or brown, when dissolved with a light sensitive ‘iron carboxylate’ creates the reaction of ferrous ion with ferricyanide to precipitate the highly insoluble substance Ferric ferrocyanide, also known as Prussian blue, or Berlin blue. This is the blue of the final tone. In the process between the change from Prussian Yellow to Prussian blue, ferrous ferricyanide (Turnbull’s Blue) is produced but this is extremely unstable and instantly turns to Prussian blue. It could be that the yellow brown substance observed by Read is the original compound of Prussian Yellow though Ware makes no reference to the pink colours mentioned by Read. The fading Prussian blue by light is explained by Ware to be a reaction which produces a colourless substance, ferrous ferrocyanide, also known as Prussian white.

101 Ibid, 187.
Ware provides scientifically based observations for stability which are eluded too via original light fade tests on the original Hershel formula. In conducting these light fade tests Ware found that the fade in the toning ‘is not proportional to the concentration of Prussian blue’ noting that the fading ‘reaches a broad maximum in the mid-tones’ and that this ‘may explain the wide disparities between “anecdotal” reports of the fading - or otherwise’. For example an image with high contrast with fewer mid-tones will lead to less fading explaining the apparent random nature of some fading. This quality of non-proportional discolouration also ‘suggests that fading is not an intrinsic property of the substance’. Indeed referenced tests on the inherent stability of pure Prussian blue show that its light fastness is classified as ‘excellent’. With this in mind Ware discovered that ‘the most likely origin of light sensitivity in cyanotypes is the incorporation of impurities deriving from the sensitizer’, what Ware refers to as ‘oxidisable organic anions...[which]...render Prussian blue sensitive to photoreduction’. This was proven by tests with variation of sensitizer but in practical use was also observed via washing length. Samples with a shorter rinse were much more susceptible to light fading.

One means to increase the light fade stability of iron-blue toning is to ensure that as much of the ‘impurities deriving from the sensitizer’ are washed away as possible. Again a difference between iron blue toning and the cyanotype process should be noted. Unlike the gelatine binder of roll film cyanotypes ‘are always matte, because they have no binder layer and thus retain all of the surface qualities of the paper they were produced on.’ It is unclear what kind of affect this has on the washing process of roll film tones suspended in gelatine compared to the paper of cyanotypes. Despite this observation though the issue of washing is dealt with by the Kodak manual which states ‘washing should not be carried out for too long a period, especially with water inclined to be alkaline, because the toned image is soluble in alkali.’ Again Ware provides practical advice, the solubility of Prussian blue to alkali can be somewhat overcome by using pharmacist bought ‘purified water.’ With regard to the creation of new iron-blue tones as a restoration technique steps could be taken to ensure better washing and in general stability.

104 Ibid, 8-9.
105 Ibid, 8.
106 Ibid, 16.
The darkening of iron blue tones previously observed by Read could be the slow reaction of Prussian white back to Prussian blue which occurs in the dark in the presence of oxygen in the air. Ware found that within five cycles of the tests ‘the regain of density in the dark was usually at least...99% within five days or more.’ The fading process, at least with fresh samples is reversible. 110 This process from Prussian white back to blue is slow but can be created rapidly by an oxidising agent such as hydrogen peroxide and the impurities left in the toning process can be progressively destroyed and finally ‘burnt out’ via cycles of fading and regain. This research could possibly give a means to further increase the light fade stability of iron-blue toning when creating new samples.

Like cyanotypes, a link with applied colour can be found in the Autochrome process though this relates to the dyes used in tinting rather than iron metal toning. Bertrand La Vérdrine has identified the dyes used in the natural colour process and two of these, Patent Blue and Tartrazine were historically used in motion picture tinting. Like Ware, Vérdrine also provides data on density loss due to light exposure. Although analysis and comparison of the stability of these colour techniques provides better understanding and context of the chemicals and processes involved, and indeed in terms of Ware’s research on cyanotypes can be argued to provide practical techniques such as the use of purified water when rinsing to reduce colour loss. The role of light fade stability and its practical benefit in the context of motion picture film use has to be questioned. No doubt iron blue toning and the identified Autochrome dyes are susceptible to light fade, but the question remains how this translates in use. Autochrome (which have to be exhibited with a backing light) and cyanotypes are still-photography processes which when exhibited receive extended uninterrupted exposure to light. In contrast a film frame is exposed to extreme heat and light for only a fraction of a second in each screening. Some writers on colour stability are also sceptical of the role of projection light. Henry Wilhelm claims light exposure is so short to be inconsequential to colour fading of film in motion 111 and scientists at IPI have also expressed similar scepticism. 112 In terms of data this is a very complex process which is hard to match in terms numbers and values. At IPI initial calculations made an attempt at converting a modern day xenon bulb of 100,000 lumens to the energy seen in the Autochrome tests of Lavedrine and indicated an approximate exposure of 62 seconds. At 16 fps this is the equivalent of 1000 screenings yet even if this was possible for a print it is unclear to what extent the density loss of the Autochrome dye tests would be perceivable in cinema projection.

