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From Edge to Edge: The Restoration of *La battaglia dall'Astico al Piave* (1918) and the Search for a Digital Historical-Critical Infrastructure

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Abstract

The restoration of *La battaglia dall'Astico al Piave* (Italy, 1918) has been funded by MiC (the Italian Ministry of Culture) and carried out by the University of Udine in collaboration with several film archives. Starting from a historical-philological and restoration framework, the case study offers some reflections and considerations between the fields of the digital humanities, film preservation, and cinema history. Furthermore, it provides a concrete opportunity to achieve the two goals of raising awareness about the status of digitized film artefacts, framing them as the result of modelling practices, and documenting the film preservation process as well as the surrounding historical and cultural network in a digital historical-critical infrastructure.

Keywords: First World War; Cinema History; Film Restoration; Film Philology; Digital Infrastructure.

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1 Introduction

This paper is based on the restoration of *La battaglia dall'Astico al Piave* (Italy, 1918), funded by MiC (the Italian Ministry of Culture) and carried out by the University of Udine in collaboration with Kinoatelje, La Cineteca del Friuli, Istituto LUCE, Cineteca Milano, Museo Nazionale del Cinema, and Lobster Films.[1] Starting from a historical-philological and restoration framework, the case study offers some reflections and considerations between the fields of the digital humanities, film preservation, and cinema history.[2]

The contribution has two main objectives. On one hand, I will frame the digital representations of film artefacts as the result of modelling practices, in other words, as heuristic processes that construct representations of a specific object or phenomenon (McCarty 2005). Historical and archaeological research on cinema history and film artefacts and the growing field of digital film studies and digital humanities stress the need for specific sub-disciplines. The science of film preservation and film historiography should focus on, and thus become fully aware of, the existence of a kind of *film artefact imaging* field. This would echo what has happened since the outset in several other disciplinary fields in terms of imaging sciences and the visualization of scientific objects (Daston and Galison 2007; Rheinberger 2010; Olsen et al. 2012; Drucker 2014), namely, constructed and mediated scientific observation for analytical-experimental, archival-documentary, and educational-pedagogical ends. In order to critically frame digital surrogates of film artefacts, their preservation and restoration quality needs to be assessed (Barricelli et al. 2020) along with documentation of the interdisciplinary research framework, methods and choices adopted. What is more, to consciously investigate film history and material culture at a "*distance*" (Salber Phillips 2013), film and media studies scholars working in digital and data-driven research environments should acquire a critical and educational approach to the modelling concepts and cultural techniques behind the visual representation of archival material artefacts. This approach should also be adopted towards digitized sources and the related digital tools and interfaces.

The second aim is to reload and reframe the longstanding field of *digital critical editions of films* made for research, education, and presentation purposes. Indeed, our research project will include a second phase in which we will design and create a web-based, historical-critical digital environment. The goal is to document the archival processes, giving a wider account of the restoration process, and of the material, visual, and cultural history of the film as a set of intertwined sources, practices, and discourses scattered among different and often unrelated archives.

Hence, the restoration of *La battaglia dell'Astico al Piave* provides a concrete opportunity to achieve the two goals of raising awareness about the status of digitized film artefacts and documenting the film preservation process as well as the surrounding historical and cultural network in a digital edition.

2 A Battle Diary. The Restoration of *La Battaglia dall'Astico al Piave* (1918)

La battaglia dall'Astico al Piave[3] was made by the Italian Royal Army Film Department in 1918.[4] TThe film bears testimony to the events between 15 and 24 June 1918 which decided the outcome of the second battle on the Piave (fig. 1). Four versions have been documented to date: the 1918 Italian and French versions premiered

1. This contribution is written by the author on behalf of a wider technical and scientific work team whom I thank for their collaboration (Serena Bellotti, Anna Donati, Petra Marlazzi, Daniela Pera, and Gianandrea Sasso). For their fundamental support and collaboration, the author also thanks: Elena Beltrami, Serge Bromberg, Patrizia Cacciani, Mariapia Comand, Roberto Della Torre, Alessandro Faccioli, Livio Jacob, Fabrizio Micarelli, Elena Nepoti, Gabriele Perrone, Sarah Pesenti Campagnoni, Cosetta Saba, Andrea Tessitore, and Camillo Zadra.

2. Located in this borderline position, the article aims at a wide readership while nevertheless remaining aware of the risks of offering an excess of theoretical and methodological reflection for the field of archival practices and too much technicality for many scholars. On the other hand, I believe that this type of approach responds to the fundamental purpose of this special issue, namely to create a connection between film and media studies, film heritage and computer-based techniques for the analysis and visualization of film-related data.

3. Length: 1255 m; censor visa no. 13649, 11 July 1918, http://www.italiataglia.it/search/opera (Last access: 11 July 2021).

4. 'Sezione Cinematografica - Regio Esercito Italiano'; the department consisted of both photographic and cinematographic sections. They shared vehicles, equipment, and shot several events from similar points of view (see among others Pesenti Campagnoni 2013, Faccioli and Scandola 2014, Faccioli 2016, Faccioli 2020).

during July and August, both made by the military film department; a '2000-foot' Scottish version named *The Battle of the Piave*, announced in July 1918,[5] and a re-edited version (*Ta Pum*) released in 1927 (probably by Istituto LUCE).

Figure 1. *La Battaglia dall'Astico al Piave* (1918): Assault on Montello

The restoration has been carried out through the digital intermediate route and aims to reconstruct the Italian edition of 1918. The first public projection of the restored edition, accompanied by live music, was held on 6 October 2021 as part of the Pordenone Silent Film Festival.[6]

The surviving film materials (*witnesses*)[7] gathered from film archives and private collections during the *recensio* phase are set out in the diagram below (fig. 2). Witness 'K' from Associazione Kinoatelje is a 35mm nitrate, first-generation tinted and toned print. It retains the original Italian intertitles, and handwritten information about editing and the colour palette on the film edge. The 'G' family came from Cineteca del Friuli and Lobster collections and witnesses the 1918 French version, whose first public screening in Paris is known to date from 7 August 1918.[8] The preservation masters and new positive prints, made several years ago at Haghefilm through a photochemical route, are held by Cineteca del Friuli, while the original nitrate materials are no longer available. Witness 'RM' from Istituto LUCE in Rome is a 35mm fourth-generation duplicate negative, in four reels, with flash intertitles. The editing and intertitles witness both the 1918 and the 1927 versions and preserve several segments which are missing in 'K' and 'G'. Witness 'MI' from Cineteca Italiana in Milan is a 35mm positive tinted nitrate fragment made close to the 1927 re-release, as attested by the intertitles and the insertion of

5. *The Bioscope*, 4 July 1918, p. 73.

6. http://www.giornatedelcinemamuto.it/la-battaglia-dallastico-al-piave/.

7. In this text, owing to the philological method adopted for the film reconstruction, I use several common terms from textual philology, such as *witness*, *recensio*, *examinatio*, *collatio*, *loci critici*, etc.

8. *Gazzetta Ufficiale del Regno d'Italia*, 8 August 1918.

later documentary materials. Witness 'TO', *Dio segnò i confini d'Italia*, became part of the collection of the Museo Nazionale del Cinema of Turin during the 1960s. It contains just a few scenes of *La battaglia dall'Astico al Piave*, and has given us a missing intertitle and scene.

Witness	Title	Version	Format	Element	Support	Reels	Length	Colour
K (Associazione Kinoatelje)	[La battaglia dell'Astico al Piave]	IT (1918)	35 mm	Positive	Nitrate	3	913 m	Tinted and toned
G1 – G2 (Cineteca del Friuli/ Lobster Films)	*La bataille sur le Piave*	FR (1918)	35 mm	Positive Dupe Negative Dupe Positive	Nitrate Acetate Polyester	2	521 m	Tinted and toned
G3 (Cineteca del Friuli/ Lobster Films)	*Da Capodistria a Fiume italiana*	IT (1918)	35 mm	Positive Dupe Negative Dupe Positive	Nitrate Acetate Polyester	1	336 m	Tinted and toned BW
RM (Istituto Luce)	[La battaglia dall'Astico al Piave - Ta pum]	IT (1927)	35 mm	Dupe Negative Dupe Positive	Safety	4	1073 m	BW
MI (Cineteca Italiana)	*La battaglia dall'Astico al Piave*	IT [1927]	35 mm	Positive	Nitrate	2	[402 m]	Tinted
TO (Museo Nazionale del Cinema)	*Dio segnò i confini d'Italia*	IT [1918]	35 mm	CTN Positive	Safety	1	540 m	BW

Figure 2. Witnesses' List

Witness K turned out to be the key material for the reconstruction of the 1918 Italian version. Other partial missing sequences were found in RM and G. The final sequence of the film came from witness MI, while we found a further missing scene in witness TO. Specialized scholars gave us fundamental help to identify, locate, and date sequences and find other witnesses and sources, such as the Turin and Library of Congress film materials.[9] Indeed, we are currently waiting to analyse materials preserved by the Library of Congress and Cineteca Nazionale in Rome, having spotted a few other missing shots (fig. 3).

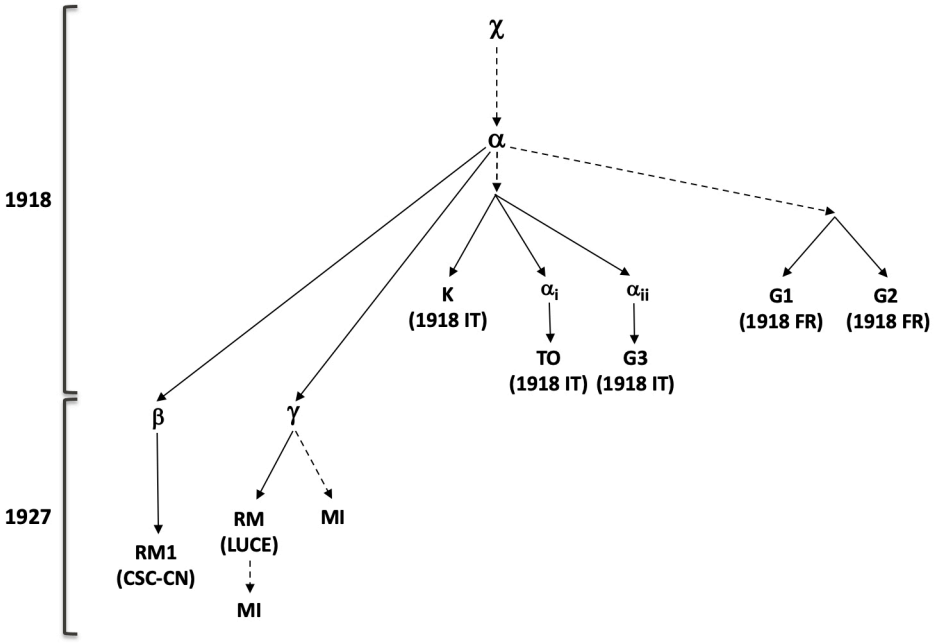


Figure 3. *La battaglia dall'Astico al Piave* (1918): *Stemma codicum*

As far as the intertitles are concerned, we decided to keep the original ones from the Italian 1918 version as preserved in K (fig. 4). Where missing in K but found in the G family or RM, we opted for a conservative

9. Respectively, thanks to Alessandro Faccioli (University of Padua) and Livio Jacob (Cineteca del Friuli). I would also like to thank Camillo Zadra (director of the Italian War History Museum in Rovereto) and Elena Nepoti (Imperial War Museum).

approach,[10] reporting the intertitle text, its sequential number and the film number ('R37') in square brackets and on a black background in the digital file.

