Image as Collective

A History of Optical Effects in Hollywood's Studio System

Thesis

presented to the Faculty of Arts and Social Sciences
of the University of Zurich
for the degree of Doctor of Philosophy

by
Birk Weiberg

Accepted in the fall semester 2014 on the recommendation of the doctoral committee:
Prof. Dr. Bettina Gockel (main supervisor) and Prof. Dr. Barbara Flückiger.

Zurich, 2016

Abstract

Birk Weiberg

Image as Collective: A History of Optical Effects in Hollywood's Studio System

This dissertation provides a historical account of a until now neglected field of moving image production. It identifies and focuses on optical effects as a practice of montage within moving images as opposed to the montage of like images in time. Drawing on a wide range of new archival material, my dissertation presents previously unknown reasons for the developments of different techniques of image compositing such as traveling mattes, color-based processes, rear projection, and optical printing. This field has currently gained relevance as a forerunner to contemporary digital effects and image processing, a fact that in part also explains the marginal presence optical effects in earlier scholarship. My work collects original publications by participants and critically relates them to each other and akin areas of film production. As a result I will show that there were no single privileged sources of agency but rather chains of translation that involve humans as much as non-humans.

I will draw on Actor-Network-Theory as a methodological framework as it provides an approach that tries to avoid presumptions that inform the analytical descriptions. Therefore, I will deploy individual case studies, in which I explore the specific functions of such different entities as groups of studio employees, the studios themselves, entrepreneurs and manufacturers, professional associations and organizations, devices and sets, patents and other publications, and finally images. The image as the result of these production practices (rather than as an aesthetic phenomenon alone) here is regarded as representation and aim of its production practices that at the same time it tries to conceal. It thus assembles its own collective which I will understand not as a model but as an hypothesis that guides my historical descriptions.

Acknowledgments

A project like this that is driven by an interest in primary sources would not be possible without excellent archives and the people working there. Therefore, my primary acknowledgments go to the Academy Film Archive (May Haduong), the Margaret Herrick Library (Barbara Hall, Jenny Romero), UCLA Performing Arts Special Collections (Julie Graham), the Warner Brothers Archive at USC (Sandra J. Lee, Jonathon Auxier), the Hugh M. Hefner Moving Image Archive at USC (Dino Everett), the USC Cinematic Arts Library (Ned Comstock), the Frank Mt. Pleasant Library of Special Collections and Archives at Chapman University (Claudia Horn), the Naval History and Heritage Command (John W. Greco), and the National Archives and Records Administration in Washington, DC, College Park, MD, and Riverside, CA. After a unwieldy start at the xerox machines of several libraries, I could witness how during my research increasing amounts of publication became available in digital archives that will change scholarly research substantially. My most relevant resource here was the marvelous Internet Archive and later its partner, the Lantern project at the Media History Digital Library.

Personally, I want to express my gratitude to my two supervisors, Bettina Gockel and Barbara Flückiger, at the University of Zurich for their support (and trust) in my transdisciplinary venture. I am indebted to my former superiors at the Zurich University of the Arts, Nils Röller and Felix Stalder, for their appreciation and words of advice. The Swiss National Science Foundation provided me with a generous grant that allowed me to enjoy six months in Los Angeles and to work intensely with the above-named archives. I want to thank the California Institute of the Arts as my host during that stay and especially Norman Klein for our intriguing discussions and Charlotte Pryce and her students for sharing their optical printer magic with me. Furthermore, Stewart McSherry and the iotaCenter generously gave me shelter. John Kiel of Acme/Photo-Sonics and special effects expert Bill Taylor provided professional insights into the history of their craft.

Last but not least, I am gleefully indebted to Margarete Vöhringer and Margit Rosen for acting as shining examples to follow, and to Daniela Müller most simply for being there.

Contents

Acronyms

Journals and Newspapers

AC	American Cinematographer
FD	Film Daily
IP	International Photographer
JSMPE	Journal of the Society of Motion Picture Engineers
JSMPTE	Journal of the Society of Motion Picture and Television Engineers
LAT	Los Angeles Times
NYT	New York Times
TSMPE	Transactions of the Society of Motion Picture Engineers

Associations

AMPAS	Academy of Motion Pictures Arts and Sciences
ASC	American Society of Cinematographers
SMPE	Society of Motion Picture Engineers
SMPTE	Society of Motion Picture Television Engineers

Archives

AFA	Academy Film Archive, Academy of Motion Picture Arts and Sciences, Los Angeles
FMPL	Frank Mt. Pleasant Library of Special Collections and Archives, Chapman University, CA
HMIA	Hugh M. Hefner Moving Image Archive, School of Cinematic Arts, University of Southern California, Los Angeles
MHL	Margaret Herrick Library, Academy of Motion Picture Arts and Sciences, Los Angeles
NARA DC	National Archives and Records Administration, Washington, DC
NARA MD	National Archives and Records Administration, College Park, MD
NARA RS	National Archives and Records Administration, Riverside, CA
NHC	Operational Archives of the Naval Historical Center, Washington, DC
PASC	Performing Arts Special Collections, University of California, Los Angeles
WBA	Warner Bros Archives, School of Cinematic Arts, University of Southern California, Los Angeles

The fade-in reveals first a door, under which light enters an otherwise darkened room. This central slit is the lightest area of the image. Its foreground is dominated by a large drinking glass holding a silver spoon. These two objects occupy an area as big as that of the door in the background. To the right stands a little pharmaceutical bottle. The cork lies next to it on the silver plate, which carries all foreground objects. The ensemble implies the earlier ingestion of drugs. Between plate and door we dimly see a bed with a body that is only recognizable as such through the lifting and lowering of the chest. Above the body rises a defocused silhouette of shaggy hair. We hear a breathing that follows the movement of the body. Behind the bed unfurls a room that suggests wealth and appears still not larger than it has to be. To the breathing the sound of knocking is added. We hear somebody rattling at the door. Shadows, which interrupt the floor light under the door, prefigure further actions. The door opens with a swing and two men tumble into the room. One of the two precedes with age-related stiffness. The other follows tentatively. The old man comes up to the bed, knees down, and turns the woman's head in profile. While his mouth steadily moves, he does not speak a single word, until he turns to the second man. "Get Dr. Corey," remains the only dialog spoken in this scene. The addressed speeds out of the room. The kneeling stays behind with the woman and both—along with the room—disappear in a slow fade-out.

1 Introduction: The Problem of Writing on Film as Technique

Special effects in the movies have become an apparent matter with the modern blockbuster since *Star Wars* (George Lucas, 1977) and some twenty years later again with the digitization of movie production. Digital technology through increasing virtualization has also merged two previously distinct domains, those of mechanical effects—everything that takes place before the camera from miniatures to pyrotechnics—and optical effects—everything that happens by means of cameras and related devices. While this distinction cannot always be made clearly, the mechanical effects, with their "Wire, Tape, and Rubber Band Style,"[1] as one of their veterans described it, have mostly attracted attention. One of the reasons might be that there comes a certain heroism with doing such things that are often large, dangerous, and costly. Optical effects, on the other hand, have seen little recognition. This changed with the advent of digital technology that raised new questions on the ontological and semiotic status of photographic images. This project tries to retrace the development of optical effects in its presumably most vital context, the studio system of Hollywood in the 1920s and 1930s. By doing so, it also raises the question why montage within moving images has been overlooked for such a long time. The available literature on optical effects can by no means match up to how much has been written about editing. For a long time film was understood substantially as the combination of images in sequences. First a camera, a machine, assembles them frame by frame and then a human editor does something very similar shot by shot. This notion of film as 'photography plus time' is boiled down to its much too simplifying essence in Jean-Luc Godard's dictum. "Photography is truth. And cinema is truth 24 times per second."[2] This confidence in the authenticity of photographic images and in temporality as the dominant feature of motion pictures have both suffered with the digitization of the respective technologies. With digital tools the distinction between editing and compositing blurs as in a lot of cases it can be done with the same software.[3]

I will start by reviewing different approaches and methods that were used to account for special effects in particular or technical aspects of cinematography in general. In some cases these will in fact feature the *omission* of technical aspects and I will call into question whether this is reasoned. Finally, I want to suggest to adopt a different approach to handle the interdependencies of cinema and its techniques. While the topic of my investigation here are motion pictures, I assume a significant likeness with still photography. Vilém Flusser speaks in this regard of 'technical images' that feature a collective authorship of humans and machines.[4]

---

1 L. B. Abbott, *Special Effects: Wire, Tape, and Rubber Band Style* (Hollywood: ASC, 1984).
2 Dialogue line from *Le petit soldat* (1963).
3 The term compositing refers to the layering of moving images. It has only become customary with digital video but will be used here retrospectively also for analog methods.
4 See Vilém Flusser, *Towards a Philosophy of Photography*, trans. Anthony Mathews (1983; London: Reaktion, 2000).

1.1 Bazin and Technique

The French film critic and theorist André Bazin refers at least twice to the shot from *Citizen Kane* (1941), which I described beforehand, as a "typical Welles scene." He first analyzes it in an article for *Les Temps Modernes* in 1947, about a year after the release of Orson Welles's acclaimed modernist masterpiece in France. The second description is part of a small book about Welles, which Bazin publishes together with Jean Cocteau in 1950.[5] Both descriptions are written to demonstrate how Welles and his cinematographer Gregg Toland depict the event of an attempted suicide and its discovery in a single shot. Regularly a scene like this would require "at least five or six shots"[6] that carefully direct the viewer towards the intended reading. Bazin conceives this exception from the norms of period story-telling as more realistic. The assumption Bazin makes here is that a long shot without breakdown grants the viewer a similar freedom to focus attention selectively as in real life. Such a conception (by the filmmakers as much as by the film's critic) is a departure from the prevalent notion that the virtuosity of cinema lies specifically in the sequential montage of images that supports the narrative by interpreting the actions.

A premise for such a vagrant gaze is that as much of the depicted space as possible is focused in order to avoid guidance and allow cognition of all elements. Technically the optics of a camera can only focus on a single plane. The farer away an object is from the selected focus plane the less sharp it will be depicted. The decrease of sharpness occurs gradually and depends on several factors. Virtually the depth of focus, therefore, can be increased so that an entire setting is shown without perceptible blur. *Citizen Kane* features a good deal of technical innovations but the high degree of depth of focus is something that stands out as an ambition of Welles and Toland as much as an interest of period experts already before Bazin.[7] Cinematographer Toland himself widely exploits his achievements and coins the term 'pan focus' for his technique of extended sharpness.[8] And just like Bazin he names realism as his main objective. "The normal human eye sees everything before it (within reasonable distance) clearly and sharply. There is no special or single center of visual sharpness in real life. … The attainment of an approximate human eye focus was one of our fundamental aims in *Citizen Kane*."[9]

The realism claimed here by Toland and also by Bazin marks a watershed in the aesthetics of cinema. It no longer strives for a supposed essentiality of the medium as most theorists of silent cinema did but pits its reproductive qualities against human perception. And there seems to be a general consensus between Bazin and the artists and engineers of the American film industry when both call for realism as an aesthetic ideal. In 1934 A. N. Goldsmith, the president of the Society of Motion Picture Engineers (SMPE), describes the mission of his members as follows: "It is the presentation of a real or imagined happening

5 André Bazin, "The Technique of Citizen Kane," in *Perspectives on Citizen Kane*, ed. Ronald Gottesman, trans. Alain Piette and Bert Cardullo (1947; New York: G.K. Hall, 1996), 229–37; André Bazin, *Orson Welles: A Critical View*, trans. Jonathan Rosenbaum (1950; New York: Harper & Row, 1978).

6 Bazin, *Orson Welles*, 78.

7 See "Technicians Discuss 'Citizen Kane,'" *Cine-Technician* 7, no. 34 (November 1941): 134–38, 149.

8 The attention in the trade and popular press would suggest a higher impact of Toland's concept than can be found in later Hollywood productions. Pan focus almost immediately turns into an obsession of movie enthusiasts rather than an addendum to the vocabulary of feature film production. See John Mescall, "'Pan-Focus' For Your Home Movies," *AC* 22, no. 12 (December 1941): 576, 593

9 Gregg Toland, "I Broke the Rules in 'Citizen Kane,'" *Popular Photography* 8, no. 8 (June 1941): 90; reprinted as: Gregg Toland, "How I Broke the Rules in 'Citizen Kane,'" in *Perspectives on Citizen Kane*, ed. Ronald Gottesman (repr., New York: G. K. Hall, 1996); a more detailed account can be found here: Gregg Toland, "Realism for 'Citizen Kane,'" *AC* 22, no. 2 (February 1941): 54–55, 80.

Fig. 1.1: Susanne Alexander's attempted suicide in *Citizen Kane* (1941)

to the audience in such approach to perfection that a satisfactory illusion of actual presence at the corresponding event is created. Briefly, it is the production of an acceptable semblance of reality."[10] The crucial point here is the understanding of representation and this is where Bazin and Hollywood drift apart. Noël Carroll in his analysis of Bazin distinguishes between two modes of representation. This is first the concept of an image as a reference to something of that we cannot know whether it is or was real as we accept the image as the only authority. This is what Goldsmith means when he says that it does not matter whether something is real or imagined as long as the image has certain aesthetic features that make us believe in the reality of its motif. In contrast to that, Carroll describes the Bazinian concept as 're-presentation' or the assumption that an image originates from an specific situation.[11] So when Toland defines realism as "looking at reality, rather than merely at a movie,"[12] we can assume that his emphasis is on *looking* while Bazin's would be on *reality*. The difference is one of causality and agency alike; in the first case 'reality' is a joined effect of the image and ourselves as beholders, while in the second case it is caused by the world itself. Bazin's notion of the photographic image, therefore, is less aesthetic but rather ontological as it becomes explicit when he defines realism as "the recreation of the world in its own image."[13]

While many of Bazin's theories are debated controversially in the coming decades, his reading of the suicide scene from *Citizen Kane* is not questioned until the early 1980s when Robert Carringer presents his account of the production of the movie. Carringer is the first who notices that while fore- and background of the shot are in focus, the body of Susan Alexander Kane (Dorothy Comingore) in between is not. Within a single shot this is technically not possible as the depth of focus is continuous.[14] What we see is not a single exposure but two exposures assembled into one. Carringer suggests that Toland used a so called in-camera matte. This means that two subsequent exposures with individual foci are

[10] A. N. Goldsmith, "Problems in Motion Picture Engineering," *JSMPE* 23, no. 6 (December 1934): 350.

[11] Noël Carroll, *Philosophical Problems of Classical Film Theory* (Princeton, NJ: Princeton UP, 1988), 131.

[12] Toland, "Realism for 'Citizen Kane,'" 54.

[13] André Bazin, "The Myth of Total Cinema," in *What is Cinema?*, ed. and trans. Tim Barnard (1946; Montréal: Caboose, 2009), 17.

[14] Cinematographer Hal Mohr reports a few years before how he managed to twist the focus plane with a special lens mount so that it is no longer at right angles with the camera axis. This way he created the illusion of an extended depth of field while the focused objects still had to share a single, now tilted, plane. Hal Mohr, "A Lens Mount for Universal Focus Effects," *AC* 17, no. 9 (September 1936): 370–71

done with complementary masks.[15] An alternative method of masking by means of selective lighting is mentioned by the studio's optical effects expert, Linwood Dunn, in an earlier interview: "[Toland] would underlight his set, film his two exposures, and focus on either one of them."[16] This requires that each time the unfocused area has to be entirely dark. But is perfectly possible with precise lighting and a set that features static pictorial zones. With both methods what appears to be a coherent space is effectively the combination of asynchronous image fragments.

There are other deep focus shots in *Citizen Kane*, which were produced without process techniques. And one might simply consider it bad luck that Bazin exactly uses this one to argue for Welles's realistic style. The perceptual impact of the suicide scene, that we can have a look around with as little guidance by the authors as possible, is unharmed. Even if in this case the central body is blurred—not least because the disorder of the hair and the optical unsharpness blend—it remains recognizable also due to its movements and the sound of breathing. Therefore, we can agree that the image features an emancipatory effect for the audience as Bazin demands. But his misjudgment is still expressive and worth asking the question why Bazin, as an expert, does not see that the supposedly real space is built up by optical effects. As several of his texts show, Bazin is neither unaware of nor indifferent towards the techniques involved in producing motion pictures. His knowledge seems to be profound though not always up-to-date.[17] His take on *Citizen Kane* is without doubt informed by the texts of Toland who explains in detail what makes his depth of focus photography possible (improvements in film stock, lenses, and lighting). While Toland also gives credit for the studio's effects department, he does so in such a generic way that a specific contribution to the production of realism is not conveyed.[18] But the reticence of Toland in this point still makes a bad excuse for Bazin if we take his ontological realism for granted.

Bazin knows as much as his coevals about the technical aspects of film production but his approach towards technology is different. This becomes most evident in comparison to Georges Sadoul, the communist turned surrealist, and his history of cinema.[19] Contrary to Sadoul's materialist historiography Bazin states: "Cinema is an idealist phenomenon; men's idea of it existed fully equipped in their brains, as in Plato's higher world, and the tenacious resistance of matter to the idea is more striking than technology's prompting of the inventor's imagination."[20] The realization of this ideal or, as he says, 'total' cinema is defined positively by Bazin as a 'myth.' Such a teleological conception involves primary assumptions, which make it difficult to observe and understand later developments that depart from the chosen main line. A central as much as essential idea of what cinema as a cultural technique strives for predesignates the study of particular matters. In the case of *Citizen Kane* this might be an explanation why Bazin misreads not only the processed suicide scene

15 Robert L. Carringer, "Orson Welles and Gregg Toland: Their Collaboration on 'Citizen Kane,'" *Critical Inquiry* 8, no. 4 (1982): 651–74, JSTOR: 1343191; followed by Robert L. Carringer, *The Making of Citizen Kane*, rev. ed. (1985; Berkeley: U of California Press, 1996).

16 Linwood G. Dunn, Interview with Graham J. Shirley, 1972, transscript, MHL, Linwood G. Dunn papers, 66-f.995, 5.

17 When he writes for example about the so called Dunning process, the method long since has been widely abandoned. See André Bazin, "The Life and Death of Superimposition," in *Bazin at Work: Major Essays and Reviews from the Forties and Fifties*, ed. and trans. Bert Cardullo (1946; New York: Routledge, 1997)

18 Toland, "Realism for 'Citizen Kane,'" 80.

19 See Georges Sadoul, *L'invention du cinéma: 1832-1897*, vol. 1, Histoire générale du cinéma (Paris: Denoël, 1946).

20 Bazin, "The Myth of Total Cinema," 13.

but also leaves the trick work of many others without comment.[21] But even if a teleological model is correct in its basic assumptions about a development it still does not provide a method to explain when and where historical changes occur.

Citizen Kane as much as Welles's second movie *The Magnificent Ambersons* (1942) contains several deep focus shots that are photographed without optical effects. But subsequent to Carringer's account, *Citizen Kane* and its abundance of trick shots are mostly perceived by scholars as an expression of the studio system's world of make-believe. David Bordwell reconstructs an entire history of artificiality that is coroneted by Welles's former milestone of realism.[22] And Norman Klein has no problem to integrate *Citizen Kane* into his study of animated cartoons: "The Bazinian space, so often an argument for a 'realism' in cinema, was also an *animated* space, in Hollywood anyway—Lumière and Méliès as a hybrid."[23] We can perceive this turnaround as a disclosure that simply falsifies Bazin's evaluation. But this does not explain how as viewers we still can see the suicide scene as realistic. To understand Bazin's enthusiasm we have to remember that his rejection is directed against the alternative to edit the scene from several single shots. This has to do with what I outlined as ontological realism; i.e., Bazin's insistence that what assembles in the virtual space of the narrative at least once has to meet in the real space of the film set or location. Bazin elaborates on this idea in regard to the problem of animal actors. Animals in movies are problematic because they are difficult to direct and also possibly dangerous. Therefore, they are often integrated by means of editing or optical effects—much to the displeasure of Bazin.

> It is a fact that other devices such as process shots make it possible for two objects, say the star and a tiger, to be seen together, a proximity which if it were real might cause some problems. The illusion here is more complete, but it can be detected and in any case, the important thing is not whether the trick can be spotted but whether or not trickery is used, just as the beauty of a copy is no substitute for the authenticity of a Vermeer.[24]

It might seem askew that Bazin insists here on 'the real thing' and that he plays off an actual event against—off all things—a painting. And while authenticity in this quote relates to the originality of the painting and not the style of the painter, it is still peculiar that he names Vermeer as a referee who stands for a plain and straight genuineness that is achieved by means of optical instruments and composition.[25] But if we take Bazin's claim for an ontological realism serious and still acknowledge that cinematic images are possibly highly constructed, we have to address the question of construction. How can we reconsider montage in a wider sense as a concept, which not only refers to the combination of images in time but also to assemblages within the moving image and in the pro-filmic space. When Orson Welles later calls *Citizen Kane* "a big fake,"[26] he has the sets in mind but this charac-

[21] Linwood Dunn later claims that 75% of the movie was processed. *Linwood Dunn: An American Film Institute Seminar on His Work*, typescript, American Film Institute, April 18, 1973, 15

[22] See David Bordwell, "*Citizen Kane* und die Künstlichkeit des klassischen Studio-Systems," in *Der schöne Schein der Künstlichkeit*, ed. Andreas Rost, trans. Ingo Fließ, lecture presented in 1994 was only published in German translation. (Frankfurt/M.: Verlag der Autoren, 1995), 117–49.

[23] Norman M. Klein, *Seven Minutes: The Life and Death of the American Animated Cartoon* (London: Verso, 1993), 146.

[24] André Bazin, "The Virtues and Limitations of Montage," in *What is Cinema?*, trans. Hugh Gray (1953; Berkeley: U of California Press, 2004), 45-46.

[25] Cf. Daniel A. Fink, "Vermeer's Use of the Camera Obscura: A Comparative Study," *The Art Bulletin* 53, no. 4 (1971): 493–505, doi:10 . 2307 / 3048905; Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: U of Chicago Press, 1983).

[26] Orson Welles and Peter Bogdanovich, *This is Orson Welles* (New York: HarperCollins, 1992), 79.

terization also applies to the processed images and of course the editing. To avoid confusion with the established term of montage I want to suggest to speak of assemblage/assembly in cases where I do not distinguish strictly between the three domains of time, image, and space in which construction can happen.

1.2 Application-orientated Publishing on Cinema Techniques and Special Effects

Idealistic authors like Bazin tend to marginalize the role of technology in relation to human agency. But there is a corpus of literature that originates from production practices and develops parallel to the primarily theoretical line of film scholarship from criticism to academia. I will, hereinafter, outline accounts of film techniques as they emerge after World War II in regard to methodology and their state of research. (A survey of early literature will be subject of the next chapter.) Roughly the literature on special effects or cinematography can be divided into three groups.

The first segment of publications are handbooks that seek to provide practical help with filmmaking. Such handbooks also document a cleavage between integrated industries with an enclosed production of knowledge and independent filmmakers, which are addressed by such publications. The Marxist author Raymond Spottiswoode broaches this situation directly in his 1951 *Film and Its Techniques*.

> Until very recently, professional film making was a closed occupation confined to the few writers and technicians who, in only a few score cities throughout the world, had learned skills which were as jealously guarded as the secrets of a medieval craft. Indeed, the atmosphere of a craft guild prevailed in every branch of film making. The worker graduated through a long apprenticeship; he was narrowly specialized to a single task; and there were few who could command the financial resources needed for production and at the same time learn its technical skills.[27]

A similar attitude underlies Leslie J. Wheeler's *Principles of Cinematography*.[28] Both authors take a materialist approach, which attempts to emancipate independents and movie amateurs. The first handbook that has a focus on special effects (and that was reprinted consistently until digital techniques took over), is Raymond Fielding's *Techniques of Special Effects of Cinematography* from 1965. Fielding is a historian, who comes from and works in academia, but his book follows mainly the concept of the other handbooks in that it focuses on techniques that are in use at the time of writing and only occasionally explains historical developments.[29] It is still the most relevant reference for all technical issues of optical effects. At about the same time Frank P. Clark publishes his *Special Effects in Motion*

[27] Raymond Spottiswoode, *Film and Its Techniques* (London: Faber & Faber, 1951), 1.

[28] Leslie J. Wheeler, *Principles of Cinematography: A Handbook of Motion Picture Technology* (London: Fountain, 1953), Open Library: ia:principlesofcinema00whee.

[29] Raymond Fielding, *The Technique of Special Effects Cinematography*, 4th ed. (1965; London: Focal, 1985) Fielding also publishes the first bibliography of special effects literature, an account of effects pioneer Norman O. Dawn, and an anthology with reprints of trade journals articles: Raymond Fielding, "Special-Effects Cinematography: A Bibliography," *JSMPTE* 69, no. 6 (June 1960): 421–24; Raymond Fielding, ed., *A Technological History of Motion Pictures and Television: An Anthology from the Pages of the Journal of the Society of Motion Picture and Television Engineers* (Berkeley: U of California Press, 1967); Raymond Fielding, "Norman O. Dawn: Pioneer Worker in Special Effects," *JSMPTE* 72, no. 1 (1963): 15–23

Pictures with a focus on mechanical effects. What Fielding and Clark have in common is that they no longer differentiate between industry insiders and independents but rather between cinematographers and other professionals, who they want to inform about the possibilities of special effects. Clark writes here: "This book is written to stimulate and guide film directors on how special effects can enhance a film, and to assist and instruct those who must produce the effects."[30]

A second, more marginal, line of writing can be found in applied academia, namely at the University of Southern California (USC) in Los Angeles.[31] Maybe the first scholarly works on special effects are those by Harrison Penrod Hilfinger, who studied at USC under Lewis W. Physioc, a cinematographer and matte painter who regularly published on art and cinema. Hilfinger's report *A Survey of Contemporary Methods for the Production of Special Effects* is an extensive overview over practices and history of trick work in Hollywood.[32] It is followed by his master's thesis on the production of *King Kong* (1933). Both studies are based mainly on trade journal publications. In his analysis of *King Kong* Hilfinger complains about the rejection by industry insiders to discuss the special effects of the movie. As a consequence "an unusual emphasis had to be placed on personal observations," as he writes.[33] His observations from three screenings of the movie are in several cases refuted by later research. In 1952 Sverre Haakon Christopherson writes his master's thesis at USC on matte shots as one specific optical process. What distinguishes the surveys of Hilfinger and Christopherson from each other is not only the different scope but also that special effects experts later are more open towards revealing their processes, as Christopherson explains.

> The work or the special effects staff has long been shrouded in mystery, and is little understood even among film makers. This secrecy was due, in many cases, to a certain attitude on the part or these experts reminiscent of the guild spirit of medieval times, manifested itself in the desire to keep the secrets "within the family." This state of affairs had at least one undesirable feature about it. How could directors, writer, and producers be expected to make use of effects shots if they were not fully acquainted with the tremendous potentialities of the special photographic processes? The special effects staff decided that in order to justify their existence on the lot, they should contribute more to the planning and executing of a picture by offering advice and suggestions with regard to what their department could perform. Since then the effects technician has developed a slight case of schizophrenia. One part of him wants the writer to use more special effects, and the other part of him tears his hair out in despair trying to solve the problem the writer concocts for him.[34]

30 Frank P. Clark, *Special Effects in Motion Pictures: Some Methods for Producing Mechanical Special Effects* (New York: SMPTE, 1966), 6.

31 USC had started to offer practical film education in the early 1930s in cooperation with the Academy of Motion Pictures Art and Science (AMPAS) and several of the major studios. See Birk Weiberg, "Classical Hollywood as an Epistemological Network," *Journalism and Mass Communication* 2, no. 2 (February 2012): 421–27

32 Harrison Penrod Hilfinger, *A Survey of Contemporary Methods for the Production of Special Effects*, report (Los Angeles: Department of Cinematography, University of Southern California, June 1941).

33 Harrison Penrod Hilfinger, "A Study of the Significance and Application of Special-Effects to the Cinema" (master's thesis, Department of Cinema, University of Southern California, 1942), 2.

34 Sverre Haakon Christopherson, "A Study of Current Methods and Techniques Used in the Creation of Matte Shots for Films" (master's thesis, Department of Cinema, University of Southern California, 1952), 22-23.

In short, these studies in defiance of their merits do little more than to give an overview over already published sources. This is slightly different with a later thesis by Mehrdad Azarmi, finished in 1973. Azarmi has extensive access to industry insiders like Linwood Dunn as he works for several years with half a dozen companies involved in optical effects. As an aftermath of earlier secrecy he addresses the problem of an unstable terminology, which even around 1970 still results in situations where experts have problems working at other companies because terminology is not standardized throughout Hollywood. This applies also to the question how to call the processes that are the subject of my study as we will see. Azarmi also comes up with a definition that I would still regard as valid and useful: "Optical effects cinematography is the process of recording on film by means of an interlocked camera and projector that which cannot be photographed under ordinary conditions by conventional equipment."[35] But while Azarmi calls to name several problems of the available literature and characterizes the handbooks mentioned above as often misleading in their descriptions of processes, he finally does not fulfill the promises he initially makes as his accounts of the different techniques are too abridged. Like Hilfinger and Christopherson before him, his main interest is not so far away from the handbooks in an applicable and up-to-date knowledge. The historical developments that they all add to different degrees and the academic framework do little to upgrade their studies when it comes to methodology and content.

A third type of publication, finally, appears in the late 1970s as part of what can be described as a renaissance of special effects. This mainly derives from blockbusters like *Stars Wars* and the vision with that director-producer George Lucas uses effects. Lucas actually starts the company Industrial, Light & Magic, which conducts own research and becomes a major innovator for modern special effects. The popular books that accompany this development no longer address industry members or movie amateurs but the audience itself.[36] They feature attractive visual source material and take a different approach to investigate the topic. This often seems to include contact with industry insiders, which occasionally provides new information. But due to the lack of reference it is hardly possible to validate such findings. In recent years this genre has also brought forward publications that address professionals and collectors like *The Invisible Art* by Mark Cotta Vaz and Craig Barron, an extensive volume on the history of matte paintings and related optical effects.[37]

Summing up, we can say that the value of these non-academic publications is limited. This has two main reasons that affect all three types to different degrees. The first is that the accounts are application-oriented and, therefore, show limited epistemological or scientific interest. They describe less developments but rather results, dead ends are omitted, and if genealogies are provided than only as 'great men narratives.' The second reason is that they work with sources that are either know and accessible (like the trade journals) or that are unreliable (like second hand oral histories).

35 Mehrdad Azarmi, "Optical Effects Cinematography: Its Development, Methods and Techniques" (PhD diss., University of Southern California, 1973), 7.

36 Cf. Ron Fry and Pamela Fourzon, *The Saga of Special Effects* (Englewood Cliffs, NJ: Prentice-Hall, 1977); Harold Schechter and David Everitt, *Film Tricks: Special Effects in the Movies* (New York: H. Quist, 1980); Jane O'Connor and Katy Hall, *Magic in the Movies: The Story of Special Effects* (Garden City, NY: Doubleday, 1980).

37 Mark Cotta Vaz and Craig Barron, *The Invisible Art: The Legends of Movie Matte Painting* (San Francisco: Chronicle, 2002).

1.3 Liberal Arts Approaches to Film Techniques

The above mentioned works tend to be solely concerned with techniques whereas theoretical texts try to relate technical aspects discursively to aesthetic and social ones. This academic field itself opens up in the 1970s with the establishment of film studies as an independent and non-applied discipline. It is rooted rather in the tradition of film critique than in an academic film education that is related to practice. In the identification stage of film studies the role of technology for cinema is a central matter of concern. I will summarize different approaches in order to evaluate whether or not they can be helpful to understand optical effects.

One of the founding moments for film studies is a conference entitled "The Cinematic Apparatus," which is held 1978 at the University of Wisconsin–Milwaukee. The main ideas, which are discussed there, are later often summarized under the umbrella term of apparatus theories.[38] But while the associated scholars make technology a subject of discussion, they do not simply put it in a privileged position but tend to envelop it with a critique of ideology. What most of them share, is a materialist approach that is electively combined with semiotic, psychoanalytic, feminist, or other liberal arts theories. Jean-Louis Baudry, who is more than others seen as an apparatus scholar, in his influential text "Ideological Effects of the Basic Cinematic Apparatus" analyses how cinema constitutes the transcendental subject of idealist philosophy by technical means. It does so by using central perspective to constitute a viewer who is then constantly dissolved by the deprivation of an own position and the concealment of the technical means. Technology here is not only the material base of ideological effects, as Baudry's title suggests, but also the implementation of that ideology.[39] This circular causality is but one problem of apparatus theories in general that actually makes everything an effect of ideology. Technology here is predominantly rendered as static and ahistorical. Just as Bazin imagines a Platonic idea of cinema that pursues total immersion in a medial reality, Baudry uses Plato's cave as a metaphor for his critique. The difference between them at this point lies less in their definitions of cinema as illusionistic than in their assessments of the same. Both do not foresee non-linear genealogies or possibilities of individual authorship that affect technical developments.

Barry Salt is one of the most severe critics of apparatus theories that he regards as an infiltration of film studies through Marxism, psychoanalysis, etc. Salt himself, who never manages to overcome his outsider position within the discipline, on the other hand is accused of isolating technology through his claim for "Scientific Realism."[40] One reason for these divergences are different academic backgrounds. Salt originally comes from physics and only after his PhD in that discipline becomes involved with motion pictures. From this perspective he regards humanities as inferior sciences because he misses universally accepted agreements about methods and models there. One part of Salt's own methods is the measurement and statistical analysis of shot scales and lengths.[41] Salt is without doubt a major contributor to studies of film technology. But his main interest is the development of film styles, which for him are based on technical changes. This echoes his methodological

---

[38] See Teresa De Lauretis and Stephen Heath, eds., *The Cinematic Apparatus* (New York: St. Martin's, 1980).

[39] See Jean-Louis Baudry, "Ideological Effects of the Basic Cinematic Apparatus," in *Narrative, Apparatus, Ideology: A Film Theory Reader*, ed. Philip Rosen (1970; repr., New York: Columbia UP, 1986), 286–98.

[40] Barry Salt, *Film Style and Technology: History and Analysis*, 3rd ed. (1983; London: Starword, 2009), 1.

[41] See Barry Salt, "Statistical Style Analysis of Motion Pictures," *Film Quarterly* 28, no. 1 (1974): 13–22, doi:10.2307/1211438.

approach that takes the concepts of natural science as a starting point to study art in a positivistic manner. Though he does not suggest that the first can explain the second, Salt has little to say about how this relationship actually works. This limits the value of his works when it comes to methodological questions of how to study the development of optical effects. As a source his usefulness is also limited because he tries to cover all technical aspects of film production of which optical effects are naturally only a smaller part. A question that arises with Salt is whether optical effects should be considered in the context of film styles at all. The concept of style, which should become essential to film studies, appears to be more inherited from film critique than worked out independently. Salt conceives it as a conformity of formal qualities (like the average length of a shot) over several movies that refers back to a mutual author who expresses himself in that way.[42] Practitioners of optical effects, on the other hand, usually claim the invisibility of their work as a primary goal. Such a lack of perceptibility—may it be real or only intended—runs contrary to the idea of an expressive author. It will have to be studied how and when optical effects do inform the aesthetics of composited images. But we cannot presuppose a *Kunstwollen* (literally 'will to art'), as originally described by Alois Riegl.[43] And just as it is difficult to trace back the artificialness that we perceive watching old movies to its originators, we cannot make secured assertions on how period audiences perceived such images for a lack of reliable sources.

The most influential movement in regard to scholarship of technological and aesthetic developments of motion pictures is likely the so called Wisconsin school. Its cornerstone is the extensive study *The Classical Hollywood Cinema* by David Bordwell, Janet Staiger, and Kristin Thompson.[44] I will only cover a few elements of this method that are relevant for my study. In this regard it makes sense to compare the Wisconsin school to the work of Barry Salt. Bordwell and Thompson, in fact, do this themselves when, at the same time of the publication of their own study, they review Salt's earlier book on basically the same topic.[45] The critique they bring forward can be focused on two main arguments that are relevant here. The first is that Salt presents technical processes of innovation as isolated and naturalistic. Devices are merely 'introduced' which makes them occur just as natural events. (This reduction is especially significant as Salt has the background and technical knowledge to describe such processes in their complexity.) The second objection is related to the first. The reviewers criticize that Salt does not have a concept of collective authorship and, therefore, his understanding of the developments of technology and movies alike remains deficient.[46] The question how to raise film studies from its origin (i.e., the critiques of works of individual authors) to a method that also covers distributed modes of agency is a main concern of the Wisconsin scholars. Thompson had already analyzed the division of labor in animation in the apparatus conference;[47] Staiger studied work practices and their relations

---

42 See Salt, *Film Style and Technology*, 27-28.

43 See Alois Riegl, *Problems of Style: Foundations for a History of Ornament*, ed. David Castriota, trans. Evelyn Kain (1893; Princeton, NJ: Princeton UP, 1992).

44 David Bordwell, Janet Staiger, and Kristin Thompson, *The Classical Hollywood Cinema: Film Style & Mode of Production to 1960* (New York: Columbia UP, 1985).

45 David Bordwell and Kristin Thompson, "Toward a Scientific Film History?," *Quarterly Review of Film Studies* 10, no. 3 (Summer 1985): 224–37.

46 The review itself is debated by Salt and the reviewers in several articles that follow it. Cf. Barry Salt and Ernest Callenbach, "Peppery Salt," *Film Quarterly* 39, no. 2 (1985): 61–64, doi:10.2307/1212342; David Bordwell and Kristin Thompson, "A Salt and Battery," *Film Quarterly* 40, no. 2 (1986): 59–62, doi:10.2307/1212357; Barry Salt, "Reply to Bordwell & Thompson," *Film Quarterly* 40, no. 4 (1987): 59–61, doi:10.2307/1212270; David Bordwell and Kristin Thompson, "Salt II," *Film Quarterly* 40, no. 4 (1987): 61–63, doi:10.2307/1212271

47 Kristin Thompson, "Implications of the Cel Animation Technique," in De Lauretis and Heath, *The Cinematic Apparatus*, 106–19.

to an aesthetic standardization in regard to the studio of Thomas H. Ince around 1915;[48] and she follows this question with her account of the so called producer-unit system as a specific mode of production that the studios brought forth.[49] For the role of technology in the studio system Bordwell and Staiger then develop a model that explains advancements by the combination of three factors, namely production efficiency (economy), production differentiation (novelty), and adherence to standards of quality (aesthetic norms).[50] Their analysis of motion picture technology is also the first that discusses the role and emergence of industry standards and the institutions behind them.[51] What I would criticizes here, is that the Wisconsin school features a similar bias for style as does Salt. Bordwell defines it as "the film's systematic use of cinematic devices."[52] Although the term (as an adoption from Russian formalist theory of narration) in this case is more precise, it is still based on the assumptions of intentionality.[53] For Bordwell et al this leads to an understanding of studios as authors that are characterized by specific styles. Instead of extending or redefining the term to make it productive for my study, I will rather discard it and speak more universally of the aesthetics of composited images.

Another scholar who is generally included with the apparatus theorists but has developed a less static model of technical developments is Jean-Louis Comolli. In his essay "Machines of the Visible" he quoted Gilles Deleuze and Claire Parnet saying that "the machine is always social before it is technical."[54] But he also acknowledges that cinema does change, technically and aesthetically, in a more complex way as others had admitted. One of the examples he refers to is the deep focus cinematography in the movies of Welles and Wyler that Bazin had read as a sign of the inevitable progress of cinema. For Comolli this development is neither an automatism nor is it linear it its form.

> The historical variation of cinematic techniques, their appearance-disappearance, their phases of convergence, their periods of dominance and decline, seem to me to depend not on a rational-linear order of technological perfectibility nor an autonomous instance of scientific 'progress' but much rather on the offsettings, adjustments, arrangements carried out by a social configuration in order to represent itself, identify itself, and itself produce itself in its representation.[55]

These complex processes of representation cause delays in the application of technologies. When Comolli follows here Deleuze and Parnet he seems to marginalize technologies as *tools* that precede *machines* that are now conceived as thoroughly social structures in the

48 Janet Staiger, "Dividing Labor for Production Control: Thomas Ince and the Rise of the Studio System," *Cinema Journal* 18, no. 2 (1979): 16–25, doi:10.2307/1225439.

49 Janet Staiger, "The Producer-Unit System: Management by Specialization after 1931," chap. 25 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 320–29.

50 See David Bordwell and Janet Staiger, "Technology, Style, and Mode of Production," chap. 19 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 243-47.

51 See Kristin Thompson, "Initial Standardization of the Basic Technology," chap. 20 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 262–80.

52 David Bordwell, *Narration in the Fiction Film* (Madison, WI: U of Wisconsin Press, 1985), 50.

53 One could read Bordwell's definition of style as an autonomous usage by the film itself. But the qualification that this usage has to be 'systematic' suggests a tactic that again is bound to an author or a group of such. In a later text Bordwell and Thompson then demonstrate their concept of style by simply comparing different directors. See David Bordwell and Kristin Thompson, *Film Art: An Introduction*, 8th ed. (Boston: McGraw-Hill, 2008), 304-305

54 Jean-Louis Comolli, "Machines of the Visible," in De Lauretis and Heath, *The Cinematic Apparatus*, 122; Gilles Deleuze and Claire Parnet, *Dialogues*, trans. Hugh Tomlinson and Barbara Habberjamn (1977; New York: Columbia UP, 1987), 70.

55 Comolli, "Machines of the Visible," 121.

sense of *dispositifs*. But being a materialist, his development model is dialectic. In opposition to somebody like Baudry, he calls to mind that cinema technology is multifaceted and should not be reduced to optics as a symbolic technique. The crux with Comolli, though, is that while he embraces the complexity of cinematic techniques and concepts with all its dialectic frictions, he still conflates all historical developments under the unifying roof of ideology.

John Belton in his account on historical methodology appreciates the materialist approach, which had been predominant since the 1970s, and he follows Comolli's criticism of Bazin's myth-of-cinema-essay. But he also sees the structural similarities between them when they persist in modes of representation of either an idea or an ideology.

> As methodologies, they can only generate the sort of data they have been programmed to produce. … Thus idealist methodology will reveal only the essential linearity of history, while materialist methodology will only reveal the essential contradictions and discontinuities that underlie historical change. In short, both project a predetermined scenario upon raw evidence.[56]

What Belton questions specifically regarding Comolli, is that the latter's conceptions of ideology and economy are too monolithic to escape determinism. (Ideology is conceived as realism based on central perspective. Economy is always an economy of profit.) He, therefore, adds to Comolli's notion of delay that of reason; i.e., he demands to ask not only why something is happening at a certain time but also who makes it happen. Raising this apparently obvious question directly crushes any notion of essences within technology or ideology that are realized autonomously. Belton deploys his method by showing the complex processes leading to the emergence of wide-screen formats in cinema. One question though, that he does not ask explicitly, is the one for definitions. This is closely related to calling reasons for development and application of these formats but it is not identical with asking how they are actually defined. As the sociologist Wiebe E. Bijker has shown in regard to the implementation of fluorescent light, involved parties there consciously negotiate for years whether such lamps should be conceived as highly efficient (i.e., producing the same amount of light with less energy) or intensive (i.e., producing more light with the same energy).[57] Also apparently undisputed notions of the identity of a specific artifact are never intrinsic; they emerge in different ways just like the artifacts themselves. Techniques with all their particulars and practices are not identical with their definitions. And to look at these as distinct may support the understanding of their developments.

Despite of all merits, especially of Bordwell, Staiger, Thompson, and Belton, I want to raise two general objections that should clarify my next steps. The first is nearly trivial, but I have to insist that none of the studies has given sufficient consideration for optical effects and treated them by satisfying methods. This is also due to a predominant focus on matters of style that is at odds with the aspiration of optical effects to remain unseen. They are still a blind spot of film studies, which maybe only now can receive more attention in view of today's digital effects. The latter meanwhile have been carefully studied and hopefully this study will contribute to future comparisons of both.[58]

56 John Belton, "CinemaScope and Historical Methodology," *Cinema Journal* 28, no. 1 (1988): 23, doi:10.2307/1225015.

57 See Wiebe E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Cambridge, MA: MIT Press, 1995).

58 See e.g. Barbara Flückiger, *Visual Effects: Filmbilder aus dem Computer* (Marburg: Schüren, 2008); Julie Turnock, "Plastic Reality: Special Effects, Art and Technology in 1970s US Filmmaking" (PhD diss., University of Chicago, 2008).

The second demur is broader and, thereby, exceeds the reference frame of motion pictures. A basic question of any study on modern media is how to relate aesthetic, technical, and social aspects. Janet Staiger writes here: "We need to understand that the production of meaning is not separate from its economic mode of production nor from the instruments and techniques which individuals use to form materials so that meaning results."[59] But for film studies these complex networks tend to amount to questions of style. In order to look at this issue from another angle, we should reconsider these domains as different modes of representation, what I will do in the next section.

1.4 Actor-Network-Theory

As I have tried to show, there lies an intricacy in writing about an art form such as film, which is at the same time the product of one or more individuals and which also involves technologies and natural phenomena. The challenge to develop an integrated mode of analysis occurs basically with all arts but possibly can be best studied with film. As we have seen, anthropocentric approaches tend to downplay the involved technologies either by considering them as static or as developing along stable trajectories. Technocentered methods, on the other hand, present their subjects either as pervasive structures or as backdrops against which individual authorship becomes possible. A first step to make these contradictory perspectives compatible is to look at their preliminaries. In both cases the choice of a research focus—i.e., looking at humans or looking at machines—is at the same time a commitment to a specific attribution of agency. For an unbiased approach to media (i.e., devices of semiotic practices and the resulting artifacts), I want to suggest that we will have to adopt an alternative concept of agency first.

This is the point where Actor-Network-Theory (ANT) and its most prominent representative Bruno Latour come in. Since the 1980s, ANT has developed as one type of Science and Technology Studies (STS). STS scholars have investigated the history of natural sciences and later technologies within the discipline of sociology. Their work was encountered skeptically by the scientists and engineers that became objects of research. A sociological 'explanation' of scientific 'facts' could only be understood as social constructivism and as an assault towards the truth claim of natural sciences. Actor-Network-Theory tried to pacify this conflict by self-examining its own discipline, sociology. Latour, whose early work cannot completely clear the suspicion to be social constructivist, does so by "Reassembling the Social."[60] In a détournement of Margaret Thatcher's infamous (but not genuine) dictum "There is no such thing as society," he broadens the term to a degree that it designates all kinds of operations. Society is conceived as the result and not the cause of interactions. Accordingly the concept of society can longer provide explanations. Latour stepwise deploys and deconstructs what he calls the sources of uncertainty but what for sociologists are nothing less than basic assumptions of their work.[61] In a fictive dialogue Latour's alter ego says on this act of self-destruction: "ANT is first of all a negative argument. It does

[59] Janet Staiger, "The Hollywood Mode of Production: Its Conditions of Existence," chap. 8 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 87.

[60] Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford UP, 2005).

[61] Namely, he discards the concepts of groups as enclosed entities, actions as ascribable to single actors, passive objects, the dichotomy of facts and fictions, and the avoidance of uncertainty in the work of sociologists.

not say anything positive on any state of affairs."[62] ANT thus is a heuristic approach that assumes that the researcher does not know more about his or her objects than the objects know themselves.

With its dissolution of society as an external body ANT possibly helps other disciplines that often regard 'the social' as something that surrounds if not besieges their research objects.[63] Art historian Wolfgang Kemp in 1991 (and without affiliation to ANT) noticed that an increased interest of scholars in the 'context' of art works rather points to the problem than manages to solve it.

> The philosophy of art of this century, no matter of which observance, is bound to the insularity of the art work much more than its predecessors ever were. And if it allows for institutional aspects … then it does so in such a way of over-affirmation that everything becomes a function of context and context is understood in such a general way as before the art work.[64]

The very notion of a periphery that only refers to its center is difficult to overcome. Latour could easily ally to Kemp's demands when he writes: "Society is not the whole 'in which' everything is embedded, but what travels 'through' everything, calibrating connections and offering every entity it reaches some possibility of commensurability."[65] What stands in the way of art historians to make this step, as Kemp himself observes, is an enduring propensity for intentionality. Just as the 'context' points to the 'text,' the latter serves as a proxy for the author. Kemp's corollary is a call for an art history of complexity, which with Latour we might also read as one of distributed agency.

> It is not the master plan but the melange that binds the material. Accumulation, interference, annihilation, a constant readjustment, that is how history operates, and it would be a classical fallacy to devaluate this open, "unruly," and processual structure against whole designs that are only presumedly not subject to the same rules.[66]

Kemp and Latour both undertake a criticism of modernity that for different reasons begins with René Descartes. Kemp simply sees Descartes's method of breaking up problems into smaller and smaller units as a cause for our unability to conceive complex issues. Latour's critique of Descartes is more wide-ranging. In *We Have Never Been Modern* he starts off his take on complexity with a description of his newspaper that assembles such diverse matters like climate change, AIDS, computer chips, etc. These contemporary phenomena according to Latour can no longer be pinpointed towards specific domains like natural sciences, politics, or economy. He calls these hybrids—i.e., entities that constantly travel between the modernist domains.[67] Hybrids run afoul of the paradigmatic dichotomies, which are considered as a mark of Western culture: nature vs. culture, natural sciences vs. humanities, fact vs. fiction … Though these pairs are not congruent, they all can be traced back to Descartes's initial distinction between *res cogitans* and *res extensa*.[68] Latour

62 Latour, *Reassembling the Social*, 141.

63 For a comparison of ANT and art history see Thomas Hensel and Jens Schröter, "The Akteur-Netzwerk-Theorie als Herausforderung der Kunstwissenschaft," *Zeitschrift für Ästhetik und Allgemeine Kunstwissenschaft* 57, no. 1 (2012): 5–18.

64 Wolfgang Kemp, "Für eine Kunstgeschichte der Komplexität," *Texte zur Kunst* 2, no. 2 (1991): 91.

65 Latour, *Reassembling the Social*, 241-42.

66 Kemp, "Für eine Kunstgeschichte der Komplexität," 91.

67 Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard UP, 1993), 1-3.

68 See René Descartes, "Treatise on Man," in *The Philosophical Writings of Descartes*, trans. John Cottingham, Robert Stoothoff, and Dugald Murdoch, vol. 1 (1664; Cambridge, MA: Cambridge UP, 1985), 99–108.

consolidates these dichotomies to the one of humans and non-humans. A primary aim of Actor-Network-Theory, therefore, is to leave behind a concept of agency that is based on human intentionality alone. The reevaluation of humans and non-humans is often described as a symmetry, a metaphor Latour later discards as mistakable when he writes: "what I had in mind was not *and*, but *neither*: a joint *dissolution of both collectors*."[69] To be exact, modernism does not reserve agency for humans but affiliates different kinds of it with the two perspectives of natural and human sciences. This distinction begins with the debates between Robert Boyle and Thomas Hobbes and derives directly from Descartes as Steven Shapin and Simon Schaffer have shown.[70] Latour's critique of modernism is easily misunderstood as postmodern or even pantheistic when one simply assigns our traditional notions of human agency to things. ANT does not deny an ontological difference between humans and non-humans but it rejects static a prioris in favor of focusing on specific processes and effects.

From text to text Latour seems to meander around and suspend one dualism after another. The one of humans and non-humans is the most prominent for sure but maybe not the most important. I want to add here two more that seem to be relevant for my venture because they correspond to problems I have highlighted in regard to film studies. The first one is that of the two fields of the real and the unreal. This allocation echoes the distinction between natural sciences and humanities and the severed responsibilities it produces. An airplane, as a real and functional object, is under the authority of physics while flying saucers can only become the subject matter of social sciences, or maybe psychology. The latter ones only seem to exist, as individuals and groups *belief* in them. An essential part of the provocation that comes with STS is that it does conduct research on airplanes from a sociologist perspective.[71] But these ostensively clear distinctions melt when we think of Higgs particles and black holes.[72] Latour suggests here to treat such phenomena not as static opposites but as elements of processes. "The real is no different from the possible, the unrealistic, the realizable, the desirable, the utopian, the absurd, the reasonable, or the costly. All these adjectives are merely ways of describing successive points along the narrative."[73] An unidentified flying object, thereupon, can be redefined as an unrealized one. The 'biography' of a thing, like an aircraft or a machine to manipulate moving images, is not always shaped in the same way (i.e., from idea to matter). It can also build on present machines that are only slightly modified. Such an approach is far away from leveling differences. The aviation of physicists is real because it is effective; but it cannot be reduced to physics. This is only possible with reference to a reality that is considered to be external and stable. Natural scientist often regard scholars of humanities looking at their research and its objects as a thread not only to themselves but also to their conception of reality.[74] ANT sees reality as something that constantly has to be rebuilt and defended. And it is important here that only the elimination of the prefixed adjective *social* allows to use *construction* as a positive concept.

---

69 Latour, *Reassembling the Social*, 76.

70 See Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton UP, 1985).

71 See John Law and Michel Callon, "Engineering and Sociology in a Military Aircraft Project: A Network Analysis of Technological Change," *Social Problems* 35, no. 3 (1988): 284–97, doi:10.2307/800623.

72 Latour, *We Have Never Been Modern*, 92.

73 Bruno Latour, "Technology is Society Made Durable," in *A Sociology of Monsters: Essays on Power, Technology and Domination*, ed. John Law (London: Routledge, 1991), 117.

74 See Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard UP, 1999), 1-23.

The last dualism, I want to mention, carries forward the one of real and unreal as basic assumptions of research to fact and fiction as specific matters of the same. Latour merges these antipodes, which he also describes as facts and fetishes, into what he calls 'factishes.'[75] What he targets here is the abrogation of a modernist conception of critique. Both, natural scientists and humanities scholars, act as critics who first select subject matters that are either real or unreal and then reveal them as facts or fetishes. Latour unveils that these movements are structurally the same and observes with such examples as climate change and the war on terror that we have been paralyzed in a catch-22.[76] As an alternative he suggests to replace the notion of matters of fact with what he calls matters of concern—i.e., things that unleash controversy and bring out networks.[77] Ultimately, the concept of matters of concern implies an unbiased approach to narratives as an element of building things. This turn might be considered provocative in regard to science and technology but should be embraced in the field of arts.

As a concrete example of ANT I will briefly introduce Latour's *Aramis, or, The Love of Technology*. Aramis is an aborted French public transport system of the 1970s. In Western countries there were nearly a dozen so called Personal Rapid Transport (PRT) projects, which aimed at combining individual transit needs with a common infrastructure. None of these projects succeeded and when in 1987 finally Aramis as the longest surviving project is canceled, nobody seems to remember who originally wanted it. Latour's study describes an investigation that is deployed as a book with several, typographically distinct text layers. What can be regarded as the scientific text, is complemented with excerpts from interviews and documents as much as a novel, which covers the work of Latour's alter ego Norbert H. from the perspective of his engineer intern, and finally a monolog of Aramis, the 'unloved' project itself. At the moment when Aramis is abandoned, there seems to be a consensus among the involved parties that the project was foredoomed to fail.[78] Instead of verifying the final closure in retrospect, Latour accepts the initial assessment of the actors that Aramis was a good idea. As much as he refuses to deconstruct the original concept, he ignores the result. In contrast, he tries to trace the development from a self-chosen starting point to the end of the project without preconceptions. The "framework is defined by the actors and not by the investigators."[79] This means that explanations are replaced by descriptions because an explanation requires an already existing framework. This is what distinguishes ANT from other approaches, which start off with the choice of an existing framework or discourse. Latour deliberately fails to deliver the expected explanation either for the stranding of Aramis or PRTs in general. The conflict that emerges between him and his clients, who commissioned his research, is grounded in the prevailing contradiction that first engineers are assigned to create Aramis as a fact and then Latour, a sociologist, is expected to expose Aramis as a fetish or social object. While failing to satisfy these expectations, the book offers an illuminating redundancy that is full of observations

75 See Latour, *Pandora's Hope*, 266-92.

76 See Bruno Latour, "Why has Critique Run out of Steam?: From Matters of Fact to Matters of Concern," *Critical Inquiry* 30, no. 2 (2004): 225–48, doi:10.1086/421123.

77 See Bruno Latour, "From Realpolitik to Dingpolitik," in *Making Things Public: Atmospheres of Democracy*, ed. Bruno Latour and Peter Weibel (Karlsruhe/Cambridge, MA: ZKM/MIT Press, 2005), 14–44.

78 There is a tendency of ANT to focus on failed projects. Madeleine Akrich here goes as far as to claim that unsuccessful projects alone can be subject matter of research as one can only here look inside otherwise opaque objects. With regard to the symmetry of realized and unrealized projects I would contradict here. The descriptions of successful technological developments, as we will see with several techniques of image compositing later, likewise tend to level out at a narrative that aims for achievement. Cf. Madeleine Akrich, "The De-Scription of Technical Objects," in *Shaping Technology/Building Society: Studies in Sociotechnical Change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 205–24

79 Bruno Latour, *Aramis, or The Love of Technology* (Cambridge, MA: Harvard UP, 2002), 19.

on the relationship between humans and technological projects, or, as reviewer Richard Powers writes: "This story has much to say about the world we want to build, the worlds we think we are building, and the worlds we have failed to pull off."[80]

1.5 ANT and Media

STS and ANT have primarily focused on subject matters of science and technology while there seem to be constraints towards media in general and art as a specific practice. When Latour started to curate exhibitions with Peter Weibel, he distinguishes this work from his research activities. "I did it as fieldwork. Every topic needs its own methodology. In this case I was not interested in writing about it, I was interested in *making* it."[81] A much earlier instance in which Latour considers media technology is when he adduces George Eastman and the introduction of the Kodak camera as an example for a technological change in "Technology is Society Made Durable." He exemplifies on Reese V. Jenkins's research on the subject as a "story of the simultaneous invention of the Kodak camera and of the mass market for amateur photography."[82] Latour identifies thirty-six distinct steps, which lead to the final situation and outline the simultaneous emergences of an object and a market. A trajectory that is driven by either objects or subjects is replaced by a dynamic field of "shifting assemblies of associations and substitutions."[83] But the heterogeneous network of amateur and professional photographers, of companies, chemicals, cameras, and, finally, George Eastman himself, which Jenkins and Latour depict, lacks one thing: and that is the crucial factor that people buy cameras to makes photos. The subject, form, and function of the images themselves are neglected.[84] The question is whether for ANT a camera (or any other media device) is still different from other appliances such as lamps, bicycles, or hairdryers?[85]

As a look back to the origins of STS can show, the assumed problem of ANT with media is actually one with the concept of semiotic representation. STS originally were influenced by the linguistic turn of the 1960s, a movement that—broadly summarized—claimed that the meaning of signs derived not from what they are supposed to signify but from their difference to other signs.[86] STS at the same time acknowledged and neglected this withdrawal into a realm of signifiers and transformed it into a commitment to realism—i.e., by looking

80 Quoted on the back of the English edition of the book.

81 Christian S. G. Katti, "Mediating Political 'Things,' and the Forked Tongue of Modern Culture: A Conversation with Bruno Latour," *Art Journal* 65, no. 1 (2006): 112, doi:10.2307/20068453.

82 Latour, "Technology is Society Made Durable," 111; cf. Reese V. Jenkins, "Technology and the Market: George Eastman and the Origins of Mass Amateur Photography," *Technology and Culture* 16, no. 1 (1975): 1–19, doi:10.2307/3102363.

83 Latour, "Technology is Society Made Durable," 113.

84 In defense of Latour it has to be noted that he is restricted here by the research that Jenkins conducted and the assumptions that informed this research. The Kodak case, therefore, should be regarded as an insufficient example for ANT scholarship on media.

85 Scholars who attempted to apply ANT to film and media studies have done so by merely grasping single popular concepts. Dorota Ostrowska for example uses Latour to critically upgrade Bordwell et al to studies of contemporary cinema. Her call for "unlocking the black-box of film production" though remains rhetorical as she disregards Latour's critique of modernism completely. See Dorota Ostrowska, "Magic, Emotions and Film Producers: Unlocking the 'Black-Box' of Film Production," *Wide Screen* 2, no. 2 (2010), http://widescreenjournal.org/index.php/journal/article/view/22

86 See Richard Rorty, ed., *The Linguistic Turn: Recent Essays in Philosophical Method* (Chicago: U of Chicago Press, 1967).

at the things themselves as differential entities. ANT and especially the later Latour translate the question of semiotic representation to political issues and their analog concepts of representation. The legacy from linguistic ideas also becomes apparent by ANT's own conceptualities. The term actant, used by Latour and others to describe any entity in a network that has an effect on others, is directly borrowed from the structural narratology of Algirdas Julien Greimas.[87] Semiotic representation is replaced by effects from one element on another that are regarded as real. Latour also refers to these effects as statements in a wider sense. "By statement we mean anything that is thrown, sent, or delegated by an enunciator. … Sometimes it refers to a word, sometimes to a sentence, sometimes to an object, sometimes to an apparatus, and sometimes to an institution."[88] A statement in that sense is not a one-way action but one that is also defined by the reaction of its addressees. Its fate lies in the hands of others as it has to be adopted, incorporated, or in the case of a scientific text cited.[89]

By implication, this means that the representational functions that originally distinguish media are inherent elements of all relations in an actor-network. Erhard Schüttpelz writes in this regard: "That the word 'media' is missing in nearly all texts of Actor-Network-Theory and at the same time all interfering entities in the chains of transformation are described as 'mediators,' is only but one consequence of the priority of chains of operations over their elements."[90] What Schüttpelz addresses here, is that Latour distinguishes between entities according to their function in a network. Latour speaks of intermediaries—"what transports meaning or force without transformation"—and mediators that "transform, translate, distort, and modify the meaning or the elements they are supposed to carry."[91] ANT's refusal to grant media a special position is a challenge for media studies. If we follow Schüttpelz, we can see this indeterminacy of media as a benefit of ANT.

> A disjunctive breakdown into material techniques, media and social relationships as much as any static drawing boundaries between material, media, and personalized processes—a juxtaposition: these are the media of an organization, these are its material tools, and there are its persons—proves to be only temporally and should be looked upon with suspicion. The profit of an inspection of mediatized processes with ANT lies in the waiver of any predefinition where 'media' can be localized in a nexus of action.[92]

Schüttpelz together with Tristan Thielmann has recently refined his approach to transform ANT itself into an "Actor-Media-Theory."[93] In his introductory text to the anthology of the same name Schüttpelz recedes from his earlier stance that did not demand a specific role

87 See Andréa Belliger and David J. Krieger, "Einführung in die Akteur-Netzwerk-Theorie," in *ANThology: Ein einführendes Handbuch zur Akteur-Netzwerk-Theorie*, ed. Andréa Belliger and David J. Krieger (Bielefeld: Transcript, 2006), 33-34; Algirdas Julien Greimas, *Structural Semantics: An Attempt at a Method*, trans. Daniele McDowell, Ronald Schleifer, and Alan Velie (Lincoln, NE: U of Nebraska Press, 1983).

88 Latour, "Technology is Society Made Durable," 106.

89 See Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard UP, 1987), 22-29.

90 Erhard Schüttpelz, "Der Punkt des Archimedes: Einige Schwierigkeiten des Denkens in Operationsketten," in *Bruno Latours Kollektive: Kontroversen zur Entgrenzung des Sozialen: Kontroversen zur Entgrenzung des Sozialen*, ed. Georg Kneer, Markus Schroer, and Erhard Schüttpelz (Frankfurt/M.: Suhrkamp, 2008), 238.

91 Latour, *Reassembling the Social*, 39.

92 Erhard Schüttpelz, "Elemente einer Akteur-Medien-Theorie," in *Akteur-Medien-Theorie*, ed. Tristan Thielmann and Erhard Schüttpelz (Bielefeld: Transcript, 2013), 15.

93 Thielmann and Schüttpelz, *Akteur-Medien-Theorie*.

for media. He partly does so by means of a tacit diversification of Latour's various dualisms through a third factor, that of signs. The semiotic dimension of ANT is no longer implicit as Schüttpelz had priorly suggested. Latour himself only talks about signs in order to explain one of the meanings of what he calls technical mediation—i.e., a translation of interests from one mode into another. An example he uses in *Pandora's Hope* is that of speed dumps that force car drivers to slow down. The speed bump as an object has basically the same function as an officer standing by or a sign evoking the speed limit. For different reasons, the object in this case is more effective than the person or the sign; but all three entities are exchangeable by means to delegation.[94] As other examples show, Latour has a tendency to favor objects over persons and signs but what matters is that he explicitly resolves the special status of signs by making them convertible into other modes of existence. All of them have meanings but none of them designates or represents the other. Schüttpelz, therefore, can define media as an umbrella term that compromises what he calls the three formations of knowledge. These are physical, social, and discursive, and should not be diminished to one or two of these.[95]

But Schüttpelz's claim for what he calls 'irreducible media' does not yet solve Latour's problem with representation and what we might consider an inherent iconoclasm when the latter writes, "we want to gain access to things themselves, not only to their phenomena."[96] To understand Latour's concern, we need to revisit the predominant dualisms neglected by Schüttpelz. Felix Stalder in his review of *Pandora's Hope* explains how Latour wants to unite the contradictory epistemological models of realism and relativism as two attitudes towards representation into a 'realistic realism.'

> Following Latour's argument, the realist's view and the relativist's view of our relationship to the world rest on a shared but erroneous assumption: An absolute ontological gap separates language from the world. Both modern and postmodern science presume a gap between the cognitive subject—a "brain-in-a-vat," as Latour calls it—and the outside world. Once this gap is accepted, the question boils down to, "Is it possible to build a reliable bridge across this gap?" "Yes," says the realist, "science is that bridge." "No," says the relativist, "science is just another language game." And Mr. Latour says, "There is no gap!"[97]

The denial of a gap is not the denial of a difference but rather the renunciation of a topography that is structured by such a fissure. A gap in that sense is something that aligns movements in the sense of either crossing or eschewing it. Structuralist linguistics had faced this alignment when it described language as a system of differential signs that create meaning not by fixed relations to objects but by differences between each other. The gap is not conquered but simply eluded. What ANT does, is to take the unaligned field of signs and to extend it to the domain of things. The dissolution of the gap now enables us to move freely in all directions. The semiotic act of representation is dissolved in a more general act of translation that seems to dispose specific identities. An alternative could be to replace identities with qualities—i.e., to combine the openness of the dynamic network with possible precedent differences between its nodes. While Latour never tries to integrate media systematically into his approach, he (together with Antoine Hennion) responds to materialistic concepts in a critique of Walter Benjamin and his essay "The Work

94 See Latour, *Pandora's Hope*, 185-87.

95 See Schüttpelz, "Elemente einer Akteur-Medien-Theorie," 56-60.

96 Latour, *We Have Never Been Modern*, 90.

97 Felix Stalder, review of *Pandora's Hope: Essays on the Reality of Science Studies*, by Bruno Latour, *The Information Society* 16, no. 3 (2000): 245, doi:10.1080/01972240050133698.

of Art in the Age of Mechanical Reproduction." Benjamin had described how in cinema the relationship between actors and audiences alters due to new technologies.[98] Hennion and Latour riposte by denying a foregoing distinction between what must have appeared for Benjamin and his contemporaries as the mechanical and the natural. "The movie camera adds another mediation to an already long chain, but it does not cut it; an actor's presence in the studio is neither more nor less real than on stage, and there is as much technique in both kinds of acting."[99]

If we accept a concept of media (as a system of semiotic devices) without specific and privileged positions, we can trace agency in a weaving movement into and out of the images. The question here is how we can describe media as something specific without essentialism and without drawing prior conclusions? A description again is not an explanation and we can follow artists just the same way as Latour does with his objects of study with the assumption that "to follow scientists and engineers we do not need to know what Society is made of and what Nature is; more exactly, we need *not* to know them."[100] Likewise, I will not define what separates media from other translations but assume a correlation with the four types of mediation that Latour defines in *Pandora's Hope*: interference, composition, folding of time and space, and, crossing the boundaries between signs and things.[101] An image in this regard is at the same time one possible mediation among others and a key metaphor that informs the field of film production. This is how we can consider the image as a collective—i.e., as a site of assemblage.[102]

1.6 Collecting the Mediators

The battle cry of ANT is "follow the actors." Latour already introduces it in his early book *Science in Action*: "This is the first decision we have to make: our entry into science and technology will be through the back door of science in the making, not through the more grandiose entrance of ready made science."[103] In the case of *Science in Action* this approach is also realized by the introduction of a rhetorical figure, the dissenter, who follows scientists and their research in a spirit of wariness and naivety. To follow the actors also is a critique of a historiography that starts with results and from there goes back to explain them. Such a procedure leads to the familiar inventor stories and teleological narratives that say more about the time they were written than their respective subject matters. Historiography of course has been diversified in a lot of ways in the past decades. ANT in this regard is not the first approach but maybe a more radical one.

98 Walter Benjamin, *The Work of Art in the Age of Its Technological Reproducibility, and other Writings on Media*, ed. Michael William Jennings, Brigid Doherty, and Thomas Y. Levin (Cambridge, MA: Belknap/Harvard UP, 2008), 31.

99 Antoine Hennion and Bruno Latour, "How to Make Mistakes on So Many Things at Once—and Become Famous for It," in *Mapping Benjamin: The Work of Art in the Digital Age*, ed. Hans Gumbrecht and Michael Marrinan (Stanford, CA: Stanford UP, 2003), 94.

100 Latour, *Science in Action*, 143.

101 See Latour, *Pandora's Hope*, 178-90.

102 In an apparently much simpler explanation of ANT's media problem, Lorenz Engell and Bernhard Siegert recently expressed the idea that Latour might have turned to 'mediator' and 'intermediary' because in his native tongue French the term 'media' denotes exclusively mass media. See Lorenz Engell and Bernhard Siegert, editorial, *Zeitschrift für Medien- und Kulturforschung*, no. 2 (2013): 5–10; "Den Kühen ihre Farbe zurückgeben: Von der ANT und der Soziologie der Übersetzung zum Projekt der Existenzweisen," interview with Bruno Latour by Michael Cuntz and Lorenz Engell, *Zeitschrift für Medien- und Kulturforschung*, no. 2 (2013): 83–100

103 Latour, *Science in Action*, 4.

The first problem I have to face (and that possibly already invalidates my project) is how to follow actors of processes that date back nearly a century? How to identify mediators that have long since been buried in black boxes? Anybody who was actively involved in the development of optical effects in Hollywood in the 1920s and 1930s is meanwhile deceased. Production material of the respective movies is virtually non-existent. The movies are nicely packaged as DVDs. The black boxes are closed and it is unclear whether they can be turned from obstacles to sources. Two precautions have to be taken: to follow Bloor's symmetry of true and false statements (i.e., to avoid a strict distinction between successful and unsuccessful projects) and to question any narrative that is informed by later developments.[104]

Another question is who and what to follow or collect? This project does not claim universality in what it describes. In this regard, it contrasts a project like *The Classical Hollywood Cinema* for which Bordwell, Staiger, and Thompson carefully selected hundreds of movies that are supposed to represent the entire production of Hollywood until 1960.[105] Following Latour's notion that mediators are entities that have an effect on others, I will assume that these effects have to be rendered visible in order to follow them in retrospect. Such a visibility is something the networks have to produce by themselves. *Making Things Public*, to quote a more recent venture by Latour, is the act of deployment of matters of concern.[106] In the case of techniques that are developed within the studio system of Hollywood this happens by publications in trade journals, by adopting standards, by giving awards, hiring people, and last but not least by producing and releasing motion pictures. When I follow these traces, I will not travel the entire terrain of optical effects. Some people, studios, and techniques will gain dominance in this narrative while others will not be mentioned at all. This does not mean that they did not work in the field but simply that they presumably did not create or join visible networks. Some paths will turn into blind lanes as material is not longer available. These constraints will be made explicit just the same way unsuccessful projects will be given the same relevance as successful ones—as long as they manage to produce the same kind of visibility.

What I will do next—to enumerate and describe various entities that may be involved in studio networks—needs comment as it seems to contradict everything said so far. Such a list of different types of entities should not be misunderstood as an attempt of differentiation as it is typical for modernist narratives. As we will see, none of these entities dominates the developments, I am trying to retrace. They are only effective in combination with often shifting responsibilities. "By themselves, a statement, a piece of machinery, a process are lost. By looking at them and at their internal properties, you cannot decide if they are true or false, efficient or wasteful, costly or cheap, strong or frail. These characteristics are only gained through *incorporation* into other statements, processes and pieces of machinery."[107] The aim is rather to unwind or 'undefine' them, to restore their operational compatibility. I will further have to comment on and explain if and why I will depart from the general concepts of ANT. The following list, therefore, should be read as the sketching of an open framework, a disclaimer, and a collection of foregoing clarifications for forthcoming problems.

