Technology and Film Scholarship

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On Viewfinders, Video Assist Systems, and Tape Splicers: Questioning the History of Techniques and Technology in Cinema

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Abstract
This chapter presents two case studies, one on viewfinders and the other on video assist systems, that enable a consideration of the way film techniques and technologies are defined and historicized. Such historiography often turns on the way new technologies are characterized, either in terms of “innovations” or “inventions,” which thus create different possible continuities or discontinuities within the historical field. Moreover, identifying salient elements of cinematic machines for historical description requires a parallel investigation of the internal logic of the machine and its procedures at a given time, as well as the technical networks (historical, cultural, economic) to which they belong. Such histories must also include a rethinking of the technicity of gestures involved in the operation of film apparatuses.

Keywords: viewfinders, tape splicers, innovations, Annales School, historiography, film theory

Problems of Historiography

History of Techniques and Technology

‘Technical innovation’ is a thoroughly and immediately historical notion. Its definition cannot but raise historiographical and theoretical implications: theory of history, theory of technology (as to its very notion as well as to its
relations with society and general history), and, finally, for what concerns us more specifically here, theory of the cinema.

These problems have been considered in the field of general history during the 1920s by Marc Bloch and Lucien Febvre, founders of the Annales d’histoire économique et sociale review in 1929. The Annales School deeply transformed the dominant conceptions of the writing of history in twentieth-century French thought. After Marc Bloch got involved in a few polemical exchanges from the mid-1920s onward about the question of the place of techniques in social history, the Annales devoted their first thematic issue to this problem, under the title Les techniques, l’histoire et la vie (‘Techniques, History and Life’). The volume included a long essay by Bloch on the ‘Advent and Conquests of the Water Mill’, and was introduced by a programmatic text by Febvre, titled ‘Réflexions sur l’histoire des techniques’ (‘Reflections on the History of Techniques’). It opened with these sentences: “Technique: one of those many words whose history hasn’t been done. History of techniques: one of those many disciplines that are still entirely to be created – or almost.”

The issue as a whole leaves the reader with the strong impression that its contributors are very aware of opening a new field, with the obvious enthusiasm it can arouse, as well as with the urgent need to set the methodological and theoretical prerequisites to the foundation of this new discipline. This new area of history – perhaps the only one to be younger than film history itself as a discipline – has known a slow and still relatively marginal institutionalization, but played an important role in several fields. In France for instance, it has developed within two rather separate intellectual traditions: the first is ethnology, with Marcel Mauss, André Leroi-Gourhan, and others, and the second is historical epistemology, notably through the founding works of Gaston Bachelard and Georges Canguilhem. Other fields have imported these questions, such as sociology (Georges Friedmann, Bruno Latour) or art history (Pierre Francastel). The presence of the history of techniques in the French intellectual field is thus rather complex, remaining apparently subdued when most of its most important figures have been centrally concerned with the problem.

There existed before the Annales, in English-speaking and German countries, a field with the name of ‘technology’, initiated with the similar awareness of a break first by Christian Wolff in his Discursus Praeliminaris de Philosophia in Genere (Preliminary Discourse on Philosophy in General, 1728), where he invented the concept in its modern sense. His proposition did not seem to arouse much interest, before being taken over, as both a theoretical and a pedagogical project, by Johann Beckmann first in
1772, and then in 1776 in his Anleitung zur Technologie. The notion then reappears in English with Jacob Bigelow’s 1829 Elements of Technology. But this discipline aims at something entirely different: technology’s proposed task is the description, classification, and analysis of technical operations and mechanical arts, the study of “the rules of the arts and the works accomplished by the arts,” as phrased by Christian Wolff.

The discipline itself has seldom been studied; only in the framework of the seminar headed between 1963 and 1965 by Georges Canguilhem at the Institute for the History of Sciences has a systematic history of the ‘beginnings of technology’ been realized; that is to say, of “the constitution of the discourse on technical operations as a scientific type of discourse.” The writers of the published version of this collective work, Jacques Guillerme and Jan Sebestik, make a point at the outset: this “history of meta-technique presupposes a history of techniques themselves.”

In English-speaking countries, this terminology has a rather different history. As Leo Marx summarized it in a 2010 essay:

The word technology, which joined the Greek root techne (an art or craft) with the suffix ology (a branch of learning), first entered the English language in the seventeenth century. At that time, in keeping with its etymology, a technology was a branch of learning, or discourse, or treatise concerned with the mechanic arts. [...] the word then referred to a field of study, not an object of study.

