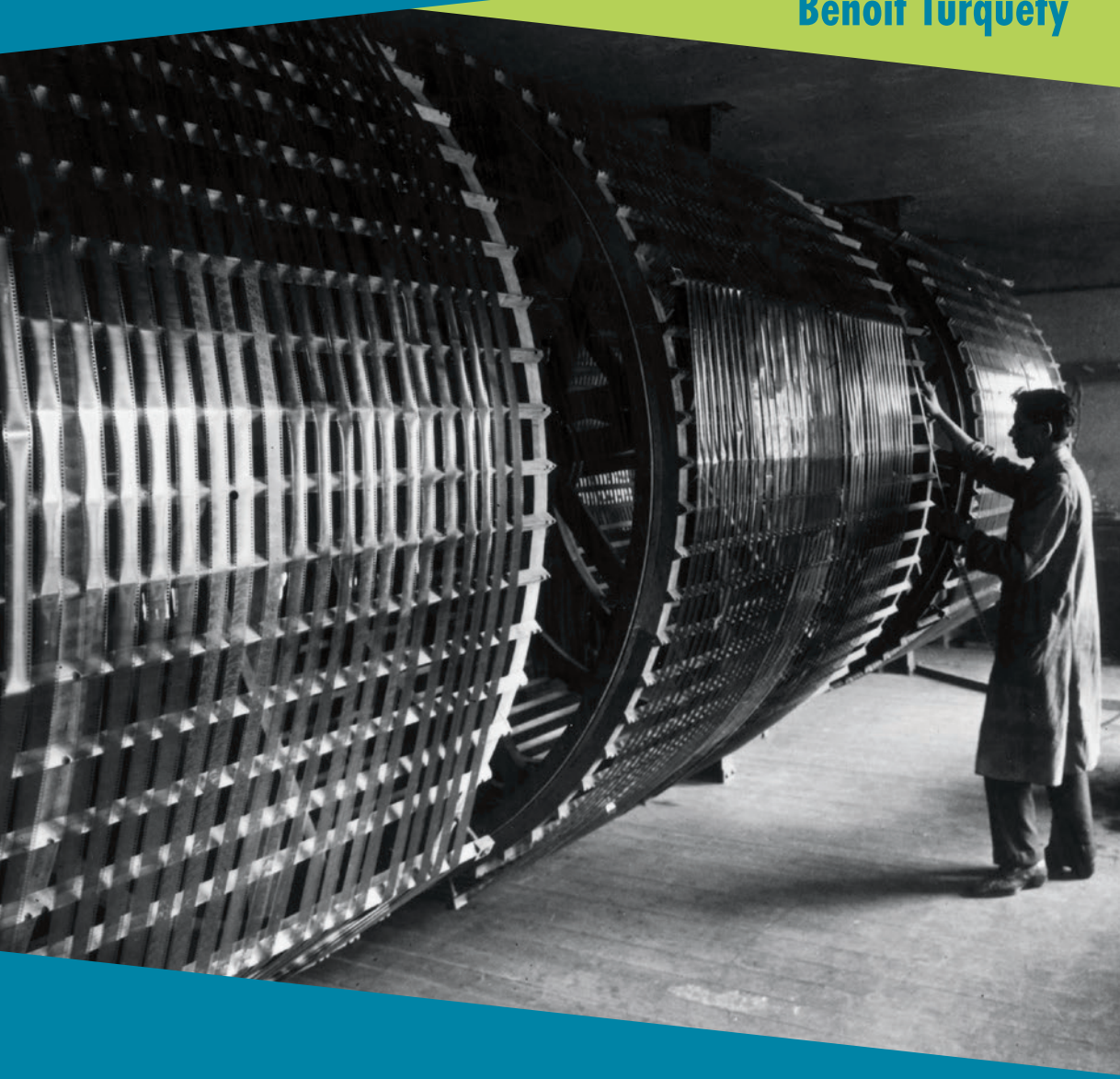
INVENTING CINEMA

Machines, Gestures and Media History

Benoît Turquety



Amsterdam University Press

Cinema and Technology

Cinema and Technology

Cinema and Technology focuses on the emerging field of study on the history of film technology and its impact on the way the world is experienced, rationalized and apprehended. The materiality and nature of film devices, their function and use in diverse industrial, educational, and social contexts, and the integration of film technologies as an enduring element of consciousness, forms the basis of the scholarship presented in our books.