---

104 See David Bloor, *Knowledge and Social Imagery*, 2nd ed. (1976; Chicago: U of Chicago Press, 1991).
105 See Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 388-96.
106 Latour and Weibel, *Making Things Public*.
107 Latour, *Science in Action*, 29.

1.6.1 Places

When I focus my project on one place that is Hollywood, this might be considered as just another offense against the rules of ANT. But following actors requires a starting point. I will occasionally travel to other sites of construction but likewise always return to where the movies are made. Besides, Hollywood does have a specific topography as Hortense Powdermaker accounts in her ethnographic study of the studio system.

> Hollywood itself is not an exact geographical area, although there is such a postal district. It has commonly been described as a state of mind, and it exists wherever people connected with the movies live and work. The studios are scattered over wide distances in Los Angeles, and are not particularly impressive-looking. They combine a bungalow and factory in their appearance, and many give the feeling of being temporary. The homes of movie people are found in Beverly Hills, Bel-Air, Westwood Village, the San Fernando Valley, the original Hollywood district, and other areas.[108]

On the other hand there are several movements of concentration. Service providers settle on Santa Monica Boulevard between Formosa Avenue and Gower Street, and companies from the East Coast stay in touch with their customers by opening branches in Hollywood. Business as much as research tends to be local. This is especially true for Hollywood, as Powdermaker notes: "The stimulus of contact with those from other fields of endeavor, which is so accessible in most big cities, is lacking in Hollywood. For the most part, people work, eat, talk and play only with others who are likewise engaged in making movies."[109]

Another aspect of this localization is that Hollywood brings remote places to the studios by painting, rebuilding, or projecting them. The studios resemble what Latour in his studies of science has called centers of calculation: "Any site where inscriptions are combined and make possible a type of calculation. It can be a laboratory, a statistical institution, the files of a geographer, a data bank, and so forth."[110] But unlike laboratories movie studios are semiotic spaces that can be local and global at the same time. They represent other places. This way a movie itself, which depicts and constructs a location, can also *be* a site where mediators meet.

1.6.2 People

In a post-anthropocentric approach the appropriate depiction of people is a delicate issue.[111] Humans will also dominate my narrative but the roles they play are more eclectic than that of the sole inventor. In a lot of cases we can observe that they no longer see themselves in that role. Linwood Dunn e.g., who is often credited as the inventor of the optical printer, knows better when he says in an interview: "The optical printer existed ages and ages before because that's nothing more basically than a camera photographing the aperture of a projector."[112] The role which Dunn then plays when he presents him-

[108] Hortense Powdermaker, *Hollywood, the Dream Factory: An Anthropologist Looks at the Movie-Makers* (Boston: Little, Brown, 1950), 18.
[109] Ibid., 19.
[110] Latour, *Pandora's Hope*, 304.
[111] The focus on human authorship is not least owed to art history's founder Giorgio Vasari and his *Lives of the Most Excellent Painters, Sculptors, and Architects*.
[112] Linwood G. Dunn, *Interview with International Cinematographers Guild*, AFA (February 15, 1993), VHS.

self with 'his' optical printer on photos and talks about it at conventions is what Latour calls a spokesperson. "A spokesperson is someone who speaks for others who, or which, do not speak."[113] This relationship between the speaker and the mute is built on bilateral engagements. It is but one type of mediation. In the case of Dunn, the optical printer gives his voice authority and Dunn's speech acts literally feed the development and survival of the device. This is only one example of how humans are reconsidered as elements of the network.

The group of people which will appear are primarily engineers, process and production cinematographers, producers, directors, and actors. This sample feels odd and unsatisfactory as the amount and variety of people involved in the production of motion pictures is of course much bigger. But again, we will be guided by self-generated visibility. We could expect that art directors would make an interesting supplement to that group; but as long as they and the actants involved in optical effects do not make them visible, we cannot follow them.

Finally, there is one point that palpably contradicts the concepts of ANT and its chase method. I am going to use biographical information as far as it is available. Though the notion of identity runs contrary to that of action, I feel confident that it helps to understand specific actions by relating them to the background, education, and, ultimately, knowledge a person has. But biographies should be seen in regard to what Latour calls "person making"—i.e., the understanding of persons out of the act of speech. Identity, just as society, is not the cause but the result of action.

> In person making what counts above all, what requires the utmost sacrifice, is the designation, here and now, of the person at hand, being presented with the gift of presence. But there is no way to produce this effect by directing attention *away* from the scene. On the contrary, the only way is to *redirect* attention by pointing, through cracks into the discourse, to the character in the flesh listening to the story or watching the scene.[114]

This redirection on actuality is something we do ourselves, as Latour shows by the example of love confessions. The question "Do you love me?" cannot be answered with a positivist "I have *already* told you." It requires a repeated "I love you" that updates the existence of sender and receiver through their performed interaction. Biographical 'facts,' as something that is at the same time made and given, here will be understood in relation to the act of making oneself or someone else visible.

1.6.3 Collectives

Revisionist film scholars since the 1970s have shifted their focus from individual authorship to film as the work of groups of people, primarily film studios. Based on additional sources such as production records, trade journals, and publications by unions and guilds, they came to histories of collective authorship. Most prominently this was done by Bordwell, Staiger, and Thompson. In this study collectives are not only the studios but also their individual departments, professional associations, and unions—i.e., any group of people that share either interests or working practices. Associations, organizations, and the like

113 Latour, *Science in Action*, 71.

114 Bruno Latour, "How to Be Iconophilic in Art, Science, and Religion?," in *Picturing Science, Producing Art*, ed. Caroline A. Jones and Peter Galison (New York: Routledge, 1998), 429.

seem to be the ideal subject for ANT scholarship. In a post-anthropocentric perspective, they are not only places for the assemblage of people but also of appliances, practices, papers, etc. One tends to identify them with acting networks. “B-52s do not fly, the US Air Force flies,” as Latour writes.[115] But while in film studies there are many publications dealing with individual studios or professional associations, there is virtually no monographic study in ANT that depicts a single organization alone. The reason is that an actor-network exists not as ontologically closed entity but only in its performance. The attribution of a history and character to a collective tends to produce similar accounts as that of individual persons. It, therefore, misses the point of ANT that tries to overcome individual authorship. In the case of film studies, studios replace directors but are still defined by individual styles just as in prior auteurism. In contrast, collectives here will be conceived in a similar way as places—i.e., as stages for actions, as possibilities to aggregate and exchange knowledge, money, and emotion as the three currencies of film production.

Collectives have gained relevance in media historiography because they are not only sites of knowledge production but also of storage of the same. They develop materialized memories in form of records that make actions traceable if they persist. With corporations and associations that still exist there is the possibility that their business documents of the 1920s and 1930s are available. The archive of Warner Bros at USC is one of the most extensive. The records of RKO at UCLA on the other hand consist of documents from a few department that make it difficult to change perspectives.[116] But heritage from independent service providers that often were an integral part of movie production are altogether lost. When Latour writes that the status of a statement largely depends on the statements that follow, we can add that it also depends on the efforts to preserve it that are often independent from the individual statement but from its context. The uneven weights that different collectives gained in this study, therefore, is not necessarily an indicator for their respective relevance.

1.6.4 Machines and Methods

Machines and methods are not necessarily ontologically distinct. They are often just different phases of the same development. When cameras were still hand cranked the common practice of speed changes was subsequently supported by special gears, so called ‘trick handles.’ Such overlaps have occurred increasingly since the automatisms of the Industrial Revolution and is described by many scholars. Lewis Mumford has analyzed the “Myth of the Machine” and understood it as an indicator or mirror for the state for societies.[117] Raymond Williams with his chastened materialism has put emphasis on the emancipatory power of practices that change the meanings and effects of machines.[118] For the early Latour the emergence of a machine is primarily another translation.

[115] Latour, *Pandora’s Hope*, 182.

[116] I had to rely of the production records, which mainly cover the financial aspects. Other possibly relevant records are no longer accessible. For details on the history of the RKO Collection see Carringer, *The Making of Citizen Kane*, xi-xii

[117] See Lewis Mumford, *The Myth of the Machine: Technics and Human Development* (New York: Harcourt, Brace & World, 1967).

[118] See Raymond Williams, *Television: Technology and Cultural Form*, ed. Ederyn Williams (1974; London: Routledge, 2003).

> The simplest means of transforming the juxtaposed set of allies into a whole that acts as one is to tie the assembled forces *to one another*, that is, to build a **machine**. A machine, as its name implies, is first of all, a machination, a stratagem, a kind of cunning, where borrowed forces keep one another in check so that none can fly apart from the group. This makes a machine different from a tool which is a single element held *directly* in the hand of a man or a woman.[119]

The history of a machine depends mainly on how it is evaluated by its human peers. Whereas in science results are judged according to their assumed relation to 'Nature,' machines are asserted whenever they 'work.' Bijker has interpreted the notion of the 'working machine' in an ostensively paradoxically way: "The 'working' of a machine is not an intrinsic property of the artifact, explaining its success; rather, it should figure as a result of machine's success. … In a symmetrical explanation, 'working' and 'notworking' will not figure as causes for a machine's success or failure. The claim is that 'working' is merely in the eye of the beholder, but that it is an achievement rather than a given."[120] 'Nature' and 'working' are both explanandum and not explanans. In the case of optical effects the notion of working (either for devices or methods) is most explicitly defined in the context of legal assessments of patents. Here it means that something is commercially usable—i.e., that the usage is affordable or cheaper than its alternatives—and that the results are 'good enough' for theatrical distribution. Especially that last criteria has what Bijker calls an "interpretative flexibility."

1.6.5 Publications and Records

Articles in trade journals and newspapers, advertisements, production records, and letters are the most used sources for historiography of movies besides of the movies themselves. Positivist approaches tend to regard such texts as transparent accounts. With the linguistic turn, as we have seen, they became opaque. ANT on the other hand tries to level out the hierarchy of objects, processes, people, and texts by looking at the translations that are happening between them. For me that means that I will observe the effects of publications and records and relate them to the possible intentions that proceed them.

With time passing and in the context of archives also the borders between published and unpublished sources blur. Likewise they facilitate the connectivity between different fields and disciplines. "Economics, politics, sociology, hard sciences, do not come into contact through the grandiose entrance of 'interdisciplinarity' but through the back door of the *file*."[121] Texts are also predominant because their chances to survive are much higher than that of other artifacts. Especially when they are produced for publication they are instantaneously multiplied. In archival work they can be transcribed, photocopied, and scanned. The ongoing digitization of large amounts of publications has furthermore changed research as it permits full text search that brings to light even tiny bits of information otherwise impossible to locate. This new access also permits to bypass filters

[119] Latour, *Science in Action*, 128-29.
[120] Bijker, *Of Bicycles, Bakelites, and Bulbs*, 14-15.
[121] Bruno Latour, "Drawing Things Together," in *Representation in Scientific Practice*, ed. Michael Lynch and Steve Woolgar (Cambridge, MA: MIT Press, 1990), 25.

such as bibliographies of older research or the focus on certain journals and their indexes. The result of these developments is an immense heterogeneous field that seems to create also a kind of redundancy. In the spirit of Bloor's symmetry I will try to embrace this.

1.6.6 Patents

Patents do play an important role for Hollywood as they are one reason for its very existence. In 1908 the major American film companies join forces and initiate the Motion Picture Patents Company (MPPC) to protect their interests against European competitors. This also has an effect on American independent producers who are barred from the trust. The power of Edison and his partners lies in their patents, which cover most aspects of motion picture production and distribution. As it is well known, this is one cause why the independents move to the West Coast.[122] Thereby, patents not only seem to mark the emergence of Hollywood but are also related to its progression—even as here in the form of denial.

The position of patents within film studies seems to be influenced by the conduct of the MPPC and its outstanding importance for the early development of the industry. Thus Staiger and Thompson describe patents as opposed to standardization of technology and regard only the latter as a progress for the industry.[123] By contrast, scholars of media history have shown an increased interest in patents that also comes with a more differentiated approach to them as documents. This is mainly owed to the influence of STS where patents naturally play a crucial role. Patents as source material for historians become especially relevant when there is a lack of other sources.[124]

The usage of patents as sources has to consider the changing practices that inform them. In their beginning patents are contracts between an individual or organization and the public. The state as a mediator guaranties exclusive rights for a limited time; the inventor, therefore, discloses his knowledge to the public. This idea is internationally accepted since the beginning of modern patent law in the 18th century. But the implementation in regulations and practices varies with nation and time. This includes also questions of how to obtain a patent and in reverse to which degree the granting of a patent gives evidence on the originality and practicability of an invention.[125]

In regard to US patents and following ANT, Nadine Taha distinguishes between what she calls 'ready made patents' and 'patents in action.' Ready made patents derive from the original patent concept of authentic representation of inventor and invention at the same time. As part of the mutual agreement to grant rights and to share knowledge the patent has to contain all information on an invention. In the second half of the 19th century patents are progressively integrated into their production environment. They no longer

[122] See Eileen Bowser, *The Transformation of Cinema, 1907-1915*, vol. 2, History of the American Cinema (New York: Scribner, 1990).

[123] See Staiger, "The Hollywood Mode of Production"; Thompson, "Initial Standardization of the Basic Technology."

[124] This is for example the case for the history of telephotography where Christian Kassung and Albert Kümmel-Schnur have edited an account based largely on patents. See Albert Kümmel-Schnur and Christian Kassung, eds., *Bildtelegraphie: Eine Mediengeschichte in Patenten (1840-1930)* (Bielefeld: Transcript, 2012)

[125] B. Zorina Kahn develops the history of US patent law in contrast to the ones of Great Britain and France. See B. Zorina Khan, *The Democratization of Invention: Patents and Copyrights in American Economic Development, 1790-1920* (New York: Cambridge UP, 2005)

exhaustively describe what they protect. The documented innovations are no longer self-contained. They have to be actualized by their industrial networks. Taha gives as an example Bell's patent for the telephone that originally only defines improvements in telegraphy but protects the telephone as an application retrospectively.[126]

Geoffrey C. Bowker treats patents as elements of a discursive historiography that can be distinguished according to "forms of relationship between 'what actually happened' and what gets written about it."[127] Bowker suggests three forms of narrative that relate to "immediate validity," "institutional setting," and "the contribution of the narrative to making itself true."[128] In his case study of well logging industry or specifically the Schlumberger company these are coextensive with three concentric fields of controversy: the courtroom, the company, and the oil field. At court there is only the possibility to discuss whether a patent correctly describes its subject and if it is in conflict with other patents. Within the company patents become relational documents next to correspondence and publications that try to position Schlumberger in the market. And finally the successful application in the real world covers a patent that no longer has to proof its validity itself.

The models of Bowker and Taha are similar in that they start off with patents as plain documents that represent a technical innovation and move from there to more complex relations. In a similar way I will assume that patents are simultaneously descriptive, interpretative, prospective, and strategic—they can document an original invention, re-frame existing ones, sketch a concept that should turn functional later, or simply fill a vacancy for later patents. As these alignments involve possible contradictions, usually one of them dominates. But the character of individual patents can change over time or in relation with different parties as we will see.

Patent texts differ significantly from those in trade journals that often accompany them though they cover the same subject and have the same author. Due to formal requirements patent texts are usually written (or translated) by specialized lawyers. In the case of Hollywood, as we will see, some studios employ their own lawyers while others work with a few specialized law offices. After filling a patent application, the text undergoes a reviewing process at the Patent Office. The reviewers write objections, which often result in deletions of text sections, especially of claims. The accepted and published text, therefore, is not an authentic statement of an author but a translated and truncated description of his or her technical concepts. The fact that patents do not have one but two dates (for filling and in the case of acceptance for publication) points rather to the process of negotiation than to an imaginary moment of invention.[129] Unfortunately, the correspondences that document these processes are not as easily available as the patents themselves. My exploration of patents where I could not access such documents are done in the knowledge that conclusions are provisional and further research would be advisable.

---

[126] See Nadine Taha, "Patent in Action: Das US-amerikanische Patent aus der Perspektive der Science and Technology Studies," *Zeitschrift für Medienwissenschaft*, no. 1 (2012): 36–48.

[127] Geoffrey C. Bowker, "What's in a Patent?," in Bijker and Law, *Shaping Technology/Building Society*, 54.

[128] Ibid.

[129] Kümmel-Schnur goes as far as claiming (with Derrida) that invention as an event is not possible at all because it is already contained in the potentiality that necessarily precedes it. See Albert Kümmel-Schnur, "Patente als Agenten von Mediengeschichte," in Kümmel-Schnur and Kassung, *Bildtelegraphie*, 15–38

1.6.7 Movies

Movies are the primary source of film history. If anything persists of a film production, it will most likely be the negative of a print thereof. As long as it is considered to be the primary reason to establish such an extensive production network, we can expect that everything will be done to preserve it as a final product. (If on the other hand the aim is to make money, even the movie might get lost, once it has served its purpose.) The more time has passed after the production has finished, the higher the chance that records are lost, that raw footage is destroyed, and that participants are deceased. The movie turns into a black box that in texts is easily addressed with its title, year of production, and director. As mentioned above in regard to Kemp, the seclusiveness of the art work has informed the methods of its interpretation for a long time. To turn this around is an adventurous operation facing the lack of additional sources.

The selection of movies follows the same principle of self-generated visibility within the production networks. Movies are possibly commercially or critically acclaimed due to their optical effects, some are featured in presentations or in advertisements, some are awarded by the Academy of Motion Picture Arts and Sciences (AMPAS) as an association of representatives of the entire industry. Or, finally, they are mentioned in the existing literature on optical effects and their descriptions are if possible verified here. A non-representative sample of about 200 motion pictures will be used.

When I try to follow in retrospect the people and machines who produced optical effects in the studios, I also have to acknowledge their perspective. What they see are rarely the entire movies but rather single shots or scenes. The department head likely would read the script to calculate his budget; he would give advice where he thinks money can be saved; he might suggest to use optical effects for specific scenes and thereby increase his influence on the production. These perspectives change only after a movie was released, hopefully made some profit, and maybe even won an award. Only then it turns into another black box that can be used as an argument to strengthen the position of optical effects. The final images do everything to conceal their production processes. Raw footage that could document this process within the same medium has survived only in rare cases. The same accounts for work sheets and sketches.

A reversion to the original perspective is not easy to attain. In “Drawing Things Together” Latour describes the world as a laboratory that has only one aim: to produce texts or inscriptions.[130] If I will understand moving images as inscriptions, I do so not in order to seal and abandon them in an ever expending domain of post-structuralist ‘texts,’ but on the contrary to regard them as convertible with other modes of existence. With Schüttpelz I will regard personal, material, and semiotic agency as much as distinct as translatable.[131] What is special about semiotic agency is that it can comprise other forms of agency. Thereby, I will understand the image as a collective that likewise contains and connects.

[130] Latour, “Drawing Things Together.”
[131] Schüttpelz, “Elemente einer Akteur-Medien-Theorie,” 51.

Fig. 1.2: Members of the RKO Special Camera Effects Department producing a revision of the studio's trademark around 1931.

1.7 Image as Collective

An impression of how we can encounter an image as a collective is conveyed in a movie still that shows five men in a set for the trade mark animation of the RKO Studio (fig. 1.2). The silent scene, this still is taken from, shows the men joking and gesturing in a way that is relaxed and clumsy at the same time and reminds of early amateur film family portraits, families that happily gather in front of one of these at the time new devices and that are still not sure how to behave differently from still photographic portrait sessions. The man to the right of the radio tower is Paul Detlefsen, RKO's matte painter, who previously painted the clouds on the backdrop and on the glass plane that has been mounted between set and camera. To the left is Linwood Dunn, optical printer operator, who has strictly speaking no function on this set other than documenting his own involvement. But he is the person who will later superimpose an animation of serrated cartoon-style radio bolts and the lettering "A Radio Picture" with his optical printer—and who will preserve this piece of film. Next to Dunn is Jim Davis, a grip, about whom nothing is known but who is significant in his function as he presumably assembled the set we see. Detlefsen, Dunn, and Davis represent different modes of construction that are translatable within the domain of photographic imagery.[132]

To understand such an image as a collective means to read it as the result of several kinds of assembly. There are at least five men who meet somewhere on the RKO lot at Hollywood's Gower Street to assemble a world (literally) that consists of a panel painting, another one on glass, a miniature globe (which is nearly too large to be called a miniature) with a proportionally outsized radio tower. In addition to this, there are lights and a movie camera. To the three image layers later a fourth one will come that is plain white, pure light one could say. The construction on the stage is continued within the image and, as the front clouds on

[132] The other two men are Harry Keehnel, painter, and Joe Neal, electrician. See "Making Our Trademark," *RKO Studio Club News* 4 (December 1941): 29

glass show, the distinction between stage and optical effects become indistinct.[133] Latour's 'realistic realism' with its denial of a semiotic gap that is understood as incomparable allows us to regard both constructions as one. Their differences are not absolute but relative. I do not want to develop this idea as a theoretical model, one that conciliates the contradictions that come with it, and finally turns into such a framework that ANT opposes. I will instead start a hopefully unbiased collection of 'facts'—in the double sense of what is found and what is made—that I will relate to each other without the ambition to depict a superstructure.

In Tay Garnett's self-referential movie *Stand-In* (1937) the prim East Coast accountant Atterbury Dodd (Leslie Howard) takes over the management of a Hollywood studio in financial difficulties. Urged by his local secretary to *do something*, he apologetically replies: "An orderly mind, Miss Plum, does not attempt to arrive at a total until it has assimilated complete list of the items involved." Of course Dodd will never accomplish such a list but, by the way of trying, he will still save the studio.[134] To avoid a priori frameworks and generalizing conclusions alike seem to be two sides of the same coin for ANT. After all such conclusions would be also the preconceptions of a following study. Maybe this is the difference between the theorists and the historian or archaeologist that the latter collects with the humbleness of knowing that such collection will hardly disclose any comprehensive order. But it offers the chance to disseminate unrecognized translations, the onces that are hidden and only rarely show up in such a lucidity as the RKO scene above.

I have shown why I will not follow the concepts of Latour and his allies in an orthodox manner. But before I finally start, I think it is worth to call to mind, as Latour writes, "what differentiates a good ANT account from a bad one—a crucial quality test—by asking three questions: Have all the difficulties of traveling been recognized? Has the complete cost of the travel from one connection to the next been fully paid? Has the traveler not cheated by surreptitiously getting a ride from an already existing 'social order'?"[135]

133 In this case two additional shots are preserved that proclaim at least an aspiration of authorship. The first looks like the final studio logo animation but the official text "A Radio Picture" has been replaced by an evenly faithful "Done by Dunn." A second one shows the iconic flashes that actually come from the top of the radio tower scratched by hand into the semi-close up of a topless Afro-American dancer—springing from her breasts.

134 The scene reminds of similar one in the fictional text layer of *Aramis* where Latour's alter ego counters the prompting of his intern to come to an conclusion with the claim of a study that can only end when it runs out of money or into an dead end. See Latour, *Aramis, or The Love of Technology*, 152

135 Latour, *Reassembling the Social*, 25.

2 Antecedents: Published Knowledge of Trick Films

As a first step to understand the developments in the 1920s and 1930s, I will do a survey on the published knowledge of optical effects until then. Optical effects in this period are still described as tricks. As Judi Hoffman has shown, the notion of 'doing tricks' is rejected by cinematographers involved in optical effects in the 1920s. For them it is too deeply rooted in the spheres of magic and theater. The idea of showing an effect for its own sake is in conflict with being a method to improve the telling of a story.[1] As my account will show, trick cinematography, if it is not directly based on time, is also still closely related to tricks in 19th century photography. This lack of autonomy might be another reason for the reservations cinematographers show towards it. Trick cinematography, therefore, here can be seen as something that is technically the basis of optical effects but at the same time its aesthetic antithesis.

All relevant publications that explain such tricks are drafted as handbooks and appear between 1911 and 1921. Taking these handbooks as a source should not be understood as reading their descriptions as accurate accounts of the contemporary practices. (Hoffman in fact has pointed to techniques that are missing and that I will cover in the next chapter.) A study of early trick films would have to analyze the works of Georges Méliès, Robert W. Paul, Walter R. Booth, Edwin S. Porter, and others. It is beyond the scope of this project to give a precise account of methods and practices of these productions. This is first of all an attempt to collect basic phenomena and concepts that build starting points for the developments from the 1920s onward. And these were made a subject of discussion in the handbooks of the preceding decade. It will be assumed that they represent the knowledge that for the majority of people working later was the one most easily accessible. None of these publications lays its focus on trick work. Their subjects are either cinema in general or cinematography. The more it is of interest to which extend they do cover trick work and what kind of techniques. I will first collect a catalog of what often oscillates between being a technique and a motif. The depictions here are suspiciously congruent and I will describe individual authorships and motivations at the end of this chapter.

2.1 Basic Operations

2.1.1 Speed Manipulation

Early film cameras are simple and manually operated. Their interface is first and foremost the hand crank. It therefore is manifest that a significant mode of advanced engagement with the camera is to handle the crank in a different way than intended. The results of these manipulations are speed changes. All authors of cinema handbooks of the time enlist these. By turning the crank slowly and exposing less than the usual sixteen frames per second the manifested action would appear faster when later projected at the standard

[1] See Judi Hoffman, "The Discourse of 'Special Effects' Cinematography in the Silent American Cinema," *Post Script* 10, no. 1 (Fall 1990): 30–49.

Fig. 2.1: One actor replacing the other during the production of Louis Feuillade's *Un accident d'auto* (1907)

frame rate. This practice was deployed in comedies to alienate actors' movements, in action films to increase the speed of vehicles, or in educational and scientific films to make natural phenomena perceivable in a way never seen before.

From speeding up natural movements it is only a small step to create artificial ones. What was usually described as the 'stop crank' method (and today would be called stop motion) means that the cameraman executes always only one turn with the crank to expose a single frame. Between the exposures the objects in front of the camera are slightly moved. When later projected these preferably mundane things come alive similar to the animation of photography with the motion pictures. "By the stop picture it is possible to give inanimate objects the appearance of life. Dolls are made to walk. Toy animals of the 'humpty-dumpty' type are made to perform circus feats. Saws are made to cut off boards without hands; hammers are made to drive nails without hands; shoe laces tie themselves, etc."[2] Film from its beginnings questions established categories of objects as period film theory already displays.

A similar alienation is achieved by reversing the film—i.e., to change the order of the images so that actual movements would be seen from their end to the beginning. The recommended method here is not to crank the film backwards but to turn the camera upside down. Spatial and temporal modifications start to become interchangeable.

2.1.2 Substitutions

An interruption in the recording is not only used—like with stop motion—to arrange minor changes on the set that will reassemble in the projection process to a more or less natural movement but also to place, remove, or exchange protagonists. The result will be appearances, disappearances, and substitutions that are either arbitrary or of higher order. While the first two exchanges will always be visible as such the latter might be used in two ways, either be a perceptibly in itself—like turning smoke into a person—or by remaining invisible to render possible a very different performance. Talbot describes here in all details the production of the short film *Un accident d'auto* (Louis Feuillade, 1907, fig. 2.1). He recalls the narrative of a workman who is supposedly walking home after work when he "is

[2] David Sherrill Hulfish, *Motion-Picture Work: A General Treatise on Picture Taking, Picture Making, Photo-Plays, and Theater Management and Operation* (Chicago: American School of Correspondence, 1913), 161, Open Library: OL23320711M.

Fig. 2.2: Still image from *Princess Nicotine* (1909)

smitten with an irresistible desire to sleep"[3] and lays down in the middle of the road. The motionless worker is then run over by an automobile, which detaches both his lowers legs. The passenger of this cab, as it turns out, is a doctor who is willing to help the victim. In a following ad hoc operation the lost shanks regain their places and function.[4] Like in a magic show on stage the film conceals that there are two actors, which look alike except for that one of them really does only have fake legs.[5] But Feuillade merely spins a new story around a technique that goes back to the beginning of cinema when the Edison short *The Execution of Mary, Queen of Scots* (1895) showed how a woman turning into a dummy that could be beheaded. Objects and actors become exchangeable by merely stopping and starting the apparatus.

2.1.3 Spatial Manipulations

A second group of techniques can be described as modifications of the pro-filmic space of action—i.e., the stage itself. Talbot explains the production of Vitagraph's *Princess Nicotine* (Paul Panzer and Gladys Hulette, 1909), a five minute film about a bachelor who encounters two small fairies playing with his tobacco to tease him and "one of the finest trick films ever made in the United States."[6] The film uses several techniques and remains an eclectic buildup of these tricks. The principal setup consists of a table flanked on its left by a chair on which the protagonist sits. The fairies (first two, then only one) stand on the table. Without narrative legitimization in the middle of the movie the set changes. The background of the upper-class interior is replaced with plain black (fig. 2.2). The two armchairs in the foreground, which gave the stage-like set some depth, disappear, an additional chair on the table's right side appears. Until this revision man and fairies could only be seen for a few seconds in a unified shot. The girls looking poor in contrast in front of one of the

3 Frederick Arthur Ambrose Talbot, *Moving Pictures: How They Are Made and Worked*, new ed. (1912; Philadelphia: Lippincott, 1914), 211, Open Library: OL23320757M.

4 Walter Benjamin, who likely saw films by Feuillade in his youth, in his essay "The Work of Art in the Age of Mechanical Reproduction" attempts to distinguish the figures of the modern filmmaker as a surgeon and the painter as magician. If we perceive Feuillade's narrative as dated and funny it might be because he presents the two roles still in one person but seems to sense their polarity. See Benjamin, *The Work of Art in the Age of Its Technological Reproducibility, and other Writings on Media*, 35

5 See Talbot, *Moving Pictures*, 211-13.

6 Ibid., 242.

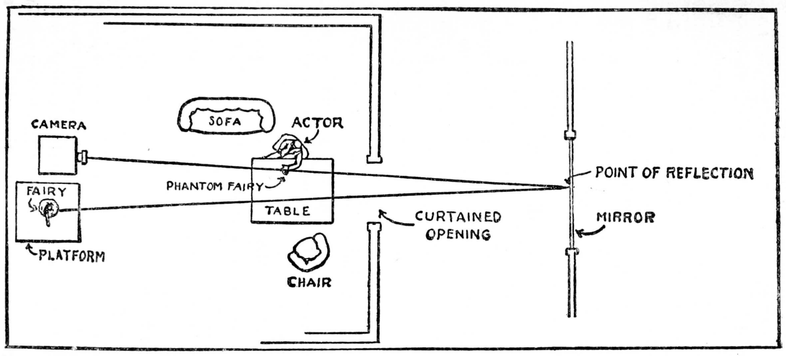


Fig. 2.3: Figure from Talbot's *Moving Pictures: How They Are Made and Worked* showing the set of *Princess Nicotine*

black panes of the transom window. What is likely a double exposure limits their space of action to a single window pane because any collision with the light grid of the window would render them semitransparent.

The change to an all black background suspends such limitations and the reduced visual complexity of the set also gives space for an alternative compositing technique. The new shot is just like the one before interrupted by closer ones showing the girl(s) with extremely enlarged props. But the combination of the protagonists within a single image is much more persuasive here. The way this impression was achieved, as Talbot explains, is by placing a mirror behind the table that is slightly swiveled to not reflect the camera but the place next to it where the actress performs. Only the different distances to the camera make her look so much smaller than the man sitting at the table (fig. 2.3). This trick is at the time well known and established on the theater stage but the fixed position of the camera (compared to a more widespread seated live audience) allows a higher degree of precision in the implementation here. Though spatial modifications and the resulting tricks are much easier to produce with photographic than theatrical devices they never become a popular motive with photography itself. The reason might be that it requires an action that is happening in such a cleft space. It is not sufficient that a collage like the described shot is technically possible but also that it needs an extrinsic function that renders it persuasive. And this takes place here through an interaction between bachelor and fairy by means of sights and gestures that additionally materializes in the smoke, which travels between them.

Another method of spatial modification endorses this impression of required action. In tilted film sets actors can perform or simulate movements that otherwise would be difficult or impossible to do, like walking up walls and houses or swimming at the ground of the ocean.[7] Walter E. Woodbury shows in his book *Photographic Amusements* a photograph entitled *A Catastrophe* that can clarify this phenomenon simply because it remains an exception in this medium. The frontal depiction shows us a man turned upside down inside a room. On the floor we see insignificantly standing a bottle of wine, a chair, and a glass. From the right a ladder extends into the image askew. Behind it hangs a painting. On the left

[7] For examples see Bernard Edward Jones, *The Cinematograph Book: A Complete Practical Guide to the Taking and Projecting of Cinematograph Pictures* (London: Cassell, 1915), 191-92; Ernest Alfred Dench, *Making the Movies* (New York: Macmillan, 1919), 104; Carl Louis Gregory, *A Condensed Course in Motion Picture Photography* (New York: New York Institute of Photography, 1920), 278-79, Open Library: OL7066740M; Austin Celestin Lescarboura, *Behind the Motion-Picture Screen*, 2nd ed. (1919; New York: Scientific American, 1921), 198-99, Open Library: OL7205396M.

a Madonna figure is attached to the wall. In between these two a skewed mirror or second painting can be seen that might be either falling on the floor or hit the saint. In the center is the alleged creator of this evolving chaos, underneath him the falling hammer that will hit the floor while he stills wonders what brought him in this situation.

The first thing that causes doubts about the narrative is the twisted body of the man. His head is pointing down to the floor while his feet are still attached to the top step of the ladder—a position much to high to hang up the falling framed object. Facing the factiousness of this downfall, one starts to realize that even the very prosaicness of the objects standing on the floor is far from an every day situation. They are only signifiers to disguise that the floor is not as we should expect at the bottom of the depicted space but rather the background on which the unlucky fellow is arranged lying and not flying. When comparing this photo of a tilted room with the other trick photos in Woodbury's book, it strikes that this catastrophe has a much higher level of action then all the ghosts, beheaded, and doubles whose interactions are reduced to gazes.

The apparent realism of photographic images makes it difficult to read image structures that are in conflict with this notion. Jones writes in regard to the shrunken fairies:

> It is worthy of note that these reduced living images are not in reality reduced, but appear to be so, owing to their greater distance from the camera, and especially because all cinematograph pictures are reduced to one plane; that is, they are flat images on a flat surface (the lantern sheet). Hence they do not present a double perspective for consideration, and herein lies the power to deceive the eyes of the observer, who is unwittingly robbed of that sense of sight known technically as binocular perception (vision of two eyes in nature).[8]

Images deriving from spatial manipulations at this time are still closely related to the physical presence of the stage on the one side and the limitations of cameras on the other side. Before the formalization of close-ups and other alternative field sizes scenes are often dominated by long shots depicting an idealized theatrical stage. The camera is not only static but also has a defined distance of about fifteen feet. With fixed focal length optics different scales within an image can only be achieved by varying the distance between object and camera. Talbot explains this effect in detail when writing about trick film producer Robert W. Paul.

> [His] studio was excellently adapted to producing strange variations in stature. He could make a giant or Lilliputian at will. The camera was mounted upon a special trolley, which could be moved forwards and backwards in relation to the stage over a pair of rails similar to a railway track. The closer the camera was to the stage the larger were the figures.[9]

Again we are confronted here with a phenomenon that did not tangle photographers of the 19th century but seems to become notable only due to the vividness of the cinematographic image.

8 Jones, *The Cinematograph Book*, 193.
9 Talbot, *Moving Pictures*, 201.

2.1.4 Combined Spaces

Supernatural phenomena are popular motives with the trick photography of the 19th century, which also find their places in early cinematography. By technical means these tricks are produced by exposing a single negative plate or piece of film twice. The distinct exposures allow for the combination of different spaces that replaces the manipulation of a single site as we saw with *Princess Nicotine*. The term ‘double exposure’ as a technical process is initially understood not as a technique but as an “error often made by amateurs in unconsciously exposing the same plate on two occasions.”[10] Only by reestablishing the lost pictorial and narrative order—i.e., by carefully planing the relation between them, it evolves into an aesthetic practice. In order to achieve this it is recommended in photography and film to restrict the second exposure to certain image areas or singular items. A partial exposure is done by blocking light. This can either be done by placing a person or object in front of a non-reflective background (preferably black velvet) or by inserting masks in front of or inside the camera. The areas of the image that are exposed twice this way will show a mixture of both motives giving them a pretense of semitransparency. A semitransparent person than is conceived as a ghost, an implication that is further supported by the factor that evenly light apparel produces the most satisfying results. “Ghosts are always to wear something light otherwise only their faces would be visible against the black ground.”[11]

The effect of semitransparency can be avoided by attributing a specific area of the image to the second exposure. (Technically, the ‘second’ exposure can be made also first but the fact that it is usually made later reflects its status as a secondary or additional elemental of the image.) Leaving a part of the first exposure black and filling this void with a second motif usually adds up to a discrepancy between the two parts that has to be explained. A secondary story, which happens in a different place or time, is read as a vision or a dream. Unlike with ghosts it, therefore, is no longer important to have matching perspectives in both exposures but rather to keep them separate in their own domains. A vision or dream is usually placed above the person it is associated with and works similar to a window connecting two spaces.

2.1.5 Combined Images

Another theme, which produces amazement in photography and early cinematography, is either the fragmentation or duplication of bodies. More than ghosts, such body manipulations as beheaded and *doppelgänger* produce the uncanny because as images they remain realistic. While semitransparency always can be read either as a feature of the depicted or of the image itself, a well manipulated body image can only be debunked by knowing how it was produced—a knowledge that no longer can be provided by the image itself. Watching a person talking with him- oder herself, we *know* that this cannot be real but we do not necessarily *see* it. Parted or doubled bodies were produced by means of splitting their images along invisible lines than separated distinct exposures. Simple pairing masks in front of the lens or inside the camera divided the image for example into left and right side that could show the same protagonist usually looking with bafflement at his or her twin brother

10 Walter E. Woodbury, *Photographic Amusements: Including a Description of a Number of Novel Effects Obtainable with the Camera* (New York: Scovill & Adams, 1897), 172, Open Library: OL22889606M.

11 Gregory, *A Condensed Course in Motion Picture Photography*, 281.

and sister. While doubles until today have their not numerous but period appearances, the modified body remains an oddity in cinema.[12] This again can be attributed to the latter's lack of physical agency as in the case of combined spaces.

2.2 Features of Temporality

In questions of the temporality of the image cinematography obviously has to develop own practices that go beyond what she borrowed from photography. This is the case with the entrances and exits of unnatural entities described above, which have to be staged the same way as their presence. The stop trick offers a simple technical option that soon proves to be dramaturgically unsatisfying. Instead of letting actors and objects appear or disappear from one frame to another, transitions are embellished with smoke puffs as they are known from magical performances on stage.[13] In theater this effect is necessary to disguise the usage of floor openings but in the movies the invisible cut itself is the opening to hide.

The same applies to the usage of fades. The literature describes several different methods to produce this gradual in- or decrease of blackness. They can be done by chemical treatment of the developed film—frame by frame. This method is regarded as difficult and risky. Another option is to reduce exposure time and light by speeding up the film transport either when shooting or printing the film. But to keep speed changes invisible the actors are not allowed to move. For that reason it is preferred to stop down the film by closing the diaphragm inside the camera. But this obvious possibility has two problems: As the diaphragms are constructed for exposure adjustment and not for fades, they do not close completely. Besides with growing f-number the depth of focus increases likewise. This side effect contradicts the intention to disperse the image in darkness and possibly irritates the audience. Therefore, the closing diaphragm often is combined with the use of a graduated screen—i.e., a piece of glass coated with a gradient that is pushed in front of the lens to reduce exposure. The method though that turns out to work best and that is only implemented into cameras when practitioners have articulated a need for it is a variable shutter, which often even could be automated. The shutter then opens or closes over a predefined number of frames—a technical factor that contributes to the standardization of cinematographic styles.[14]

A variation of the fade is the lap dissolve, a gradual transition from one shot to another. While a fade is made with one shot only (going to or coming from black) the lap dissolve by definition always engages two shots. So far a combination of two shots was described as a double exposure without addressing the fact that this can happen on the set, inside the camera, or later when printing the film. This distinction between double exposure and double printing opens up a basic question that comes up with most effects: Should they be produced while shooting or in post-production? The answers to this question vary over time and as we will see are not only based on technical considerations. To clarify the difference once more: to do a double exposure means to shoot a certain amount of film stock,

12 An example here would be Joseph Green's b-movie *The Brain That Wouldn't Die* (1962).

13 Colin N. Bennett, *The Handbook of Kinematography: The History, Theory, and Practice of Motion Photography and Projection* (London: Kinematograph Society, 1911), 95, Open Library: OL7134277M.

14 See Homer Croy, *How Motion Pictures Are Made* (New York: Harper & Brothers, 1918), 175-76, Open Library: OL23439710M; Jones, *The Cinematograph Book*, 188; Gregory, *A Condensed Course in Motion Picture Photography*, 276; Lescarboura, *Behind the Motion-Picture Screen*, 92-94.

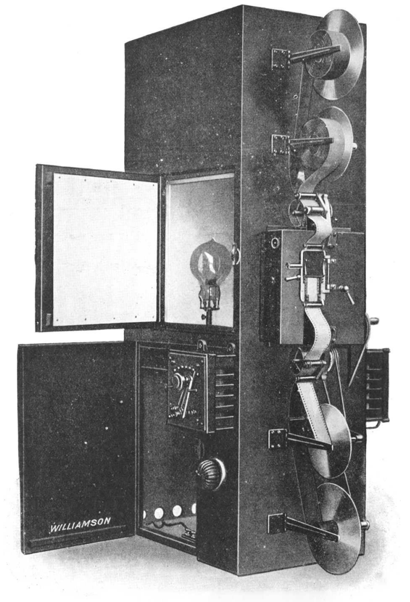


Fig. 2.4: Motor driven contact printer, ca. 1910

then rewind it in the camera partly or completely and expose it a second time. Double (or sometimes combination) printing means to film both shots on individual pieces of raw stock and do the combination when printing the positive. This can be done either successively, as it is done in the camera by rewinding the film for the second exposure, or by putting both negatives on each other and do the printing in one step only.[15]

The two ways of double printing have different results because sequential printing adds up the light of both shots while simultaneous printing adds the dark parts of both. Printing at the time of early film means contact printing. Opposed to optical printing, which will be covered later in depth, the negative and the blank film stock are lying on each other with facing emulsions while being exposed. Printing two negatives at the same time means that one of them can be in contact directly with the unexposed film. As the light that does the exposure is not focused the result is a slightly blurred positive of the secondary negative. For visions and other fantasies this was appropriate and even appreciated but for shots that demanded realism it was regarded a drawback. Another physical problem was that printers were not equipped with extra spools for an additional negative so that both negatives had to be wound up on one spool, which naturally caused a tension between them. Extra spools would not have caused a problem for manufacturers but were seemingly not regarded attractive for a bigger market. A printer itself was already a professional and special piece of equipment. For amateurs it was regular practice to do their printing with the camera itself for which as a matter of fact negative spool attachments were ordinary accessories. Bennett—though admitting that double printing became more and more important for trick work—clearly discourages his readers when writing that "it is in itself so complicated as to be more easily approached by the man of experience than by the one newly interested in film production."[16]

[15] Otto Brautigam, a cinematographer working in those days, later writes that the possibility to rewind the film was not a feature of early cameras. Double exposure known as a potential problem of photography is belatedly implemented in movie cameras only when covers a requirement of practitioners. See Otto Brautigam, "Double Exposures of the Early Days," in *The ASC Treasury of Visual Effects*, ed. Linwood G. Dunn and George E. Turner (1922; repr., Hollywood: American Society of Cinematographers, 1983), 83–86

[16] Bennett, *The Handbook of Kinematography*, 96.

A significant disadvantage of combining shots in post-production is that it requires an extra positive and negative resulting in a decreased image quality or has to be done again for each and every projection print. The latter is not a problem for amateurs but incompatible with the requirements of professional production and distribution. Talbot describes double printing as "the method [of] the early days" and sees the transition to double exposure in the camera as a progress.[17] Gregory is descriptive of the production of a double exposure scene and it becomes obvious that the comfort, which film makers presumptively find with this technique, has a lot to do with the feeling of control and how to obtain it. But as Gregory shows to master such a situation depends most notably on the capability of measuring it.

> The student will now have to learn to count while he is turning the crank. He must not count every turn but every other turn. If he tries to count every turn he will find that his breath will give out when he reaches about one hundred or so. He must count aloud so that the actors can hear him above the buzz of the arcs.[18]

The other methods of control are chalk marks on the floor to memorize positions of actors and markings on the ground glass of the camera.

Double exposure proves to be a practical method for trick movies with entrances, exits, and transformations of persons and objects within the same studio set. But for dissolves from one shot to another it turns out to be more of a burden. The shots in this case represent different setups that sometimes are filmed at different locations and of course times. When any problem occurs with the successive shot the one before has to be repeated also. In an anecdote reported by Gregory a cameraman has the task to connect ten subsequent shots with dissolves. When he makes a mistake with the last shot the team's work of a whole week is ruined and has to be repeated.[19] It is easy to see that with the narratives also the production practices and demands change when short trick movies give way for longer and more complex feature films. But in addition the connotation of the dissolve itself changes. While with trick movies it erases a piece of time that is needed to produce a certain effect, in feature films with so called continuity editing, which creates a consistent time span, the lap dissolve has the narrative function to point to a leap in time. It no longer tries to keep quiet but says: here we skip to what happened later.

This inconsistent appraisements of production practices—to produce a lap dissolve on the set or in post-production—illustrate that technical developments do not have straight trajectories. One thing that helps to trace them is to observe when they find their way into material forms as features or accessories of the basic apparatuses. As mentioned above rewind shots were easily produced by turning the camera upside down. The material side of this practice is that manufacturers start to furnish their cameras with an screw thread on the top when cameramen approve the respective practice.[20] In a similar way speed changes are supported by gears for cranks, so called 'trick handles.'[21] The usage of masks for partial exposures is facilitated by sets of mattes, which can be inserted into the camera gate (fig. 2.5), and by small rigs, which are mounted in front of the lens.[22] A special version of

17 Talbot, *Moving Pictures*, 224.
18 Gregory, *A Condensed Course in Motion Picture Photography*, 270.
19 See ibid., 276.
20 See Bennett, *The Handbook of Kinematography*, 90.
21 See Hulfish, *Motion-Picture Work*, 157.
22 See Lescarboura, *Behind the Motion-Picture Screen*, 79.

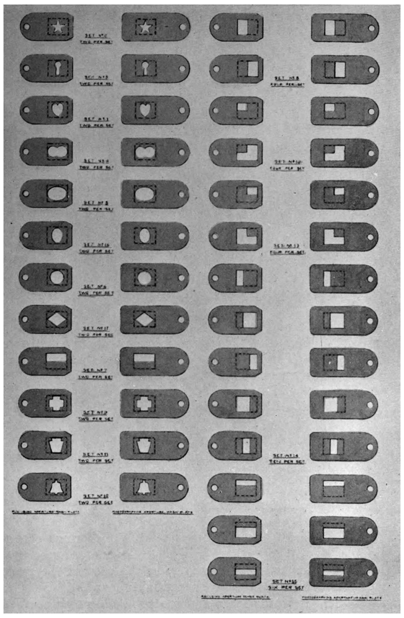


Fig. 2.5: "Aperture vignettes used in regular work. Two or four mattes constitute a set, one or two for filming and one or two for focusing." (Austin Celestin Lescarboura, *Behind the Motion-Picture Screen*, 2nd ed. [1919; New York: Scientific American, 1921], 95, Open Library: OL7205396M)

the latter ones enforces the popularity of the opening and closing circle vignette that is by no means a 'natural' phenomenon of cinematography but an arbitrary element of style.[23] Finally also fades could be automated which not only tightens their usage but furthermore establishes fixed lengths.[24]

2.3 Canonizing Trick Cinematography

All publications as mentioned above are largely consistent in their account of trick cinematographic practices and I will therefore primarily regard them as means of establishing a common concept of what trick cinematography is. *The Handbook of Kinematography* as one of the earliest books was initiated by the British magazine *Kinematograph Weekly* as a collaborative endeavor under the guidance of Colin N. Bennett "a well-known writer on scientific matters."[25] He is a cameraman himself and later develops a color film system called Cinechrome. Another author, Frederick A. Talbot, is not a practitioner himself but writes about diverse technical issues like railways, airplanes, and lighthouses. He gains his knowledge from studio visits and thanks British producer Robert W. Paul for giving an insight into his practices.[26] Talbot devotes more space to trick work than others but it remains equally uncertain whether the techniques he describes do represent the state of the art. Homer Croy at the time of writing *How Motion Pictures Are Made* is a young novelist who got in touch with the movie industry when he worked as a production manager in Paris during World War I and organized the distribution of American movies to Allied troops.[27] Finally, the books of David S. Hulfish are compilations from the American School of Correspondence, a distance education high school based in Chicago.[28] Hulfish himself

23 See Lescarboura, *Behind the Motion-Picture Screen*, 94-95.
24 Gregory, *A Condensed Course in Motion Picture Photography*, 267.
25 Bennett, *The Handbook of Kinematography*.
26 Talbot, *Moving Pictures*, 199.
27 Croy, *How Motion Pictures Are Made*.
28 David Sherrill Hulfish, ed., *Cyclopedia of Motion-Picture Work: A General Reference Work on the Optical Lantern, Motion Head, Specific Projecting Machines, Talking Pictures, Color Motography, Fixed Camera Photography, Motography, Photo-Plays, Motion-Picture Theater, Management and Operation, Audience, Program, etc* (Chicago: American School of Correspondence, 1911), Open Library: OL7243260M; Hulfish, *Motion-Picture Work*.

is a patent attorney, technical adviser, and editor for *The Nickelodeon* magazine where he also publishes an article series called *New Amusements Patents*. Though the authors are coming from different fields their depictions are surprisingly consistent and likely in parts copied from each other. They contribute to the formation of a first canon of optical effects. But just as most of them are not professional movie makers (not to speak of scholars) their publications are aimed at movie amateurs.

Beyond the technical means, the literature describes trick movies as a genre in decline. Croy argues that they were merely a transitional phenomenon of cinema as an attraction before it moved on to telling stories.[29] Hulfish gives the argument that they are simply too much work and, therefore, do not pay off.[30] And Talbot follows him describing how British producer Paul had to fight with American piracy, which seriously compromised his profits.[31] Just like trick movies disappear the people who write about them also vanish—at least as authors writing about motion pictures. In the 1920s there is a lack of new popular publications. This might also be an outcome of professionalization that is expressed in the establishment of institutions like the Society of Motion Picture Engineers (SMPE) in 1916 and the emergence of the respective trade journals.

One exception from the handbook canon above is Austin Celestin Lescarboura, managing editor of the *Scientific American* magazine and author of *Behind the Motion-Picture Screen*, a book "for the film devotee of a more serious turn."[32] Though the majority of the given examples and techniques are the same as in other publications, Lescarboura takes an independent approach that mediates between concrete and structural aspects of film practice as he not only explains techniques but also reflects on them. "Essentially, a photoplay is a picture; and all pictures require backgrounds. Pretty backgrounds make good pictures. Hence it is small wonder that the subject of sets and locations enters so extensively in the production of films."[33] That way Lescarboura is one of the first writers who articulates what the emergence of optical effects actually means for motion picture production and in which direction it will develop. The industrial division of labor is extended from a primarily economic to an aesthetic phenomenon where image elements are traded, collected and assembled. "The scenery of the entire world is available for the picture play; and all the world's scenery can be brought to the studio in these days of skilled screen artisans to whom nothing seems impossible. Realism has made the success of present photoplays; and the screen artisans have made film realism what it is."[34]

The only author who remains active after the early 1920s within the domain of motion picture technology is Carl Louis Gregory, who's *Condensed Course in Motion Picture Photography* is considered a standard publication at the time. The reason for his relevance might be that Gregory's motivation, more than that of the other authors, is to educate and to develop the knowledge of cinematography. Gregory had a rather adventurous life and after receiving a Bachelor of Science in Chemistry in 1904 changes occupations and locations alike rapidly.[35] But during World War I he is training cameramen for the Signal Corps of the US Army and at the same time writes regularly for the *The Moving Picture World*. The articles on all kinds of aspects related to cinematography read like a draft for his later book,

29 Croy, *How Motion Pictures Are Made*, 153.
30 Hulfish, *Motion-Picture Work*, 94.
31 Talbot, *Moving Pictures*, 205.
32 Lescarboura, *Behind the Motion-Picture Screen*, introduction.
33 Ibid., 130.
34 Ibid., 107.
35 See Charles "Buckey" Grimm, "Carl Louis Gregory: Life through a Lens," *Film History* 13, no. 2 (2001): 174–84, JSTOR: 3815424.

which he publishes as the new Dean of the New York Institute of Photography. Gregory, in 1920, also marks the transition to a new understanding of trick cinematography when he distinguishes between two kinds of effects: the ones that “deceive the eye into believing it sees something which really never occurred”[36] and those that help to tell the story as a film.

[36] Gregory, *A Condensed Course in Motion Picture Photography*, 267.

3 From Static to Motion Compositing: Optical Effects in the Silent Era

3.1 The Dawley Patent

On August 17, 1914, J. Searle Dawley files a patent application for the "Art of Making Motion-Pictures." The problem he promises to solve by means of his technique is that of carrying out stories taking place at distant locations. "With my invention I do away largely, or entirely, with expensive sets or artificial scenery, and at the same time I obtain photographic effects that are much superior to anything possible with artificial scenery."[1] Hitherto, there had been basically two options: the construction of sets—built or painted either in studios or on back lots—or voyages to actual sites. But artificial sceneries seldom deceive the eyes of the audience as Dawley notes. And a trip to original locations not only costs money but also time and holds a variety of risks.

The first step of Dawley's solution is to replace the original scenery with a photograph that is reasonably more realistic than any painted or built set and at the same time mobile in space and time. A photograph of Egypt or the Swiss Alps—to cite the examples given in the patent—can be transported and archived for later use. It is a commodity as the motion picture itself. The real site is simply replaced with its photographic impression (fig. 3.1). His conceptual approach of industrial fragmentation needs a technical implementation. He envisages a glass plate that is positioned in front of the camera, rotated by $45°$. If now the scenery image is laid on the glass plate by projection, an overlay with the actors and objects on stage occurs and a combined image is recorded by the movie camera. How the projected image would manifest itself on the glass plate remains unclear.

Dawley's patent is not driven by a technical concern but derives from his practice as a director for the Edison Studios. He has ten years of theater experience in his home state Colorado when he meets Edison in 1907 and both agree that the latter's short films would profit from Dawley's professional background. Dawley claims later that he was the first movie director ever and he is likely right with that as his entry to the Edison Studios means the separation of the tasks of production, cinematography, and direction with a focus on guiding the actors. In an autobiographic text the late Dawley describes himself without false modesty as a man of firsts: the first director, maker of the first stop-motion picture, the first sound picture etc. "Made *first*, now called Process shots, in the business, in Haggard's 'She.' The stone Ethiopian head was painted in the studio, then double painted on the edge of the sea."[2] At the Edison Studios he is working with Edwin S. Porter as a cameraman who in 1913 convinces Dawley to follow him to the newly founded Famous Players Studio. Until the early 1920s Dawley is to direct more than 150 mostly short films and starts careers of

[1] J. Searle Dawley, Art of Making Motion-Pictures (Patent 1,278,117 [US], filed August 17, 1914, and issued September 10, 1918), 1, Google Patents: US1278117.

[2] J. Searle Dawley, autobiographic typescript, box 1, file 18, J. Searle Dawley papers, MHL, 1947 In another bundle of notes he makes long lists to document his achievements in life: "Stars I have directed", "Plays I have written", "Things I have done."

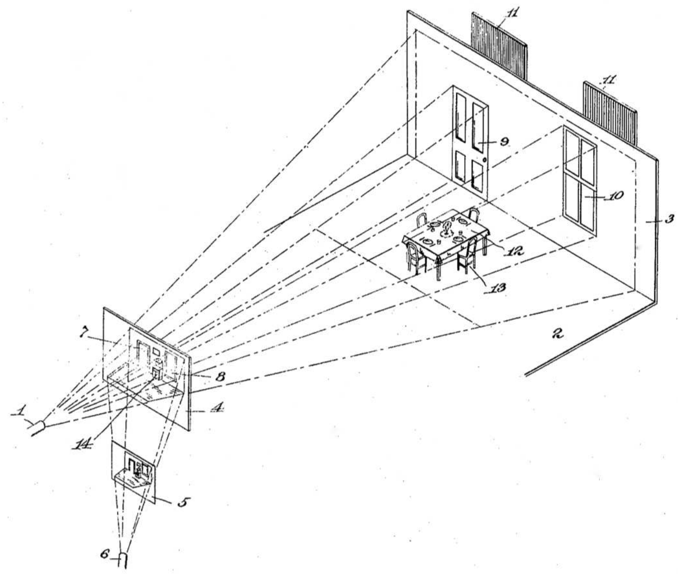


Fig. 3.1: J. Searle Dawley, *Art of Making Motion-Pictures*, US Patent 1,278,117, filed August 17, 1914

Hollywood legends as D. W. Griffith (as an actor), Douglas Fairbanks Sr., and Mary Pickford. One of his better know films is his 1910 adaption of Mary Shelley's monstrous assemblage story *Frankenstein*.

The patent is accepted and published in 1918 but a practical relevance in the production of motion pictures is not traceable. It seems to develop relevance only a decade later as part of a discourse on patents related to motion picture techniques. In March 1929 *American Cinematographer*—the journal of the American Society of Cinematographers (ASC)—starts a small series of articles on the topic. Patent attorney Ernest L. Wallace writes about "Patents as Related to Photography" as a basic introduction for practitioners and technicians. "A patent is, in effect, a contract between the patentee and the government whereby the patentee is granted an exclusive right to prohibit others from using the invention recited in the patent."[3]

Wallace identifies four classes of inventions. 'Art,' as in the case of Dawley, according to patent laws and when it comes to film is "a chemical or physical process or method and includes photographic processes."[4] 'Machines' and 'manufactures' are devices or instrument with or without power supply like e.g. a camera or a tripod respectively. Finally, a 'composition of matter' refers to a substance like an emulsion for film stock. While this explains differentiations made already in the titles of patents, a more crucial distinction that is not defined by law but rather by common sense is the one between *basic* patents and *improvements*. The vast majority of patents do not describe primordial ideas but are based on other patents. The reason why Dawley's patent suddenly is considered relevant is not because it defines a process that 'works well' but because it is apparently autonomous and for that reason can dominate other patents that follow. And to improve another patent it requires to be authorized by ones precursor.

A following article by New York patent lawyers Prindle, Wright, Neal, and Bean then analyzes specifically the Dawley patent. Prindle et al describe the process of Dawley's application and negotiation with the examiners of the Patent Office. Instead of the granted

[3] Ernest L. Wallace, "Patents as Related to Photography," *AC* 9, no. 12 (March 1929): 25.
[4] Ibid.

seven claims Dawley originally had ten of which three had to be dropped. The Patent Office pointed to older patents that contained mirroring glass. As a consequence of these negotiations Dawley focused his patent application on being a method rather then a technical innovation. The final sovereignty of the patent, therefore, was rather enforced than intended. Furthermore the lawyers are pointing to the fact that the preceding patents cited by the Patent Office are dealing with image illusions as stage effects or as part of the presentations of motion picture but not their production. The patent's commitment to film production and the insistence on a specific method that is independent from theater has first of all legal reasons.

The question the lawyers seemingly try to answer—though it is not addressed directly—is whether Dawley's patent covers current practices in the studios. Their conclusion without doubt is that Dawley has a right to compensation or at least acknowledgment because he offers a technique rather than an apparatus. "The Dawley patent appears to us to be a pioneer or basic patent in the sense that the inventor was the first to recognize the problem and to accomplish his solution of the problem by the invention of the art or method of the patent, and that therefore the patentee is entitled to a wide range of equivalents and a liberals interpretation of the terms of his patent."[5] A consequence of this reading is that it becomes negligible what kind of technique is used to picture the scenery. It does not have to be photography but could also be a painting. Dawley's claim would still be valid.

In the same issue of the *American Cinematographer* Carroll H. Dunning who presents himself as practitioner who is working with the studios expresses his doubts about patent practices. He raises the question of legitimacy if a motion picture patent relates to one dealing with photography by describing the same optical phenomena that are captured simply by a different apparatus. Specifically, he refers to photographic patents by F. J. Dischner and Hugo Sontag that have recently expired or are to expire soon.[6] If these patents are describing the production of composite photographic images, could there be new patents simply transferring the same techniques to moving images? Prindle et al argue that the only way to contest the patent of Dawley would be to proof that the claimed practice was in public use at least two years before he drafted his concept.[7] If one consents with Dunning by equating cinematography with photography, this was the case.

Dunning not only doubts the authority of the Dawley patent he also questions the basic functionality of the method. "But frankly, I know of no way by the reflection method to move actors across or in front of a picture of Egypt, as he mentions, without having a Pyramid sticking through an actor's face or elsewhere. Of course I have never seen a demonstration or motion picture using Dawley's described method and unfortunately I have failed to find anyone else who has."[8] A similar assessment is given a few years later by H. D. Hineline, a New York patent solicitor. "The way in which ghosting is avoided is not given, and this lack may be fatal to the process. It is doubtful whether this should really be considered

[5] Prindle, Wright, Neal and Bean, "The Dawley Patent," *AC* 10, no. 1 (April 1929): 34.

[6] See Carroll H. Dunning, "Patents vs. Patents vs. Practice," *AC* 10, no. 1 (April 1929): 18, 35; Friedrich Julius Dischner, Process for the Production of Photographs with Any Desired Background (Patent 858,162 [US], filed December 26, 1905, and issued June 25, 1907), Google Patents: US858162; Hugo Sontag, Process for Photographing Objects with Projected Backgrounds (Patent 1,053,887 [US], filed March 4, 1912, and issued February 18, 1913), Google Patents: US1053887.

[7] Wallace argues in the same way: "It is now 1929 and the proof would have to relate to events in 1914 or prior to that time. The difficulty experienced in obtaining such proof and in presenting it is obvious." Wallace, "Patents as Related to Photography," 26

[8] Dunning, "Patents vs. Patents vs. Practice," 35.

as a projection process."[9] The distrust in the practicability is also supported by depictions of the collaboration between Dawley and his cameraman Porter. The two men besides of friendship also shared a mutual understanding that Porter was in charge of everything that was related to the actual photography while Dawley was working with the actors.[10] Dawley entered the young movie industry as a theater director and constitutes his new task exactly by not touching the camera. While Porter, in fact, was a cinematography pioneer who produced composite images as early as 1903 in *The Great Train Robbery* but never called for formal acknowledgments as Dawley did. Dawley had understood and given a precise account of a major production problem of motion pictures. But his proposed solution was not more than a simultaneous double exposure well known since decades to produce ghost photography.

Already in 1919 Dawley filed another patent that reads like a concession to the earlier shortcomings. The subject matter of his new approach stays the same but the ambition has changed. "An object of this invention is to provide a method by which distant and inaccessible places may be exhibited on a screen with the living and moving element added to them and without the necessity of the places being visited either by the moving picture photographer or by the living or moving element which appears in them as a phantom."[11] The criticism Dunning would only articulate years later, that shots according to the Dawley method would show overlapping image elements, is already absorbed here by tracing it back to an old topic of trick photography. And just like it was done in photography Dawley insists on shooting white phantoms in front of black velvet backings. He tries to set himself apart from trick photography by announcing the option of white backgrounds in the final images behind the familiar white ghosts—a prospect that he neither elaborates on technically nor aesthetically. The method described uses a backlit still transparency that is shot with a movie camera before the film is rewound and double exposed with actors and objects. The transparency is produced from an internegative that again comes from a scenery photograph. Dawley does not explain why these two intermediate steps are necessary when one also might shoot the original photo directly. Dawley's second patent is a bizarre document that seems to lack any technical or practical relevance and is only fed by his earlier insight into production requirements. His original claim to present a universal production technique is reduced to a questionable instruction for shooting an already dated theme.[12]

3.2 Glass Shots and Other Static Mattes

In June 1917 Norman O. Dawn files a patent for *Cinematographic-Picture Composition*.[13] It describes a method for combining natural subjects with artificial ones into realistic moving images as follows: The pristine scene with actors is photographed with a custom made

9 H. D. Hineline, "Composite Photographic Processes," *JSMPE* 20, no. 4 (April 1933): 292.

10 See Tom Gunning, *D. W. Griffith and the Origins of American Narrative Film: The Early Years at Biograph* (Urbana, IL: U of Illinois Press, 1991), 46.

11 J. Searle Dawley, Method of Preparing Films for Kinetoscope (Patent 1,463,802 [US], filed September 8, 1919, and issued August 7, 1923), Google Patents: US1463802.

12 Dawley likewise does not explain how his "Method of Preparing Films for Kinetoscope" actually relates to Edison's movie presenter—at the time even more outdated than the ghost theme.

13 This section draws heavily on the three seminal depictions of Dawn's life and work: Fielding, "Norman O. Dawn"; Judi Hoffman, "The Norman O. Dawn Collection of Cinematic Effects," *The Library Chronicle of the University of Texas at Austin* 20, no. 3 (1990): 97–121; Vaz and Barron, *The Invisible Art*. These texts are rather congruent as they are all based on Dawn himself as a source—i.e., his notes and interviews. Dawn was documenting his work

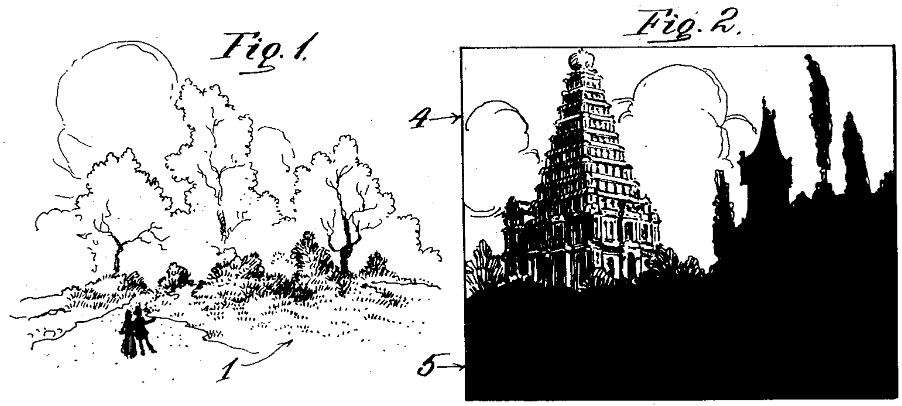


Fig. 3.2: Figures from Dawn's 1918 patent showing the original scene and the drawing to be added to it later.

vignette that prevents exposure of the negative where further image elements—in Dawn's example an exotic temple—shall be added. Later a drawing or possibly "any other artificially prepared or natural subject"[14] is fabricated that fades smoothly to black or any other non-actinic color. The original negative is then exposed a second time with this composite part of the image.

The technique that Dawn claims here is later called original negative or in-camera matte painting because the second exposure is done directly on the primary film footage. When Dawn formalizes the technique, he already had used it for several years and it has to be noted that it is not covered by any of the handbooks referred to above. It is difficult to determine how much the movie industry knows about the details of the process and whether others also make use of it at that time. The temple that is depicted in the patent comes from a shot in the Keystone comedy *Oriental Love* that was produced in the spring of 1917 and to which Dawn contributed several effects that caused some sensation within the industry. Producer Mack Sennett hence urges Dawn to protect his process with a patent.[15]

In the patent text Dawn does neither refer to any method that would help to design the drawing nor any system to determine the proper second exposure. Raymond Fielding describes that on location additional footage of the same scene was shot specifically to be able to determine the correct perspective and exposure. In the studio Dawn then uses a modified Bell & Howell 2709 camera that is fixed on a massive concrete stand with lathe bed. The modification of the camera allows him to insert a developed piece of the additional footage and to see through the view finder the exposed part of the original set and his drawing in front of the camera together. Once the drawing is finished several test exposures are made on pieces of the additional footage to detect the best settings.[16]

To understand Dawn's technique of 1917 better it makes sense to trace it back to a much earlier and well known example of image compositing from Edwin S. Porter's *The Great Train Robbery* (1903). The first scene of the movie shows the hold-up by two masked ban-

(including all effects he produced) in some 800 notebooks. At a later point in his life he reassembles parts of his notes together with newly produced illustrations into 164 display cards that explain his work. The Ransom Collection of the University of Texas, Austin, has made all of them accessible online.

14 Norman Dawn, Cinematographic-Picture Composition (Patent 1,269,061 [US], filed June 8, 1917, and issued June 11, 1918), Google Patents: US1269061.

15 Vaz and Barron, *The Invisible Art*, 54.

16 See Fielding, "Norman O. Dawn," 146.

dits in a telegraph office. Through a big window in the upper right corner we see a train arriving and departing. The single long shot connects two sites—the interior of the office and the exterior of the train station—by means of the window on the right and a black hatch on the left through which the train driver picks up a telegram from the office clerk. The hatch does not reveal any exterior scenery and, therefore, can be regarded as a simple stage component. The window prospect is done by means of double exposure and masking. The two image elements jiggle independently due to the imperfect registration of early cameras and they seem to overlap in the light window frame and grate. Homer Croy, in 1918, writes that the compositing was done by first filming the studio set with a black curtain hanging behind the window and days later doing an exposure of the train outside while protecting parts of the image with a mask.[17] Porter then integrates inside and outside by means of precise timing and the interaction with the alleged train driver. But what separates Porter from Dawn—besides of the technical deficiencies of the earlier composite scene—is first of all the singularity of the trick shot in *The Great Train Robbery*. Though it is acclaimed by contemporary professionals the technique is not adapted into regular production practices. The means Porter uses (black curtain, double exposure, mask) are generally available but the process he applies them for seems to lack universality. The fact that it could be successfully applied in this case is also due to that the specific set provides a mask in form of the window that easily could be combined with a generic rectangular mask. Dawn on the other hand chooses his matte lines freely. In the patent he describes this as an "attempt to eliminate physical subjects in cinema-photography."[18] The notion of elimination is significant because it acknowledges that *something* has to vanish from the image and not a generic image area as it was done in the case of double exposure with masks. Additionally, he understands the ability of the camera not only to even out various sites but also different media. This notion to fuse film with painting, drawing, photography, and sculpture makes image composition an attractive option worth pursuing.

Dawn who was born to an American train engineer on the border between Bolivia and Argentina in 1886, grew up in California and developed an early interest in photography and later in drawing. For his 12th birthday, his aunt, who takes care of him after his father's untimely death, gives him a camera obscura as a present. Dawn later describes the device on one of his autobiographical cards as "a small tent of black canvas with a small sketching table and a camp chair inside. At the top of this tent was a lens that could be rotated around and it reflected an image of the scenery down on the sketching tablet. The student could sketch what he liked, or move the tent some other place and add on some other scene."[19] The mobility of the drawing aid and the resulting assemblage was used by painters since the 17th century but as a technique that must have been striking for a California teenager around 1900.[20] Dawn's usage of the camera obscura clearly foreshadows and informs his later practice of optical effects in its combination of manual selection and reproduction of image elements and the realism of the perspective rendered by optics. "He would sketch in the foreground portion of a scene with the turret or tent in one position, then turn the

[17] See Croy, *How Motion Pictures Are Made*, 164-65.

[18] Dawn, Cinematographic-Picture Composition.

[19] Cited after Hoffman, "The Norman O. Dawn Collection of Cinematic Effects," 100.