Marx then went on to assert that this sense of the word technology is “now archaic,” being replaced around 1900 by “the now familiar sense of the word – the mechanic arts collectively.” In an earlier essay, Eric Schatzberg described “the current characterization of technology as the methods and material equipment of the practical arts,” a meaning whose domination in the English language he dated back to the 1930s, in the wake of Thorstein Veblen’s works.

To return to film studies, a good example of the misunderstandings between English- and French-speaking scholars is given by Rick Altman’s 1984 polemical essay titled ‘Toward a Theory of the History of Representational Technologies’. Altman begins by complaining about “the general tendency of cinema theorists to conflate the concepts of technique and technology,” a tendency for which, he claims, Jean-Louis Comolli’s landmark 1971-1972 series of essays ‘Technique et Idéologie’ is partly responsible. Altman does not really define the terms in his essay, apparently taking the respective concepts’ meaning to be obvious, common knowledge. He rather recalls the
importance of their distinction on the basis of one of the most controversial examples in the history of film theory: “deep-focus image [that] depends on a combination of technical and technological concerns”:

While technological changes in the late thirties (availability of new lenses) make deep-focus photography easier and more economical to achieve, anyone who has ever used a camera knows that a depth-of-field choice must be made every time the shutter is tripped. The difference between an exposure made at f/5.6 with a speed of 1/250 and another made at f/16 with a speed of 1/30 is a question of technique, not of technology; the latter image may be a deep-focus image, the former cannot possibly be.12

Technology seems, then, to delineate the realm of the hardware-related, the machines, and their components, whereas technique describes what concerns gestures, practices, and the conscious choices implied on the operators’ side. Microphones belong to technology, while miking is a set of techniques.13 For Altman, this distinction is crucial: “The important thing to remember is that a dialectical understanding of history is destroyed from the start by any theory which reduces to one those practices that interact as two.”14

That meaning of technology is mirrored in the contemporary uses of the term in the then developing approach known as SCOT, ‘Social Construction of Technology’. This trend, originating within sociology, does not deal primarily with historiographical problems, though some of its important contributions involved historical research and implications. An essay like Wiebe E. Bijker’s ‘The Social Construction of Bakelite: Toward a Theory of Invention’ deals explicitly with a historical case study, and the historiographical problem of invention. But the SCOT project is to be understood as a sociology of the techno-industry, trying to understand how and why technical products are produced, and the reasons for their evolution. Bijker formulates the aim of his article as “an approach to a theoretical analysis of the development of technological artifacts.”15 Technology is here defined mainly as a set of industrially produced artifacts, circulating among social groups (engineers, consumers, etc.); techniques appear as belonging to a separate realm that remains outside the scope of study.

Interestingly, the French-speaking tradition of the history of techniques and technology also emphasizes the importance of preserving the distinction between the two concepts, but defines them on an entirely different basis. If it does differentiate objects and procedures, it still considers their history as a coherent whole. According to Febvre, “the history of techniques
should first be the history of the methods of ‘workers’, in flesh and blood, or in wood and metal: men, or machines.” As Gilbert Simondon later wrote, “[w]hat lies in machines is human reality, human gesture fixed and crystallized in working structures.” Machines – that Simondon named ‘technical objects’ – and techniques are then observed as complementary aspects of one single phenomenon, that is to be understood in its complex cohesion. The term ‘technology’ is then restricted to the designation of the science that studies these technical objects and procedures. If this meaning is ‘archaic’ for Leo Marx and most English-speaking scholars, it is still the only accepted one in the French academic world of the history of techniques, a meaning adopted by Guillerme and Sebestik as has been mentioned, but also for instance by Marcel Mauss from the 1920s on, or by the ethnologist André-Georges Haudricourt, who campaigned for the recognition of ‘technology as a human science’ as late as 1964.

We could argue that adopting either one of these traditions, the notion of ‘technological innovation’ undergoes quite important changes in meaning. In the French sense, a ‘technological innovation’ will designate a transformation in the field of the discourses about techniques. Such an innovation belongs immediately to theory or historiography. It may or may not correspond to a technical innovation, i.e. the apparition of a new machine and/or a change in procedures. The history of technology in that sense, as has been elaborated by Guillerme and Sebestik, can be constructed on discursive sources, like other, more ‘traditional’ forms of history. By contrast, the history of techniques poses other problems, as its sources present themselves as deeply heterogeneous in nature, and essentially non-discursive: objects and sets of objects, gestures, and uses, traditional procedures that may never have been described with words.