Figure 4. Witness K: intertitle no. 36

As often happens, the film thresholds present specific *loci critici*: first of all, the four initial missing Italian intertitles which we found in the French 1918 version, but in a different order, probably due to the different role of the Italian monarchy in France, as in Italy the presence of the King's portrait would force audiences to stand up and pay tribute. Second, the final shot, depicting the awarding of medals to the Arditi assault troops on 29 June 1918, is the result of a hermeneutic and editorial decision, since there are no concrete traces of its original position in the Italian edition.

At present, the reconstruction covers more than 90% of the Italian edition (1170 metres out of the 1255 metres recorded by the censorship visa). This exceptional result has enabled us to indirectly resolve and clarify the relationships between several films and documents of the period.

As far as non-film materials are concerned, they should not be considered secondary or as merely supporting and validating the restoration and reconstruction tasks. Indeed, studying these materials is a core activity in framing the film artefacts as historical objects and inserting them in an entangled intermedial and intertextual network of sources and practices. Hence, by using them, we were able to date and locate most of the sequences in the film and indirectly confirm the chronological coherence of the film editing.

The primary sources include bulletins (*Gazzetta Ufficiale del Regno d'Italia*) and journals (e.g., *The Bioscope 1918*, *Kinema*, *Il mattino illustrato*, *Giornale del Mattino*, *Il Resto del Carlino*) which attest to the circulation of the film between 1918 and 1933 in several countries and cities.[11] Furthermore, we gathered many other primary sources, such as books, military reports, diaries (such as the diaries of Captain Maurizio Rava and Lieutenant Luigi Marzocchi),[12] and photographs of the same events taken by the Italian Royal Army photographers.[13] Images and related captions on the Battle of Piave circulated through the press of the time, such as in issue no. 14 of *La Guerra* published by Fratelli Treves, made using military department photographs. By comparing diaries, moving images, and pictures we were able to observe key moments from a prismatic historical point of view as the battle was told visually and in writing from different complementary angles and voices (fig. 5).

10. The conservative approach, with the preservation of the historical traces contained in the artefact, follows in the wake of many experiences and good practices adopted in the Italian cultural heritage, and this as a whole is the approach we took in the restoration of *La battaglia dall'Astico al Piave*.

11. 'Kinema', June 1930; 'Il mattino illustrato', 9-16 June 1930; see also the poster announcing the screening of *La battaglia dall'Astico al Piave 1915–1918* at the Teatro Civico in La Spezia, 1933 (preserved in the Museo Centrale del Risorgimento). See Pesenti Campagnoni 2013, Nepoti 2018 and Faccioli 2020.

12. As of 1917, Rava directed the newly established Supreme Command Press Office cinematographic section. Marzocchi was the officer in charge of the photographic section.

13. Preserved in the *Museo della Battaglia* in Vittorio Veneto, *Museo Storico Italiano della Guerra* in Rovereto, and *Museo Centrale del Risorgimento* in Rome.

Military archives (USSMI) and cinematic sources accessible through the European Film Gateway (EFG) and other digital repositories provided further crucial support.[14]

Figure 5. Witness K, frames 1181 and 2486 (on the left) and issue no. 14 of *La Guerra. La battaglia dall'Astico al Piave*, published by Fratelli Treves (1918), images 27 and 53 (on the right)

3 What Remains

Every restoration project implies an interdisciplinary approach and the support of different devices and infrastructures. With the multitude of sources and documentation available in the *La battaglia dall'Astico al Piave* project, the research results harbour great potential. However, since the results will be filtered into a basic digital package file (the restored version on DCP, an archival master) accompanied by essays and articles, this potential will remain unexpressed. Besides, the field of film and media studies has to deal with the fact that Italy at least is behind in designing and implementing digital research infrastructure that can support innovative forms of dissemination and different scales of investigation. A digital (media) infrastructure should

> (i) enable distant reading [...], that is, [identify] patterns or new research questions in and across aggregated collections, (ii) facilitate close reading: the detailed examination of individual items (e.g., videos) in a collection or specific sections of these items [...] and (iii) make sure that the "scholarly primitives" [...], basic activities such as "discovering", "annotating", "comparing" and "storing" [...] are well supported (Ordelman et al. 2019: 133-4).

Even though this kind of infrastructure is being set up in various ongoing projects and research activities,[15] in the Italian context many film and media scholars still struggle to place digital methodologies and applications within their heuristic outlook or to see archive practices as an equal field of knowledge production (Hanley and Heftberger, 2012; Op den Kamp 2017; Venturini 2019). This is in spite of the potential unleashed by radical technological changes intertwined with film preservation and research and disciplinary areas such as the digital humanities and media archaeology which, over the last 20 years, have helped to put medial agency in the limelight and therefore rewrite the conditions of archival research.

14. The portal http://www.14-18.it/ (14-18 Documents and Images of the Great War), coordinated by the Central Institute for the Union Catalogue of Italian Libraries, virtually brings together the most important collections of documents and testimonies of the war made in Italy between 1915 and 1918. The portal hosts a collection of documentary and memoir sources that testify to all aspects of the period, from military actions to political satire, personal memories to war songs. The catalogue enabled us to retrieve several sources related to the film and the Italian Royal Army Film Department.

15. See, for instance, the National Research Project 'Modes, Memories and Cultures of Film Production in Italy (1949–1976)', https://cineproduzione.uniud.it/en/homepage-en/.

In this picture, our case study offers grounds for reflection and useful cues for discussion. As a recent publication devoted to the Italian WWI film heritage states,

> a large part of the Italian films made during the Great War have been lost. The impact when we see the surviving images, often scattered in new film carriers that have little to do with the "originals", is the same as when we look at a building or late medieval monument built with stones from ancient times: moved, reused, rematched. We can sense where they come from but struggle to imagine what the ancient building they came from might have looked like (Faccioli 2020: 9, own translation).

Despite the impressive work to recover and digitize the European WWI heritage in recent years, a large part of the surviving cinematic documents, especially in the Italian area, lack adequate datasets and critical descriptions establishing their exact intertextual relationship, historical entanglements, modes of production, formal structures, archival history, and material status. As is often the case, little or nothing is known about the archival backgrounds of the surviving copies (Flueckiger et al. 2016). We can only fully trace the provenance (Bernardi et al. 2021) and cultural history of witness K thanks to the careful documentation at the moment of excavation and recovery (Humar 2001). In some ways it is a longstanding and transversal question:

> the availability of comprehensive, reliable datasets is still rather limited, especially when it comes to the earlier periods of media history. Another problem is that even datasets on the same phenomenon [...] are not always based on the same data model, complicating their combined use (Noordegraaf 2016: 55).

A scholar wishing to combine archaeological, historical, and formal research on Italian WWI film archival artefacts and documents can encounter both a lack of entangled digital environments (able to connect different sources by linking data, annotate, and compare materials, etc.) and information (un)available on the tangible, technical, archival, and historical status of the materials:

> scholars therefore struggle with an abundance of sources [...] At the same time access to primary sources is in many cases still lacking, and the databases currently employed by film archives and other collecting institutions as well as online sources tend to differ, at times substantially, in terms of metadata quality and the available search functions (Heftberger 2019).

Despite the extraordinary and generous collaboration of several archives and scholars, when surveying and examining the witnesses we had to deal with limited research tools and functions. We experienced this paradoxical condition while performing the critical examination of the single film materials described above and the parallel analysis of other films belonging to the WWI film heritage. It was only by mainly using traditional methods that we were able to rebuild the network of intertextual relations expressed by the tradition (in the philological sense) of the film. At the current stage of the research, the witnesses of *La battaglia dall'Astico al Piave* contain or conflate with *L'altro esercito* (1917), *Resistere* (1918), *L'ingresso degli Italiani a Trento e Rovereto* (1918), *Da Capodistria a Fiume italiana* (1918), and *The Battle of Arras* (1918). Images from the film are reused in many other post-war films, among which *Dio segnò i confini d'Italia* (1918), *Guerra Nostra* (1927 and 1929), *Il Piave mormorò* (1934), and *Gloria — La Grande Guerra* (1934).

Considering the general picture briefly described here, 'to imagine [...] the ancient building they came from' (Faccioli 2020), we should on one hand go beyond the analogue-digital divide (Heftberger 2018; Burghardt et al. 2020) and on the other foster the entanglement between historical-philological and archaeologically driven research and the digital humanities. In other words, my aim is to 'think about how the digital is modulated within various materialities' (Berry and Fagerjord 2017: 16). As such, here I will adopt a post-digital framework and critical approach to computational knowledge (Dobson 2019). This slant provides evident added value both for the restoration and reconstruction of the film and the large-scale organization of an important slice of the Italian WWI film heritage tradition.

4 Non-isomorphic and Isomorphic Modellizations and Knowledge Representations

I will take the digital surrogates and infrastructures used during the *La battaglia dall'Astico al Piave* restoration project to be forms and tools emerging from modelling processes which in turn shape the "choices we make in representing and analyzing the materials we study" (Flanders and Jannidis 2019: 4). As represented in the digital humanities:

> by "modelling" I mean *the heuristic process of constructing and manipulating models*; a "model" I take to be either *a representation of something for purposes of study*, or *a design for realizing something new*. These two senses follow Clifford Geertz's analytic distinction between a denotative "model *of*", such as a grammar describing the features of a language, and an exemplary "model *for*", such as an architectural plan (McCarty 2005: 24).

Here I use the subdivision introduced by McCarty (in the wake of Geertz, Goodman, and many others), to reflect on two different types of modelling used in our project: isomorphic (such as 'edge-to-edge' scanning) and/or non-isomorphic (such as visual and/or textual scene-by-scene annotation) representation, visualization, and annotations of film artefacts (the 'model of') and the design of a critical edition as a 'design for realising something new' (the 'model for'). The model of/model for subdivision must not be taken as absolute since there is a thin boundary between visualization as representation and as a knowledge generator: 'A basic distinction can be made between visualizations that are *representations* of information already known and those that are *knowledge generators* capable of creating new information through their use' (Drucker 2014: 65). On these bases, in the following paragraphs I will reflect on the non-isomorphic and isomorphic representations of the film artefacts involved, and the current function and usefulness of a film-centred critical media environment and infrastructure.

In other words, I propose subdividing the modellizations into non-isomorphic (or hybrid) and isomorphic. In the first case, the film is seen as a *witness* and the focus is on textual reconstruction so it requires annotation and comparison tools. Instead, in the second case, the film is seen as a material object, so attention is paid to critically framing its *digital representations* and annotating and documenting its *archaeological history* (Marconi 2002: 48).