[20] An example of this process is Vermeer's *View of Delft* (ca. 1660/61). See Ben Broos, Albert Blankert, and Arthur K. Wheelock, *Vermeer: Das Gesamtwerk*, ed. Arthur K. Wheelock (Stuttgart: Belser, 1995), 120-27; John Law and Ruth Benschop, "Resisting Pictures: Representation, Distribution and Ontological Politics," in *Ideas of Difference: Social Spaces and the Labour of Division*, ed. Kevin Hetherington and Rolland Munro (Oxford: Wiley-Blackwell, 1997), 162-64

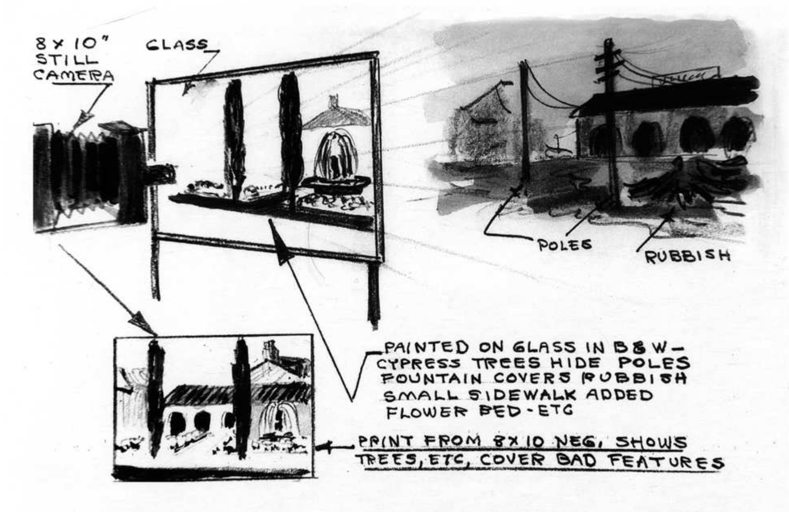


Fig. 3.3: Illustration by Norman Dawn showing the setup for his first glass shot.

turret or move the tent to a new locale, position his sketching pad on the projection screen with respect to the new scene, and then add the background component, thus creating a composite image which did not actually exist in nature."[21]

His skills in photography bestow him with a job at the Thorpe Engraving Company of Los Angeles. On February 11, 1905, he is assigned to photograph a building but has to find out that it is partly hidden by a light pole (fig. 3.3). He seems to be familiar with period practices of retouching photos but his colleague Max Handschiegl suggests a different, easier approach to eliminate the hideous pole. Handschiegl, who will become relevant for optical effects later on his own, proposes to solve the problem on site by placing a glass plate between camera and the subject. Dawn mounts the glass in a fixed position and then is able to paint a tree on it that covers the light pole.[22] This seems to be the first incident of what is called a glass shot but Dawn himself later is not sure whether he actually coined the term or if it already existed.

In the following year he travels to Paris to receive formal training as an artist. He also meets Georges Méliès in his studio and witnesses a lot of the special effects pioneer's practices including the usage of a theatrical tormentor made of painted glass that covers the lights above the set. Dawn looks through the viewfinder and is puzzled that despite of knowing of the artificiality he cannot see it from the forced perspective of the camera. He meets further people from the still young and small film industry like the Lumière brothers, Arthur Lee, an American producer at the Gaumont film company, and the camera manufacturer André Debrie from who he buys one of his first cameras. The device that costs a formidable $500 at that time cannot be legally imported into the USA because of Edison's patents. Dawn, therefore, is forced to travel back with an English freighter to New Orleans to avoid an informed customs check.[23]

Back in California he produces *Missions of California* (1907), a travelogue about the old Spanish missions of his home state. He travels together with an assistant and for the first time uses the glass shot technique for motion pictures when restoring the decayed build-

[21] Fielding, "Norman O. Dawn," 143.
[22] See Vaz and Barron, *The Invisible Art*, 31.
[23] See ibid., 33.

ings to a possible original state on big plates of glass mounted in front of the camera. The genre and the process work well together and Dawn spends the next four years traveling the world, producing movies, and refining his glass shot technique.

According to his notes on January 14, 1911, he uses, for the first time, the original negative or in-camera matte technique while shooting *Story of the Andes* in Bolivia.[24] Unlike his earlier travelogues the two-reel drama features additional actors and makes the tedious glass shot technique more difficult to apply. To matte out parts of the image while working on location and only filling the void later in post-production accelerates the shooting process itself. The fact that the very same year Dawn settles in Los Angeles and starts working for the local movie industry backs the impression that the new method is more suitable for bigger teams. Dawn's salary in Hollywood is about $100 per week—two to four times as much as that of a regular cameraman—which is due to his ability to reduce production expenses. In 1914 he buys an all-metal Bell & Howell type 2709 with fixed pilot-pin movement for the enormous price of $1,800.[25] Concurrently, he improves his personal practice by cutting tiny custom mattes from card board that are directly inserted into the camera. "After a few year's experience, Dawn got to the point where he could cut such miniature mattes in about one minute—a considerable saving in time over that previously required for the painting of an external matte."[26]

But the industry is not consistently open about applying Dawn's in-camera mattes. The biggest and most expensive film set of the time is a reconstruction of Babylon built for D. W. Griffith's *Intolerance* (1916). Dawn as virtually every cameraman in town works on that set and tries to explain for the director and his main cameraman Billy Blitzer how they could simplify the production with matte shots. But especially Blitzer remains reluctant towards Dawn's suggestion because he is displeased with the idea to fake parts of the scenery by other means then building them.[27] A later reevaluation of the matte process is probably supported by the commercial failure of *Intolerance* that contributes to the collapse of its production company Triangle the following year.

Griffith follows his very own idea of the economics of motion picture production. In an interview in 1915 he argues that the higher the budget of a movie would be the more the audience would pay for a ticket to see it.[28] This would render the necessity to save money basically irrelevant. The financial failure of his high budget productions must have caused a later insight that even led to an own patent that made it "possible to have a picture representing ancient Babylon at a small expense."[29] The patented method, which in the later review by Hineline is considered "somewhat doubtful,"[30] envisages a stage where fore- and background are separated by a wall with window. Behind the window a miniature or painting is placed. This ordinary theater setup is then expanded by a black curtain behind the window that is supposed to allow for independent exposures of both domains. Hineline concludes that the "reason for the sequential, rather than simultaneous, photographing of

[24] Hoffman reports that he already uses such a method in 1907 when he shots an experimental film for Edwin S. Porter on the occasion of selling *Missions of California* to Gaumont in New York. See Hoffman, "The Norman O. Dawn Collection of Cinematic Effects," 103-104

[25] See Vaz and Barron, *The Invisible Art*, 41.

[26] Fielding, "Norman O. Dawn," 147.

[27] See Vaz and Barron, *The Invisible Art*, 40-41.

[28] See Richard Barry, "Five Dollar Movies Prophesied," in *D. W. Griffith: Interviews: Interviews*, reprint from the New York Times, March 28, 1915 (Jackson, MS: UP of Mississippi, 2012), 23–27.

[29] David Wark Griffith, Method and Means for Taking Moving Pictures (Patent 1,476,885 [US], filed November 17, 1921, and issued December 11, 1923), 1, Google Patents: US1476885.

[30] Hineline, "Composite Photographic Processes," 287.

the two does not appear."[31] Griffith picks up two concepts of the emerging compositing—the separation of fore- and background and the asynchronous production of both—but fails to derive an advantage from these distinctions. His misunderstanding of such production practices reminds of that of his former patronizer Dawley.

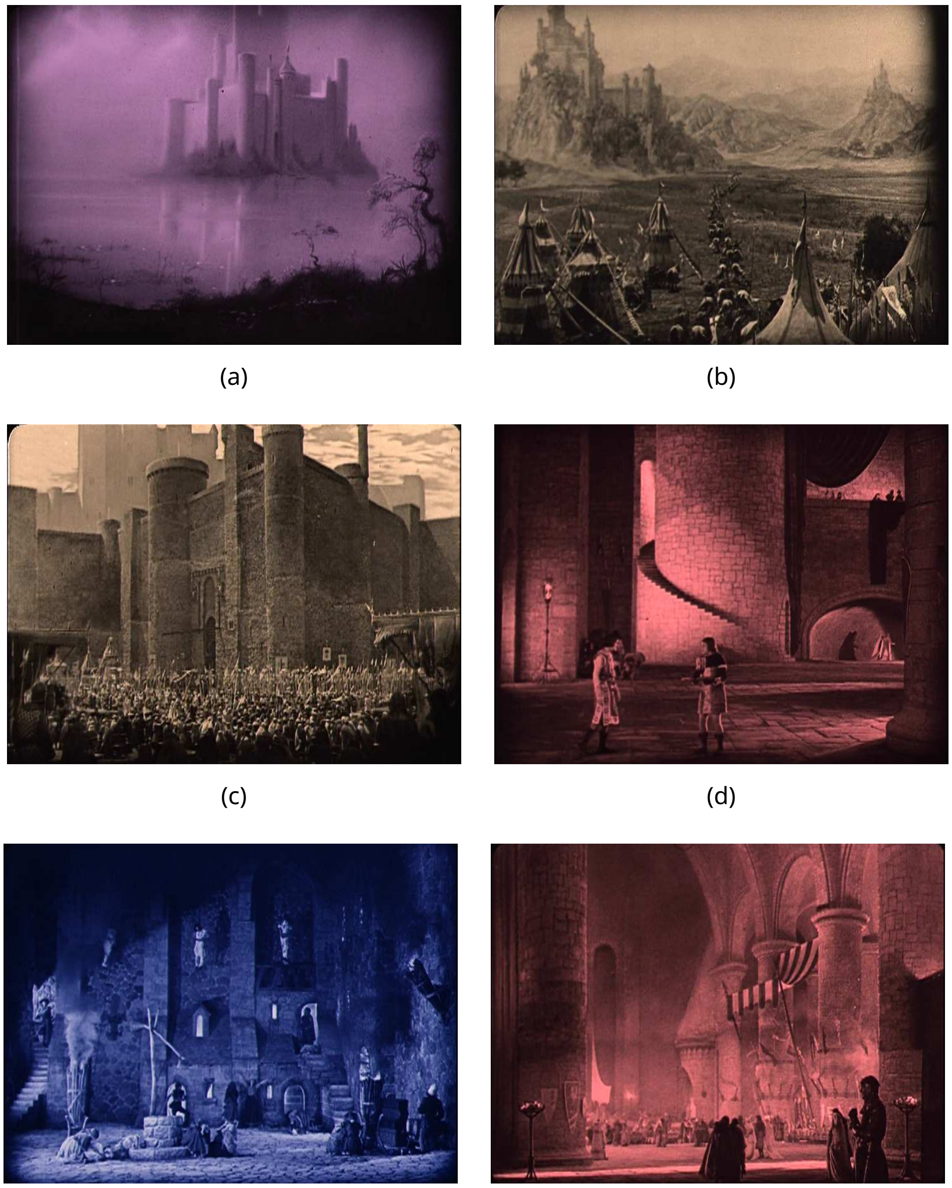
Dawn's involvement in the production of *Oriental Love* one year after the release of *Intolerance* must be seen as related to each other as both films originate from the same environment. The production companies Keystone and Triangle are associated is several ways. Triangle's name points to its three principal producers D. W. Griffith, Thomas Ince, and Mack Sennett. The latter one also produces *Oriental Love* for his own company Keystone. But the film is distributed by Triangle. When *Oriental Love* is released in the summer of 1917 the *Triangle Magazine* publishes an article praising Dawn's contribution to the production. The article picks up the screen credit Dawn must have received for the film (whose whereabouts are unknown). As a so called "cina-luminist" Dawn is presumably the first individual in Hollywood accounted for special effects work.

> By some marvellous Aladdin photographic trick the fantastic characters of "Oriental Love" seem to be moving through the most magnificent structures that could be conceived by man—temples, palaces, grottos and many more beautiful places, most of them apparently more than a hundred feet high.
>
> It is only in knowing the impracticability of building such vast edifices for a single production that makes one look for a trick, because the scenes are so accurate in perspective and fit in so well with the chiaroscuro of the remainder of the action that they all seem like genuine locations. All this combined with the unusual title of cina-luminist, given in the beginning of the picture, make one certain that this must be the art indicated.[32]

One of the first major features that uses glass shots is the Douglas Fairbanks production *Robin Hood* (1922). Some of the displayed locations have similar dimensions as the ones in Griffith's *Intolerance*. Therefore, there is a potential demand for replacing real structures with painted substitutes. The scene type that is most easily done with matte paintings is the establishing shot, a static long shot that has to convey a spacial orientation rather that any specific action and is apparently based on the fine arts vedute. *Robin Hood* features one of a castle with moving clouds (fig. 3.4a) and one of a majestic landscape with several edifices and crusaders marching from the foreground into the depth of the image (fig. 3.4b). Especially if such shots are partially done by means of painting, it becomes crucial that they show some kind of movement as a demonstration of life. To animate paintings with clouds or smoke is relatively easy to do because it only requires double exposure or printing that lightens or darkens parts of the image. A scene more pronounced as a glass shot shows a fortress with a large crowd. An apparent border that divides the building into a lower and upper part—i.e., an actual set and a painting—reveals the used process (fig. 3.4c).

But not all excrescent image spaces are enhanced by painting. The heights of interiors that characterize movie spectacles of the silent era are often utilized until the top what hinders the usage of painting. The room in figure 3.4d is shown several times and seized on from front to back and bottom to top when people walk up the stairs and on the gallery in the upper right corner of the image. The upper half of similar images is hardly ever still but

[31] Ibid.
[32] "Enter the Cina-Luminist," *Triangle Magazine*, June 2, 1917.



(a) (b) (c) (d) (e) (f)

Fig. 3.4: Glass shots and actual sets in *Robin Hood* (1922)

animated by smoke, flags, or even hanging corpses as if the image would make an effort to register its real set (fig. 3.4e). Only in one case the upper part of an interior shot is visibly painted. The smoke from the torches in this case disappears into the blurred edge that separates the two techniques (fig. 3.4f).

Dawn, who is not involved in the production of *Robin Hood*, in the early 1920s has probably reached the climax of his career in the movie industry. A photo of 1920 shows him as an attendee at the birthday party for Universal President Carl Laemmle. In 1921 Dawn's contract with Universal runs out after five years and he starts to free lance again. In September he makes the mistake (as will turn out) to file a bill of complaint against Ferdinand Pinney Earle, Earle's production company and the "John Doe Corp." for using his patented original negative process without a proper license. The place holder company is later identified by Dawn as virtually the entire motion picture industry.

Earle is a writer and painter who works for the industry since several years, mainly producing artistic intertitles. But he has higher ambitions and waits for a chance to direct. Initially he wants to do motion pictures based on operas but then decides to develop a script based on poems of Persian writer Omar Khayyám—*The Rubáiyát of Omar Khayyám*. Earle's production concept is technically and aesthetically opposed to Hollywood standards as he wants to avoid the regular sets and rely on what he knows best: painting. When columnist Louella O. Parsons visits him in his home studio, he explains his idea.

> My object has been to create a dream world so convincing in its realistic aspect as to baffle the beholder and at the same time to achieve many times richer and vaster sets—without wrecking the finances of a Rockefeller … To accomplish this end economically—and artistically—the painters' canvas and brush have brought the poet's wildest fancies within practical reach. Thus a ten-inch painting in my production conveys all the vastness of the city and plains of ancient Nisapur. Within this 'Motion Painting' we have introduced by multiple exposure actual living actors in movement.[33]

The production of *Rubaiyat* at Earle's estate at the foot of the Hollywood Hills starts in June 1921 and—though Earle has good connections within the industry personally and through his brother, the director William P. S. Earle—is financed by impresario Theodore Ahrens. Besides of the lawsuit against Dawn, Earle also finds himself in a conflict with his financier who later gets hold of several reels of the original negative and tries to release his own version of the movie. Earle wins at court against Ahrens but falls short of releasing his version of *Rubaiyat*. The benevolent report by Parsons the following February marks the beginning of an alliance between Earle, who started out as an independent, and the industry, who feels pressurized by the comprehensive claim raised by Dawn's lawsuit. Until the autumn Earle can rely on a strong support from producers and even popular (producing) actors like Mary Pickford and Douglas Fairbanks.[34]

The *American Cinematographer* covers the conflict between Dawn and Earle in September 1922 and describes Dawn's technique simply as "that form of double exposure in which an artificial scene is blended with a natural"[35] and, thereby, blames Dawn for laying claim to something that is regarded as a "common property" of the industry. (This is exactly the same argument that Earle puts forward to defend himself at court.) Among the people

33 Cited after Louella O. Parsons, "In and Out of Focus: The Artist and the Screen," *The Morning Telegraph* 99, no. 53 (February 26, 1922): 6.

34 "Movie Facts and Fancies," *Boston Evening Globe*, September 9, 1922, 12.

35 "Attempts to Control Double Exposure Method," *AC* 3, no. 1 (September 6, 1922): 4.

listed who oppose Dawn's claim is also Mack Sennett, who had recommended for Dawn to patent his process in the first place. Especially the motion picture industry of the West Coast seems to have a vital interest in impeding any patents on basic techniques. The article ends with a strong reference to the constitutive conflict with Edison that only ended in 1915: "No one, who has the interest of the cinema art at heart, desires that conditions be brought about in the slightest way similar to those in vogue during the regime of the Motion Picture Patent Company whose activities sapped at the early growth of the industry."[36]

As Earle is still not able to release his film, also in September 1922 a private screening of a truncated version takes place for various industry members. The film is received enthusiastically and United Artists offers to distribute it.[37] The court trial ends two years later with a settlement between Dawn and Hollywood. As Dawn reports decades later, producer Irving Thalberg had taken him for a ride and explained to him that his patent was simply too important for him alone. Dawn is prevailed by his employer Thalberg to sell his patent for the price of $10,000 to the recently founded Motion Picture Producers and Distributors of America (MPPDA), the trade association of the major Hollywood studios. Dawn likely saw this as a humiliation and when a few years later First National trick cinematographer Ralph Hammeras is awarded a patent for glass shots[38]—a process that if not invented by Dawn but at least affected by him like by nobody else—he leaves Los Angeles for Australia. Ironically, Dawn's opponent Earle replaces him at MGM doing matte paintings for their production *Ben-Hur* in 1925.

Norman Dawn loses all his money in the world economy crisis in 1929 and later returns to the USA. He works as a special effects cinematographer and director but never manages to tie in where he left. His accomplishments when it comes to glass and matte shots are unquestionable but he also experimented with other processes. For his own feature *The Drifter* (1913) he experiments with rear projection with a still image. He also develops an early mirror reflection method similar to what later became popular with Eugen Schüfftan.[39] Both methods did not produce satisfying results for him but it has to be acknowledged that he worked on such concepts much earlier than others. The two methods that are associated today with Dawn—the glass shot with a painting on a glass plate between camera and action and the original negative matte shot where the glass plate carries a black painted matte that only later is replaced by a second exposure—coexist for a while and confusingly both were referred to as glass shots. The original technique carries a certain fascination that derives from the surprisingly realistic effect one can experience when looking at the setup first and then through the view finder of the camera. Director Allan Dwan, who uses the technique in 1922 in *Robin Hood*, later calls it "the most fascinating thing we ever did in films."[40]

---

36 "Attempts to Control Double Exposure Method."

37 The film, of which only a fragment survived, actually only is released in 1925 under the title *A Lover's Oath* by Astor Pictures, a small independent distributer. Earle's son later claimed that United Artists were not interested in distributing the movie but rather used it as a visual source book for their own production *The Thief of Bagdad* (1924). See André Soares, *Beyond Paradise: The Life of Ramon Novarro* (Jackson, MS: UP of Mississippi, 2010), 25

38 Oscar R. Hammeras, Method of Making Motion Pictures (Patent 1,540,213 [US], filed March 3, 1923, and issued June 2, 1925), Google Patents: US1540213.

39 See Hoffman, "The Norman O. Dawn Collection of Cinematic Effects," 100.

40 Peter Bogdanovich, *Who the Devil Made It: Conversations with Robert Aldrich, George Cukor, Allan Dwan, Howard Hawks, Alfred Hitchcock, Chuck Jones, Fritz Lang, Joseph H. Lewis, Sidney Lumet, Leo McCarey, Otto Preminger, Don Siegel, Josef von Sternberg, Frank Tashlin, Edgar G. Ulmer, Raoul Walsh* (New York: Alfred A. Knopf, 1997), 87.

So far the question has not been answered whether Earle's 'motion paintings' used double exposure as described in Dawn's patent. Dawn and Earle for sure shared similar ideas of miniaturization as a means to save money and gain creative freedom. "We have magnified the power of the dollar as we have the size of the set," as Earle explains for Parsons.[41] Enlarging a set means also that the production can be scaled down as Earle demonstrates when shooting *Rubaiyat* at his home. Dawn, who worked more years outside of Hollywood than as a member of the industry, presumably shared that view. An enthusiastic report about *Rubaiyat* that appears in *Motion Picture Classic* in January 1923 contains details of the Earle production. While he painted the sets 18×14 inches in size, the actors are photographed against a black velvet curtain in the back of his studio.[42] Dawn's technique on the other hand is arranged for defining distinct image areas that are exposed in two or more steps. If Earle shoots his protagonists against a neutral, non-actinic background, he could either combine them with his paintings through regular double exposure (without matte) or by creating a traveling matte from the actors' negative. The latter option would not be the technique secured by Dawn's patent but the so called Williams process that emerges at the same time and is described later in this chapter.

An article that is published in *American Cinematographer* in October 1921 quotes Universal's trick cinematographer Philip H. Whitman saying that Earle

> has solved the greatest economic problem of motion picture production. He is filming scenes in which a score of noted actors and actresses appear, but … there is not one player on the payroll! The setting is the most beautiful of the production but there are no actors before the camera. They are inside the camera. When the action was photographed by George Benoit, the setting was invisible to the eye. Now the setting is photographed and the actors in *proportia persona* are not needed. In Earle's production of *The Rubaiyat of Omar Khayyam* hundreds of scenes are photographed at separate times of action.[43]

Dawn at that time is working at Universal. So Whitman should know his technique and the latter's praise for Earle suggests either some kind of originality of Earle's approach or is a first move of the industry against Dawn who filed his law suit in September. When Earle presents his 'motion painting' in 1923 in a trade directory publication, it comes across a simple variation of the original glass shot technique. The glass plate is replaced with cardboard. An entire set is painted, a part of that scenery is cut out so that the picture can be placed between the camera and a minimal studio set with actors.[44] Both possible methods of Earle are fairly close to the two techniques attributed to Dawn. But whatever process Earle used, if it was viable, why did he not pursue working with it? He presumably does something similar in two earlier films of his brother William: *Within the Law* and *Womanhood, the Glory of the Nation*. Both are produced in 1917, both are lost, and the latter one is co-directed by J. Stuart Blackton of *Princess Nicotine* (1909). Earle might have

41 Parsons, "In and Out of Focus: The Artist and the Screen."

42 William Huntigton Wright, "Eastern Magic," *Motion Picture Classic*, January 1923, 49–50; cited after Vaz and Barron, *The Invisible Art*, 57.

43 Cited after Rolf Giesen, *Special Effects Artists: A Worldwide Biographical Dictionary of the Pre-Digital Era with a Filmography* (Jefferson, NC: McFarland, 2008), 55.

44 See Ferdinand P. Earle, "Screen Renaissance Through Motion Painting," in *The Blue Book of the Screen* (Hollywood: Blue Book of the Screen, 1923), 345–48, Open Library: ia:bluebookofscreen00unse.

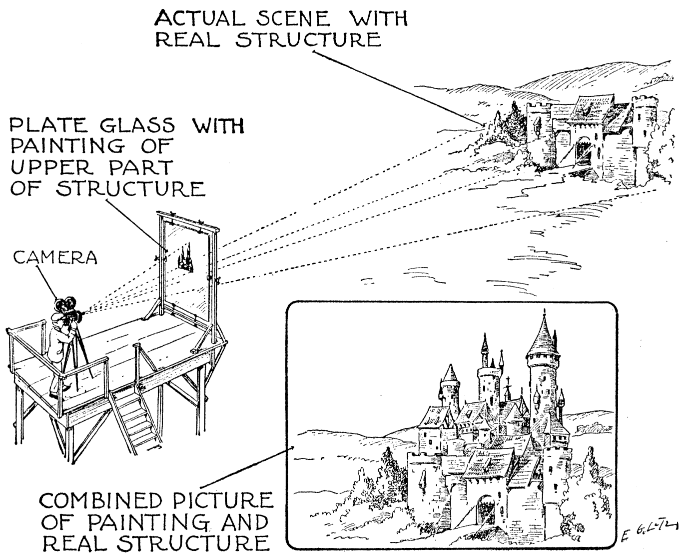


Fig. 3.5: Diagram of the original glass shot setup from E. G. Lutz's book *The Motion Picture Cameraman* (1927)

avoided ghostlike layering associated with simple double exposure by painting parts of his miniature sets black.[45] Whether somebody else uses Dawn's original negative matte process in the early 1920s remains unclear.[46]

While film studies since Fielding's initial appreciation for Dawn's work[47] consistently identify him with the glass shot technique, the technical literature of the studio era denies Dawn the credit for his early process. Dawn's debarment and the implementation of glass shot techniques coincidence in the beginning of the 1920s. A 1923 article from *Popular Mechanics* explaining the process for a wider audience does well without an inventor. The text points to a specific problem of film production as there is a high demand for impressive sceneries that are distant (in space and time) from the Californian studio lots. The approach to build bigger and more expensive sets turns out to be a dead end as even the most elaborate artificial sets never are convincing enough. "But in the past two years the problem has been solved, and now Westminster Abbey, the House of Parliament, or the Tower of London may be made ready to photograph on an hour's notice."[48] The promise of miniatures to be fast and cheap finally is taken serious as "producers have learned that illusion is more effective than truth itself."[49]

[45] Earle actually receives an own patent for a composite images method shortly after. It covers the process of placing actors in front of a full size painting or photograph in the studio. The improvement Earle claims to have developed is to light image and actors from an extreme flat angle to avoid reflections from a preferably shiny background. See Ferdinand P. Earle, Method of Producing Composite Motion Pictures (Patent 1,575,478 [US], filed June 3, 1925, and issued March 2, 1926), Google Patents: US1575478

[46] Earl Theisen, curator at the Los Angeles Museum in the 1930s, collects examples for various techniques of the movie industry. Part of his collection (now at the Margaret Herrick Library) are four pairs of frames showing the before and after states of what he identified as glass shots, dated 1920. The production frames feature matted out areas as they appear with in-camera mattes. Unfortunately the productions are not identified and, therefore, it remains open whether these were produced by Dawn himself or prove illegitimate use of his technique.

[47] Fielding, "Norman O. Dawn."

[48] "How the Moving-Picture Camera Lies: By Fibbing Scientifically and Artistically it Adds Last Touch of Realism to Screen," *Popular Mechanics*, December 1923, no. 6, 879, Google Books: LNoDAAAAMBAJ.

[49] Ibid., 878.

But the article also shows what is furthermore needed to apply the technical concepts of Dawn within the structures of feature film production. One given example is the main set of *The Hunchback of Notre Dame* (Wallace Worsley, 1923). In order to show the entrance and forecourt of the cathedral only the front is built to a height just above the main doors of the cathedral. The rest of the edifice with its towers is added as a miniature placed between the camera and the partial facade. This practice, which was to last for decades to come, differs from Dawn's own approach as he started out with a given scenery and reworked it only by means of optical effects.[50] He, thereby, underestimates the relevance of physical site construction for motion picture crew and cast. While the adherence to sets might be seen as hanging on to traditions, the studios also advance the glass shot by using two planes (one after another) of which one is moved during the exposure. The additional glass is to animate long shots with moving objects like ships or clouds. The time, as mentioned earlier in the article, therefore, is not needed to develop a new technique but to integrate perfectly working processes into established production practices.[51]

The second aftermath of the Dawn conflict is that the industry establishes structures to cope with such interferences. A central role here plays the MPPDA or later Hays Office—best known for its guidelines for self-censorship established in the 1930s. The policy of the MPPDA regarding patents will be described on the basis of another example later.

The fact that Dawn himself falls in disgrace is one reason why he is not remembered as the main originator of the technique. Another reason is the decisive article by East Coast attorney Hineline, which appears ten years later and is based on the author's patent research. The only patent Dawn ever applied for is the one for his later original negative matte process. This is acknowledged by Hineline and others who take him as a reference. The glass shot or more general the method of placing static artifacts between camera and scene becomes a practice without originator. Instead it is characterized as something that was *improved* by Walter L. Hall as depicted in his patent filed in December 1918.

The Hall patent names several related intentions that it claims to fulfill. In general it aims at "producing pictures in which the natural and the artificial are combined so as to make a scene appear to have been taken in a different place or at a different time than is actually the case."[52] Hall generally calls the artifacts that will be integrated into the pictures miniatures. But, as Hoffman has pointed, this term until the 1920s covers all kind of scaled down substitutes—may they be painted, drawn, or built as objects.[53] Like with Dawn's glass shot technique Hall's miniatures are positioned between the camera and the real scene.[54] What distinguishes the Hall method is that the miniature is not produced on location but in the artist's studio based on a photograph taken as a first step. The production of the miniature is separated from the production of the combination shot. Miniature, camera and scene

50 Unlike other techniques, glass shots could be easily used when color cinematography takes hold. Cf. Edwin G. Linden, "Glass Shots in Color," *IP* 8, no. 4 (May 1936): 22

51 The first example depicted is a set at MGM Studios, as it is also featured in a short studio tour film made two years later. As Dawn actually works for MGM in the early 1920s, one can assume that either he or his successor Earle is in charge of the anonymously presented glass shot in *Popular Mechanics*.

52 Walter L. Hall, Method of Making Pictures (Patent 1,372,811 [US], filed December 23, 1918, and issued March 29, 1921), 1, Google Patents: US1372811.

53 See Hoffman, "The Discourse of 'Special Effects' Cinematography in the Silent American Cinema," 48.

54 Turner points to the fact that Edward G. Rogers in England successfully made glass shots as early as 1912. This possibly inspired his fellow countryman Hall to work on that methods. See George E. Turner, "The Evolution of Special Visual Effects," in Dunn and Turner, *The ASC Treasury of Visual Effects*, 27

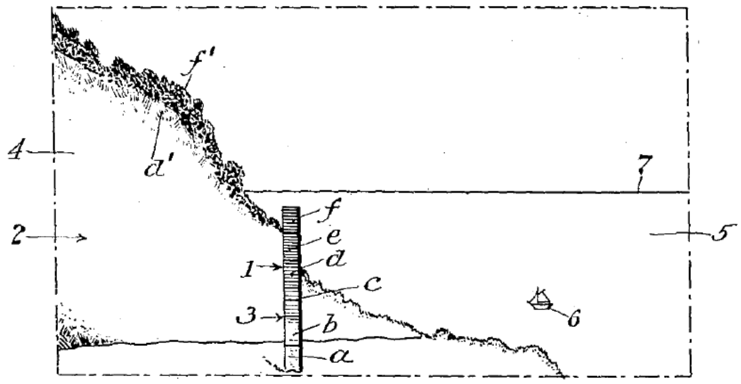


Fig. 3.6: Walter L. Hall, *Method of Making Pictures*, US Patent 1,372,811, filed December 23, 1918. Item 1 is a test pattern of arbitrary shape with different shades as references for the miniature.

then have to be realigned for final photography. The challenge to produce a coherent perspective at this stage is not seen as problematic. Hall's text rather focuses on the question of how to produce a miniature that matches the given scenery. The initial photograph contains already an artificial object, a test pattern with distinct shades and distances between them (fig. 3.6). This way the artist later has a reference that helps him to choose matching shades and sizes for the miniature. Additionally a grid of vertical and horizontal lines is drawn on the photograph just as the vanishing point and its lines.

While having similar aims, Hall and Dawn take different approaches to achieve them. As can be seen in Dawn's auto-historiographic illustration (fig. 3.3), he assumes that the motive he wants to photograph actually exists though not in the state he expects it to look like. The roof of the depicted building is not in its preferred state and the building itself is partly hidden behind electricity poles. Dawn now only draws trees and other embellishments to cover up what he does not want in the picture. Hall starts from the other end. He selects an almost devoid scene and constructs his own world aided by linear perspective (fig. 3.7). Of course virtually the same results can be achieved with both techniques but the illustrations Dawn and Hall choose to explain them exemplify their different approaches. The first one's approach comes from photography and the practice of retouching, the latter one's from fine arts. This shows that there is not a single origin of optical effects.

Despite the esteem Hall sees in the 1930s he soon falls into oblivion when it comes to glass shots. As a matter of fact, today he is remembered primarily as one of the first art directors—namely for Griffith's *Intolerance* (1916).[55] This connection is not an incident. Theisen writes that Hall actually begins working on his method during the production of *Intolerance* but only uses it in around 1920 in films by Cecil B. DeMille.[56] Hall's background in fine arts explains his approach to combination photography. The images are built up the same way like the detailed drawings he makes for the *Intolerance* sets. Hall prepares these drawings/paintings on compo board as he writes in the patent and cuts away the void parts that are then filled by the actual scene. (This is the same method that Earle uses though it looks like he has a higher share portion of painting.) Just as the patent is not

[55] For a personal account of Hall's contribution to the film see Karl Brown and Kevin Brownlow, *Adventures with D. W. Griffith* (London: Faber & Faber, 1988), 150-154.

[56] Earl Theisen, "In the Realm of Tricks and Illusions," *IP* 6, no. 5 (June 1934): Unfortunately no trick work was found in the respective movies by DeMille. Earl Theisen, "The Evolution of the Motion Picture Story. Part II," *IP* 8, no. 4 (May 1936): 12–13, 27.

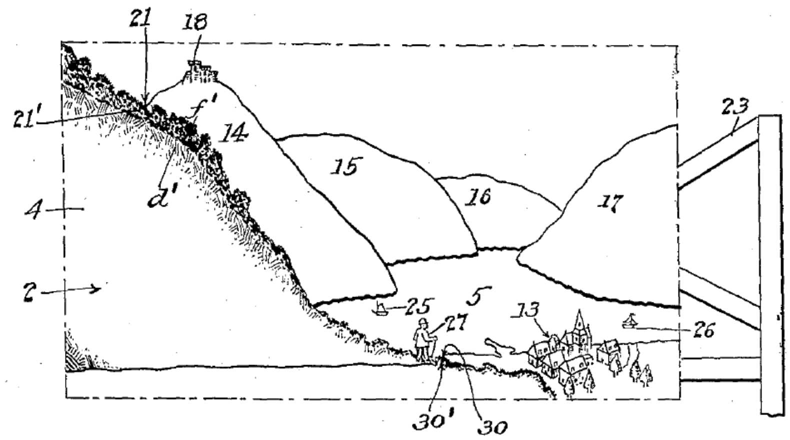


Fig. 3.7: Walter L. Hall, *Method of Making Pictures*, US Patent 1,372,811, filed December 23, 1918. Final camera view with artificial items (13-18), actual vessels (25, 26), and an actor (27).

limited to a specific imaging technique it also covers more image carriers. But Hall tries to avoid the term glass and names the alternative to compo board simply a “transparent panel.”[57]

In 1925 *Ben-Hur*, the Douglas Fairbanks production on which Ferdinand P. Earle worked, shows the entire spectrum of scaled artifacts that replace or extend actual scenery. This includes unmasked double exposure with painting and animations that feature reserved voids for the actors (figs. 3.8a and 3.8b). In another shot a matte painting shows giant rock walls throning over the so called valley of lepers. Before a character on her way to the valley is seen in a medium close shot in front of a painting on stage (figs. 3.8c and 3.8d). But most notable are the model miniatures as in one shot where an edifice collapses over a crowd (fig. 3.8f). The fact that in all these cases the camera does not move and the shots feel accordingly static contributes more to the impression of watching a painting than the fact that the sceneries are painted itself. The site for the famous chariot race is in part realized with hanging miniatures. Unlike composites with flat miniatures in these scenes the camera can move to a certain degree. The sequence begins with a tracking shot into the arena. At the end of that movement the camera pans upward and the extent of the entire structure becomes apparent (fig. 3.8e).[58]

While techniques of physical matting (glass shots, hanging miniatures) have obtained acceptance as production practices with *Ben-Hur*, concerns regarding proprietorship no longer intrigue the industry alone. Pierre Artigue, a cartoonist and newspaper artist, tries to gain access to Hollywood as an art director for an independent production and sees similarities between glass shots and his already existing patent for *Means for Producing Animated Shadowgraphs* from 1918 that covers “projecting shadows of persons, animals, or other objects on a suitable screen and then photographing said shadows while in motion with a moving picture camera.”[59] In February 1925, therefore, he first sues Paul Cosgrove and Paul Grimm, two individuals who take similar positions at the periphery of the industry as his own, and later that year First National’s Oscar Hammeras—basically days after the latter has received his own patent for glass shots.[60] In 1926 Artigue files a bill of complaint

57 Hall, Method of Making Pictures, Patent 1,372,811 [US], 1.
58 See Kevin Brownlow, *The Parade’s Gone by …* (1968; London: Columbus, 1989), 392.
59 Pierre Artigue, Means for Producing Animated Shadowgraphs (Patent 1,263,355 [US], filed August 23, 1915, and issued April 16, 1918), 1, Google Patents: US1263355.
60 See “Charge Patent Infringement,” *Variety*, February 25, 1925, “News from the Dailies,” *Variety*, June 24, 1925,

Fig. 3.8: Image compositing techniques in *Ben-Hur* (1925)

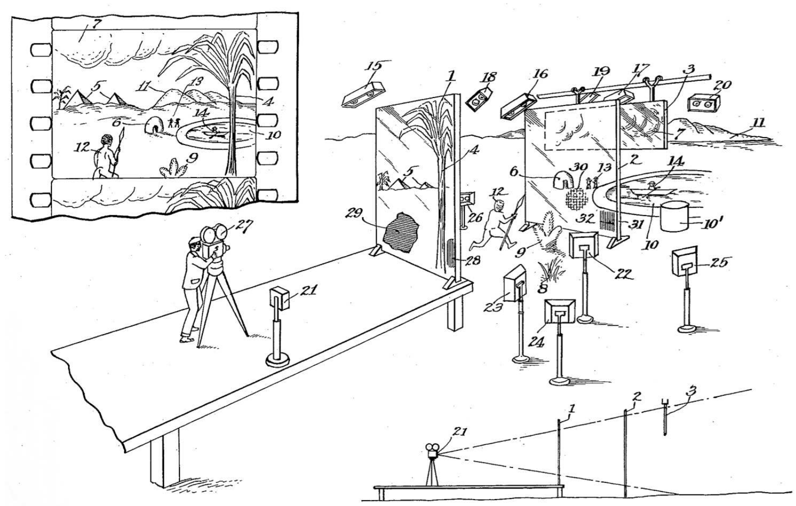


Fig. 3.9: Pierre Artigue, *Method of Making Motion Pictures*, US Patent 1,742,680, filed November 12, 1925. As Artigue cannot claim to be the inventor of the glass shot technique, he presents an increased (but in practice unfeasible) complexity of set-ups as an improvement.

against most major studio in Los Angeles pressing for compensations of initially $1 million and later $2.6 million based on what he estimates was saved in constructions through optical effects.[61] Hammeras at this time relocates from First National's studio at the East Coast to Burbank and sells his patent to an attorney—apparently to make it available to the industry as no further infringements in this matter are known.[62]

Artigue's claims feature two problems. First of all, the production of shadowgraphs was well know at the time when he filed his patent but Artigue argues to have improved the concept by drawing static objects on the screen and by filming the combination of both. The aim that is originally articulated in the patent is to automate the laborious process of animating shadows by drawing discrete images. Secondly, the technique has little to do with glass shots. At best it can be compared to animation stands or the much later established technique of rear projection. But Artigue has another patent application pending since 1923 that comes close to the techniques of Dawn and Hall and clearly targets movie production.[63] Artigue had moved from his home in Kansas to Los Angeles between his two applications and it is unclear if he developed the ideas on his own or witnessed them in Hollywood. As the second application is not yet accepted it is irrelevant for the proceedings. Accordingly, Artigue's pretenses are easily disputable and all cases are finally dismissed without prejudice.[64]

But the incident shows two phenomenons that seem to become relevant for the relationship of art and technique. First of all, while arts and crafts traditionally depended on and are protected by personal knowledge and talent, in an industrial and commercial environment like Hollywood knowledge in any form becomes vagrant and subject to legal arrangements.

61 See "Suit over Invention," *FD*, February 26, 1926, "Coast Suit on Patent Starts," *FD*, March 4, 1926, "Sues 8 Producers," *FD* 36, no. 63 (June 14, 1926).

62 See Hammeras, Method of Making Motion Pictures; "Hammeras in California," *FD* 38, no. 26 (October 31, 1926): 13; "Hammeras Sells Patent," *FD* 38, no. 78 (December 31, 1926): 1; Ralph Hammeras, untitled advertisement, in *The Film Year Book*, 9th ed. (New York: Film Daily, 1927), 286.

63 Pierre Artigue, Method and Apparatus for Producing Composite Motion Pictures (Patent 1,669,407 [US], filed October 2, 1923, and issued May 15, 1928), Google Patents: US1669407.

64 United States. Patent Office, *Official Gazette of the United States Patent Office*, vol. 395 (Washington, DC: The Office, June 17, 1930), 713, Handle: 2027/wu.89048465140.

Not only is a motion picture a commodity but also the technique to produce it. The patent attorney of Famous Players-Lasky and later Paramount, James T. Barkelow, under the impression of Artigue's first lawsuit composes a report on his investigations on patents in the motion picture industry. Barkelow had consulted another expert in Washington, DC who "stated a patent was nothing more or less than a license to sue as the Government specifically states they do not guarantee anything when they issue a patent."[65] Independent from Artigue's original intention in the context of the glass shot interference his patent, which likely never was applied, becomes an agent with questionable plausibility. It is followed by further patents Artigue applies for and that he receives that all seem to do hardly more than to paraphrase and distend the state of established practices.[66] The basic notion of distributing sceneries of actions into multiple planes and techniques is the common notion of all. This goes along with using central perspective to flatten and scale elements in one way ore another (fig. 3.9).

3.3 Frank D. Williams and the Emergence of the Traveling Matte

The person who actually provokes the discussion of the Dawley patent described earlier is Frank D. Williams, who with his company Patents Process, Inc., in October 1928 initiates a test case at the Federal Court of Los Angeles. An article in *Film Daily* quotes Williams as follows: "James Dawley applied for his patent in 1914. It is so far reaching in its claims that it practically anticipates all the developments in double exposure that have occurred in the intervening 14 years."[67] Williams himself holds a patent for one of the various new techniques he refers to here. And he explains further that he only regards his own patent as subordinate to the one of Dawley. For that reason he obtained an option to license Dawley's patent. The combination of both patents would not only protect him against potential lawsuits but also enable him to take action himself against competitors. A court decision in his favor would "affect printing, double exposure, imbibing or transferring by typing—in fact any process that involves superimposing or combining of motion picture photographs."[68] Therefore, the term 'double exposure' used here is no longer a technical one but covers the entire concept of image compositing. The resulting infringements according to Williams would amount to more than $5 million. Williams follows a different and more shrewd strategy than Artigue before him. The latter tried to sue Hollywood majors on the bases of a weak patent that he seeks to update while already in the middle of the litigation. Williams on the other hand attempts to combine his own, functional but scarcely exclusive patent with die dysfunctional but conceptually wide ranging one from Dawley.

Williams filed his own patent in May 1916.[69] The process he developed turns out to become one of the main compositing techniques of the 1920s and 1930s as it allows the combination of foreground action with moving backgrounds. But the method is rather an improvement

65 James T. Barkelow, *Report on Patent Matters*, typescript, MPPDA Digital Archive, April 25, 1925, 1.

66 Pierre Artigue, Method of Making Motion Pictures (Patent 1,742,680 [US], filed November 12, 1925, and issued January 7, 1930), Google Patents: US1742680; Pierre Artigue, Method of Making Motion Pictures (Patent 1,764,490 [US], filed November 12, 1925, and issued June 17, 1930), Google Patents: US1764490.

67 "Double Exposure Patent Test Case Planned," *FD* 46, no. 20 (October 23, 1928): 4.

68 Ibid.

69 Frank D. Williams, Method of Taking Motion Pictures (Patent 1,273,435 [US], filed May 22, 1916, and issued July 23, 1918), Google Patents: US1273435.

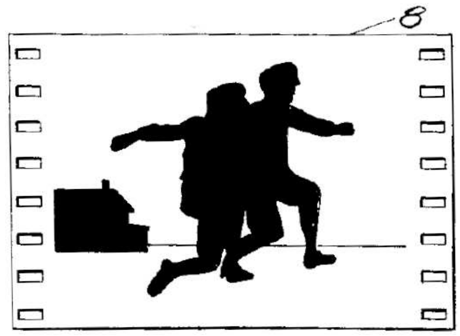


Fig. 3.10: Frank D. Williams, *Method of Taking Motion Pictures*, US Patent 1,273,435, filed May 22, 1916.

of other methods than an original concept. The Williams process is based on the technique to photograph actors against a black, non-reflecting background as it is well known in photography and motion pictures. The isolation of actors until then only had been used to produce ghost images through double exposure. In the Williams process the footage is printed on high contrast film stock in order to extract a matte and a counter matte that show foreground and background as transparent or opaque regions only. This procedure might require several print iterations but with the final paired mattes it is possible to print the isolated elements in combination with any other footage without the phantom effect of regular double exposure. As the mattes are complementary it is also possible to start with objects filmed against a white background in case they themselves are dark. Williams sums up his technique as follows:

> The primary feature of my invention is to mask a sensitive film with a silhouette showing the object to be produced thereon, projecting a background on the unmasked portion thereby producing a silhouette of the object in the unexposed film. Next the exposed portion of the surface is masked and a picture of the object projected in the silhouette. A film is thereby produced which when developed shows the object disposed in the background.[70]

In the patent he outlines two examples or applications. One is the familiar option to show an actor or actress at a place where he or she never has been. Williams points out that the final background might either be a motion or still picture. But virtual sets for him do more than just saving travel expenses. "By my invention, scenes such as the chaining of a woman to a track and her liberation therefrom at just the moment that the train running at high speed is about to bear down upon her, may be produced without actually placing the actors in such a dangerous position."[71] The described prototypical period scene first of all can be read as that of an actress in the studio with a processed background of an approaching train. But it is more ambiguous than that. One of the biggest problems of such blended sets is the ground they do not share. This is not a problem when actors travel in cars or airplanes as they do so often in process shots. But in this case the actress is literally chained to the tracks that connect her with the train. Her liberation, therefore, must also be understood as a symbolic act—with Williams as her savior.

He goes further with his another example, "a boy racing with himself,"[72] that seems to point to a predominant assignment for trick movie makers, the theme of actors playing double roles. It helps Williams to have a more open understanding of compositing as not

70 Ibid., 2.
71 Ibid., 1.
72 Ibid.

only a technique to combine fore- and background. In the example of the doubled boy he emphasizes that with regular split screen double exposure the spaces for the actors are if not fixed than at least distinct. Even if the invisible border between the doubles can be moved during the shot it never can be crossed. With his traveling matte the boys can overlap with each other. Only later in the text he returns to a confinement of compositing as mainly a displacement of studio actions. But Williams's conception is still much more extensive than just that because he thinks of what can be done and not of what is needed as a useful application.[73] Theisen writes that Williams started to work on the process in 1910 at the Essanay Studios. Initially he only managed to isolate silhouettes and print them as shadows on another image. The first subject he works on are camels walking through a desert. Two years later he is able to add an actual image.[74] But only while working with Mack Sennett from 1914 he manages to perfect his process using a Bell & Howell camera with registered pins that provides images that are stable enough to be combined in printing.[75]

In 1918 Williams leaves Sennett to work for the small studio of actor-producer Sessue Hayakawa. When Hayakawa is forced to close his company three years later, Williams advertises in a trade annual to offer his services (fig. 3.11). As it looks like this is the time when he really engages himself in process techniques. His original patent application from 1916 is now followed by several others. The first of these does not directly have to do with compositing but more general with image improvements. He attempts to adapt the retouching technique of photography to balance uneven exposure for the movies. What his patent foresees is a practice of contact printing with a camera (i.e., bi-packing) that uses a partly darkened screen to vary the light intensity for certain areas of the image. To be able to determine the areas that should be darkened beforehand, the film is projected a the screen and the overexposed areas are air brushed. Though the method may be used with any shot, Williams mentions trick photography as an area in need of the application.[76] Keeping in mind this method is an additional and lossy printing process, it is only advisable for in-camera trick shots where the control of exposure is especially difficult. Five years later a second, improved application follows that foresees background illumination of the screen and in general broadens Williams's claims.[77]

Just as these two patents are presented as aids for established process methods, a third patent addresses the problem that glass paintings executed on the set might bring good results as Williams argues but is too cumbersome. He suggests to transfer the production of the painted image to post-production where by means of projecting the original, party exposed shot a painting or drawing with fitting perspective can be made.[78] This process is quite similar to Norman O. Dawn's in-camera matte.[79] The difference lies in the fact with the process of Williams the composite is a dupe while Dawn uses the original camera negative.

73 We can also describe Williams' as pre-modern and his ontological homogeneity only returns with postmodernity of the moving image. An example that comes to mind here is Zbigniew Rybczyński's short film *Tango* (1980).

74 This is the date that Williams himself gives as a starting point for his process work. See Theisen, "In the Realm of Tricks and Illusions," 8

75 See ibid.

76 Frank D. Williams, Method of Printing Motion Pictures (Patent 1,464,054 [US], filed July 20, 1922, and issued August 7, 1923), Google Patents: US1464054.

77 Frank D. Williams, Process of Printing Motion Pictures (Patent 1,861,515 [US], filed April 18, 1927, and issued June 7, 1932), Google Patents: US1861515.

78 Frank D. Williams, Method of Motion-Picture Composition (Patent 1,589,731 [US], filed March 8, 1924, and issued June 22, 1926), Google Patents: US1589731; Re-issued as Frank D. Williams, Method of Motion-Picture Composition (Patent Re. 17,330 [US], filed March 8, 1924, and issued June 18, 1929), Google Patents: USRe17330.

79 Dawn, Cinematographic-Picture Composition.

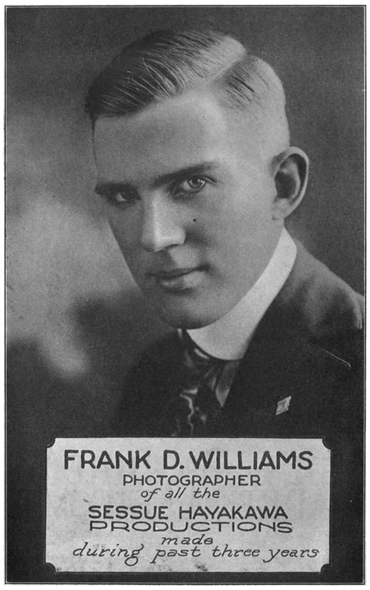


Fig. 3.11: Advertisement of Frank D. Williams in Lilian R. Gale, ed., *Motion Picture Studio Directory and Trade Annual 1921* (Motion Picture News, 1921), 138

The latter method secures best quality by avoiding extra printing steps but bears the risk of ruining the original negative. These additional patents by Williams are not self-sufficient but rather variations of established practices. It is doubtful if they really bring improvements. But they document his ambition to establish himself as a process cinematographer after the end of his work with Hayakawa and they protect him in his work because they cover most of the effects needed at that time. This means that he even might use Dawn's in-camera matte for the sake of better quality but in case of possible charges can refer to his own patented method.

Likely, the first commercial use of the Williams process occurs in *Beyond the Rocks* (1922) by director Sam Wood and the only collaboration between silent era stars Gloria Swanson and Rudolph Valentino. The Williams process is used in two scenes—one long shot showing a group of people getting on a car in an alpine landscape and a medium shot showing the same group getting off a car and buying flowers in front of the Jardin des Tuileries in Versailles (fig. 3.12).[80] In the Versailles shot there is a significant quality gap between the foreground and the background. The image of the building lacks gradations being mostly plain white. The better quality of the alpine background shows that this defect is probably not caused by the Williams process itself but due to a degraded background plate. But what stands out is that while Gloria Swanson's garment is entirely white the older lady who sells flowers is dressed in black. If the process was applied as described in Williams's patent with a black or white background, either of the women would have to disappear. An actual photographic background on the set can be rejected as an option because the relationship between the image elements is shaky. The light soil on the set finally suggests a black background but, nonetheless, the matte could not the generated automatically as promised by Williams. Therefore, neither the patent nor the image itself can explain the production process.

Later that year another movie that utilizes the Williams process is released: *Manslaughter* by Cecil B. DeMille. The director, who is known for his style of excess, uses the possibilities of compositing in a much more direct way. The very first scene shows the heroine of the movie speeding with her cabriolet and a police man chasing her on his motorcycle. What makes the sidewise close-ups of the woman driver dramatic is the feeling of speed caused

[80] The movie also features an elaborate glass shot with mountaineers in the would-be Tyrolean Alps.

Fig. 3.12: *Beyond the Rocks* (1922)

by the flagging cloths and the horizontal motion blur of the background (fig. 3.13). The cloth of the actress with their high contrast feature a similar problem as the Versailles scene in *Beyond the Rocks*. The changing of light and dark tones prevents any automatic extraction of a matte based on gradation differences. Around the driver one can identify dark and light edges that indicate an imperfect matte. As both types of lines occur on opposite sides of the foreground figure, the reason for this should be a shifting between the counter mattes. In the flagging of her scarf parts are visible that are darker than they should be. It therefore is likely that the mattes were touched-up manually as the foreground did not show clearly against the neutral backdrop.[81] This kind of inconsistency can also be observed from one shot to another when the steering wheel of the car is rendered half transparent like in straight double exposure or striking dark respectively.

Aside from such technical shortcomings, *Manslaughter* demonstrates impressively the ability of the Williams process to use moving backgrounds. The separation of foreground and background not only allows for the assemblage of different locations, views, and/or points in time but also of different speeds. The handbook edited by Carl Louis Gregory describes the possibility to show a man "running along a street at the rate of a hundred miles an hour."[82] Gregory's textbook already in 1920 actually details a process very similar to the one by Williams—without giving it a specific name. In the given example an airship is supposed to sail up New York's Fifth Avenue. Independently the actual street and a gray miniature airship against a white background are filmed. The airship negative is developed and a dark print is made from it showing a virtually black airship on transparent ground that works as a matte. The background negative is printed in contact with the foreground matte. Finally, the airship negative (with its black background as an embedded mask) is printed on the same film stock.

> The result will be a perfect illusion. Every detail of the ship will show clearly and there will be no visionary effect since the print of the airship was run through the printing machine with the negative of Fifth Avenue and this served as a mask

[81] Williams and others later admit that the finishing of the mattes was usually a tedious and expensive work to do.
[82] Gregory, *A Condensed Course in Motion Picture Photography*, 284.

(a)

(b)

Fig. 3.13: *Manslaughter* (1922)

> and left a clear space which the final negative of the airship followed identically. Every rope and spar will automatically find its proper place on the masked film and imprint itself there.[83]

It has to be noted that the method described here—two years after the publication of Williams's patent but also two years before its successful commercial implementation—goes without a counter mask and, therefore, suggests a process that is easier to handle with better results. Looking at other films of that period one can further put the Williams process in perspective. The Mack Sennett comedy *Astray from the Steerage* (Frank Powell, 1921) features scenes that can be compared to the ones mentioned above. The movie is about an immigrant family that arrives in the USA and gets mixed up with a whiskey smuggler. When the immigrant undergoes a physical examination, he is placed on a rotating chair. The scene, which is all about assessment as a means of socioeconomic integration, escalates when we first see the experimentee's point of view in rotation and then a composite image showing him in front of a spinning wall (fig. 3.14a). He is only dressed with shorts and shoes. His body—pale, flat, and white—is superimposed in an unmasked double exposure as can be seen when the background shows through the dark trousers. In a later scene the immigrant tries to keep together the family luggage on the loading area of a pickup (fig. 3.14b). Camera and car seem to be stationary while the landscape behind flies by. Neither edges nor transparencies can be observed that would point to a traveling matte process. The scene was likely produced with a cyclorama, a revolving painting, on the set but no technique whatsoever is evident in this case.[84] What is more important is that the two examples from *Astray from the Steerage* show that the Williams process, being the first technique to produce real composite images with motion picture background, can resort to an aesthetic practice that precedes it. The technical flaws it still shows appear as a gradual improvement towards older techniques as double exposures that try to avoid visionary effects by choosing appropriate motives and by mechanical tricks as the cyclorama.

[83] Ibid.

[84] On the usage of the cyclorama at the Sennett Studio see Hilde D'haeyere, "Stopping the Show: Film Photography in Mack Sennett Slapstick Comedies (1917-1933)" (PhD diss., Ghent University, 2012), 175-77, Handle: 1854/LU-3030507

(a) (b)

Fig. 3.14: *Astray from the Steerage* (1921)

The Thief of Bagdad (1924) is sometimes cited to feature shots done with the Williams process.[85] This lavish swashbuckler adventure has to be looked upon as a work not only by director Raoul Walsh and actor-producer Douglas Fairbanks but also by William Cameron Menzies who designed the giant sets and can be considered to be the first professional art director in Hollywood. The influence of Menzies on the movie shows to advantage with his aspiration to not only tell a story but also to bring a world into being. With its budget of $2 million, mostly spent for the sets of enormous size and large crowd scenes, the production has all means to use any optical effect desired and available. All this supports the assumption that *The Thief of Bagdad* makes the ideal project for Williams process shots as the most recently emerged and most advanced technique of the time.

One of the trials Fairbanks' nameless thief has to pass is the fight against a dragon. The "Valley of the Monsters," where the fight takes place, is a dark location, which is shown first in an extreme long shot. A tiny thief enters from left, walking in front of dark big rocks. From the right something moves in that first neither the thief nor we can recognize. In a medium shot we see the hero starring and pulling his sword. The next medium shot shows the dragon in a mixture of self-emissive steam and gleam and much lighter than its surrounding. In the following shots either the dragon or the thief are 'glowing.' If they do not appear in a shared shot, their linkage is maintained through gazes, protective gestures of the thief, and the steam of the monster that finds its way into his shots. Several times he rams his sword into the beast's head until he finally—in an isolated shot of the beast's throat—can cut into the same. It is the only time that the camera leaves its frontal perspective. The otherwise permanent flatness of the scene adds to the impressions of seeing something staged maybe even more than the inconsistent lighting of the opponents and the setting. Whenever the thief is doubled in, the shading of his image is reduced and the gain increased. The dark and shallow backgrounds and the light appearance of the thief make a Williams needless in this case.

Another motif that requires some kind of process are the flight scenes either with a flying carpet or a Pegasus. In the Pegasus shots whenever clouds and foreground action meet, the clouds do lighten horse and rider. But this might also be read as embedding the action in the clouds and not only using the sky as a backdrop. This also corresponds with other images of the film that show superimposed flames, explosions, and clouds. These are phenomena that due to their partial transparency are difficult to matte and at the same time work well as overlays. The shots with the flying carpets are different in several regards. While the

[85] See e.g. Orville Goldner and George Turner, *The Making of King Kong: The Story Behind a Film Classic* (South Brunswick, NJ: A. S. Barnes, 1975), 99.

Fig. 3.15: Flying carpet on the set of *The Thief of Bagdad* (1924).

Pegasus scene plays at night the two occurrences of the flying carpet take place in a light day sky. When towards the finale of the movie the three contesting princes rush back on the flying carpet to Baghdad to safe the poisoned princess, we see them high in the sky above vague terrain. The position of the carpet within the image is static while the landscape flies by in a swish pan. The white clouds hardly render against the light sky and the overall blur of the background nearly conceals that it is in fact repeating every 1.5 second. The restart of this tiny loop is not even hidden by a fast lap dissolve. It is enough to see the carpet fringes and passengers' garments flapping in the wind to deploy the narrative. Clouds and figures seem to merge in a similar way as in the flight of the Pegasus. The lights and shadows in both shots blend differently. In the night shot the lights add up while they are subtracted in the daytime. This means that the footage in one case was combined by double exposure while in the other the two negatives were combined by double printing. Mattes were not involved in both cases.

Technically the most complex scene is the departure of thief and princess, which ends the movie. They run through the palace reduced to superimposed feet that find their way to the magic carpet. The following series of shots show the carpet elevating inside the palace, flying amid the applause of the crowd and between the towers on which it drops a floating shadow, and finally vanishing into the night sky. The sequence consists of various techniques like mere miniature shots, hanging miniatures combined with sets and extras, and—as production photos show—a flying or rather hanging carpet elevated to an impressive height (fig. 3.15). Only one shot sets itself apart as it could not be done with one of the above mentioned techniques. It shows a top view of the couple on the carpet flying over the crowd. A traveling matte must have been used in this case as both image layers show real actors while they do not posses any kind of transparencies as they would derive from simple double exposure. Presumably this is the only shot in the entire movie that actually uses the Williams process. This can either mean that the more traditional processes are regarded as satisfying in most cases or that the Williams process is still too intricate to apply it on a more regular basis.

While in the early 1920s all descriptions of the Williams process depict a technique that delivers convincing results with reasonable efforts, the application seems to be limited as *The Thief of Bagdad* shows. The movie has the need and the budget for such a process but still draws on older, much simpler techniques in most cases. Just a few years later even the

Fig. 3.16: Filming the flying carpet for *The Thief of Bagdad* (1924).

inventor himself gives a detailed account of the drawbacks that come with his method. As with all kinds of double exposure there is the problem of timing. The actions captured in multiple takes have to look later as if they had happened simultaneously. Williams mentions that "rehearsing of the action against the background is necessary" but it remains unclear whether the projection of background keys was a regular practice.[86] The second problem, which is more specif, is the insufficiently precise registration of the film. While with straight shots a slight tremble is acceptable, it easily can spoil illusions when image elements jiggle independently from each other. Two ways to overcome this are by improving the film movement mechanism and the film base so that it does not shrink after exposure. Shrinkage even at the end of the 1920s is still one of the major problems of process work and leads to discussions on whether it might be better to store film stock for a certain time and only perforate it right before usage.[87]

The need to print sometimes multiple generations of a shot in order to secure a clean matte has the side effect that silhouettes might spread and no longer fit the edges of the actors. In any case, it is rare that the traveling mattes are really as self-matting as intended. When the process is discussed a few years later in Germany the disadvantages of the Williams process are undisputed. The editor of the trade journal *Kinotechnik*, Leopold Kutzleb, writes: "Lets take as an extreme example a foreground scene against the black wall consisting of a clown dressed with costume of black and white plaid. How is one supposed to extract a matte from such a negative that renders the figure transparent on the ground or vice versa respectively?"[88] And while Kutzleb awards to Williams to have personally developed a virtuosity in the required microscopic touch-ups, the latter himself, already in 1928, admits that in general he is not doing the corrections himself. "This hand work is done by girls."[89] Williams names two methods to fix improper mattes that are both known from photography—i.e., to touch-up the film strip itself under a microscope or to work with enlarged paper prints of all frames. Barry Salt in his critique of the Williams process suggests that none of the two improvement methods were used but that the mattes were produced entirely by hand.

[86] See Frank D. Williams, "Trick Photography," *TSMPE* 12, no. 34 (April 1928): 538.
[87] See ibid., 539.
[88] Leopold Kutzleb, "Der gegenwärtige Stand der Bildkombinationsverfahren," *Kinotechnik* 15, no. 6 (March 20, 1933): 100-101.
[89] Williams, "Trick Photography," 538.

> It has been said by people actually working in the 'twenties that what was actually done by the operators of the Williams process was to rotoscope (project frame by frame) the negative of the foreground action onto a series of large sheets of paper on which counter-silhouettes were painted by hand around the changing outlines of the moving figures on every frame, and then to refilm these hand-painted mattes frame by frame onto positive film stock which was given high contrast development.[90]

But however capably applied, any of these methods proves to be laborious enough to work on improvements. And when Williams presents these a few years later, he admits that with the original process it took between one and six weeks to finish a single scene.[91] After all, the practice of manual touch up does explain why actors could wear costumes with high contrasts, as in the flying carpet scene described above, that hardly can self-matte against either light or dark backgrounds.

In his effort for diversification Williams in 1928 files one more patent that shows another possible use of projection. While the previous patent practices feature projection as an aid to create instruments for image modification (fitting paintings, traveling mattes), here he shows projection as a method of printing the film itself that replaces the regular contact printing. The projection may be from front or rear on a semi-transparent screen. Bi-packed masks can be used in the projector and camera as much as multiple projectors are possible a the same time.[92] This patent is remarkable as it pursues the previous ideas of projection and somehow anticipates the practices of rear projection and projection printing of the 1930s. But it does not address any of the technical issues—like synchronization of projector and camera or screen material—that will be relevant in these fields (p. 117). This raises questions concerning the practicalness of the method at least at the time when Williams files the patent.

3.4 Duplication and Panchromatic Film Stocks

Until the mid-1920s motion picture production uses basically two types of film stock that are defined by their functions as camera negative and print positive. With these functions come specific characteristics. A camera negative is required to have high speed and latitude and low contrast and gamma. The positive film stock does not have to be as fast and, therefore, can feature finer grain to reduce loss of quality when the film is printed. As the exposure can be controlled better in the lab than on location the latitude of the film can be exploited for higher contrast and gamma. Typically the gamma of camera negative is about 0.6 and that of print positive between 2.0 and 2.5. Both together result in an ideal gamma of 1.3 to 1.5 for the theatrical print.[93]

---

90 Salt, *Film Style and Technology*, 188.

91 See Frank D. Williams, "Inventor Describes New Process," *IP* 4, no. 8 (September 1932): 10.

92 Frank D. Williams, Picture Process (Patent 1,827,924 [US], filed April 9, 1928, and issued October 20, 1931), Google Patents: US1827924.

93 See C. E. Kenneth Mees, "History of Professional Black-and-White Motion-Picture Film," *JSMPTE* 63, no. 4 (October 1954): 135; Paul Read, "A Short History of Cinema Film Post-Production: A Summary as the Basis for Future Research," in *Zur Geschichte des Filmkopierwerks – A Short History of Cinema Film Post-Production*, ed. Joachim Polzer, vol. 8, Weltwunder der Kinematographie. Beiträge zu einer Kulturgeschichte der Filmtechnik (Potsdam: Polzer, 2006), 69.

This layout proves suitable for most production practices until the mid-1920s. A film is recorded on camera negative stock and then copied by means of a step or later continuous contact printer. Editing is often done with the positive film only and has to be repeated with each and every projection print. This practice was feasible while motion pictures were short and the montage simple. Variations between individual projection prints are inevitable but also bring along advantages. Positive editing allows for the easy replacement of intertitles in other languages. Local censorship can be executed literally with a pair of scissors. And finally the common practice of tinting (and more rarely the costly toning) has to be done with the single scenes of every projection print. Alternatively film stock is available with an already tinted base that would be combined for different scenes. Positive editing here is compulsory in both cases.[94]

But the two film stocks do not offer an easy way to make intermediate prints that are needed for most optical effect techniques. When photographic images are copied they change and these changes in gradation and grain result in a loss of image quality. Furthermore, as a photographic copy is inverted, an additional identical print requires two generations of reproduction. This means a second negative needs an intermediate positive first. This is one reason why early effects are mainly done with the camera negative inside the camera by rewinding and double exposure. Neither camera negative nor print positive are suitable film stocks for intermediate prints mainly because they do not offer the option to retained constant gamma and contrast. Paul Read reports that it was common practice though to make a master positive from the camera negative on print positive stock with increased exposure and reduced developing time in order to decrease the gamma from 2.5 to 2.0. Then a duplicate negative was made (gamma 0.6) and a regular positive print (gamma 2.5). The resulting projection print had a gamma of 1.8 and a correspondingly high contrast.[95] Presumably, the figures were slightly different in Hollywood due to the usage of Kodak Eastman film stocks.[96] Eastman's Type 1301 features a lower gamma of 2.0 and is the standard positive print stock from its introduction in 1916 until 1940. The usual negative film stock at this time is Type 1201, an orthochromatic film stock used since 1917. (The type numbers are introduced as a result of Eastman Kodak's diversification in the mid-1920s.[97])

At the end of 1926 Eastman Kodak answers an increased demand for additional prints for protection purposes and international distribution with the introduction of a third type of film stock intended for 'neutral' copies, called Eastman Type 1503 Duplicating Film. Loyd Jones and his team in Rochester initially try to draw on the established laboratory practices and find developers—or developer conditions—that would lead to a positive prints with lower gamma. But beside of the problem that the contrast could not be reduced to a neutral level, the changed development practice has other side effects. One is the so called Eberhard effect (named after the Danish astronomer) and the Mackie effect that both causes artifacts at the border between areas of low and high densities. As a consequence, Eastman Kodak designs a high quality film stock that with regular development

94 See Mees, "History of Professional Black-and-White Motion-Picture Film"; Paolo Cherchi Usai, "The Color of Nitrate: Some Factual Observations on Tinting and Toning Manuals for Silent Films," in "Spring/Summer," *Image* 34, nos. 1-2 (1991): 29–38; Paul Read, "'Unnatural Colours': An Introduction to Colouring Techniques in Silent Era Movies," *Film History* 21, no. 1 (2009): 7–46, JSTOR: 27670755; Barbara Flückiger, "Timeline of Historical Film Colors," http://zauberklang.ch/filmcolors/.

95 See Read, "A Short History of Cinema Film Post-Production," 70.

96 I am concentrating on Eastman Kodak here as the company not only dominates the film stock market in the studio era but also drives the technical development. Other companies often usually are adrift by about a year.

97 See Mees, "History of Professional Black-and-White Motion-Picture Film."

processes features a gamma of 1.0 and very fine grain. The speed is only about 1/20 of that of regular film but this drawback can be compensated with light condenser systems and increased exposure times.

Beside of increased contrast and grain duplication prints also suffer from scattered light within the film base. The 1503 Duplicating Film allays that problem by combining its orthochromatic emulsion with a yellow dye coating that neutralizes irradiation and also contributes to the reduction of contrast. The dye is washed out later so that the prints are colorless. Color filters can also be used to control the contrast—violet to reduce and yellow to increase it. This is how the new film stock is represented by Kodak Eastman employees at a SMPE meeting and later in the Society's *Transactions*.[98] In a subsequently published brochure it becomes also evident how the company intends to sell its new product. By naming the well known side effects of the practices developed in the laboratories to make duplication prints, Kodak presents the film stock as a clear alternative to them and the existing needs they derive from.

The company claims that from its new film stock prints can be made that are virtually identical with those from original negatives and that are without degradations. In a subsequent article Eastman Kodak employees vividly demonstrate this claim by suggesting a straightforward test to verify correct reproduction: "A simple method of comparing the contrast of the master positive and the original negative is to superpose identical frames of each. If the two images are entirely blotted out, it means that the contrast of the two images is exactly equal."[99] Aiming at a much bigger market than that of optical effects work, Kodak suggests to make backup prints of every original negative. Furthermore it is praised that the film stock is ideal for allover image corrections. Shots that are over- or underexposed can be improved with duplicate negatives that can be used for an edited negative master.[100] While Kodak essentially only responds to established practices with the new film stock, the company sustainably changes film production as the duplication film finally makes so called dupes feasible. Before production companies often worked with multiple negatives to be able to send a second one for the European market. The task of the second cameraman was to copy in a subordinate position the images of the first one. Alternatively a scene was shot subsequently several times to have more than one negative. (This practice is shortly re-established with the introduction of sound when actors subsequently speak their lines phonetically in various languages.) With the homogeneous duplication negative the second cameraman and his negative become obsolete. Their previous function is translated into an automated process. Likewise, the option for negative editing empowers the consistent motion picture and post-production (a term that is only introduced in the 1980s) in its modern sense becomes possible. Type 1503 initially is used for the intermediate positive and duplication negative alike, but in 1929 Eastman Kodak introduces Type 1355 film stock for the duplicating positive. Another special negative duplicating film stock is presented in 1930 as Type 1510.[101]

A year after the first duplicating film stock panchromatic emulsions seem to supersede orthochromatic ones. Photographic film in its original state is only sensitive for light of wavelength from 400 to 530 nm (violet–blue–green). Yellow and red hues, therefore, do not register and are rendered dark on the final print, blue on the other hand leaves the highest impact and shows as white. Faces appear darker than they should, red lips turn

98 See J. G. Capstaff and M. W. Seymour, "Duplication of Motion Picture Negatives," *TSMPE* 10, no. 28 (1927): 223–29.
99 C. E. Ives and E. Huse, "Notes on Making Duplicate Negatives," *TSMPE* 12, no. 34 (April 1928): 384.
100 See Eastman Kodak Company, *Eastman Duplicating Film: Its Properties and Uses* (Rochester, January 1927).
101 Mees, "History of Professional Black-and-White Motion-Picture Film," 1936.

black, a blue sky with white clouds is rendered white in white. When it comes to actors these problems can be solved with special make-up and costumes. But this could only be an unsatisfying surrogate for an emulsion that renders light intensities of different colors in a similar way as the human eye. The strategy to expand the wavelength band then is to sensitize the emulsion chemically to further colors. The first step in this undertaking is orthochromatic film stock, which improves the rendering of green, and the final solution is panchromatic film stock, which also can display yellow and red hues (fig. 3.17). Panchromatic film stock had been available commercially since 1922 but around 1926/1927 Eastman Kodak is able to lower its price to that of orthochromatic film stock and explains the advantages of the product in an article in the *SMPE Transactions*.[102] In 1928 the product is finally sold as Type 1203 Negative Panchromatic I and supplemented with Type 1218 Negative Panchromatic II.[103] Just like with duplication film stock panchromatic emulsion had been on the wish list of filmmakers for a long time. In fact studio technicians made tests with self-sensitized film stocks to develop alternative production practices that required a wider range on colors to be registered. But a lack of image quality and the high expenditures prevented the commercial application.[104]

The development of negative film emulsions is highly interrelated with that of illumination as different kind of lights have different compounds of colors. Eastman Kodak employee Emery Huse describes this process a decade later in retrospect.