**History and Technology**

In his introduction to the *Annales* special issue, Lucien Febvre asked “What is ‘writing the history of techniques’?” and proposed a threefold answer. The first task was to “clarify the way that workers have proceeded, at the various times, in each craft or industry” – what Febvre called ‘the technical history of techniques’. The historian was to study then the interactions between technical inventions and scientific evolution, and finally to integrate the techniques within the whole range of human activities – economics, politics, art, religion, etc. This triple development, necessary to the coherence of the new discipline, shows the amplitude of the methodological difficulties: new sources to discover and exploit, sources that can be textual,
but also iconographic or material; transdisciplinary collaborations to establish between technicians and historians from different backgrounds, etc.

Today, the historiography of techniques shows that, if Febvre presented the ‘technical history of techniques’ as fundamental in every way, that part has remained generally the most neglected area of research. Maurice Daumas still complained in 1969 that: “Our insufficient knowledge of the technical history of techniques can partly justify the distortions [...] that are too often visible when general history takes over the history of techniques.”

Daumas blamed economic history the most harshly:

Economic history absorbs in an authoritarian way the history of techniques within itself. It takes the latter as it naturally is and walking hastily imposes on it its own methods of analysis and themes of interpretation.

In cinema history, as elsewhere, the history of techniques tends to be considered, even constructed from the outside, by general or by economic history.

This last approach has been advocated for instance by Douglas Gomery in the framework of the study of one of the key moments for the traditional technological historiography of the cinema: the conversion of the Hollywood industry to sound. He argued in 1975:

Its advent can be appreciated by viewing it in terms of the economic theory of technological innovation, which posits that a product or process is introduced to increase profits in three systematic phases: invention, innovation, and diffusion.

The term ‘invention’ here refers to the part of the process that occurred in the obscurity of laboratories – those of the AT&T and RCA companies, as it happened. Then comes the ‘innovation’ phase, defined as “the adapting of an invention for practical use” and attributed to the Warner Brothers and Fox companies. Finally, “the final phase, diffusion, which occurs when the product or process is adopted for use,” concerns ‘the industry’ as a whole. But several problems arise. First, as Edward Buscombe already noted in *Jump Cut* in 1978:

Economic theories can only partially explain technological innovations; economics cannot say why innovations take the form they do, only why they are an essential part of the system.
In fact, the reasons for the creation and the choice of a sound-on-disc system on one side (the Warner Vitaphone) and of a sound-on-film apparatus on the other (the Fox Movietone and the RCA Photophone) are here left unexplained, when their technical, but also aesthetic, theoretical, epistemological, and even economic implications are absolutely crucial.

Moreover, that distinction in phases presupposes a clear break between a ‘research’ process involving only scientists in their laboratories, and an ‘adaptation’ process involving practitioners. As a consequence, the users’ contribution can never affect the major level of invention, but remains restricted to a superficial adjustment to professional uses, these last thus supposed virtually unchanged. This distinctly hierarchized division corresponds to the one between science and techniques, or between engineer and skilled worker.

The history of techniques in cinema poses the same problems as in general history: elaborated from the outside by general theory or by economic history, specifically technical issues disappear or are misrepresented, shaped by the methods and problematics of these disciplines. Thus, approaches corresponding to Febvre’s third perspective – that of the relation between techniques and the social context – have been favored, without the concrete reality of techniques having been explored in its complexity. Only when this complexity is apprehended can we imagine confronting ourselves with what ethnologist Pierre Lemonnier still considered a major task in 2011: “to associate in a convincing and useful way – and not simply to juxtapose – detailed studies of technical processes (‘how does it work?’, i.e. minute analyses of operational chains) with the comprehension of particular aspects of systems of thought and social organizations.”

Douglas Gomery’s contribution is also exemplary of an approach to technological history organized by the question of innovation, certainly crucial even though other concepts could prove helpful complements. David Edgerton, for instance, proposed, in a 1998 article in the Annales published in English in 1999 in History and Technology, the following ‘eclectic’ thesis:

The innovation-orientation of most studies of technology makes difficult a serious engagement between general history and the history of technology. Conversely, an engagement with general historical problems has produced histories of technology-in-use.