Cinema and Technology is published in association with the Laboratoire CinéMédias at Université de Montréal and the TECHNÈS International Research Partnership on Cinema Technology, supported by The Social Sciences and Humanities Research Council of Canada Partnership Grant, as well as The Canada Research Chair in Cinema and Media Studies.

Inventing Cinema

Machines, Gestures, and Media History

Benoît Turquety

Translated by Timothy Barnard

Amsterdam University Press

Originally published as: *Inventer le cinéma. Épistémologie : problèmes, machines*, Éditions L'Âge d'Homme (Lausanne), 2014.

Series logo created by Erwan Geffroy with a font by Isaac González

Cover illustration: *Film drying at Kinemacolor House, Wardour Street, London, c. 1910s*, printed with permission from the Science & Society Picture Library

Cover design: Coördesign, Leiden
Lay-out: Crius Group, Hulshout

ISBN	978 94 6372 462 3
e-ISBN	978 90 4855 046 3
DOI	10.5117/9789463724623
NUR	670

1. That the instruments be very accurate, so that the expense not be pointless and that there be no chance of error.
2. That their cost not be increased by superfluous adornment in order that they be used more frequently by putting them within reach of people of modest means as much as possible.
3. That their construction be the simplest, the most natural and most solid possible, in order for them to be copied or repaired at the least cost, with the least learning, and with the least level of skill.
4. That they be applicable to the greatest number of applications, when the extent of their use does not detract from their simplicity, so as not to multiply their number unnecessarily and in order to save expense and usefully and pleasingly to provide the means for varying experiments of the same kind.

– Abbé Jean Antoine Nollet, *Programme, ou Idée générale d'un cours de Physique expérimentale, avec Un Catalogue raisonné des Instrumens qui servent aux expériences*, Paris, 1738

In memoriam Jules Carpentier

For François Albera

Table of Contents

Acknowledgements

Firstly, I would like to thank the Section d'histoire et esthétique du cinéma at the Université de Lausanne, the Sandoz Family Foundation, and the TECHNÈS International Research Partnership on Film Techniques and Technologies.

This volume took shape through research carried out under the aegis of the Lausanne section's research group 'Dispositifs', led by Maria Tortajada. In this sense, it enters into dialogue in particular, explicitly or implicitly, with the individual or joint work of François Albera and Maria Tortajada. I can only thank them as warmly as possible for their availability and interest and for the exactingness and amiability they always demonstrated in our intellectual exchanges.

Some underlying elements of the ideas found in this volume took root in a doctoral seminar at Université Paris 8 Vincennes – Saint-Denis that I participated in several years ago, when I was developing my doctoral dissertation. This seminar was led by Guy Fihman and Claudine Eizykman and I extend my thanks to them here.

The TECHNÈS framework has also been important for the development of this book. I would like to thank, in particular, Santiago Hidalgo and André Gaudreault for their sustained enthusiasm.

Very warm thanks to Werner Nold, who worked as a film editor at the National Film Board of Canada for more than 30 years, and to his wife Lucette Lupien. Our discussions were fascinating, their information was irreplaceable, the machines were splendid, and our friendship invaluable.

My thanks also for responses to my questions from: Jean-Marc Lamotte, head of the heritage department at the Institut Lumière in Lyon; to Laurent Mannoni, director of cultural heritage and conservation of cinematographic technology at the Cinémathèque française; to Marie-Sophie Corcy, head of collections in the field of communication at the Musée des Arts et Métiers; and to Todd Gustavson, director of the collection of devices at the George Eastman House, now the George Eastman Museum.

Finally, my thanks, once again, to Caroline Zéau, for everything.

Introduction: The Problems of Digital Cinema

Abstract
This introduction first describes the current situation in the cinema production industry and the discipline of film studies. Digital means involve new problems regarding remediation, perceptual specificities, the notion of reproducibility, or archival ethics. These transformations force us to rethink what the concept of invention means in media studies. In turn, this implies finding ways to analyse both machines and gestures.

Keywords: digital cinema, archival theory, technology, reproducibility, remediation, facsimile

This book materialized at a quite precise moment, albeit the periodization and determinations of this moment remain fairly difficult to specify. It lies in the midst of a period when 'cinema' is being transformed, with the gradual abandonment of its original system of analogue image and sound recording on a photo-chemical base in favour of their digital coding and storage. This evolution has not only affected cinema: it has already had an impact on music and sound recording, photography, book publishing, etc. In the case of cinema, its complexity has delayed somewhat a process that soon appeared inevitable.