> It is difficult to state whether panchromatic film or tungsten lighting equipment first attracted the attention of the photographic world, since for years experimental research had been carried on in both fields, but it is interesting to note that both of them were brought forcibly to the attention of the motion picture industry during the latter part of 1927 and the early part of 1928. The real reason for this was due to the fact that the years of research in the two fields had reached a practical culmination at the approximately the some time and since each was partially dependent upon the other, it is not difficult to understand their almost simultaneous introduction to motion picture photography.[105]

Huse further explains that panchromatic film and incandescent light come with a third factor, the introduction of borax developer in 1929 that is considered “much less violent”[106] and delivers finer grain. The simultaneous change of light, film stock, and developer results in various adjustment problems for cameramen and laboratory technicians. The benefits from these technical improvements for that reason become only visible gradually over a period of several years.

Both duplication and panchromatic film stock are much more demanding when it comes to precision and repeatability in the laboratory. As panchromatic film stock is sensitive to red light that was used as working lights, laboratory practices have to be adjusted. Read suggests that most operations had to be relocated into dark environments—either dark rooms or light proof devices.[107] Jones and Crabtree who present the film stock as employees of Eastman Kodak on the other hand claim that it would be enough to reduce the light and

[102] Loyd A. Jones and J. I. Crabtree, “Panchromatic Negative Film for Motion Pictures,” *TSMPE* 10, no. 27 (January 1927): 131–78.
[103] See Mees, “History of Professional Black-and-White Motion-Picture Film,” 134.
[104] See e.g. a description of Fred Jackman to which I will come back later. *Affidavit of Fred Jackman*, document 3524B_F015997_002, April 1931, WBA
[105] Emery Huse, “The Characteristics of Eastman Motion Picture Negative Films,” *AC* 17, no. 5 (May 1936): 190.
[106] Ibid., 191.
[107] See Read, “A Short History of Cinema Film Post-Production.”

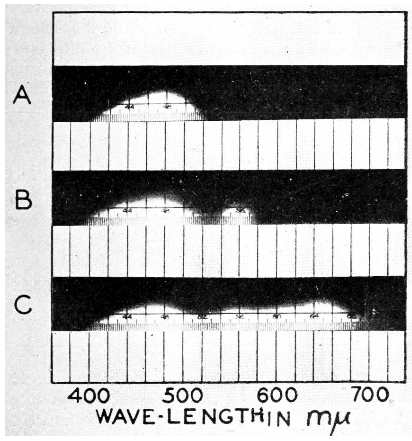


Fig. 3.17: Wedge spectrograms showing distribution of sensitivity for: (A) ordinary blue sensitive photographic material, (B) orthochromatic material, (C) panchromatic material.

change it from red to green.[108] By all means, the increased sensitivity of all new film stocks enforce a dissociation between humans and material. The development of orthochromatic film stock could be controlled by the human eye that watches the looming gradation in the red light. Now the eye is replaced by measuring equipment that performs sensitometric and density tests. Processing of the film with developing machines is favored over manual work for more uniform results. The handling of film stocks attains a new degree of precision that would help future process work just as the material itself. This unseen accuracy, which might be described as Hollywood's scientific turn, is often attributed to the concurrently beginning introduction of sound but should be seen as an integrated development that comes to an end around 1931 when sound practices are uniformly established and Eastman Kodak discontinues its orthochromatic film stock and introduces Type 1505 Duplicating Negative and the Type 1217 Supersensitive Panchromatic II.[109] On the occasion of introducing the latter, trick work for the first time is mentioned as a targeted application of a new emulsion.[110] The new film stocks are in several ways essential for optical effects at the end of the 1920s as we will see. But to understand this relation it is important to bring to mind that improved film stocks are crucial but only one of several factors that solve the problems—some of the others being better lighting, laboratory practices and materials, and in general an increased precision in the handling of film material.

3.5 Color-separation Processes

Motion picture processes are often based on those used in photography. The transfer in some cases (like double exposure) is straightforward, sometimes techniques need to be refined. German Hans Goetz works on separation and compositing in the domain of pho-

108 See Jones and Crabtree, "Panchromatic Negative Film for Motion Pictures," 171.

109 For a detailed account of period lab practices see Frank E. Garbutt, "Laboratory Technique for Sound Pictures," in *Recording Sound for Motion Pictures*, 1st ed., ed. Lester Cowan (New York: McGraw-Hill, 1931), 180–95.

110 See Emery Huse and Gordon A. Chambers, "Eastman Supersensitive Panchromatic Type Two Motion Picture Film," *IP* 3, no. 2 (March 1931): 5–6; Emery Huse and Gordon A. Chambers, "Eastman Supersensitive Motion Picture Negative Film," *Projection Engineering* 3, no. 12 (December 1931): 21–23.

tography but develops concepts that entail bridges to the requirements of process work in the movies. This connection can be studied well with the patents he starts to file first in 1913 in Germany and then in 1920 also in the UK.[111]

Goetz's question is how to generate a mask that allows to combine a photographic subject with a different background. The effect he takes advantage of is that negative and positive transparencies add up their complementary shades of gray to black if laid on each other. Goetz now suggests to make two photographs of the same subject, once with black and once with white background. The black background shows transparent on the negative while the white one renders opaque. A diapositive of the latter then will feature a transparent background. Combined with the first negative there will be two transparent backgrounds that add up just like that while the two complementary foregrounds result in a black silhouette, which can then be used as a mask. The alternating background here resolves the problem described earlier that objects with high contrasts will always results in imperfect masks (either with white or black background) that have to be touched up manually.

But the fact that two successive exposures are needed, not only makes the process unusable for motion pictures but also for the photography of moving objects. Goetz is aware of this and describes a second process that can be applied in both cases. The improvement foresees two cameras (either photographic or for motion pictures) placed next to each other for simultaneous exposures. Instead of white or black backgrounds now a colored backdrop is used. By means of complementary color filters in front of both lenses the background color is rendered different on the two negatives. In case of a red background red and green filters are required. The red filter allows the red light to pass through and produces a black background while the green filter blocks its complementary light. The negative in this case shows a transparent background. The resulting two negatives are the same as with the original process and the mask is done accordingly. Therefore, Goetz translates time—i.e., the interval that is needed to make two exposures with different backgrounds—into color—i.e., the difference between complementary hues.

It has to be pointed out that the two cameras (either still or motion) always will show slightly different views. While variations in framing and speed of the still hand-cranked movie cameras can be minimized, such a parallax remains an inherent problem for that Goetz has no solution yet. There is also no indication that the process is actually used for movie production at any time or place. Nor does it influence the technical development in Hollywood. The British patents that Goetz owns are only discussed here from 1927.[112] And as we will see, that is years after similar developments have started in Hollywood. It is not exactly clear for what reason different parties in the movie industry refer to Goetz and his patents. It is likely a mixture of different facts: the patents do not inhibit new developments as they are not valid in the USA; they discount any new claims for original inventions as they show an older usage of color-separation systems; and they are not functional for movie production and, therefore, give a chance for improvement initiatives. They somehow con-

---

111 Hans Goetz, Verfahren zur Herstellung photographischer Silhouetten (Patent 286,283 [DE], filed June 1, 1913, and issued November 4, 1922); Hans Goetz, Verfahren zur Herstellung photographischer Silhouetten (Patent 362,951 [DE], filed May 5, 1918, and issued November 4, 1922); Hans Goetz, A New or Improved Process of Producing Photographic Silhouettes (Patent 169,233 [GB], filed June 16, 1920, and issued September 16, 1921); Hans Goetz, Improvements in the Production of Photographic Silhouettes and Combination Photographs (Patent 147,621 [GB], filed July 8, 1920, and issued October 10, 1921).

112 See E. J. Wall, "Some Patents for Trick Photography," *TSMPE* 11, no. 30 (August 1927): 328–33; C. Dodge Dunning, "Composite Photography," *TSMPE* 12, no. 36 (September 1928): 975–79.

tribute to a situation that provides a certain space of action but that is difficult to trace and understand due to a lack of sources. But for us they make seizable one possible chain of translations that leads from photography to motion pictures.

3.5.1 The Dunning Process

Carroll H. Dunning, who is among those who state doubts on the legitimacy of the early Dawley patent in 1929, is not without own interests in this matter.[113] His son Dodge since two years then holds a patent that claims to solve just the same problems and is based on an invention that he supposedly made when he was only seventeen years old.[114] The identities of father and son regularly blend as they closely work together and the denomination of this process refers rather to family or company than to one of the two persons. Dunning Sr. was from 1917 until 1923 vice-president of the Prizma Corporation, the company that marketed a homonymous color system for motion pictures. This system (the later one of actually two) was developed by William Van Doren Kelley. Like all photographic color systems it is based on the two steps of color separation and recombination of single color channels. Kelley's Prizma Color utilizes the complementary colors cyan and orange. By means of color filters and a special camera these are recorded on two separate films that are later recombined by printing them on duplitized (or double-coated) film stock. The two sides of the film are toned in the two complementary colors to get a film that can be shown with any standard film projector.[115] This system is used for dozens of films until the mid 1920s but already in 1922 Kelley's color separation is also applied for stereoscopy or three-dimensional films. Instead of separating the light that is captured by one lens, now two lenses mimic human vision and with anaglyph glasses (well known in photography) create the illusion of stereoscopic moving images. Prizma II here already provides a flexibility in application that augurs the later translation by Dodge Dunning. The separation of complementary colors can either be used to reproduce a part of the full color spectrum or two different perspective that are need to see spatially.

Dodge Dunning (born 1907), therefore, grows up in an environment were he can witness the adaptability of optical procedures in general and techniques of color photography in particular. His invention greatly draws on the work of his father and Kelley's when he reinterprets the two color channels for not representing different domains of the color spectrum or discrete perspectives but associates them with separate layers of an image that no longer depict a real space but to a certain degree synthesizes a virtual one. So his answer to Dawley's concept and Williams's technique of distinction between fore- and background or action and scenery is to produce them by distinguished complementary colors. In an interview Carroll Dunning later suggests that he himself had worked on such a process but was not successful with it. The Dunning family actually moves to California when Prizma Color is outplayed by Technicolor and Carroll Dunning decides to retire. "I had forgotten all about my old experiment—which was an attempt to put living people into a painted garden and project it on the screen until a former associate of the old Prizma days

---

113 See Dunning, "Patents vs. Patents vs. Practice."

114 Carroll Dodge Dunning, Method of Producing Composite Photographs (Patent 1,613,163 [US], filed April 17, 1926, and issued January 4, 1927), Google Patents: US1613163; regarding the invention process see J. Eugene Chrisman, "What Isn't Possible?: Through the 'Dunning Process' Greta Garbo Could Play opposite Valentino," *Motion Picture* 40, no. 4 (November 1930): 30–31, 105.

115 See Robert A. Nowotny, *The Way of All Flesh Tones: A History of Color Motion Picture Processes, 1895-1929* (New York: Garland, 1983), 167-185; Barbara Flückiger, "Timeline of Historical Film Colors: Prizma II," http://zauberklang.ch/filmcolors/timeline-entry/1235/.

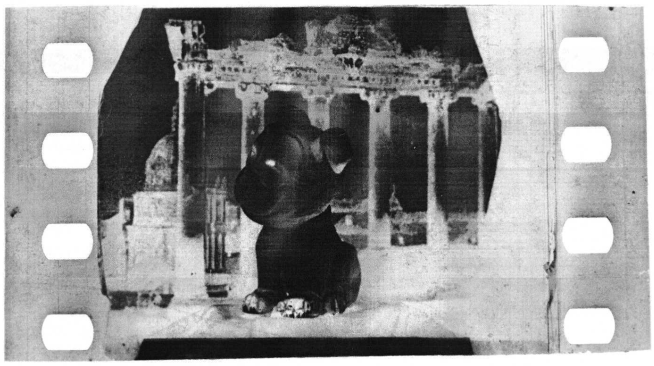


Fig. 3.18: A Dunning example from the Earl Theisen Collection. Though it does not show a little girl walking through the Roman Colosseum as described by Dunning Sr. in an interview, this negative frame with a pet in front of the Roman Forum might be from the experiments of young Dodge Dunning. The object in the foreground clearly stands out against the ruin in the background but is underexposed probably due to a disproportion of the lights.

recalled it to me. Dodge was with us at the time and that evening, after dinner, he said, 'Dad, that business you and Mr. Cadwallander were talking about to-day—I can do it.'"[116] Dodge starts with experiments and when he is able to let his little sister walk through the Roman Colosseum, his father organizes him a small lab at the Robertson-Cole Studios on Gower Street in Hollywood where he improves on the method. There are different statements regarding the first movie that actually uses the Dunning process. Once Carroll Dunning names *Lady Robinhood* (Ralph Ince, released July 26, 1925) and at another occasion *Silver Comes Through* (Lloyd Ingraham, released May 27, 1927).[117] Both movies are shot at the Robertson-Cole Studios and are apparently lost today.[118]

The process works as follows: A regular negative is taken from any kind of scenery or motive that shall be used as background. From this negative a positive is made which is dye-toned blue and tinted gray. That means that black parts of image are chemically substituted with blue color while white or transparent parts of the film are darkened to gray. This colorized film is then bi-packed in the film camera together with panchromatic raw stock. The prepared film with the colorized background covers the raw stock and, therefore, filters the light that exposes the latter. It basically replaces the color filters that Goetz suggested. The exposure now takes place on a stage prepared with a yellow background in front of which actors and objects are lighted with blue filters. In the example given in the patent the scenery is a landscape with a tree that stands out in dark grades against a light, transparent sky. The colorized transparency, therefore, shows a blue landscape with gray sky. When yellow light reflected from the stage background passes the transparency it is partially blocked by the blue, complementary colorized tree. The new negative here will show a light tree against an dark sky. For the blue light reflected by the actors the blue and

[116] Cited after Chrisman, "What Isn't Possible?," 30.

[117] See "Expansion With a Big 'E,'" *IP* 2, no. 1 (February 1930): 34–35; Chrisman, "What Isn't Possible?"

[118] Turner describes the scene from *Silver Comes Through* as follows: "It showed the beloved horse, Silver King, urged on by his rider, Fred Thomson, leaping over a moving train. So convincing was the scene that censorship boards were aroused against the producers for endangering the life of the horse (and, presumably, the actor)." Turner, "The Evolution of Special Visual Effects," 42

the gray of the transparency have the same effect. Therefore, the background will not be printed in these parts of the image and only the actors will be shown as if there was not filter at all.[119]

The Dunning process is a good example to show how the presentation of something that is technically stable changes over time. In September 1928 the twenty years old Dodge Dunning presents his technique at the fall convention of SMPE in Lake Placid, New York, and later publishes his text in the SMPE's *Transactions* and the ASC's *American Cinematographer*.[120] Dunning tries to relate his technique to those of Williams, Goetz, Handschiegl, Pomeroy, and Schüfftan. Eugen Schüfftan's mirror technique is easily excluded as a competitor because it does not include traveling mattes at all and resembles more the concept of Dawley. It requires sets and background that 'fit' (i.e., where specific areas of an image are allocated to actions) while self-matting should work with any background. But to distinguish Dunning from the others seems to be more difficult. Some processes also use a colored background to create a matte. But the resulting matte then has to be recombined with the foreground footage in an additional step while Dunning—and that should become a main argument for the process—gets a combined negative in one step only. "In all cases the producer sees the finished results on the screen the next morning, when he is reviewing the 'rushes' of the previous day."[121] Dunning also assures that the technique is already successfully applied and gives an example of background showing a miniature fleet that was recently shot with a high-speed camera. And he mentions one argument for separating fore- and background that is easily missed: it does not only create two visual but also two acoustic domains that can be produced independently. A scenery is possibly not only expensive to build, difficult to control, or simply too far away. It also can be too loud to permit satisfying recording of dialog in the foreground. In a later advertisement the Dunnings, therefore, offer "outdoor action backgrounds behind any intimate dialogue on the sound stage."[122] This likely is another reason that supports the development and application of image compositing in general since the late 1920s when film sound becomes mandatory.

In the following year Dunning Sr. takes a different approach when he presents the same process in the same two trade journals. His account is less technical and tries to call upon the heroic tradition of cameramen on their mission to create sensations.

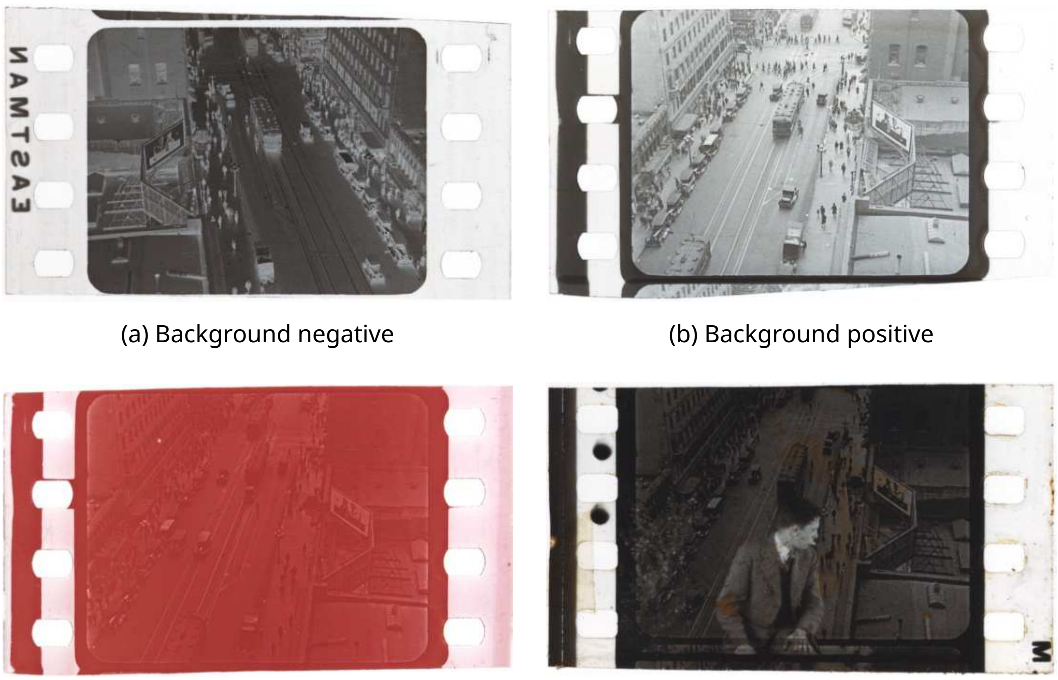
> One of the early motion picture spectacles was created by buying two old locomotives and having them crash together in a head-on collision. The engineers had pulled open the throttles and jumped prior to the impact. A couple of empty engines butting each other will not suffice today. The human element must be included in the shot. You must appear to maim at least one engineer and strew the track with the injured, or the option on your employment contract will not be renewed. … This necessity has created in Hollywood a small group of men who are outstanding in their versatility and resourcefulness. Some are under contract with the large studios, others are free lancing. Problems are presented

119 Dunning, Method of Producing Composite Photographs.

120 Dunning, "Composite Photography"; C. Dodge Dunning, "Composite Photography," *AC* 9, no. 11 (February 1929): 14, 16.

121 Dunning, "Composite Photography," 977.

122 Dunning Process Company, "Outdoor Action Background," advertisement, *IP* 1, no. 7 (August 1929): 14.



(a) Background negative

(b) Background positive

(c) Tinted background positive

(d) Final composite

Fig. 3.19: An example from the Earl Theisen Collection (specimen 60-b) shows frames from the now lost movie *The Whip* (Charles Brabin, 1928). In this case the transparency is tinted red. Attention should be paid to the loss of quality from the original background positive (b) to the dark background in the in the final image (d). This deficiency in contrast is likely a reason why red transparencies did not prevail against yellow or orange with blue as the complementary color.

> to them at a moment's notice, which require an adequate understanding of mechanical, electrical and illuminating engineering, a proper appreciation of art and a due regard for dramatic values.

Audience and producers demand spectacles that bring humans (and we can add animals here) in dangerous situations that should look as realistic as possible. And it needs special cameramen to create these situations by means of effects. Unlike Dodge Dunning his father Carroll no longer promotes a technique but the people who can handle it. As the president of an independent service provider he tries to build alliances with special effects cameramen.[123] They are the ones who can come up with solutions for intricate problems of movie productions: an actress who doesn't want to fly, sound that cannot be recorded on location because the equipment is still too big and heavy, or the Canale Grande in Venice that is not only far away but also too big to be lighted. In order not to miss this central argument, a reprint of Dunning's paper in the *American Cinematographer* is introduced by an editorial comment.

> So much is written about the screen stars and their exploits that the picture fans rarely hear about the men who are responsible for many of the most thrilling, artistic, and sensational scenes in pictures. These men are the highly trained cinematographers who in miniature and special process photography make possible the picturization of scenes that could never be made in any other way. They are the unsung heroes of the film world, and this article will give some idea of what service they perform.[124]

Dunning aligns himself with the discourses of emerging identities of optical effects people as described by Hoffman, which reach a critical point in the late 1920s.[125]

A third presentation in 1931, this times at a symposium on laboratory practices at the spring meeting of the SMPE in Hollywood, goes even one step further. After obtaining licenses for additional variations of the technique from Roy J. Pomeroy or rather his employer Paramount Pictures, technical details of the process itself appear subordinate. What is most import for producing satisfying composites, is to shoot good process backgrounds, also called keys or plates. And Carroll Dunning is advising his partners in the studios how to do that. His advice tries to stay close to the conventions: backgrounds should have a standard quality and neither be over- nor underexposed, too high contrast might cause phantom effects, and he recommends to shoot the background in focus. That latter point is debatable as backgrounds in straight photography often appeared blurred and arguably even have to in black and white photography to separate actors and scenery. Dunning acknowledges that there is a potential conflict here between directors and cinematographers on the one side who tend to blur the background and producers on the other side who want what they regard as the highest possible quality of an image. Avoiding to take up a position in this question he recommends to shoot in focus and soften the transparency later if required or requested.

What is more important are compositional considerations. When shooting the background one has to imagine the entire final image. Two aspects come into play here. On the one hand the perspectives of background and action should not contradict. But on the other hand the

123 He enumerates Ralph Hammeras, Fred Jackman, Alvin Knechtel, E. Roy Davidson, and Ned Mann.
124 Carroll H. Dunning, "Some Problems Related to Composite Photography," *AC* 10, no. 3 (June 1929): 9.
125 See Hoffman, "The Discourse of 'Special Effects' Cinematography in the Silent American Cinema."

background should be visible behind the action. These two demands build a potential conflict. While a location that according to the perspective of the camera might have a neutral or empty background, like a clear sky without visible horizon, this would not be attractive for a composited shot. For this reason Dunning recommends to position the camera slightly higher and deflect the it. "The most important accessories required when shooting backgrounds are an excellent imagination and a bevel protractor. … The best lens height for auto shots is six feet from the ground. The camera should be tilted slightly downward so as to bring the interesting part of the background picture into the upper half where it will be seen through the rear window of the car."[126] Compositing as a technical process merges with composing as an aesthetic one.

The Dunning process is quickly utilized in the studios as a series of advertisements in the trade journals in 1930 show. The listed productions from most major studios are diverse but already point to the coming dominant topoi of composited images. But in 1931 the process is already under pressure from the emerging alternative of rear projection. This might be another reason why Dunning no longer presents himself as technical innovator but as a specialist with aesthetic competences.

3.5.2 Applications of the Dunning Process

Within short time after the presentation of the Dunning process, the technique is widely embraced by the industry. Unlike with the Williams process before, there are numerous examples of Dunning shots that can be easily identified and allow to describe application approaches and resulting image structures. The fact that in this case the traceability is much higher, has not only to do with the technique itself and the produced scenes but also with the Dunnings' inclination to propagate their successes. In a series of advertisements in the trade journals they regularly list new productions with Dunning shots.

The movie *The Pay-Off* (Lowell Sherman, 1930) about a young (and poor) couple that gets entangled with a group of gangsters in New York features a short dialog in a cab. The twosome and one of the gangsters are on their way to a jeweler that is going to be hold up. The innocent couple does not know that the apparently generous act of giving them money to purchase engagement rings is only a trick to make them accessories of a murder. The scene starts with a driver's point of view showing location footage of nightly Manhattan. The images are in low-key so that hardly more than the silhouettes of other cars and the neon signs of the stores are visible. The next (and process) shot shows the protagonists in the back of the closed cab with tight rear window. The luminance of fore- and background differs, but unlike with the previous shot the background key in this case is all together lighter. As both planes are mostly black, this ostensible deficit is the only way to keep both spheres apart and the spatial order intact. What is more striking is the fidgetiness of the street footage in contrast to the stasis of the cab interior. What seems to foreshadow the turbulences to come at a moment when the young couple still feels comforted by their new companions, actually might be a drawback of the location footage. Going back to the preliminary point of view shot, which points towards the driving direction of the vehicle first, it strikes that the following swivels are not owed to movements of the camera car itself but

[126] Carroll H. Dunning, "Dunning Process and Process Backgrounds," *JSMPE* 17, no. 5 (November 1931): 745-46.

(a) (b)

Fig. 3.20: *Half Shot at Sunrise* (1930)

likely are pans. What is represented here, is not the movement of a vehicle but the looking around of one of its passengers. This footage still rejects its service to the composited shot. But the motive of the people sitting in a vehicle will be continuous topos to study the development of composite shots.

Half Shot at Sunrise (Paul Sloane, 1930) is a light RKO comedy with stage stars Bert Wheeler and Robert Woolsey playing American soldiers in Paris during World War I. The film features scenes shot on sound stage, on backlot, and on location. It starts with a long shot that depicts the streets of Paris and is partially painted. In the middle it contains a scene with the two heroes and a girl driving by car through a serpentine landscape. The editing switches back and forth between a medium close-up that shows all three figures (fig. 3.20a) and a closer shot of the couple in the back seat that excludes the driver (fig. 3.20b). The latter is smoking a cigar and through the fume remains present even in the closer shot of the couple. His steering seems as generic as his line of sight but never conflicts with the curvy street seen behind. While the group shot is filmed straight from front, for the closer shot the camera is positioned slightly on the right. This way the driver's shoulder may disappear and, therefore, the adverse front pole of the car enters the image as a blurred bar on the right side. Though camera angle and focal length change with the shots, the background remains more or less identical. Due to the direction of the overall movement along the street, it stays unclear whether the changes in the background with each cut are owed to alternate framing (i.e., specific keys for each scene) or simply time leaps within the same key. The increased focal length of the closer shot brings along a greater liberty in the composition of the image planes. This is only overrun when an oncoming vehicle passes behind and the angles of movement contradict. The various parts of the image slightly wiggle independently. While these incidental movements regularly would be regarded as unacceptable, in this case they point to the bad condition of the road and prepare a more significant jump up of the vehicle that enforces a dared but not yet accomplished kiss of the couple in the back seat. The fact that the car moves up and not down first as it would have to only becomes noticeable after repeated viewing. Additionally, the background features a noticeable lower gamma than the foreground. This is not necessarily attributable to technical reasons of the process. It might be owed to the different light inside and outside the vehicle. As it enhances the readability of the black and white image it might even be a desired effect.

The documentary *Africa Speaks!* (1930) by director Walter Futter and explorer Paul L. Hoefler shows spectacular scenes all shot on location in Central Africa. The travelogue genre had been popular since the beginning of cinema but around 1930 receives new impulses

Fig. 3.21: *Africa Speaks!* (1930)

due to the entry of sound as the title here innervates. *Africa Speaks!* shows a succession of encounters with animals and natives with the travel route itself as the only storyline. In spite of its aseptic voice-over that alternates between educational and humorous, the footage brings along a feeling of immediacy like in a scene that depicts the violent death of a native young guide by lions. It looks like only a single shot of the film was 'enhanced' later. In the middle of the film the explorers encounter a herd of white rhinos near Lake Victoria. The animals are shown in a series of long shots, but in one of them we see the two men from behind—one kneeling down, cranking the camera, the other standing with a gun in his hand, looking at a rhinoceros in the center of the image (fig. 3.21). The animal seems to look back at them while they are expressing their amazement about the beast. In striking opposition to the rest of the film everything about this shot looks and even sounds artificial. The light of the two image planes is different, they differ in focal length, and slightly seem to wiggle independently. The over-emphasized dialog bounces back from the walls of the sound stage and the protagonists are apparently acting for the first time. Only the shrubbery, which flanks the protagonists in the studio, extends the original vegetation convincingly. Despite of these artisanal shortcomings and the aesthetic objections that result therefrom, the composited shot carries forward the general concepts of the film. The self-referentiality—i.e., the portrayal of Futter and Hoefler as filmmakers—for one thing helps to connect the unrelated depictions of animals, for another thing offers the audience an access to the narrative. This means that not everything what makes the scene look artificial for us today is owed to the application of the Dunning process but can also be found in other, straight shots.

A non-documentary movie that partially is filmed on location in Africa is MGM's *Trader Horn* (W. S. van Dyke, 1931). It is inspired by a real figure of the same name and tells the story of an expedition that discovers a white woman who grew up among natives. Director van Dyke insists to shoot the film on location and manages to tie in with the travelogue genre with a variety of shots of wild animals. The movie is a product of technical transitions. Initially the crew did not bring any sound equipment along. And the recording devices that are sent later turn out to be poorly conceived. The sound revolution literally overruns the production. At the end basically the entire sound has to be re-recorded at MGM's studio in Culver City. Especially the animal sounds are partly fictitious. Some animal shots are later produced in Mexico. Just as the original book is more a sequence of unrelated events that has to be transformed into a narrative, the post-production of *Trader*

Horn has to assemble various shots and sounds recordings.[127] The Dunning process is used for several scenes of the movie—most famously the scene in with Horn's native gun bearer kills an attacking lion with a spear. The actual spearing is presented in two shots: a long shot with the performer Mutia Omoolu shown from behind in the lower right, holding up a spear and looking at the lion who runs towards him. A following medium close-up adheres to this perspective but practically excludes the environment. Omoolu's lifted arm sticks out of the frame and when it swings down the lion gets in fact speared. The spear was no longer in Omoolu's hand but part of the background key. The cut or the separation of what is usually described as one shot into two Dunning shots was necessary to let the spear migrate from one domain to another—from fore- to background or from Culver City to Central Africa.

In an earlier scene the trading group is traveling on a small boat on a river whose shores are colonized by dozens of crocodiles. Attracted by the boat the crocodiles get in the water and Horn's companion Peru starts to shoot at them. The shots of the crocodiles pick up the movement of the boat but we never see humans and reptiles together until they meet in a single Dunning shot (fig. 3.22). The camera shows the passengers from behind, looking at a crocodile on the bank that turns and starts to move parallel to the boat practically staying longer in sight that way. When the reptile reaches the water the coast line shows parallel to the view axis, in a right angle to what would be expected. Apparently the key was not shot from the water but from the bank looking parallel. But this visual conflict is less apparent than the one in scales. The background is much too big, the crocodile looks too large to be approximately thirty feet away as we can expect it to be. It suddenly is as close as the colored Dunning wall in the studio could be. In a coeval (and uncommonly critical) review British author Paul Rotha stumbles upon the crocodile writing that "it was unfortunate that the photography of the two different shots was not matched up more carefully and the fake rendered a little more convincing."[128] The most obvious problem of the shot are the poor proportions. The crocodile in the background is much too big compared to the people in the foreground. This becomes most apparent when it descends into the river on the basis of the water splashes. But Rotha's critique remains vague when it comes to naming reasons for this mismatch. On the one hand he mentions double printing as a technique to combine two shots. On the other hand he calls to mind that someone informed him that crocodiles of this size do not live in Africa and that we likely see a specimen from South America here. So even the (film) expert Rotha does not arrive at an unambiguous diagnosis. He sees the problem but cannot trace it back to either casting or compositing.

So what is the problem with this shot? Besides of the wrong proportions, also the perspectives and movements do not match. Moreover the contrast of the foreground is higher and there is a light border that edges the gunman in the middle. Only the last points are of technical nature and probably those that contribute least to the overall impression of the image. Therefore, one can raise the question whether there was not a more appropriate background key available? That this is not the case can be easily seen by comparing the used key with shots of the riverside that appear earlier in the same scene. The selection of an obviously too close beast shot, hence, is a decision that serves the dramatization rather than realism.

---

127 See "How 'Trader Horn' Was Made," *Photoplay* 39, no. 5 (April 1931): 30, 129; Rudy Behlmer, "Tarzan: Hollywood's Greatest Jungle," *AC* 68, no. 1 (January 1987): 39–48.

128 Paul Rotha, *Celluloid: The Film To-day* (London: Longmans, Green, 1931), 201.

Fig. 3.22: *Trader Horn* (1931)

It can be assumed that experiences like the production problems of *Trader Horn* promote the use of the Dunning technique or process shots in general. Filming on location in Africa here turns out even more troublesome than expected. MGM has to establish the required infrastructure and build an own small photo laboratory in Nairobi.[129] Several of the crew members become seriously ill. Lead actress Edwina Booth will need five years to recover completely from an unidentified disease she catches. Her young career is ruined and she sues MGM for more than $1 million.[130] Compared to these problems the re-shooting of the ruined sound scenes in the studio works apparently well.

3.5.3 Dunning and Sound

Process techniques profit from the introduction of sound as we have seen with the previous examples. But the impact of sound production is not specifically geared to the Dunning process. The latter is rather by chance the most feasible option to do process cinematography at the time when sound emerges. On the other hand the Dunnings themselves do react to the sound as a production practice and try to profit from it. Carroll Dunning already in October 1928 (i.e., right after the first presentation by his son Dodge) applied for the second patent that expresses this clearly. "The present invention presents a novel and useful method of being able to photographically record … a scene along with any accompaniment desired, whether it be voice, music, gun-fire, or the like, under the direct control of the producer of such a picture and without extraneous sounds other than the sounds desired being present."[131] The Dunning process not only promises to solve the problem of ambient noise but also shares an interest with sound in that both techniques aim for a discrete control of background action. While the first patent is illustrated with the schematic drawings of the various images involved in the process, the second patent only comes with one figure that displays an actor on a small sound stage with microphone and lamp (fig. 3.23). Behind him is the colored wall and in front of him the camera with the prepared background transparency. His wave of hand as a minimal action seems like a hint to the immobility of performers as speakers in early sound productions. The patent here is remarkable

[129] See Carl Kountz, "A Laboratory on Location," *IP* 2, no. 9 (October 1930): 18, 20.

[130] See "Medicine: Trader Horn's Goddess," *Time*, 1934, "Edwina Booth, 86: Actress Who Won Fame Due to Illness," *NYT*, May 24, 1991,

[131] Carroll H. Dunning, Method and Means of Producing Composite Photographs with Sound Accompaniment (Patent 1,858,767 [US], filed October 1, 1928, and issued May 17, 1932), 1, Google Patents: US1858767.

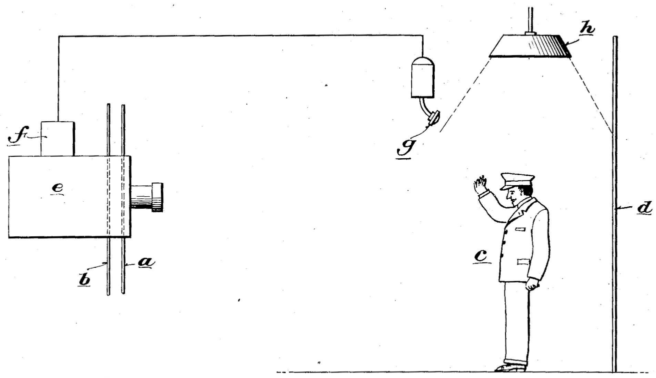


Fig. 3.23: Carroll H. Dunning: *Method and Means of Producing Composite Photographs with Sound Accompaniment*, US Patent 1,858,767, filed October 1, 1928

because it does not offer any improvement of the process as such if one understands it technically. But it does redefine it as a practice that solves existing problems of sound production.

Another problem that occurs with sound production is that of internationalization. With silent movies it was an easy task to replace intertitles with translated substitutes. For sound the industry has to develop an entirely new strategy. Studios have tried either to shoot scenes in several languages with the actors repeating their lines in different tongues phonetically or by hiring native speakers. Both approaches fail for various reasons and are quickly given up.[132] The prospect of the Dunnings solving this problem is a predominant aspect of articles published in popular magazines around 1930. Carroll Dunning in an interview claims to have recently applied his concept for a big musical revue in multiple languages. "Through our process, we replaced the Hollywood stars with native stars of nine foreign countries, using the original Hollywood set and Hollywood extras, lights and all production details, with the foreign players working in their own studios abroad. Thus we actually made nine different foreign versions of the picture at a cost of less than a thousand dollars a version."[133] The idea is a logical sequel to existing concept of compositing. Sceneries may not only be distant landscapes or scaled-up miniature edifices but also lavish studio sets with extras. What changes is the direction of transportation; instead of bringing images of foreign locations to Hollywood, the industry is now supposed to export locations abroad in the same way they export finished movies.

The musical cited by Dunning remains unidentified and might only by a publicity chimera. The Dunning Process Corporation in 1930 moves to a new location at 932 North Lea Brea Avenue becoming "the first private studio ever built for special process work exclusively."[134] The series of popular and benevolent articles can be seen as part of a marketing campaign that tries to leave no doubt that Dunning is the future of movies. "It requires Edisons, Eastmans and Dunnings to bring the cinema art into existence!"[135] The Dunnings also inform the press when early in 1931 first father then son travel to Europe to promote their dubbing

132 See Douglas Gomery, "Economic Struggle and Hollywood Imperialism: Europe Converts to Sound," in *Film Sound: Theory and Practice*, ed. Elisabeth Weis and John Belton (New York: Columbia UP, 1985), 25–36; Donald Crafton, *The Talkies: American Cinema's Transition to Sound, 1926-1931*, vol. 4, History of the American Cinema (New York: Scribner, 1997), 418-41.

133 Chrisman, "What Isn't Possible?," 105.

134 "Expansion With a Big 'E,'" 35.

135 Campbell McCulloch, "Boo! It's Only Hollywood!," *Photoplay* 39, no. 4 (March 1931): 123.


DIE GEYER-WERKE

SIND ALLEINBESITZER DES NEUESTEN VERVOLLKOMMNETEN PATENTRECHTLICH GESCHÜTZTEN

ORIGINAL-DUNNING

BILD-KOMBINATIONS-VERFAHRENS

FÜR DEN GESAMTEN KONTINENT UND SIND

ARBEITSBEREIT

GEYER-WERKE A.G., BERLIN
SO 36, HARZER STRASSE 39/42
F 8 OBERBAUM 9591. ABT. DUNNING

Fig. 3.24: "The Geyer Laboratories are sole owner of the most recent and patent protected Original Dunning image combination process for the entire continent and are ready to work." Advertisement of Geyer-Werke AG, Berlin, *Kinotechnik* 13, October 5, 1931

concept and their compositing process in general.[136] The Geyer laboratory in Berlin buys an exclusive license for the European market and offers process shots under the Dunning label (fig. 3.24).[137] Officially the Dunnings do not travel to sell licenses but to prepare the internationalization of RKO's *Beau Ideal* (Herbert Brenon, 1931). This third part of a trilogy about an American in the French Foreign Legion is supposed to be dubbed into German, Spanish, French, and Swedish.[138] But there are no hints that the movie ever was dubbed with the Dunning process. Looking at the original version it is even difficult to imagine how this actually might have worked out. One would expect to find concessions in the camera work to following optical effects—like static shots, isolation of the main actors—but there are no such things in the released film. While the Dunnings' visits take place in the first quarter of 1931, already in the May issue of *Kinotechnik* Kutzleb, who is also the head of Geyer's newly founded Dunning Department, writes that the dubbing problem is basically solved and names three techniques—none of them is the Dunning process.[139] A pamphlet, specifically produced by Geyer to advertise the process, likewise ignores the option to use it as an alternative to dubbing.[140]

A motion picture that exists in distinct English and German versions and that contains more or longer Dunning shots than others of the time is MGM's *Anna Christie* (1930). The two versions are directed by different directors, Clarence Brown and Jacques Feyder, but both have Greta Garbo playing the eponymous heroine. Anna Christie is a young woman who comes to New York to see her father, a former sailor who left the family when she was still a little girl and now works (and lives) in the harbor on a coal barge. The little boat, as it appears in the film, consists of a deck and a small coach. The harbor is introduced first with an establishing shot that pans from the Brooklyn Bridge down on the East River where the barge is pulled by a towboat. In the next shot the camera is positioned left side of the coach looking along the heading. There is no clear indication that this might not be a straight shot apart from the skyline of Manhattan that is rendered as a pale backdrop.

136 See "Carroll Dunning Returning," *IP* 3, no. 2 (March 1931): 34; "Dodge Dunning Home," *IP* 3, no. 5 (June 1931): 20.
137 See Leopold Kutzleb, "Das Dunning-Aufnahmeverfahren," *Kinotechnik* 13 (July 3, 1931): 232.
138 See "'Ideal' in 4 Tongues under Dunning Process," *Film Daily* 55, no. 1 (January 2, 1931): 1.
139 See Leopold Kutzleb, "Ueber Nachsynchronisieren," *Kinotechnik* 13, no. 9 (May 5, 1931): 163.
140 See Geyer-Werke AG, *Was der Produzent, was der Regisseur vom Dunning-Verfahren wissen muß!*, Geyer plant chronicle, Stiftung Deutsche Kinemathek, Berlin (Berlin, n.d. [1931]).

Fig. 3.25: *Anna Christie* (1930): Greta Garbo and smoke co-star in this Dunning shot.

The different gradations that mark the images described so far, therefore, can hardly be regarded as a decisive indicator for process shots. Anna's father walks along the opposite railing towards the coach. In the next shot Anna is sitting behind the coach, smoking, and hastily tossing away her cigarette when her father is approaching. The light has changed. The place behind the coach lies in the shadow, but Anna's head and hands show light reflections. The entire dialog is shown without closer shots of the two protagonists. While they talk, buildings and other boats—some with steams emerging from the chimneys—pass bye in parallax. Birds fly. The luminance of the background falls off toward the right edge and in such manner reflects the shady coach wall and porch on the left. Several times the father addresses the city and whenever he does so, both of them affirm her existence with short looks towards the background. At one point the otherwise smooth background movement jerks for a few frames. This is the best indication that the city only exists on Dunning's transparency that runs through the camera with the negative. What distinguishes such a scene from one done by means of the Williams process is first of all its length. This can only be done because the Dunning process does no longer requite tedious handwork. The production of the transparency is complicated but independent from the duration of the key. Additionally, what the images here expose is the possibility of semi-transparencies in the foreground like Garbo's smoking. Smoke could already be seen in *Half Shot in Sunrise* but here it is exhibited very explicitly in a liaison with the star of the movie. The oil lantern hanging down from the porch shows the same slight transparency in its dark glass and metal base when a skyscraper passes it behind. But as much as the scene advertises the Dunning process like few others, what *Anna Christie* does not do is to use the technique for internationalization. MGM produces two versions and exchanges the entire cast—except for the multi-lingual star—and the director. But the production itself follows the conventions of the time.

Even if the process is not used as Dunning had suggested, around 1930 it is the most important method for image compositing. Kutzleb (maybe still trying to make money from the license his employer bought) in 1933 leaves no doubt that it has superior possibilities and is overall the process that is most practicable. It outdoes processes like those of Williams or the German Schüfftan system with reflecting glass planes.[141] Hilfinger still in 1941 points to the fact that with the Williams process it usually takes seven to ten days to see results.[142]

141 See Kutzleb, "Der gegenwärtige Stand der Bildkombinationsverfahren."
142 See Hilfinger, *A Survey of Contemporary Methods for the Production of Special Effects*, 84.

The Dunnings on the other hand advertise their service with the slogan "You shoot today—screen tomorrow"[143] and are referring, thereby, to the normal studio procedure where the director would screen the rushes on the morning after shooting for fast control of the state of production. But the process of adjusting the exposure and toning of the background transparency with the lighting of the sound stage is complex. The shooting itself has to be well prepared and during its realization neither director nor actors or cameraman can see the actual background. Therefore, what still causes problems with moving backgrounds is to interrelate the timings of events in background and foreground. How can actors react to their environment when they do not see it as they are just standing in front of a blue wall? With the double exposures of the trick pictures is was usual to count while filming and use specific numbers as cues for actions (p. 41). But it looks like this practice later makes way for alternatives. British crime writer Edgar Wallace, who comes to Hollywood in 1929, describes the production of a Dunning shot in his diary.

> I then went to see [Merian C. Cooper] taking one of these process shots. The camera shoots against a blue background lit up by about fifty orange arc lamps. It was two men making an attack upon a prehistoric beast. The beast, of course, was not there: he is put in afterwards, and every movement of the men is controlled by a man who is seeing the beast through a Moviola, that is to say the film of the beast, and signals by means of a bell every movement that the men make. It is called the Dunning process, with which Bryan [Wallace's son] will be familiar.[144]

It is not clear which production Cooper is shooting here. It might be tests for *King Kong*, the movie for which Wallace will write a draft screenplay after his studio visit. His description falls short in some details. It is of course not the set background that is lit orange but the action and the image background is not added in post-production. What is relevant here is Wallace's depiction of direction by means of a concurrent viewing of background footage. The Moviola is a small device used by film editors to watch the film and that here stands in for the projector that is about to supersede the blank blue wall as I will show in the next chapter.

3.5.4 Pomeroy and Paramount

Carroll and Dodge Dunning are not the only ones who come up with the idea to functionalize complementary colors as means of separating different areas of the studio space. But as independent service providers they have to propagate their work in contrast to those who are developing and using such techniques within their own studios. One of them is Roy J. Pomeroy, an Englishman born in India, who joins the industry in 1922 when he parts the Red Sea for Cecil B. DeMille's *The Ten Commandments* (1923). Pomeroy before had worked in New York as an illustrator for journals. Contemporary publications describe him as a person with a great technical and cultural knowledge at the same time. He becomes head of special technical effects first at Famous Players-Lasky and later at the studio's follower Paramount Pictures.[145] Though the effects he receives most recognition for are all mechanical in nature he also works on optical effects.

143 Dunning Process Company, *Dunning Process Company*, advertisement, ad, November 1930, 26.
144 Edgar Wallace, *My Hollywood Diary* (London: Hutchinson, 1932), 93, Open Library: ia:myhollywooddiary00edga.
145 Cf. Anthony Slide, *Silent Topics: Essays on Undocumented Areas of Silent Film* (Lanham, MD: Scarecrow, 2005), 77-84.

The fact that the processes of the two parties are often jointly referred to as the Pomeroy-Dunning process already indicates their similarity. Pomeroy files his first patent in December 1925—i.e., four months before Dodge Dunning. The process he describes is in its general concept analogous to the Dunning process: a dyed transparency is placed between the stage and the negative that in doing so becomes the final negative without further lab work.[146] Both, Pomeroy and Dunning, emphasize this to be a significant advantage of their processes as additional copies mean a loss of image quality and time. The Pomeroy patent is more detailed e.g. when it comes to how exactly to produce the transparency. And while Dunning favors blue dye for the transparency, Pomeroy chooses red. But both do not restrict their claims to specific color combinations. Whatever colors are chosen for the transparency in the camera and the background of the stage, they have to be complementary. To distinguish the process from the questions of attribution and presentation it seems to be advisable to speak only of the Dunning or Dunning-Pomeroy process in connection with presentations of the respective parties. Another period expression, 'transparency process,' that directly refers to the dyed plate unfortunately is too ambivalent as an alternative because it may also be used for the later rear projection process. Therefore, I will speak of the color-separation process whenever authorship is irrelevant or contested.[147]

Though the patentees argue that the toned transparency is neutral to light of the same color as it is used to lighten the subject, they both provide options for adjustments. Additionally to toning the background positive—i.e., to replace black with color—, Dunning allows for additional gray tinting, which darkens the otherwise transparent parts of the positive. Pomeroy recommends to combine the positive with a negative toned with the opposite color if needed.

There are different ways of how to place a transparency between the subject and negative. Dunning focuses his description on bi-packing. A transparency film is transported through the camera along with the negative and prints individual frames in direct contact. Pomeroy comes from a still transparency that is significantly larger than a film frame and mounted in front of the camera lens. In order to create a focal plane for it additional lenses are needed (fig. 3.26). Such a big still transparency has the advantage of higher definition, it does not need a special camera, and it gives a better impression of the final composite as it can be seen through the viewfinder. To compensate for its lack of depicted motion it can be shifted during the filming and in such a manner create a panoramic background effect. But Pomeroy also holds claims for motion picture transparencies for animate backgrounds. In return Dunning mentions the option to place transparencies in front of the lens but he does not expatiate upon it.[148] Raymond Fielding later classifies the Pomeroy process as a successor of Dunning's basically because it is easier to handle with the equipment that is available at the time.

> By moving the diapositive outside of the camera and changing its form to that of a glass-shot stereo, a number of advantages are gained over the older system. First, the composite may be photographed with any conventional camera,

[146] See Roy J. Pomeroy, Method of Making Composite Photographs (Patent 1,673,019 [US], filed December 19, 1925, and issued June 12, 1928), Google Patents: US1673019.

[147] Hilfinger in 1941 is the first who comes forward with the term and who also gives the following definition. "The color-separation process differentiates between the foreground and background by virtue of complimentary [*sic*] color combinations and their cancelling qualities." Hilfinger, *A Survey of Contemporary Methods for the Production of Special Effects*, 83

[148] See Dunning, Method of Producing Composite Photographs, 2.

Fig. 2.

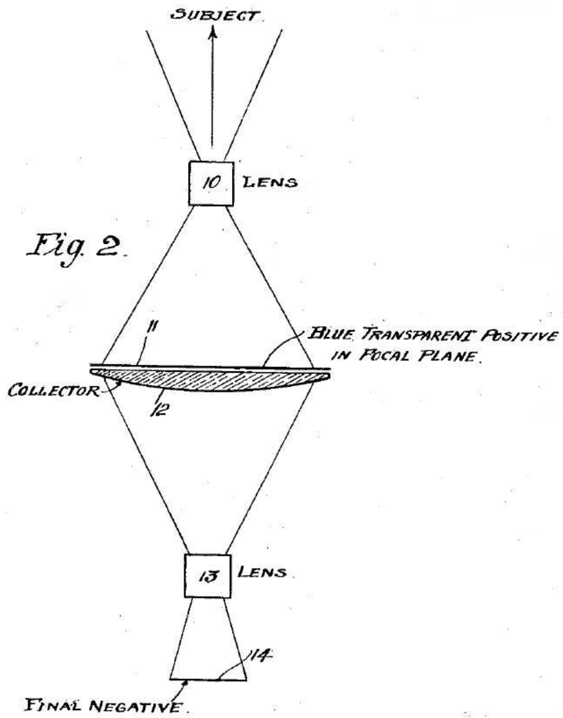


Fig. 3.26: Roy J. Pomeroy, *Method of Making Composite Photographs*, US Patent 1,673,019, uses a transparency as an aerial image.

> inasmuch as bi-pack operation is no longer required. Second, the photographic transparency is relatively convenient and inexpensive to prepare. Third, so long as the camera and transparency are rigidly mounted, there is no possibility of registration weave between components of the composite—even if an inferior intermittent movement were employed, both the foreground and background images would jiggle in synchronism with one another. Fourth, with the background plate positioned outside of the camera, it is now possible for the director and cameraman to view and compose the complete composite by simply sighting with the 'through-the-lens' viewfinder. Finally, by temporarily substituting a Polaroid-Land camera for the motion picture equipment, test photographs of the composite can be quickly produced as an aid in balancing foreground lighting.[149]

Hineline additionally finds Dunning's patent text unclear and also for that reason favors Pomeroy's. "This patent appears to contain the broadest claims to the process."[150] Pomeroy's attention to still transparencies owes a lot to the practices in the studios where artificial backgrounds first and foremost are not expected to move but are likely architecture or landscapes—painted or built as miniature models. The enlargement of the transparency reminds of the prevalent glass shots. And the idea of the sliding background is something that is in use with cel animation since at least a decade.[151] Pomeroy's approach is that of a practitioner who knows what is needed to produce desired effects and what kind of practices are already available that can be adapted. The Dunnings on the other hand are looking for a clean and logical solution that derives from the technical matters

149 Fielding, *The Technique of Special Effects Cinematography*, 182-83.

150 Hineline, "Composite Photographic Processes," 295.

151 See Edwin George Lutz, *Animated Cartoons: How They Are Made, Their Origin and Development* (New York: Charles Scribner's Sons, 1920), 192-94, Open Library: OL6622808M.

themselves. Their reference is the process that Frank Williams offers also as an independent specialist and that—despite of its numerous drawbacks—does provide animate backgrounds.

The extent of Pomeroy's claims also manifests in his further patent ambitions. Already in the first patent he mentions three following applications, all filed February 7, 1927, of which two later are accepted. One of them describes a printing process in which an "action positive"[152] filmed in front of a white background is combined with a toned background transparency. The action positive is tinted and toned with two complementary colors so that it practically contains a matte. This matte is supposed to become effective when both positives are printed together on negative stock with light that is mixed from the very same colors. This printing process resembles the Williams process in that it offers animate backgrounds, uses a white background for the photography of the action, but also because it inherits the problem that a white background is difficult to separate from lighter elements in the action foreground. Pomeroy's patent, though it comes with detailed recipes for the processes of tinting and toning, lacks a real solution for the basic problem of the older process it tries to improve.

A second patent improves Pomeroy's original studio process. The transparency is located inside the camera in its original black and white condition. The setup on the stage stays the same: subject and background are illuminated by complementary colors. The light (after passing the camera lens) is split by a prism. The two light beams are passing filters of the two stage colors. This way they carry corresponding traveling mattes. The beam with the action matte and image directly exposes the negative from one side while the second beam prints the background positive from the other side of the negative.[153] With his further patents Pomeroy basically covers the entire range of transparency approaches often adapting older practices by utilizing double exposure, mirrors, and so forth.[154]

It is not clear which of the described processes is actually used to which extend and Pomeroy's traceable contributions to individual movie productions and his role at Paramount raise further questions. A film that in a lot of scenes surprisingly does not make use of Pomeroy's process techniques is William Wellman's World War I aviation drama *Wings* (1927). Pomeroy has worked on the film and later even receives the first and only Academy Award for "Engineering Effects." The film contains shots with colorized machine gun fire; but the shots that show the pilots in their planes are all filmed in the air with real cloudy skies as backgrounds. These images are sometimes combined with shots of miniature models but only by means of editing and not compositing. Wellman who himself is a pilot insists on this realism in the battle scenes that make *Wings* an extremely expensive production and until today an impressive experience. Pomeroy's contribution here is less visual than

[152] Roy J. Pomeroy, Method of Making Composite Pictures (Patent 1,686,987 [US], filed February 7, 1927, and issued October 9, 1928), 2, Google Patents: US1686987.

[153] Roy J. Pomeroy, Method of Making Composite Pictures (Patent 1,788,740 [US], filed February 7, 1927, and issued January 13, 1931), Google Patents: US1788740.

[154] Roy J. Pomeroy, Method of Making Composite Pictures (Patent 1,715,510 [US], filed February 7, 1927, and issued June 4, 1929), Google Patents: US1715510; Roy J. Pomeroy, Method of Making Composite Photographs (Patent 1,755,129 [US], filed July 14, 1926, and issued April 15, 1930), Google Patents: US1755129; Roy J. Pomeroy, Method of Making Composite Photographs (Patent 1,755,130 [US], filed July 14, 1926, and issued April 15, 1930), Google Patents: US1755130; Roy J. Pomeroy, Correction of Color Transparencies (Patent 1,776,269 [US], filed December 19, 1925, and issued September 23, 1930), Google Patents: US1776269; Pomeroy, Method of Making Composite Pictures; Roy J. Pomeroy, Composite Photographic Method and Apparatus (Patent 1,818,354 [US], filed December 19, 1925, and issued August 11, 1931), Google Patents: US1818354.

rather acoustic as Anthony Slide describes. “When the film received its world premiere at New York’s Criterion Theatre on August 12, 1927, it was notable not only for a live music score by J. S. Zamecnik, but also live sound effects designed by Roy Pomeroy. Percussionists had added some sound effects to music scores. Pomeroy actually added realistic plane sound and explosions through recordings, played on turntables by prop men, watching the screen at each performance.”[155] Paramount had assigned Pomeroy to study the different sound systems that were just about to emerge. He tries to use his new knowledge as profitable for himself as possible. In 1928 he becomes Director of Sound Effects at Paramount and makes test shots with the studio’s entire stock cast for reappraising sound talent—a position that gives him enormous power.[156] He directs the studio’s first real sound production *Interference* (1928) and locks the sound stage as long as possible not to allow other directors to learn from him. As Head of the Special Effects Department he had earned $250 per week. With his new position he manages to increase his salary tenfold to $2,500. *Interference* is produced in two versions, a traditional silent one directed by Lothar Mendes in July and August 1928 and a sound version for which Pomeroy re-shoots major parts of the movie in late September.[157] It is based on a play on adultery and extortion and is obviously chosen also for its tiny interior locations. Only two scenes take place outside the predominant small apartment rooms: a church service that contains a shot with likely partially painted architecture and a series of shots showing people getting on and off cars without any dialog.

Meanwhile, Pomeroy has already filed nine patent applications but he apparently does not use any of the techniques in movies he is involved in. At the same time the Dunnings have started to work for First National, where the Dunning process is used in *The Whip* (Charles Brabin, 1928, fig. 3.19). The long absence of movies that use one of the color-separation processes patented by Pomeroy is another reason to question how relevant his patents and optical effects work practically are at Paramount. At the end of the same year he asks for another raise of his salary that is turned down. By that point he presumably alienated enough people at the studio with his conduct (sometimes described as arrogant) that he finally has to leave early the next year and returns to England. [158]

The movie that is supposed to contain the first Pomeroy process shots is only produced after Pomeroy’s departure from Paramount—*The Four Feathers* (1929), directed by Merian C. Cooper, Ernest B. Schoedsack, and Lothar Mendes. Cooper and Schoedsack had traveled the world before and directed the documentaries *Grass* (1925) and *Chang* (1927). When Cooper approaches Paramount producer Jesse L. Lasky with the idea to do a similar movie in Africa, Lasky suggests to make it a feature film and to combine the proposed production with studio footage.[159] A small team around Cooper and Schoedsack spends a couple of months in West Africa collecting often spectacular shots of animals. On their return to

[155] Slide, *Silent Topics*, 79.

[156] See ibid., 80.

[157] See Edwin Schallert, “Interference: Exclusive Review of Paramount’s Talkie,” *Motion Picture News* 38, no. 17 (October 27, 1928): 1270.

[158] See “Pomeroy Leaving Param’t on January First,” *Motion Picture News* 38, no. 23 (December 22, 1928): 1860; “Pomeroy May Join British International: Settles Contract Troubles With Paramount And Will Go Abroad,” *Motion Picture News* 39, no. 9 (March 2, 1929): 613
Pomeroy’s trip to England also becomes a failure. In December 1929 he signs a contract with RKO and directed *Inside the Lines* (1930). After his last movie *Shock* (1934) for a minor production company he finished his motion picture career.

[159] See “Transparency Backgrounds by Roy Pomeroy’s Process Make ‘Location’ Unnecessary,” *Variety*, October 10, 1928, 4.

Fig. 3.27: Hippo attack in *The Four Feathers* (1929)

Hollywood they are joined by Mendes who helps to combine the footage by means of regular editing and process work with shots of the actors. Apparently all the process shots contain motion picture backgrounds and, therefore, do not use large still transparencies so prominently featured in Pomeroy's original patent. Instead it looks like the bi-pack-system preferred by the Dunnings is used. A shot that can be easily identified to be process work shows as its subject two men sitting in a small boat while in the background a herd of hippos (for no obvious reason) jump off a cliff like lemmings (fig. 3.27). Paul Rotha later calls *The Four Feathers* "a patchwork of good animal shots"[160] but likely is not aware how right he is.

The question what kind of color-separation process is actually used at Paramount is only answered in 1932 when Farciot Edouart, by then the studio's head of transparency process photography, does a presentation of the work of his department. The used color, which so often vary and remain vague in the descriptions, are here clearly identified by comparison to the Wratten & Wainwright filters 26 (red) for the transparency and 46 (blue) for the stage background. Except for the colors and the chemical treatment of the transparency—Edouart here mentions "ten additional laboratory and chemical operations"[161]—the process is identical with that of the Dunnings.

3.5.5 The Pomeroy-Dunning-Paramount Deal

The consequence of the similarities of Dunning's and Pomeroy's processes is not like in earlier cases a conflict but an alliance. In the *International Photographer*'s issue of August 1930 the Dunning Process Company places an advertisement that reads: "We wish to announce that in addition to the Dunning Process patents controlled and operated by us, we have acquired an exclusive license to all 'Transparency' patents owned by Paramount Publix Corp. and Roy J. Pomeroy."[162] The agreement between the three parties was signed in July and regulates the exchange of all licenses regarding the color-separation processes. Paramount and Pomeroy contributed five patents (1,715,510, 1,686,987, 1,755,129, 1,755,130, 1,673,019) and two pending applications (later patents 1,788,740 and 1,776,269). The Dunnings only

160 Rotha, *Celluloid*, 197.

161 Farciot Edouart, "Economic Advantages of Process Photography," in *Technical Bulletin*, Supplement No. 9 (Hollywood: Academy of Motion Picture Arts & Sciences, July 20, 1932), 2.

162 Dunning Process Company, "Dunning Process," advertisement, *IP* 2, no. 7 (August 1930): 28.

have one patent (1,613,163) and two applications of which only one was later granted (1,858,767).[163] The agreement allows for all signing parties to use all involved patents. Licenses for others can only be granted if all parties agree. It remains uncertain whether that ever is the case but possible profits are to be shared: Dunning 50%, Pomeroy 25%, Paramount 25%. Presumably, the idea behind the partnership is primarily that Paramount needs the processes for its own productions while the Dunning Process Corporation offers them as a service provider to other production companies. From all gross income resulting from such business Dunning was to pay 5% to Paramount and Pomeroy each. The agreement is appointed for five years with an option for renewal.

When W. C. Harcus, a Paramount employee, is asked the following year to explain the differences between the processes of Dunning and Pomeroy he emphasizes the superiority of their own patents because they were easier to handle.

> The Dunning process, as applied for, differed essentially from the Paramount process in that Dunning induced a negative balanced image in his colored background or key plate, which was supposed to care for what is known as "ghost" or "phantom," more clearly described as the showing through of one object into another when superimposed. This necessitated balancing three factors, which was found extremely difficult. The Paramount process required the balancing of only two factors, which proved to be a more practical solution to the problem, and gave little trouble due to "ghost."[164]

The effects of semi-transparency, which Harcus describes here, can occasionally be spotted in color-separation process shots if the colors are not exactly complementary. The third factor he alludes to is Dunning's gray tinting of the light parts of the transparency that is supposed to compensate for a loss of light due to the toning of that darker parts. Probably the gray tinting is also discarded by the Dunnings—latest when they seize licenses of Pomeroy's patents through the deal. The fact that the term 'Dunning process' prevails, therefore, points to the market presence of the Dunning Process Company as a service provider and not to the specific technique, which is actually used.

If the Paramount processes are superior to those of the Dunnings or at least more usable then the agreement looks rather favorable for the latter. Pomeroy's profit from the agreement also comes as a surprise. Contracts with studio employees usually imply that all rights over possible inventions made go to the employer. Patentees like Pomeroy are left with an individual license for personal use. Paramount's interest in the agreement is not driven by commercial or technical intents but by the requirement to avoid contingent patent infringements. The similarity between the Dunning and Pomeroy processes gives the Dunnings an option to sue Paramount for a possible contravention. This is deflected by obtaining a license—whether the process was actually used or not. Additionally the Dunning Company is to function as a stooge to sue third parties for patent infringements. Paramount that way is not directly involved in law suits but controls them by paying all "costs and expenses connected with such litigation"[165] in advance and by choosing the lawyer.

---

163 Paramount Publix Corporation, Roy J. Pomeroy, and Dunning Process Company, *License and Agreement*, July 16, 1930, Equity T-110-C/Equity T-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS.

164 W. C. Harcus, "Making a Motion Picture," *JSMPE* 17, no. 5 (November 1931): 810.

165 Paramount Publix Corporation, Pomeroy, and Dunning Process Company, *License and Agreement*, 6.

Fig. 3.28: FBO Studios in 1926 (formerly Robertson-Cole and later RKO) seen from Gower Street. In the background behind the outdoor sets the Famous Players-Lasky Studios (later Paramount) can be seen. After World War II the two lots are merged and until today are the home of Paramount Pictures.

For the involved parties their deal makes the question who initially developed the color-separation process obsolete. But historically we have to ask whether this parallel is a pure coincide. Pomeroy and Dunning file their original patents virtually at the same time—December 1925 and April 1926. Dodge Dunning makes his first experiments earlier in 1925. Paul Rotha later seems to attribute the invention to his fellow countryman Pomeroy without naming him when he complains about the technical misery of the British film industry. “Why was the first offer of the Dunning Process turned down and its English inventor allowed to go to Hollywood, where he has made a fortune for himself and caused a revolution in production methods?”[166] Pomeroy without doubt has a necessity for the transparency process but Dodge Dunning through his father has a strong precondition to develop it. While *The Four Feathers* (1929) seems to be officially the first film featuring the Pomeroy process, information about the first movie with Dunning Process differ as mentioned above. What is more relevant than the first application is the place where Dodge Dunning is developing his method. The Robertson-Cole Studios, which in February 1926 are bought by Joseph Kennedy and merged with his Film Booking Office into FBO Studios,[167] are located on Gower Street—next door to Famous Players-Lasky or later Paramount Pictures (fig. 3.28). Carroll Dunning says that the process until its presentation in September 1928 was used without the knowledge of the industry and the same is the case with the color-separation work done at Famous Players-Lasky on the neighbor lot. At this point we cannot attribute authorship to one of the two parties but at best to the site itself on Gower and Melrose.

[166] Rotha, *Celluloid*, 44-45.
[167] Cf. Crafton, *The Talkies*, 136.

3.6 Alternative Processes and Resulting Conflicts

In retrospect the processes of Dunning and Pomeroy seem to dominate the time of the late 1920s. But this is a highly competitive period when it comes to proposals for process techniques. I will, therefore, describe two alternatives that are usually neglected—likely because the names of the involved initiators are associated with other techniques.

Max Handschiegl is best known for the color process named after him, which he developed together with Alvin Wyckoff for Famous Players-Lasky in 1916. The process, in use until 1927, does not reproduce natural colors but is utilized to partially colorize black and white films as a refinement. At the time of Wyckoff's and Handschiegl's invention this is a tedious and expensive work as it has to be done manually with a brush or tiny stencils (that only delivered improper results) for every single frame of every projection print that only delivered improper results.[168] Having worked originally as an engraver and lithographer Handschiegl has a different perspective on color processes than those who come from photography.[169] He got in contact with photography and motion pictures when he was working at the Thorpe Engraving Company with later effects pioneer Norman O. Dawn and suggested the glass shot technique for him.[170] The process Handschiegl developed with Wyckoff is constituted of a dye transfer from one film on another. The printing film is a dupe negative that is prepared chemically to absorb and reject color in its different parts, an approach similar to planographic printing techniques.[171] The Handschiegl color process is used in several high-budget films to emphasize single elements of the images like the Red Sea in *The Ten Commandments* (Cecil B. DeMille, 1923), the gold in *Greed* (Erich von Stroheim, 1925), and the muzzle flashes of the airplane guns in *Wings* (William A. Wellman, 1927). So, this is neither a compositing method nor a reproductive color system but a technique of refinement.

Around 1922 Handschiegl builds his own plant. By the mid 1920s and among the many color companies on the market Technicolor gains a leading role that it becomes difficult to compete with and Handschiegl merges his business with that of William Van Doren Kelley, one of the inventors of the Prizma Color system and hence former partner of Carroll Dunning.[172] But Handschiegl's interest has already extended to compositing when he starts his own business as his first patent application in the field, dated January 2, 1923, indicates. The way how he introduces his method shows that there is a well defined demand that he thinks he can satisfy. "It is an object of my invention to provide a means whereby a figure or an object may be photographed in one location and the partly exposed film taken to another location and a scene or other action photographed upon the same negative, thus making the two light impressions which the film has received cooperative and non-interfering in

[168] See Read, "'Unnatural Colours.'"

[169] See "Max Handschiegl," obituary, *TSMPE* 12, no. 34 (April 1928): 574.

[170] See Fielding, "Norman O. Dawn," 15.

[171] See Alvin Wyckoff and Max Handschiegl, Art of Coloring Cinematographic Films (Patent 1,303,836 [US], filed November 20, 1916, and issued May 13, 1919), Google Patents: US1303836; Alvin Wyckoff and Max Handschiegl, Machine for and Art of Coloring Cinematographic Films (Patent 1,303,837 [US], filed November 20, 1916, and issued May 13, 1919), Google Patents: US1303837.

[172] See Richard Koszarski, *An Evening's Entertainment: The Age of the Silent Feature Picture, 1915-1928*, vol. 3, History of the American Cinema (New York: Scribner, 1990), 130; "The Week's Headlines," *Film Daily* 39, no. 1 (January 2, 1927): 12.

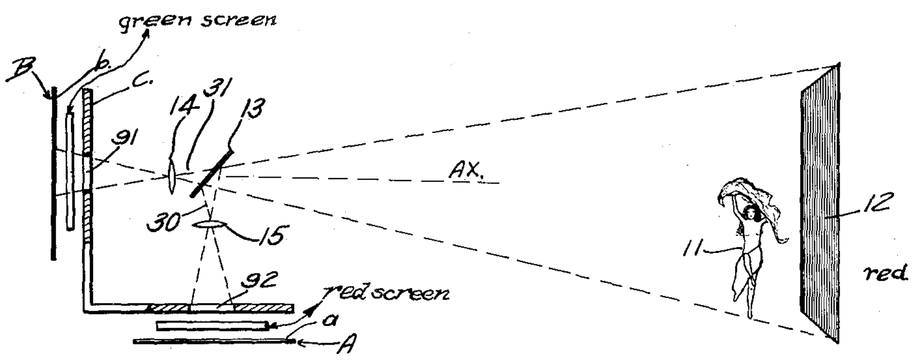


Fig. 3.29: Max Handschiegl, *Double Exposure Process*, US Patent 1,860,737, filed September 30, 1925

their effect."[173] The figure that Handschiegl introduces here and that will appear in all of his following patents regarding compositing is a dancing wood nymph holding a piece of fabric above her head.

When Handschiegl files his application, the processes of Dunning and Pomeroy are not yet presented in public. His reference thus is Williams's traveling matte and with this in mind he promises a technique that "shall be of greater simplicity, reliability and precision than any process now employed."[174] The stage where the action is photographed in both cases looks the same: an actor in front of a black velvet curtain. But while Williams develops the original negative to print a high contrast mask and counter mask from it, Handschiegl immediately exposes two films. The two films are bi-packed in the camera with facing emulsions to ensure identical images. But only the back film is developed and fixated, in fact over-developed to ensure that the action is rendered as an opaque silhouette while the unexposed background remains transparent. In the next step the same two films are again bi-packed but this time the developed matte film is in front. When now the background is photographed the opaque action silhouette protects the undeveloped negative. The result is a composited image without any intermediates and probably no shifts between mask and image element.

It is likely that the back film here does receive only diffused and not enough light. In the next application, therefore, Handschiegl separates the exposure of both films by means of a semi-transparent mirror that splits the light into two beams. Additionally, he uses colors to amplify the contrast between action and background (fig. 3.29). The black velvet curtain is replaced by a red one and the split light has to pass green and red filters before it hits action and matte films. The traveling matte is then developed and bi-packed in front of the action negative to expose its remaining parts with the desired background as before. The production of the two negatives can also be achieved by the usage of two cameras though Handschiegl does not recommend this option. The usage of a single lens is the only way to avoid the parallax that comes with different lenses and perspectives. This conformity, which is so crucial for Handschiegl, though only concerns the action and its traveling matte and not the perspectives of fore- and background. He explicitly mentions the possibility that the action might feature an enlarged or reduced scale. This is also justified by the fantastic character of his still present heroine, the wood nymph.[175]

173 Max Handschiegl, Process of Making Double Exposure (Patent 1,840,669 [US], filed January 2, 1923, and issued January 12, 1932), 1, Google Patents: US1840669.

174 Ibid.

175 Max Handschiegl, Double Exposure Process (Patent 1,860,737 [US], filed September 30, 1925, and issued May 31, 1932), Google Patents: US1860737.