This proposition – where ‘technology’ appeared as ‘techniques’ in the French version – can be discussed in some of its presuppositions, but it is
an important reminder of the non-coincidence of the histories of techniques and of innovations, and of the domination of the latter.

**Innovation and Invention**

This notion of innovation remains, if only for the place it occupies in historiography and the comparatively relatively few questions it arouses, one of the keys of the technological perspectives. It has been the object of, amongst others, a course titled ‘Invention and the Development of Techniques’, given by Gilbert Simondon in 1968-1969, at the request of Georges Canguilhem. Simondon returned to the traditional paradigmatic couple of *invention* and *innovation*, to redefine the concepts as they emerge specifically from the genesis of what he calls ‘technical objects’, in a way that makes explicit their historiographical implications. Simondon distinguished between two modes of evolution of technical objects, corresponding to the two fundamental levels of their mode of existence. “The technical object,” he writes, “is on the one hand a mediator between organism and environment, and on the other hand an interiorly organized and coherent reality.” From this conception, Simondon described the two phases of technical evolution:

In a rather general way, relational progresses [bearing on the adaptation of the technical object to the environment] are gradual, continuous improvements, occurring by trials and errors throughout use; they result from experience and add up: they retain the shape of the relation between organism and environment. On the contrary, the progresses of [internal] self-correlation require a problem resolution, an invention that establishes a synergistic system of compatibility. That invention can be brought up by the need of relational progress, but it re-generates the internal logic of the system. [F]or that reason, internal technical progress can barely be continuous; it occurs by leaps, by discontinuous phases [...].

Simondon’s analysis results in the distinction between two opposed and complementary evolution principles: innovation, a minor alteration that is part of a continuous process, and invention, a major transformation producing a break in the technical lineage. Thus, a preference for the term *innovation*, or even the complete rejection of the notion of *invention*, corresponds to a continuist conception of history, whereas Simondon’s position, in the tradition of French historical epistemology, is dominantly discontinuist.
If we are to adopt this historiographical distinction, the historical knowledge of cinematic techniques then implies to isolate, in the wide range of techniques in use at each period and in the various areas of the field (professional industry or amateur practices), what is to be considered as an innovation, and what has to be seen as an invention, i.e. to distinguish the historical breaks in the machines and the practices and evaluate their importance. Elaborating the ‘talkies’ as an innovation for instance means producing a historical and technical continuity between the ‘silent film’ and the ‘talking pictures’ dispositives. One could imagine that the technical and professional reorganizations, as well as the aesthetic transformations, be judged important enough for the ‘sound film’ to be erected as an invention, a new system whose coherence is based on principles deeply different from the former one. In a similar manner, it could be argued that ‘color cinema’ is an invention, an entirely autonomous dispositive, whose history is specific and whose origins are independent from – and older than – that other dispositive which may be only one of its innovations, ‘black-and-white-cinema’.

But the strong breaks in the history of cinematic techniques should also be searched in the blind spots of general theory and historiography. Some of the major transformations of the way that workers have proceeded, at the various times, in each profession of the film craft or industry, to paraphrase Febvre, have remained invisible from the outside, unperceived or left unexplained. I would like to take a few examples.

The Task of the Historian of Cinematic Techniques: Two Case Studies

On History, Archaeology, and Epistemology: The Viewfinder

The Lumière cinématographe is not equipped with a viewfinder. As with a photographic chamber, the frame is chosen while the camera is open, the operator looking through the lens and camera gate before the film is loaded, using a ground glass to materialize the image. The film is then loaded, the machine closed, the crank inserted, and the camera is ready to shoot whenever will seem appropriate. During this phase, the camera must be prevented from moving. All these last operations, including shooting, are technically ‘blind’: the operator, beside his machine, can only estimate what is inside the frame or not by memory and habit, through the sole observation of the space in front of the camera and with no means
of precise control. That observation is in turn conditioned by the size and place adopted for the crank in the camera, which regulate the distance between the machine and the operator. This distance is an essential factor of the operator’s work. It is precisely defined by the form of the machine, its ergonomics, involving the arm as well as the eye.

This configuration of the cinématographe as a technical object derived from a series of contemporary procedures, part of which were elaborated in professional or ‘amateur’ photography – amateur in a more restricted sense than is known today – that field being precisely the ‘target audience’ for the cinématographe as conceived by the Lumières. The majority of the photographic cameras of the time were not equipped with viewfinders, even if some were beginning to appear, in different shapes. The viewfinder poses a non-trivial technical problem: it must give the photographer the most exact idea of the frame, without altering the image itself – a problem to which that of the focus must be added, which is beyond the scope of this chapter.