This shift has shaken up every field in which cinema operates: with the creation of new professions and the transformation of existing trades; the appearance of new industries and the bankruptcy of film laboratories and motion picture camera manufacturers; companies no longer producing film stock; major transformations in the ways in which 'copies' of 'films' are distributed; profound alterations to the system's overall economy involving entirely new circulations of money; radical changes to the way moving images are consumed by viewers (on computers, mobile

Turquety, B., *Inventing Cinema: Machines, Gestures, and Media History*. Amsterdam: Amsterdam University Press, 2019.
DOI 10.5117/9789463724623_INTRO

telephones, etc.); new problems for film archives; the list goes on and on. The scope of the transformations appears so great that our vocabulary no longer seems adequate to the task: can we still call cinematic works 'films' if film, meaning light-sensitive film stock, is no longer present at any point in the production, storage, or dissemination process?[1] Can we still use the term 'cinema' to name what is produced or consumed in ways seemingly so different from the traditional model – or must we speak more broadly and more vaguely of moving images, of media, of expanded cinema, of 'post-cinema'? The very essence of the medium appears to be called into question, as Francesco Casetti, for example, has summed up:

> The advent of the digital image changes cinema's relationship with physical reality. No longer, the story goes, are we dealing with an image based (as with photography on film) exclusively on a direct record of objects placed in front of the camera, the essential link between the world and its representation of things without ever having need of things themselves, thanks simply to the elaboration of an algorithm.[2]

This transition to the digital appears to have changed everything – everything except *one* thing, in fact: the viewer's experience in the movie theatre. Strangely, the 'digital revolution' is even built on a heartening assurance: for the viewer, all of this changes nothing. You will not see the difference, or hear it either. Even if you wanted to, it would not be possible. Naturally, the digital appears to bring novelties with it – so-called 3D, for example – but they already existed in 'traditional cinema' (silver gelatin, photo-chemical, analogue). As John Belton points out in an article with the explicit title 'Digital Cinema: A False Revolution': 'All that the proponents of digital projection are claiming is that it is comparable to 35mm. That does not sound like a revolutionary technology.'[3]

What, then, is happening? Is it justifiable that every movie theatre in the world has to purchase digital projectors, whose technology is doomed to obsolescence, in the short term because the standards for digital projection are not yet stable or worked out, even if it means getting rid of their 35mm projectors in (more or less) good operating order?

1 See Dan Streible, 'Moving Image History and the *F*-Word'.
2 Francesco Casetti, 'Sutured Reality: Film, from Photographic to Digital', 95.
3 John Belton, 'Digital Cinema: A False Revolution', 105.

All of these issues have had a major 'impact'[4] on film theory and film studies. In particular, they have led to the re-examination of the role of technics in the discipline. In fact, for a number of reasons, this discipline was established independently from technological questions, if not by obscuring them. Although film history was, initially and until the mid-1920s, the history of its technics, cinema's legitimation as an art went hand in hand with a downplaying of these issues as questions shifted towards the films themselves, towards movements and currents, artists and 'auteurs'. To a degree, the technical question, in some of its precise forms (depth of field in particular) returned to the theoretical forefront in the 1970s, under the impetus in particular of Jean-Louis Comolli's famous series of texts in *Cahiers du cinéma* in 1971-1972 entitled 'Technique et idéologie'.[5] Other studies followed,[6] in some cases guided by the idea that a *materialist* history of cinema could not dispense with technological issues and the analysis of determinations that guide it and that, in turn, it could influence. Quickly, however, technical questions were relegated to the background once again, with the exception of studies of historical moments of manifestly technological import, in particular the advent of the 'talking film'. But even in these cases the approach adopted was primarily economic and not especially technological.

At the same time, historical or pragmatic technological studies of cinema came to constitute a separate body of work, often carried out by people outside the university and little known to those within it.