It is clear that the two types overlap a great deal: hiding behind the difference between isomorphic and non-isomorphic is the traditional distinction between restoration and reconstruction, which, ever since the configuration given to it by the so-called Bologna School,[16] has exposed the deep entanglement between editorial and formal order and material order. This entanglement has been widely discussed in the literature, from different angles and at different levels of framing the film dimension, starting from the film-as-object (*film come oggetto*), film-as-spectacle (*film come spettacolo performativo*), and film-as-work (*film come opera*) originating in the Bologna School literature. In the last twenty years, several other similar tensions and layers have been added: the distinction between 'mystical body' and 'mechanical body' (Toffetti in Vignaux 2003, Catanese 2014);[17] the film artefact as a conceptual, logical, and material record (Kirschenbaum 2007: 3); film as a material and conceptual artefact and the related frameworks (film-as-dispositive and film-as-performance, among others, see Fossati 2009 and 2018); and film-as-work, film-as-score, and film-as-performance (Hediger, 2011). Furthermore, there has been reflection on the material properties of film in the digital (Flueckiger, 2012), experimental cinema restoration practices (Venturini et al., 2013), and the archaeology of handmade films and artist-run lab practices (Catanese and Parikka 2018). With this knowledge, the distinction between isomorphic and non-isomorphic was used to create a practical frame not so much of the film as the forms of description and visualization adopted during a restoration and reconstruction process.

16. The reference is to the so-called 'Bologna School' which grew up around the encounter between the university, film archives and restoration laboratories. The movement can canonically be retraced to the respective figures of Michele Canosa, Gian Luca Farinelli, and Nicola Mazzanti. For a reconstruction of this context, see Venturini 2006, Frappat 2013, Catanese, 2014.

17. The reference is to the traditional distinction between the properties and the consistency of an intangible intellectual creation (*corpus mysticum*) and its manifestation in a material element (*corpus mechanicum*). See Kant 1996 (1797).

In these terms, a film restoration project implies immersion in a hybrid research and production environment, in which traditional analytical methods and tools combine and are aided by several different digital environments and analysis tools.

Nevertheless, even for the most up-to-date researchers accustomed to dealing with digital preservation practices, 'introducing computational research requires [them] to review and complement the methods they traditionally work with' (Noordegraaf 2016: 51-52). An additional difficulty is finding one's way in the vast field of solutions and tools on offer. It is not rare for them to be unadaptable or obsolete, and so it has to be decided whether to use them anyway or to develop new ones without, however, the right skills or resources (Melgar Estrada et al. 2017: 44; Karsdorp et al. 2021).

In our case study, except for the research performed in digital archives, we mainly used digital research environments and tools as organizational support to deal with the different data gathered in the initial phases of the research. As will become clear in the next paragraphs, our attention was mainly focused on the digital assessment, visualization, and analysis of the film artefacts.

4.1 The Non-isomorphic or Mixed Model

The non-isomorphic (or mixed) approach aims to document the material and editorial film layout and at the same time lay the foundations for its reconstruction. The non-isomorphic description and annotation of a film artefact is grounded in 'its segmentary nature' (Heftberger 2018: 29) and therefore historical tools such as so-called *découpage*, in the sense of a prismatic theoretical and analytical concept for understanding film structure. Straddling avant-garde and classical European film theory (Barnard et al. 2020), it was designed as an entomological and anatomical approach to the formal and material artefact, in order to dissect it. Historically, the so-called '*sceneggiatura desunta*' (usually translated as 'technical screenplay') has played a particular documentary and pedagogical function since it was used in the 1920s and 30s during the institutionalization of film culture, in an age lacking in study resources (Pitassio and Venturini 2014). At the time Renato May wrote:

> it is in essence more of a *documentation* [emphasis added] than a script [...] It is like examining the structure of a building and discovering the static laws that allow two thin columns to support a massive arch, or how the stones were arranged so that a wall would acquire a certain solidity. (May 1939: 21-22, own translation).

Like in the case of the allegory of WWI film heritage as a 'late medieval monument built with stones from ancient times', here I deliberately take the metaphor of *documenting* a composition's rules in a much more literal and materialistic way than May intended in his time.[18]

During our project, which adopted a philological method, the *examinatio* (the description and analysis of the single materials/witnesses) and *collatio* (their comparison) phases were conducted using basic *spreadsheets*, *pivot tables*, and markers and annotation tools which supported us in segmenting and comparing the material, formal, temporal, and intertextual characteristics of each witness (fig. 6). Even though here it is not one of my goals to assess methods and uses, it is evident that a *digital film philology* has to evolve towards specific tools and applications that mix collation, multimedia annotation, and automatic recognition software (such as the CLARIAH app suite or VIAN annotation software).

In the example shown in the figure (fig. 7), we imported three different versions of the film incipit into *CollateX*, each of which is witnessed in the surviving materials. We normalized the different intertitles so they could be used as references to apply a collation algorithm, realign and reorder the witnesses, and provide a visual account of the variants. This tool enabled us to check and support our critical hypothesis and so reconstruct the incipit of the 1918 Italian version.[19]

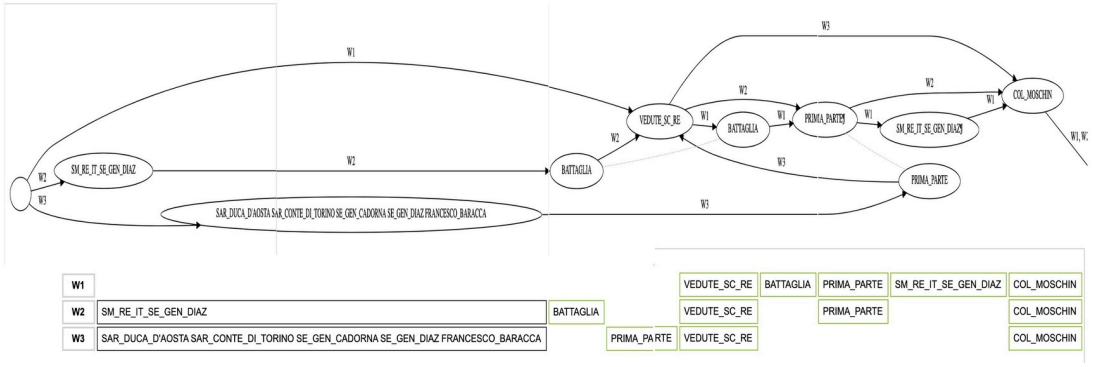
18. In this perspective, the philological method is indebted to historical, philological, palaeographical, codicological, and bibliographical precepts, such as the principles of the philology of printed texts (Tanselle 2020).

19. The nitrate negative fragment very recently discovered at the Cineteca Nazionale in Rome, which among other things preserves a few missing shots, including the fourth Italian intertitle, confirms the soundness of the computational approach that had been adopted in its absence. Nonetheless, we are conscious, using such vizualization tools, of the need to prevent forms of observation and observed phenomena merging into each other and so kept a certain critical distance between them (Drucker, 2014: 125).

17*	GIALLO (Soldati caricano il cannone e sparo da lato frontale)	K3	14704	15149	446	G1	94319	94766	448	RM1	8170	8624	455
18	GIALLO (Prati con casa e spari in lontananza)	K3	15150	15290	141	G1	94767	94908	142	RM1	8625	8758	134
19	GIALLO (Soldati caricano il cannone e sparo tra le trincee)	K3	15291	15571	281	G1	94909	95219	311	RM1	8759	9055	297
20	GIALLO (Soldati caricano il cannone tra le trincee cambio angolazione)	K3	15572	15773	202	G1	95220	95452	233	RM1	9056	9278	223
21	V - SEPPIA - FORTE (esplosioni in lontananza e panoramica)	K3	7641	7770	130	G1	95453	95583	131	RM1	9279	9406	128
D12	Lunghe file di autocarri trasportano le riserve.	K3	7771	7864	94	G1	95584	95705	122	RM1	9407	9411	5
22	ARANCIO (autocarri)	K3	7865	8586	722	G1	95706	96480	775	RM1	9412	10161	750
D13	Una brigata in cammino verso la fronte di combattimento.	K3	8587	8702	116	G1	96481	96609	129	RM1	10162	10166	5
23	GIALLO (lunga fila di soldati)	K3	8703	9179	477	G1	96610	97087	478	RM1	10167	10636	470
G-D14	Traino e postazione di una batteria di obici Pesanti Campali.					G1	97088	97171	84	RM1	10637	10641	5
G-24A	Trasporto e sistemazione obice					G1	97172	98604	1433	RM1	10642	12053	1412
G-24B	Caricamenti e spari con obice					G1	98605	99304	700	RM1	12054	12751	698
G-24C	Prati con casa più vicina e spari in lontananza					G1	99305	99572	268	RM1	12752	13021	270
D15	I palloni-drago salgono a osservare i tiri delle artiglierie.	K3	9180	9294	115	G1	99573	99696	124	RM1	13022	13025	4
25	ROSA (preparazione mongolfiera)	K3	9295	9439	145	G1	99697	99833	137	RM1	13026	13169	144
25*	ROSA (preparazione mongolfiera)	K3	9440	9526	87	G1	99834	99940	107	RM1	13170	13280	111
25** [A]	ROSA (decollo)	K3	9527	9781	255	G1	99941	100207	267	RM1	13281	13543	263
25 [*+**]	ROSA (soldati sul carro)	K3	9782	9886	105	G1	100208	100320	113	RM1	13544	13645	102
25** [B]	ROSA (pallone in volo)	K3	9887	10176	290	G1	100321	100617	297	RM1	13646	13928	283
26	V - VERDE (esplosione di cannone con soldati)	K3	10177	10337	161	G1	100618	100771	154	RM1	13929	14062	134
D16	Reparti di cavalleria si incamminano per il "rastrellamento" delle pattuglie nemiche infiltratesi tra le nostre linee.	K3	10338	10555	218	G1	100772	100945	174	RM1	14063	14067	5
27	V - SEPPIA (fila di soldati a cavallo)	K3	10556	10912	357	G1	100946	101299	354	RM1	14068	14415	348
D17	Gruppi di prigionieri "rastrellati."	K3	10913	11015	103	G1	101300	101405	106	RM1	14416	14420	5
28	ARANCIO (fila di prigionieri)	K3	11016	11164	149	G1	101406	101558	153	RM1	14421	14566	146
28*	ARANCIO (fila di prigionieri)	K3	11165	11357	193	G1	101559	101699	141	RM1	14567	14756	190

11	EASTMAN KODAK ▪	Mentre il nemico tira coi gas asfissianti.	14433	14488	56	giunta a colla					14466	14465-14468
						edge code	KODAK ▪ (nero su bianco)					14476-14479
17	EASTMAN KODAK▪ (bianco su nero)	GIALLO	14489	14574	86	giunta a colla				contraria	144489	14487-14490
						scritta a mano	S - O - 155	17 - GIALLO				14499-14502
						edge code	KODAK▪ (bianco su nero)					14553-14556
						giunta a colla					14554	14553-14556
						scritta a mano	S - O - 155	17 - GIALLO				14573-14576
						giunta a colla					14574	14573-14576
16	EASTMAN KODAK ▲ (bianco su nero) EASTMAN KODAK ▪ (nero su bianco)	GIALLO	14575	14703	129	scritta a mano	S - O - 155	16 - GIALLO				14584-14587
						edge code	KODAK ▲ (bianco su nero)					14680-14683
										macchia azzurra		14675-14678
						edge code		KODAK ▪ (nero su bianco)				14693-14696
						scritta a mano	S - O - 155	16 - GIALLO				14693-14696
						giunta a colla					14703	14702-14705

Figure 6. *Examinatio* and *Collatio*



W1				VEDUTE_SC_RE	BATTAGLIA	PRIMA_PARTE	SM_RE_IT_SE_GEN_DIAZ	COL_MOSCHIN
W2	SM_RE_IT_SE_GEN_DIAZ	BATTAGLIA		VEDUTE_SC_RE		PRIMA_PARTE		COL_MOSCHIN
W3	SAR_DUCA_D'AOSTA SAR_CONTE_DI_TORINO SE_GEN_CADORNA SE_GEN_DIAZ FRANCESCO_BARACCA		PRIMA_PARTE	VEDUTE_SC_RE				COL_MOSCHIN

Figure 7. *Incipit*: collation and variants (French and Italian versions)

In the reconstruction it was not possible to operate without non-linear editing systems, such as *Resolve*, to annotate, align, and visually compare the main witnesses with each other. These systems are increasingly used as learning and sharing interfaces for post-production restoration lab analysis because of the verbal, graphic, and visual annotation tools, and the multiscreen and multi-trace visualizations (fig. 8) which support both comparative and macro readings of the whole film tradition and the examination of variants, contaminations,[20] and *loci critici*. This measurement and comparison post-production practice did not come about in the digital era but is rooted in analogue film editing techniques which used comparison moviola and film synchronizers, practices still used in restoration projects involving direct, side-by-side comparison with original film materials.