In a third application Handschiegl tries to simplify this process again. He still uses colors to separate action and background but abandons the complicated simultaneous exposure of two films. Instead he exploits the fact that emulsions are still not sensitive to the entire spectrum of colors. The filming of the actions is now done with a regular camera, a single negative and "a black or red or other non-actinic background." He describes the film as being non-sensitive to red light which is the case with the regular orthochromatic films stocks of the time. In fact this first step is exactly the same as what Williams foresees. The difference lies in the procedure of extracting the matte. Handschiegl does not develop the action negative but contact prints it onto a high contrast film stock that is sensitized for red light. The red light used for this step does not affect the orthochromatic negative but is expected to print its latent image as a matte. The final step of printing the background on the action negative is again the same.[176] Later patents make clear that Handschiegl tries to further improve the process and make it adaptable to different production situations. But looking at the details of his different concepts it remains difficult to deduce a clear route of development.[177]

When Handschiegl presents a compositing process in the summer of 1926 (i.e., two years before Dodge Dunning), the description matches his second application with split light and color filters though the curtain on the stage is now blue. The camera used for it is described as his own device. As it becomes apparent now, Handschiegl has teamed up with former director Ray C. Smallwood to develop the process. According to a later report the latter holds a worldwide and exclusive license. Smallwood and Handschiegl make clear that they have a product at their hands that follows a clear concept of application. They present a show reel that depicts an actress in combination with a succession of stock shots from around the world that are pleasantly connected with lap dissolves. Special attention is payed to walking and the feature to connect studio feet and stock footage ground by naturally falling shadows.[178]

All color-separation processes are conceived in some way as alternatives to the traveling matte process of Frank Williams. One reaction to the increasingly competitive market is Williams' attempt to control process work legally by licensing the Dawley patent (p. 64). In a presentation he gives at the ASC in 1928, he describes basically the application of his known process that uses differences of lightness between foreground and background to extract a traveling matte. But parenthetically he also mentions that colors can be helpful. "In some cases colored backgrounds may be used and a complementary filter fitted over the lens to insure contrast."[179] Nonetheless it takes him three more years to file a patent application that catches up with his competitors and that is sometimes referred to as the improved Williams process.[180]

In his new patents he names two objectives that inform his advanced method. First, the generation of the traveling matte has to be improved for which he uses complementary colors. Second, the necessity of dupes has to be reduced. In the original Williams process

[176] Max Handschiegl, Simplified Double Exposure Method (Patent 1,697,315 [US], filed April 26, 1926, and issued January 1, 1929), Google Patents: US1697315.

[177] See Max Handschiegl, Trick Method of Producing Composite Negatives (Patent 1,840,670 [US], filed October 11, 1926, and issued January 12, 1932), Google Patents: US1840670; Max Handschiegl, Production of Pedrigreed Negatives (Patent 1,899,032 [US], filed December 27, 1926, and issued February 28, 1933), Google Patents: US1899032.

[178] See "New Photographic Process is Launched," *AC* 7, no. 5 (August 1926): 23; "Handschiegl Gets Patents on Photographic Process," *FD* 54, no. 76 (March 30, 1928): 2.

[179] Williams, "Trick Photography," 538.

[180] Frank D. Williams, Production of Silhouettes for Composite Motion Pictures (Patent 1,955,993 [US], filed November 3, 1931, and issued April 24, 1934), Google Patents: US1955993.

the foreground shot required dupes as much as the background. The improved process now foresees a second exposure onto the original and undeveloped negative just as Handschiegl suggested. For this purpose the background area has to remain unexposed during the action cinematography. Williams describes here a set with blue background and regular foreground with special lights. During exposure the negative is behind a uniformly red filter. This vaguely complementary color filter then blocks the blue light from the background. In order to print the background in this areas, Williams needs a traveling matte. In the old process this required him to develop the film. Now he uses a platinized prism inside the camera and a second transport mechanism to acquire the mask.[181] For that two additional films are needed, which are bi-packed with facing emulsions. The front film is additionally covered with red dye on its emulsion side that, therefore, works as color filter between them. After the shooting the front film is developed and shows a negative but normally graded image of the foreground and an opaque background as the blue wall had to be overlit. The latent image on the back film shows the same regular foreground negative but a transparent background as the blue light was blocked by the red dye. The developed front film, which also has been cleared of its red dye, is now contact printed onto the back film. This will result in an opaque silhouette of foreground. (Goetz is using the same effect that complementary shades of gray add up. See p. 77) This is the mask that is required in a final contact printing to fill the background of the original negative. All of the film stocks used of course should be panchromatic. As one of the variations that Williams offers and (that might reduce complexity and effort) the high contrast matte film can possibly be replaced with orthochromatic stock that primarily reacts to blue light and hence renders the red coating expendable.

A second patent that relates to the improved process covers further variations of the basic idea with the main aim to make the process easier to handle. For this reason different kinds of light increase the contrast between fore- and background on stage. Williams also abandons electively bi-packing or the platinized prism through the mixture of panchromatic or orthochromatic films stock. In the case of the variation without prism the two different emulsions are applied to the two sides of the film base. This way any regular movie camera (without prism and double reels) could be used and the double coated film might be sold as a ready to use compositing stock.[182] All in all, though, we can say that these improvements are hardly original and that Williams presents them years too late to compete with the other color-separation processes—at least in patent terms.

The described color-separation processes are not always easy to distinguish and the patents do not necessarily mirror actual practices. It is not clear which of the involved parties and to what extend successfully applies image compositing within the industry. Apparently neither then nor now the images themselves can provide clearance in this matter as one hardly tell from them alone how they were made. This state of disarray results in several legal conflicts. When Handschiegl's business partner William Van Doren Kelley in 1927 presents their process at a SMPE meeting, he describes it on the one hand as a successor to the original Williams process. But on the other hand he has to admit that the succession is not yet regulated admitting that there is "an interference in the Patent Office involving Handschiegl, Williams, Pomeroy, Crespinel and Mitchell."[183] Not all of these are traceable

181 Prism cameras like this are already in use for early color systems. The use of motion picture prism camera can be traced back at least until the first Technicolor process. See Herbert T. Kalmus, "Technicolor Adventures in Cinemaland," *JSMPE* 31, no. 6 (December 1938): 565-66

182 Frank D. Williams, Composite Picture Mat (Patent 2,024,081 [US], filed August 30, 1932, and issued December 10, 1935), Google Patents: US2024081.

183 William Van Doren Kelley, "Trick Photography," *TSMPE* 10, no. 27 (January 1927): 129.

in their origins and outcomes but at least some should be covered here to understand the further development. Williams in this situation strives for a test case at the Los Angeles Federal Court about the original Dawley patent that he optioned and that he wants to use to defend his supremacy with the big studios. For him this patent has gained value exactly because he sees it not as technical (and functional) description but as the manifestation of the very idea of compositing as such.[184] His patents on the other hand (and in contrast to those of Handschiegl) do only describe technical matters. Any application or use case has disappeared from them. For Williams, the person in this dispute who due to his older process has the most experience with compositing, these questions are resolved.

In the litigation between Handschiegl and Williams, the latter argues against the operativeness of the process described in the pending patent.[185] He assumes that the bi-packing of two films would not deliver two negatives of equal quality due to inevitable diffusion of light and that together with additional problems of registration no matte could be retrieved that would satisfy professional requirements. To proof his point he asks cameramen of the MGM Studios in Culver City to conduct practical tests. Among them is Raymond O. Binger, a renowned expert for the Williams process, who finds the Handschiegl method useless though not for the reason that Williams has suggested but because he encounters transparency issues in his tests, which means that actions in the foreground are partly rendered translucent. The court, which is likely overextended with these inconsistent arguments, finally decides in April 1931 in favor of Handschiegl—simply because it does not agree with Williams' definition of 'operativeness' tied to commercial feature production. Additionally it is stated that even if the Handschiegl process would not be functional with motion pictures, the patent as a whole would not be devaluated as it also covers still photography.[186] Handschiegl could neither clarify his claims nor defend himself in this matter as he has already passed away on May 1, 1928.[187] All his patents related to compositing are only published after his death with his widow Bessie given as assignor who herself dies in 1930. The status of Handschiegl's bequest remains unclear for years as his stepdaughter commits suicide under unresolved circumstances shortly after the death of her mother.[188]

It is also unclear to which extend Kelley and Smallwood can profit from the inventions of their business partner. The patents for Handschiegl's color process turn out to be worthless as Kelley is not able to reproduce satisfying results with the documented knowledge alone and has to abandon the process.[189] Kelley also dies soon in 1934.[190] Therefore, it is not exactly clear who Handschiegl's lawyers actually represent in the process against Williams as Handschiegl and his wife are dead by its end. Likely Kelley has an interest in protecting the patents if they were still applicable for him. But also special effects cinematographer Smallwood is still involved in the case. After having heard of the tests made by Binger and others and just days before the verdicts, he writes a letter for MGM's Louis B. Mayer to complain

184 "Double Exposure Patent Test Case Planned."

185 The two patents that are at stake here are Williams's accepted 1,589,731 and Handschiegl's still pending but earlier filed 1,840,669.

186 United States. Patent Office, *Official Gazette of the United States Patent Office*, vol. 410 (Washington, DC: The Office, September 22, 1931), 817-19, Open Library: ia:officialgazette410unit.

187 According to his obituary "he won a priority decision on this process in which seven or eight inventors were involved in interference." "Max Handschiegl"

188 *Estate of Muller, 14 Cal. App. 2d 129*, May 18, 1936.

189 William Van Doren Kelley, "Handschiegl and Pathéchrome Color Processes," *JSMPE* 17, no. 2 (August 1931): 230; Roderick T. Ryan, *A History of Motion Picture Color Technology* (London: Focal, 1977), 84.

190 W. E. Theisen, "William Van Doren Kelley," *JSMPE* 24, no. 3 (March 1935): 275–77.

that the studio uses the process without having licensed it.[191] Later that year Smallwood announces his (never realized) plan to produce a series of short films depicting characters from *Alice in Wonderland* with the Handschiegl process.[192]

Neither the color-based processes of Williams nor Handschiegl can establish themselves as the Dunning process does. Leopold Kutzleb in the German trade journal *Kinotechnik* writes: "One has never heard, that these methods though possible in theory found their way into production practice as their application is rather complicated."[193]

3.7 Jackman-Pomeroy-Interference

The conflict between Williams and Handschiegl (or his heirs) is one between equally small service providers of what becomes known as 'Tek-Nik-Towne.' Among several other legal battles there is one that deserves attention for sure. In August 1930 the Associated Process Patents Company represented by lawyer Samuel L. Harris sues the Dunning Process Company for infringing the Dawley patent. The relationship of Harris and Associated Process Patents with James Searle Dawley himself remains unclear.[194] As we have seen with Williams's attempt to launch a test case based on the Dawley patent, the claim of Harris is not only a thread to the Dunning company but to the entire industry. The Dunnings, therefore, receive support by major studios like Fox and MGM. But the situation is more complicated as the Dunnings are not only defendants but at the same time plaintiffs together their partners Paramount and Pomeroy. In September 1930 Paramount's attorney James T. Barkelow raises claims against Warner Bros on behalf of the Dunning Process Company in a letter to his colleague at Warner Bros, William E. Beatty. He argues that Warner Bros infringed Pomeroy's first patent 1,673,019, which his clients have licensed exclusively.[195] This brings Warner Bros, or specifically Beatty, in a delicate situation as he is asked at the same time to follow the other majors and support the Dunnings against Associated Process Patents and has to face that the Dunnings themselves might sue Warner. In a letter to Jack Warner Beatty suggests to support the Dunnings despite of their own claims. "In weakening the Dawley patent, we would not thereby strengthen the Pomeroy patents, which stand on their own feet. In fact, a search through the prior art for the Dawley patent might even disclose an anticipation for some of the Pomeroy patents."[196] The claims Barkelow formulates concern not only Warner Bros but also its subsidiary First National Pictures and specifically Fred Jackman who works for both studios. Initially Beatty is uncertain how to judge the claims he is confronted with. Therefore, he asks Jackman several times to clarify the situation.

Barkelow had suggested to negotiate about obtaining licenses but finally in April 1931 Dunning, Pomeroy, and Paramount file lawsuits against Warner Bros and Jackman.[197] The defendants do not contest that Jackman uses the transparency process, as it is also called. But they argue that the different processes as patented by Pomeroy and Dunning are hardly

[191] Ray Smallwood to Loius B. Mayer, letter, April 8, 1931, Metro-Goldwyn-Mayer Legal Department collection, MHL.
[192] "26 'Wizard of Oz' Shorts Planned by Ray Smallwood," *FD* 56, no. 6 (July 7, 1931): 4.
[193] Kutzleb, "Das Dunning-Aufnahmeverfahren," 230.
[194] United States. Patent Office, *Official Gazette of the United States Patent Office*, vol. 399, 4 (Washington, DC: The Office, October 28, 1930), 632, Handle: 2027/wu.89048465116.
[195] James T. Barkelow to William E. Beatty, letter, September 2, 1930, document 3508A_F015990_002, WBA.
[196] William E. Beatty to Jack Warner, letter, October 9, 1930, document 3508A_F015990_001, WBA.
[197] There are two cases, Equity T-110-C/Equity T-111-H, that in the following, for the sake of simplicity, are described together as they are virtually identical.

original but, as they say, "matters of common knowledge among those skilled in the art."[198] In order to consolidate their line of argument Warner's lawyer Beatty refers to more than thirty American and international patents in the field and various articles in trade publications.[199] They also name people and companies that are known for having worked publicly with composite images years prior to the filing of Pomeroy's and Dunning's applications. Among these are Fred Jackman, Mack Sennett, Hal Roach Studios, First National Pictures, and finally Carroll Dunning himself.[200] The invention of the transparency process is attributed to Jackman and Dunning but excludes Pomeroy who is accused of having appropriated it unlawfully with his patent applications.

In a later hearing the defendants ask the plaintiffs to specify the violated claims, to give a more detailed description of their own method, and to provide evidence of the original invention. The plaintiffs, on the other hand, argue that they cannot specify the claims until the defendants disclose their methods utilized to produce combination images.[201] The situation at court soon comes to a deadlock when the plaintiffs refuse to commit themselves to the exact patent claims they consider to be infringed upon and when the defendants are not willing to reveal the technical details of the process they claim to have used. The patents of Dunning and Pomeroy stand against the movies of Warner Bros. Both seem to be only effective if they remain carefully shuttered black boxes. In the moment when they are unclosed they become attackable.[202]

In May 1932, the defendant Fred Jackman finally lays open details of his own working practice when he has to answer plaintiffs' interrogatories. The Jackman process indeed is in its basic idea the same as the ones from Dunning and Pomeroy. A background is filmed, a positive printed and dyed yellow. An example of a resulting transparency is attached to Jackman's statement (fig. 3.30). The final composite is produced with yellow light on the actors in front of a blue background. In order to distinguish his own practice from the one of Dunning, Jackman emphasizes that the light part of the transparency is actually clear and no tinting with neutral gray is used. Jackman claims to have used that process for many years—even before he started to work for First National in January 1927. When the defendants later give their interrogatories they again target the fact that the Dunnings in patents and articles write about the transparency with a "neutral negative image in its highlight."[203] Furthermore, they ask various questions on Albert W. de Sart, a former technical director, first of Famous Players-Lasky and then Paramount, and by that way allege that de Sart actually developed the blue-dyed transparency that was claimed by Pomeroy.[204] For two years—from summer 1932 to summer 1934—the court procedure is apparently dormant while both parties are negotiating. Finally, as a reaction to Warner's insistence

198 Warner Bros Pictures, Inc., Vitaphone Corporation, and Frederick Jackman, *Answer*, June 20, 1931, Equity T-110-C/Equity T-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS, 14.

199 Among the patents they refer to are: Dawley, Art of Making Motion-Pictures; Williams, Method of Taking Motion Pictures; Hammeras, Method of Making Motion Pictures; Eugen Schüfftan, Making Moving Pictures (Patent 1,569,789 [US], filed September 15, 1923, and issued January 12, 1926), Google Patents: US1569789; Handschiegl, Process of Making Double Exposure.

200 Warner Bros Pictures, Inc., Vitaphone Corporation, and Jackman, *Answer*, 17-18.

201 *Reporter's Transcript of Hearing*, June 29, 1931, Equity T-110-C/Equity T-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS.

202 Regarding the concept of black boxes see Latour, *Science in Action*; Ostrowska, "Magic, Emotions and Film Producers."

203 The defendants quote from Dunning, "Dunning Process and Process Backgrounds," 743.

204 Roy J. Pomeroy, Dunning Process Company, and Paramount Publix Corporation, *Interrogatories Propounded to Plaintiffs by Defendants*, July 11, 1932.

Fig. 3.30: Transparency produced at Warner Bros.

on the fact that their own transparencies feature clear highlights, Dunning, Pomeroy, and Paramount in 1935 withdraw three out of four patents from their bill of complaint. Only Pomeroy's patent 1,673,019 is left.[205]

3.8 The Role of Fred Jackman

What both parties share during the entire lawsuit is their inability to bring forward evidence for the asserted origins of their processes. But what Warner Bros simultaneously tries to do is to attack the Pomeroy patent at the Patent Office by filing patents for Jackman that would invalidate Pomeroy's claims. In a letter Beatty, who handles the applications of Jackman, informs the latter that claims of an application were rejected by the Patent Office. "This case was filed originally in an attempt to take some of Pomeroy's claims away from him and the disclosure differs from Pomeroy's disclosure only in the respect of rotating filter arrangement on which seven claims have been allowed in your application, S.N. 370,297."[206]

In order to enforce Jackman's claims at the Patent Office, Beatty collects testimonies to proof that Jackman worked on the transparency process long before Pomeroy and Dunning filed their patents. The most descriptive and detailed affidavit comes from Jackman himself.

> The transparency process of [Pomeroy's] Patent 1,673,019, herein considered, has an early history very similar to that of most of the other trick and process work now used. Most of it dates back to the early days upon the old Sennett lot, at which place and during such early period I believe ninety per cent of all the different classes or types of trick photography now in general use were originated and developed. It was at the time when the Keystone Comedies were so prosperous and the company maintained a group of cameramen whose business it was at that time to put on the screen the many ideas of every type and character which the gag men and comedy writers, including Mack Sennett himself, would

[205] Roy J. Pomeroy, Dunning Process Company, and Paramount Publix Corporation, *Memorandum of Points, Re. Objections to Defendents' Interrogatories*, May 27, 1935, Equity T-110-C/Equity T-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS.

[206] William E. Beatty to Fred Jackman, letter, November 9, 1933, document 3517A_F023172_001, WBA.

Fig. 3.31: Fred Jackman

> request or work out in the process of writing slap-stick comedies. This particular process was only one of dozens of different methods which were developed by this institution.
>
> I was head cameraman for Sennett, and made it a rule that all the men in the technical division of the company should fully collaborate with each other and work as a group, with one idea in mind, to produce results desired by the company we were working for. There were among us no secrets nor secret individual work.[207]

Jackman attributes the authorship of the transparency process to the entire group of cameramen, lab people, and other technicians that worked at the Sennett Studio: Henry Fisher, Paul Guerrin, Ed Holmgren, Edwin B. DuPar, William N. Williams, Hans F. Koenekamp, Homer Scott, Floyd Jackman, Kenneth MacLean, Robert Walters, Oliver March, and finally Fred Jackman.

> All of the men in the above group, including myself, have continued very closely in the same line of work for the past sixteen or seventeen years, and no one of the group has ever applied for a patent, each one realizing that the group and not anyone individual was responsible for the development of this great number of trick processes.[208]

Jackman's former assistant William N. Williams also gives a detailed account of the development since their initial meeting in 1915. He states that the first process work they do is for *Mickey* (F. Richard Jones and James Young, 1918). According to Williams, they use a negative transparency (8 × 10 inches) with clouds that is moved against an actual landscape. This technique clearly derives from glass shots and double printing and does not yet utilize color.[209] The only shot in *Mickey* that fits the description of Williams does not show any movement of the clouds (fig. 3.32). Another example utilizes a partly colorized transparency and color gelatins of the same color on the set. The earliest case of a transparency shot, which actually uses color-separation, seems to be a scene with actor Ray Griffith riding a donkey through papier mache rocks before a blue background. The lights are not yet colored but they manage to combine the set with a postcard of the Grand Canyon. The

[207] *Affidavit of Fred Jackman*, 1-2.
[208] Ibid., 2.
[209] *Preliminary Deposition of William N. Williams*, typescript, April 12–27, 1932, document 3524B_F015997_005, WBA.

Fig. 3.32: Cloud shot from *Mickey* (1918) that does not back William Williams's account of a transparency with clouds placed and moved in front of the camera. Besides of the apparent stillness of the entire subject, the clouds with their body and edges darken and lighten the sky which is not possible with a transparency. If this is in fact a process shot, then dark foreground would easily allow for double printing.

scene according to Williams is used in *His Foothill Folly* (Reggie Morris, 1917). Griffith later becomes a director at Paramount, where in 1926 he works with Pomeroy who at that time does not know about the transparency method.[210]

Four years later, actor Harry Gribbon plays in a test shot, "illuminated from the shoulders up, with two baby spot lights covered with red gelatine, … standing in front of a blue drop, illuminated with arc lights."[211] Though the compositing works, the image quality is not high enough to use the process in regular productions. Williams reports that the background is grainy and the actor's skin color renders simply white due to the red light.[212] Williams himself poses in another test in the same year where he is combined with a yellow-dyed transparency showing airplanes.[213]

The biggest problem that opposes the very idea of color-separation is the orthochromatic film stock that is not sensitive for all colors but first of all for blue tones. Kodak presents its Panchromatic Type I film (1203) in 1922. But the contrast is still too high and not yet suitable for commercial film work. The alternative is to sensitize the film to make it receptive to red light. This process has similar effects on the quality of the image but the concept of compositing by means of color-separation can at least be validated. The person who runs the Sennett laboratory is Henry Fisher who credits himself with a substantial share of the development of the color-separation process. Together with his father around 1900 he works on concepts to print wallpapers as composite images using color-separation.[214] (Like with Handschiegl, who has a background in lithography, the motion picture compositing here can be traced back to printing rather than photography.) Fisher sensitizes the emulsion for other colors and produces all transparencies for Jackman. From 1918 until 1922 they develop and actually finalize the concept to the process. The fact that it is not applied is owed to the lack of a quality panchromatic film that Kodak introduces with the Type II (1218) in 1928.

[210] *Ray Griffith's Story*, undated typescript, Affidavits. Int. 61,953, Jackman vs. Pomeroy, box 3512B, WBA.
[211] William E. Beatty to W. H. Tayler, Jr., letter, September 6, 1935, document 3539A_F015999_003, WBA, 1.
[212] *Preliminary Deposition of William N. Williams*, 4.
[213] William N. Williams to Ralph Lewis, letter, 1931, document 3524B_F015997_004, WBA.
[214] *Statement Henry Fisher*, typescript, November 3, 1930, Affidavits. Int. 61,953, Jackman vs. Pomeroy, WBA.

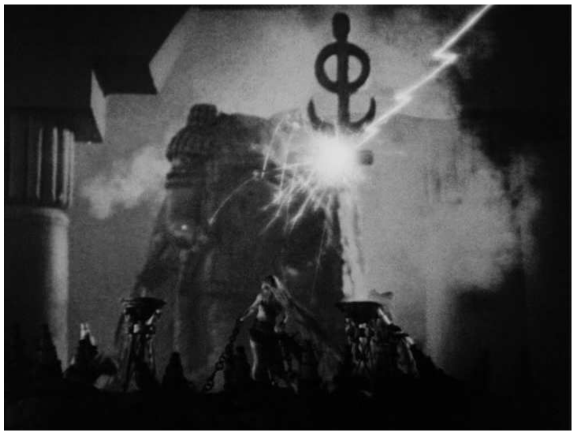


Fig. 3.33: Color-separation shot from *Noah's Ark* (1928) done by Jackman, Koenekamp, and Fisher.

Jackman leaves Sennett in 1922 for Hal Roach but in a small group the experiments are continued in Homer Scott's garage in Beverly Hills until 1926—apparently without exchange with other members of the industry. According to Jackman's own statement, he never met Roy Pomeroy and with Carroll Dunning never discussed the color-separation process. The first commercial use of Jackman's process is in 1928 for *Noah's Ark* (Michael Curtiz), a production that uses every effect technique available at the time to combine live action with miniature buildings that are swept away by the flood. Jackman for this venture hires his former colleagues from Sennett Hans F. Koenekamp and Henry Fisher who as lab technician is in charge of the complicated toning process. (Fisher later returns to Sennett and it is unclear who at Warner Bros is doing such advanced lab works then.) The color-separation shots in *Noah's Ark* show high similarities in image composition but also in shortcomings like a low-key action and a respective falling apart of image layers when it comes to gradation (fig. 3.33).

The affidavits by Jackman, Williams, Fisher, and Koenekamp give a coherent depiction of a development that is independent from Dunning and Pomeroy and precedes the latter's patents by years. But the court papers contain no historic evidence comparable to the recent yellow transparency presented by Jackman (fig. 3.30). The experimental laboratory, where they worked at the Sennett Studio and collected samples for future reference, is destroyed in the fire in 1922. And as the internal communication shows, the provided statements are far from being spontaneous but have been carefully collected and constantly reworked.[215] When Williams finds old test shots as described above, it is discussed whether he should be compensated for his affidavit.[216] Ernie Crockett, who worked with Jackman at the Sennett Studio as a cameraman and later on *Noah's Ark*, states that he does not remember Jackman ever doing transparency work and that he first hears about it in 1930. Crockett is looking for work at the time and Beatty in a letter writes: "As far as his testimony is concerned, we have nothing to gain by employing him."[217] A statement of Koenekamp, who is named by Jackman as one of the people who co-developed process techniques at Sennett, remains somehow contradictory because he claims that in 1924 he still does not understand the color-separation process when Jackman talks about it. But he sheds light on the circumstances under which the Dunnings take action against Warner Bros. They had just started to work for First National in August 1928 right before the studio

215 See Ralph E. Lewis to William E. Beatty, letter, April 4, 1931, Affidavits. Int. 61,953, Jackman vs. Pomeroy, box 3512B, WBA.

216 William E. Beatty to William Koenig, letter, April 6, 1932, document 3524B_F015997_006, WBA.

217 William E. Beatty to William Koenig, letter, April 25, 1932, document 3524B_F015997_001, WBA.

(a) Dunning process shot for First National's *The Divine Lady* (1929) with a visibly grainy and faded background.

(b) Color-separation work by Fred Jackman for *The Dawn Patrol* (1930) with a slightly transparent pilot head due to mismatched colors.

Fig. 3.34

is absorbed by Warner in September. After working on *The Whip*, the Dunnings also do the ship battle scene for First National's *The Divine Lady* (Frank Lloyd, released March 31, 1929, fig. 3.34a) and charge $2,000 per month. Warner Bros reorganizes the two studios and after Koenekamp is transfered to the Burbank plant, the profitable contract work comes to an end.[218] For the Dunnings this swift change must have been quite troublesome as they later describe their work for *The Divine Lady* as the "initial work of any importance done by this company."[219]

But all in all Jackman's description of the Sennett Studio as a creative spot where gag writers and technicians push each other's imagination further and further is plausibly. It is also supported by recent and more general accounts of the studio history. Rob King e.g. reports that from 1915 Mac Sennett started to invest in the development of all kind of new techniques as he recognized that it helped to sell his movies as more and more spectacular.[220] Therefore, the legal conflicts that start 1931 come for Jackman as a surprise. Until then he has never applied for a patent and the very idea of claiming individual authorship for such processes seems cock-eyed for him. In regard to the situation at the Sennett Studio he says in his affidavit:

> I believe that out of all the various methods and processes developed during this time by this group only one patent was taken out, which was taken out by Frank Williams, who had no individual right to the invention since it was developed as were the others … and until his patent was allowed some years later we were not aware that a patent application existed.[221]

Williams had worked at Sennett from 1912 (with interruptions) until 1916 and for that reason was not part of the group that later worked on color-separation as means of compositing. But it is likely that, as Jackman suggests, Williams's patented compositing process originates from his time at Sennett. The turnaround that Jackman himself performs

[218] *Koenekamp's Story*, undated typescript, Affidavits. Int. 61,953, Jackman vs. Pomeroy, box 3512B, WBA.
[219] "Expansion With a Big 'E,'" 35.
[220] See Rob King, *The Fun Factory: The Keystone Film Company and the Emergence of Mass Culture* (Berkeley: U of California Press, 2009), 182-85.
[221] *Affidavit of Fred Jackman*, 1.

when he starts to file various patent applications in the early 1930s, therefore, needs explanation. He publishes his thoughts in the January 1934 issue of *American Cinematographer*.

> It's an absolute certainty that, no matter how original an idea may be, someone else, engaged in the same line of work and trying to get a similar result, will sooner or later parallel the original line of thought, and achieve a similar, if not identical, result. And any way you look at it, when two independent researchers have arrived separately at the same result, and each finds that the other has duplicated his methods and results, a great deal of unnecessary unpleasantness is bound to ensue before the question is satisfactorily untangled.[222]

Jackman describes himself in a conflict. On the hand, he doubts his exclusive authorship of the process and likewise believes in knowledge as a common. On the other hand, he legally claims authorship with the patents he fights for.

> It took me eighteen years, and cost me and my producer many thousands of dollars to learn that patents aren't a sign of monopolistic intent, but simple insurance that you'll be able to use your own ideas, without interference.[223]

The solution, he proclaims, is to use patents as a way to secure ideas for the community, to make them known so that one member of the community can build his or her work and research on that of others.

3.9 The Patent Pool

While they are suing each other, Paramount and Warner are both in difficult situations. Paramount goes into receivership in 1933 and officially is bankrupt by 1935.[224] Warner in 1934 looses $2,500,000 partly due to a fire at the end of the year.[225] In a letter to Harry Warner, Beatty tries to explain what the lawsuit from Paramount et al could mean for the studio. Warner Bros at that point made between 800 and 1,000 transparency shots. In case of a defeat the studio at least would have to pay Dunning the cost usually charged for his services, which would be about $250,000. It might even get worse and the damage to be decided to be the money Warner saved by using the technique, by not building sets and traveling.[226]

Paramount's positions, finally, is not much better after Warner manages to legally control the newly introduced rear projection process through the Brainerd patents. (I will cover Warner's activities here in the next chapter.) Paramount's attorney Barkelow in 1934 makes an offer for settling all lawsuits. He demands $20,000 for Dunning and $10,000 for Pomeroy for past infringements of their rights. And he wants a license for

222 Fred W. Jackman, "Patents and the Cinematographer," *AC* 14, no. 9 (January 1934): 358.
223 Ibid.
224 See Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 642.
225 See Cass Warner Sperling, Cork Millner, and Jack Warner Jr., *Hollywood be Thy Name: The Warner Brothers Story* (Rocklin, CA: Prima, 1994), 209.
226 William E. Beatty to Harry M. Warner, letter, August 16, 1935, document 3539A_F015999_004, box 3539A, WBA.

the Brainerd patents from Warner. The claim seems to be moderate already compared to the legal costs of $37,720 Warner has accrued meanwhile.[227] But still no settlement is struck.[228]

Warner not only negotiates directly with Paramount but also involves a third party, the MPPDA or Hays Office. Will Hays starts his effort to conciliate at the end of 1932 but is initially unsuccessful. In the annual report of the MPPDA he points the industry to a historical parallel with referent power.

> In 1914 under the Cross Licensing Patents Agreement fostered by the National Automobile Chamber of Commerce, 136 companies contracted without the payment of money royalty to exchange their patent rights for ten years, each manufacturer controlling the patents he owned and receiving in return licenses under patents owned by other manufacturers, and agreed to include in the arrangement all patents acquired by invention.
>
> So successful was this arrangement that upon its expiration an immediate request for an extension to 1930 was made, and again a further extension to 1935 was requested, and the arrangement now embraces more than 1700 patents. I recommend a like arrangement for the process patents of the motion picture industry to the end that litigation may be avoided; to make available without excessive cost all known developments of the art so that the industry may progress more rapidly; to enable the public to benefit from the developments in the mechanical fields of motion picture production; and to permit all producers to make the best motion pictures that the known art permits.[229]

Hays, who nowadays is doomed for establishing Hollywood's self-censorship, at the same time strives for an agreement concerning process techniques that not only will solve problems between Paramount and Warner but that will also stabilize production for the entire industry. A final solution is, furthermore, aided by the fact that the deal between Dunning, Pomeroy, and Paramount expires in July 1935 and is not renewed. The value of Dunning's patent has been severely degraded in the meantime and by 1936 also the Brainerd patents (issued in 1919) expire after seventeen years. In general, the power has shifted from individuals like Dunning, Pomeroy, and others who dominated the field of optical effects in the 1920s to the studios or the people integrated into them like Jackman.[230]

Finally, the MPPDA is successful and all involved parties on August 4, 1936, sign an agreement for granting each other licenses for the patents they control. The patent pool involves not only Paramount and Warner but virtually the entire industry. It is seen as a necessary

227 William E. Beatty to Abel Cary Thomas, letter, May 10, 1935, document 3539A_F015999_007, box 3539A, WBA.

228 An internal Warner report lists one more lawsuit of Warner's subsidiary United Research against Paramount that is related to printing processes. *Narrative in re Patents*, typescript, August 1, 1935, document 3539A_F015999_006, WBA

229 Motion Picture Producers and Distributors of America, *Annual Report* (New York, March 27, 1933), 9-10.

230 The test case of Williams, who files bankruptcy in 1931, about the Dawley patent has been dormant for years for unknown reasons. But the Dawley patent likely expires in 1935. The trial is finally scheduled for January 1936 but the outcome is unclear. ("Double-Exposure Patent Suit is Set for Hearing on Coast," *FD* 69, no. 2 [January 3, 1936]: 1, 4) The claims of Associated Patents are dismissed without prejudice in 1938. (United States. Patent Office, *Official Gazette of the United States Patent Office*, vol. 493, 2 [Washington, DC: The Office, August 9, 1938], 206, Open Library: ia:officialgazette492unit)

corporation in order to ensure legal security and sustained progress. "Any reputable producer, including independent producing firms, independent special-effects studios, producers of industrial, commercial or educational films, and foreign producers, may obtain licenses under any or all of the patents involved."[231] The pool consists of 46 American and international patents: twenty-seven from Warner, seventeen from Paramount, three from RKO, and two from Fox. Future patents are likewise to be shared. Dunning and Pomeroy receive compensations of $35,000 paid from a fund financed by the studios. All lawsuits between Paramount, Warner, and other studios are dropped.[232]

The patent pool is relevant for the development of motion pictures techniques because it marks the end of a learning process. The studios, initially, cannot relate to the idea of applying for patents. While companies like Eastman Kodak, Bell & Howell, etc produce their technical innovations as an investment in their position within an open market, the studios practice research as a private endeavour that regards the development of means of production as primarily technical and subordinate. This changes with litigations of the early 1930s and the resulting patent pool as it is also noticed by the annual progress report of the ASC in its comment on special effects cinematography. "The outstanding development in this field was legal, rather than technical."[233]

[231] William Stull, "Producers Pool Composite Process Patents," *AC* 17, no. 11 (November 1936): 461.

[232] *Conformed Copy with Photostats of Signatures of Agreement for the Granting of Licenses under Patents in the Field of Composite Background Photography*, August 4, 1936, document 16067A_F023178_001, WBA; "Producers Pool 46 Patents as First Step to Wholesome Action," *Motion Picture Herald* 124, no. 12 (September 19, 1936): 56.

[233] "Technical Progress in the Industry During 1936," *AC* 17, no. 12 (December 1936): 503.

4 Rear Projection

Hollywood around 1930 sees several changes in its production practices, of which the transition to sound is only the most apparent. As the individual studios increase their production and the work flows become more elaborate and complex, production management is split and diversified with the producer-unit system after 1931. While before one head of production controlled all movie productions of a studio, he now delegates the daily tasks to a few reasonably autonomous producers. These producers are specialized in specific genres and have more influence on script development, casting, and production issues. This also takes away power from the directors as the producers have more time and competence to deal with production particulars.[1]

The increasing specialization in the domain of camera effects work leads to an apparently reverse movement: the amalgamation of small service units into centralized special effects departments. In parts this is owed to the higher demands on optical effects. The color-separation methods of the late 1920s had shown that process work could no longer be covered by a skilled but individual cameraman.[2] Contractors like Williams, Handschiegl, and Dunning filled this gap and offered their services to the studios. Around 1930 this system slowly comes to an end when the studios increase their efforts to gather expertise, work craft, and technology on their lots. For the conversion to sound production, studios had invested heavily and started for the first time to conduct research systematically. The nucleus of their own efforts are often the machine shops.[3] In this situation their partners—the movie theaters and traditional suppliers like Bell & Howell or Mitchell—show themselves reluctant to invest in developing new equipment. This incongruity gives the studios the confidence to be the driving force in the development of the industry. Only bigger companies, which have research units anyway, can afford to do alike. In April 1929 Kodak opens the Eastman Research Laboratory, a service building in the heart of the industry on Santa Monica Boulevard. It contains conference rooms, a lounge, a reference library, a small state of the art cinema with sound, and a "research laboratory containing approximately $35,000 worth of modern equipment."[4] All of this is open to cinematographers and technicians from the studios. Towards the end of the decade the *International Photographer* can already speak of "Hollywood's Service Army" that involves "firms supplying the industry with technical products. They exist not merely to sell their firms' products, nor merely to serve as 'trouble shooters' when things go wrong, but to make the men on the production firing-line active partners in the evolution of products and equipment specifically suited to their problems."[5] Compared to the 1920s the networks that develop new techniques have grown from individuals and small groups to structures that connect companies and associations.

1 See Staiger, "The Producer-Unit System."
2 This is also valid for regular camera work. Until the late 1920s cameramen were often hired with their own equipment, a practice that disappears with the setup of increasingly sophisticated studio machine parks.
3 See David Bordwell, "The Introduction of Sound," chap. 23 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 299.
4 "Eastman Research Lab Opened in Hollywood," *AC* 10, no. 2 (May 1929): 23.
5 "Hollywood's Service Army," *IP* 10, no. 3 (April 1938): 11.

As Bordwell and Thompson have pointed out, not only the studios benefit from the new situation but also professional organizations like the ASC or the SMPE. "Relatively few employees of Hollywood studios belonged to the SMPE in the 1920s, but the arrival of sound filming gave engineering a new pride of place."[6] In 1928 AMPAS initiates the Producers-Technicians Committee, which will later become the Academy's Research Council. The focus is not only on sound as a technology but also on practices that have to be adjusted like conventions for integrating dialog intro movie scripts.[7] The Academy takes a unique position here between studios, suppliers, contractors, and their employees and other parties. "While the Academy neither financed nor innovated such improvement, in its role as a clearing house it made the industry's needs known and helped spread and organize a uniform usage of the innovations."[8]

Finally, what changes around this time is the relationship between regular cameramen and those doing special effects. Bordwell and Thompson notice that cinematographers sustain a loss of influence on productions. This has several practical reasons and also finds its symbolic forms: Silent movie production often was done with a single camera and everything is staged for that camera. With the introduction of sound the continuous recording of dialogue turns into a high priority that is now merely accompanied by several camera perspectives. In-camera effects (like double-exposure or transitions) are practically abandoned and replaced with optical printing as a post-production practice.[9] And while cinematographers have to see how they forfeit their privileged positions, the new special effects departments slowly but surely try to make themselves indispensable. The latter often seem to have much more vital ties to other departments and unlike the cinematographers are consulted already during the preproduction phase.[10] This is the situation in which rear projection, as a technology and production practice, appears.

In his standard reference Raymond Fielding highlights the outstanding position of this technique to film actors in front of projected backgrounds. "Significantly, in the literature of special-effects cinematography, the largest number of articles and reports have been devoted to background projection, reflecting the popularity which this technique has enjoyed during the last three decades. Quite likely, too, more money has been spent for the development of background projection than for any other composite process."[11] Fielding describes a break-through of the technique in the late 1920s and early 1930s and ascribes the development to the need of sound film production to retreat to the silence of soundproof stages and the deprivation of original locations. Rear projection cinematographer Farciot Edouart, one of the driving forces here, later describes this change as the sudden and totally unexpected realization of a long-term dream. "It was never invented, in the strict sense of the word—much less engineered. It just simply happened. And from its earliest beginnings, it had to take off its coat and go to work, with no opportunity for being engineered into a technologically streamlined coordination of methods and equipment."[12] If the technique is not invented as Edouart says, we have to ask how it emerges. What are the premises and forces that define its tasks, criteria of quality, and primary applications?

---

6 David Bordwell and Kristin Thompson, "Technological Change and Classical Film Style," in *Grand Design: Hollywood as a Modern Business Enterprise, 1930-1939*, ed. Tino Balio, vol. 5, History of the American Cinema (New York: Scribner, 1995), 121.

7 See Irving Thalberg, "Technical Activities of the Academy of Motion Picture Arts and Sciences," *JSMPE* 15, no. 1 (July 1930): 3–16; Weiberg, "Classical Hollywood as an Epistemological Network."

8 Bordwell, "The Introduction of Sound," 301.

9 See Bordwell and Thompson, "Technological Change and Classical Film Style," 131-33.

10 See Staiger, "The Producer-Unit System," 327.

11 Fielding, *The Technique of Special Effects Cinematography*, 246.

12 Farciot Edouart, "The Evolution of Transparency Process Photography," *AC* 24, no. 10 (October 1943): 359.

The recent discussion of rear projection has concentrated on the quirks of the technique and a presumed artificialness. Laura Mulvey speaks here of "an aesthetic emblem of the bygone studio era."[13] In her brief article, which became the springboard for a slowly growing debate, she collects a few valuable observations regarding rear projection. Mulvey contextualizes the technique within the opposing demands for physical action and star appeal. Subsequent accounts are essentially informed by Mulvey's assessment that performances with rear projection tend to appear factitious and fragile.[14] On the other hand, her observation that "two diverse registration times are 'montaged' into a single image"[15] remains unappreciated. The only scholar who investigates the quality structure of such images more specifically is Adrian Danks who argues against Mulvey's asynchronicity with his diagnosis of modernist dislocation of actors and audiences alike.[16] What all recent accounts have in common, is that they emanate from our own contemporary estrangement towards rear projection images. They all focus on movies that were produced in the second half of the 20th century when, possibly, the film makers themselves already address the technical idiosyncrasies of rear projection compositing as self-aware aesthetic concepts. As before and in contrast to that, I will try to reconstruct rear projection in its emergence.

4.1 Reasons for Delay

The idea of filming a projection and using this actualization of the image to place actors, props, and set elements in front of it stands to reason. The initial question, therefore, is why it takes a quarter of a century to come to a practice that proves to be functional within commercial movie production. Norman O. Dawn, who is one of the first who successfully applies glass paintings and static matting techniques (p. 48), documents an unsatisfying attempt from 1913 in his notebooks. For *The Drifter* he shoots two scenes with a stereopticon (i.e., stationary) projection on a relatively small ground glass. But the quality is so poor that he abandons the process altogether.[17] It looks like Dawn is unable to cope with the technical challenges he has to face. He lacks the knowledge and resources to improve the technique gradually. I will, hereafter, try to show which problems had to be solved before and which while rear projection is applied in the studios.

4.1.1 Synchronization

While Dawn apparently already fails on a basic level, the challenge is actually much higher with moving backgrounds. Movie projectors and cameras operate with the alternating states of exposure and transport. In order to film a projection it is vital that these processes are executed simultaneously by both devices. Independent movements due to insta-

13 Laura Mulvey, "A Clumsy Sublime," *Film Quarterly* 60, no. 3 (2007): 3, doi:10.1525/fq.2007.60.3.3.

14 Cf. Julie Turnock, "The Screen on the Set: The Problem of Classical Studio Rear Projection," *Cinema Journal* 51, no. 2 (Winter 2012): 157–62, doi:10.1353/cj.2012.0000; Johannes Binotto, "Rück-Sicht auf Darstellbarkeit: Zur Ästhetik und Aussagekraft der Rear Projection," *Filmbulletin* 55, no. 2 (March 2013): 37–43.

15 Mulvey, "A Clumsy Sublime," 3.

16 See Adrian Danks, "Being in Two Places at the Same Time," in *B is for Bad Cinema: Aesthetics, Politics, and Cultural Value*, ed. Claire Perkins and Constantine Verevis (State University of New York Press, 2014), 65–84.

17 As usual with Dawn the actual film is not preserved and the only primary source is Dawn himself or his notebooks respectively. See Fielding, "Norman O. Dawn," 148; Hoffman, "The Norman O. Dawn Collection of Cinematic Effects," 108; Vaz and Barron, *The Invisible Art*, 108

ble frame rates will lead to awkward results with low to no exposure or oscillating intensities in the case of a phase shifts. Unlike other problems, which might be solved gradually to improve quality, efficiency, and practicability, interlocking is a vital requirement that has to be fulfilled from the outset.

An early article in the German *Kinotechnik* from 1919, mentioned in the *International Photographer* later as portraying the first application of rear projection, revealingly describes a setup of stop motion animation that circuits the problem of phase shifting simply by using discrete and noncontinuous exposures.[18] George E. Turner in his account on special effects history names *Sahara* (Arthur Rosson, 1919) as the first production that uses synchronized projector and camera movements for rear projection. The interlock then is still mechanically. Both devices are connected with an 80-foot drive shaft that runs across the stage floor—a trip hazard for the actors that still does not produce satisfying results.[19] Cameraman Paul E. Eagler had made his entry to the movie industry at the age of eleven as a projectionist and later runs several movie theaters himself in San Diego. So it comes as no surprise that he engages the projector and not only the camera for doing image compositing.[20]

The mechanical interlocking system used for *Sahara* does not prove to be a viable option and the replacement of mechanical through electrical interlocking is one part of the implementation of rear projection around 1930. The rigid drive shaft gives way for a simple cable that also provides more flexibility in length and positions. The elements that are needed to interlock projector and camera by that means are synchro systems—i.e., couplings of at least two synchro motors of which one controls the other(s) (fig. 4.1). The controlling and the controlled unit in such systems are at their core both electrical motors. But one of them is used as a generator that not only delivers an electrical current but also the information of its actual rotor position. This reassessment of a technical structure and its combination into a setup of mirroring units resembles that of rear projection system with projector and camera itself as the latter two are effectively different in their application but not in their fundamental structure.

What later is known as synchro systems originally is presented and trademarked by General Electric as Selsyn systems in which Selsyn is a portmanteau term for 'self-synchronizing.' The company's employees Edward M. Hewlett and Waldo W. Willard file an original set of patents for the concept in September 1921 that is followed and backed by various others.[21] But the Selsyn concept goes back to 1914 as the patentees describe in their company's journal. "The best known use of the Selsyn system is in connection with the control of the great locks of the Panama Canal to duplicate in reduced size on a

---

[18] See Konrad Wolter, "Neue Trick-Möglichkeiten," *Kinotechnik* 1, no. 2 (1919): 10–12; J. Henry Kruse, "New Projector for Background Process Shots," *IP* 5, no. 5 (June 1933): 23.

[19] Turner, "The Evolution of Special Visual Effects," 46.

[20] A 1946 portrait of Eagler in the *American Cinematographer* (the only informative source on him at all) praises him for establishing "the first stage exclusively for trick work" at the then new Thomas Ince Studios in Culver City (later RKO-Pathé, today Culver Studios) for *Sahara*. The Ince studio only opened that year with three large glass stages as they were usual for silent film production. Glass stages disappeared quickly with sound films in behalf of enclosed sound stages. A trick stage in 1919 amounts to one that has a control light situation—another point were effects and sound complement each other. Eagler later works at MGM where he supervises process work until 1933. See W. G. C. Bosco, "Aces of the Camera: Paul Eagler, ASC," *AC* 27, no. 3 (March 1946): 86, 104–6; Julie Lugo Cerra and Marc Wanamaker, *Movie Studios of Culver City* (Charleston, SC: Arcadia, 2011)

[21] Edward M. Hewlett and Waldo W. Willard, Control System for Ordnance (Patent 1,612,118 [US], filed September 27, 1921, and issued December 28, 1926), Google Patents: US1612118; Edward M. Hewlett and Waldo W. Willard, Position Indicator (Patent 1,551,393 [US], filed September 15, 1921, and issued August 25, 1925), Google Patents: US1551393; Edward M. Hewlett and Waldo W. Willard, Means for Accurately Reproducing Angular Movements

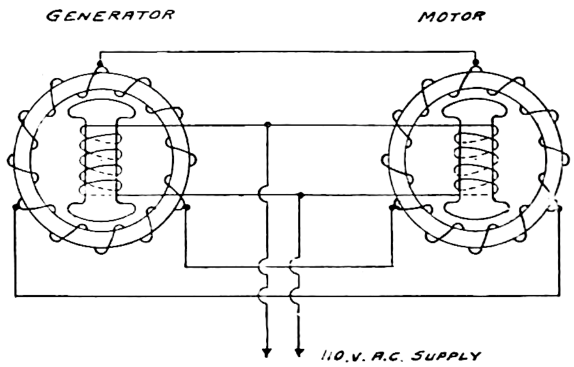


Fig. 4.1: Selsyn or later synchro system with transmitting and indicating units. In the motor unit the rotor is moved by a dynamic electromagnetic field as in every electrical motor. The structure of the generator unit is basically the same but the externally moved rotor by means of electromagnetic induction here causes currents in the surrounding windings. The currents are translated into three phases that represent the exact position of the generator rotor that is reproduced by the one in the motor. The synchro motor on the left, thereby, functions as a measuring and transmitting device while the depending motor on the right indicates the status of the other.

control board the movements of the lock gates and fender chains and to indicate visually at all times the height of the water in the canal and the position of the water gates and valves."[22] A Selsyn system can be understood as one of remote control with passive or active ends. The information of a rotation angle is transmitted either to be watched or to be executed. In the case of the Panama Canal the signaling function still dominates as the article by Hewlett and Willard suggests. While the water gates are actively operated by pumps and motors, Selsyn systems are used to provide a feedback on the current states of the gates.

The entertainment industry is in need of active remote controls—i.e, setups in which the state of one film movement automatically determines another. At the SMPE meeting in September 1928 two systems are presented for synchronizing image and sound for projection in theaters. One is by H. M. Stoller from the Bell Telephone Laboratories and the other by William H. Bristol representing his own business. While they do not mention General Electric's Selsyn system in their talks, in the following discussions they are both asked about how their respective systems relate to it.[23] Bristol here points out that the notion of electrical interlocking can be traced back at least to a turn-of-the-century patent he has licensed by German Carl Joseph August Michalke, an employee of Siemens.[24] I do not want to explore the technical details of the different systems here. What seems to be more relevant is that electrical interlocking is already available for some time but it needs a specific application—i.e., the joint presentation of sound and image from discrete devices—and engineers like Stoller and Bristol to solve that problem to set the stage for General Electric to dominate that field later. GE is neither the originator of self-synchronizing motors nor the first to apply them to the sound issue but they have the weight to stabilize the solution.

(Patent 1,559,524 [US], filed September 15, 1921, and issued October 27, 1925), Google Patents: US1559524; Edward M. Hewlett and Waldo W. Willard, System for the Transmission of Angular Movements (Patent 1,612,117 [US], filed September 15, 1921, and issued December 28, 1926), Google Patents: US1612117.

22 E. M. Hewlett, "The Selsyn System of Position Indication," *General Electric Review* 24, no. 3 (March 1921): 211.

23 See H. M. Stoller, "Synchronization and Speed Control on Synchronized Sound Pictures," *TSMPE* 12, no. 35 (1928): 696–708; William H. Bristol, "An Electrical Synchronized and Resynchronizing for Sound Motion Picture Apparatus," *TSMPE* 12, no. 35 (1928): 778–89.

24 Carl Joseph August Michalke, Synchronizer for Electric Machines (Patent 649,942 [US], filed December 31, 1897, and issued May 22, 1900), Google Patents: US649942.

The actual Selsyn system seems to enter the field of entertainment not through the movie industry but when it is installed to control the lights of the Chicago Civic Opera House the following year.[25]

Early sound systems that use discs to store the sound track as a first step turn out to be too difficult to synchronize to the image and are replaced with sound tracks that are printed next to the image to connect them physically. But this only possible with the final prints for distribution. During the production phase sound is recorded on a separate film strip that has to be kept interlocked with the image film. The same applies to the screening of daily rushes or other temporary states of a movie. Here an interlocking of separate devices is still needed and constitutes the application for that Selsyn systems are developed in the film industry. According to Crafton, tests of this concept can be traced back until 1923 when Western Electrical starts to record sound on film with a modified camera and links the two cameras via Selsyn motors. But as the company already has gained serious expertise in disc recording, the option of recording sound on film is temporally shelved.[26] When it finally prevails and sound discs and Selsyn systems are found on films sets to interlock the image camera with the sound recording camera, it is a relatively small step to extend that network with a rear projector.[27] Selsyn systems provide the options to distribute, scale, and dematerialize control and, thereby, find their way in several production practices. This applies to the control of light and sound volume in movie theaters or the set. In the course of optimizing rear projection practices, Selsyn systems are also used later to focus projectors remotely.[28]

4.1.2 Stabilizing the Image

Just as projection and photography have to be harmonized in time, they also have to match in their positions. This means that the projected image has to be as stable as the set in front of it. The problem here is that all moving images jitter to different degrees because the film strip may not register precisely after it was transported between exposures. With straight cinematography the tolerance for the resulting jitter is relatively high. But when a projected background moves independently from the studio foreground, the aspired illusion of the composited image is easily destroyed. Therefore, the tolerance for such inaccuracy in film transport is much lower. This is not only the case with rear projection but with all kinds of image compositing. In the first years after the introduction of rear projection this is one of the most common problem that occurs on the set. And it is difficult to find a consensus on what causes the unsteadiness of the projected plate as it can have various reasons: the plate camera, the printer, the projector, or the perforation of the film itself.[29] At

[25] William Ornstein, "G. E. Develops New 'Curtain Light Operator' for Theater," *FD* 50, no. 17 (October 20, 1929): 11; "Sight Replaces Cue System in New Lighting Control: Selsyn Adapted to Light Regulation—Dimming and Changes Controlled From Board Located in Front Curtian—Pre-Setting Feature," *Motion Picture News*, November 2, 1929, 58, 83; "New Theatre Light Control System: Lighting Operator in Front of Curtain Controls Theatre Lights Through Series of Knobs," *Projection Engineering* 1, no. 3 (November 1929): 14–15, 31.

[26] See Crafton, *The Talkies*, 54.

[27] On the introduction of sound see also Bordwell, "The Introduction of Sound"; James Lastra, "Standards and Practices: Aesthetic Norm and Technological Innovation in the American Cinema," in *The Studio System*, ed. Janet Staiger (New Brunswick, NJ: Rutgers UP, 1994), 200–225; Bordwell and Thompson, "Technological Change and Classical Film Style."

[28] See Harold Miller and E. C. Manderfeld, "35-mm Process Projector," *JSMPE* 51, no. 4 (October 1948): 373–84.

[29] See Kruse, "New Projector for Background Process Shots."

the end it comes down to the transportation and registration of the film that has to be unified through this chain of production. This affects the producers of cameras and all other devices that process the film, namely Bell & Howell and Mitchell.

The predominant camera of the 1920s is the Bell & Howell Standard 2709. It is a high precision apparatus, likely the first motion picture camera with an all metal box.[30] Due to its high price and the conflicting patents of the Motion Picture Patents Company (MPPC), it needs several years to prevail.[31] The most significant feature of the 2709 in the context of optical effects is its film movement with pilot-pin registration usually referred to as Unit 1 shuttle. Most previous film cameras use a claw that grabs the film, pulls it one frame forward, and holds it for exposure. The film, therefore, is registered with the same component that moves it. This combination results in a certain amount of instability. Pilot-pin registration, on the other hand, separates these two functions and downs the film with its perforation holes on solid pins. The pins are joint with the aperture frame and ensure sublime image stability.

But the main reason for the position of Bell & Howell in the industry is maybe not even the features of individual products but the fact that the company establishes standards. Their camera is preceded by a much smaller and simpler device—a film perforator. Donald Bell, when giving an account of his business life in 1930, is well aware of the relevance of this early product.

> My years of experience as an operator and designer of projectors established in my mind the paramount necessity of producing a standard perforator, this to be our first development toward effecting standardization of all motion picture producing machinery. … Most certainly Mr. Howell joins with me in the belief that the design and making of a perfect perforator, effecting the beginning of standard cine-machinery has been an important factor and of lasting benefit to the moving picture industry now resulting in perfect projection and that this machine, our first undertaking, was our most important offering to the industry.[32]

A first film printer is introduced in 1908 so that Bell & Howell does not simply offer various devices but a system that sets standards for quality and convenience. The printer is improved first 1911 with magnetic light control and again in 1923 as Model D that has same central position in its field as the 2709.

Bell & Howell's main competitor starts in 1919 under the name "National Motion Picture Repair" in Hollywood close to the corner of Santa Monica Boulevard and Gower Street that should become the center of equipment suppliers. As the name suggests (and just like B & H did also), they start with repairing and improving cameras from Pathé, DeBrie, and also Bell & Howell.[33] Therefore, it comes as no surprise when the company (renamed as Mitchell Camera Corporation) introduces its own camera that pretty much resembles the 2709. The Model A, which excels the B & H mainly in convenience, sells about sixty times

[30] The official company history has it that their very first camera is actually made with a wooden box. Two of them are sold to two explorers that later complaint that the cameras were eaten up by ants and termites on an expedition in Africa. This moves the company founders to change the camera body for metal. See Jack Fay Robinson, *Bell & Howell Company: A 75-Year History* (Chicago: Bell & Howell, 1982), 25

[31] Cf. Earl Theisen, "The Story of Bell & Howell," *IP* 5, no. 9 (October 1933): 6–7, 24–25; Thompson, "Initial Standardization of the Basic Technology," 267-68; Koszarski, *An Evening's Entertainment*, 97.

[32] Donald J. Bell, "A Letter from Donald Bell," *IP* 2, no. 1 (February 1930): 19.

[33] See *A Brief History of the Mitchell Camera Corp.*, April 14, 1954.

until it is replaced with the Model B in 1925.[34] The new camera with its Type AB movement offers higher frame rates and less noise. Especially the prevention of noise becomes crucial with the introduction of sound and is refined with the Models NC (1932) and BNC (1934), which are the dominant studio cameras of the 1930s. Bell & Howell only in 1933 manages to answer their customers plies for a more silent camera but can no longer compete with Mitchell. Bordwell and Thompson have pointed out that, unlike the research oriented sound companies, camera suppliers around 1930 collectively are not advancing progress but are impelled by it. Nonetheless, Mitchell can cope better than Bell & Howell with customer needs.[35]

The situation with the two camera suppliers is relevant for optical effects because it upholds an emerging division of the field into regular and process photography. The silent and effective Mitchell for production cameramen on the one side and the precise but noisy and somewhat impractical 2709 for effects people on the other side. The former standard device 2709 becomes a peculiarity, which in fact is used by animators until the 1980s. This opposition is driven further by technical details. Mitchell cameras just like the Bell & Howell feature pilot-pin registration, which makes it suitable for process work. Both camera types have two pins, a larger one that exactly matches the size of the perforation whole and a smaller one located on the opposite edge, which fits only vertically and is undersized horizontally. The problem, though, is that the Bell & Howell pins are located above and the Mitchell pins below the aperture.[36] The different origin for alignment makes the two incompatible when it comes to process work. A background key that was photographed with a Mitchell camera requires a likewise film transport in the rear projector. Bell & Howell at this point can rely on its strong position in the film laboratories where their contact printers dominate the processing of the film material. Correspondingly, process projectors at first are equipped with Bell & Howell movements.

4.1.3 Film Stock

As shown earlier, the introduction of reproduction film stock did not target optical effects work (p. 73). The supporting effect, it had though, was merely unintended. When Eastman Kodak in 1931 introduces its Super Sensitive Panchromatic Type 1217, the company acknowledges with the new negative film stock existing studio practices to compensate shortcomings of previous products that also include process work. "In the past when an emulsion of very high speed was desired for color photography, filter shots, or trick work, it was customary to especially treat the film in some kind of sensitizing bath."[37] The main feature of Type 1217, tough, is that it features double speed with tungsten lights compared to its successor Panchromatic Type II (1218). The prime application is production cinematography on the sound stage.

The first film stock that addresses explicitly the effects domain is intended for background negatives. Two ads in September and October 1933 name the three characteristics that should make Type 1213 the perfect film stock for background photography. These are first

[34] For a detailed comparison of the different movements see Laurence J. Roberts, "The Mitchell Camera: The Machine and Its Makers," *JSMPTE* 91, no. 2 (February 1982): 141–52.

[35] Bordwell and Thompson, "Technological Change and Classical Film Style," 120.

[36] See John P. Kiel, "Film Registration Systems Used in Process Photography," *JSMPTE* 71, no. 1 (July 1962): 493.

[37] Huse and Chambers, "Eastman Supersensitive Motion Picture Negative Film," 21.

of all the fine grain, second “adequate speed,” and finally its processing characteristics.[38] The latter feature, though not further explained, should express that the film base is protected against shrinkage during the development and drying that might cause unsteadiness in the projected images. The speed is about the same as that of the till recently standard Type 1218. This means that cinematography for rear projection just lags two years behind production cinematography when it comes to film stock. Another ad in January 1934, captioned “A Question Answered,” relates the new product very clearly to the recent change of production practices: “What big picture today does not include backgrounds that call for composite photography? The answer is obvious.”[39] One of the first major productions that actually uses Type 1213 Background Negative is *State Fair* (Henry King, 1933, see p. 148).[40] Agfa later follows Eastman Kodak with its Finopan film stock.[41]

Rear projection not only profits from (or becomes feasible through) the fine grain background film stock but also because of the faster films that are available for sound stage work. In the very first article that covers rear projection in the *American Cinematographer* in January 1932, Ralph G. Fear names the recent fast films by Eastman Kodak and Dupont as one basis for the technique and intensified projector lights for wide screen formats as the other.[42] Light and film stock in the context of the closed sound stages become complementary factors that converge and allow for rear projection as real time compositing. The concept itself, in the account of supplier Fear, is so old that the patents that cover it (by Sontag, Goetz and others) have already expired.[43]

4.1.4 Screens

A screen for rear projection is an object that by definition has to combine two antithetic requirements: It has to be transparent and opaque at the same time; transparent because it should allow for as much light as possible to pass from its back to the front; and opaque as it should catch and refract the same light to actualize the latent image for the camera in front of it. With Latour we can describe it as intermediary—i.e., “what transports meaning or force without transformation”[44]—and mediator—i.e., what actively leaves an impact—at the same time.

The screen for Paul Eagler’s *Sahara* rear projection was “made of silk especially woven in New York to Eagler’s specification.”[45] But the first widely accepted option for rear projection screens around 1930 is glass as a progress report in the SMPE *Journal* suggests. “Considerable interest is being evinced by several of the West Coast studios in the recently revived process of composite photography which consists in photographing action in front

38 Eastman Kodak Company, *A New Film for Composite Shots*, ad, September 1933, 41; Eastman Kodak Company, *Extremely Fine Grain*, ad, October 1933, 348.

39 Eastman Kodak Company, “A Question Answered,” *JSMPE* 22, no. 1 (January 1934): 80.

40 An article by distributor Brutalator falsely describes the film stock as having a gray back to avoid halation but this feature could not be verified through other sources. “‘State Fair’ is Film Triumph,” *IP* 5, no. 1 (February 1933): 20

41 “Technical Progress in 1935,” *AC* 16, no. 12 (December 1935): 512.

42 See Ralph G. Fear, “Projected Background Anematography: A New Method of Making Composite Photographs,” *AC* 12, no. 9 (January 1932): 11–12, 26.

43 Fear himself holds several patents related to motion picture technology but not process work. He worked for Famous Players-Lasky in the 1920s and started his own business as an equipment provider.

44 Latour, *Reassembling the Social*, 39.

45 Turner, “The Evolution of Special Visual Effects,” 46.

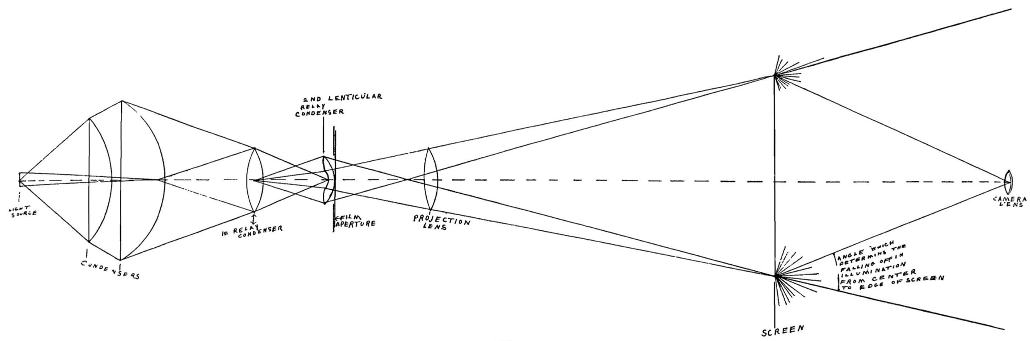


Fig. 4.2: Emergence of the hot spot due to screen material and projection angles.

of a large (ground) plate glass upon which is projected the desired background for the action."[46] It is not evident why glass is a primary choice. It might be a direct transfer from the glass shot technique where the transparent material is partially covered with paint. In the case of glass projection screens this polarity persists. The glass itself is transparent and only by the process of sand-blasting it is furnished with a non-transparent layer. But glass screens have several problem that make them finally impracticable. They are expensive, their size is limited, and they are also dangerous as they break easily. Cinematographer Arthur Campbell in 1934 reports in the *American Cinematographer* of an incident where a glass screen broke and "amputated an arm as cleanly as any guillotine."[47] In contrast to the issues of interlocking and film stock, the glass screen works a transitory solution that shows the concept of rear projection is viable as a commercial practice. The drawbacks of the material then trigger further research for alternatives that will be described below.

4.1.5 Hot Spot

Closely related to the contradictory screen requirements is the problem of the hot spot. This in fact is the most talked about issue regarding rear projection in the early 1930s. Engineer Hartley Harrison in 1934 describes it as follows.

> Now, in order for the transmission of the screen to be high so as to obtain sufficient exposure on the negative, the diffusion of the screen must be low, yet in order to pick up the marginal light from the screen, the screen must have a high diffusing property, and these two opposites cannot be reconciled, with the result that all translucent screens with sufficient transmission qualities to give adequate exposure allow a large percent of the projected beam to pass through the screen and the hot-spot condition is apparent to the observer or camera from any position which is directly in line with the projector, or which is the zero angle.[48]

Apart from the material of the screen the other factor that influences the captured image are the angles of incidence of the light beams. With an even screen the outer beams are depicted weaker than the ones that hit the screen close to the center (fig. 4.2). The rays passing through the screen pretty much unrefracted are inevitably stronger than any of

[46] Glenn E. Matthews et al., "Progress in the Motion Picture Industry," *JSMPE* 17, no. 6 (December 1931): 916.
[47] Arthur Campbell, "A Fireproof Process Screen," *AC* 14, no. 10 (February 1934): 406.
[48] Hartley Harrison, "Problems of Background Projection," *AC* 14, no. 9 (January 1934): 353-54.

Fig. 4.3: Visible hot spot the in the background in *County Hospital* (1932)

the refracted ones. The angle between an unrefracted ray and one that hits the camera lens defines the amount of fall-off in illumination from center to edge. I will come back to different options to solve this problem later. Harrison himself suggests "to progressively increase the illumination from the center of the projection screen to the edge in order to compensate for angle loss."[49] An example of how the hot spot becomes apparent can be found in a street race in the Laurel and Hardy comedy *County Hospital* (1932) from the Hal Roach Studio (fig. 4.3). Looking back at the movies of the early 1930s, the problem seems less significant than the central role it takes in period discourses would suggest. What makes it a significant issue is that it concerns a more widespread network than for example the problem of screen material. It involves more people, devices, and practices because there is a bigger variety of possible solutions. Avoiding the hot spot might be the task of improved screens with varying densities or special refraction patterns. It might be avoided by inserting a slide into the projector with a concentric gradient that compensates the different light intensities. Or it can be controlled by increasing the distance between projector and screen. The last option is not only a technical solution but as an symbolic act of claiming territory—rear projection sets suddenly are in need of more space than traditional ones—it is in one line with the high aspirations of the new technique.[50]

4.2 Early Rear Projection at Fox

In the early summer of 1930, Fox is producing *Liliom*, a movie based on the play by Ferenc Molnár and directed by Frank Borzage. The title hero Liliom (Charles Farrell) is a carousel barker who starts a romance with a girl, Julie (Rose Hobart). The theme is the disorientation of youth, petty crimes, and resulting failure. In the case of Liliom this is paid with his life after the girl gets pregnant and he is involved in a failed hold-up. For his suicide he spends ten years in Purgatory before he is tentatively allowed to return to Earth. The sets of the movie are often reduced and stylized and resemble more a theater stage than a movie set. The acting is likewise histrionic and pronounced in this early talkie. This world is not 'realistic' in the way Hollywood will define realism in the following years. This should be emphasized when writing about Liliom's ascension by train that follows his suicide.

49 Ibid., 386.
50 See Edouart, "Economic Advantages of Process Photography," 9-10.

(a) Julie (Rose Hobart) mourns over her dead lover when a train arrives through the window.

(b) Liliom (Charles Farrell) actively watches the first rear projection to appear in the movie.

(c) Dulled window with changing lights behind.

(d) Indirect fidgety light in the compartment of the suicides.

Fig. 4.4: *Liliom* (1930)

When the girl mourns the laid out Liliom in a big empty room with a prospect of the fair where they met and got entangled, a train approaches from the depth of the space through the window until it fills the entire image (fig. 4.4a). The dead Liliom boards the train that, thereupon, ascends into a (miniature) cloudscape with high rise viaducts. It is in this 'heavenly' atmosphere that the train's interior and exterior meet through the windows by means of rear projection. The scene proceeds with a tracking shot along the aisle that first follows Liliom and then pauses with him when he sees the first window and the processed cloudscape (fig. 4.4b). This is something that would not be possible with the established traveling matte processes as the movements of the layers could not be synchronized. The physical space of the stage is needed to render this linkage convincingly. The camera can only move because the rear projection as a setup is a static element of the set. Wondrousness and displacement alike seem to shape Liliom's view on/through the window. When he first catches sight of the window and its prospect, he stops and enters the compartment to watch it closer. While he does not show puzzlement to his kidnapping and the flying train itself, the prospect of the window is something that he (as much as we) have to get used to. Whenever the exterior location is regarded as less relevant in the following scenes, the windows of the wagon are depicted in a simplified way. When Liliom sees other passengers, the windows of their compartments are either shown as dulled glass with lights passing by or off-screen by flickering lights in the room (figs. 4.4c and 4.4d).

Fig. 4.5: Actors flying over a miniature city in *Just Imagine* (1930) combined with the color-separation process. Rear projection screen in such a size are not yet available and possibly could not be mounted in the required angle.

The setting of the passenger train in the sky proves favorable for the application of rear projection in its infancy. The window specifies a compact size for the projection screen and the cloudscape is so distant that no direct linkage to the train, its speed or its movements, is needed to render a convincing relation. Also the high-key exterior and the low-key interior build a similar uncertain connection where the difference in luminance no longer can be read simply as technical deficiency but suggests a specific factual or symbolic situation—heaven simply is lighter than the train compartments and the latter is the site for obscure parleys. Sometimes it seems that the structure of the glass is still perceptible but it merges well with the passing clouds.[51]

Just like *Liliom* the science fiction and musical movie *Just Imagine* (David Butler) is often referred to for featuring the primal application of rear projection in Hollywood. Both films premiere within a short timespan in October and November 1930, respectively, and, therefore, are presumably in production at the same time at Fox. The imagery of both is artificial but while the artificiality of *Liliom* derives from its theatrical style and origin, *Just Imagine* with its vast cityscapes, which are inspired by *Metropolis* (1927), has an inherent need for optical effects. The imagined New York of the year 1980, where the story takes place, is a $200,000 miniature model, which has to be combined with the live action.[52] Compositing is done with rear projection and the color-separation process. The Dunnings advertise their participation in the production and it is safe to assume that they are responsible for most of the process shots.[53] There are still too many problems to be solved with the new process.