The solution of ‘reflex’ viewfinders has been proposed in the 1930s in photography, and adopted progressively until it became dominant from the 1960s, not without discussions. For instance, some cameras among the most expensive and prestigious on the market today – Leica M models – are furnished with non-reflex viewfinding systems. All non-reflex viewfinders are marked with parallax, thus providing only an approximate version of the actual frame, whose level of accuracy depends on the distance of the object to the camera. If that feature could be useful for street photography, where quickness of reaction can prove more vital than neatness of composition, framing through the film gate remained the most precise technique, thus adopted within the framework of professional fiction film shooting. It did imply a very specific conception of what it is to take a photograph, quite different from the one dominant today: the ‘operational chain’ (André Leroi-Gourhan) was based on a temporal delay between the composition of the image and its taking. Framing and shooting were two clearly disconnected operations, separated by seconds or minutes. In photography, this could be partly settled by the requirement of immobility: neither camera, nor subject would move between the two moments, so that the time break would not affect the image. But in cinema, the introduction of movement complicates the problem. In any case, that did not seem complicated enough for Lumière to introduce some kind of viewfinder on his machine.

As is well known, the Lumière views, and in particular those shot by Louis Lumière himself, show a great precision of what he called mise en page (‘layout’), whether on static elements or on objects entering, leaving,
or moving within the frame. Replacing this attention to the composition of the image within the technical practices of the time makes us reconsider the gestures and mental operations involved. Lumière did not coordinate the space and time organization of his views with his eyes constantly watching the edges of the frame; rather, an important part of his activity (deciding when to start cranking on the platform of the La Ciotat railway station for instance) was based on the memory of the limits of the field, as transposed in the profilmic space perceived directly by the naked eye, and from a point of view quite different from the physical place of the lens. Thus, recontextualized, the virtuosic composition of the resulting views is of course rather impressive, but beyond the question of Lumière’s skills as a photographer, it reveals a singular visual practice, emerging from the particular set of skills required of the trained photographer of the time.

This ‘lack’ of a viewfinder may appear as a strong constraint. But if the cameras conceived for the amateurs or newsreel operators have been equipped with parallax viewfinders rather early, an important proportion of professional cameras remained unfitted with such items for quite a long time, even though these appendices were light, wieldy, and inexpensive to make. The ‘Professional’ Pathé camera has been, as Laurent Mannoni recalled, “one of the most widely used cameras in Europe and in the USA from 1908 and into the 1920s”; it was, for instance, Billy Bitzer’s main tool. It was not fitted with any viewfinder, entailing working procedures similar to those of the Lumière operators – as can be attested through photographs showing Bitzer at work, framing through the camera gate of the open machine, or shooting watching the actors directly, some two feet away from the camera. That Pathé camera was also one of the very rare devices, after the Cinématographe, where the crank was placed at the back of the machine. On the majority of other models, the crank was on the right-hand side, so that the body of the operator got closer to the apparatus. All these elements conditioned Bitzer’s perception of profilmic space and of the acting, as well as the relative positions – whether physical or hierarchical – of the operator and the director in the concrete space and time of the shooting, and within the division of labor organizing the industry of the time. Of course, Bitzer and Griffith’s intellectual and human relations, together with their respective conceptions of what a frame is, have also been an important factor for the structuration of both the works and the labor organization in the films they made together.

The arrival of ‘reflex’ viewfinders in cinema in 1937 with the Arriflex 35 and their diffusion after World War II have deeply altered these practices. From that moment on, the cameraperson kept his/her eyes glued to the
viewfinder. S/he could not easily withdraw them from the camera: chances were that light would enter through the viewfinder and fog the image. The camera thus got closer to the operator’s body to the point of almost merging with it, a tendency that kept developing through the researches on light cameras, that can be carried on the shoulder – Cameflex, Arriflex, Éclair, then Aaton. Building a portable camera supposes thinking in an entirely different manner the position of the elements – the viewfinder, but also motor, magazine, battery, handle, etc. – to facilitate the necessary gestures while maintaining the proper balance. That constitutes an example of innovation by adaptation to the environment, even if in the end, the importance of the internal (as well as procedural and aesthetic) reorganizations involved could make us wonder if it could not be considered an invention.