Figure 8. Non-linear editing systems: annotation tools and multiscreen and multitrace visualizations

4.2 The Isomorphic Model: Film Artefact Imaging and Interoperable Documentation for Film Restoration

Since the early 2000s, the growing numbers of digital objects and platforms, and the market-driven obsolescence of carrier-based formats has made more and more attention be paid to active preservation in terms of the production of interoperable formats and sustainable practices. Although so-called active preservation currently corresponds to safeguarding primary and secondary information in the digital domain (Prentice and Gaustad 2017), the secondary information nevertheless pays a price (Gosvig Olesen et al. 2016). In the digital humanities, the issue has been problematized in terms of the 'modeling of analog artifacts' and 'formal representation' (Burghardt et al. 2020: 7). Nevertheless, Multimedia Information Retrieval (MIR) is mainly focused on the conceptual artefact (primary information) and therefore the semantic-syntactic and stylometric rather than material and media levels.[21] From this point of view we are invited to unbox preservation practices and apply a form of digital source criticism (Kirschenbaum, 2010, Fickers 2012, Treleani 2013, Hoekstra et al. 2018).

Indeed, film artefacts have always been constantly reshaped historical and techno-cultural objects. If we closely observe 'the digital folding of memory and archives' (Berry and Fagerjord 2017: 61), like in the case of most of the digitized materials available about the Italian WWI film heritage, they are the result of several layers of photochemical, electronic, and digital work, since they are part of different and periodical remediation processes. In the long history of the mediation and representation of artefacts, our field has been one of

20. 'Contamination' or interference is an umbrella term in textual philology, here used to describe the mixture of different versions and segments from different films (for instance, in the RM witness there is a sequence from *The Battle of Arras*) or at least how different materials can be part of a single witness. For example, witness K, repeatedly manipulated by its historical owner (a collector, see Humar 2001), consists of two first-generation prints of the 1918 Italian edition of *La battaglia dall'Astico al Piave* and a single shot in black and white added at the end of the last reel, traceable to a late 1920s release of the film, printed on Ferrania positive stock.

21. There are obviously various exceptions. Here I will just point out Heftberger 2018: 34, 74-77.

the last to touch on this issue. The historiography of material culture has learned how to operate from disciplines such as palaeontology and archaeology, for which '[...] visual media are indispensable in the process of documentation, that is, the practice of transforming things from the past into manageable and malleable forms' (Olsen et al. 2012).

There are essentially three reasons why it is necessary to produce 'manageable and malleable forms', namely isomorphic models such as *proxies* or *facsimiles*, and that is to safeguard the originals, allow widespread access, and enable machine-assisted visual analysis (Berry and Fagerjord 2017: 71). In our case study, we documented the 'things from the past' — the film artefacts — in three different ways: using a/v screeners, edge-to-edge scans, and repro camera pictures (figs. 9-10).

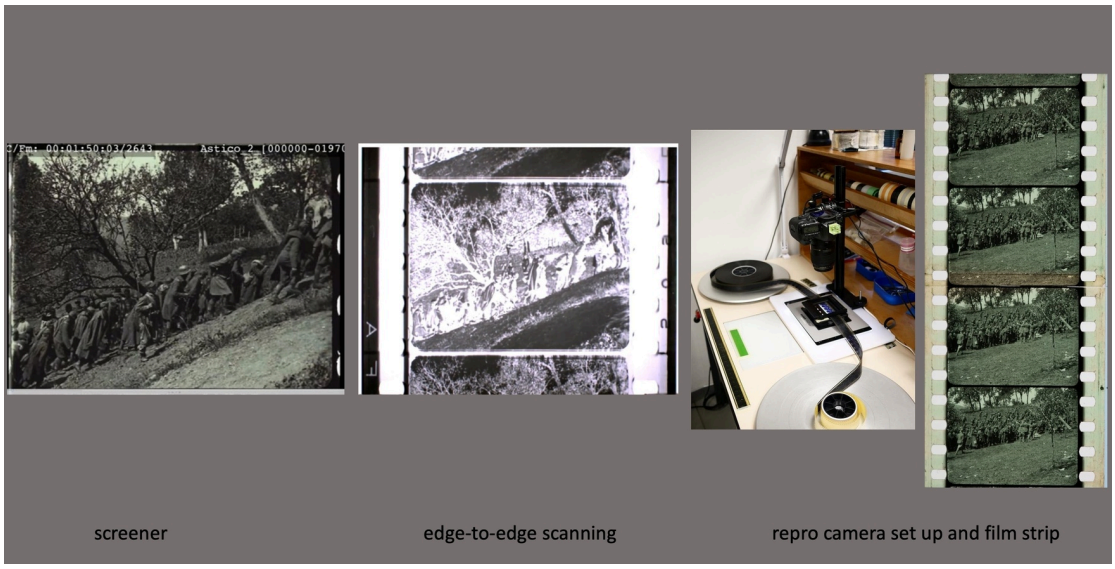


Figure 9. Screeners, edge-to-edge scanning, and repro camera pictures

Witness	Proxy	Edge-to-edge	"Repro-set"
K (Associazione Kinoatelje)	✓	✓	✓
G (Cineteca del Friuli/Lobster Films)	✓	×	✓
RM (Istituto Luce)	✓	✓	×
MI (Cineteca Italiana)	✓	✓	×
TO (Museo Nazionale del Cinema)	✓	×	×

Figure 10. Overview of the isomorphic description produced for each witness

While screeners aim to reproduce primary information and are particularly useful to compare witnesses, edge-to-edge and repro camera visualizations focus on visually keeping secondary information and more generally preserving the general relationship of *coextensiveness* between image and matter that influences the whole artefact (Brandi 1963).

Edge-to-edge visualizations and scanning, performed since the early 2000s, can be framed as modes of visualization grounded on the archaeological and philological tradition.[22] As with *La Battaglia dall'Astico al Piave*, edge-to-edge scanning describes, analyses, and shares a range of secondary information. In turn, repro camera devices (Flueckiger 2015; Flueckiger et al. 2018; Marlazzi 2021), which use specific and different settings and environments to take pictures of the film strip, fall under an analytical and diagnostic approach originating in the traditional cultural heritage fields. In our case, we used this approach on witness K to map the colour

22. The idea of an edge-to-edge 'digital facsimile' of the film strip and the capture of the material object as an archaeological or bibliographical finding has emerged in several places. See among others Gschwind 2002; Venturini 2007a and 2007b.

palette and relative edge annotations (fig. 11) and classify *faults*, *errors*, and *defects* (Bordina, Venturini, 2012: 257-259) on the material (fig. 12).

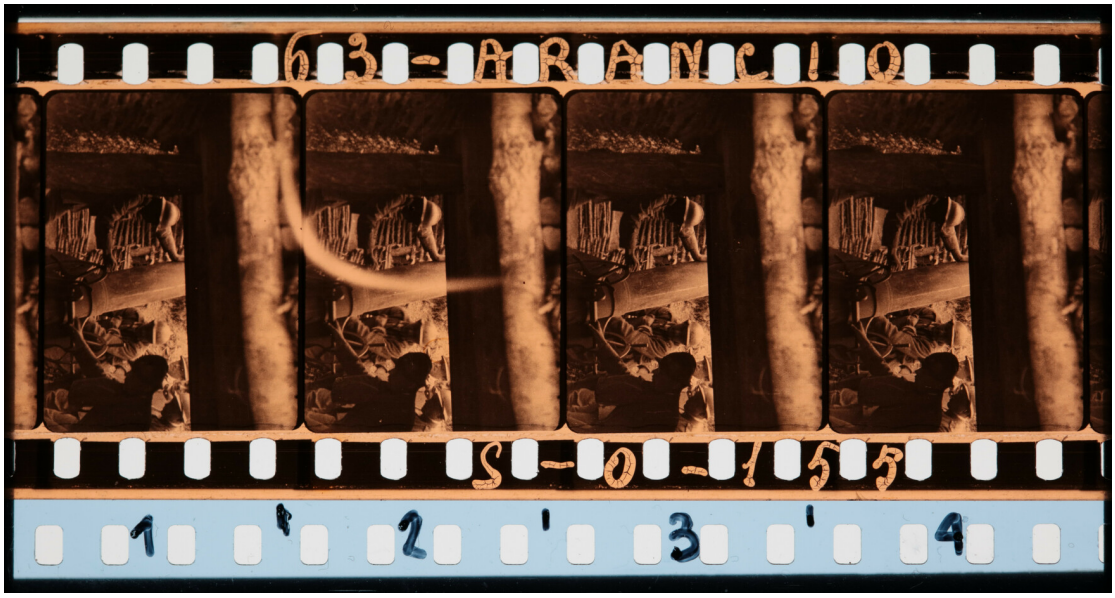


Figure 11. Witness K – reel 1 – frames 3009-3012 "63 – ARANCIO" (Shot no. 63 – Orange tinting) with light defect