The first appearance of a rear projection in the movie is similarly accented as in *Liliom*. Two friends with the futuristic names of J-21 (John Garrick) and RT-42 (Frank Albertson) sit by a large roof window that is matted and does not reveal city or sky. J-11 stands up to call up his fiancée and walks over to a device mounted into a wall that turns out to be

51 Note that German cameraman Guido Seeber in 1927 writes that he used rear projection also for train windows for Paul Wegener's lost film *Lebende Buddhas* (1925). Guido Seeber, *Der Trickfilm in seinen grundsätzlichen Möglichkeiten* (1927; Frankfurt/M.: Deutsches Filmmuseum, 1979), 149

52 See "Imagining New York City of 1980," *IP* 2, no. 10 (November 1930): 30–31; Ralph Hammeras, "An American Cameraman in American Studios," *IP* 7, no. 5 (June 1935): 20, 24.

53 See Dunning Process Company, *Just Imagine!!*, ad, November 1930, 42; McCulloch, "Boo! It's Only Hollywood!"

(a) Rear projection video phone.

(b) Window prospect of the animated city processed as rear projection.

Fig. 4.6: Rear projection in *Just Imagine* (1930)

a video phone. The screen is switched on and the image lights up—initially blurred and then focused (fig. 4.6a). Even though the screen only measures approximately 2 × 3 feet, the fall off towards the corners and the hot spot in the center are clearly perceptible.[54] Shortly after that scene, the entire group of the two friends and the fiancée find themselves in front of a window that is bigger than the rear projected screen but shows similar deficiencies in its depiction of an animated cityscape with airplanes (fig. 4.6b). Due to their lack of size both projections remain pieces of the set instead of becoming virtual sets themselves.

Trying to detect an agent behind the windows of rear projection, turns out to be difficult or at least uncertain. Neither Fox Film as a company nor any of its employees actively represents the techniques installed at the studio in period publications or by means of patents like others do. While other studios are mostly associated with specific people, Ralph Hammeras, who is in charge of optical effects at Fox, is too often omitted in such cases. A sole article by him remains as generic as its title "An American Cameraman in American Studios" and simply takes position for the entire American effects community without designating what either he or Fox have contributed to the asserted accomplishments.[55] On November 10, 1931, at the 4th Academy Awards ceremony, Fox Film is honored with a Class II Certificate for their "effective use of synchro-projection composite photography."[56] It is the first time that the Academy honors scientific and technical achievements; individuals are only denominated two years later. In the patent pool of 1936 Fox contributes two pending applications that apparently are not granted later. It remains unclear whether these were related to rear projection and whether it is Hammeras who applied for them.[57] Hammeras, though, does find recognition for his work on *Just Imagine*. Together with Stephen Goosson, the regular art director at Fox, he is the same year nominated in the category Art Direction. (They share a screen credit for "Settings.") At the very first Academy Awards he had already received a nomination for the one-off category "Engineering Effects"—won

54 Just like the futuristic cityscape this scene is clearly inspired by a similar scene in *Metropolis* (Fritz Lang, 1927), which was realized the same way technically.

55 See Hammeras, "An American Cameraman in American Studios."

56 Academy of Motion Picture Arts & Sciences, "The Academy Awards for Scientific or Technical Achievement," *Technical Bulletin* (Hollywood) 1937 (March 4, 1937).

57 See *Conformed Copy with Photostats of Signatures of Agreement for the Granting of Licenses under Patents in the Field of Composite Background Photography*.

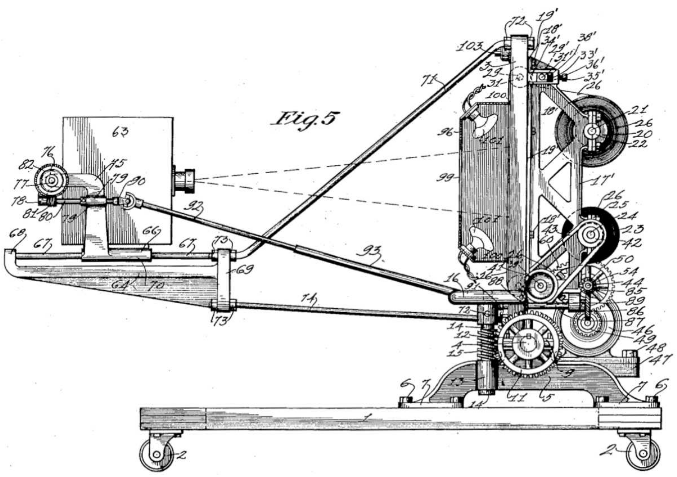


Fig. 4.7: George J. Teague, *Means for Producing Animated Cartoons*, US Patent 1,292,149, filed March 22, 1916

by Roy Pomeroy for his sound effects for *Wings* (1927)—without association to any specific production or technique. (Regular awards for “Special Effects” are only introduced in 1939.)

Hammeras has a education in fine arts and in 1915 begins to work as a background artist at the Realart Studio. He manufactures and photographs titles, glass shots, and miniatures at several other studios thereafter. His entrance to optical effects by means of fine arts and matte painting later leads to a patent (filed in 1923) that claims to improve an older patent by Walter Hall for glass shots (p. 59). The basic concept is the same. A glass plate is positioned between camera and a full-size but partial set which is then completed by a painting on the glass. Hammeras adds details to this practices: a dark blue lens, that enables the cameraman or painter to see the composited set with the relative tones as they are registered by the orthochromatic emulsion of the time; a mirror is set up above the camera to reflect light from the set on the glass painting; and semi-transparent elements are integrated into the glass painting to simulate windows. Instead of an improvement one might speak of an adjustment or a redefinition of the Hall process according to motion picture practices. Telling in this regard is that while Hall uses a landscape e.g. an exterior view as an example, Hammeras points out that the method is likely more useful with artificial sets (i.e., in the controlled environment of the movie stage). The entire method in both cases is developed out of the concept of central perspective but while Hall describes his glass shot process as a fine artist, working in movies and doing set design there, Hammeras is manifested here as an experienced cameraman with a fine arts background.[58] The year before filing the application Hammeras had started to work with animator Willis O’Brien on preliminary tests for what finally will become Harry O. Hoyt’s *The Lost World* (1925). The fact that Hammeras chooses an indoor stage to illustrate his patent is revealing in this context as artificial and stable lighting was crucial for O’Brien’s stop motion work but an exception for live action that was either shot outdoors or in glass-roofed studios.[59] According to Rolf Giesen besides of O’Brien and Hammeras also George Teague works on

[58] Hall, Method of Making Pictures, Patent 1,372,811 [US]; Hammeras, Method of Making Motion Pictures.

[59] First National later moves the production of *The Lost World* from West to East Coast, where the studio erected stages with strong arc light to set something against the California sun. But this did not change the production environment for Hammeras and O’Brien. Cf. Don Shay, “Willis O’Brien: Creator of the Impossible,” *Cinefex*, no. 7 (January 1982): 21

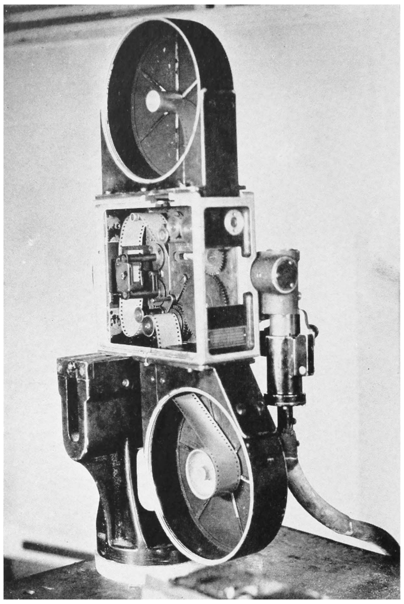


Fig. 4.8: Rear projector printed by *International Photographer* in 1939 and dated 1928 indicates that George Teague actively worked on the technique before he is hired by Fox Film in 1929.

The Lost World.[60] Teague is the same age as Hammeras (born 1894) and grew up in Los Angeles, where he was trying several craftsman jobs before in 1913 he starts to work for D. W. Griffith's cameraman Billy Blitzer. For Blitzer he engineers effects. He works at other studios until he joins O'Brien and Hammeras on *The Lost World*. Compared with Hammeras Teague is more of a craftsman. He possesses patents for a spring actuated gear for cameras that guaranties steady film transport without electric motors and for a device to produce animations.[61] The latter apparatus synchronizes a camera with a continuous paper roll that depicts drawings. Filed already in 1916 this patent depicts the same structure of later optical printers and rear projection set-ups—just with a different and more simple form of display (fig. 4.7).

When First National is annexed by Warner in 1929 Hammeras, O'Brien, and Teague move to Fox. But O'Brien does not stay there and begins to work for RKO while Hammeras and Teague will do *Liliom* and *Just Imagine*.[62] They bring along their previous work on rear projection and continue their tests at Fox. Hammeras's tests with rear projection can be traced back until August 1927 but initially prove unsatisfying due to lack of high intensity arc lamps for projection.[63] One year later Teague builds a projector (without lamp house) that primarily addresses the problem of image stability (fig. 4.8).

As we have seen in *Liliom* and *Just Imagine* the early rear projection at Fox does not solve the screen problem. The studio still uses plate glass in 1932—then blasted with a mixture of sand and flour of widths up to twenty feet.[64] The Academy Award suggests that the merit of Fox (or Hammeras and Teague) lies in the synchronization of the devices. But synchronization turns out to be a contested field. On the one hand, the stimulus comes from the protagonists in the domain of the recently introduced sound techniques. A transfer, though not to be far to seek technically, might comprise legal threats. In 1933 the studio's patent

60 Giesen, *Special Effects Artists*, 156.

61 George J. Teague, Camera-Actuating Means (Patent 1,262,284 [US], filed December 21, 1915, and issued April 9, 1918), Google Patents: US1262284; George J. Teague, Means for Producing Animated Cartoons (Patent 1,292,149 [US], filed March 22, 1916, and issued January 21, 1919), Google Patents: US1292149.

62 Shay, "Willis O'Brien," 14; Giesen, *Special Effects Artists*, 72-73.

63 Compare comments of Hammeras in a discussion following a presentation of Paramount's Edouart at the Academy: Edouart, "Economic Advantages of Process Photography," 10.

64 Ibid., 7-8.

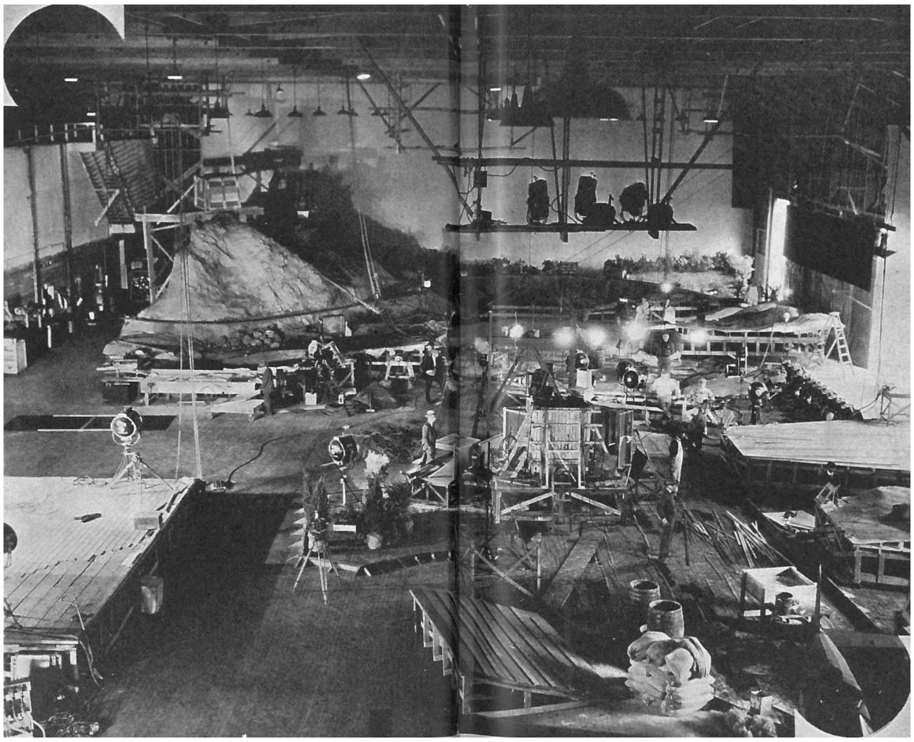


Fig. 4.9: "Biggest Stage on Earth Devoted to Special Effects Process Work"

lawyer, Alfred Wright, tells to his colleague at Warner Bros, William E. Beatty, that Fox had developed a "non-infringing apparatus"[65] *without* synchronous coupling of camera and projector in order not to infringe patents owned by Warner—and that the technique had not yet been used in a commercial picture.

4.3 Special Effects at Warner Bros around 1930

The years following the success of sound are shaped by Warner Bros maybe more like by other studios not only because it produced the first talking movies, *The Jazz Singer* (released October 1927) and *The Singing Fool* (released August 1928). Talkies are an immediate box office sensation and vault the former poverty row studio to a major player. Already before *The Jazz Singer*, Warner had constantly acquired smaller studios, distributors and theaters. But the new prosperity enables them now to absorb the much bigger but struggling First National Pictures. After a rivalry with Fox Films in September 1928 Warner borrows the notable amount of $100 million and, finally, buys a majority of First National shares.[66] Besides of First National's theaters Warner obtains the company's studio in Burbank, which only opened in 1926 and until today is the location of Warner.[67]

At the time of the merger the special effects team at Warner Bros is just about to gather around the production of *Noah's Ark*. It is headed by Fred Jackman who brings in former collaborators from the Sennett studio: Hans Koenekamp, Vernon Walker, and Henry

65 Cited after William E. Beatty to Abel Cary Thomas, letter, March 24, 1933, box 3508A, WBA.

66 Sperling, Millner, and Warner Jr., *Hollywood be Thy Name*, 147.

67 Though Warner Bros quickly accomplishes the merger, First National is kept as a brand and financial unit until 1936 for fiscal reasons. For the sake of simplicity I will, furthermore, write about Warner Bros after the merger as one studio.

Fisher. At the First National studios in Burbank Alvin Knechtel, Ralph Hammeras, and Willis O'Brien are working. In the April 1929 issue of the *American Cinematographer* the fused department, under the direction of Jackman, presents itself working at the "Biggest Stage on Earth Devoted to Special Effects Process Work."[68] Its roster now looks not only impressive but also comprehensive when it comes to individual skills. The listed staff covers every aspect of period special effects from glass shots (Hammeras), photographing miniatures (Walker), and laboratory work (Fisher) until optical printing (Knechtel). Additionally, engineer James A. Gibbons is chief of a Scientific Research Department. *Noah's Ark* is the showcase project of this team and a photo shows Jackman standing in the middle of a vast space of alleged 150 × 300 feet entirely under his control. First National's production *The Divine Lady*, which also features some respectable process work and was just released in March, is not mentioned at all. The two teams are still working in two locations: the Warner people around Jackman at the former Vitagraph studio in East Hollywood and the First National team under Hammeras in Burbank. As a matter of fact, they never really will work together. The First National department mostly disintegrates while Warner moves its production to Burbank in the fall of 1929. Alvin Knechtel, who is not only an expert in optical printing but also a pilot, tragically dies in a plane crash in July that year. As mentioned before, Hammeras and O'Brien leave for Fox; the latter after a short time is moving on to RKO where Walker is on his way to become department head. Henry Fisher goes back to Sennett. (The only former First National employee that veritably stays is Doris Farrington, a former actress, script writer, researcher, and cutter who now serves as Jackman's secretary who budgets and catalogs the process work.)

Warner's claim to conduct research is related to the studio's role as a technical innovator with the Vitaphone sound system. To enforce their sound system against competitors with professional research facilities, it seems appropriate to emulate their deeds. At an ASC meeting in October 1930 Warner presents "undoubtedly the finest and most advanced motion picture camera thus far developed."[69] The heads of Camera Machine Shop, Electrical Engineering, and Laboratory, Albert Tondreau, Frank Murphy, and Fred Gage, with the explicit encouragement by Jack Warner have come up with a camera that on second view seems less revolutionary that it's announcement might suggest. More often than naming real innovations, an article in *American Cinematographer* emphasizes the conventionality of most features. Warner does not develop a camera from scratch but rather makes certain improvements. The first one is to give the apparatus a double-wall case to silence it and make it suitable for sound stage work. The second feature is a lens that allows focusing with shifting elements without rotating them. Therefore, the extend and capabilities of the scientific research should be put into perspective. But it shows the aspiration of the former poverty row studio that has become one of the major players in Hollywood within in a very short time.

This mixture of change and ambition after the merger with First National is favorable for Jackman and Koenekamp who know each other since their common years at the Mack Sennett studios. Koenekamp in a lot of ways is concealed by his boss Jackman but is later described by his colleague Byron Haskin as "the greatest effects man of them all."[70] He started his career in the movie industry as a projectionist when projectors were still hand-cranked and learned that he could increase the effect of movies by changing their pace at the right time. This is a technique he also uses after he is hired by Sennett as a camera-

[68] "Biggest Stage on Earth Devoted to Special Effects Process Work," *AC* 10, no. 1 (April 1929): 20–21, 35.

[69] William Stull, "Warner Brothers' New Camera," *AC* 11, no. 8 (December 1930): 11.

[70] Quoted after Giesen, *Special Effects Artists*, 98.

man. Koenekamp then not only experiments with speed but also with shooting indoors to become independent from the weather and he proofs to have a unique sensitivity for exposures. A later portrait about him in the *American Cinematographer* says that "in 1916, when there were no meters or nonhalation film, he created a mild sensation among those who were in a position to appreciate his accomplishment by shooting a two reel picture, that included interiors, exteriors and stopmotion, so evenly exposed that the picture was printed on one light!"[71] After several years with Sennett, Koenekamp closely works with comedian Larry Semon who is notorious for his demanding aspirations when it comes to making impossible camera work possible. In 1932 and 1933 he applies for three own patents that are all related to a better synchronization of projector and camera. Two of these are granted and become parts of the patent pool.[72]

4.4 Development of a Concept and Patent History

In regard to the Jackman-Pomeroy-Interference that begins in 1931, I have so far only covered the aspects that are directly related to the disputed origin and proprietorship of the color-separation process and the denouement through the patent pool of 1936 (p. 105). But in the course of the interference, Warner Bros does not only develop Fred Jackman's narrative on the genesis of that process. The studio also investigates alternative methods for image compositing as correspondence between Warner's William Beatty and his colleague H. D. Hineline, who works for Warner's subsidiary United Research at the East Coast, shows. Among other things a variation of the color-separation process with alternative types of light is evaluated. "The suggestion is to use ordinary white light upon the actors, and for the background, a parabolic reflector focused [*sic*] upon the camera lens and illuminated with very deep red or infra-red radiation."[73] But these alternatives are either covered by the wide ranging claims of Pomeroy and Dunning or dysfunctional like when Hineline writes that "the ultra-violet is objectionable because of the sunburning the actresses would get!"[74]

Therefore, as a direct reaction to the lawsuit by Paramount et al, Warner Bros in May 1931 switches its process work to rear projection. Beatty has a decisive influence here as he urges Jackman to give up the color-separation process. In a later memo he writes: "Our use of the translucent screen type of shot grew out of the two suits brought by Paramount et al against Warner Bros, First National and Fred Jackman. After studying the Pomeroy patent involved in this suit, I did not feel too happy about our defenses and was instrumental in having Jackman adopt an alternative."[75] But rear projection as an alternative has to be protected against possible future claims by other parties. So far the documented unsuccessful attempts to apply rear projection—by Dawn and Eagler—did not lead to any patent that at least covers the concept. Fox will receive an Academy Award later that year but it is unclear whether the studio strives for any patents in this regard.

[71] W. G. Campbell Bosco, "Unseen Aces of the Camera: Hans (Koney) Koenekamp," *AC* 25, no. 1 (January 1944): 30.

[72] Hans F. Koenekamp, Composite Motion Pictures (Patent 1,980,806 [US], filed August 17, 1932, and issued November 13, 1934), Google Patents: US1980806; Hans F. Koenekamp, Composite Motion Picture (Patent 2,004,992 [US], filed October 30, 1933, and issued June 18, 1935), Google Patents: US2004992.

[73] H. D. Hineline to William E. Beatty, letter, April 10, 1931, document 3539A_F015999_008, WBA.

[74] H. D. Hineline to William E. Beatty, letter, April 14, 1931, document 3539A_F015999_008, WBA.

[75] William E. Beatty to Mr. Hazen, inter-office communication, August 15, 1935, document 3539A_F015999_005, WBA; see also *Narrative in re Patents*.

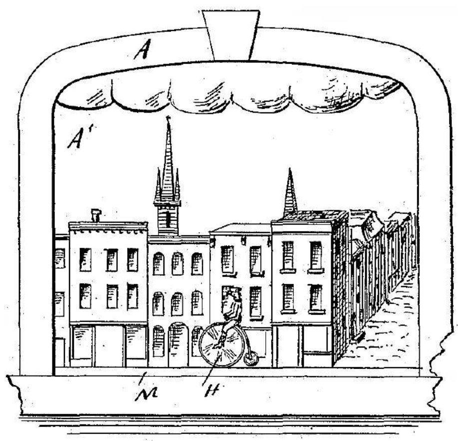


Fig. 4.10: Francis Seymour, *Apparatus for Producing Scenic Effects*, US Patent 486,606, filed November 22, 1892

Warner starts to file patent applications for the projection process but there remains the question whether existing patents have to be accounted for. So, in this process of legal conflicts and applications for new patents, canons of older patents are built by the different parties—i.e., the examiners of the Patent Office and the solicitors of the studios. One of these canons is later presented by Hineline in the SMPE *Journal*. Hineline's article presents a genealogy of process techniques that is based on patents alone and that is later adopted by academic texts without calling into question the intents of the author—who is admittedly not identified as an employee of Warner Bros. Nevertheless, the account of Hineline shows how deceptive such a legal approach that collects single patents without asking for their effects and interdependencies can be. Such a historiography is not one of explaining developments but a technique of making itself. Another trace of this process is collection of patents that is preserved at the Margaret Herrick Library under the title "Joseph and Katherine Westheimer Collection of Patents." Joseph Westheimer was a longtime employee of Warner Bros who starts his special effects carrier in the late 1930s. The collection not only contains a wide range of process patents but also expert assessments of single concepts that are relevant here. As a matter of fact, anonymous comments within some papers even suggest that they come from Warner's legal opponent Paramount. Westheimer—though he already works at Warner as a messenger boy in 1931—is still too young to be actively involved in the compilation. It is important to understand that there is no public discourse on rear projection until it is actually introduced in the early 1930s. The following genealogy is first of all one that is assembled in retrospect by the involved parties and that necessarily leads to this point.

The oldest patent that gains relevance in the discourses of the 1930s is one by Francis Seymour from 1892 entitled *Apparatus for Producing Scenic Effects*. Seymour's patent depicts an application of stage rear projection by means of a stereopticon (fig. 4.10). But the defining feature of his concept is not the rear projection itself but rather the idea to shift the slide showing "trees, fences, houses" horizontally and to create a moving scenery on stage. In front of the screen any vehicle may be placed—"boat, wagon, bicycle, horse, train of cars"—creating the illusion of actual movement. Seymour substitutes the movement of a vehicle with a depicted movement within the background.[76] The notion that any depicted movement can be understood and produced as a relative movement of different image

[76] Francis Seymour, Apparatus for Producing Scenic Effects (Patent 486,606 [US], filed January 23, 1892, and issued November 22, 1892), Google Patents: US486606.

elements is a crucial conceptual step towards rear projection as it will by applied in the movies. But it is also in one line with other cinematic compositing techniques as the cyclorama used at the Sennett studio or driving shots from Frank Williams and the Dunnings show.

The recording of such images involves further challenges. A photography patent by Rudolph M. Hunter shows how to produce studio photos with arbitrary photographic backgrounds without touching up and masking the images. Instead he suggests to arrange a translucent screen behind the person to be portrayed and project a stereopticon slide from behind on it. While he saves the trouble, expense, and quality loss of a finishing process, he is not yet able to produce a composite image with a single exposure. Instead the patent suggests to photograph the person while the screen is covered with black velvet and in a second step expose the rear projection while the figure in front remains unlighted. Presumably the successive exposures are necessary because the low light intensity of the stereopticon requires a significantly longer exposure.[77] Single exposure, however, is offered by Hugo Sontag from Germany who holds international patents for a similar setup. This is one of the few patents that are actually discussed before the Jackman-Pomeroy-Interference (p. 47). The way Sontag suggests to balance the different lights is by using different colors to which the negative is more or less sensitive. Thus he suggests to coat the front of the rear projection screen with a color like orange to which the negative is less sensitive. He does not explain how this would not effect the already weak stereopticon light.[78] The applicability of both patents, by Hunter and Sontag, is not ascertained.

Three patents by Lura S. Brainerd are mentioned for the first time in June by Jackman in internal correspondence regarding the lawsuits from Paramount et al. “I still think you should follow up the Brainard [*sic*] Patent, if for no other reason than to keep some outside party from getting it and attempting to capitalize on the thing.”[79] Brainerd is dead by the time and her patents are without owner as she was not married and had no children. She had applied for the patents consecutively in the first half of 1915.[80] About herself little is known. Besides of the patents she hardly left traces. She was born in 1863 in Meriden, Connecticut, and later moved to Brooklyn, New York. In the US Census files of 1910 and 1920 she first shows up as an unemployed designer of ladies’ gowns and later as a working milliner. She lives as a lodger with different families. In 1910 she apparently produced a movie entitled *The Eternal Law* that is lost and only known because her production company Lusobra (short for Lura Sophia Brainerd) registered it for copyright. She dies at some point in the 1920s. When Warner Bros finds out that her unclaimed patents might be useful, they track down her brother John Marshall Brainerd who lives as a laborer in Chester,

77 Rudolph M. Hunter, Art of Producing Photographic Negatives (Patent 656,769 [US], filed March 19, 1897, and issued August 28, 1900), Google Patents: US656769.

78 Sontag, Process for Photographing Objects with Projected Backgrounds.

79 Fred W. Jackman to William E. Beatty, letter, June 9, 1931, document 3502A_F015996_001, WBA.

80 Lura S. Brainerd, Method of Making Motion-Pictures (Patent 1,296,471 [US], filed January 18, 1915, and issued March 4, 1919), Google Patents: US1296471; Lura S. Brainerd, Apparatus for Making Motion-Pictures (Patent 1,301,538 [US], filed February 3, 1915, and issued April 22, 1919), Google Patents: US1301538; Lura S. Brainerd, Method of Producing Moving Pictures (Patent 1,307,846 [US], filed June 9, 1915, and issued June 24, 1919), Google Patents: US1307846.

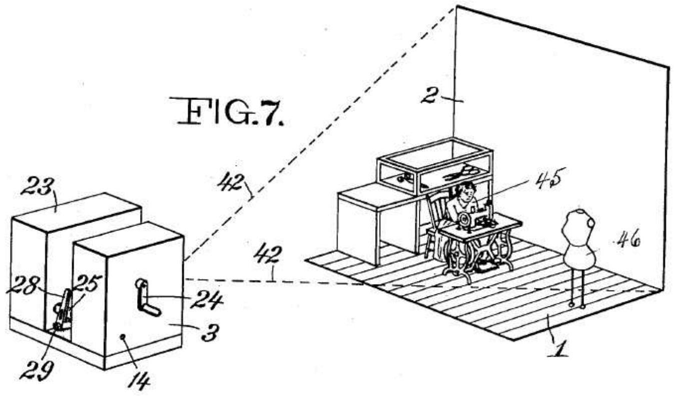


Fig. 4.11: Lura S. Brainerd, *Apparatus for Making Motion-Pictures*, US Patent 1,301,538, filed February 3, 1915

Connecticut.[81] In July 1931, he and his daughter lay claim to the patents and within days sell them to Warner's subsidiary United Research for $250. United Research immediately resells the patents to Warner for a symbolic amount of $1.[82]

All three patents call for solving the same problem or production task. They all make use of the same situation as illustration—a woman with a sewing machine sitting in her studio. The scene with Brainerd's alter ego is supposed to be augmented with animated characters. In the first patent the animated cartoon is placed inside a box in front of the camera. A single frame can always be seen through a window so that the camera simultaneously films the cartoon and the live action set behind. The transport mechanisms of both, animation film and the negative inside the camera, are interlocked mechanically through a chain.

The second patent is an advanced version. Now the animation is projected from front onto the set. Projector and camera are placed next to each other and likewise interlocked—this time with a clutch mechanism (fig. 4.11). The third patent is a condensed version of the second. The projected film is no longer defined as an animated cartoon. Therefore, the claims are broader and in the context of the legal conflicts later this is likely the most relevant patent of the three. In none of the texts does Brainerd give details about how the prepared film looks like and how it is supposed to blend with the live action set. One can say that in all cases the film is 'projected' from front. In the first patent the camera and projector are still one device. And while later with rear projection the live set automatically works as a mask for the background film, with the Brainerd techniques both layers simple overlap like with double exposure. The effectiveness of the Brainerd process is questioned at court by Pomeroy. In internal correspondence Beatty here refers to a test made by Jackman that should verify the usefulness of the patents (fig. 4.12). He names two drawbacks of the process that are results of the front projection: The background is laid onto the actors and possibly perceivable on them if they do not wear dark costumes and the actors drop shadows on the projection screen. Taken as a whole, Beatty shows himself satisfied with the test. "I am assured that the results would have been considered commercial as of 1915 when the

[81] For the history of the Brainerd/Brainard family see Lucy Abigail Brainard, *The Genealogy of the Brainerd-Brainard Family in America: 1649-1908* (Hartford: Case, Lockwood & Brainard, 1908).

[82] Warner Bros Pictures, Inc., *Bill of Complaint*, NARA's Pacific Region (Riverside), Perris, CA, January 28, 1932, Equity V-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS.

Fig. 4.12: Rear projection test at Warner Bros studios to prove the functionality of the Brainerd patents, 1932. This photo was enclosed in a letter by William Beatty as evidence. But it remains questionable what can be seen here. Neither is the front projector as foreseen by Brainerd identifiable nor does the shadow the actress drops on the background fit with straight front projection.

Brainerd patents were filled, and that these results are just as good if not better than many process shots which were included in motion pictures which were commercially released at that time."[83]

Hineline observes in his article that after the Brainerd patents there is a break of ten years before something vaguely similar comes up with the process of Eugen Schüfftan.[84] The interruption claimed by Hineline can be doubted and is first of all expressive for Warner's needs in this matter. The combination of the early but still not expired Brainerd patents, which cover the general idea of a projection process, and the studio's own patents, which describe functional devices and practices, is all that Warner needs.[85] This combination of the older concept patents and current functional ones is exactly what Warner in 1936 will contribute to the patent pool.[86]

83 William E. Beatty to Abel Cary Thomas, letter, April 5, 1932, document 3508A_F015989_001, WBA.

84 Hineline, "Composite Photographic Processes," 293.

85 Outside the USA Josef Behrens works on rear projection in Germany and applies for a patent in 1918. But as Behrens does not influence discourses in Hollywood he will not be taken into further account here either. See Joseph Behrens, Verfahren zur Aufnahme beweglicher Lichtbilder (Patent 323,939 [DE], filed November 16, 1918, and issued August 12, 1920); Claus Grosskopf, *Josef Behrens: Erfindungen 1918-1947: Rückprojektionen, Kinematographie, Optik, Maschinenbau* (Berlin: Gebr. Mann, 2007)

86 Warner's US patents in the pool without equal British versions: Brainerd, Method of Producing Moving Pictures; Brainerd, Apparatus for Making Motion-Pictures; Brainerd, Method of Making Motion-Pictures; James A. Gibbons, Method of Photography (Patent 1,980,795 [US], filed September 22, 1931, and issued November 13, 1934), Google Patents: US1980795; Fred W. Jackman, Composite Picture (Patent 1,945,193 [US], filed May 4, 1931, and issued January 30, 1934), Google Patents: US1945193; Fred W. Jackman, Composite Motion Picture (Patent 1,926,722 [US], filed September 8, 1931, and issued September 12, 1933), Google Patents: US1926722; Fred W. Jackman, Sound Accompaniment for Composite Motion Pictures (Patent 1,979,937 [US], filed May 23, 1931, and issued November 6, 1934), Google Patents: US1979937; Fred W. Jackman, Mounting for a Flexible Translucent Motion Picture Screen (Patent 1,960,632 [US], filed October 11, 1932, and issued May 29, 1934), Google Patents: US1960632; Fred W. Jackman and

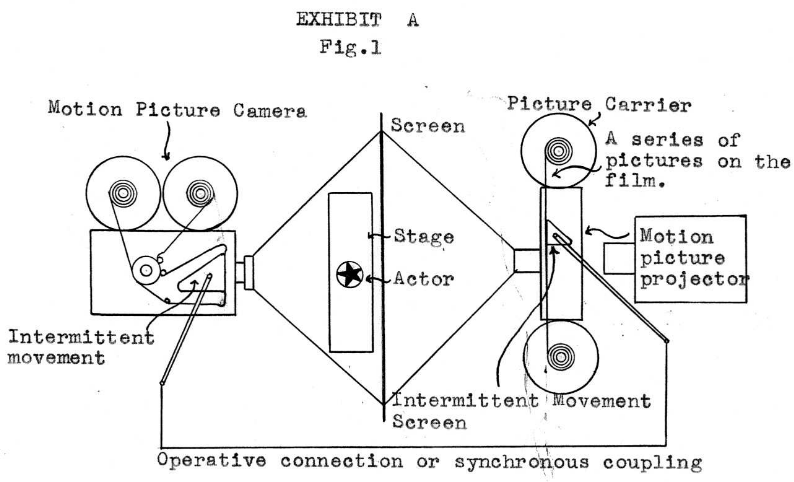


Fig. 4.13: Figure depicting the rear projection process from Warner's bill of particulars. It differs from the figures in the Brainerd patents and resembles Jackman's own still pending patent applications. The similitude concerns not only the technical setup but also the visual language with the star emblem.

While Warner Bros is still threatened by the law suits from Paramount, Dunning, and Pomeroy, the studio uses the Brainerd patents to riposte. On December 22, 1931, Beatty sends a letter to Pomeroy informing him that Warner owns the Brainerd patents and that they regard his production of rear projection equipment as an infringement of their rights. The same letter is sent to the Hal Roach Studio and on January 28, 1932, Warner Bros files a bill of complaint against both at the District Court of Southern California. The Roach studio disputes the originality and functionality of the Brainerd patents with reference to the older patents of Sontag, Dischner, Messter, and others. The defendants argues that "Lura S. Brainerd in her lifetime never attempted to operate or employ the said methods or apparatus of said Letters Patent in suit, or either thereof, nor licensed any one under the same, and regarded said Letters Patent as inoperative and worthless and abandoned the same and the alleged and pretended inventions alleged to be covered thereby."[87] The current practice of rear projection is considered as common knowledge in the industry and not covered by any patent at all. Pomeroy, nonetheless, concedes that he "furnished to the defendant, HAL ROACH STUDIOS, INC., a motion picture projection head with lamp house, the projection head driven by a Western Electric 'interlocked' motor which was supplied by the defendant, HAL ROACH STUDIOS, INC., all mounted on a studio truck."[88] Furthermore, he names two short films produced at the Hal Roch Studio that uses the technique: *The*

Hans F. Koenekamp, Method of Making Composite Photographs (Patent 1,939,304 [US], filed June 12, 1929, and issued December 12, 1933), Google Patents: US1939304; Koenekamp, Composite Motion Pictures; Fred W. Jackman, Composite Picture (Patent 2,014,435 [US], filed October 12, 1931, and issued September 17, 1935), Google Patents: US2014435; Fred W. Jackman, Composite Motion Pictures (Patent 2,015,272 [US], filed May 6, 1931, and issued September 24, 1935), Google Patents: US2015272; Fred W. Jackman, Composite Motion Pictures (Patent 2,004,987 [US], filed January 8, 1934, and issued June 18, 1935), Google Patents: US2004987; Fred W. Jackman, Focusing Device for Cinematographic Apparatus (Patent 2,008,020 [US], filed November 15, 1932, and issued July 16, 1935), Google Patents: US2008020; Fred W. Jackman, Color Separation for Composite Motion Pictures (Patent 2,013,886 [US], filed May 6, 1931, and issued September 10, 1935), Google Patents: US2013886; Fred W. Jackman, Composite Photography (Patent 2,030,300 [US], filed October 25, 1933, and issued February 11, 1936), Google Patents: US2030300; Fred W. Jackman, Composite Motion Pictures (Patent 2,004,986 [US], filed May 25, 1931, and issued June 18, 1935), Google Patents: US2004986; Koenekamp, Composite Motion Picture.

87 Hal Roach Studios, Inc. and Roy J. Pomeroy, *Answer*, NARA's Pacific Region (Riverside), Perris, CA, September 29, 1932, Equity V-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS, 19.

88 Roy J. Pomeroy, *Answer of Defendent Roy J. Pomeroy to Interrogatories*, NARA's Pacific Region (Riverside), Perris, CA, October 1, 1932, Equity V-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS, 2.

Tabasco Kid (released January 30, 1932) and *Red Noses* (released March 19, 1932) both by director James W. Horne. (Fig. 4.3 shows a slightly later example of rear projection at the Hal Roach Studios.) Like the other court cases this one is suspended until the establishment of the patent pool and then dismissed without prejudice.

In April and May 1931 Warner Bros produces *The Last Flight*, a buddy movie about four traumatized World War I pilots who celebrate the end of the war with a wealthy party girl in Paris. This is a major project for the studio that sells it through its star Richard Barthelmess. It falls exactly in the transitional period when Warner is supposed to change from the color-separation methods to rear projection. The movie has about a dozen scenes that are based on process techniques and sets. As usual the production records do tag process scenes/sets as such but do not specify the technique applied. All of them are shot on Stage 5 on the First National lot in Burbank that the production records already identify as “Process Stage #5.” In the entire industry the term ‘Process’ replaces that of ‘Dunning’ at this time though this does not mean that, concurrently, rear projection replaces the color-separation methods. It only informs other departments that a background is added by the effects department. The specific implementation is left for those who are finally in charge.[89] In the case of *The Last Flight* a script analysis, done to plan requirements and to schedule the production, notes for all effects scenes “Process make up.”[90] Makeup in this regard is rarely mentioned and there is no documentation what exactly is meant by the term. But it seems reasonable that the idea of a special makeup for process shots is to counterbalance the side-effects of the artificial light used for the color-separation process. (In a similar way the insufficient sensitivity of orthochromatic film stocks in the 1920s was encountered with special makeup.) This shows that when the production starts in the middle of April all process shots are expected to be done with the legally contested color-separation process.

The process scenes in the movie cover the entire spectrum of situations suitable for artificial backgrounds in the early 1930s. This starts with close-ups of pilots in their airplanes, people riding an elevator with grill, walking on the street or in this case the platform of a train station, and sitting in a railway compartment with a window (fig. 4.14). The pilot close-ups are showcase shots for the color-separation and rear projection method alike. Their foreground subject has a limited extend while the background is characterized by its physical and causal detachment. Possible problems of conflicting perspectives or absent interactions are avoided. The pilot shots in *The Last Flight* only have one shortcoming, that is the darkness of the foreground (fig. 4.14a). The good quality of the background does not provide any indicator what kind of process Jackman and his department used here. Compared to that the background in the train station scene it looks flat with a lack of distinct highlights and shadows alike. Together with the absence of hot spots and fall offs towards the edges this very likely is still a color-separation process shot (fig. 4.14b). What actually spoils the illusion of a coherent space is the discrepancy of various movements. The plate camera had to perform a tracking that is defining the guiding movement of the shot. But the background image simultaneously jiggles due to an instability of the plate camera or its film movement. The actors on the sound stage are not supposed to move effectively while they pretend to walk. This is done by putting them on a treadmill which seems to give their walking a specific artificiality. All this is recorded by a studio camera that stands completely still. The treadmill by itself is not a new device in film production.

89 The multivalent usage of the term ‘process’ is still common even after rear projection has gained supremacy as a small publication at Paramount shows. Special Photographic Department, *Process*, Prepared under the supervision of W. L. Pereira by Marvin Weldon, pamphlet, Paramount Productions, 1941, MHL

90 *The Last Flight*, production records, 1931, box B00247, WBA.

(a) (b)

(c) (d)

Fig. 4.14: Process shots in *The Last Flight* (1931)

It was used before optical effects in a combination with drum-mounted rotating paintings. Seemingly, it then disappeared with the painted backgrounds but with the process shots in the 1930s is rediscovered and refined. Watching the scene and the self-awareness of the actors on the treadmill, Danks's description of dislocation comes to mind. "In the process, it presents something that is most definitely a movie but also a movie within a movie (that the characters sometimes watch and interact with it but mostly don't)."[91] In the elevator shot the background rushing past has the characteristic light flatness of early rear projections. The actors stare in the direction of the projection but instead of looking at something specific, seem to observe the abstract idea of their own vertical movement (fig. 4.14c). The background in the train compartment scene has a similar gradation than the one in the elevator. The fact that it only occupies the limited area of the window makes the application of rear projection also easier (fig. 4.14d). There is a high chance that the last two scenes do use rear projection and that a switch of methods during the production of *The Last Flight* takes place as claimed by Beatty and Jackman.[92]

Between December 1931 and February 1932 Warner Bros produces Howard Hawks' *The Crowd Roars* featuring James Cagney as a motor-racing champion. The subject of process photography here are naturally the various races. Hawks uses footage from actual contests, location long shots, and process close-up from his actors on the sound stage. The quality and characteristic of the process shots throughout movie varies widely. Often images do not render clearly because the scenes take place in a sand imbued atmosphere. Possible deficiencies of the process merge with added noise (fig. 4.15a). But single shots also show fore-

91 Danks, "Being in Two Places at the Same Time," 69.

92 Frederick Jackman, *Answer to Plaintiffs' Interrogatories*, May 5, 1932, Equity T-110-C/Equity T-111-H, Civil Law Case Files, compiled 1907-1938, ARC Identifier 613585, NARA RS.

(a) (b)

Fig. 4.15: *The Crowd Roars* (1931)

ground of high quality and a background with significantly more grain (fig. 4.15b). These can be identified as rear projection. But the extent of usage shows that Warner already at the end of that year seems to be content with the quality achieved.

4.5 Paramount's Turn to Rear Projection

Paramount since the deal with the Dunning Process Company controls all relevant patents for color-separation processes—a generally accepted method of compositing. But still the studio will become one of the major users of rear projection in later years. This is happening despite of the fact that Warner Bros, the studio's opponent in the Jackman-Pomeroy-Interference, manages to control this process by legal means. We have seen how this contradictory situation is solved through the patent pool as far as patent issues are concerned. The question remains how and why Paramount undertakes this conversion as they are not forced to do so like Warner Bros is.

Paramount's special effects cinematographer Alexander Farciot Edouart will be a dominant figure in this regard. This is not only the case within his own studio but he is going to be one of the most visible representatives of rear projection for the entire movie industry of Hollywood. He publishes several articles explaining the then current state of rear projection, summing up the history of the technique, and participates in working committees, writing recommendations for standards and specifications. As a spokesperson he represents miscellaneous entities like his own department at Paramount Pictures, process photography experts, cinematographers in general, techniques, devices, and concepts of feature film production. Of course he also represents himself, but not all of his actions can be understood by reducing them to expressions of Edouart, the process cinematographer. As a matter of fact Edouart, the person, leaves hardly any traces. There are few photographs of him in the archives of the motion picture industry. Today his name only appears if occasionally one of his Academy Award statues shows up as memorabilia at an auction for sale.

Biographical data about him is sparse but enough for our purpose. Edouart was a native (Northern) Californian born 1895 into a family of fine artists and photographers. As a teenager he picks up an interest in photography. At the age of 16 he already exhibits color bromoil transfer prints in national photo shows. In 1913 at Catalina Island he witnesses the production of *The Sea Wolf* by producer, director, and actor Hobarth Bosworth. Two years later he starts a job as assistant cameraman at Boswarth's Realart Studio. During

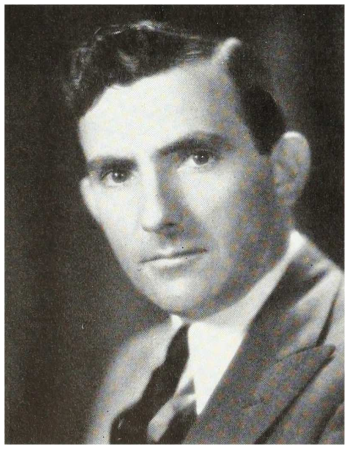


Fig. 4.16: Farciot Edouart, ca. 1939

World War I he serves as a cameraman for the US Army Signal Corps in France. After the war he works for two more years in Europe as a photographer for the Red Cross. After his return to Los Angeles in 1922, he continues his studio career at Famous-Players Lasky, the successor of Realart Studio. He starts to specialize on special effects photography. And after the incorporation of his employer into Paramount Pictures in 1927 he becomes the head of their newly established Transparency Process Department. He keeps this position until 1967 when the studio closes the department without warning and finishes his contract.[93]

Edouart also works on the color-separation process in the 1920s but it is not documented how his contribution and relation to Pomeroy at Paramount looked like.[94] It should be remembered that the process—if it is not applied by the Dunnings themselves—is usually called transparency process and Edouart's unit is the Transparency Process Department. This name stays even after the transition to rear projection that is referred to by the same term. During the transition period, in case of doubt, usually the older process is named color-separation transparency and the new one projection transparency. In the following, I will show with two movies produced in 1931 at Paramount that the transition to rear projection is not happening significantly later there than at other studios.

Richard Wallace's movie *Man of the World* is about an American expatriate in Paris (William Powell) who blackmails American tourists with their painful affairs in France until he falls in love with a girl (Carole Lombard) who accompanies her uncle on a trip. With only a few exceptions the production does well without process shots. The majority of the scenes play indoors and the large urban back lot at Paramount studios acts well for the streets of Paris as long as the scope of scenes is limited to nearby houses. But on their first rendezvous Powell and Lombard cross a bridge over the Seine and behind them the nightly city comes to light (fig. 4.17). The cityscape is (and looks like) a matte painting except for the added lights and the moving water. The scene begins with a tracking shot that follows the actors walking on the bridge (fig. 4.17a). When they come to a stop, there is a cut to a medium close-up (figs. 4.17b and 4.17c). Later the scene cuts back to a medium shot that is slightly closer than the first one (fig. 4.17d). Looking at the foreground alone, the changing fields of view show a montage that is simple and straight-forward. What irritates though

93 See Walter Blanchard, "Aces of the Camera XVIII: Farciot Edouart, ASC," *AC* 23, no. 6 (June 1942): 256, 269–70; "After 52 Years With Paramount: Edouart Given 4 1/2-Days Exit Notice," *Variety*, October 13, 1967, 1, 4; "Laudation for Farciot Edouart" (ASC dinner, 1974), MHL.

94 Gordon B. Pollock, ASC Membership Proposal for Farciot Edouart, August 22, 1927, ASC collection, MHL.


(a) (b)


(c) (d)

Fig. 4.17: Different shots from one scene from *Man of the World* (1931) that all feature exactly the same background plate due to the contact printing of the color-separation process.


(a) (b)

Fig. 4.18: At the end of *Man of the World* (1931) the background for these two process shots slightly changes. This might either point to two different plates for color-separation shots or a switch to rear projection during the production.

Fig. 4.19: Burned out highlights and too large persons in the background indicate rear projection in this shot from *Shanghai Express* (1932).

watching the sequence, is the fact that the background remains unchanged in its view and unaffected from the camera's change of position and/or focal length. This effect occurs with traveling matte and color-separation shots as the background key is independent from the studio set and does not reflect changes therein.

It is difficult to say whether this must be considered a mistake or just a matter of carelessness. But the final scene of the movie makes an effort to use an alternative background for a closer view (fig. 4.18). The second scene is also done with the color-separation process but for the closer shot an extra plate was produced. If the scene was done by means of rear projection, a closer position of the camera or a longer focal length would result automatically in a different background. This example makes comprehensible the need for camera mobility that is rarely mentioned as a reason for the change to rear projection. Only if the background plate is translated from an image to a part of the set, its depiction can reflect what is happening on the sound stage.

Later that year Paramount produces Josef von Sternberg's *Shanghai Express* (released February 1932). The train interiors of the movie are all shot at the studio on Melrose Avenue. In several scenes the bypassing landscape can be seen through the windows of the compartments. The perspectives of the studio and plate cameras do not match exactly. The view of the background is too low and subjects sometimes seem to be too close. Presumably, these were filmed from a car from at normal height. Not all backgrounds but some feature burned out highlights that are characteristic for rear projection in its beginning (fig. **??**). The same holds true for the windows themselves that restrict the size of projection.[95] In each sequence they are only visible in a single and basically static shot. But just the first time a window appears there are two tentative and tiny adjustments the studio camera makes when it reacts to movements of the actors that in fact attest the usage of projection. Such movements only become feasible with projected backgrounds on the set. Overall, it can be reasoned that Paramount starts the transition to rear projection during 1931 at about the same time as Warner Bros. But here it is not happening because but despite of the legal situation. The specific implementation in the case of *Shanghai Express* can be described as a primarily technical changeover that takes into account the existing confinements of rear projection but does not yet enforce new aesthetic practices.

[95] The amount of plates though is extensive. The production budget foresees forty different angles here. See *Shanghai Express*, production records, 1931, 187.f-1, Paramount Pictures Production Records, MHL

4.6 Adoption and Presentation of Rear Projection from 1932

On the evening of June 28, 1932, the Technicians Branch of the Academy is holding a meeting at the Paramount studios where Edouart gives a talk about transparency processes.[96] Edouart talks as Head of Transparency Process Photography while his colleague Gordon Jennings is Head of Special Effect. Most studios distinguish between optical and mechanical effects but Edouart explains the distinction and his own responsibilities differently. He sees visible and invisible effects—with himself being in charge of latter ones. Visible effects are tricks that are recognized by the audience as such while invisible effects add production value without notice (hence, the title of his presentation: "Economic Advantages of Process Photography"). The focus on economy is not surprising as all studios face difficulties that year and especially Paramount falls from a profit of more than $18 million in 1930 to a deficit of nearly $16 million in 1932 that will be followed by receivership the next year.[97] But one can also read his classification as one between old and new effects. On the one side miniature, glass shots, or trick shots in general, on the other side the "untouched new fields, unlimited possibilities and close supplementary alliance in combination with straight cinematography"[98] that color-separation and projection processes promise.

Edouart reports of extensive tests for projection screens that have been done with forty-two different materials. Paramount at that time uses "a uniformly sand-blasted plate glass processed on one side and etched with a hydrofluoric acid bath on the sand-blasted side."[99] Sound system, projector, and camera are synchronized; the film transport in the projector head can be exchanged depending on whether still or moving backgrounds are used; and the projection is also flexible enough so that either cameras by Bell & Howell, Mitchell, or DeBrie can be used making cinematographers independent from questions of specific transport mechanisms. The following discussion is concentrated on the hot spot issue and how to solve it. Beside of the quest for better screen materials and treatments this problem is generally encountered with increased distances for the projectors. An employee of MGM reports that at his studio they increased the throw to 106 feet for a screen of 12×18 feet. Limited stage sizes are a major problem for everybody dealing with rear projection.

As a member of the Technicians Branch and a technical expert Edouart as much as the other present effects people takes no account of the legal situation. After all, he is presenting a technique that Warner Bros lays claim to and later that year will sue Pomeroy and the Hal Roach studio about. But Edouart makes himself here known as the studios' expert for process photography and especially rear projection. Besides of his presentation, which will be published by the Academy, he also comes forth with an article in the June issue of *American Cinematographer* that presents rear projection as an already established production practice. Edouart claims that in some cases it provides up to 80% of the final movie.[100]

96 Among the experts who are present at this event are Ralph Hammeras (Fox), John Aalberg (RKO), Fred Pelton (MGM), and Robert Layton (MGM). Not all of them are process cinematographers but simple projectionist or studio managers. There is no indication that employees from Warner Bros do attend.

97 John Douglas Eames, *The Paramount Story* (London: Octopus, 1985), 37; cf. Balio, *Grand Design*, chapter 2: "Surviving the Great Depression".

98 Edouart, "Economic Advantages of Process Photography," 1; reprinted as Farciot Edouart, "Using Projection in Photography," *Motion Picture Projectionist* 5, nos. 10, 11 (August 1932): 21, 22, 34, 22, 23.

99 Edouart, "Economic Advantages of Process Photography," 4.

100 Farciot Edouart, "The Transparency Projection Process," *AC* 13, no. 3 (July 1932): 15, 39.

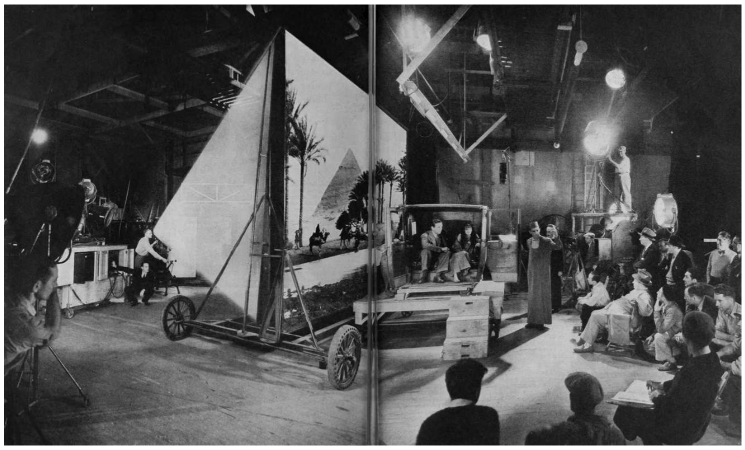


Fig. 4.20: "The Great Pyramids Move to Hollywood And the Egyptian Mummy Comes to Life!" (*Photoplay*, December 1932)

The new method to produce moving images at this point is still something of which itself no images are present in the public. (Edouart's article comes without illustrations.) The first photo that (re)presents rear projection appears in December 1932 in the popular magazine *Photoplay* and depicts a set of Universal's horror movie *The Mummy* (fig. 4.20). The photo shows a highly factitious situation but is nonetheless reprinted next June as part of SMPE's annual progress, which notices an increased use of rear projection as a result of the introduction of special film stock for shooting background plates.[101] The rear projector is positioned much too close to the large mobile glass screen. Palpably the rays of light were added later to the print. The circumstance that the projection perfectly fills the big screen of frosted glass seems likewise unrealistic. Later photographs depicting the practice of rear projection show that it is usual not to project onto the entire screen but only on that part that would be visible for the camera. A smaller projection would also make the position of the projector, which is only identifiable as the source of the fake light and by the position of its apparent operator, more reasonable. The bisected automobile body as such suggests a much closer, frontal shot. Finally, the release version of *The Mummy* does not contain any scene like the one depicted in *Photoplay*.[102] Therefore, a public discourse on rear projection, as it can be traced back in either professional or popular publications, only starts in the summer of 1932 when several studios have already been using the process for up to two years.

(a) (b)

Fig. 4.21: Rear projection connects the two domains of location and sound stage in *Island of Lost Souls* (1932).

4.7 Examples of Early Integration into Contemporary Standards

Paramount's *Island of Lost Souls* is approximately produced at the time of Edouart's presentation for the Academy's Technical Branch and released at the end of that year. The movie, based on H. G. Wells's novel *The Island of Doctor Moreau*, exemplifies well the role of optical effects at this time. The horror movie about a mad scientist, who tries to push on evolution by turning beasts to men is in equal parts shot at the Paramount studios in Hollywood and Santa Catalina Island off the coast of Los Angeles. Catalina already has a long tradition as a location to stand in for all kind of islands in movie productions. (Edouart himself entered the business when watching a movie production there in 1913. See p. 141). The island itself offers various settings including the ocean and is close enough to be integrated into regular production practices. Accordingly, there is little urge to apply optical effects in *Island of Lost Souls*. Apparently though, rear projection is used in four cases. The first is on a boat when the protagonists approach the island. A preceding and straight long shot of the boat and a bigger ship in the background suggests that process technique is primarily used here to transfer sound recording to the stage. At the end of the movie three people leave the island on a small boat while behind them the burning estate of Moreau is visible. This is a night scene and process is chosen because the burning estate is likely a miniature but also because the delicate light situation would be difficult to shoot without process. Finally, there are two virtually identical scenes, both depicting the arrival of people on the island. In the background we see an actual jetty on Catalina Island with people and boats while in the foreground there is a framing entrance to a cave that was built in the studio. In the first scene Dr. Moreau (Charles Laughton) and Edward Parker (Richard Arlen) walk towards the camera (fig. 4.21a), disappear behind the cave frame, and reappear in it—now on the sound stage (fig. 4.21b). In all four cases rear projection is located on the edge between location and sound stage. This means that not only quantitatively the process still has a minor position but that it leaves the two established domains of film

[101] "The Great Pyramids Move to Hollywood And the Egyptian Mummy Comes to Life!," *Photoplay*, December 1932, no. 1, 48–49; J. G. Frayne et al., "Progress in the Motion Picture Industry," *JSMPE* 20, no. 6 (June 1933): 459–99.

[102] The movie contains at least two scenes that use process shots but cannot be unambiguously identified as rear projections. One of them is a driving scene with two people in a car on its way through Cairo that shows one background key through rear and side windows. Another shot shows a desert landscape through an opening door. Both are not impossible to do with rear projection in 1932 but at least untypical as early applications. Besides Brosnan reports that in 1932 Universal (like other studios) builds a sound stage exclusively for effects work. See John Brosnan, *Movie Magic: The Story of Special Effects in the Cinema*, rev. ed. (London: Abacus, 1977), 68

(a) (b) (c)

Fig. 4.22: *Three Cornered Moon* (1933)

production—location and sound stage—substantially unaffected. It does neither enhance imagery nor save larger amounts of money; it simply connects the two established practices with as little intrusion as possible. Compared to the restraint size of windows seen previously the extend of the screen is now increased to about 8×12 feet. A certain haze remains that likely derives from the sand blasted glass surface. The process technique here has the function to link the two domains but no additional value.

Produced by Paramount in the first half of 1933 *Three Cornered Moon* contains a similar extend of process work. Beside of the prevailing cab shot we find a scene with a young couple (Claudette Colbert and Hardie Albright) sitting on a bench in front of a traffic circle in Brooklyn. The entire scene is photographed on a sound stage in front of a screen of similar size than the one used for *Island of Lost Souls*. In the long shot there is a noticeable fall off in light intensity towards the edges of the images that albeit matches tree branches framing the composition. Furthermore, the hot spot sets a focus on the image center with the couple (fig. 4.22a). The montage of the scene exhibits a conventional succession of field of views. The initial long shot, in which the couple buys an apple from a bypassing salesman, is followed by a medium shot of both reading and discussing a page of his theater play (fig. 4.22b) that ends with a pan to the lower left on a painting, standing on the floor. This is followed by two close-ups of him and her (fig. 4.22c) and, finally, again the medium shot of both.

Two things are interesting about this scene. First is a pan that could only be done with rear projection and second is the increasing unsharpness of the background with closer views. In straight photography the latter effect results not only from moving the camera closer to the subject but also from an increase of focal length. With rear projection this effect would turn out less explicitly as the distance between subject and projected background is smaller than it would have to be. In order to simulate the familiar effect the rear projection has to be blurred manually. The auxiliary blur of projected backgrounds is a disputable practice—at least during the establishing phase of process backgrounds as Dunning suggests (p. 83). The result here is a scene that aesthetically does not owe anything to process techniques except for the fact that money was saved just as Edouart had promised. The production practice is adjusted but the style of narration remains unaffected and the process proves its own transparency.

A movie that uses rear projection more extensively is *State Fair*, premiered February 10, 1933, and Fox's most prestigious and gainful production of that year. The success of *State Fair* at the height of economic crisis is owed to the combination of a sentimental rural story and an all-star cast headed by Will Rogers. For the industry it is important that a

(a) (b) (c)

Fig. 4.23: Tracking shot with rear projection in *State Fair* (1933)

movie that—as a SMPE progress report proudly announces—consisted to 65% of process scenes is approved by a wide audience. One reason for the increased technical quality is the introduction of Eastman's Type 1213 Background Negative.[103]

The story of the movie is about a family with two adolescent children in rural Iowa that leaves their farm to visit the annual state fair, an event that brings together farmers for amusements and competitions. Production takes place partly on a farm in Corona, close to Los Angeles, and the Fox studios in Beverly Hills. Basically all longer exterior shots at the state fair are produced by means of rear projection. Striking is not only the scope of process work but also that it is done without concessions in the way of story-telling. There is no substantial change in the composition of shots and the editing of scenes. When the family has put up their tent, the son Wayne Frake (Norman Foster) takes a first stroll around the fair and its amusements. This is a continuous tracking shot of nearly 40 seconds that follows Wayne to look around until he comes to a stop in front of a tent advertising lightly dressed showgirls (fig. 4.23). The image is not only composed of a projected background and the actor in the foreground but has additional layers behind and in front of the protagonist. While he walks looking left and right at the buildup of tents and booths, workers and props float across the image. The proportions are occasionally flawed when extras in the projection appear larger than persons on stage. The relative movements of the various layers do not match exactly, which supports the insincere feeling we impute to Wayne. What is called into action here is a treadmill Norman Forster walks on.[104] Later in two nearly identical scenes with the daughter Melissa (Louise Dresser) and her suitor Pat Gilbert (Lew Ayres) walking through the woods, shrubbery, and trees are pulled along the treadmill to disguise that actors, camera, and the projection screen behind them are not moving at all. After an invisible cut both tracking shots come to an end at a small glade where also the feet of the actors can be shown again.

The high complexity of many shots seem to compensate the deficiencies that still come with rear projection practice here. In the case of *State Fair* this even results in an interesting contrast between the realistic location scenes on the farm and the illusive world of the fair where the two adolescents are experiencing their first love affairs. Cameraman Hal Mohr in retrospect indicated that this kind of effect also has to do with a lack of experience regarding how to produce plates that be easily used later. "Henry King went to the state fair in Kansas and shot all of his process plates there. But he shot all of these plates and everything … livestock halls, livestock, etc, with a 25 mm lens in order to get scope. When

103 Frayne et al., "Progress in the Motion Picture Industry," 463.

104 A later article shows that Teague produces such devices. The use though is not exclusive for Fox productions at that time but can be detected in other studios, too. See Roger Broggie, "New Teague Walking Device," *IP* 9, no. 2 (March 1937): 31

(a) (b)

Fig. 4.24: Transparency issues in *Today We Live* (1933)

it came to building the interiors that had to go with these plates I had to resort to building them in false perspective. In other words, a hog pen tapered back incredibly, in order to meet the perspective of the 25 mm lens. That was a hell of a problem on a lot of that film for that reason."[105]

The parallel descent of the Dunning process as contract work is accompanied by conflicting accounts. In May 1933—two years after Warner has carried out an almost complete transition for rear projection—*International Photographer*'s column reports: "The Dunning Process shots are coming back stronger than ever. It seems the projection shot has been tried and found limited in possibilities. In the Joan Crawford picture, *Today We Live*, which is being made at M-G-M, there are forty-one Dunning shots. In this studio alone, Dunning has worked on five different pictures. Photographic quality is the feature that will bring this process back into the wide use it enjoyed a few years ago."[106] As earlier examples have shown, the Dunnings are bustling when it comes to producing favorable press coverage. *Today We Live* is a World War I aviation movie based of a short story by William Faulkner that is directed by Howard Hawks between December 1932 and February 1933. Process work is needed for extensive air fight sequences with attacks on German factories and two torpedo boat rides. Several close-ups of the pilots in the air show signs of the color-separation process—i.e., highlights like explosions in the nightly sky seem to overlay the foreground (fig. 4.24a). Hawks uses aerial footage from *Hell's Angels* (1930) but also process shots from his own *The Dawn Patrol* (1930) like a Dunning shot of German air defense soldiers (fig. 4.24b).[107]

As the example of *Today We Live* shows 'technical quality' is not a primary reason to choose a technique. There seem to be agreements on a standard of quality that has to be reached. But beyond that it is more important how a process fits into the predominant production practices as much as techniques of narration. For *Today We Live* MGM goes back to existing footage and possibly even to the same toned transparencies. The other examples that actually use rear projection do so because it stays invisible not only as an image but also as a practice. The technique does not impose any more constraints than the color-separation process. It allows even for a few more liberties like the slight camera movements that suddenly become possible.

105 Leonard Maltin, *Behind the Camera: The Cinematographer's Art* (New York: New American Library, 1971), 121.

106 Ty, "From Ty's Hollywood Notebook," *IP* 5, no. 4 (May 1933): 29.

107 Barry Salt mistakenly classifies the shots from *The Dawn Patrol* as early rear projection, shot with "large screens, presumably made of some thin white cloth." Salt, *Film Style and Technology*, 230

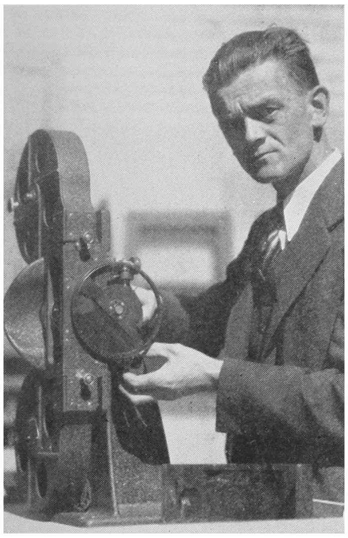


Fig. 4.25: William Neumann with his projector head for rear projection, 1933

4.8 Improvements in Devices and Infrastructure

4.8.1 Rear Projectors

Parallel to these early successful applications, the equipment is gradually improved. This effects mainly projectors and screens that are 'good enough' to commence rear projection in 1930/31 but are still far from delivering satisfying results. As the market for such specialized devices is too small to attract regular providers of equipment, they are developed locally in Hollywood. In regard to rear projectors a contemporary article describes the role of "Hollywood's Service Army."

> The manufacture of motion picture projectors has always been centered in the east. It might be expected, then, that projectors for projection background photography would have been developed there. Instead, virtually all of the process projectors used in the world's major studios have been designed and built by two firms in Hollywood: Teague, and Neumatz. The reason is simple: a projector may be superlatively steady for theatrical work and yet wholly unfit for the more exacting demands of the projection background process.[108]

While the synchronization of projector and studio camera controls temporalities, it remains a challenge to harmonize the relative positions of the frames through the chain of reproductions. This is maybe the most relevant difference between a regular and a process projector that it avoids any jitter of the projected background. This issue is still addressed even years after rear projection has become a regular production practice. According to cinematographer Henry J. Kruse the industry had great difficulties to locate the source of the problem.

> Not realizing what caused this trouble—the camera, printer, projector and film perforations were successively blamed, when, as a matter of fact the difficulty was found to be irregular perforations; each machine, camera, printer and projector using a different perforation hole, thereby causing lack of register and subsequent unsteady projection.

[108] "Hollywood's Service Army," 11.

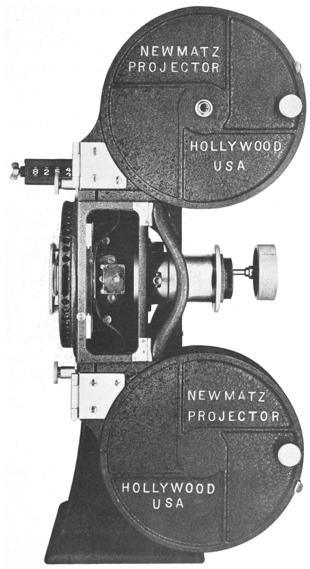


Fig. 4.26: Newmatz projection head, 1936

> William Neumann was one of the first to realize that this trouble could be overcome by constructing a special projector and using the same perforation holes as the camera and printer.[109]

The second feature that Teague and Neumatz are working on is the increase in luminous power.

A few words have to be said about the names Neumann, Neumatz, and Newmatz here. William Neumann, who starts his business around 1929 and about whom no further information are available, is the developer of a projector especially for process work that, therefore, bears his name. Three years later the same named company "Neumann Process Projector Company" is re-branded to "Newmatz Process Projector Equipment Company" and the projector becomes a Newmatz projector. This has lead to confusions and even generated the name 'Neumatz' as a mixed form. Neumann himself now is called William Matz. He initially gives his name for his invention but when his invention changes its name, his name is likewise modified. In the following I will call the person William Neumann and the device the Newmatz projector as it was mostly known in the industry under this name. The Newmatz projector is a very compact and mobile projection head of 24 inches height that can be combined with any regular lamp house. Integrated is a Western Electric camera motor that ensures synchronization with the studio camera. But at its core it features a Bell & Howell camera movement that is supposed to provide the most steady registration. It is interchange with its Mitchell equivalent in case the plate was shot with such a camera. Camera and projector are converging by using same parts and thereby carry forward the temporal synchronization.

4.8.2 The Saunders Screen

Writing about the Saunders screen is difficult simply because all information that is available goes back to as much as one single source, a short article by RKO's special effects department head Vernon Walker published in *American Cinematographer* in October 1932. Less then half a year after its first experimental deployment in the test photography for

109 Kruse, "New Projector for Background Process Shots."

King Kong (Merian C. Cooper and Ernest B. Schoedsack, 1933), which is supposedly the studio's first use of rear projection at all, Walker presents the technique itself as well established. "Since it is, therefore, in every-day use in practically every studio, any detailed discussion of the process itself at this time would be merely an unnecessary repetition of what is already well known."[110] Besides Walker aligns himself to the canonical definition of what a good screen for rear projection needs: large size, even illumination, and safety. The Saunders screen reduces the hot-spot by more than 50% and increases the overall brilliancy by over 20%. It is made of cellulose and acetate, "resembles a large sheet of waterproofed canvas,"[111] and is just like a canvas mounted on a frame. The screen cannot break like the glass plates used to and it does not burn. Unlike with the expensive and fragile glass, size seems to be unlimited. The biggest version installed so far measures 17 × 23 feet, the one at RKO is 16 × 20 feet. "The appearance, therefore, of a non-breakable, inexpensive, non-vitreous screen for this work is a development of an importance second only to the invention of the projection process itself."[112]

Walker's statement of the case, his depiction of the Saunders screen as a significant contribution to a well established process must also be read as an expression the enthusiasm over an extremely fast (but far from finished) development. Sidney Saunders himself only becomes visible with his screen—in case of the article literally in a photo. He neither has a history nor is he heard of again. Walker introduces him as an engineer in the studio's Mechanical Department. Later he is usually entitled Head of the Paint Department. It, therefore, remains unclear how he comes up with the idea to develop a screen of cellulose-acetate. We can only try to describe the situation or network in which the new screen emerges. In 1932 there is an increased interest in rear projection in all major studios in Los Angeles. The ground glass or frosted glass screens are generally seen as an unsatisfying and dead-end option. Whether RKO uses rear projection with glass screens in production or maybe only makes tests remains unclear. What distinguishes the situation at the studio from others is the work that animator Willis O'Brien is doing (behind closed doors) since 1930, first on the unfinished *Creation* and later on *King Kong*. While there is no evidence for an ongoing research on rear projection in any of the studios, O'Brien with his experiences from *The Lost World* has not only a vital interest in *miniature* rear projection but due to his independent mode of production also a good possibility to work on it. What gives him an edge, is the reduced size of his sets. Morton writes that O'Brien experiments with different materials which is easier with such tiny screens as needed for animation than with the conception of an image that has to be as big as possible. O'Brien ends up with using rubber for his screens because the structure of cellulose is visible in his scale.[113] But for testing the materials and molding the screens he might need somebody like Saunders who successively does not invent something but scales it up for other needs. Saunders in 1933 receives a technical award in Class III from the Academy ("Honorable Mention in the Report of the Board of Judges") that he shares with Fox Film and with Fred Jackman from Warner Bros. The unnamed person in charge at Fox is presumedly Ralph Hammeras who had worked with O'Brien and Jackman at First National before the company was annexed by Warner in 1929. This further queries the relevance of Saunders as a person.

110 Vernon L. Walker, "Saunders Cellulose Screen Reduces 'Hot Spot,'" *AC* 13, no. 6 (October 1932): 11.
111 Ibid.
112 Ibid.
113 Ray Morton, *King Kong: The History of a Movie Icon from Fay Wray to Peter Jackson* (New York: Applause, 2005), 44.


(a) Rear projection shot that perfectly depicts the foreground but a background with more grain and burned out highlights.


(b) While the sky in preceding straight shots of the approaching train is completely even, in this rear projection shot the light intensity falls off towards the edges of the background as can be seen in the upper left corner. (The darkness on the right side is the actual smoke of the train.) The train approaches until it has reached a larger than life size. Then the movie cuts to a medium long shot from the side that depicts an actual crash of train and carriage.