112 James Reilly at presentation on colour stability given to Students on the L. Jeffrey Selznick School of Film Preservation programme at George Eastman House in October 2010.
It should be noted that historical documents do mention the role of projection as a cause of fading but they also need to be placed within context. The Kodak manual of 1922 states a property of dyes used for tinting should be that they are ‘fast to light even under the heat of the projector, otherwise local fading will result in patchiness on the screen.’ This does not mean that fading from projection had necessarily been observed or actually tested. As mentioned it has been proposed that the Kodak manuals could have been a result of a wish to conform the formulations used in tinting and toning to those most stable for use in motion picture film. It could be that Kodak’s reasoning was simply based on similar conjecture as above where in the previous twenty five years fading may have been observed and then blamed on projection or similarly light fading was observed in extended exposure in still images and then attributed to motion picture film via the light of projection. Without data it is unknown.

Read’s original reasoning for light fade by projection, referred to as ‘the most common cause of fading of coloured films from the silent era,’ is based on visual comparison alone. A new sample being more vibrant than an original does not account for the loss in density being caused by projection light. Read also attributes the common pattern of localised fading of applied colour seen as a strip down the central area of the film frames as evidence of fade by projector light noting that when inspecting samples it is ‘essential to look at the extreme edges of any frame to see if any less faded or altered toning or dye can be seen’. Again this is not evidence of fading caused by projection. Following this logic one can counter the argument simply by highlighting the samples where the localised fading has occurred down the edges rather than the centre. Read & Meyer themselves even provide plate reproductions of iron-blue toning which has only faded along the left hand side of the frame. This is not to say these faded patterns were not caused by projection light, just that without data it is still an unknown and needs to be questioned, they are possible causes, not facts. For example another hypothesis could be that the common fading of colour down the centre of the film is caused by an interaction between the decomposition of the nitrate film base and the metal particles suspended in the gelatine which make up the image. It can be argued that the fading will commonly occur from the centre as this is where degradation caused by oxidising by-products such as oxalic acid will be most concentrated unable to off gas at the same rate as the

113 Read and Meyer, Restoration of Motion Picture Film, 98.
114 Paul Read, “Tinting and Toning Techniques and Their Adaption for the Restoration of Archive Film,” in Tutti i colori del mondo [All the Colours of the World], ed. (Gamma-Group) (Bologna: Diabasis, 1998), 165-166.
115 Paul Read and Mark-Paul Meyer, Restoration of Motion Picture Film (Oxford: Butterworth-Heinemann, 2000), 186
116 Paul Read and Mark-Paul Meyer, Restoration of Motion Picture Film (Oxford: Butterworth-Heinemann, 2000), Plate 7.e.
edges of the roll near the sprocket holes. Indeed there is a general common pattern of a strip similar to Read & Meyer’s pattern which indicates general nitrate decomposition which is also common in nitrate samples with no applied colour. This is unknown, but just as possible to be true as the projection light hypothesis which is so often stated as a fact.

Going back to IPI’s prediction of 1000 screenings with a 100,000 lumen bulb projector being needed to replicate the data from the Autochrome studies IPI have a xenon unit which can recreate these hypothetical 1000 screenings in 7.9 hours. It must be emphasised though that it would still be difficult to know what this data truly means. Samples of eighteen different tints and tones including Kodak, Agfa and Pathé formulations and more general historical tints were left with IPI after the conclusion of the internship. Marissa Haddock a graduate of RIT’s colour science programme and the George Eastman House L. Jeffrey Selznick School conducted some tests as part of an internship at IPI. In these tests density loss was measured after twenty-four, forty-eight and seventy-two hours of exposure, the approximate equivalent of multiple thousands of screenings. The data certainly showed iron blue toning was most susceptible to light fade with generally good stability in the other metal tones and dyes. Haddock notes:

‘It is difficult to conduct a practical test on light fading that properly simulates theater exhibition. The intervals of light exposure to which the samples were exposed were much longer than any film would endure in its lifetime. However, this study was designed to determine whether a change in density was even measurable, and whether more practical studies should be conducted in the future.’¹¹７

The experiment provides data that the inherent stability of the processes as observed in the earlier equivalent data such as cyanotype is true but how this translates to motion picture film is still open to debate.