Today, these questions are re-emerging, in tandem with transformations seen as fundamental to the system of 'cinema' as a whole, but whose place and the issues they raise are not always grasped precisely. This is due both to the fact that these changes are overwhelmingly taking place on multiple fronts and to the instability of the devices themselves. The latter's properties, forms, and functions seem almost indescribable: ephemeral 'black boxes' that are constantly being 'improved', with yesterday's obvious

4 A major conference was held in Montreal from 6 to 11 November 2011 entitled 'The Impact of Technological Innovations on the Historiography and Theory of Cinema', co-organized by André Gaudreault (Grafics/Université de Montréal) and Martin Lefebvre (Arthemis/Concordia University), under the aegis of the Permanent Seminar on Histories of Film Theories.

5 Jean-Louis Comolli, 'Technique et idéologie'. Published in translation as 'Technique and Ideology: Camera, Perspective, Depth of Field'.

6 See in particular Patrick Ogle, 'Technological and Aesthetic Influences on the Development of Deep-Focus Cinematography in the United States'; Douglas Gomery, 'The Coming of the Talkies: Invention, Innovation and Diffusion'; Edward Buscombe, 'Sound and Color'; Edward Branigan, 'Color and Cinema: Problems in the Writing of History'; and Brian Winston, 'A Whole Technology of Dyeing: A Note on Ideology and the Apparatus of the Chromatic Moving Image'.

defects or qualities suddenly disappearing or becoming *unrecognizable*. The temptation is therefore great to try to isolate, beyond these successive transitory and ill-defined incarnations, the 'essence' of these procedures and thus to bring the theoretical issues raised by such transformations (but also their perceptual and aesthetic issues) back to an overall ontological framework.

The fundamental problem in apprehending this shift from photo-chemical base to digital storage – by way of that fascinating but today often forgotten object, the analogue electronic image on magnetic tape, the *video* – is primarily methodological. It consists of constructing a possible mode for apprehending the transformations underway that would make it possible to grasp all of their aspects without reducing their complexity. One must, for example, conceive of the connections between technics and aesthetics without falling into 'technological determinism', a methodological spectre that sets out a simple and unidirectional link between device and form. Rather, this link can be found on several levels. We might ask ourselves, for example, how a filmmaker pictures and chooses his or her material, beyond or *taking into account* the often crucial economic questions. Why did Raymond Depardon shoot *Délits flagrants* and *Modern Life* in 35mm rather than in 16mm or on digital equipment? Johan van der Keuken shot *The Long Holiday* with a small digital camera rather than on 16mm and wondered explicitly, in the film itself, how that changed the shots he took, how this new form in his hand, this different weight, modified his style. In 1990, Philippe Grandrieux commissioned Robert Kramer to make a one-hour film in a single uninterrupted shot, a performance made possible by (analogue) video, something impossible with film. Kramer made *Berlin 10/90*, an extraordinary reflection on (among other things) that formal and political monstrosity known as the sequence shot.[7]

We may also ask ourselves what may change the base on which the work is viewed, and the perceptual issues raised by the technical ways in which it is viewed. Today, for example, Michael Snow and Peter Kubelka do not allow their *films* to be 'reproduced' on DVD. This does not prevent Snow from making videos or digital works, some of which explicitly address the possibilities of the new medium. **Corpus Callosum* (2002) is a case in point. But ↔ (*Back and Forth*, 1969) and *La Région centrale* (1971), made on (16mm) *film*, must be viewed only on film – even though this means that

7 On this point I take the liberty of referring the reader to my article 'Épaisseur du temps et chronographie de la terreur: *Berlin 10/90 le Temps dans le cinéma documentaire*'.

the opportunities for seeing these works, today, are singularly reduced. Snow has made some exceptions: *'Rameau's Nephew' by Diderot* (*Thanx to Dennis Young*) *by Wilma Schoen* (1974) and *Presents* (1981) were released on VHS in 2002 and then on DVD in 2012 and 2010 respectively.[8] Snow has also produced a rather incensed illustration of the reasons for his reticence: in 2003, he made a DVD from *Wavelength* (1967). This new work is a meditation on the fundamental principle of the digital: compression. The original 45-minute film was broken down into three equal 15-minute segments, scanned directly from a 16mm print without eliminating the scratches and dust on it and superimposed. The result is entitled *WVLNT*, or *WAVELENGTH For Those Who Don't Have the Time*;[9] the transition between the two media brought about a complete reconfiguration of the work's plastic and temporal densities. The compressed and digitized film is a completely different film.