Fig. 4.27: *The Conquerors* (1932)

Directly before the presentation of the Saunders Screen, in August and September 1932, William A. Wellman directs for RKO *The Conquerors*, a movie that spans the lifetime of a Midwest banker played by Richard Dix. The production mostly takes place on location in Northern California. Compositing, therefore, is not needed to make studio sets stand in for resemblant outdoor locations. Dunning shots are no longer scheduled. The major part of the photographic effects budget goes for titles, regular transition, and the work on the montage sequences by Slavko Vorkapich (p. 230). But the budget also lists 400 feet (about 4.5 minutes) projection prints and one day work for a projectionist and a process grip. The sequence they are needed for is a train crash that causes the death of the protagonist's young son. A crowd of people is gathered to welcome the first train to come to their small town. Meanwhile, an intoxicated family friend takes the son for a ride on his horse carriage. He looses control and the carriage eventually collapses on the railroad tracks. The son is trapped under the wrack and killed by the approaching train. Live-action for the scene is shot on location on August 12 and 13 by cinematographer Edward Cronjager. A few days later Lloyd Knechtel photographs "glass projection shots" that combine the carriage with different backgrounds (fig. 4.27).[114] The first is a quite regular drive process shot (medium close-up, slanting angle) that is mainly produced this way to ensure image steadiness as much as dialog clarity (fig. 4.27a). The second was still defined as a miniature shot in the screenplay: "The train hits the buggy squarely – splintering it. We see the bodies of Dan and Junior fly out of the buggy."[115] The fact that the miniature idea was abandoned is likely due to the expected problems to produce a convincing crash that involves a train, a carriage and two human bodies. The shot would look significantly different from the one that is now in the movie. But earlier productions have shown that this process shot could haven

[114] See *The Conquerors*, production records, 1932/1933, folder A 614, box 20 P, RKO Radio Pictures Studio records, PASC.

[115] Robert Lord and Howard Estabrook, "The Conquerors," final script (July 16, 1932), 101.

been easily made with the Dunning process. The reason that rear projection (still with a huge glass screen) is chosen in this case, must be explained also with lower costs. While a Dunning plate, which is not yet the final shot but only the transparency used for it, recently was reduced from $350 to $175, additional costs for the two rear projection shots sum up at about $30 for labor and material. This seems a legitimate reason for an investment in a special projector and screen that are always available and adds just another reason why studios change for rear projection.

4.8.3 The Bodde/Transco Screen

In the beginning of 1934 cinematographer Arthur Campbell writes in the *American Cinematographer* about a new fireproof process screen that was just installed at Farciot Edouart's department at Paramount. Campbell claims that it is the result of several years of collaboration between the inventor Bernard M. Bodde (falsely named Benjamin), Farciot Edouart, and Roy Pomeroy. Pomeroy had already left Paramount Pictures years before but despite of his layoff as a director still maintains relationships with his former studio. His own company is located in close vicinity to Paramount on North Highland Avenue and had furnished the Hal Roach Studio with rear projection equipment (p. 138). Bodde's Transco Products Co. resides in between on Santa Monica Boulevard and Vine Street. It is unclear whether there is any contact with Sidney Saunders who develops his screen literally next door on the RKO lot. Both, the Saunders and the Bodde screen, are always presented as single inventions. This means that historical accounts choose either one of them to be the origin of the modern rear projection screen. The only case where they are mentioned together is a progress report in the *American Cinematographer* that points to the advanced features of the Bodde screen and makes it look like a successor. As a replacement of ground glass, both screens offer larger size, smaller weight, and increased safety. Furthermore, the Bodde screen is supposed to solve the hot spot problem by means of active gradual refraction of the projection light. Bodde picks up the separation between transparent base and diffusing surface as it is known from sand-blasted glass plates. The base of his screen is made of sprayed cellulose acetate or nitrate. In a second step ground quartz together with cellulose is applied. This layer, which fractures the light, varies in thickness to increase diffusing in the center and, thereby, reduces the hot spot problem.

There is no hint that Bodde tries to patent his screen at this time. And it is unlikely that he knows that Fred Jackman has a pending application that shares basic ideas. This starts with the rejection of glass screens as dangerous and expensive, continues with the technique of spraying the screen, and, finally, Jackman also uses cellulose acetate as an inflammable material.[116] The main difference between the two screens is that Jackman achieves the roughened surface not by a second material but by actually using the sand blasted glass he wants to replace as a matrix to spray the new material on. This way the structure of the glass is copied on the cellulose acetate. Additionally the Jackman method foresees to spray the solution without any pressure from above and not like in Bodde's case from below (fig. 4.28).

[116] Fred W. Jackman, Method of Making Translucent Picture Projection Screen (Patent 2,071,344 [US], filed September 7, 1932, and issued February 23, 1937), Google Patents: US2071344.

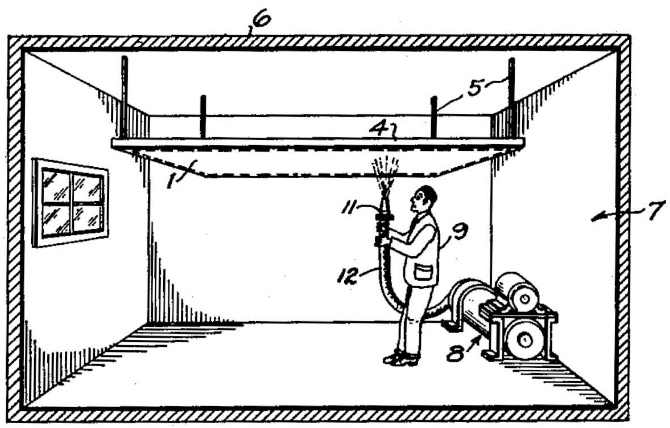


Fig. 4.28: Figure from Bodde's patent 2,202,370, filed November 22, 1935, showing the production of the screen by means of spraying cellulose acetate and later fractured quartz from underneath to avoid impurities.

By no later than June 1935 when Jackman files two improvement patents, somebody at Warner Bros must have foreseen the ineluctable conflict with Bodde.[117] Warner's patent lawyer Beatty contacts Bodde with reference to Jackman's single accepted patent on projection screens at this time. This patent does not cover the production of cellulose acetate screens but the mounting of such screens by means of integrated eyelets on a wooden frame. But it also mentions the still pending patent 2,071,344, which covers the spray process. Barkelow, who at this point still tries to resolve the conflict with the Dunnings, Pomeroy, and Paramount, wants to avoid a similar situation with the technique that was just chosen to leave the legal problems with the color-separation process behind. On June 15, 1935, Warner Bros and Bernard M. Bodde (in the name of his Transco Products Co.) sign an agreement that foresees the mutual and non-exclusive exchange of patent licenses. Both parties are free to use all their current and future patents for their own use. Every screen that Bodde produces that involves Warner patents has to be marked with a license note and the studio receives 10% of the gross selling price according to monthly settlements.[118] Later that year in November Bodde, assisted by Warner's attorney Beatty, files an application that is later split into three independent patents.[119]

While Bodde's screens are for sure safer and deliver better image quality than ground glass screens, they were presumably still expensive. A later patent that shows how to produce an improved version of the screen names reduction of costs as one of its main objects.[120] One of the improvements made is a more flexible screen base for which Bodde gives credit to Jackman's older patent.[121] The Bodde screen—"now manufactured under a patent agreement between the Flat Light Screen Company and Warners-First National"—is later named

117 Fred W. Jackman, Translucent Projection Screen (Patent 2,071,342 [US], filed June 17, 1935, and issued February 23, 1937), Google Patents: US2071342; Fred W. Jackman, Manufacture of Plastic Sheets (Patent 2,184,672 [US], filed June 17, 1935, and issued December 26, 1939), Google Patents: US2184672.

118 *Non-exclusive License Agreement*, June 15, 1935, document 16067A_F023180_001, WBA.

119 Bernard M. Bodde, Translucent Projection Screen (Patent 2,133,076 [US], filed November 22, 1935, and issued October 11, 1938), Google Patents: US2133076; Bernard M. Bodde, Manufacture of Translucent Screens (Patent 2,202,370 [US], filed November 22, 1935, and issued November 22, 1940), Google Patents: US2202370; Bernard M. Bodde, Manufacture of Translucent Screens (Patent 2,242,567 [US], filed November 22, 1935, and issued May 20, 1941), Google Patents: US2242567.

120 Bernard M. Bodde, Translucent Picture Projection Screen and Manufacture Thereof (Patent 2,257,999 [US], filed August 20, 1938, and issued October 7, 1941), Google Patents: US2257999.

121 Jackman, Translucent Projection Screen.

in the *International Photographer* as one of the crucial developments that made rear projection to the extend it is used than possible.[122] In 1938 Transco Products becomes Flatlight Screen Company.[123]

4.8.4 Light Transmission Screen

Warner Bros and its subsidiary United Research Corporation are simultaneously working on other concepts for rear projection screens as correspondence of United Research's Vice-President Clair L. Farrand and in this case H. Sidney Newcomer show. Newcomer had informed Farrand about "an embossed refracting sheet of small lenses" late December 1933. The screen is supposed to collect and refract light in a more controlled manner than the roughened surfaces so far available. The multi-lens-shaped surface should have a precise resolution of "2060 × 1500 = 3,090,00 Picture elements."[124] The concept itself is not new and resembles an older patent by Danish Rasmus Olaf Jonas Jensen that aims at an increase of luminous efficiency for photography.[125] To ensure the originality of the idea, he presents, Newcomer emphasizes that the optical elements are hyperboloids (i.e., cylinders with reduced volumes in the middle) and "*very very* far from being spheres or portions thereof."[126] The notes continue until 1936 and contain a list of patent claims. But it remains unclear whether an application was rejected or not even filled.

4.8.5 Creating a Stage for Special Effects

The transition to rear projection at Warner Bros-First National takes place during 1931 and quickly shows convincing results. But the technique is not yet applied to longer shots due to a lack of large screens. The screens and the technique as such need growth. Since Warner moved its production activities to Burbank, Jackman and his team are gathered around one of the stages there specifically. Stage #5 is seen as a process stage.[127]

Warner's urge to develop an efficient infrastructure for rear projection sets again becomes also visible by a series of patents. Starting May 1931, Fred Jackman and Warner's patent attorney Warren Beatty file patent applications that cover all kind of aspects of the technique. The first one picks up an aesthetic rather than a technical problem. When a rear projection set is made for a long shot—in Jackman's illustration it is the lateral view of a car—film grammar usually requires a connecting closer view. In most cases the following shot eschew to show the background. This is a reason why process shots often appear to be isolated artifacts in period movies. Jackman's interest is to use the same set with the same projected background. The problem in this case is that while moving closer to a foreground object like the car makes it significantly larger in the recorded image, a distant background is supposed to be depicted in nearly the same size. The relative change of distance with far away objects is much smaller than with those that are closer. With rear projection the background as an image is usually much closer than the subjects it depicts. The result is that in

122 "Rear Projection Big Advance," *IP* 10, no. 3 (April 1938): 31.
123 "Flatlight Screen Moves," *FD* 74, no. 126 (December 15, 1938): 3.
124 *Disclosure #223 Transparent Screen*, 1933, box 3523B, WBA.
125 Rasmus Olaf Jonas Jensen, Screen for Showing Projected Images in Lighted Rooms and for Short Exposure Photography (Patent 1,824,353 [US], filed September 22, 1927, and issued September 22, 1931), Google Patents: US1824353.
126 H. Sidney Newcomer to Clair L. Farrand, letter, December 26, 1933, document 3523B_F023182_002, WBA.
127 See Fred W. Jackman, "Organization of a Special Effects Department," in *Technical Bulletin*, vol. 1934, 10 (Hollywood: Academy of Motion Picture Arts & Sciences, September 28, 1934), 1–3.

Fig. 4.29: The Warner Bros studio in 1932. Stage 5 is the edifice with the painted arrow on the roof. It is the only stage with windows and that means offices. There is indication that these offices belong to the Art Department.

the closer shot only a small portion of the entire projection is visible. This causes two problems: The first, technical one, which is not mentioned by Jackman, is that by filming not the entire screen the grain of the background plate becomes is accordingly enlarged. The second, aesthetic problem, which Jackman worries about, is that the size of the background no longer seems to fit to the preceding long shot.

Jackman's solution, as described in the patent, is to modify the projector in the same way as the camera (fig. 4.30). If the camera is moved closer to action and screen, the projector is likewise brought closer. If the focal length of the camera is changed, the same has to be done with the projector. This is a very simple solution but the fact that it is brought forward at this point and in the way Jackman does it is relevant. As the patent text and its figures show a high degree of redundancy when it comes to its actual claims. A lot of these details are well known at the time and covered by other patents like the electrical interlock of camera and projector with a DC motor as time base or masks preventing stray lights from the screen. But it also shows auxiliaries like a mirror that gives the actors the chance to see the scene from an external point that does not match the one of the camera but resembles it. Jackman also suggests to utilize the different temperatures of lights sources. "Due to the fact that an arc light, such as employed for the projector 2, has a relatively large amount of blue light, whereas an ordinary filament Mazda lamp, such as illustrated at 1, has a large amount of light of a substantially complementary color, i.e., red or yellow, the light reflected from the automobile 6 or action component is not reflected from the screen 1 into the camera."[128] This is a direct transfer from color-separation, the predominant methods until May 1931 when this patent is filed. Further details and improvement are added in an following application filed three years later.[129]

Another aspect of process shots is covered by a patent filed in October 1931 that describes what Jackman calls "a method of co-relating"[130] but in this case not of devices but the two depicted sites—i.e., the plate location and the studio set. Jackman elaborates his idea again

128 Jackman, Composite Motion Pictures, 1.
129 Jackman, Composite Motion Pictures.
130 Jackman, Composite Picture, 1.

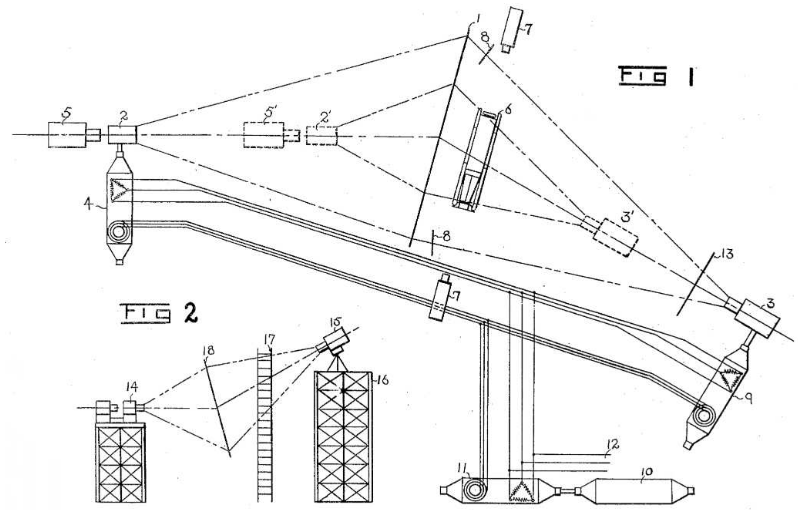


Fig. 4.30: Fred Jackman, *Composite Motion Pictures*, US Patent 2,004,986, filed May 25, 1931

starting from a vehicle shot as the prime application of process techniques. He addresses the problem that in process shots often the background and the action do not build a unison because perspectives and speeds do not fit. To collect such parameters at the time of filming the plate is a regular practice at least of experienced process cinematographers. What distinguishes Jackman's patent is the concept to write down these information on a slate and to film it before the actual background is filmed. This implies that the parameters are directly linked with the plate as they are a single piece of film. One might say the film is augmented with meta data that explains the images that follow (fig. 4.31). As this information is recorded in advance it functions like a script for the plate. It is supposed to contain all necessary information, which is needed to set up the studio camera: height, lens, tilt, camera speed and angle, car speed, and direction. The camera speed is recorded because it may vary from the standard frame rate of 24 frames per second in order to make the final movement look faster. As we already saw with Dunning who suggests to use different camera heights for car process shots, divergences between action and background photography are used to create certain effects, primarily of increased visibilities.[131] Beyond its actual claims the patent also describes aids for the actors to react appropriately to the changing backgrounds while sitting in a car in the studio. He or she may rehears the manipulation of the controls while watching the projection; the scene might be shot without sound to give the director the chance to shout commands; and the dashboard of the studio car might be furnished with signal lights so that an assistant can give for actions.

Another of Jackman's successful applications in 1931 explains how to film a miniature airplane (or virtually any other vehicle) by connecting it with the camera.[132] The background in this case is a painted studio backdrop supposedly because the majority of claims had to be dropped in the course of application because the patent office turned them down for conflicting existing patents.[133]

All of these patents describe the making to connections—between a miniature and a camera that makes it look big, between two sites or to be more precise the cameras on location and on the sound stage, and between a camera and a projector. At the core of the first patent

131 Cf. Dunning, "Dunning Process and Process Backgrounds."

132 Fred W. Jackman, Method and Means for Producing Composite Pictures (Patent 2,045,084 [US], filed December 26, 1931, and issued June 23, 1936), Google Patents: US2045084.

133 *File Wrapper Method and Means of Producing Composite Pictures Patent*, 1932–1936, box 3512B, WBA.

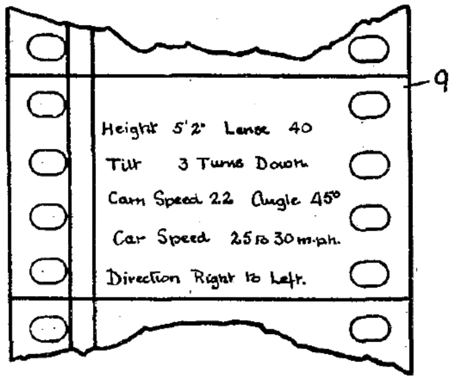


Fig. 4.31: Fred Jackman, *Composite Picture*, US Patent 2,014,435, filed October 12, 1931

is the mirror relationship between projector and camera, the fact that these two machines look at each other and have to be kept in balance. With earlier process techniques it was impossible to move the camera because the background plate was not located in the space of camera movement. For a second field size a second plate was needed (fig. 4.18). The views had to be static and, therefore, could only be connected with a cut. One has to be aware that the increased usage of compositing techniques since the 1920s runs contrary to an increased freedom of camera movement at the same time. This is another important point where production and process cinematographers drift apart. The interest of many production cinematographers in traveling shots is primarily impaired by sound recording but process methods demand similar concessions.[134]

Another link between camera and projector is established by means of a focusing remote control. The projectionist himself is not able to determine whether the projected image is focused due to the light that is reflected from the backside of the screen. The projector lens, therefore, is equipped with a tiny motor that can be controlled from the position of the camera.[135]

What still causes problems after the introduction of rear projection in commercial production and requires attention beyond the linkage of established elements, is the projection screen itself. Like other studios Warner Bros initially uses ground glass and faces the known limitations. To reduce weight, cost, and fragility and to increase size, Jackman's department decides to spray a solution of cellulose acetate in multiple layers onto a large matrix. The surface that carries the screen at this point is sandblasted to roughen the screen. Spraying is done "solely under gravitational pressure,"[136] which means that the spray can is hanging and additional air pressure is avoided because it might cause air inclusion or porous texture. To be able to mount the cellulose acetate screen later, an edge with eyelets is prepared that merges with the layers of the screen when they dry under constant air conditioning. A large wooden frame provides "self-compensating resilient mounting."[137]

[134] See Salt, *Film Style and Technology*, 227-28; Bordwell and Thompson, "Technological Change and Classical Film Style," 126-28.
[135] Jackman, Focusing Device for Cinematographic Apparatus.
[136] Jackman, Method of Making Translucent Picture Projection Screen, 1.
[137] Jackman, Mounting for a Flexible Translucent Motion Picture Screen, 1.

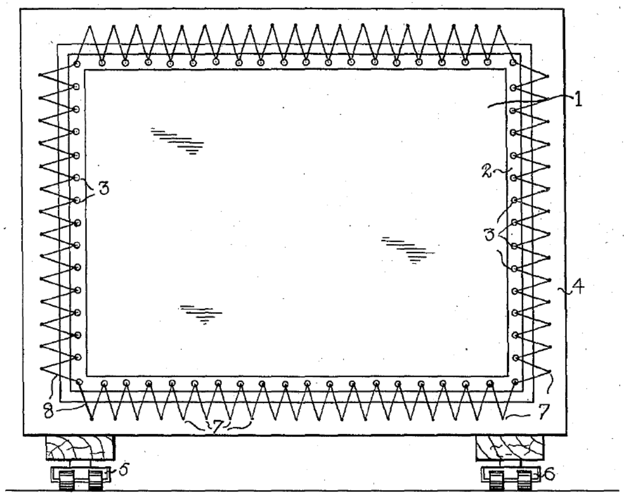


Fig. 4.32: Fred Jackman, *Mounting for a Flexible Translucent Motion Picture Screen*, US Patent 1,960,632, filed October 11, 1932

(fig. 4.32) The two initial patents from 1932 are improved and elaborated in two similar patents three years later. Jackman now gives further details on the recipe and procedure of manufacture that cover refinements achieved in the recent years.[138]

4.9 The Way of RKO

The development at RKO Radio Pictures is different from other studios in several ways and this is also the case with the entry of rear projection at the studio. RKO emerges directly from the introduction of sound as it was supposed to help the Radio Corporation of America (RCA) to establish its own sound system.[139] The trick department at RKO is still very small when Linwood G. Dunn starts there in 1929. It then only consists of trick cameraman Lloyd Knechtel and matte painter Paul Detlefsen, the former assistant of Ferdinand Pinney Earle at MGM. They are doing basics like matte shots and dissolves with a simple optical printer. Vernon Walker is brought over from Warner Bros-First National in July 1930 to do rear projection, as Dunn later recalls, for *Check and Double Check* (1930), a movie featuring the popular radio stars Amos and Andy.[140] Walker is still hired with his own camera. Together they earn a respectable amount of $300 per week and are sent to New York for two weeks to shoot backgrounds in Harlem and on Fifth Avenue that made their way into the final movie.[141] But technically this is not done as rear projection but regular traveling matte. This is perceptible by the light matte lines, an occasional transparency of the cab driver's cap badge, and the fact that the live-action is rendered too dark (fig. 4.33).

[138] Jackman, Translucent Projection Screen; Jackman, Manufacture of Plastic Sheets. The issues of screen size and making connections meet in yet another patent that describes sets with multiple screens and synchronized projectors. Jackman, Composite Photography.

[139] See Richard Brownell Jewell, "A History of RKO Radio Pictures, Incorporated 1928-1942" (PhD diss., University of Southern California, Los Angeles, 1978); Richard B. Jewell, *RKO Radio Pictures: A Titan is Born* (Berkeley: U of California Press, 2012).

[140] Dunn, Interview with Graham J. Shirley.

[141] *RKO Pay Rolls*, RKO Radio Pictures Studio records, PASC; "Vernon Walker Finds New York Hot," *IP* 2, no. 9 (October 1930): 45.

(a) (b)

Fig. 4.33: *Check and Double Check* (1930): Traveling matte shots with backgrounds from Vernon Walker.

It looks like RKO is still far away from doing rear projection when Walker starts there. Further productions of that time show that the traveling matte processes are not yet abandoned. So, Walker likely is not hired for a specific technique but generally for integrating process work into the studio. The change is reflected in the studio administration. The standard form "Budget and Construction Cost" lists an item "Contract Work," referring to third parties like the Dunning Process Corp. While the budget from *The Lost Squadron* from November 1931, here still lists five Dunning Plates for a total of $1,750, for productions like *The Most Dangerous Game* (May 1932) and *Flaming Gold* (May 1933) the item is changed by hand for "Process Shots."[142] That term unfortunately is too generic to derive specific practices from it. But there is a clear tendency to integrate optical effects work into the studio structures. In the fall of 1932 RKO consolidates different units into a single department for camera effects managed by Walker.[143] But even if Walker does not take up employment at RKO in order to do rear projection, as Dunn remembers, he moves into that direction. His newly attained management position, therefore, possibly reflects RKO's steering towards the new process. Lloyd Knechtel, on the other hand, in the summer of 1933 leaves the studio for London where he works for Randal Perraneau who earlier purchased an exclusive UK license for the Dunning process.[144]

In May and June 1932 directors Ernest B. Schoedsack and Irving Pichel are shooting the adventure movie *The Most Dangerous Game*. Film historian Richard Jewell later calls it at "warm-up exercise"[145] for RKO's *King Kong* and in fact both productions are highly entangled on several ways. Both movies are actually directed and/or produced by Schoedsack and his partner Merian C. Cooper under ward of production head David O. Selznick. Part of the cast and crew are identical. Production times are overlapping and actors work primarily with Cooper on *King Kong* and during interruptions due to special effects work on *The Most Dangerous Game*. A vast jungle set is built at the RKO-Pathé studio in Culver City and used for both productions. Author James Ashmore Creelman also works parallel on both scripts. *The Most Dangerous Game* is based on a popular short story Richard Connell, originally published in 1924, about a maniac living on a deserted island where he hunts humans that come ashore for his own amusement. So while in *King Kong* film makers as hunters come to a lonely island, here it is the hunter who waits on the island for whoever comes there. Creelman's script is exceptionally detailed when it comes to the

142 See respective production records in the RKO Radio Pictures Studio records, PASC.
143 "RKO Trick Departments Consolidated," *AC* 13, no. 6 (October 1932): 45.
144 "Tek-Nik-Town," *IP* 5, no. 6 (July 1933): 36–37.
145 Jewell, "A History of RKO Radio Pictures, Incorporated 1928-1942," 140.

(a) Assumed rear projection showing the view from the deck of the ship on its way to the island.

(b) Jungle shot with atmospheric grading that will virtually be the same appear in *King Kong*.

(c) Static matte shot where the actors and the entrance to the cave are on the sound stage and the rest including the waterfall is a miniature. The live action has a higher contract than the rest and shakes slightly due to imperfect registration.

(d) Again a static matte but in this case the fighting man and dog cross the border to the miniature waterfall. When they enter the spray, they turn into silhouettes that blend with the waterfall by double printing or exposure.

Fig. 4.34: Different composite shots from RKO's *The Most Dangerous Game* (1932)

translation of story into images. He specifically mentions the Dunning process as a technique and also projection backgrounds, as rear projection are called here.[146] As Creelman does not have too much experience with film production, this points to a close cooperation with Cooper and Schoedsack. The script has to be reworked and shortened several times because RKO, finally, budgets it anxiously at little more than $200,000.[147] The fast paced movie at the end is little longer than an hour which, once again, makes it look like a test for *King Kong*.

The original budget allows for fifteen Dunning shots and ten projection background shots. The price for a Dunning shot is down to $175 each, a price the company officially only offers for independent producers.[148] Projection backgrounds are slightly more expensive at $225. As the surviving production records for the film are incomplete, the techniques actually used can only be identified by visual inspection. The final budget only registers globally

146 Richard Connell and James Ashmore Creelman, *The Most Dangerous Game*, revised final script, May 13, 1932, box 194 S, RKO Radio Pictures Studio records, PASC.

147 *The Most Dangerous Game*, Budget of Production Cost, 1932, box 18 P, RKO Radio Pictures Studio records, PASC.

148 Dunning Process Company, *Dunning Shots $175*, ad, April 1932, 38.

that process shots turned out to be 40% cheaper than expected.[149] The reason seems to be mainly that planed rear projection shots were spared and replaced by static mattes done with the optical printer.

While a planned rear projection on the ship is likewise executed like that, the compositing for the island scenes is mostly done with the Dunning process or static mattes (figs. 4.34). The first exhibits a pronounced realism and clarity while the latter ones have a pictorial indistinctness. Close and an unprocessed shots feature an easily recognized structure and content. The longer process shots on the other hand present

Hardly any movie in this study is equally well documented as *King Kong*. The movie's status as a special effects milestone has also the negative side effects that primary sources are basically no longer available in the archives but are in the hands of private collectors. Therefore, I have to rely here upon the publications of Goldner, Turner, Shay, and Morton as secondary sources.[150] Additionally, I will use the early and hitherto unnoticed study by Harrison Penrod Hilfinger entitled "A Study of the Significance and Application of Special-Effects to the Cinema". Hilfinger's master's thesis from 1942 also sheds light on the situation of special effects in the later studio era. As his title already suggests, he wants to raise awareness and appreciating for the craft of special effects. But he also finds himself in the situation that the very people he wants to support show little interest in supporting him and "divulge intimate details of their individual methods to anyone for purpose of this sort."[151] Hilfinger has to rely on already published information and his own analysis of the movie. Already during the production of *King Kong* producer Cooper is anxious not to reveal too many details of the special effects used while still trying to provoke curiosity. Thus the popular magazine *Modern Mechanix and Inventions* in April 1933 for the release of the movie professes to publish production secrets when it claims that Kong was played by an actual actor in front of red screen.[152] The reason for this deceit is that nobody should know that whenever Kong is seen full figure, it is a tiny puppet of eighteen inches height we see—brought to live by stop motion animation. As Morton has pointed out, more than with any other movie of that period a convincing compositing is crucial for *King Kong* because it determines the believability of the story and its main protagonist.[153] Kong and the other monsters are to be animated frame by frame in a much smaller scale, except for body parts seen in closer shots. While in other cases artificial image elements that are recognized as such, do not necessarily damage the characters and their story, with *King Kong* it had to be ensured that the alleged size, presence and agency of the monsters were believable. Scaling, or the combination of different scales of depiction, which is a central element of all optical effects, becomes precarious in regard to the giant ape.

Animator Willis O'Brien improved his technique over a period of twenty years. His most popular work then is *The Lost World*, a dinosaur adventure based on the novel by Sir Arthur Conan Doyle that should be followed by a similar movie entitled *Creation* on which O'Brien was working at RKO. To combine animation with live-action in *The Lost World* O'Brien and Arthur Edeson (who had worked on *The Thief of Bagdad*) used static mattes and in-camera double exposure. Occasionally a third exposure for steam or fog was added. This means that O'Brien first animates the miniature beast with a part of the aperture covered up,

149 *The Most Dangerous Game*, Statement of Cost of Production, September 24, 1932, box 18 P, RKO Radio Pictures Studio records, PASC.

150 Goldner and Turner, *The Making of King Kong*; Shay, "Willis O'Brien"; Morton, *King Kong*.

151 Hilfinger, "Significance and Application," 2.

152 See Goldner and Turner, *The Making of King Kong*, 87.

153 See Morton, *King Kong*, 39.

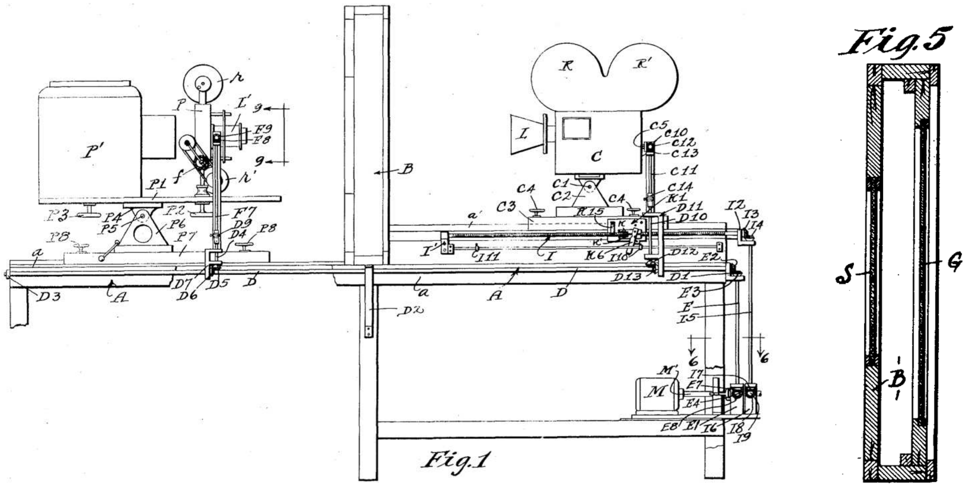
Fig. 4.35: Animated miniature dinosaurs in *The Lost World* (1925) with an actor observing them in the lower right corner. The two image parts are combined with static mattes and double exposure in the camera.

rewinds the film, and with a counter-matte exposes the rest of the image with live-action (fig. 4.35). The disadvantages of this method are as obvious as they are numerous: As it is only possible to develop the film and see the result after both exposures are made, it is not possible to correct mistakes but in that case one has to start all over again. The exposures have to match as much as the two mattes. It is not possible to direct both actions to the same timing. Results feature expressive gestures that do not enact but merely signify individual reasons. The static matte line finally separates both domains even if not visibly than in a dramaturgical way because it prevents actions that are spanning across the entire image. O'Brien's answer to this problem is the attempt to integrate photographed live-action into his miniature sets as projections or actually rear projections.

Until 1933 he successfully applies for two patents.[154] The first one is filed already in April 1928 and covers a method to rephotograph existing footage on a translucent screen. The comprehensive view in the patent shows projector and camera facing each other with a screen case between them (fig. 4.36a). Both devices are mechanically connected and driven by a shared motor. As the patent text explains, the camera can also automatically move towards the screen by the same force. The case not only consists of a screen but actually of two glass planes—one frosted to render the projection and one clear to be painted on. The modest distance between them should cause a parallax effect when the camera moves, enable a shift of focus, and also make the lighting of the painting easier (fig. 4.36b). The transparent glass (G) is significantly bigger than the projection screen (S) which O'Brien explains with the concept that "artificial and fanciful settings may be painted on the glass as a background for a proposed picture, and scenes of action which may have been photographed in foreign or remote settings and with a different background may be merged into a single new picture."[155] The glass painting extends the original footage. It is no longer corrected in details as done by Norman Dawn in his early glass shots but a component of the new, constructed image.

154 Like others O'Brien only files applications for patents after making bad experiences and loosing what he considered to be his idea. Herbert M. Dawley, a former producer of O'Brien, in 1920 had filed and received a patent for a dinosaur model and blamed the latter one who to have stolen the idea. Herbert M. Dawley, Articulated Effigy (Patent 1,347,993 [US], filed July 27, 1920, and issued February 26, 1920), Google Patents: US1347993; see Shay, "Willis O'Brien," 18

155 Willis H. O'Brien, Means for Producing Motion Pictures (Patent 1,897,673 [US], filed April 16, 1928, and issued February 14, 1933), 3, Google Patents: US1897673.



(a) (b)

Fig. 4.36: Willis O'Brien, *Means for Producing Motion Pictures*, US Patent 1,897,673, filed April 16, 1928

The second patent is much more particular as it concentrates (in a simplified set-up) on the small translucent screen alone. Rear projection is here described as a usual practice. Projector and camera are now synchronized electrically. The problem that the patent claims to solve is that especially with small screens it is possible that the material structure of the screen itself overlays the projection and becomes apparent. O'Brien's solution is to use a small motor and let the screen vibrate vertically.[156] He addresses here the paradox that is in the center of all rear projection screen discussions: How can the screen make a projected image visible and remain invisible itself? Through the constant movement any irregularities of the ground glass in this case disappear in a motion blur. The concept of the oscillating screen is not applicable to full-size studio sets but it likewise addresses problems that are more pressing when working in small scales. Both patents deviate from a straight forward trajectory to the techniques that are used in *King Kong*. While the screen-glass-patent allows any kind of footage (live-action or animation) to be supplemented with static painted elements, it does not allow the combination of animation and live-action because the inherent matte (of the painting) is notwithstanding parallax effects static. The oscillating screen on the other hand seems to be difficult to integrate into a miniature set but can rather be used as a comprehensive background for a small animated model.[157]

These two patents are only elements of a larger system that is not represented within there. Shay describes a final animation setup that could integrate flexible miniature rear projection.

> The system, simply stated, employed a small translucent ground glass or rubber screen mounted in a frame with a synchronously operated stop-motion camera and projector positioned on either side. Both camera and projector were capable of independent movement on various axes, so the projected image could be varied in size and positioned wherever desired. Then, on a pane of glass located on the camera side of the screen, an artist could trace the key elements of the projected image and prepare a carefully rendered painting to blend in and

156 Willis H. O'Brien, Composite Picture (Patent 2,029,500 [US], filed September 13, 1933, and issued February 4, 1936), Google Patents: US2029500.

157 Harold E. Wellman reports on vibrating screens as small as 2 × 3 inches being used for *King Kong* Harold E. Wellman, "Composite Process Photography," in Dunn and Turner, *The ASC Treasury of Visual Effects*, 212.

> surround it. Numerous variations were also possible. Two or more projectors could be used to insert separate live-action elements into a single composition; multiple glass panels, appropriately spaced, could serve to enhance the sense of dimensional reality; and miniature settings could be constructed in front of, or between, the glass paintings. Economically and aesthetically, the advantages over stationary split-screen mattes were manifold. Live-action footage could be photographed on a set no larger than was required to contain the specific action. Stop-motion figures could be made to pass in front of live-action elements, as well as react to specific actions on the rear projection screen. Compositional placement of the live-action element could remain flexible until the final setup was tested and approved; and, though time-consuming, effects shots *could* be re-accomplished, for technical or other reasons, without sacrificing the approved stage photography. The end result was a much more fully realized integration of live-action and miniature subjects.[158]

The resulting complexity of images demands exact planing. Byron Crabbe and Mario Larrinaga are doing concept drawings based on sketches by O'Brien who names the French artist Gustave Doré and his illustrations for *Paradise Lost* as inspiration. The style of the filmic translation already becomes apparent in *The Most Dangerous Game* when multi-layered miniature sets with glass paintings and projections are used (fig. **??**). It is important to point out that O'Brien's invention—even if he himself as an animator takes a quite unique position—is not the product of an isolated inventor but well connected with other experts. Since 1922 O'Brien had worked with Ralph Hammeras who himself had worked at Realart Studio with Farciot Edouart before.[159] Hammeras is doing rear projection at Fox while Edouart has the same job at Paramount. *The Lost World* was produced at First National on the East Coast before the studio moved to Burbank (where Fred Jackman was hired) and was acquired by Warner. These connections are manifold and while they cannot be rendered as causalities in most cases it still does not make them irrelevant.

About two third into *King Kong*, we find two consecutive scenes that can be analyzed as examples for how miniature rear projection is used in this case. Kong has abducted Ann Darrow (Fay Wray) and carries her up on Skull Mountain into a cavern while John Driscoll (Bruce Cabot) follows them. In the first scene they enter the cave and Kong kills an attacking serpent before he moves on. The scene does not progress the story but is, as Hilfinger writes, "merely an extra thrill for the spectator."[160] In his analysis Hilfinger segments the scene into three parts: Kong carrying the girl and placing her on a high rock, Kong fighting the serpent with the girl watching, and John entering the foreground while Kong regains Ann and carries her up to the top of the cave. Hilfinger assumes that the compositing for the first and last part were done with the Williams process while part two looks like rear projection for him.

The first problem with Hilfinger is that his segmentation of the scene is story-based and not based on the actual editing or single images. The reason why he concludes that miniature rear projection was used for the fight between Kong and the snake is that he looks for pertinent artifacts. No such artifacts means for him that an established technique like the Williams process was used. Hilfinger's incapability to analyze the compositing of the cave

[158] Shay, "Willis O'Brien," 29-30.
[159] Ibid., 14.
[160] Hilfinger, "Significance and Application," 49.

(a) Long shot

(b)

(c)

(d)

(e)

Fig. 4.37: Cave scene in *King Kong* (1933)

scene—as somebody who watched the movie several times, who is a film student, and who previously has done research on special effects—gives an idea of how convincing the tricks were at their time.

The scene is extremely rich in its details that make it vivid and entertaining. In the center of the space a little lake is located, steam raises, and in the foreground sludge bubbles. (All these are details that Hilfinger does not notice as he concentrates on the combination of animated models and actors.) From the long shot (fig. 4.37a) that still exudes the stasis of similar shots in *The Lost World* the movie cuts away to closer views. Some of these are straight shots of the actors that do not entail any optical effects (figs. 4.37c and 4.37e) and that are also used in longer shots as image elements. Throughout the scene different processes are used for the compositing of Ann and John. The footage of the girl, being often covered up by the Kong model, is projected from behind on a small screen, which is part of a miniature set and, therefore, seen by O'Brien while he is animating Kong. The shot of her future savior in the lower right corner was probably added later by means of optical printing with a static matte. By visual inspection it is impossible to identify all elements that were brought together in the recurring long shot. The miniature set should consist of the puppets as much as built and painted rocks. The added photographic parts comprise the projected footage of the two actors in full-size sets; elements like the water in the center, the rocks and bubbling lava in the foreground were added with static mattes; and steam shots with black background were simply double printed. By means of using various techniques, compositing catches up with editing as the options to integrate details either in time or space become convertible—just as Ann here is several times transposed from actress to puppet and back.

In the following scene on a ledge Kong holds the unconscious girl in his right hand and with his left first gently tears off parts of her dress (like leaves of a flower) and then tickles her to tease her (fig. 4.38).[161] The rear projection is easier to spot here than in other cases because it is slightly blurred and the highlights are burned out. But what makes the scene noteworthy is the ambitious integration of the two domains. All subjects that appear in the image seam to be part of the miniature animation and the live action set: the rock face in the background where the edge of the projection becomes most obvious, Kong whose left arm is part of the miniature while his right arm is a full-scale body fragment in the projection, and finally the girl whose dress is stepwise transposed from projection to miniature. Fay Wray is first photographed in a full-size model of Kong's hand. Stagehands are pulling fishing lines that are affixed to parts of here dress. The pulling anticipates later movements of Kong done in animation in front of the projection screen.

In the long shot of the ledge scene the requirements of compositing techniques show themselves in a rock on the ground that only has the function to disguise the border between the areas of rear projection and miniature. Whenever Ann and later John are seen on the right side, they are projected live-action and when they are on the left, they are animated six feet miniatures. The rock gives them the possibility to move freely between these two technical domains. While the dramatic function of the scene is to show Kong as a sensitive creature, technically it seems to be about attitudinizing—first showing the border and then crossing it. (The degree of integration is pushed further in the swiftly produced sequel *The Son of Kong* by Schoedsack also released in 1933.)

[161] When the movie is re-released in 1938 it has to be adjusted to the censorship rules, which were established after its premiere. The partial undressing, therefore, is significantly shortened and only reconstructed in its original form decades later. Hilfinger's description of the scene is accordingly false because he has to work with the censored version.

Fig. 4.38: Ledge scene in *King Kong* (1933)

King Kong uses basically all compositing techniques that are available at the time. Stationary mattes are applied just as the Williams and color-separation processes and finally full-size rear projection. Hilfinger, Goldner, Turner, Shay, and Morton try to identify the processes used for most of the scenes and often come up with different suggestions. These confusions are also caused by disorderly designations. Frank D. Williams e.g. presents an improvement of his original traveling matte process under his own name in the middle of 1932 that uses colors to separate image domains (p. 102). It resembles the color-separation processes of Pomeroy and the Dunnings. But by using colors it destroys one of its main advantages, namely the possibility to be applied for much wider shots where it was no longer possible to light and/or paint the background blue. My focus here is not on a reconstruction of the entire production but to understand dynamics that shape the productions practices and techniques as a whole. One shift that is happening is from stage to post-production as a later account of RKO's Linwood Dunn shows.

> [A]s I watched what they were doing, I would see O'Brien animating and at the same time compositing and bi-packing. An he would be animating and ending up with the composite, and then would be off, something wrong, but the animation would be fine. So I said, "Why don't you just animate it and I'll do the bi-packing later?" So I got into it that way, really stuck my nose into it, and then I was loaded with work, and I did a lot of contrast adjustments too, through the picture.[162]

The Williams process, which apparently made way for the more sophisticated color-separation processes years before, suddenly is seen as a viable option for compositing again. One argument that is given here is the high quality of optical printers available at the studios, most notably the device Dunn fosters at RKO.[163] In this regard it has to be taken into account that unsatisfactory printers were not an argument against the Williams process, but rather the difficulties to extract a satisfying traveling matte and the loss of image quality in the post-production process. Therefore, one can argue that it is first of all the better quality of dupes due to new film stocks and higher precision in the laboratories that

[162] Linwood G. Dunn and Academy of Motion Picture Arts and Sciences, "An Evening of Special Visual Effects," transcript (October 9, 1978), MHL, 18; see also Goldner and Turner, *The Making of King Kong*, 99-100.
[163] See Shay, "Willis O'Brien," 41.

Fig. 4.39: Rear projection in *King Kong* (1933)

support the traditional traveling matte. It is a significant change when, as Dunn suggests, images by means of further printing become better and no longer worse. It is this new bias towards post-production that backs the Williams process.

Full-size rear projection on the set is here the opposite pole. In *King Kong* it is primarily used to show actors in front of stop motion animations. As the animation has to be produced first in this case live photography of these scenes is scheduled for the end of the production in December 1932 and January 1933.[164] But at least one scene of rear projection is already part of the test scenes shot in May/June 1932: Ann watching the fight between Kong and a *Tyrannosaurus rex* (fig. 4.39). According to Shay these are the first rear projections done at RKO and also done using the newly developed Saunders screen. The line-up turns out to be so complicated that it takes three days to shot it.[165] Actress Fay Wray, who supposedly once has to shoot for twenty-two hours and becomes sour from sitting on the tree, remembers the shooting in her autobiography.

> A battle scene between Kong and a tyrannosaurus had been prepared by Willis O'Brien for rear projection onto a huge screen. I was placed in a tree alongside the screen. Photographing the two elements together gave the illusion that I was actually seeing the monstrous fight. Cooper directed these scenes. From his vantage point behind the camera, he had perspective and detailed clarity. From my position, all I could see was large blurry shadowy movements on the screen. It was like having the worst seat in the house, too close to define what the shadows were. But I kept moving, kept reacting as though I really could see the fearsome creatures, and would scream when Cooper said, "Scream! Scream for your life, Fay!"[166]

Wray's recollection clarifies one point that is usually simplified. Traveling matte processes have the disadvantage that on the set the future background is not yet visible which makes it difficult for the entire crew to react to it. When pretending to drive a car for example, the actors do not know whether the street in the background goes into a curve and whether they would have to turn the steering wheel in one direction or the other. Rear projection

164 Morton, *King Kong*, 51-52.
165 Shay, "Willis O'Brien," 37.
166 Fay Wray, *On the Other Hand: A Life Story* (New York: St. Martin's, 1989), 127.

makes the background present on the set at the time of shooting—but first of all for the director and the cameraman and not necessarily for the actors. They do not have a clear view of what is happening on the screen and often are not supposed to watch the screen anyway—like when they are driving and the street is only behind them. They depend on a third person or technical aids to translate the visual information of the screen into other signs.[167]

4.9.1 Rear Projection in Miniature Sets

It thus looks like RKO's turn to rear projection is especially informed by the combination with miniatures and animation. This option has several advantages starting with the fact that the smaller sets content themselves with weaker projections. Concomitant the exposure times may be longer and synchronization of projector and camera shutter becomes less relevant. For the process of rear projection with matte paintings there is the rare case of a short explanatory motion picture by an industry member. Linwood Dunn who does optical effects for RKO studios for more than two decades in 1952 produces a five minutes film explaining the production of two matte painting shots for the historical movie *Androcles and the Lion* (Chester Erskine and Nicholas Ray) of the same year that I will uses here assuming that production practices here did not change significantly since the 1930s.

Dunn presented his film at the Los Angeles convention of the (meanwhile renamed) Society of Motion Picture and Television Engineers (SMPTE) in April 1953.[168] The film makes comprehensible the practices involved in the production of miniature rear projection and though it is from the 1950s we can assume similar practices in the 1930s as further examples will show.

One of the opening shots of *Androcles* depicts ancient Rome from one of its hills (fig. 4.41). The first step of its production is a relatively small but detailed sketch from the Art Department (fig. 4.40a). This sketch is then executed by a matte painter on glass with a size of approximately 30 × 40 inches (fig. 4.40b). The glass painting is subsequently mounted in a scaffold in the studio to be easily accessible (fig. 4.40e). In this case the matte painting contains four blank areas that are to be filled with live-action. Behind the glass as translucent screen is placed that covers the three smaller voids of the painting (fig. 4.40f). For each of them a small rear projector stands by with previously shot live-action footage in front of fragmentary sets (figs. 4.40c and 4.40d). The necessary interlock between the projectors and the Mitchell camera is neither discernible nor mentioned. As Dunn explains in a later voice over to the originally silent film, the filling of the larger gap in the lower left corner is spared at this time due to a too low definition of rear projection. The missing guards in the foreground are added later by means of optical printing with static mattes.

[167] Fred Jackman in one of his patents makes three suggestions for solving this problem: 1. Turn the car around for practice. 2. Shot without sound and let the director give cues. 3. Give the driver a cue sheet and signal lights mounted on the dashboard. Jackman, Composite Picture

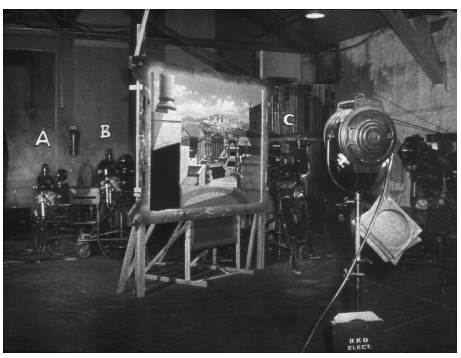
[168] Two years before he already produced a similar film entitled *A Graphic Example of Composite Cinematography* that explains optical effects for *Payment on Demand* (Curtis Bernhardt, 1951). That movie saw very positive feedback and SMPTE invited Dunn to write out an article for the *Journal* based on it. Dunn did not follow that request but the existence of both films must be seen as a sign for Dunn's increasing independence from his studio RKO and a requirement to advertise his services See *Society of Motion Picture and Television Engineers (SMPTE) 1950-1951*, 94-f.1451, Linwood G. Dunn papers, MHL.

(a) Art department sketch of the planned establishing shot.

(b) Matte painting on glass. The lower left corner and three areas in the center are transparent.

(c) Background plate for lower left corner blank.

(d) Background plate for central blank space.



(e) Studio setup with rear projectors.

(f) Studio setup with rear projectors.

Fig. 4.40: *An Example of Composite Cinematography* (1952)

Fig. 4.41: Establishing shot of *Androcles and the Lion* (1952) as it is seen in the final movie.

Linwood Dunn's demo reel, which he uses from the late 1960s for presentations, contains several similar shots also from earlier movies produced at RKO. The one that in its days already stirred curiosity is the final scene from *The Hunchback of Notre Dame* (William Dieterle, 1939). Esmeralda has been saved and leaves the church square with her lover. Quasimodo looks after her from an high exterior gallery of Notre Dame. He leans against one of the gargoyle sculptures (and a way against the entire church) and in a original medium close shot sights "Why am I not made of stone like these?" The following shot shows slightly more of his environment and then the camera rapidly pulls back until after some thirty seconds the entire edifice is seen in front of a slightly cloudy sky (fig. 4.42). Compared to the preceding straight shot the process shot is identifiable by a higher contrast and less intermediary grades. But the rear projected image of approximately 2×2 inches and the painted architecture merge seamlessly.[169] The shot is produced similarly to the one from *Androcles and the Lion* but the camera in this case is pulled back which animates the otherwise static matte painting. In other cases the movement is often reversed so that the camera literally flies into the painting ending with a live action shot that fills the entire frame. The combination of painting and live action is a standard procedure for more than two decades at that time. But the replacement of mattes in the camera or in an optical printer through small rear projection setups furnishes combination images with physical spaces that allow for spacial modes of representation.[170] And it is this physical component of the actually immaterial rear projection that makes the technique attractive.

4.10 Discovering Distinct Styles and Methods

As described above, rear projection is initially successful not for its own sake but because of its apparent transparency. Styles and practices that developed independent from it can be used in a way that the color-separation processes did not allow for. The scene in *Three Cornered Moon* would about the same if it was shot on location or with a widespread set on the sound stage; and O'Brien would animate his creatures just the same way if there was no projection in his miniature sets. This is the approach that not only Paramount's

[169] See *Linwood Dunn: An American Film Institute Seminar on His Work*; Wellman, "Composite Process Photography."

[170] Miniature projections are not an exclusive technique of RKO as a patent from Warner's Byron Haskin that covers frontal projections on miniatures shows. See Byron C. Haskin, Composite Photography (Patent 2,169,045 [US], filed November 23, 1936, and issued August 8, 1939), Google Patents: US2169045

(a)

(b)

Fig. 4.42: Beginning and end of the final shot from *The Hunchback of Notre Dame* (1939)

Farciot Edouart takes but that is a general tendency for Hollywood and its relationship to techniques. But there are movies that—whether by chance or by purpose—develop idiosyncrasies that cannot be understood without rear projection as a production practice.

MGM's first Tarzan movie, *Tarzan, the Ape Man*, is clearly a follow-up to the studio's expensive but successful *Trader Horn* to which also the story owes more than to the books of Edgar Rice Burroughs, the creator of the Tarzan character. The movie is shot in November and December 1931 and released less than a year after *Trader Horn*. It plays in the same way with the visual appeal of African exoticism and combines it with Burroughs' title hero. Both films are directed by W. S. Van Dyke who does not travel to Africa this time but relies on existing footage that is often easily identified due to flickering stains and other deficiencies. The first sequence in which stock footage is combined with sound stage action shows trader James Parker (C. Aubrey Smith) and his daughter Jane (Maureen O'Sullivan) who just arrived. Later they are joined by Parker's partner Harry Holt (Neil Hamilton). Natives visit the camp to trade their goods as we are told. The combination of both types of footage is first done by means of editing until Jane happily steps in front of the dancing natives, smiling back at her father (fig. 4.43a). The sequence continues with changing groups of natives. The process shots with minor exceptions lack the visual discrepancies of *Trader Horn* but are nonetheless easily identified. John Brosnan in his description complains, that the "shots of the natives are grainy and out of focus and their perspective does not match that of the studio shot; it is a glaringly obvious process scene."[171] Furthermore, the light seems to be different for the two domains. The sound is maybe even more revealing as the voices sound like in a large but closed room whenever the background noises are not concealing their reverberation. Additionally, the actors fill the lack of interaction with the natives with referencing gestures and dialogs that point to them with questions and comments.

> Jane: What's that? Who are they?
>
> Father: The Wakumbas.
>
> Jane: The ones with the big hats, who are they?
>
> Father: No, they're Kabaranda. There are a couple of hundred ostrich feathers in each of those headdresses.

[171] Brosnan, *Movie Magic*, 49-50.

(a) Jane posing in front of stock footage natives, smiling at her father.

(b) The child on the right is rendered too big but the remaining process shots hardly show such obvious problems with perspective.

Fig. 4.43: *Tarzan, the Ape Man* (1932)

> Jane: What you might call putting a feather in your cap with a vengeance. What are they doing here?
>
> Father: They come to trade.
>
> Jane: All right, let's trade them.

With the exception of the cottage built on the sound stage, which we see from inside and outside, the sequence does not render a coherent but only a fragmented space. The collection of plates shows a similar heterogeneity as the presented tribes themselves. The only reason why the scene does not fall apart is the continuous presence of the actors who pass from one stock footage shot to another. Brosnan also notices the problem of a missing common sphere as he starts his complains with the observation that one should never combine people in fore- and background. But as with other critiques on process work, he elaborates on this point exclusively with problems of image quality. This means that he, just like other scholars, defines the problems of rear projection as technical ones that have to be solved by technical means. This contradicts his own initial observation that renders the entire situation of people in front of and within the projection as problematic. But his critical position closely adopts the perspective of the period protagonists in the studios who put their efforts into the improvement of image quality. Are they not aware that image quality is not the only problem or is this a pragmatic way to solve the problem that process shots do not yet have the same representative quality as regular photography?

Looking again at the scene in *Tarzan, the Ape Man* we can ask what it displays if not the encounter of three white traders with natives in Africa? Taking into account the deficiencies of the scene one might say that we see three actors standing in front of huge frosted glass plates on a sound stage at the MGM studios in Culver City. Travelogue footage from Africa is projected on the glass from behind. This is what we might see today when we consider the scene to be failed. But this is hardly what period audiences saw. In order to be sensible for them the scene must show something that is neither a sound stage but not yet Africa. The representation of a remote site like Africa in society then differs from that of today. The prospect audiences had in the 1930s was less informed by TV or actual traveling but by visits in ethnographic or natural history museums. If we look at the sequence again, now all its features—the segregation, the glass, the pointing and commenting, and even the reverberation of big halls—blend into a Sunday museum visit. The fact that the sequence

Fig. 4.44: *Tarzan and His Mate* (1934): Martin Arlington (Paul Cavanagh) looking 'down' at lions in a tilted rear projection set.

renders unrealistic for us today has less to do with technical or aesthetic shortcomings but with the invalidity of the reference it is based on. Hollywood as much as any other cultural producer is part of changing reality of life.

The first Tarzan movie still falls into the time of transition to rear projection and it is not always clear whether and in which cases the new process is actually used. Turner still cites *Tarzan, the Ape Man* as an example for the usage of the Dunning process.[172] Goldner writes that Carroll Dunning screened scenes of the movie at RKO to advertise his process for the production of *King Kong*.[173] And Belmer adds that the Dunning process still was used for at least one shot of the sequel *Tarzan and His Mate* when Martin Arlington (Paul Cavanagh) looks down from a rock at a group of lions because rear projection could not be done vertically from underneath.[174] While vertical shots in fact are a problem with rear projection because of the screen and the long projection throw, the pale background with burned out highlights looks more like early rear projection than a late color-separation shot. To achieve this shot, one simply had to turn the set, which means that Cavanagh might actually not be lying but standing (fig. 4.44). If this is really the case, it would another idiosyncratic application of rear projection.

To determine the technical processes used for *Tarzan, the Ape Man* is difficult also because it is not as well documented as with the sequel who actually is in charge of effect work. Clyde De Vinna (*Bird of Paradise*, *Eskimo*) works as a cinematographer in both productions, first together with Harold Rosson then with Charles G. Clarke. Warren Newcombe is doing the matte paintings for both productions. For the second movie Irving G. Reis is known to be in charge of optical printing and James Basevi for mechanical effects and supervision of rear projection. Both already worked on the effects of MGM's *The Mysterious Island* (1929). Effects work at MGM is organized differently than at most other studios as it is part of the art department of Cedric Gibbons. Gibbons has a screen credit for art direction for the first movie (though this does not mean that he as department head actually was involved in it) and directs the second movie—the only credit he ever received as a director. The fact that Basevi and Reis are only mentioned in connection with *Tarzan and His Mate* in the account of film historian Rudy Behlmer might be because the credit scoring by the

172 Turner, "The Evolution of Special Visual Effects," 42.
173 Goldner and Turner, *The Making of King Kong*, 99.
174 Behlmer, "Tarzan," 46.

(a) (b) (c)

Fig. 4.45: *Tarzan and His Mate* (1934): Jane attacked by various process animals.

Academy, which documents participations for other industry members, only starts after the production of the first movie. None of the effects people receives screen credit for their work.[175]

As often the case with movie series, Tarzan develops its own cliché story elements and images. One of these is specifically related to the application of rear projection. Repeatedly Jane and others are attacked by wild animals and Tarzan is called for rescue. These attacks come without warning and right out of the process plates. The beasts run straight towards the camera to create a maximum effect with the audience. The result is always the same image as three shots with Jane under attacks in *Tarzan and His Mate* show (fig. 4.45). These shots become stereotyped openings for arbitrary fight scenes as in reference movies like *Africa Speaks!* and *Trader Horn*. But despite of the technical, which flaws the process background still features in *Tarzan and His Mate*, the progress that rear projection in comparison to color-separation processes brings here is that the screen can be much better embedded into the set. This is a feature of the new method that also becomes apparent in the miniature sets for *King Kong*. The background turns into a set element in a way that the blue Dunning wall never was.

This integration works even better when it does not have to withstand direct interaction between the two domains and when the depicted space is not familiar in its characteristics. In the Tarzan movies this is especially the case in scenes that play up in the trees. Similar to pilot shots in aviation movies, process shots here represent a spatial structure that is beyond the experience of the audience. While with air process shots there is a lack of any ambient structures, in the treetops of the jungle we find an excess of chaotic branches, leafs, and vines. These elements are part of the set and the process plate and the junction is often difficult to identify (fig. 4.46).

Around the same time Paramount produces *Alice in Wonderland*, directed by Norman Z. McLeod but also attributed to William Cameron Menzies, long time art director and later director who officially has a screen credit here as co-writer with Joseph L. Mankiewicz. David Bordwell specifically attributes the storyboard drawings for the movie to Menzies and his assistants.[176] With *Alice in Wonderland* we have the lucky case that not only the storyboard drawings are available but also a personal working copy of the script that belonged to Farciot Edouart.[177] The movie itself runs contrary to Edouart's concept of transparent effects as couched in his presentation in the preceding year. Naturally, a story as

[175] *The Academy Awards for Scientific or Technical Achievement*, January 31, 1935, Behlmer, "Tarzan."

[176] David Bordwell, "Foreground, Background, Playground," March 30, 2010, http://www.davidbordwell.net/blog/2010/03/30/foreground-background-playground/.

[177] Joseph L. Mankiewicz and William Cameron Menzies, *Alice in Wonderland*, script with storyboards, personal copy of Farciot Edouart, 1933, Script Collection, MHL.

(a) (b)

Fig. 4.46: *Tarzan, the Ape Man* (1932)

that of Alice suspends common ideas of realism. But in several cases it exhibits a self-awareness of optical effects in an almost naive and childish way. This starts with Alice's entrance to the looking-glass world. Part of the living room, which she leaves and simultaneously enters, is a photograph of Alice's aunt and uncle that hangs on the wall next to the mirror. While most of the objects here are simply mirrored (as it is made clear for example through the transformed texts on books), the image on the wall shows the back view of the depicted couple as if a second picture was taken from behind. This paradox raises the naive question of the backside of pictures that becomes much more knotty if—as in the case with rear projection—these picture are actually of semi-transparent material, free standing, and produced from behind. When Alice reaches out to touch that photo, her hand partly enters and makes visible the dark zone that separates stage set and rear projection (fig. 4.47a). Following the logic of her imagination, uncle and aunt turn around and start to chat with her (fig. 4.47b). Alice makes a remark on the damaged trouser of her uncle and again—like as a comment to the practice that makes this scene possible—he remarks: "But after all it's really only the front of the picture that counts." With the movement and talk it finally becomes evident that we do not watch a photo but rather a movie projected from behind on frosted glass that is incorporated into the set similar to the video phone of *Just Imagine* (1931) or the train windows of other earlier movies.

What this short scene already inherently introduces is the theme of scaling that is elementary for optical effects. While different scales in the case of a girl watching a photograph of 'grown-up' people still is understood as an effect of depiction, this is no longer the case in the following encounter of Alice with living chess figures. Optical effects here do not have the function to merge distant locations or different times but different scales. There are two sets—a full-size set for Alice and an enlarged set for the chess figures—that are either connected by regular editing or process techniques. The majority of the chess figures are gathered in front of the fireplace on the floor where Alice initially discovers and watches them. Then she hears the cries of a pawn and spots him on a commode. The storyboard sketch shows (from rear to front) the fireplace, Alice, and on the commode the pawn, a pair of glasses, and a table lamp (fig. 4.48). Edouart's description of the process foresees three image layers and production steps here: First Alice is photographed together with the fireplace. Then this shot is used as a background plate for the pawn. And finally this combined shot is used once again as a projection behind the table lamp. The first combination is inevitable as the proportions of the two actors have to be changed. The final step, on the other hand, has only financial reason as it saves the expenses for building a giant lamp. Menzies uses the lamp in his sketch to give the image additional depth. But in the final shot it is missing (fig. 4.49a). Instead of it we find on the right side of the image a dark area that

(a)

(b)

Fig. 4.47: *Alice in Wonderland* (1933): The highlights of the projected image are still burned out.

suggests that the lamp was not removed from the shot for aesthetic reason but rather due to technical difficulties. The image area that is preserved for it later cannot be filled because the additional step of photography proves to lack the required quality. The first rear projection with Alice already features strong highlights and a visible hot spot—problems that would increase with an additional process step.[178]

The scene proceeds with different kinds of interactions between the two domains of projected and real space. When the Queen hears the cries of "her child," as she calls the pawn, she climbs up the grate of the fireplace, and Alice grabs her—just like King Kong does with Ann virtually at the same time next door at RKO—to lift her up on the commode (fig. 4.49b). Alice's hand only comes in for a brief moment before there is a cut to a longer shot showing Charlotte Henry with a figure of the Queen in her hand. The note in Edouart's copy of the storyboard here says: "Either Blue or Projection."[179] It remains unclear why exactly this shot might have been an option for the older color-separation process. But it shows that the process is not yet considered obsolete in all cases.

Alice drops the Queen next to the pawn in a similar shot like when she is watching the pawn alone. The storyboard sketch for this scene 30 tries to vary the view and increase its depth by leaving aside the lamp in the foreground and showing instead the remaining chess men in the background (fig. 4.50a). This would require again a three layer compositing like in scene 22 but the final result shows the same reduction to a single rear projection of Alice with two layers (fig. 4.50b). Like before, the quality of the recorded rear projection is not sufficient to use the composited image as a plate for another projection process.

A scene towards the end gets to the heart of the movie's self-awareness in a single shot. When Alice finally has become a Queen, she is locked out from a festivity. She uses a magic wand to disperse the door that prevents her access and enters the room (fig. 4.51). This is done by replacing the door with a background plate that shows a lap-dissolve from door to room. Like in a dialectical movement the process shot first reveals itself with the lap-dissolve that has no equivalent in real life and then recreates the illusion when Alice seems to step into the room of which we now know that it is an illusion.

178 Paramount at this time seems to lag behind its neighbor RKO where optical printing is giving higher priority.
179 Mankiewicz and Menzies, *Alice in Wonderland*, 30.

Fig. 4.48: *Alice in Wonderland* (1933): Storyboard sketch for scene 22.

(a) Scene 22 (b) Scene 30

Fig. 4.49: *Alice in Wonderland* (1933)

(a) Storyboard (b) Film still

Fig. 4.50: *Alice in Wonderland* (1933), Scene 32

(a) (b)

Fig. 4.51: *Alice in Wonderland* (1933)

The self-aware style of *Alice* is first of all owed to the narrative and source material. But it also has to be ascribed to William Cameron Menzies who tries to construct images that—as visual gags—play with their own credibility.[180] This requires careful planing that manifests itself also in very prosaic images: A general problem of rear projection that *Alice* solves well is that the screen cannot extend underneath the feet of the actors. In a lot of early rear projection work for that reason the feet are simply omitted or the projection area is restricted to some kind of recess in the set like a window. The process sets of *Alice*, on the other hand, often use elevations like stones for the protagonists to stand in front of or on that merge perfectly with the projected background and hide the lower edge of the screen. This improved integration reflects Menzies's attitude to the picture as an aesthetic rather than a dramatic entity that directly leads him to an interest in the picture background as being equal to the (foreground) action. And he is well aware that such an integration of image elements is based on an analogue production practice when he writes "screen composition is the collective result of a number of minds working together."[181]

But such a pictorial approach to the construction of images is not beyond dispute as it runs contrary to an interest of many production cinematographers to move the camera. With his provenance from fine arts and his practice of drawing Menzies takes a stand against the ideal of the freely moving camera. As a later article on Menzies says, he "believes in cutting and not in the moving camera, for he holds that the latter wastes footage, that the cameraman has less control of composition and that the audience is disturbed by it."[182] The lack of control is not only an aesthetic but also a technical one as movements in perspective render most optical effects at the time nearly impossible. This is a recurring potential conflict between production and process cinematographers in which integrated industry members like Edouart keep a low profile while independents like Menzies or Slavko Vorkapich (p. 230) develop distinct attitudes.

180 Menzies had recently co-directed *Chandu the Magician* (1932) for Fox, an adventure movie that features several old-fashioned techniques like double exposure and self-aware motives like scaled *doppelgänger*.
181 William Cameron Menzies, "Pictorial Beauty in the Photoplay," *Cinematographic Annual* 1 (1930): 173.
182 Ezra Goodman, "Production Designing," *AC* 26, no. 3 (March 1945): 83-84.

4.11 Collecting Plates (and Places)

A presentation of Roy Pomeroy's color-separation process in *Variety* defines it first of all as the "death knell of distant and lengthy location trips."[183] The article continues that traveling filmmakers like Merian C. Cooper and Ernest B. Schoedsack now can combine the exotic locations of their recent movies *Grass* (1925) and *Chang* (1927) with professional actors from Hollywood. "Should the transparency background system be employed extensively, costly location trips will be a thing of the past. All that will be necessary will be the services of a couple of cameramen who can be sent to any part of the world to photograph backgrounds of every conceivable nature and come back to permit the actors to do all their stuff in the studio."[184]

Those who are responsible for obtaining backgrounds for the studios are the ones who will be in charge of combining them with studio sets and actors later. This does not necessarily have to be the same persons but the responsibility for process plates lies with the newly emerging effects departments. In 1930 Vernon Walker, head of the still small trick department at RKO, travels to New York to photograph backgrounds for *Check and Double Check*.[185] The trip takes Walker two weeks and once he becomes head of his own department, he will limit such expeditions to the vicinity of Los Angeles. One of the cameramen who will specialize in plate photography is Dewey Wrigley. In the summer of 1931, Wrigley together with a first and an assistant cameraman travels also to New York to shoot backgrounds for *Suicide Fleet* (Albert S. Rogell, 1931). Two weeks are planed for the team for shooting, but Wrigley individually is budgeted for another two weeks to find locations and prepare photography. The budget allows for the trip a total amount of nearly $3,000 that is split equally for three productions of which the other two could not be identified.[186] At this point there is no specialization yet in collection of process plates and inserts, even though an assignment to collect such images for several production at the same time is a first step in that direction. Wrigley is also in charge of photographing the process shots on the studio's sound stages and miniature ships at RKO's backlot 40 Acres in Culver City. He later will become one of the main collectors of location backgrounds, working mainly for Paramount but in cooperation with other studios. In 1950 the New York Times dedicates a longer article to him when he travels Europe to update the studio's film library with postwar scenarios. At this point he has already shot half a million feet that was then "added to the millions of feet of background shots, lying rolled up in thousands of round tin cans which are stored in fireproof vaults all over Hollywood—the sum and substance of the film industry."[187]

RKO still uses the Dunning process for *Suicide Fleet*—charged with $3,200 for six shots—and the Dunnings themselves make the collection and distribution of background plates a part of their business. About the same time when Wrigley travels to the East Coast, they team up with New York photographer Irving Browning to deliver plates for their service studio in Hollywood and a partner, the George Humphries Motion Picture Laboratories in London.[188] The extend of this stock footage trade with small and independent produc-

[183] "Transparency Backgrounds by Roy Pomeroy's Process Make 'Location' Unnecessary," 4.
[184] Ibid.
[185] "Vernon Walker Finds New York Hot."
[186] *Budget Detail "Mystery Ship" [Suicide Fleet]*, production records, August 25, 1931, box 18 P, RKO Radio Pictures Studio records, PASC.
[187] Helen Colton, "Stocking Studios with Stock Shots," *NYT*, April 9, 1950,
[188] "Browning to Represent Dunning Process in East," *Film Daily* 56, no. 6 (July 7, 1931): 2.

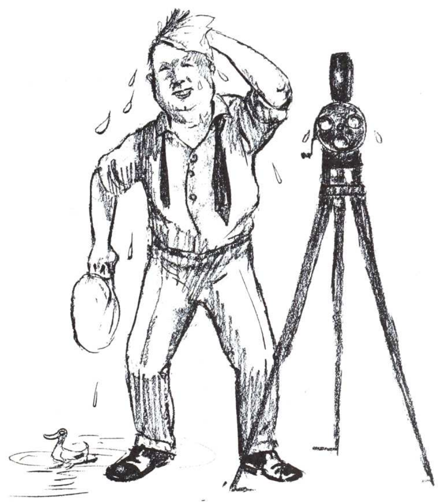


Fig. 4.52: Drawing by *King Kong* animator Willis O'Brien showing Vernon Walker and his camera sweating in New York.

ers at this time is uncertain but the Dunnings do not only sell their services to the big studios with own stages but also have a stage available for rent at their own headquarters.