D/E/G	Intervento (rimozione/conservazione/attenuazione)	Sintomologia	Descrizione del sintomo	ftg di riferimento Rullo1					
G		disturbo impulsivo	macchia chiara da decadimento emulsione puntuale	193	195	212	241	368	381
G		disturbo impulsivo	macchia chiara da decadimento emulsione locale	255					
G		disturbo impulsivo	macchia scura da agenti esterni/ossidazione	244	2340				
E	rimuovere	stabilità	fuori quadro stampato nel rullo 1 - non presente in rullo 3	307-311					
D		giunte/tagli	linea di giunta sul quinto di fotogramma inferiore	407					
D		giunte/tagli	sfocatura da giunta stampata	308	2436-2437				
D		disturbo impulsivo	baffo di luce imbibito	422	423	427			
E	conservare	disturbo impulsivo	perlage: sequenza di piccole macchie di sforma sferica allineate	508	627				
G		disturbo impulsivo	macchia da concentrazione di colore	657	1298				
G		instabilità di luce	sbalzo di luce che influisce sul colore in forma continuativa	688-844	4233-4260				
G		disturbo continuativo	increspamento dell'emulsione (umidità che entra?) - recuperare Betacam	858-861	2926				
G		disturbo impulsivo	macchia chiara asportazione dell'emulsione puntuale	1080	1081	1084	1091	1092	2227
E	conservare	disturbo impulsivo	perlage non allineato (champagne)	1128-non stampata	1239				
E	rimuovere	disturbo impulsivo	impronta digitale su positivo	1367	1368	4539			
G		disturbo continuativo	graffi verticali imbibiti chiari	1374-1378					
E		disturbo impulsivo	sfocatura da rottura stampato - errore congiuntivo	1477					
D		disturbo continuativo	serie di graffi neri trasversali su positivo	1510-1515					
D		disturbo impulsivo	macchia scura [da assenza di emulsione sul negativo]	1656	1664	1773			
G		disturbo impulsivo	rottura riparata	2630					
D		disturbo impulsivo	graffi neri intensi [da graffi sull?emulsione del negativo]	3287					
D		disturbo impulsivo	perlage nero non allineato e continuo - stampato quindi da tenere	3768-3786 (in LUCE)					

Figure 12. Damages, errors, defects classification

By faults (or damage), I mean biological, chemical, and mechanical alterations to the material due to use or negligence and the decay of materials.[23] By errors, I mean issues present during the transmission of the contents, or rather during the duplication of the materials. While errors belong to the area of cultural history and the copying process, defects are understood as signs and indications of limits, of the characteristics but also of incorrect uses of the recording system and the technology employed when the film was made.[24]

The results helped us to choose the colour grading (by using the edge annotations as a reference and the repro set results to measure the colours and identify the chroma vectors, and comparing the colours in the film

23. See also the Image Permanence Institute, which describes three categories of environmentally induced decay: biological decay, chemical decay, and mechanical decay (Adelstein, 2009: 2).

24. For a definition of errors, see Farinelli and Mazzanti (2001) and Canosa (2001).

material with different colour tinting and toning palettes used at that time, fig. 13) and restoration of the image (we repaired several instances of substantial damage and errors, but kept the defects, such as the marks that came from the negative).

Both edge-to-edge and repro tools and visualizations satisfy a forensic (Kirschenbaum 2007) and morphological (Ginzburg 1979, 1986) approach to film artefacts.[25]

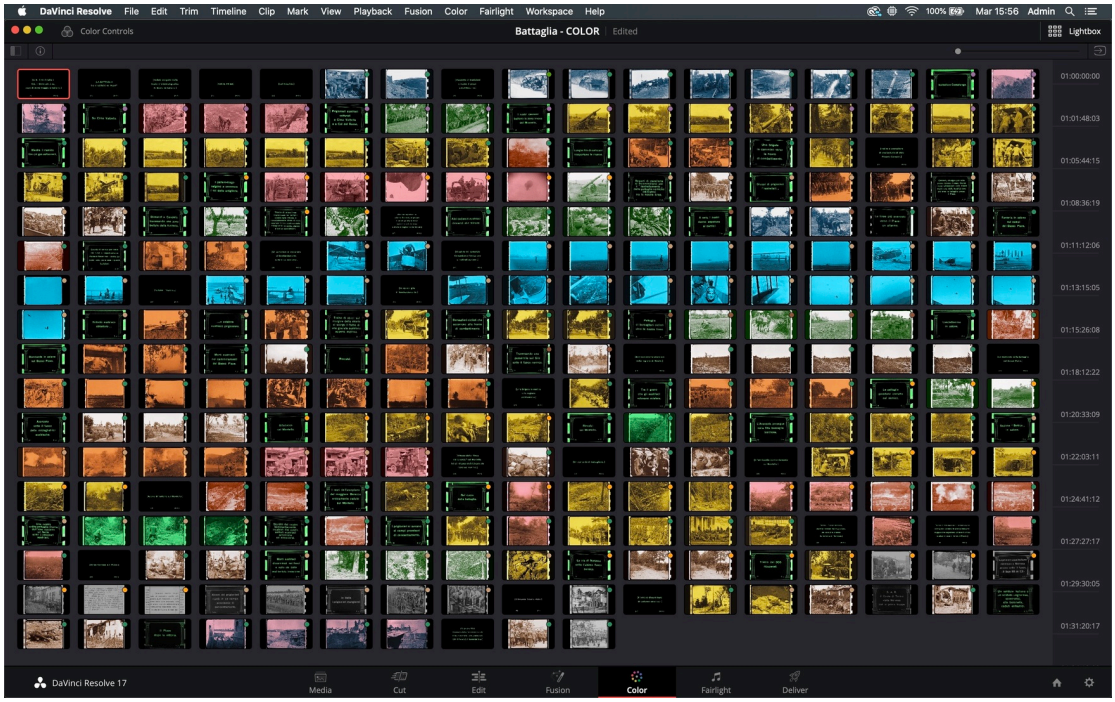


Figure 13. Colour Grading

Alongside the abovementioned specialized annotation software and media suites, preservation and restoration practices can be made easier if we frame them as *modes of production* (and post-production) within the digital industry.[26] Non-linear commercial editing software and digital restoration software (such as Diamant Annotator) increasingly host advanced annotation and cooperation tools. In addition, *de jure* standards, such as the Interoperable Master Format (IMF), can be taken as guidance. Designed to simplify the exchange and production of single masters, today it is the leading standard for international over-the-top film and television distribution and production. As underlined since the early 2010s, the development of IMFs that can host multiple versions and large amounts of metadata goes hand in hand with the need for apparatus to document the remediation processes (Mazzanti 2012). In other words, it would seem to provide a 'future-proof' set of tools and packages that are useful for archiving and documenting historical and archaeological knowledge of archival artefacts: from their initial multiple, plural, unstable editorial dimension, which can be traced, preserved, and modified in line with the progress in historical and archival research (Arrighetti 2017) to their

25. The morphological approach to the physical characteristics of film has a long history, since being pioneered by 'excavator' Brown (Brown 2020). Despite linking Brown's technique to the inductive-deductive method and mentioning the relations between restoration, history, and art, Lenk (2016) does not trace it all back to Ginzburg's conjectural paradigm.

26. Film restoration is a labour-driven activity. Work practices, for example, for the production of documentation and research, are often not economically viable for a private laboratory or a public organization struggling with funding. Extensive annotation practices and historical-analytical research, as well as the production of digital critical editions of films, can be sustained in most cases by research institutions and dedicated grants. However, more and more film archives are introducing research-driven tasks in their infrastructures. The International Federation of Film Archives (FIAF) and the Association of Moving Image Archivistes (AMIA) are also addressing topics such as knowledge exchange and continuing education. Furthermore, more academic institutes and the FIAF itself are working on tools for image quality assessment and documenting restoration practices. In the near future, the increasing use of automatic computer-based technologies and applications could shift the attention and resources from traditional sectors such as digital repair to others more related to knowledge production and exchange.

conditions of digital existence. Here, IMF is seen as a potential way to overcome the 'lack of a structured way to store production, preservation, or restoration metadata within the archival package itself' (Arrighetti 2019: 38) and to counterbalance the digital 'fragmentation of the archival object' (Noordegraaf 2019: 246).

As such, instead of being hidden in lab processes, the heuristic and technological processes of film preservation and restoration slot perfectly into the digital research design, and into documentation and multimedia annotation in the humanities, archive sciences, and technical and professional fields.

5 For a Post-digital Critical Film Edition

Besides the restoration of the 1918 Italian version, our aim is to design a historical-critical, digital web-based environment that relates the primary sources, documents the restoration process, and offers a common research infrastructure. The debate on critical film editions, at least in Italy, has been at a standstill for some time. In the wake of several pivotal studies and proposals (Loiperdinger 2003; Dubrek-Meyer and Izvolov 2006), almost 15 years ago, the idea to build digital critical film editions was put forward in this journal, and thereafter elsewhere (Bursi 2007; Bursi and Venturini 2008). They were to be based on interdisciplinary grounds (from the humanities computing to film historiography and philology of printed texts) and on the collaboration between archives, universities, laboratories, and research centres (Bursi and Venturini 2008: 9).

While I do not intend to dwell on that phase,[27] I will, however, point out that these experiences proceeded parallel to the appearance of the digital humanities and quantitative studies (Moretti 2005, 2013) and in part came from the same basis (the proposal for a form of non-normative knowledge organization; correlation and annotation of sources; primary role of apparatus). Not by chance, some of these experiences were close to advanced computer-aided film analysis projects begun in that same period (Heftberger 2016) or provided inspiration for more recent digital humanities projects applied to new cinema history (Gosvig Olesen and Kisjes 2018; Flueckiger 2020).[28]

Critical film editions now find fertile ground in both the scientific and the production and industrial sphere. A digital critical film edition can lead to a 'more comprehensive view on the history of film as part of a broader cinema culture' (Noordegraaf 2018: 107) and a common *research infrastructure* (Heftberger 2018), placing it at the centre of a network of modular relations promoting a multidimensional and open contextualization.

Hence, if digital critical editions enable a broader understanding of cinema history and the creation of a hybrid infrastructure (Park and Starosielski 2015), their design and development can give us a non-normative vision of media production and research dissemination environments (Schnapp and Presner 2009) and frame archives as research labs (Fossati, van den Oever 2016).

The next stage of the research, still in an embryonic stage, is to design a web-based, historical-critical digital environment. It will be supported by a further grant over the next year. A first and very raw outline is as follows. We will start from the restored version (the critical text) that can be played back as a basic audio-visual stream (fig 14). Then, we will gain a first overview of its interactive and searchable critical apparatus (fig 15), where we can grasp the textual-driven aspects such as variants, lacunae, or formal/material-related annotations such as corrective interventions or highlights about where and how a specific source material has been used to build the restored edition. Next, we will directly visualize the film artefacts in their different isomorphic descriptions, such as screeners, edge-to-edge scanning, or repro camera pictures (fig 16). We will compare several witnesses as conceptual (fig 17) or material artefacts (fig 18) and then investigate the film phylogenetically, through overall visualizations such as stemmatics and variant graphs. We will go through the documentation of the restoration process workflow, highlighting the choices and actions made, the software and hardware used, and the master and copies produced (fig 19). Lastly, we will relate the different primary and secondary sources with each other.

27. May I just briefly mention the philological theoretical models (Venturini 2007a) and published historical-critical editions (think of the *Metropolis Studienfassung* or *Hyperkino* DVDs).

28. See also the well-known and ground-breaking ERC Advanced Grant *FilmColors. Bridging the Gap Between Technology and Aesthetics* (https://www.film.uzh.ch/en/research/projects/verbund/ERC-Advanced-Grant-FilmColors.html).