This question of the transition between media has been a central topic of discussion in the film archive milieu. Restoring a film using current methods will, at one point, involve changing the base of the work, which today is often definitive. The 'original' silver gelatin print is scanned and digitally reworked; until recently, it was then copied back onto film. Today, however, it is packaged in the form of a DCP, or digital cinema package – the digital equivalent of a distribution print – and/or a DVD. What happens to the work in the course of this transition is one of the major questions confronting archivists. Here, too, the issues are many, and each is complicated by financial implications. What does it mean, ultimately, to restore a film? And what are the tasks of a film archive? All that may be recast by the digital. Giovanna Fossati, for example, explained in 2009:

> Digital projection at high resolution (the only kind of digital projection whose quality is comparable with that of film projection) is in many ways not a viable option yet, as discussed earlier. Projectors are too expensive and technology is still developing too rapidly, resulting in a lack of standardization, and, thus, in high risks.
> However, apart from technical aspects, there is another important argument for archives not to use digital projection for exhibition. If preserving films as such is one of the film archives' primary tasks, preserving the practice of film projection, and its related viewing experience, is perceived as an equally important task. For many film archivists, indeed, projecting

8 Published by Re:voir vidéo in Paris.

9 Published by Art Metropole, Toronto.

> a (digitized) film-born film through a digital projector means betraying its original form. This is no surprise since the FIAF code of ethics explicitly states that only a duplicate on film, in the original format, is to be considered a preservation master (FIAF, 1998).[10]

The situation changed drastically in 2013. Although standardization of digital projection had still not been achieved, as debate still raged between the champions of '2K' and '4K'[11] in particular, digital projection had become common enough in commercial exhibition that film archives also equipped themselves with it. Today, it is common to attend screenings of digital 'restorations' of films originally shot on film in practically every institution connected with the International Federation of Film Archives (FIAF) – sometimes without this fact ever being mentioned in the institution's programme. Several points in Fossati's above remarks could, nevertheless, be commented on, as they articulate recurring presuppositions in discussions of digital cinema. In the first paragraph she states that, under certain conditions, digital projection is of *comparable quality* to film projection. These conditions have to do above all with image resolution. Yet, such a statement supposes the existence of criteria for judging the quality of the respective systems, which would make it possible to compare them. Naturally, the very definition of *quality* in this context, and thus as a result the determination of criteria, can only be entirely ideological. A high-resolution image is of 'higher quality' than a 'low-resolution' image, just as 35mm is of 'higher quality' than 16mm or Super-8. This criterion is based on the quantity of information contained in the image, seemingly conveyed by the 'resolution' data. Four million pixels for an image is objectively more information than two million; it is thus a 'higher quality' image.

To describe phenomena in this way is already to conceive of the image as an ensemble, a system or a flow of information and to think of it in terms of transmission, mediation, and transparency rather than in terms of plasticity, depth, and form. An image conceived as an accumulation of information is already an image conceived digitally, even when it is recorded on a photo-chemical base – or painted on canvas, carved in wood, etc. Are the great and sumptuous plastic depth of the reversal 16mm stock in

10 Giovanna Fossati, *From Grain to Pixel: The Archival Life of Film in Transition*, 99-100.

11 '2K' is the term for an image with 2048 pixels (a standard adopted for 'digital cinema' or D-Cinema, as specified in 2005 by the Digital Cinema Initiatives [DCI]). A '4K' image has 4096 pixels.

Jonas Mekas's *Notes on the Circus* (1966), the materiality of its contrasts and superimpositions, the specific granularity of its soft-focus and pulsation, the density of its blacks and the iridescence of its reds, of lesser 'quality' than the perfect and no less splendid 35mm VistaVision Technicolor print of *The Searchers*, lit by Winton C. Hoch for John Ford in 1956? Is the amateur 'DV' digital format used by Pedro Costa for *Juventude em marcha* (2006) of lesser 'quality' than the 'HD' used by Michael Mann for *Collateral* (2004)? And what would that mean?

Making these sorts of comparisons between film and digital involves another supposition: recognizing a kind of equivalency between the *grain* of the emulsion and the *pixels* found in digital images. Once this equivalency has been made – and Fossati's book is entirely based on such a thing, as the title itself indicates: *From Grain to Pixel* – such a comparison becomes possible and quantifiable. And yet, it is a dubious comparison, on several levels. On the technical-perceptual level, firstly, as has been explained many times in lectures by Jean-Pierre Beauviala, an engineer, inventor, and head of the Aäton company. The pixels in a digital image form a fixed matrix, an underlying grid that cannot change from image to image, whereas the random position of grain in each silver-gelatin film frame produces a sharp focus and a shifting materiality completely unlike the image definition found in a digital image. This comparison, moreover, is not neutral on the theoretical level, as it supposes the divisibility of the photographic image into 'picture elements', placing the analogue image into the framework through which we understand the digital.