Of course, such a study should be furthered with the analysis of the internal conception of viewfinders, of their interactions with the other elements of the machine, the technical systems of which they partake and its self-correlation. The reflex viewfinders of Arriflex 35 cameras consisted in revolving mirrors fixed on the shutter; those of the reflex Bolex H16, introduced in 1956, in a semi-reflecting prism. These technical decisions involve multiple problems, including the internal coherence of the machine as well as considerations of cost, ergonomics, and use, sturdiness, integration within current practices, etc. A mirror viewfinder makes the shutter heavier and more fragile, and presents to the operator an image altered with a rather significant flicker – due to a one-bladed shutter. By contrast, a prism absorbs a noticeable quantity of light, which can be annoying in itself but moreover imposes to take that absorption into account in the gradation of lenses. That is not a major problem for amateur cameras, which can be fitted with a specific set of lenses; but it may become unacceptable for a professional who needs to adapt particular lenses to the machine.

Thus, following diachronically the evolution of one element of cinematic machines – the viewfinder, for instance – has to be done in parallel with investigations of the internal logic of the machine and the procedures it is involved in at a given time. The set of technological decisions founding a machine’s coherence is based on a certain idea of its task and of the right way of doing it. An archaeology of these decisions must be established. The mirror reflex viewfinder comes from the photographic apparatus of the tip-over mirror associated with curtain shutters; but its cinematic version is more ‘concrete’ in the sense developed by Gilbert Simondon, as the reuse of the revolving shutter makes it not two synchronized distinct devices, but one single apparatus with a dual function. Still, the principle remains the same: the user can see the exact image through the lens except at the very moment...
of exposure, when the user is blind, the mirror obstructing the view to let light impress the film. Practical difficulties then follow similarly for the photographer and the cinematographer, all media differences being taken into account. A study on longer terms shows that the forms of viewfinders can be traced back to the perspective machines designed by Alberti and Dürer, some of their components being quite rigorously transposed. As in these devices conceived to help the painter compose accurate perspectival representations, viewfinders materialize and fix the monocular point of view, and decompose the visual field according to a predefined regular geometrical pattern. Such an archaeology would involve the observation of circulations and crossings between technical lineages, a specific form of intermediality than can include non-mediatic technical objects.

But an epistemology of these technological decisions is also needed: the reconstruction of the overall logic of these machines and procedures, and the technical networks to which they belong. These networks are historical, cultural, economic, and involve producers, spectators, theaters, industries, modes of diffusion, etc. The internal logic of machines and gestures can thus unveil its implicit presuppositions, the paradigms within which they were conceived and used. Jacques Guillerme and Jan Sebestik summarized Christian Wolff’s justifications for the foundation of technology as a science thus:

Even as low a manual art as wood cutting entails an implicit conceptual structure that dictates the execution of instrumental operations: ‘there is a reason why wood can be cut, and why it can be cut with a wedge, and nevertheless also with the axe.’37

If deciding what is or is not an innovation or an invention is a technological act, its coherence must be determined by the research of these ‘implicit conceptual structures’, of their progressive or sudden transformations, and by the understanding of the precise points affected by these changes. The viewfinder is a device of mediation between technical object and environment, between machine and operator. Any conception of the viewfinder is thus immediately connected with a conception of the work and function of the camera operator, favoring a certain organization of procedures and professions, certain gestures, a certain idea of what it means to compose a frame. As a consequence, it is also related with an aesthetic conception of the cinematic frame.

If (most) ‘professional’ digital movie cameras are still fitted with a traditional ‘optical’ viewfinder, some middle-range models, used for
documentary among other things, only bear electronic viewfinders in the form of small display screens – as do amateur photographic cameras, cell phones, etc. The operator’s eye thus regains its distance from the camera. The consequences of this transformation are rather important, and involve the relation of the operator’s body with the machine, with the outside world, but also the relation between the one who films and the one who is filmed. French documentarist Denis Gheerbrant explained that when shooting with a traditional camera:

At a certain moment [...] I take the camera on my shoulder, I put the eyepiece in front of my right eye, I close my left eye and facing the one who is filmed are a face whose eyes are closed and a camera. We are not anymore in the framework of a day-to-day relation sustained by the exchanged gaze. We are in a relation larger than ourselves, each with a specific place. The camera is the spectator between us and I almost feel like saying that it is by closing my eyes that I create a place for the spectator, it’s a paradox for a filmmaker!38

With a screen instead of an eyepiece, that place constructed for the spectator disappears.