Figure 14. Historical-Critical Digital Environment Prototype

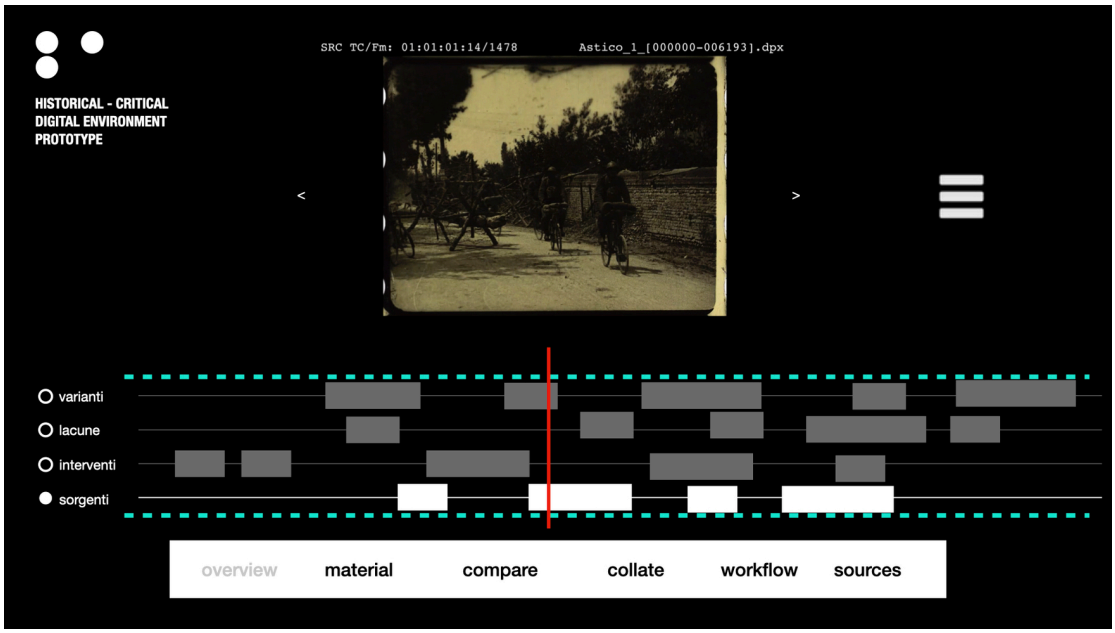


Figure 15. Historical-Critical Digital Environment Prototype

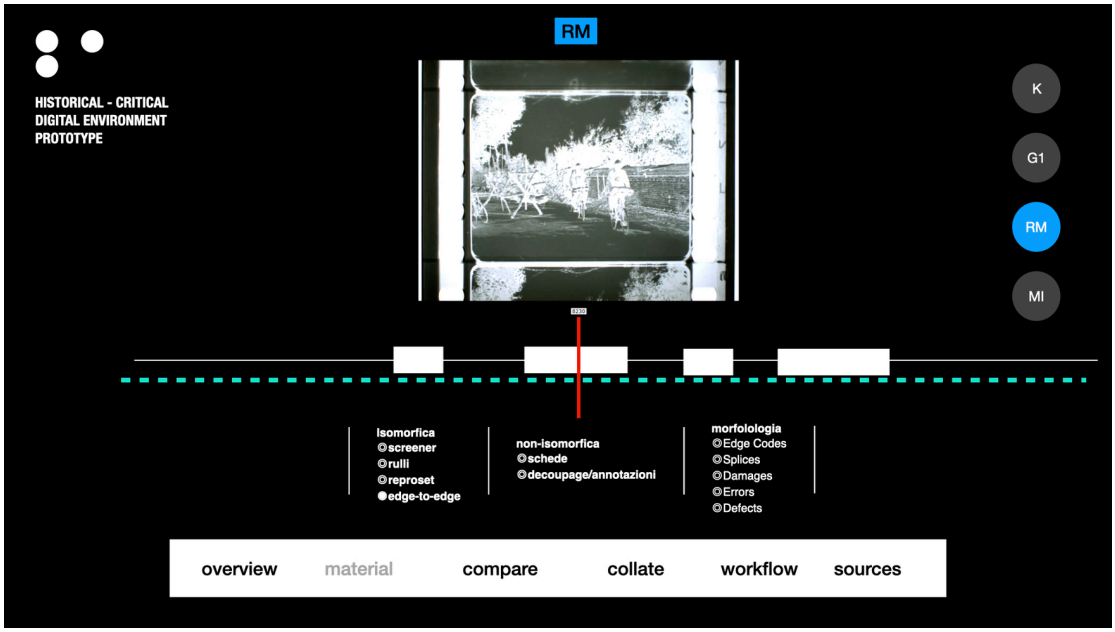


Figure 16. Historical-Critical Digital Environment Prototype

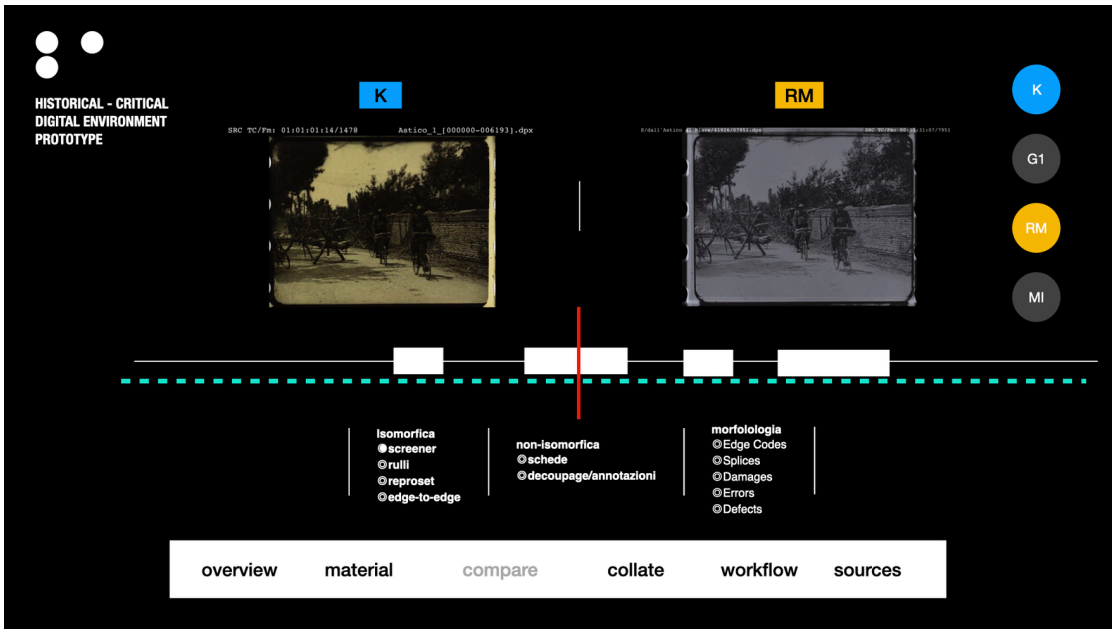


Figure 17. Historical-Critical Digital Environment Prototype

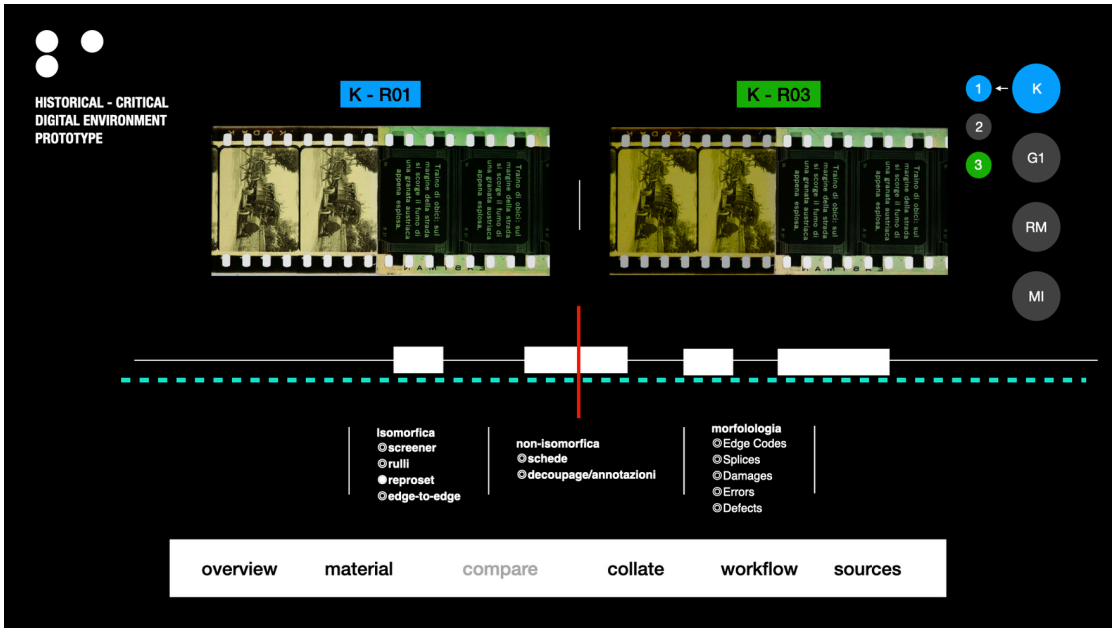


Figure 18. Historical-Critical Digital Environment Prototype

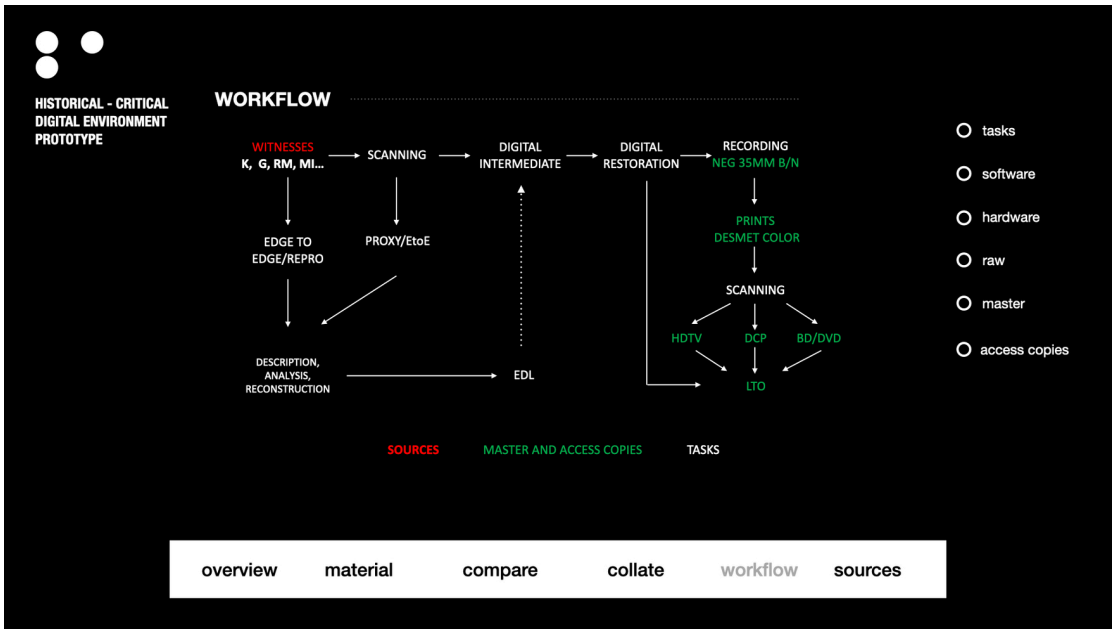


Figure 19. Historical-Critical Digital Environment Prototype

Our operational model also envisages further experimental workplaces, where real-time, virtual collaboration on content, remote expertise and training can be carried out. In other words, distant research and remote working, using mixed-realities environments and devices (such as document camera) on materials and original documents preserved in the archives and laboratories. This will involve the contribution of scholars, archivists, and technicians from different disciplines during live work sessions which are useful both for research and training purposes.