The next part of Fossati's argument has to do with the 'betrayal of a film's original form' potentially involved in the transition between media. On this topic, in a documentary made in 1996-1997, Stan Brakhage declared:

> One of the major things in film is that you have 24 beats in the second, or 16 or whatever the projector's running at. You're in a medium that has a base beat that's intrinsically baroque. And aesthetically speaking it's just appalling to me to try to watch, for example, as I did, Eisenstein's *Battleship Potemkin* on video. I mean, it dulls all the *rrrrip!* of the edit. And because video looks – in comparison to the sharp, hard clarities of snapping individual frames, and what that produces at the cut, video looks like a pudding that's virtually uncuttable, like a gel, a jello, it's all ashake with itself.[12]

12 Colin Still, *Brakhage on Brakhage*, 1996-1997.

Thinking about the shift from one base to another should be seen in light of the question of the 'facsimile', as Erwin Panofsky developed the idea in 1930:

> I wish and hope that we will learn to improve and will continue to make 'better' facsimile reproductions. It is because of these advances, not in spite of them, that we will be increasingly adept at distinguishing the original from its facsimile reproduction. Furthermore, it is because of these advances, and not despite them, that we will increasingly regard facsimile reproductions with benefit and even enjoyment.[13]

A film seen on video is a facsimile of the original. It transmits a certain quantity of the original's 'information' or characteristics, while other information or characteristics disappear or are transformed. In any event, it can only be seen as a facsimile.[14] What remains, as Panofsky remarks,[15] is to evaluate the nature and degree of the transformations for each work according to the degree of the form's dependence on the material in which it is bound up. This question of the relations between form and medium was in play before the digital, whether with respect to the dissemination of works in general, or more precisely with respect to archives. To make, show, and preserve on 'safety stock' (film made out of cellulose acetate) an original 'nitrate' film ('flam' film, made out of nitrocellulose) is already to make a facsimile: the base has changed and the work's visual (and aural) properties with it. This can be accompanied by other transformations with varying degrees of importance: from an orthochromatic emulsion to a panchromatic one; from an original in colour to a black-and-white copy; from a varying projection speed, from about 18 to 20 frames per second, to a standardized 'talking film' speed of 24 frames per second; from one aspect ratio to another; from one audio system to another; etc. The indisputable underestimation in the history of film theory of the perceptual variations brought about by changes in the base is undoubtedly the result of complexly intertwined factors. According to Paolo Cherchi Usai, we should, on the one hand, see in this a limited attention to the 'content' of the image, and on the other a conceptual framework defined by 'a superficial reading of Walter

13 Erwin Panofsky, 'Original and Facsimile Reproduction', 337.

14 On this question and some of its implications for film studies, see the Society for Cinema Studies Task Force on Film Integrity (headed by John Belton), 'Statement on the Use of Video in the Classroom', 3-6.

15 Erwin Panofsky, 'Original and Facsimile Reproduction', 54.

Benjamin's canonical essay "Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit".[16]

FIAF's code of ethics, quoted by Fossati, states that 'within the technical possibilities available, new preservation copies shall be an accurate replica of the source material.'[17] A statement such as this leaves open a wide margin for necessarily ideological interpretation (the 'accuracy' of the 'replica') and for pragmatic relativism by acknowledging constraints, including financial ('within the technical possibilities'). What the digital has transformed is the breadth of this margin, to the point of changing the status of the questions themselves. The problems associated with the facsimile, as well as the possibilities for altering a film's form while restoring it, were already present in the 'photo-chemical era', but not in the same proportions. From photo-chemical to digital, what has changed is not really the operations undertaken but their relations, their relative weight, the proportion of each when they interact. But this shift in proportions is so great that it has forced us to re-examine the precise nature of the operations. Thus, for example, the digital may establish a radical difference between the base of a preservation copy of a film made on film (a duplicate 35mm film preserving the same speed and in the same aspect ratio as the original) and that of the copy made for exhibition (a DCP copy whose projection speed may have been modified). And yet, the digital may make it possible to render the original's *appearance* in a way that would be difficult to achieve (for strictly technical or economic reasons) by photo-chemical means alone. This is striking in the case of the first 'natural colour' film processes, such as Kinemacolor, which will be discussed below, Chronochrome, etc. These additive processes require specific projection systems to achieve their colour synthesis; because the original projection conditions are, in concrete terms, practically impossible to recreate, the possibilities afforded by the digital for the treatment of colour have made it possible to achieve a *simulation* of the process that is certainly closer to the original on numerous points. We thus find an intriguing clash between the *look* of a procedure and the medium, and this is a clash on which archivists must take a position. Fossati, for example, clearly positions herself on the side of simulation: 'I argue that maintaining the original film's look is more important than remaining true to the original format.'[18] Naturally, the emphasis on appearance can only be understood on the basis of concrete familiarity with what each procedure could look