**12. Conclusion**

In the introduction it was initially proposed that to overcome the issue of Uricchio’s ‘conceptual dangers’ relied on two steps. The first was the need for a means or tool to justify the decisions taken in restoration work whilst the second was the means to convey this information via documentation so others could understand the decisions taken in the first step.

¹¹７ Personal email 11th January 2012.
With regard to the first step, this thesis has focussed on the formulation of a means to justify the approaches taken in restoration work which carries authenticity without relying on the sometimes limiting notion of a need to maintain the original format. In motion picture restoration this has traditionally been dictated as photochemical duplication. As Fossati argues ‘maintaining the original film’s look is more important than remaining true to the original format’ and in the case of applied colour this is particularly true as the original format by its very nature cannot be duplicated. Indeed as the study of applied colour cross-section samples show it can be argued all forms of applied colour replication rely on a form of simulation.

Using Fossati’s theory of archive practice particularly the notion of human mediation as carrier of authenticity the thesis argues that research specifically can act as a means to carry authenticity. This was initially formulated in the application of Fossati’s theoretical frameworks to a case study of the recent restoration of Die Niebelungen. In doing so it was shown how the research conducted on the genealogy of surviving elements informed knowledge of the production history. Specifically that all surviving camera negative elements could be treated with equal authenticity in the creation of the restoration and choice of source material. This conceptual approach to the creation of a new version of Die Niebelungen was also then shown to be tied to the conceptual approach of applied colour.

The restoration case study of Die Niebelungen showed how research via Fossati’s theoretical frameworks could be used to formulate the justification for decisions taken in the restoration. Further research also showed how it could be useful to conduct specific research on applied colour stability as a means to inform decisions regarding the application of colour. Specifically it was shown that by taking an archeologically approach to applied colour provided a context to question many of the assumptions made of applied colour stability.

Though the research case studies in the thesis specifically focussed on the role of applied colour it is hoped the formulation of the approach on research as a means of authenticity could also be applied generally to restoration work as well.

With regard to the second step and the role of documentation it is proposed this is the next point of development and research needed to overcome Uricchio’s ‘conceptual dangers’. As already stated the issue of documentation has often been mentioned in archive and restoration literature over the last twenty years with no formal solution or answers. It has also often only focussed on internal documentation. The proposed need is not just in terms of internal documentation but specifically external documentation, the means to convey information to viewers of restoration work. In the last
twenty years silent cinema has relatively often been released on various consumer video formats by publishers such as Kino, Masters of Cinema, Flicker Alley, British Film Institute and Edition Filmmuseum. It can be conjectured that with these releases and the greater exposure they allow there is now a generally greater acceptance, even expectation by the audience that many of these releases will feature forms of applied colour. Similarly at silent film festivals, particularly Pordenone many more film restorations are being shown with applied colour. Some higher profile restoration examples from the last two years include *Le Voyage dans la lune* (dir. Georges Méliès, 1902), *J'accuse* (dir. Abel Gance 1919), *The White Shadow* (dir. Graham Cutts, 1923), *The Great White Silence* (dir Herbert Ponting, 1924) and films from the NFSA’s Corrick Collection. In both the examples of home video releases but also festival programme notes there is often very little if any documentation of the processes which informed the applied colour work. In this respect Urrichio’s notion of conceptual dangers are still very present as there is often no means to understand the restoration in the context of the work done.

There are numerous means to convey documentation and they all can influence the experience of watching a restoration, this is why a theoretical framework for documentation might be particularly useful. For example documentation can be placed within the film itself, this can come at the beginning as a set of titles contextualising the work done or as Gunning argued in the introduction through the choice of music or even intertitles. In this sense the documentation can be thought as taken different approaches, is it subtle or overt? Is it part of the text or removed? For example documentation can also be placed in screen notes, festival catalogues, a website, given in a presentation, a DVD extra or even an essay all of which provide different means to provide different type of information., much of which can of course be ignored by the audience if they wish.

Throughout the thesis the relationship between fine art restoration and the moving image archive field has been touched upon. In the first instance this was via Fossati’s identification of the moving image field assimilating approaches to the archival object which were shown to be limiting in some contexts. Later it was shown how the objective, more scientific approach of fine art restoration could provide useful approaches to moving image restoration too. In light of taking documentation in moving image restoration forward it might be fruitful to return to the influences of fine art restoration seen in the introduction. For example the moving image archive field may learn a lot from approaches in media art preservation where issues regarding duplication and simulation covered

in this thesis are often even more overt, such as in the case of performance art where documentation alone may be relied upon to convey and ‘archive’ works.