The basic design presented here is one of the possible modellizations of a digital critical film edition, which opens a range of new possible standards and normativities. Alongside the traditional form that comes to mind while thinking of literary editions (the critical text, apparatus, etc.), it also appears as an interdisciplinary work environment, a temporary assembly of different interfaces and forms of visualization, and different scales and ways of examining the sources.

This kind of digital environment can also act as a meeting place between laboratory processes and scholars, and boost awareness of the sources that can be produced by digitization (the above-mentioned 'digital source criticism'). In this direction, the laboratories used for these activities should envisage

> more standardized processes of documentation and transparency [...] [B]y describing the frameworks within specific labs [...] the film historian needs to have awareness of the economic, technological, institutional, cultural, and aesthetic *filters* that affect the results from digitization. Building on established principles of restoration ethics, a historian should document all the aspects that lead to the specific appearance of the object of study (Flueckiger et al. 2016: 119).

Let us take the example of preservation practices and scanning in particular. In the case of *La battaglia* our digital raw material comes from different film scanners and, before that, from different photochemical workflows (fig 20). This multitude of sources invites us to consider the conditions for the existence of digital surrogates: '*every scan is a reading under certain conditions* [...] scanning is not a transparent practice but a transformation process that is crucial for the final results' (Flueckiger et al. 2016: 109).

Witness	Scanning	Photochemical
K (Associazione Kinoatelje)	Arriscan, L'immagine ritrovata / Kinetta, Reto.ch	From 1918 nitrate
G1 (Cineteca del Friuli/Lobster Films)	Cintel Blackmagic, La Camera Ottica	Dupe Neg from HagheFilm (original nitrate no longer available)
G2 (Cineteca del Friuli/Lobster Films)	Cintel Blackmagic, La Camera Ottica	Dupe Neg from HagheFilm (original nitrate no longer available)
G3 (Cineteca del Friuli/Lobster Films)	Cintel Blackmagic, La Camera Ottica	Dupe Neg from HagheFilm (original nitrate no longer available)
RM (Istituto Luce)	Arriscan, LUCE/Cinecittà	Dupe Neg from Unknown route (original nitrate no longer available)
MI (Cineteca Italiana)	Sondor Altra/Spinner MWA, Cineteca Milano-Nitrato Film	From 1927 nitrate
TO (Museo Nazionale del Cinema)	Lasergraphic, MNC	Dupe Neg from Unknown route

Figure 20. Film Scanners' Overview

Like in the monasteries of medieval Europe, with film scanning technology, every archive can aspire to have its own in-house *copyist*. The medium- and long-term results of this nevertheless remain to be seen and, without serious assessment methods and documentation protocols, no criticism can be made of most of the current digital film artefacts.

As such, by making processes normally hidden in archive and laboratorial practices visible and explorable, the critical edition is apt to foster in film scholars and historians the development of a 'critical attitude' towards material film culture (Flueckiger et al. 2016: 120) and towards the infrastructures making up and ordering digital representations.

6 Conclusions: a Tactical (Media) Infrastructure

To conclude, what goals can a critical edition have, beyond its traditional uses? A possible road could be to see it as a *tactical (media) infrastructure*:

> I would like to think through the way in which counter-infrastructures can be thought about as *tactical infrastructures*. That is, how through the creation of specific formations, temporary or otherwise, new modes of knowing and thinking, assembling and acting can be made possible by bringing scale technologies together (Berry 2016).

Here Berry refers to critical infrastructure studies and the notion of tactical media (Garcia and Lovink 1997), but what is even more interesting is that he finds in Feenberg's critical theory of technology and in design processes specific points of intervention and contrast with the dominating epistemic, institutional, and infrastructural grounds. The concept of design as the process to generate new forms of knowledge (Schnapp 2014), as initially framed through McCarty and Drucker, returns here in the form of tactical infrastructure, even questioning the role of the institutional and disciplinary spheres charged with the preservation and transmission of knowledge embodied in film artefacts.

The critical edition as tactical (media) infrastructure acts from the bottom up, offering formal, discursive, and temporary material assemblages (Bennett, 2010) open to new modellizations. In this sense, it hacks the data set of primary sources and the adopted historiographical, archival, and computational models. In this framework, the critical edition is a place of interaction between subjects from different fields and disciplines and a provisional, non-formalized, trans-institutional, and therefore potentially disruptive agent, since it ultimately becomes a tool of political criticism (Parikka 2012). With the *La battaglia dall'Astico al Piave* project we have attempted to produce a critique of digital representations of artefacts, and to offer an environment that places value on the flow of relations, entanglements, and palimpsest, in accordance with a critical framework of the cultural industry and film heritage. In short, we tried to go beyond a traditional film restoration and *restitutio textus* to design an environment that injects new historical and theoretical insights and ultimately acts as a tactical (media) infrastructure. Nevertheless, much remains to be done. We trust that the second phase of the project, as briefly introduced in the last paragraph, will be able to answer the many unresolved issues and introduce to the field a valid experimental example of a historical-critical digital film infrastructure.

References

Arrighetti, Walter (2017). "The Academy Color Encoding System (ACES): A Professional Color-Management Framework for Production, Post-Production and Archival of Still and Motion Pictures". *Journal of Imaging* 3(4): 40. https://doi.org/10.3390/jimaging3040040.

Arrighetti, Walter (2019). "The Interoperable Master Format (IMF) in Film Preservation." *Journal of film Preservation* 101: 35-44.

Barnard, Timothy, Kessler, Frank and Le Forestier, Laurent (2020). *Montage, Découpage, Mise en Scène: Essays on Film Form*. Montréal: Caboose.

Barricelli, Barbara Rita, Casiraghi, Elena, Lecca, Michela, Plutino, Alice and Rizzi, Alessandro (2020). "A cockpit of multiple measures for assessing film restoration quality." *Pattern Recognition Letters* 131: 178–184.

Bennett, Jane (2010). *Vibrant Matter. A Political Ecology of Things*. Durham: Duke University Press.

Bernardi Joanna, Cherchi Usai, Paolo, William Tami, and Yumibe Joshua, (2021). *Provenance and Early Cinema*. Bloomington: Indiana University Press.

Berry, David M, (2016). "Tactical Infrastructures." *Stunlaw*, http://stunlaw.blogspot.com/2016/09/tactical-infrastructures_94.html (last accessed 12 July 2021) 2016.

Berry, David M and Fagerjord, Anders, (2017). *Digital Humanities. Knowledge and Critique in a Digital Age*. Cambridge: Polity Press.

Bordina, Alessandro and Venturini, Simone (2012). "Operational Practices for Film and Video Preservation and Restoration Protocol." In *Preserving and Exhibiting Media Art. Challenges and Perspectives*, edited by Julia Noordegraaf, Cosetta Saba, Barbara Le Maître, and Vinzenze Hediger. 253-303. Amsterdam: University of Amsterdam Press.

Brandi, Cesare (1963). *Teoria del restauro*. Torino: Einaudi.

Brown, Harold (2020). *Physical Characteristics of Early Films as Aids to Identification. New Expanded Edition*. Brussels: FIAF (edited by Blot-Wellens, Camille; first and second edition: 1967 and 1990).

Burghardt, Manuel, Heftberger, Adelheid, Pause Johannes, Walkowski Niels-Oliver, Zeppelzauer, Matthias (2020). "Film and Video Analysis in the Digital Humanities – An Interdisciplinary Dialog." *Digital Humanities Quarterly* 14 (4) http://digitalhumanities.org/dhq/vol/14/4/000532/000532.html (last accessed 12 July 2021).

Bursi, Giulio (2007). "DVD ed edizioni critiche." *Cinergie* 13.

Bursi, Giulio and Venturini, Simone (2008). *Critical Editions of Film*, Udine: Campanotto.

Canosa, Michele (2001). "Per una teoria del restauro cinematografico." In *Storia del cinema mondiale. Teorie, strumenti, memorie*, edited by Gian Piero Brunetta, Torino: Einaudi.

Catanese, Rossella (2014). *Lacune binarie. Il restauro dei film e le tecnologie digitali*, Roma: Bulzoni.

Catanese, Rossella and Parikka, Jussi (2018). "Handmade films and artist-run labs: The chemical sites of film's counterculture." *Necsus* 2: 43:63.

Daston, Lorraine, and Galison, Peter (2007). *Objectivity*, New York: Zone Books.

Dobson, James E. (2019). *Critical Digital Humanities. The Search for a Methodology*. Urbana: University of Illinois Press.

Drucker, Johanna (2014). *Graphesis Visual Forms of Knowledge Production*. Cambridge: Harvard University Press.

Drubek-Mayer, Natascha and Izvolov, Nikolai (2006). "Critical Editions of Film on Digital Formats." *Cinéma & Cie* 8.

Faccioli, Alessandro, Scandola, Alberto (2014). *A Fuoco l'Obiettivo. Il cinema e la fotografia raccontano la grande guerra*. Bologna: Persiani.

Faccioli, Alessandro (2016). "Monumenti visivi per la vittoria: dai film 'dal vero' a 'Guerra nostra'." *Immagine. Note di Storia del Cinema* 13: 7-72.

Faccioli, Alessandro (2020). *Visioni della Grande guerra. Immagini sopravvissute, ritrovate, riutilizzate. Vol. 1*. Torino: Kaplan.

Farinelli, Gianluca, Mazzanti, Nicola (2001). "Il restauro cinematografico: metodo e tecnica." In *Storia del cinema mondiale. Teorie, strumenti, memorie*, edited by Gian Piero Brunetta, Torino: Einaudi.

Fickers, Andreas (2012). "Towards a New Digital Historicism? Doing History in the Age of Abundance." *VIEW Journal of European Television History and Culture*, 1: 19–26.

Flanders, Julia and Jannidis, Fotis (2019). *The Shape of Data in Digital Humanities. Modeling Texts and Text-based*. New York: Routledge.

Flueckiger, Barbara (2012). "Material properties of historical film in the digital age." *Necsus* 2: 135-153.

Flueckiger, Barbara (2015). "Color Analysis for the Digital Restoration of *Das Cabinet des Dr Caligari*." *The Moving Image* 15 (1): 22-43.

Flueckiger, Barbara, Heller, Franziska, Op den Kamp, Claudy and Pfluger, David (2016). "'Digital Desmet' Trénslating Early Applied Colors." *The Moving Image* 16 (1): 106-124.

Flueckiger, Barbara, Op den Kamp, Claudy and Pfluger, David (2018). "A Material-Based Approach to the Digitization of Early Film." In *The Colour Fantastic. Chromatic Worlds of Silent Cinema*, edited by Giovanna Fossati, Victoria Jackson, Bregt Lameris, Elif Rongen-Kaynakçi, Sarah Street, Joshua Yumibe, 237-259. Amsterdam: Amsterdam University Press.