16 Paolo Cherchi Usai, 'La Conservation des images en mouvement', 13-14.

17 'FIAF Code of Ethics', http://www.fiafnet.org/pages/Community/Code-Of-Ethics.html.

18 Giovanna Fossati, *From Grain to Pixel*, 71.

like – with what it could be theoretically, but also with what it could be in concrete terms, in the precise technical (and cultural and social) context in which it was first experienced or shown: the projectors; mechanisms; lamps (the colour temperature, intensity, and throw of the light); screens; emulsions; factors involved in enlarging the image; lighting in the theatre; kinds of images and thus the kinds of film, etc. This therefore involves close familiarity with cinema's technics – requiring in particular that film archives, as part of their work, preserve projection practices for every film format – along with familiarity with the visual experience connected with them each time.

Thus, to understand the problems connected with cinema's shift to the digital we must situate this moment in historical perspective in order to gauge precisely its unprecedented nature. More particularly, therefore, we must elaborate or re-elaborate, in light of the issues that have recently emerged, the means of and questions raised by a technological history of cinema. We must produce tools that will make it possible to grasp this transformation in all its forms, whether having to do with the practices of viewers, film archives, or those working in film production; with film theory; with economics; with commercial, amateur or experimental cinema; with aesthetic forms and issues; etc.

To this end, in the present volume I propose to examine a few historically exemplary machines, whether or not they are recognized as such by film historiography, and, more broadly, other kinds of viewing *dispositifs* and procedures: the Wheatstone stereoscope; the Lumière Cinématographe, Urban-Smith Kinemacolor, etc. These machines could be projects that never came to completion, or whose fundamental technical principles were merely formulated by their authors, as we will see with the devices imagined by Louis Ducos du Hauron and Charles Cros in the 1860s. Alongside these, we will look at the evolution of a few precise technical elements of viewing machines: viewfinders, cranks, etc.

For a variety of pragmatic and theoretical reasons, I have been obliged to abandon, temporarily, the idea of exploring specifically sound-related questions, despite or rather because of their formidable nature. The objects I examine have brought about this focus on visual elements, which has the advantage of making it possible to enter into detail when discussing them. This also demonstrates that it is indeed from within a history of optical phenomena, seen as consistent and generally autonomous, that certain problems associated with 'cinema' were worked out. On the other hand, this approach has the regrettable defect of making us underestimate the

fundamental cultural and epistemological issues around the links between our eyes and ears – between the eye and the body – as they were imagined in the history of science and the history of the arts. Audio and audiovisual questions cannot be underestimated; addressing them will intersect with, amplify, or render more complex what I have been able to do here.

This analysis will make it possible to interrogate what, *technologically*, cinema is – or, rather, how a technological description of cinema should be articulated – as well as the tasks, forms, and means of a history of cinema's technics, or a history of its machines. What are we looking for, what means do we have, what can we expect to find in constructing a history of machines?

To clarify the present moment, that of the transition to digital procedures, this study will focus on the question of invention. Under what conditions can a particular machine be seen as an invention, with all that that supposes in the way of novelty and rupture? The notion of invention, along with the rival notion of innovation, is of interest in that it is immediately historical. It involves studying the machine in the conditions of both its genesis and its reception by a given culture at a given moment. Moreover, it also brings into play a precise conception of history, one which admits as central the possibility of discontinuities in historical movement and that of identifiable ruptures, points of retrogression or moments of upheaval. Acknowledging, as Georges Canguilhem remarks, that 'the complacency of seeking, finding and celebrating precursors is the clearest sign of ineptitude in epistemological criticism,'[19] will lead us to make clear and to understand exactly the breaks and continuities in each machine, in each 'invention', whether imagined or real.