Going back to the title of this thesis, it can be argued that research has been shown as a means to convey authenticity in restoration work but with regard to documentation, as field, we still have a lot of work to do.
Bibliography


http://www.variablemedia.net/e/preserving/html/var_pub_index.html.


Appendix

Film cross-sections created at the Image Permanence Institute.

(1.1)


(1.2)


B/W Positive / Nitrate Base / Stencil Coloured / Cross-Section = 50x Magnification.
(Image Courtesy of George Eastman House / Image Permanence Institute).

Imbibition Print / Nitrate Base / Technicolor / Cross-Section = 50x Magnification.
(Image Courtesy of George Eastman House / Image Permanence Institute).

All cross-sections were created by either the author or staff of the Microscopy department at IPI.
(Fig 2.0) The Chemicals and reactions of the cyanotype

<table>
<thead>
<tr>
<th>Reactant</th>
<th>Ferricyanides</th>
<th>Ferrocyanides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferric Salts</td>
<td><strong>Ferric Ferricyanide:</strong></td>
<td><strong>Ferric Ferrocyanide:</strong></td>
</tr>
<tr>
<td></td>
<td>• Prussian Yellow (Prussian Brown)</td>
<td>• Prussian blue (Berlin blue)</td>
</tr>
<tr>
<td></td>
<td>• Soluble; a powerful oxidant, easily oxidises water etc. being reduced via green intermediates (Berlin green) to Prussian blue.</td>
<td>• Highly insoluble; most intensely coloured, and most stable of all products in this table, to which the others revert.</td>
</tr>
<tr>
<td>Ferrous Salts</td>
<td><strong>Ferric Ferrocyanide:</strong></td>
<td><strong>Ferrous Ferrocyanide:</strong></td>
</tr>
<tr>
<td></td>
<td>• Turnbull’s blue</td>
<td>• Prussian white (Everitt’s salt or Williamson’s salt)</td>
</tr>
<tr>
<td></td>
<td>• The same as Prussian blue. It is not the expected <strong>ferrous ferricyanide</strong>, which is very unstable and reverts instantly to Prussian blue.</td>
<td>• Insoluble and colourless, but readily oxidised by air (and other oxidants) to Prussian blue.</td>
</tr>
</tbody>
</table>

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119 Ware, “A Blueprint for Conserving Cyanotypes.”
### (Fig 3.0) The use of the Historical Technique in Modern Restoration

<table>
<thead>
<tr>
<th>Decade</th>
<th>Institution / People</th>
<th>Known Restoration work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980s</td>
<td>British Film Institute (Harold Brown)</td>
<td><strong>The Lodger</strong> (dir. Alfred Hitchcock, 1926)</td>
</tr>
<tr>
<td></td>
<td>Czech National Film Archive (Jan Ledecky)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Munich Filmmuseum (Elfriede Ledig / Gerhard Ullmann)</td>
<td></td>
</tr>
<tr>
<td>1990s</td>
<td>British Film Institute (João de Oliveira)</td>
<td><strong>The Lodger</strong> (1926), Napoleon (dir. Abel Gance, 1927)</td>
</tr>
<tr>
<td></td>
<td>National Film and Sound Archive Australia (Chris Swinbanks)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soho Images, London (Paul Read)</td>
<td>Quo Vadis (1912), Blood and Sand (1922), <strong>The Lodger</strong> (1926) + ten shorts and eight other features whose title is not given by Read</td>
</tr>
<tr>
<td>2000/10s</td>
<td>Filmarchiv Austria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Haghefilm, Amsterdam (Ulrich Rüdel/ Daniela Currò)</td>
<td><strong>Das Rätsel von Bangalore</strong> [Excerpt]</td>
</tr>
<tr>
<td></td>
<td>PresTech, London (João de)</td>
<td><strong>Die Nibelungen</strong> (1924)</td>
</tr>
<tr>
<td>Oliveira</td>
<td>UCLA Stanford Theatre Laboratory (Jere Guldin / Sean Hewitt)</td>
<td>Twenty features + Numerous Shorts</td>
</tr>
</tbody>
</table>

Acknowledgement must be given to James Layton for his contributions to the formulation of this list. It was primarily compiled from personal correspondence with archives.