Flueckiger, Barbara (2020). "Film Colors. Materiality, Technology, Aesthetics." In *Color Mania. The Material of Color in Photography and Film*, edited by Barbara Flueckiger, Eva Hielscher and Nadine Wietlisbach, 17-49, Zurich: Winterthur: Lars Müller; Fotomuseum Winterthur.

Fossati, Giovanna (2009 and 2018), *From Grain to Pixel. The Archival Life of Film in Transition*, Amsterdam University Press: Amsterdam.

Fossati, Giovanna, van den Oever, Annie (2016). *Exposing the Film Apparatus. The Film Archive as a Research Laboratory*. Amsterdam: Amsterdam University Press.

Frappat, Marie (2013). "L'école bolonaise' de restauration des films." In *L'avenir de la mémoire. Patrimoine, restauration, réemploi cinématographiques*, edited by André Habib e Michel Marie, 39-46. Villeneuve d'Ascq; Presses Universitaires du Septentrion.

Gschwind, Rudolf (2002). "Restoration of Movie Films by Digital Image." In *Preserve than Show*, edited by Dan Niseen, Lisbeth Richter Larsen, Thomas C. Christensen and Jesper Stub Johnsen, 168-178, Copenhagen: Danish Film Institute.

Ginzburg, Carlo (1979). "Clues. Roots of a Scientific Paradigm." *Theory and Society*, 7 (3): 273-288.

Ginzburg, Carlo (1986). *Miti emblemi e spie. Morfologia e storie*. Torino: Einaudi.

Gosvig Olesen, Christian, Masson, Eef, Van Gorp, Jasmijn, Fossati, Giovanna and Noordegraaf, Julia (2016). "Data-Driven Research for Film History: Exploring the Jean Desmet Collection." *The Moving Image* 16 (1): 82-105.

Gosvig Olesen, Christian and Kisjes, Ivan (2018). "From Text Mining to Visual Classification. Rethinking Computational New Cinema History with Jean Desmet's Digitised Business Archive." *Tijdschrift voor Mediageschiedenis* 21 (2): 127-145 https://www.tmgonline.nl/3/volume/21/issue/2/ (last accessed 12 July 2021).

Hanley Oliver and Heftberger Adelheid (2012). "Scholarly Archivists/Archival Scholars. Rethinking the Traditional Models." *The Velvet Light Trap* 70: 64-65.

Hediger, Vinzenz (2011). "Original Work Performance. Film Theory as Archive Theory." In *Quel che brucia (non) ritorna / What burns (never) returns*, edited by Giulio Bursi, Simone Venturini , 44-56, Udine: Campanotto.

Heftberger, Adelheid (2016). *Kollision der Kader. Dziga Vertovs Filme. Die Visualisierung ihrerStrukturen und die Digital Humanities*. München: edition text+kritik.

Heftberger, Adelheid (2018). *Digital Humanities and Film Studies. Visualising Dziga Vertov's Work*, Cham, Switzerland: Springer.

Heftberger, Adelheid (2019). *Materiality and Montage: Film Studies, Digital Humanities and the Visualization of Moving Images*. DOI:10.33767/osf.io/2brn7.

Hoekstra, Rik, Koolen, Marijn, and van Faassen, Marijke (2018). Data scopes: towards transparent data research in digital humanities. In *Digital Humanities 2018, Puentes-Bridges: Abstracts* ADHO

Humar, Martina (2001). *Il fondo Simonelli: catalogazione di documenti audiovisivi*. MA Dissertation. Udine: Università degli Studi di Udine.

Kant, Immanuel (1996, originally published as *Die Metaphysik der Sitten*, 1797). *The Metaphysics of Morals*, translated by Mary J. Gregor, Cambridge University Press: Cambridge.

Karsdorp Folgert, Kestemont, Mike and Riddell, Allen (2021), *Humanities Data Analysis. Case Studies with Python*. Princeton (NJ): Princeton University Press

Kirschenbaum, Matthew G. (2007). *Mechanisms. New Media and the Forensic Imagination*. Cambridge: The MIT Press.

Kirschenbaum, Matthew G., Ovenden, Richard, Redwine, Gabriela and Donahue, Rachel (2010). *Digital Forensics and Born-Digital Content in Cultural Heritage Collections*. Washington, D.C.: Council on Library and Information Resource.

Lenk, Sabine (2016). "Insight and Axioms: Harold G. Brown and the Identification of Early Films." *The Moving Image*, 16 (1): 35-56.

Loiperdinger, Martin (2003). *Celluloid Goes Digital. Historical-Critical Editions of Films on DVD and the Internet*. Trier: Wissenschaftlicher Verlag.

Garcia, David and Lovink, Geert (1997), "The ABC of Tactical Media." *Nettime* http://www.nettime.org/Lists-Archives/nettime-l-9705/msg00096.html (last accessed 12 July 2021).

Marconi Paolo (2002). *Il restauro e l'architetto. Teoria e pratica in due secoli di dibattito*. Venezia: Marsilio.

Marlazzi, Petra (2021). *Hitherto Intangible Features. Questioni di materialità nella documentazione del restauro del film tra archeologia del reperto, pratiche materiali e ri-mediazione tecnologica*. PhD Dissertation. Udine: Università degli Studi di Udine.

May, Renato (1939). "Storia e tecnica della sceneggiatura." *Bianco e Nero*, 12: 20-21.

Mazzanti, Nicola (DAEFH) (2012). *Challenges of the Digital Era for Film Heritage Institutions. Final Report*. Bruxelles: DAEFH/European Union. http://www.dae-filmheritage.eu/mediapool/100/1000452/data/final_report_en.pdf (last accessed: 12 July 2021).

McCarty, Willard (2005). *Humanities Computing*. London: Palgrave Macmillan.

Melgar Estrada, Liliana, Hielscher, Eva, Koolen, Marijn, Gosvig Olesen, Christian, Noordegraaf, Julia and Blom, Jaap (2017). "Film Analysis as Annotation: Exploring Current Tools." *The Moving Image* 17 (2): 40-70.

Moretti, Franco (2005). *Graphs, Maps, Trees: Abstract Models for Literary History*. London: Verso.

Moretti, Franco (2013). *Distant Reading*. London: Verso.

Nepoti, Elena (2018). *Storia del cinema muto a Bologna. Dalle origini agli anni Venti*. Bologna: Persiani.

Noordegraaf, Julia (2016). "Computational Research in Media Studies: Methodological Implications." *Kwalon* 21 (1): 52-59.

Noordegraaf, Julia, Lotze, Kathleen and Boter, Jaap (2018). "Writing Cinema Histories with Digital Databases: The Case of Cinema Context." *Tijdschrift voor Mediageschiedenis* 21 (2): 106-126.

Noordegraaf, Julia, (2019). "Crossing Boundaries in Digital Archives: Activating Audiovisual Heritage Through Human-Machine Interaction." In *Moving Pictures, Living Machines. Automation, Animation and the Imitation of Life in Cinema and Media*, edited by Greta Plaitano, Simone Venturini and Paolo Villa, 245-252, Milano-Udine: Mimesis.

Olsen, Bjørnar , Shanks, Michael, Webmoor, Timothy, Witmore Christopher (2012). *Archaeology. The Discipline of Things*. Berkeley – Los Angeles: University of California Press.

Op den Kamp, Claudy (2017). *The Greatest Films Never Seen. The Film Archive and the Copyright Smokescreen*. Amsterdam: University Amsterdam Press.

Ordelman, Roeland, Melgar, Liliana, Van Gorp, Jasmijn and Noordegraaf, Julia (2019). "Media Suite: Unlocking Archives for Mixed Media Scholarly Research." In *Selected papers from the CLARIN Annual Conference 2018*, edited by Inguna Skadina and Maria Eskevich, 133–143, Linköping Electronic Conference Proceedings 159. Linköping University Electronic Press, https://ep.liu.se/en/conference-issue.aspx?series=ecp&issue=159 (last accessed 12 July 2021).

Parikka, Jussi (2012). "Archives in Media Theory: Material Media Archaeology and Digital Humanities." In *Understanding Digital Humanities*, edited by David M. Berry, 85-104, London: Palgrave Macmillan.

Parks, Lisa and Starosielski, Nicole (2015). *Signal Traffic. Critical Studies of Media Infrastructures*, Champaign (IL): University of Illinois Press.

Pesenti Campagnoni Sarah (2013). *La guerra sepolta. I film girati al fronte tra documentazione, attualità e spettacolo*. Torino: Università degli Studi di Torino.

Pitassio, Francesco and Venturini, Simone (2014). "Building the Institution. Luigi Chiarini and Italian Film Culture in the 1930s." In *Knowledge Production, Institution Building, and the Fate of the Avant-garde in Europe, 1919-1945*, edited by Malte Hagener, 249-267, Oxford - New York: Berghahn Press.

Prentice, Will and Gaustad, Lars (2017). *The Safeguarding of the Audiovisual Heritage*. London: IASA Technical Committee.

Rheinberger, Hans-Jörg (2010). *An Epistemology of the Concrete. Twentieth-Century Histories of Life*. London: Duke University Press.

Salber Phillips Mark (2013). *On Historical Distance*. New Haven & London: Yale University Press.

Schnapp, Jeffrey T. and Todd Presner (2009). *Digital Humanities Manifesto 2.0*. http://www.humanitiesblast.com/manifesto/Manifesto_V2.pdf (last accessed: 12 July 2021).

Schnapp, Jeffrey T. (2014). *Knowledge Design. Incubating new knowledge forms | genres | spaces in the laboratory of the digital humanities*. Hannover: Herrenhauser Lectures.

Tanselle, G. Thomas (2020). *Descriptive Bibliography*. Charlottesville: Bibliographical Society of the University of Virginia.

Treleani, Matteo (2013). "Recontextualisation Ce que les médias numériques font aux documents audiovisuels." *Réseaux* 177: 233-258.

Venturini, Simone (2006). *Il restauro cinematografico. Princìpi, teorie, metodi*, Udine: Campanotto.

Venturini, Simone (2007a). "Dal restauro all'edizione critica." *Cinergie* 12: 53-55.

Venturini, Simone (2007b). *Le spoglie del serpente. Storia e teoria del restauro cinematografico: dal restauro all'edizione critica del film*. PhD Dissertation. Udine: Università degli Studi di Udine.

Venturini, Simone, Della Rovere, Lorenzo, Santancini, Claudio, Santi, Mirco, Sasso, Gianandrea, Nedoh, Ivan, Godina, Karpo, Rozman„ Marjan, Meden, Jurij, and Matteo Lepore (2013). "Behind an Experimental Film Heritage. Preservation and Restoration Protocols and Issues." *Journal of Film Preservation* 89: 115 – 123.

Venturini, Simone (2019). "L'archeologia dei media come 'angolo cieco' delle scienze umane." In *Archeologia dei media: nuove prospettive per la storia e la teoria della comunicazione*, Jussi Parikka, 253-271, Roma: Carocci.

Vignaux, Valérie (2003). "Archives et Histoire: des archives pour l'histoire - du cinéma?" *1895* 40: 107-119.

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