The framework of this endeavour will thus impose a methodology to connect machines and history, to connect an invention with the historical context that enabled its conception, on the one hand, and, on the other, its possible dissemination in society. This book will place a technological analysis of machines alongside a history of technics, an archaeology, and an epistemology.

The former will place devices in their surrounding technical context, which includes both other, pre-existing devices in the same domain or in more or less related domains, on the one hand, and the full range, in a broader sense, of the strictly technical or cultural uses and practices tied to them. In the case of the earliest kinematography devices, this could be the practices or technical conditions of photography at the time (the gestures associated with it, its social uses, its economy), but also mechanics, the

19 Georges Canguilhem, 'L'Objet de l'histoire des sciences', 21.

spread of the sewing machine, the place of kinematics as a discipline in education, changes to the organization of labour in industry, etc.

The archaeology proceeds from the machines to a general history: it takes up the devices as archives of the gestures, operations, and conceptions they objectify. The structure, form, and logic of the machines are the materialization of the operative series that produced them, while also bearing witness to the gestures they replaced or took part in. The machine traces the organized series of gestures that make up the way it is handled, according to which it was conceived, and which, in part, it determines in return. At the same time, each media machine is also the archive of a certain mode of perception. Seeing a film shot by Alexandre Promio with a Lumière Cinématographe is a specific visual experience, one completely different from that produced by watching *With Our King and Queen through India* (1912) on a Kinemacolor projector, and different yet again from viewing a film made by the Skladanowsky brothers with their Bioskop, or from watching the same picture by Promio in one of the 'windows' of the computer screen on which this text is being written. The archaeology of machines will thus make it possible to use devices to create a history of modes of perception, performance, and production.

The epistemology of machines attempts to understand, through the analysis of the objects and their genesis, the epistemological conditions of their conception and the 'implicit conceptual structures' that they put into play. In order to understand a machine in the precise manner in which it was conceived, one needs an idea of what it should be, what it should do, and the best way it can accomplish this task. One needs a sense of its place in the collective imagination and a conceptual framework in which the machine had a role and found the function sought for it. This framework is structured by a constellation of concepts that interact according to a singular configuration; inventors, engineers, users, etc. do not have a systematic awareness of this constellation because it is not always formulated and put into words. In fact, this conceptual framework can never be fully formulated, because the nature of technics situates it, as we shall see, on the side of the synthetic and not of the analytic – on the side of the non-verbal and of gestural or figural transmission rather than discursive explanation. This is the result of the fundamental affinity between machines and images, or more precisely between machines, images, and movement, which can be seen in the historical role granted to machines in our culture. The epistemology of machines thus aims to formulate, at least in part, this 'implicit conceptual structure' and thereby, on the basis of each individual object, to reconstruct the epistemological framework of the machine and of 'cinema' at that moment.

In this I will make central use of the concept of the *problem*, as it has been developed in particular by Gaston Bachelard, Georges Canguilhem, and later Gilbert Simondon. While invention is, as Simondon remarks and as will be discussed below, in the first place a 'resolution of a problem', what constitutes the foundation of the technician's work is *the way in which the problem is posed*. This will determine in part the precise organization of the technician's machine. The problem is not an abstract idea; it is a working tool for the technician whose coherence forms a system with the epistemological context in which it was conceived. Each machine is structured by the precise problem it is supposed to resolve, and the precise form of this problem, when recreated, can enable us to understand the way in which the object was viewed, and thus the conceptual framework of its emergence and the way it was seen in the collective imagination. Louis Lumière's problem was not that of Étienne-Jules Marey, Thomas A. Edison, or William K.L. Dickson. The problems being posed today, or which present themselves to the engineers of the RED Digital Cinema company are not those posed by the ARRI company: they do not all seek exactly the same thing, nor do they apply themselves to exactly the same difficulties. They rank their priorities differently and, as a result, develop machines whose logic is not the same.

By analysing problems we will be able to understand properly the technical organization of machines and the epistemological implications of this organization. The present volume invites readers to consider a history of problems – a history of the problem 'cinema' and the singular problems that it comprises and redirect it anew each time – through the technological study of inventions. This, the author hopes, will make it possible to set out the elements of a position on the 'digital cinema' problem and the historical issues around its possible description as an 'invention'.