The electronic viewfinder crosses another history: that of the ‘video assist’, a video monitor connected to a film camera and allowing the director and the team to watch ‘live’, during the shooting, the image about to be recorded on the film, an image which will only be visible later, after having been developed and printed in the laboratory. The ‘television’ dispositive thus inscribes itself at the heart of the ‘cinema’ dispositive. These ‘video assist’ apparatuses, introduced in the middle of the 1960s notably by Jerry Lewis and Blake Edwards, have deeply transformed film shootings and particularly the positions of the filmmaker and the cinematographer. Hitchcock or Ford used to be sitting next to the camera, watching the actors at work before their eyes, imagining a framed result they would only discover on a big screen during the projection of the dailies. Today, most filmmakers – with only a few exceptions, like Jacques Rivette or Danièle Huillet and Jean-Marie Straub – do not watch the actors anymore, but an image on a TV screen with headphones, and the physical distance between filmmaker and actors has increased to the loss of all direct contact. An early radical experiment in that direction has been led by Francis Ford Coppola and his ‘electronic cinema’ system on the shooting of One From The Heart (1981), where the director remained in a separate video editing room during the shooting. This transforms the working relations as well as
the division of labor: the cinematographer used to owe part of his authority on the set to being the only one who could foresee how the film would look like. With video assist systems, the director and other members of the team have this capacity, and can discuss lighting choices with more arguments. This seems also to participate in the transformation of the relation to frame and space in films: the predominance of long shots in works such as John Ford’s for instance is linked with a visual imaginary built by theater projection; it may seem more difficult to conceive a film based on extremely wide shots if they are controlled, during production, on an electronic screen whose size implies that the actor or actress’s facial expression become indiscernible.

Thus, elaborating on the study of the form and evolution of a supposedly modest element of the camera machine brings on, inextricably, procedural, and aesthetic implications, and leads to question the epistemological conditions of the production of the object, the users’ ways of doing and the professional organization, as well as the cultural aspects of the reception of the images.

On the Locating of Discontinuities in the History of Techniques: From Virtual Editing to Tape Splicers

In a whole other area of cinematographic work, editing also shows a series of technical transformations with major consequences. The Moviola, among the first machines allowing the editor to watch the animated pictures when choosing the cutting point, was invented in 1924. Before, and a few years afterwards depending on the contexts, editing was based almost exclusively on the observation of the series of photograms, the decisions being tested afterwards in the projection room. Therefore, the editor had to be able to judge the cut on the ‘interval of movement’, as Vertov said, between the images, and her or his activity implied a disjunction and a constant circulation between the editing room, the domain of still images, and the screening room, the only place where moving images could be seen. From a technical standpoint, the Moviola was not really an invention: it was an adaptation of the projector, made into a single-spectator machine. But it provoked a shift, as the editor could decide the cutting points on the perception of movement itself – even if on a small screen. The arrival of ‘flatbed’ editing tables such as the Steenbeck in the 1960s constituted another interesting innovation: the machine found its own coherence, becoming independent from the projector model. It adopted the continuous film motion mode based on the rotating prism of mirrors that
Emile Reynaud had invented for his Praxinoscope in the 1860s. But another thing may be more important. This machine is contemporary with a major transformation: the introduction of adhesive tape in editing techniques. Before that, when an editing point was decided, the two pieces of film were glued together using film cement. That weld is strong, withstanding the tractions of the intermittent movement in the Moviola or the projector, but impossible to undo – it is still the technique used in the laboratories for negative film editing. To correct an edit that was considered wrong in the projection room, one photogram has to be cut off on either side of the weld: two images were ‘lost’ in the process. Mistakes were barely forgiven. By contrast, tape splices can easily be peeled off. Thus, the editor can try edits knowing s/he will be able to step back without loss. Tape splicing does have drawbacks though: for instance, the tape is perceptible on the editing table as well as in the screening room, as those of the readers who have seen film projections will have experienced. It can become difficult, if trials and errors accumulate on a few images around a shot transition, to judge the success of the edit due to the jumps provoked by the successive layers of tape. Still, this solution has been massively adopted in the editing rooms, and entailed important transformations in the editors’ practices and relation to the cut. It could be argued that virtual editing is finally nothing but a radical technical accomplishment of a mode of working and a conception of the cut that was born with tape editing. In this perspective, to use Simondon’s vocabulary, the invention would be tape splicing, and the innovation virtual editing. Of course, this succession doesn’t account for the evolution of lineages of technical objects deriving from one another in their conception. It doesn’t even follow the transformation of the technical procedures of editors, i.e. of the concrete organization of their working gestures – even if the ergonomics of virtual editing software seeks to transpose as exactly as possible those of film editing rooms. But this succession can reveal the history of editing practices as linked with the evolution of procedural logics, underlying both methods and machines.

Only a close attention to the ‘technical history of techniques’ can allow to elaborate their social, economic, and aesthetic implications. Only that can help us evaluate the scope of technical transformations, whether they be the evolution of the form of camera viewfinders, the introduction of video assist systems or tape splicing, or the transition from analog to digital formats. If something like a ‘technical thought’ is a work in these objects, a specific non-verbal thought, as Georges Canguilhem or Pierre Francastel have argued, it is for us more important than ever to grasp
its coherence with precision, for its stakes are crucial at several levels. As Gilbert Simondon recalled:

Not only the consequences but also the conditions of the genesis of an invention imply collective contents and historical aspects, with the particular way that knowledge and power are transmitted in the form of constituted objects or production processes, and with the requirement of the conditions of reception, which are not only economic but cultural.40

Objects, production processes, and reception conditions cannot be separated in the historical research, because “the users” gestures are also part of the “technical reality,” and thus “technical objects cannot be considered as absolute realities existing on their own.”41 Of course, objects are of primary importance for the historian insofar as they partly objectify the processes, their lasting materiality constituting them as archives of these otherwise ephemeral phenomena that are gestures and cultural conditions. But the archaeological methodology should envision these objects only as nodal points in technical, cultural, and epistemological networks. To establish the discontinuities in the history of techniques, the consideration of operations may, in the end, be a more important tool than genealogies of objects. Splicing or framing can be done in many different ways, with many different tools; but they are specific operations, which can be distinguished within the cinema production system – if only because they constitute the attributions of different specialized workers in its division of labor. These operations can be defined by a series of particular problems, to which the apparatuses and traditional gestures are technical solutions.42

On an epistemological level there is an ‘implicit conceptual structure’ that has to be common within each of these various ‘operational chains’, and on a historical level, the coherence of the objects can be understood only within the frame of each technical system, which it can in turn participate to reveal. Moving from objects to operations probably requires major methodological shifts; but it allows for a better understanding of the major role of users in the evolutions and transformations of techniques, the users being here considered not as consumers, but for the technicity embodied in their gestures. There remains, then, no difference between a user and an inventor.
Notes

6. Ibid. (my translation).
8. Ibid.
11. Ibid., 111.
12. Ibid., 112. The radicalism of the ‘cannot possibly be’ should be discussed, as it presupposes that ‘deep-focus’ is an objective, technical quality of the image, independent of its subject. Still, if a shot is made for instance of a painting hanging on a wall, even a technically shallow depth of field can produce a perfectly sharp picture, that couldn’t be differentiated by the spectator from a ‘deep-focus image’.
13. Ibid., 115.
14. Ibid.
22. Ibid., 13.
24. Ibid., 194.
27. On the necessity to rethink the status of the user in technology studies, in particular from a feminist perspective, see Oudshoorn and Pinch, *How Users Matter: The Co-Construction of Users and Technology*.
31. For this notion, see Albera and Tortajada (eds), *Cine-Dispositives: Essays in Epistemology Across Media*.
32. On this ‘eclectic’ hypothesis, see Fihman, ‘De la “Musique chromatique” et des “Rythmes colorés”’, 319-323, and my ‘Cinéma, couleur et mouvement: Kinemacolor et abstraction’.
33. Lumière operators seem to have been predominantly male.
34. See Gaudreault’s classic analysis of Lumière’s *L’Arroseur arrosé* (1895) in *Du littéraire au filmique: Système du récit*, 31-32.
35. The *Bolex H16 Reflex Instructions Manual* specified that the brand produced a ‘Bolex Exposure Meter’ which was “designed and calibrated especially for the H16 Reflex camera and allow[ed] for the fact that 20-25 per cent of the light [was] deflected into the viewfinder by the reflex prism.” (p. 13). Should the user want to use another exposure meter, the manual featured a chart of ‘real’ and ‘adapted’ exposure times.
40. Simondon, *L’Invention dans les techniques*, 293.
41. Simondon, *Du mode d’existence*, 239.
42. On the concept of problem within this framework, see my *Inventer le cinéma*.

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