To better understand the economical aspects of image backgrounds, lets look at a production with the designating title *Flying Down To Rio* shot in fall of 1933. The story, involving band leader and aviator Roger Bond (Gene Raymond), moves from Florida to Rio de Janeiro is nearly entirely produced at the RKO studios in Hollywood. The necessary location footage is collected a few weeks before principal photography starts. The budget for the shooting in Rio de Janeiro is set to $8,500 from which alone nearly $3,000 go for flight tickets and excess luggage.[189] To put this in relation: Vernon Walker as head of the camera effects department at this times earns $300, a first cameraman $150, and an assistant cameraman $50 per week.[190] Footage in Rio is shot by the production cameraman J. Roy Hunt and one or two assistants. This makes it clear that in such cases a production on location with a regular crew and cast is out of question. If a foreign location is not directly available for a production, there are several options to link the stage action to it. It can simply be suggested without actually showing it, it can be shown in isolated idiomatic establishing shots (like the cityscape of Paris with the Eiffel Tower), or it can be integrated with story specific inserts and backgrounds. The preserved communication regarding Hunt's tasks in Rio as much as the script itself is not very precise when it comes to requirements. The plates he produces look accordingly generic as they are not directly related to the story but try to be specific about the depicted place, Rio de Janeiro. In the final movie the city as location is several times addressed in short inserted successions of shots by Hunt. The only genuine connection between the foreign footage and the story of *Flying Down to Rio* lies in the fact that Hunt takes the effort to do aerial photography that, with the finale of the movie, also becomes relevant in regard to the narrative.

What emerges here is the separation of a second production unit that has a different (and much smaller) structure, different tasks, and different images to be produced. This separation requires a reintegration within the final movie. *Hips, Hips, Hooray!* (Mark Sandrich, 1934), a following production at RKO, has more detailed descriptions of scenes to be shot by

189 *Flying Down To Rio*, production records, 1933, box 37 P, RKO Radio Pictures Studio records, PASC.
190 *RKO Pay Rolls*.

(a) Though the bus ride is always planned as a Dunning shot in the production files Dewey's plates from New York are used in the movie as double exposures for unknown reasons.

(b) Regular Dunning shot that features the common degradation of the background due to color toning and filtering. The plate was shot at the San Diego and represents the Navy yard in Brooklyn.

Fig. 4.53: *Suicide Fleet* (1931)

the second unit. There are clear allocation of second units tasks to scenes in the script but no visual aids like a storyboard.[191] The closer a location is, the bigger the second unit can be. In August 1934, e.g., Vernon Walker and crew (altogether eight people) travel to Santa Cruz to shoot process plates and inserts for *Anne of Green Gables* (George Nichols, 1934).[192] The re-use of second unit footage at this point seems to be limited at least when it comes to more prestigious productions. Studios seem to be aware of possible deficits in production value when backgrounds and inserts are either not specific enough or even recognized by the audience as coming from another picture. The latter argument can be seen as a reason for rather selling footage for other studios than using it for own productions of lesser interest. The first person to complain about inopportune re-use of footage would be the director. Cecil B. DeMille protests against the use of footage from his *The Plainsman* (1936) for Paul Sloane's *Geronimo* (1939) as the new production apparently already uses too many external scenes.[193]

Second unit work in some cases is so closely related to that of the first unit that the footage produced there is too specific to be used for any other picture. Warner Bros' swashbuckler movie *Captain Blood* (1935) contains several mass fight scenes with pirates boarding another ship. Despite of their high complexity the production of these scenes is split between the first and second unit. The first unit with director Michael Curtiz and cinematographers Ernest Haller and Hal Mohr does mainly long shots and closer ones with Errol Flynn while the second unit works on closer shots with bits and extras. The latter crew is referred to as the crew of Fred Jackman, the head of special effects at Warner. Jackman himself acts more like a second unit producer than director. The director of this unit is Jean Negolescu, not an effects person but a young director who works for several studios at the time and later becomes well-known on his own behalf. The second unit cameraman is Byron Haskin, an effects expert and staff member of Jackman's department. The usage of second unit in the movie industry varies depending on the studio and kind of production. In general second units do photography that does not require the director and the main actors. It is, therefore,

191 See *Scenes for Scarehead [Hips, Hips, Hooray!]*, typescript, October 27, 1933, box 299 S, RKO Radio Pictures Studio records, PASC.

192 *Anne of Green Gables*, production records, 1934, box 52 P, RKO Radio Pictures Studio records, PASC.

193 Cecil B. DeMille to Jack Karp: Transparency Backgrounds for Paul Sloane, memo, February 8, 1939, 83.f-4, Paramount Pictures Production Records, MHL.

(a) The Venice set on stages 9 and 10 at the RKO studios.

(b) A rear projection marks the entrance to the Venice set …

(c) … and a painted backdrop the impossible exit.

(d) Inside and outside become indistinguishable when Dale Tremont (Ginger Rogers) looks out from a supposed exterior location behind her.

Fig. 4.54: *Top Hat* (1935)

cheaper and more efficient to have another team that collects background and inserts. The Jackman team is highly integrated as they shoot major parts of the final battle—everything that involves miniature work, that might cause technical problems, and that does not incorporate Errol Flynn.

Another giant set of that time is build for Mark Sandrich's musical *Top Hat* (1935). Stages 9 and 10 of the RKO lot in Hollywood are used to construct a part of Venice with navigable canals. Function and size of the Venice set suggest an exterior location but the artificialness of the musical world makes it still feel like an interior. Inside and outside ultimately blur when Dale Tremont (Ginger Rogers) steps into a doorway looking out from what is supposed to be an exterior site (fig. 4.54d). Process screens just as painted backdrops become parts of the set that mark points of entrance and exit (figs. 4.54b and 4.54c). This is not only the case with the Venice set (named "Ext. Lido Hotel" though the famous hotel is not even close to canals but on the sea) but also with the entrance hall of a London hotel where the story begins. The likewise as hermetic as spacious interiors go along with an exterior scene with Jerry Travers (Fred Astaire) driving Dale in a hansom cab. The ride is entirely produced with process shots but does not make concessions to the technique by reducing angles or camera movements. Fore- and background show different contrast but besides of this the scene is staged as if shot on location.[194]

[194] Plates from London are provided by former RKO employee and first effects expert Lloyd Knechtel who had moved to the UK See *Top Hat*, production records, 1935, folder A 824, box 57 P, RKO Radio Pictures Studio records, PASC.

The logistics of assembly are still not standardized when it comes to process imagery. Technically rear projection provides an option that is feasible in most cases and accepted within very few years. But the acquisition of the additional image elements can be organized in a variety of ways. While most directors relay on second units and the studios' effects departments or their own cameramen to acquire backgrounds, others prefer to shoot it by themselves. Director Tay Garnett, in 1935, even tries to use this task for public relations. Garnett is not associated with a specific studio at the time. His most recent films are for MGM, Columbia, and Twentieth Century Fox where he is still filming *Professional Soldier* (1935). Like several other directors Garnett is a recreational yachtsman and maritime movie themes in the past years also turned out to be successful and satisfying for him. He, therefore, announces to sail the world to collect background plates for his next three pictures *World Cruise*, *Singapore Bound*, and *Trade Winds* of which only the last title should make it into an actual movie. The interest in Garnett and his ship Athene, at least within Hollywood, is big even if process techniques still get mixed up with other optical effects as an article in the *International Photographer* shows. "At the end of one year, to a dot, the S. Y. Athene will dock at San Pedro harbor, returning with the biggest load of backgrounds, side-wise dissolves, fade-outs, in and out irises, barn-doors, explosion transformations, double exposures and other marvels of cinematographic nature now seldom seen in captivity in the studio zoos."[195] Public interest arises due to the illustrious people on board. The group of voyagers consists of two dozen people including Garnett's wife, the actress Helga Moray, cameraman James B. Shackleford, producer Bert E. Friedlob, actress Jeanette Loff, and George P. Putnam, publisher, explorer, and widower of the just recently disappeared popular aviator Amelia Earheart. But when the ship leaves on November 17 for Honolulu, Garnett and his wife stay only as long on board as the photographers in the harbor can see them. Out of sight they return with a motor boat because Garnett still has to shoot retakes for *Professional Soldier* at Fox. One month later they board a passenger ship in San Francisco to catch up with the Athene on Hawaii. Further complications enforce the core film team to travel independently from the sailing ship until Indochina.[196] After his return Garnett explains his venture for the New York Times.

> "Well, for one thing, I disagree that atmosphere is something you can find by delving into a library of process shots. For another, I believe that the director who has been right on the scene of action has a distinct advantage over the one who hasn't the faintest knowledge of conditions in the land that is the locale of his picture. Thirdly"—and there was a twinkle in his eye when he said it—"I had a honeymoon to take and a sturdy, 125-foot sailing yacht ready for immediate action. So we hopped aboard with a few camera men and a lot of film."[197]

In his autobiography Garnett also mingles life with fiction. During his trip he neither has a ready script nor a studio to produce his three projects. He returns home basically broke but with 70,000 feet of scenic footage. Only then he writes the script for *Trade Winds* and wins Walter Wangler as production company. In the story Kay Kerrigan (Joan Bennett) escapes from San Francisco after being accused to have murdered a man who had driven her sister into committing suicide. She is chased by a group of three very different pursuers of which one, Sam Wye (Frederich March), finally falls in love with her. It is difficult not to read the travels in the movie as the dramatized version of those that Garnett and his fellow plate col-

[195] Bill Boyce, "A Shipload of Backgrounds, Etc.," *IP* 7, no. 11 (December 1935): 10.

[196] See Tay Garnett and Fredda Dudley Balling, *Light Your Torches and Pull up Your Tights* (New Rochelle, NY: Arlington House, 1973).

[197] "Mr. Garnett sees the World," *NYT*, May 1, 1938,


(a)


(b)


(c)


(d)


(e)


(f)


(g)


(h)

Fig. 4.55: *Trade Winds* (1938)

lectors did. Regarding the technical aspects of his film he later writes in his autobiography: "In addition to serving as a springboard for a celebrated romance, *Trade Winds* was unique in that it involved more process photography than any film before or since, with the possible exception of *Around the World in Eighty Days*."[198] One journey is literally embedded into the other. This high degree of immersion shows exemplarily when, towards the end of the story, the lovers try to break away to a group of islands that Garnett also describes in his autobiography. "While studying *The Pilot's Manual* I was seduced by a line reading, 'The Laccadive Islands lie green and fertile off the Malabar Coast of India in the Arabian Sea, lat. 10 degrees 20' 20' N. and long. 72 degrees 74' E. When last visited, in 1880, the natives were not unfriendly.'"[199] The scene in the movie begins with the iconic frontal shot of the couple sitting in a vehicle, in this case an open horse carriage, in front of a projected local street (fig. 4.55a). They leave the carriage, pay the driver, and a camera pan pulls them to the right (figs. 4.55b and 4.55c). They pass a big studio tree that disguises the gap between the left rear projection, showing a village, to the right one depicting a shoreline. In front two boats rock in a studio tank (fig. 4.55e). He walks back to pay another local and leaves her behind at the jetty (figs. 4.55d and 4.55f). They cast off with a boatman and find themselves in a similar shot like the first one—only the vehicle has changed (figs. 4.55g and 4.55h). The journey continues on one of the islands and is echoed by a following detective who takes the second boat and finally apprehends them. *Trade Winds* pushes the use of process shots further than any other movie of its time not so much in the absolute amount of rear projection shots but rather in its peculiar mode of integration—i.e., the repetition of the original journey on the sound stage. Though the movie is a big success with the audience, Garnett apparently does not use further footage from his trip for other productions and, as mentioned above, the other two planned projects are not realized. The reasons for this are not clear but it might be that the crop is simply reaped or that the overlay of the two trips in the case of *Trade Winds* forestalls any other use of the plates.

Garnett argues that a director should know the atmosphere of the location where his story takes place. This for him is a strong argument to collect plates himself as he already did before *Trade Winds*. The more common attitude among directors is but to eschew process work or studio sets if possible. Location works becomes feasible when the location is not too far away. This is the case with RKO's *Gunga Din* (1939), which is based on the poem of the same name by Rudyard Kipling. The story plays on the northwest frontier of India in the late nineteenth century and the sparse landscape is represented by the craggy desert half a day north of Los Angeles. Film historian Richard Jewell describes the production of *Gunga Din* as a continuous conflict between director George Stevens and studio executive Pandro Berman. Instead of the scheduled ten days in the desert, Stevens, his crew, actors, and a big crowd of extras spend more than a month on location.[200] The overrun of the schedule also has to do with conflicts regarding process shots. For a shot of fort and parade ground Stevens decides to position his camera in a different places than planned. This means that a proposed matte painting depicting barracks ($250) is canceled and three profile buildings actually have to be build ($650).[201] The production budget foresees only a few matte paintings and miniatures e.g. to add a canyon under a bridge (fig. 4.56a). The are two scenes that use traveling matte processes, once when Gunga Din (Sam Jaffe) and

198 Garnett and Balling, *Light Your Torches and Pull up Your Tights*, 221. Garnett is by far not the only one who raises such claims and the comparison with *Around the World in Eighty Days* (Michael Anderson, 1956) is owed more to the topic than technique of the Jules Verne adoption.

199 Ibid.

200 Jewell, "A History of RKO Radio Pictures, Incorporated 1928-1942," 508-12.

201 *Gunga Din*, production records, 1938, folder B 146, box 88 P, RKO Radio Pictures Studio records, PASC.

(a) Matte painting by Mario Larrinaga adds a canyon under an actual bridge. Though painting and combination printing is done in the studio, Vernon Walker and Larrinaga bother to do the trip to the Lone Pine location likely to photograph the live action according to their needs.

(b) British soldiers under fire on the top of a temple. The scenes are shot in September 1938 on Stage 8 at the RKO studios presumedly with stereopticon rear projection.

Fig. 4.56: *Gunga Din* (1939)

Cutter (Cary Grant) behold a (miniature) temple and when the soldiers surrounded on the roof of the temple at the end of the movie (fig. 4.56b). The budget still lists in this case Dunning process shots but the slight camera movements in the final footage suggests that a stereopticon (rear projection with still slides) is employed instead. Naturally all interior scenes are shot on sound stages while exteriors are locations shots. But process work here has shifted the very definitions of exterior and interior. The difference is no longer the location of something in relation to any kind of limiting boundaries but the scope of action. The soldiers on the temple make an adequate motif for process work as they cannot move. (All reverse shots with the attacking Indians and the saving backup are location shots.) Also Gunga Din and Cutter watching the temple stop moving in the moment they see the building.

That rear projection does not bring an end to even remote location shootings becomes most obvious with director W. S. Van Dyke.[202] In a similar approach as with *Trader Horn*, Van Dyke and cinematographer Clyde De Vinna in 1932/1933 spend ten months in Alaska filming *Eskimo*. But just like the Africa movie *Eskimo* shows to which degree also productions that are not confined to the studio stages are altered by the practices of optical effects. In his period book *Talking Pictures* Barrett C. Kiesling chooses these two productions of Van Dyke as case studies for what it means to “go on location.”[203] Robert C. Cannom in his book on Van Dyke describes the circumstances in Alaska in detail and emphasizes the director’s desire to be authentic.

The story by Peter Freuchen, who works as an interpreter and advisers on location and even plays a part in the movie, takes place in the late nineteenth century when contacts between indigenous people and white traders started to increase. Against the will of MGM’s producers, Van Dyke insists on casting even leading roles with local amateurs. After several weeks shooting with an Eskimo playing the hero Mala, the native insists under false

[202] The sequel to his Tarzan movie was announced to be shot on location which finally is not the case. Maybe this is one reason why not Van Dyke but art director Cedric Gibbons directs it.

[203] Barrett C. Kiesling, *Talking Pictures: How They Are Made, How to Appreciate Them* (Richmond: Johnson, 1937), 184-95.

Fig. 4.57: This process shot from *Eskimo* (1933) not only shows mismatched scales of foreground and background but the process plate also ends with a pan down that follows the diving walrus.

pretense to leave. Cannom suggests that he wanted to protect his wife against sexual approaches by crew members—a situation that also is the central motive of the movie. After the failure of this principal assembly Van Dyke is forced to recast the role and re-shoot most scenes. The replacement is a hybrid in himself. Ray Mala (formerly Wise) is half-Inupiat, half-Russian Jew who lives in Hollywood and played in the recent production *Igloo* (1932). Cannom's account of the production of *Eskimo* ends when the company wraps up in late March 1933 and returns to Los Angeles. What he withholds is that production continues and MGM later brings eight Eskimos to the studio to appear in process shots. The New York Times picks up the story and reports that the Eskimos in their traditional gowns cause quite some puzzlement in Culver City and that among the few things they enjoy there are going to the movies (instead of playing in them) and having ice cream for breakfast.[204] In the studio's process of image assembly the natives function like process plates. One can say that the problems that arise from this situation derive from the disrespecting the differences between them and the backgrounds usually brought in by second units.

The process scenes appear throughout the entire movie. The first sequence that uses them depicts the hunting of walruses and later a polar bear. The footage as it was shot on location even today still looks spectacular. But the process shots try to push the dramatic value of the sequence even further by bringing indigenous people and animals closer together (fig. 4.57). This approach and the resulting images build on the crocodile sequence in *Trader Horn*. Presumably, the used process now has changed from color-separation to rear projection. But the aesthetic concept basically is the same as can be seen when the background is rendered too large and contradicts optical realism.

At the end of the movie Mala and his second wife escape their white traitors on an ice floe. The majority of the shots here are process work. Close shots of both parties looking at each other could have been produced easily on location but likely only become necessary when MGM decides to reinterpret the ending of the story in a more conciliating way. Original long shots of the actors walking in the snow are complemented by double exposure shots that overlay the darker parts of the actors' images with the landscape. In these cases the ice drifts so fast that the movement is instinctively perceivable. Either these situations were too dangerous for the actors or the landscape was under-cranked to increase speed. In the latter case two different speeds would be combined in the final image. The reason

204 "Hollywood Startles Eskimo Actors," *NYT*, August 6, 1933,

(a)

(b)

Fig. 4.58: *Eskimo* (1933)

why MGM turns back to such an old technique here are the lack of large enough screens and—even more important—the problem that with rear projection the ground on which the actors stand cannot be part of the process plate (fig. 4.58).

4.12 Staged Worlds

With the advancing integration of foreign sites into studio productions the requirements for techniques likewise grow. The sets become more widespread but also more specific in their details. And finally, direction itself develops new approaches to organize these prospering collectives of actors, props, and images. Occasionally this integration becomes apparent not only in the images but also by named and shared responsibilities. In the romantic comedy *The Bride Comes Home* (Wesley Ruggles, 1935), e.g., Farciot Edouart shares his screen credit for 'Special Photographic Effects' with Paramount's plate cinematographer Dewey Wrigley. Wrigley, who later "is considered the most active traveling cameraman,"[205] can be described as Edouart's complement. He links the sound stages with the real world just as Edouart connects the projected background with the action foreground. One example of how stage practices react to the plates here are rear projection shots with moving vehicles. While rear projection with car scenes is probably the most frequent application of rear projection, what is special in *The Bride Comes Home* is that the movie here depicts nocturnal situations. The plates are almost black with only occasional highlights flying by. The unsteady luminosity of the plates, therefore, is answered by flickering and moving stage lights, which mimic the external light situation.

Such a simulation on stage of what is depicted by the plate is but one way of convergence, the blurring of the border between the two domains is another. A corresponding scene shows the movie's main protagonists Jeannette Desmereau, Cyrus Anderson, and Jack Bristow (Claudette Colbert, Fred MacMurray, Robert Young) having lunch at a restaurant. We find them when the camera follows an extra from the entrances to their table. The traveling shot takes off at a big restaurant window that exhibits a lively urban street. The triplet then splits due to a conflict and Jeannette and Cyrus change seats for a window table. The scene has returned to its opening shot: the interior of the restaurant, the window, pedestrian in various distances, cars, and trolleys. What makes this process shot in *The Bride Comes Home* different from preceding window views is that the pedestrians inhabit an unusually wide (or from our perspective deep) sidewalk. With their varying scales they

[205] Rella, "They Say …," *IP* 12, no. 11 (December 1940): 21.

Fig. 4.59: *The Bride Comes Home* (1935)

actively bridge the gap between the site of action and the backdrop. It becomes difficult to determine whether the entire exterior is done my means of rear projection or if the closest pedestrians are actually walking on the sound stage. When Jack, who misbehaved towards Jeannette, passes by the window table on his way out, he attempts to apologize but she ignores him. Only when he is out on the street and makes a second attempt by knocking on the window, she looks up at him (fig. 4.59). The dramatic function of the scene's action—Jack misjudging Jeannette to be a spoiled millionaire's daughter while she is actually broke and just tries to earn a living—is interwoven with the attempt to render the site of action real. Jack is walking out on the street to show that it is not only a projection (though he also might be part of the plate) and is knocking on the window to evince its existence.

A following scene with Jeanette and Cyrus sitting on a park bench features a similar handling of extras. The far background depicts a city skyline. In front a crowd promenades that shows the usual deficiencies of nighttime plates (i.e., high contrast with burned out highlights). Between the projected crowd and the bench on the sound stage a steady flow of extras passes by. One can even hear the grinding wooden floor under their feet. This added buffer zone between action and background picks up features of both. It is part of the sound stage but it is allocated to the projected background that it extends. The extras in the studio imitate the crowds behind them in the plate (just as the stage lights in the car scene mimic the passing lights of the city). But at the same time the plate extends the location that is suggested by the foreground. The result is an invisible wall between actors and extras that gives such scenes (at least for us today) such a disconcerting effect.

Wrigley and Edouart work again together on *The Plainsman*, a production that receives wider attention within the industry. After the principal photography in the summer of 1936 director Cecil B. DeMille praises the work of Paramount's transparency department in an *American Cinematographer* article. *The Plainsman* is the first production in which DeMille extensively uses not only the technique of rear projection but also the production practice of second unit photography. DeMille's second unit director Arthur Rosson (the director of *Sahara* (1919)) and cameraman George Robinson shot process plates and mass scenes in Montana and Wyoming while the first unit basically does not leave Los Angeles. "Twenty-nine of the forty-six originally scheduled shooting days were set in the great indoors. Thirteen days were to be spent on the studio back lot. Only four days of principal photography were to be shot on locations near the studio."[206] One circumstantial reason

[206] Robert S. Birchard, *Cecil B. DeMille's Hollywood* (Lexington, KY: UP of Kentucky, 2004), 296.

(a) Rear projection set with an American Indian scouting a cavalry weapon transport.

(b) Wild Bill Hickok and Calamity Jane, shortly thereafter, watching the attack of the Indians against the cavalry.

Fig. 4.60: *The Plainsman* (1936): Two scenes using the same set with identical foreground framing but a shifted and scaled background plate of the same landscape.

for DeMille to stay in Hollywood is an obligation to host a weekly radio show. But the original foundation for his change of production practice should be that Paramount reminded him that his productions of recent years resulted in an overall net loss for the studio while the expanses for him and his staff are high as ever. Paramount executives, therefore, suggest to drop the planned production of *Samson and Delilah* and to make a patriotic Western similar to RKO's *Cimarron* and Fox's *The Big Trail* (both 1931).

Just as westerns are not a genre generally associated with DeMille, they are also hardly the kind of movies one might consider ideal for the application of rear projection. The landscape in westerns is more than a mere backdrop but an integral part of action. Besides it is a landscape that is easily found close to the studios which makes productions on location viable. What DeMille starts with *The Plainsman* is a new way to integrate second unit work. Rosson not only supplies plates and inserts but also all kind of long shots with thousands of extras. This cooperation manifests itself especially in the final battle when a group of soldiers are trapped on a tiny river island and under attack by American Indians. DeMille describes it as "the longest, biggest and most dramatically important sequence that has ever been done entirely by the Transparency process."[207] This becomes possible not only due to the location plates and inserts by Rosson but also because the art department builds an extensive set for the scene. It consists of a revolvable island and two rear projection screens. The island mimics an actual site in Montana, which is featured in the location footage. The hiatus between the two projections is obscured by an artificial tree (fig. 4.61). The increased relevance of rear projection at this point becomes comprehensible looking at the physical space the set occupies rather than at the shot sizes. To avoid hot spots the throws of the projectors are several times as large as the actual projection.[208] This means that the greater part of the stage is occupied by the projection set-up that only for the production cameras appears to be flat. The set itself becomes subordinate to the projected sites. It literally spins according to the plates. DeMille describes his work on the river sequence with its two domains as follows:

> In filming scenes of this type, the Director has two dramatic elements to coordinate. In the foreground, there is the intimate action of the besieged principals. In the background, the equally important action of the besiegers. In the fore-

[207] Cecil B. DeMille, "A Director Looks at 'Process-Shots,'" *AC* 17, no. 11 (November 1936): 459.

[208] See Edouart, "Economic Advantages of Process Photography."

(a)

(b)

Fig. 4.61: *The Plainsman* (1936): The set in the foreground is placed on a revolvable platform so that the reserve shots can be done with the same rear projection screen. The architecture and the projected landscape, therefore, develop the same degree of flexibility.

> ground, he has his principals and from twenty to fifty extras to consider. In the background, he may have five or six thousand Indians and a regiment of cavalry, none of whom are at all picture-wise. Both elements must be perfectly coordinated, or the scene will fall flat.[209]

DeMille's notion of a scene that should not "fall flat" reminds of how closely related the telling of stories is with the creation of spaces in motion pictures. When he as a matter of course describes himself as directing the actions in the foreground and the background, he negates any differences in quality of his role in regard to both domains. While direction of the stage actions means the guidance of actors and crew in situ, the direction of the background is an operation that is mediated in a very different way. DeMille had participated in the planing of travelings and agreements on the subject and composition of plates. Finally, he selects photographed backgrounds and orchestrates their entry on the stage. Conceptually he absorbs the technical segregation of the set by process photography and instead establishes two corresponding domains of action. He is perfectly in line with Edouart here who, according to DeMille, "performed a first-class miracle of his own"[210] but constantly characterizes his technique as an obedient servant of the studio without own agenda. At the same time, the implicitness with that DeMille presents this practice withholds the established alternative to it. And that is the approach to connect both domains by means of editing. Of course to show all elements at the same time and within the same space augments the dramatic value of a scene. His reference, therefore, is the utterly unrealistic option to photograph what he calls "intimate action" in front of actual crowds on location.

A movie that is mainly discussed at the time under economic aspects is Michael Curtiz' *Captain Blood*, produced by Warner Bros. Two months after its release in December 1935, Jackman presents the movie in an article in *American Cinematographer* under the title "'Process-Shot' Economies Made 'Captain Blood' Possible": "I think *Captain Blood* set a precedent for the industry in one respect: due to the extreme expense of making the production by straightforward methods, the decision as to whether or not the film was to be made at all was contingent upon the work of the special-process staff."[211] The movie about an Irish doctor, named Blood and played by Errol Flynn, who gets involved in seventeenth

209 DeMille, "A Director Looks at 'Process-Shots,'" 458.
210 Ibid.
211 Fred W. Jackman, "'Process-Shot' Economies Made 'Captain Blood' Possible," *AC* 17, no. 2 (February 1936): 61.

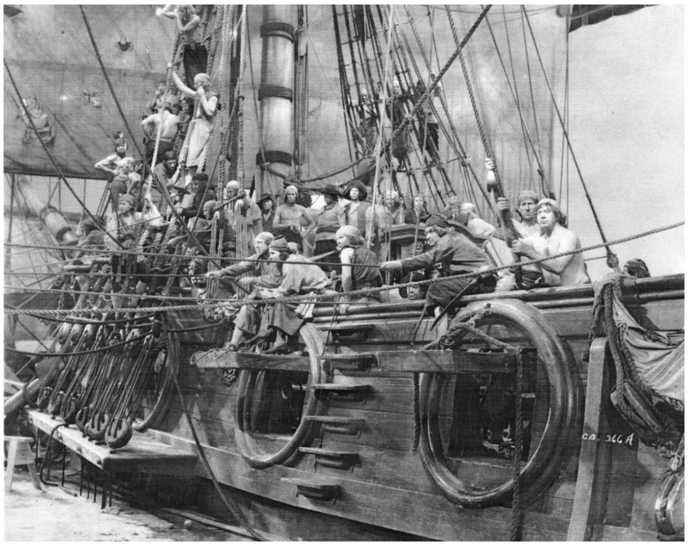


Fig. 4.62: Production of *Captain Blood* (1935) at Warner Bros.

century Monmouth Rebellion and as punishment is sold into slavery in the West Indies, is a remake of a 1924 Vitagraph production. Warner Bros owns the rights since they bought Vitagraph and, according to Jackman, was planing the remake for quite some time. But as the swashbuckler adventure contains several sea battles with sailing ships, it seemed impossible to finance it. Vitagraph had still shot its silent version with full-scale ships which turned out to be disastrous. Budget calculations for a sound remake were about $2 million. The final budget then, with the help of special effects techniques, is reduced to $700,000. 20% of the budget goes for building sets mainly on Stage 5 at the Warner Bros lot in Burbank. What Jackman and his team do, are two things: they segment and they scale down. Ships that are depicted as a whole are miniatures of eighteen feet length and all decks with actions are decks on the sound stage without hulls (fig. 4.62). Additionally, shots from the original silent movie are reused.

Captain Blood is not primarily a rear projection production though Jackman in his article conveys that impression. The backgrounds behind the decks are often painted backdrops. But the movie starts a trend at Warner Bros for sets of increasing size that try to exhibit significant production value under difficult economic conditions.[212] Another article, which is centered around art director Anton Grot, simply calls this approach the “Re-Making the World for the Movies” and describes how the illusion of seafaring is created in the studio. “Giants drops, suspended by great cables and operated by motors where painted into sky and horizon backgrounds. When these drops moved up and down an illusion of the boats being rocked by waves would result. Instead of rocking the boats, they would rock the background.”[213] These mechanical effects at the end can be more easily combined with rear projection because the background as a screen has been integrated into the set. Most rear projection shots are rather simple and connect stage action with miniature work. In a few cases the advantage to be able to move the camera is used to slightly pull in on close-ups. The most complex composite shot is the very first scene showing a horseman who is on his way to Doctor Blood to get help for a wounded rebel. The script describes the scene as follows:

212 For later productions see Sol Polito, “The Mountain Comes to Mohammed,” *AC* 22, no. 6 (June 1941): 264–65, 298–9.
213 “Re-Making the World for the Movies,” *Popular Mechanics*, April 1936, no. 4, 144A, Google Books: lNsDAAAAMBAJ.

Fig. 4.63: Opening scene of *Captain Blood* (1935).

> 1. EXT. HILLSIDE LONG PAN SHOT NIGHT
> following the progress of a horseman as he takes his mount along at a frantic pace. His course lies along the crest of a rolling hill behind which (out of sight) a battle is being fought. The black sky above the hill pulses with bursts of fire and the sound of cannon and musket fire is heard. The rider draws closer.[214]

The first challenge is to photograph a horse "at a frantic pace." Then the described image extends into two directions—laterally as he horse and its rider are supposed to move a certain distance even if the shot is only a few seconds and in depth as the battle and its outbursts are still far away. The control of such a big territory and the camera moving at race horse speed is if not impossible at least extremely expensive. What is done is to compress the extend of the area on both axis. The depths is reduced by means of miniature and rear projection. The lateral movement is restricted by (supposedly) putting horse and rider onto a treadmill or similar device. Now the background, the animal, and the camera are in fixed positions. The background image contains several layers that due to the movement of the plate camera produce a parallax effect. The objects that were closest to the camera only render as dark, blurred shadows. Due to their speed and the fact that the flickering rear projection changes the light of the action it seems as if there was a layer *in front of* the horseman. But close inspection reveals that this is an optical illusion and that the horseman is never covered—except for one dark beam at the very end of the scene that likely was added in post-production (fig. 4.63). This opening scene exaggerates a claim that a lot or process sets develop at this time, namely to represent ever growing sites. This is commensurably achieved by the projections themselves, by the physical size of the sets, or—like in this case—by widening of one dimension with the mechanical aid of a treadmill.

4.13 Closing the Black Box

Towards the end of the 1930s several developments point to a complete integration of rear projection into production practices. This does not mean that the 1940s and later will not see any further improvements but the general concept of what rear projection is and how it should be used will remain fairly stable until its supersession through electronic chroma-keys.

[214] Casey Robinson, "Captain Blood," shooting script (July 24, 1935), 1.

Fig. 4.64: Warner's Fred Jackman praises *Captains Courageous* (1937) as an example for the triumph of rear projection with an (exaggerated) portion of 80% process footage. The extend of usage is made possible because the background hardly harbors agency and the plates therefore remain generic. The cases were there is specific interaction between the domains—like a conversation between boats—remain as rare as in earlier productions. (See Fred W. Jackman, "The Evolution of Special-Effects Cinematography from an Engineering Viewpoint," *JSMPE* 29, no. 3 [September 1937]: 293–302)

4.13.1 New Eastman Kodak Films in 1938

In 1938 Eastman Kodak improves on "basic developments in emulsion making"[215] that are not defined more detailed but that increase speed and lower graininess of all films. The new products that are based on these improvements are Type 1231 Plus-X Panchromatic, 1232 Super-XX Panchromatic, and 1230 Background X Panchromatic. Type 1230 replaces the 1213 Background Negative, the first film stock specifically for process plates, that was introduced in 1932. The new film has the same fine grain that makes it suitable for rear projection but it has twice the speed of its forerunner. It reaches 75% of the speed of Type 1227 Super-X, the heretofore general-purpose film stock. But the first reason to replace Background film with Background X, according to Eastman Kodak, is not the higher speed but the lower contrast. Higher speed makes the special-purpose film catch up with general production standards and practices; the decreased contrast on the other hand allows for actual improvements with the quality of the composite image.

Regarding the application of Background X Huse and Chambers of Eastman Kodak make further suggestions when writing that "it is felt that this emulsion will be adopted generally as an exterior film for general motion picture work."[216] Eastman Kodak apparently is the only company that offers a specialized film stock for plates which likely is the case due to the fact that this market segment is still too small to be attractive for more than one manufacturer. The recommendation to extend the use of such a specialized product can be read as an attempt simply to increase sales and raise profitability. But the given positioning of Background X comes with another suspension as it expresses the assumption that not only do plates display exteriors but in reverse that every exterior shot is potentially a plate. Filming on location, thereby, does no longer require to make a decision in advance whether scenes will be used as such in later editing or become part of a studio set. This is of course

215 Mees, "History of Professional Black-and-White Motion-Picture Film," 135.

216 Emery Huse and Gordon A. Chambers, "New Eastman Emulsions: Advance Technical Data on Sensational New Emulsions," *IP* 10, no. 11 (December 1938): 24; also published as Emery Huse and Gordon A. Chambers, "Three New Eastman Negative Emulsions: Background X, Plus X, and Super XX," *AC* 19, no. 12 (December 1938): 487–90, 525.

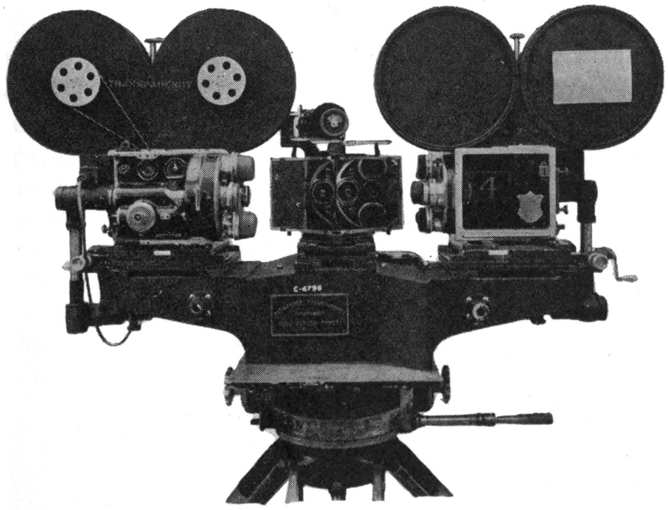


Fig. 4.65: Paramount's dual screen transparency camera.

suppositious as the production practices call for such a decision to define image content and composition. Technically though the difference is suspended. There is little independent assessment on what the introduction of the 1938 film stocks mean. The progress report of the *American Cinematographer* describes 1938 as the year of "fast film."[217] The annual review of the SMPE simply sees Background X and its improved quality as the most relevant innovation of 1938.[218]

However, rear projection not only profits from Type 1230 but, as Farciot Edouart notes, from the speed bump of all film stocks. If at the studio set Type 1227 is replaced by the faster Type 1231, for the production cinematographer this amounts to the saving of a few lights. For the "transparency cinematographer," as Edouart says, this means that he can stop down the lens and increase the depth of field.[219] Leaving aside whether production cinematographers would agree with this reading, in any case it points to the relevant fact that the light intensity of rear projections is much more limited that of set lighting as luminaries in the lamp house of the projector cannot be added up as above the set. From this Edouart concludes that new stocks directly facilitate the deployment of his technique.

4.13.2 Projector Progress

The necessity to increase projection intensity for the ever growing sets and screens makes the people in the effects departments work on improvements in this matter. Edouart had extended the set size for *The Plainsman* in 1936 by using two screens. Therefore, two continuous plates were needed and Paramount comes up with a fitting for two Bell & Howell 2709 mounted on a common base sharing one optical axis and looking at each other. Between them two mirrors are positioned in $45°$ angles to the axes so that the cameras' views

[217] William Stull, "Technical Progress in the Past Year," *AC* 20, no. 1 (January 1939): 8.

[218] See J. G. Frayne et al., "Progress in the Motion Picture Industry: Report of the Progress Committee for the Year 1938," *JSMPE* 33, no. 2 (August 1939): 119.

[219] Farciot Edouart, "Paramount Triple-Head Transparency Process Projector," *JSMPE* 33, no. 2 (August 1939): 180-81.

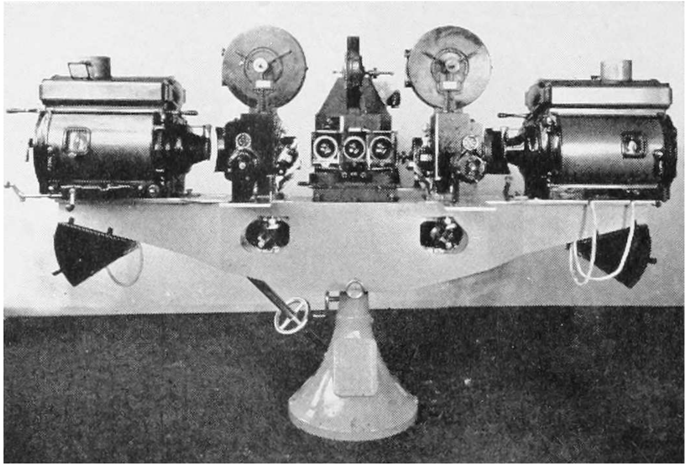


Fig. 4.66: Triple-head projector in use at Paramount studio

are deflected orthogonally. The camera movements are mechanically connected to ensure synchronism (fig. 4.65). The result are two connecting shots that—projected by two interlocked projectors—allow for a process set of double width.[220]

While the dual screen process is mastered technically, it still holds disadvantages as the production of Paramount's western *Geronimo* (1939) shows. The western, written and directed by Paul Sloane, is a low budget follow-up for DeMille's *The Plainsman*. Especially the final battle of *Geronimo* with soldiers closed in by Indians reminds of DeMille's movie. The set incorporates the same double projection with a fake tree building a link between the screens. While elsewhere the advantage of the dual screen process to have more options to move actors and camera is emphasized, in the case of *Geronimo* a conflict between Sloane and Edouart points to the downside. Sloane is unhappy with either the plates, the process technique or with shooting in the studio in general and tries to relocate shooting days outside the studio. Edouart had screened all possible plates for the director who was not familiar with Paramount's Transparency Department and printed them to ensure the highest degree of flexibility possible on the process set. When Sloane later complains, Edouart defends himself toward a studio executive.

> Paul [Sloane] knew from the first, the static character of the dual screen backgrounds about which he is now complaining, and had a number of single screen backgrounds, full of vital background action, that he originally planned to use for the build up at the climax of his "barricade" sequence. Had these been used, instead of the dual screen shots, he would have secured the desired effect he is now complaining he doesn't have.[221]

Nobody explains where the alleged "static character" actually derives from. The entire rear projection process is in a lot of ways less dynamic than non-process cinematography. The dual screen procedure had just been presented as technically manageable. The decorated twin camera can be handled nearly as easy as a single apparatus and whether the production camera is interlocked with one or two projectors hidden behind the screens makes no difference for the actors and crew in front of it. This seems to be a small price to be paid

[220] J. G. Frayne et al., "Progress in the Motion Picture Industry: Report of the Progress Committee," *JSMPE* 31, no. 2 (August 1938): 112-13.

[221] Attached to the letter is an extensive list of dual screen plates—many more than found in the final movie. Farciot Edouart to R. L. Johnston: Transparency Backgrounds for Paul Sloane, letter, April 20, 1939, 83.f-4, Paramount Pictures Production Records, MHL

for the increased freedom of movement on the growing sets. Possibly, it is not the plates that give the impression of stagnancy but it is the spread, panoramic set itself that gains presence not only due to the indispensable tree it its center.[222]

In the same days when Edouart defends his dual screen plates, he already presents another improvement by Paramount at the SMPE spring convention at the Hollywood Roosevelt Hotel. The dual camera and screen concept, which won him an Academy Award for Technical Achievement (Class II) in March 1938, is cast down to an intermediate idea and replaced by the technique of triple-head projection. In a similar manner as the twin cameras mounted on a shared base, three projector heads and lamp houses are combined in a T-formation. The central projection head points right at the process screen. The other two are collocated in orthogonal angles facing each other. Their projections are redirected towards the screen. In contrast to the dual camera setup, the projection planes here are not adjacent but congruent so that illumination and not the area itself is increased. This means that all projections run with identical plates instead of two different but coherent ones. A brighter projection of course consequently allows for bigger screens and smaller apertures. As Edouart points out in regard to Eastman Kodak's faster film stock, it is a central concern for him and other process cinematographers to face the growing sets with an increased depth of field. As an example he gives a dual screen setup for *Geronimo* where the camera was about seventy feet away from the process screens but only between twelve and eighteen feet lay between it and the actors.[223] The new film stocks alone allow to stop down the lens from $f/2.3$ to approximately $f/3.5$. A brighter projection, as promised by the new projection technique, would have a similar effect.

The biggest technical problem of triple-head projection, according to Edouart, is to avoid a parallax between the projections. For this reason two of the projection beams have to be mirrored to bring the virtual lenses as close together as possible. Once the apparatus is set up, the operation does not require noteworthy additional efforts. Three identical prints are made as process plates. The adjustment of the two additional projector heads then needs "between three and seven minutes."[224] As the illumination is virtually tripled the screen dimensions increase. Before the triple-head system Paramount's Transparency Department offered a maximum width of twenty-four feet. Now the screen extends to thirty-six feet and plans for fifty feet are made. While image quality is an obligation, which has to be fulfilled to make rear projection an option, size is the actual crux that drives its further development. Edouart says that "the dramatic and economic usefulness of the process is dependent upon the physical scope of the process being sufficient to allow the director freedom closely comparable to what he would enjoy if his company was working upon the actual location."[225]

Edouart and his Transparency Department are not the only ones who are experimenting with multi-projector setups. In his presentation he acknowledges that the staff at Warner Bros has been working independently and seemingly without knowledge of each other on virtually the same concept. Already in April 1938, Warner's Byron Haskin has filed two

222 *Geronimo* allover seems to be a production with troubles that after being closed in April requires several retakes and added scenes until September. One of the additional production plans nevertheless gives a good insight into economics at that time. The scenes to be shot require location work in El Paso and the studio has to decide whether to send a small crew to Texas to collect background plates for later sound stage use or to have a regular crew and actors on location. The process option comes up to a budget of $20,000 while an on location in this case would be $23,000. *Geronimo*, production records, 1938, 83.f-4, Paramount Pictures Production Records, MHL

223 Edouart, "Paramount Triple-Head Transparency Process Projector," 183.

224 Ibid., 174.

225 Ibid., 180.

(a) Miniature flood with matte painted sky, forest, and buildings in the foreground.

(b) Rear projection with plate showing miniature.

Fig. 4.67: *Gold Is Where You Find It* (1938)

patent applications for his device, which he presents at the SMPE fall meeting 1939. In contrast to Edouart, Haskin puts emphasis on an aspect that Edouart had only mentioned shortly: the connection of either multi-camera or multi-projector setups to the Technicolor process that is based on the separation of colors and the recording on individual film strips. The increasing relevance of color in the late 1930s raises the question how color and process cinematography can be combined. At first glance it is not a problem to use a single Technicolor print (i.e., with all colors) in a standard rear projection system. But the production of Technicolor movies at this time still requires much more light as the cameras filter and split the incoming light into three components. The growing illumination requirements naturally reduce the process screen size until it becomes impractical. Haskin is confronted with this problem in fall of 1937 when Warner Bros plans the Technicolor production *Gold Is Where You Find It* (Michael Curtiz). The movie plays in the late nineteenth century and displays a conflict between California farmers and miners. Looking at the final movie as released in February 1938 one finds hardly any process work. Nearly all exteriors are shot on location in California, occasionally enhanced with matte paintings that are added in post-production. The scene that causes a real problem is the flooding of a damn at the end of the movie. The flooding itself can be done with miniature landscapes in long shots but a dramatic value can only be created if the people are integrated in closer shots. The largest available projection size for color process work is 9×12 feet according to Haskin. The representable foreground would be so small in scope that no specific actions could be conveyed as Haskin remarks. The entire scene would fall apart into long shots of a (miniature) flood and close-ups of horrified faces. The process shots as they are finally produced with an improvised triple-projection head still look modest in size. And the entire sequence is not longer than one minute. The montage switches between the miniature (fig. 4.67a) and various shots of people mostly first facing the projected flood and then being washed away by actual water on the set (fig. 4.67b). The sudden waves of water demand more space between set and screen than usual. The actual screen width though should be about sixteen feet here.[226]

Later cinematographer William Stull sums up and compares the developments at Paramount and Warner and notes structural similarities between older and newer applications. “Synchronizing the several projection movements would present no more of a

[226] Byron Haskin, “The Development and Practical Application of the Triple-Head Background Projector,” *JSMPE* 34, no. 3 (March 1940): 252–58.

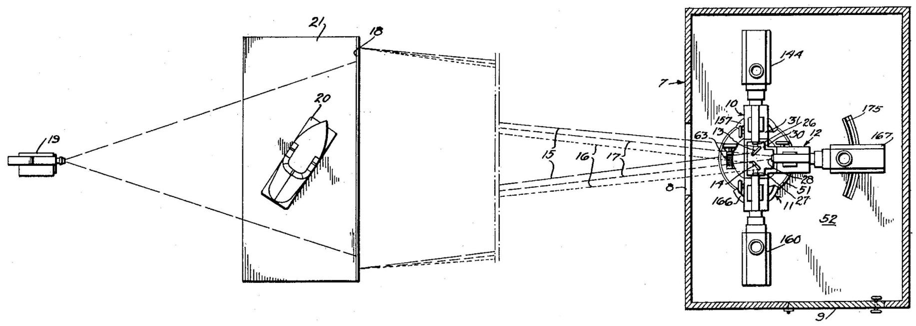


Fig. 4.68: Byron C. Haskin, Composite Photography, US Patent 2,198,815. The triple-projector arrangement is so loud that it has to be put into a sound-proof room.

problem than synchronizing a single projector and a camera."[227] While it is clear from the outset that stronger illumination is needed for rear projection, it is also clear that the effects departments have neither the resources nor the knowledge to improve on lamps and lenses. Instead they turned to recombining and adding up existing devices. The common separation of projector-head and lamphouse further diversifies the options to increase illumination. In another article (actually for movie amateurs) Stull uses professional practices as reference and mentions that in "at least one studio, it is reported that experiments are being conducted toward the development of a single-film projection head equipped with a triple lamphouse."[228] In all cases accepted technical concepts are not questioned but recombined with the aim of blackboxing the results into novel seamlessly functioning techniques. After the successful testing on what Haskin describes as a "breadboard" setup with *Gold Is Where You Find It*, the concept is refined and turned into a patent application.[229] Another act of approval is the honoring of the Haskin/Warner triple-head projector with an Technical Academy Award (Class III) in 1938.

Both, Edouart and Haskin, seem to be testing to load the projectors with color-separated prints in the hope to apply additive mixture of colors. When the results prove unsatisfying, they turn to identical compound Technicolor prints but keep the multiple projection heads. But their respective reports in front of the SMPE and Stull's synoptic article in the *American Cinematographer* suggest distinct focuses on either color or monochrome process photography. Haskin names the production of *Gold Is Where You Find It* as a catalyst for his development. And in his own view he not only fulfills a task in hand. Stull quotes Haskin saying that "it has been our experience that the use of the triple-head background projector has done more than any other single factor to advance color to production parity with black and white. In monochrome today we are so accustomed to the use of large-scale projected background process shots as a means of saving time, effort and money that we take it for granted."[230] Comparing the positions of Edouart and Haskin here helps to understand the differences between initial motivation and final effects of technical developments. Edouart stated that increased brightness was needed to meet the demands of growing sets. But in monochrome cinematography the position of rear projection is already so stable that the new projection technique comes up to a gradual improvement. For color

227 William Stull, "Process Shots Aided by Triple Projector," *AC* 20, no. 8 (August 1939): 363.

228 William Stull, "Amateur Progress in 1939 Exceeded Professional. Part II," *AC* 21, no. 2 (February 1940): 77.

229 The application is later divided into two separate patents granted in April and May 1940. Byron C. Haskin, Composite Photography (Patent 2,198,815 [US], filed April 11, 1938, and issued April 30, 1940), Google Patents: US2198815; Byron C. Haskin, Composite Photography (Patent 2,200,358 [US], filed April 11, 1938, and issued May 14, 1940), Google Patents: US2200358

230 Quoted after Stull, "Process Shots Aided by Triple Projector," 366.

(a) (b)

Fig. 4.69: *Spawn of the North* (1938)

cinematography, on the other hand, rear projection only becomes possible with improved projections. When Edouart's usage of the projector is related primarily to monochrome productions, it is not because Paramount does less Technicolor movies or has less interest in applying process cinematography there. An example is William A. Wellman's aviation movie *Men with Wings* (1938) that features several of the iconic aviators in front of clouds shots. Compared to earlier, monochrome aviation dramas the process work here still seams static and confined. Flying sequences also feature less close-ups than it used to be the case.

The production that legitimizes the development effort for Paramount is without doubt *Spawn of the North* (Henry Hathaway, 1938). The story of salmon fishers and fishing pirates takes place in Alaska but virtually all principal photography is done on a sound stage with a tank several acres in size and what Stull declares to be the world's largest process screen—36 $\times$ 27 feet. "The background was a projected transparency, of a size, as may be appreciated, never before thought possible."[231] Edouart will later receive an Academy Award for his work on the movie presumably mostly owed to a dramatic scene that involves the fishermen's boats with collapsing glaciers. But the improved integration of location and stage becomes already visible in less sensational scenes. Right at the beginning of the movie, Jim Kimmerlee (Henry Fonda) and his people are working at one of their fish traps, loading the fished salmon onto a boat. We first see Jim watching and then watch him and the fish (fig. 4.69). Both shots are process shots which is still not a standard with the shot/reverse shot editing pattern. Usually—like in situations where the protagonists are under attack as described in regard to in *Gunga Din* or *The Plainsman*—editing would go back and forth between straight and process images thus implicitly emphasizing the distinction between both domains. (With *The Plainsman* the reverse angle is shot using the revolvable set but never both shots are used directly together.) In *Spawn of the North* we find not only a panoramic concept of process space but also elements in the immediate vicinity of the action can often not be allocated structurally. This becomes most evident in situations with two boats being next to each other. Sometimes people jump from one boat to the other (being both in the studio) and in others like the fish trap scene this connection is only suggested when Kimmerlee remotely controls the lifting of the net in the background.

[231] Stull, "Process Shots Aided by Triple Projector," 366.

Fig. 4.70: Animal trainer Olga Celeste, Kathrine Hepburn, Cary Grant, and one of the two leopards that is playing in *Bringing Up Baby* (1938). As can be seen on all publicity photo for the movie Grant's relation to the leopard(s) is not the best.

4.13.3 *Bringing Up Baby* as a Case Study

Before coming to optical effects in Howard Hawks's *Bringing Up Baby* (1938) itself, a few words are necessary on the status of the movie. At the time of production *Bringing Up Baby* was not very much appreciated and the movie's process work did not receive special attention through trade journals or the Academy. The production went over budget and, depending on the interpretation of Hawks's own financial interest in the movie, RKO effectively hardly made or even lost money with it. Most people involved in it, were just happy once it was all over.[232] Appreciation through audience and critics only begins decades after the movie's initial release starting with Stanley Cavell's symbolic reading of the movie's narrative and its frivolous ambiguities.[233] What makes *Bringing Up Baby* valuable in the context of a historiography of optical effects is the circumstance that a richer body of source material is available than with other productions. This includes raw footage that was stored by Linwood Dunn who worked for RKO for nearly three decades and who uses the footage in the 1960s and 1970s in his show reel of optical effects: The optical effects of *Bringing Up Baby* are then seen by many people who later revitalize these techniques.

In regard to rear projection I will take a closer look at scene 78 of the movie that has Susan (Kathrine Hepburn), David (Cary Grant), and a leopard driving in a station wagon on a country road in Connecticut. (I will come back to other scenes in the next chapter.) The central argument of Dunn's account for the production is conveyed in a talk he gives in 1973 at the American Film Institute: "After the first days' shooting, they found that the trained leopard was not so trained. He was a little dangerous. So we had to do the whole picture with trick photography wherever the leopard appeared."[234] Dunn points to two things here. First, he reminds us that matters of space are not the only reasons for process cinematography. It allows for the integration of an element into the picture that is not only

[232] See Richard B. Jewell, "How Howard Hawks Brought Baby Up: An Apologia for the Studio System," in Staiger, *The Studio System*.

[233] See Stanley Cavell, "Leopards in Connecticut," in *Pursuits of Happiness: The Hollywood Comedy of Remarriage* (1976; repr., Cambridge, MA: Harvard UP, 1981), 111–32.

[234] *Linwood Dunn: An American Film Institute Seminar on His Work*, 6.

(a)

(b)

Fig. 4.71: Test shots for *Bringing Up Baby* (1938) with stand-ins Francis Gifford and Bill Corson and leopard Nissa.

too dangerous to be where the image makes us believe it is but in general too difficult to control. The second notion Dunn plays with is a lack of integration or undervaluation of optical effects. The production is planed without the optical effects people. But when there are problems, they are the ones to call and they know how to solve them. This is no longer the case with *Bringing Up Baby* as should be clear by now and as we will see here too. Optical effects are an integral part of most productions and are involved in planning from the moment when a budget has to be found.

Dunn's narrative of the production is already aligned to the studio's own that conceals that there is not one but two leopards—Nissa and Princess. The production reality of the movie as shown on public relation photographs and described in newspaper articles and later biographies of Hepburn and Grant knows only one leopard, Nissa. But the daily reports of the assistant director show that often two leopards are on the sets.[235] The production reality, therefore, repeats a deliberate confusion that is part of the movie's narrative. We never see more than one leopard at a time. But the protagonists have to find out that there are actually two, a gentle and a ferocious one. In his introduction to the movie, Gerald Mast later writes about "the power of structural symmetry—two leopards, two car thefts, two cages"[236] apparently without knowing how right he is about the two leopards. And Cavell in like manner emphasizes the relevance of repetition through paired appearances when he describes the final prison scene where the protagonists became aware of the two leopards. "The cutting in this passage back and forth between the leopards emphasizes that we are never shown the leopards within the same frame. It thus acknowledges that while in this narrative fiction there are two leopards, in cinematic fact there is only one; one Baby with two natures; call them tame and wild, or call them latent and aroused."[237] But what is more important than the concealed second leopard is the fact that the process work is well integrated into the production to cope with the dangerousness of the animal(s). It does not come as a surprise as Dunn suggests. On the contrary, the daily records list more problems with Hepburn (being late, requiring extensive rehearsals) than the leopards. Only once, on October 1, we find the remark "Leopard worked badly."[238]

235 See *Bringing Up Baby*, production records, 1938, box 81 P, RKO Radio Pictures Studio records, PASC.
236 Gerald Mast, *Bringing Up Baby: Howard Hawks, Director* (New Brunswick, NJ: Rutgers UP, 1988), 4.
237 Cavell, "Leopards in Connecticut," 148.
238 *Assistant Director's Report*, October 1, 1937, Bringing Up Baby, production records, box 81 P, RKO Radio Pictures Studio records, PASC.

While the transformation of the original short story into a movie script is still in progress on August 11, the movie's assistant director Edward Donahue files a request "to make trick and process shots of panther [*sic*] for picture 'Bringing Up Baby' to show director and producer how shot can be made. Process key and station wagon to be used in picture."[239] The requested budget is $3,546.06 and the shooting takes place from August 16 until 18 on stage 5. Howard Hawks himself directs the tests with a cinematographer from Vernon Walker's department, Fred Jackman's former assistant William Williams. Three sets are used: the station wagon for scene 78, Susan's apartment, to which I will come back in the next chapter, and a green set. This broad range of sets with leopard scenes strengthen the impression that the use of process techniques is well planed from the start. The question remains what exactly the tests are intended for and what kind of processes are used. The tests with the station wagon are the only ones that still exist (fig. 4.71). They show the frontal view that will appear just like that in the final motion picture and another, sideways angle of the same setup with two actors, a leopard, a car, and an exterior scenery. The two actors on the front seats talk with each other while the leopard in the back looks or rather sniffs around. Only when the feline predator climbs on the back of the frontal seat, the actors seem to react to it. The leopard's actions on the other hand throughout the shots only seem to address the vehicle and never the actors or even the scenery.

The background here is easily identified as rear projection with its frontal close shot just little above windshield width. And such a combination of passengers and scenery is a task handled with ease in 1937. The reason to do tests, after all, is the dangerous association of people and beast. The daily reports for the tests do only generically speak of 'process' and 'trick shot' and do not give details of production practices. But they document who was at which time on the set. On the first day with the station wagon and Susan's apartment set the stand-ins Francis Gifford and Bill Corson, animal trainer Olga Celeste, and leopard Nissa are there the entire time. For the second day on the green set the stand-ins, two animal trainers, two leopards, and two dogs are listed. And on the final day again with the station wagon set only the two actors are there. The question is what kind of tests the crew is doing without the animals when everything that is on the set (actors, vehicle, presumably a rear projection setup) has been easily combined for years now? The reason can only be that the leopard—as shot in front of a cityscape plate on day one—is part of the plate used for the two actors on day three. This would explain the animal's lack of interest it its supposed co-passengers. The fact that Gifford and Carson are on the set on the first day suggests that alternatives to this procedure are initially considered but then rejected. Dunn confirms the consequent double projection when he says in a later talk that "the leopard was photographed against a background of the street on a mark-up of the rear of the car. Then that film projected on a screen in back of a mark-up on the front of the car with the two people."[240] Such an additional iteration in the immanently recursive structure of process work—i.e., the filming of film—is noteworthy as it exceeds earlier practices. The repeated rear projection had been tried a few years earlier for Paramount's *Alice in Wonderland* and was rejected presumably for quality reasons (p. 178). That Vernon Walker's department manages this step is insofar remarkable as Eastman Kodak only one year later will present its improved emulsion and the newly developed practice cannot be explained with better technics. The film stock that is available for the process work of *Bringing Up Baby* is still the same as for *Alice* four years before. But by pushing the recursion one step further,

239 Edward Donahue, Avoid Verbal Orders, memo, August 11, 1937, box 81 P, RKO Radio Pictures Studio records, PASC.
240 *AFI Seminar with Linwood Dunn*, typescript, American Film Institute, April 20, 1977, 6.

Fig. 4.72: *Bringing Up Baby* (1938): Scene 78 as it appears in the final movie.

the gap between the two domains, the virtual process exterior and the present studio set, apparently is starting to close again. The vehicle is no longer driving in a media landscape but the process plate has pervaded not only the stage but also the set.

The production cinematography for *Bringing Up Baby* starts one month later, on September 24. On the same day Vernon Walker's process crew works with Olga and Nissa on stage 3, shooting plates for the station wagon scene. When they finish in the afternoon, animal and trainer are sent over to stage 5 where Hawks directs scenes in the apartment set. The shooting of scene 78 with Hepburn and Grant is first scheduled for the afternoon of October 1. In the morning Grant and the leopard are working on walking down the street together. This is the scene that connects the apartment with the station wagon. But it is also the day when the leopard "worked badly." The station wagon shots, therefore, are produced the next day—without a real leopard but with street and leopard plate.

The finished scene differs from the test shot not only in scenery and actors but it also shows a higher integration of the actors with the leopard. The script describes the situation as follows: "Baby, in the back of the station wagon, is wistfully peering into the front seat, wishing that they'd let him ride beside them. He makes several futile attempts to achieve his purpose but is pushed back by Susan, who is talking incessantly and, she thinks, convincingly."[241] The script is right suggesting that the scene is about peers or making linkages. Though its not the leopards who seeks conjunctions but the two actors who constantly refer to the animal with words, looks, and gestures.

4.13.4 Research Council Standards

The Research Council of the Academy is the successor of the Producers-Technicians Committee and the Art and Technique Committee. It follows the idea of solving problems together in order to support the entire industry in its striving for better or more profitable movies. It had started its work in August 1932 with Darryl Zanuck as chairman who then defines the encompassing entitlement of the new working group.

241 Hagar Wilde and Dudley Nichols, *Bringing Up Baby*, final script, September 16, 1937, box 589 S, RKO Radio Pictures Studio records, PASC, 57.

> The original procedure of the Producers-Technicians Committee was limited in its scope to act only on technical matters. The Research Council may consider problems of a technical nature which concern the actor, director and writer as well. It is my intention as I am certain that it is your wish to apply the same principles of co-operation, investigation and action to the problems of the writers, actors and directors that this committee has in the past applied to the technical field.[242]

None of the council's members is coming from process cinematography. The issues the Research Council is dealing with in its beginning are more fundamental. Its members and consultants discuss and define standards for script formats and film aperture, they optimize practices of sound recording and the quality of release prints.[243] It takes a couple of years until they have advanced to issues of rear projection—i.e., until 1938 when the technique is well established and has widely surpassed the earlier color-separation process. The equipment used for it was often developed or at least improved individually by each studio or its employees respectively. The diversity of devices practically hinders any substantial transfer of production and development of equipment to third parties. Manufacturers like Mitchell are suddenly confronted with the situation that studios ask them to improve on their improvised setups for which they have to offer individual solutions then. Therefore, the Research Council of the Academy initiates a committee to define guidelines for rear projection equipment.

The Process Projection Equipment Committee, which is installed by the Research Council, starts to work in March 1938 and has nearly forty members from the studios (including Jackman, Walker, Teague, and Edouart as chairman) and third parties like Mitchell, Carl Zeiss, Bausch & Lomb, and others.[244] Edouart's position as chairman reflects that at the same he receives an Academy Award for Technical Achievement (Class II) for his process work. The coordination and reconcilement of the different interests turns out to be more complicated than expected. Edouart later reports that initially fears to unveil trade secrets have to be allayed. "At first, I must admit, the sessions of this committee were something like a gathering of rival—and highly suspicious—tomcats."[245] When finally the work draws to a close after nearly a year approval and publication of the report is delayed because industry members remain hesitant about the exposure of production practices.[246] On February 2, 1939, after some 2,000 man hours of joined work the report is finally approved by the Research Council, published, and thereupon reprinted in the major trade journals.[247]

---

242 Cited after Academy of Motion Picture Arts & Sciences, "Proceedings of the Research Council; Quarterly Meeting, December 15, 1932," Supplement No. 19, *Technical Bulletin*, December 23, 1932, 7.

243 See ibid.

244 For a complete list of members see Research Council of the Academy of Motion Picture Arts and Sciences, "Recommendations on Process Projection Equipment," *JSMPE* 32, no. 6 (June 1939): 589–609.

245 Edouart, "The Evolution of Transparency Process Photography," 380.

246 "Process Progress," *IP* 11, no. 1 (February 1939): 7.

247 Research Council, Process Projection Equipment Committee, *Recommendations on Process Projection Equipment: Outlining Production Requirements for This Type Equipment*, technical report (Academy of Motion Picture Arts & Sciences, February 3, 1939); Research Council of the Academy of Motion Picture Arts and Sciences, "Recommendations on Process Projection Equipment"; Research Council, Academy of Motion Picture Arts and Sciences, "Process Projection Specifications," *International Projectionist* 14, no. 5 (May 1939): 17–18, 24–27; Research Council, Academy of Motion Picture Arts and Sciences, "Process Projection Specifications: A Report by the Research Council, Academy of Motion Picture Arts and Sciences," *International Projectionist* 14, no. 6 (July 1939): 18, 26–27; Research Council, Academy of Motion Picture Arts and Sciences, "Process Projection Specifications," *International*

In his preface Research Council's acting chairman Nathan Levinson stresses the ever increasing importance of the rear projection process. This is not only due to the opportunities to save money. The development of technical devices is seen as an emancipation from former restraints. This starts with the previous inevitability to go on location: "some day, it will be the exception, rather than the rule, to send a cast on a distant location." (An assumption that will be overruled shortly after with the emergence of Film Noir and the decline of the studio system.) And it ends with a reassessment of technology as restriction to a liberation of imagination: "whereas, up to the present time, the equipment has been the limiting factor and only the ingenuity and resourcefulness of the technicians have made its wide use possible."[248]

Edouart presents the recommendations at the 1939 spring meeting of SMPE in Hollywood. And while he confirms that more than half of the final footage of a lot of productions then are made with rear projection, he also describes the development of the technique as "haphazard." The idea to put actors in front of a projection screen came up long before it was viable to do so as we have seen. But there were neither means to apply the idea nor did anybody work on it. Only when techniques were developed for other purposes like the synchronization for sound and supersensitive panchromatic emulsion for general use, it became realistic to work on rear projection. "With these elements available, it was inevitable that cinematographers in practically every major studio should put them together to form in actuality a system which for years many of us had pondered in theory."[249] Edouart also emphasizes that the apparently spontaneous evolution also had the advantage that unlike with traveling matte processes no major patent conflicts emerged. But this may not only have to do with the kind of development but also with the specific timing as the patents that are granted to Jackman and Koenekamp at Warner Bros are directly merged in the negotiations on the patent pool.

The majority of definitions in the report can hardly be considered as controversial. They are not prospective but document the state of technology. Measurements that are given ensure a certain quality of the final product rather than interchangeability of parts, as Edouart had suggested. Subassemblies of the technique that are stable and excepted, like the interlocking of projector and camera via Selsyn motors, are mentioned without any details. What the report does, is it gathers all concerned parties around an imaginary rear projection setup that presumably documents the state of the art in the late 1930s and can be described as follows: The only available light source for the projector are carbon arc lamps that produce also a lot of heat and noise. Incandescent and hi-pressure mercury lamps are mentioned only in regard to the research that is still needed to make their usage practical. The intensity should be as constant as possible. Flickering and fluctuation are accepted if they do not aggregate to 2% per minute or 5% per nine minutes. The optical system has a speed of $f/2.0$ or greater. The projector itself is mobile. It can be moved as a whole but once its position is found the base needs to have a "rock-like stability" during operation. Optionally one should be able to rotate the projection $90°$ in both directions either by moving the projector head or a prism in front of it. The projector focus can be controlled remotely. The screen has a safety-type base like cellulose acetate or similar and

Projectionist 14, no. 7 (August 1939): 16, 23–25; "First Rear Projection Specifications," *IP* 11, no. 2 (March 1939): 21–24; "Academy Report," *IP* 11, no. 4 (May 1939): 19–24; "Rear Projection Standards," *IP* 11, no. 5 (June 1939): 18, 20.

248 Research Council, Process Projection Equipment Committee, *Recommendations on Process Projection Equipment*, preface.

249 Alexander Farciot Edouart, "The Work of the Process Projection Equipment Committee of the Research Council, Academy of Motion Picture Arts and Sciences," *JSMPE* 33, no. 3 (September 1939): 249.

comes in sizes from 5×7 feet to 27×36 feet. The illumination should not be less than 16,000 lumen. (And the report describes how to measure illumination correctly.) The projected process plate is recorded with full screen aperture (0.950×0.723 inches) and with pilot pin registration that has to be the same for camera, printer, and projector. Optionally, it should be possible to reverse the registration in the projector movement to be able to project the plate mirrored. The projector can transport the film with the same quality either forward or backward and thereby the timing of the background can be reversed. After all, the report reads more like a wish list that should have been written at the beginning of the developments rather than at the end. The *International Photographer* illustrates its reprints of the report with portraits of and several devices by Edouart, Walker, and Teague to give credit to some people who promoted the development.

Later that summer Lee Carroll, an undesignated industry member who works with Lewis Physioc, complements the Academy report with an article on recommended practices of rear projection. He focuses especially on the production of background plates and how to ensure an aesthetically convincing result. Unlike others who focus on questions of perspective—i.e., height, angle, and focal length of the camera—Carroll in a much more down to earth approach concentrates on what can be described as the most obvious mistake of composite images: a lack of unity magnification. "The figures or objects on the screen should never appear larger than life size when real actors appear in front of the screen."[250] Scaling is still a central concern in all process work. With charts and drawings from Physioc's never published book *From Script to Screen*, he explains how to find the right distance from a subject depending on focal length and expected screen size or how to determine information of an existing plate. This also includes directives on where to position actors in front of the screen. The plate is to be developed with lower contrast and gamma than a regular projection positive. Glycin added to the developer makes for a finer grain. And finally, Carroll stresses again the point to choose one pilot pin registration for the entire process of acquisition, printing, and projection—either Bell & Howell with pins at the top of the aperture or Mitchell with bottom aligned pins.

The absence of definition of a consistent registration in the report of the Academy points to a potential conflict. It is supposed that the image stability is not affected by the position of the registration pins as long as they are unified. A recommendation in favor of top or bottom pilot pins would have helped the industry by unifying the entire chain of plate production and exploitation. But it would have been a decision in favor of either Bell & Howell or Mitchell and both companies were members of the committee. While Mitchell in the 1930s develops a clear interest in the production of process projectors, Bell & Howell introduced the pilot pin registration in 1907. Bell & Howell is also active in the printer business since the beginning and just a few years before the Academy report seems be the standard when it comes to registration.[251] That still no agreement is found in the matter is telling for the outreach of this industry committee. It is not even able to resolve a standard that apparently exists effectively because not all of its members agree with it. In a similar way it is interesting that the question of multi-projector processes is omitted completely. After all, Paramount and Warner are working on this technique while their are meeting regularly in the committee. In the case of rear projection it seems as if the Research Council has a more symbolic function. It is an assembly of parties involved in a process that had evolved largely unorganized.

250 Lee Carroll, "Problems in Rear Projection," *IP* 11, no. 7 (August 1939): 5.

251 See Harrison, "Problems of Background Projection," 353.

5 Optical Printing

Optical printing is on the one hand, as Fred Jackman said, "the jack-of-all-trades of special-effects work,"[1] but on the other hand not fundamentally different from the other optical effects processes described so far. All of them are at their core methods of reproduction or of filming film. They differ in the scales of representation but as we have seen scaling itself is a phenomenon of optical effects. The main difference between optical printing on the one side and rear projection and like techniques on the other side is that they happen during different phases of the production process. Optical printing is part of what today is called post-production. This means not only that it is happening later but also that it involves different participants and follows different rules.

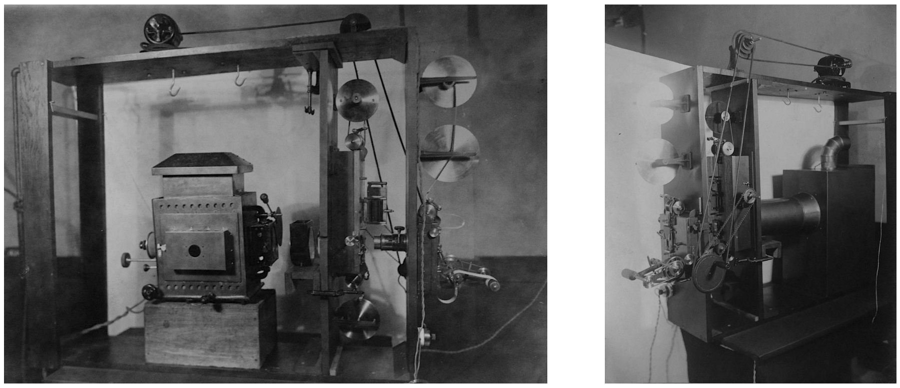
As we have seen in chapter two, the distinction between what should be done during production and post-production is at the same time decisive and a matter of drifts and shifts. Early cameramen ask themselves whether two images should be combined by rewinding and double-exposing a film in the camera or if it should be done by double printing. It seems that there is a trajectory in the 1920s towards adding things like matte paintings in post-production. Then in the 1930s a main argument for rear projection seems to be that it can be done on the set where the process is perceivable for most of the participants and where they can react to the images.

Film printers are divided in two basic classes. The first distinction is between contact and optical printers and the second between continuous and step printers. Contact printing is done by laying two films—one exposed and developed and the other one unexposed—on each other with facing emulsions. This technique derives from bi-packing the films in the camera, as the most elementary option, but is performed with distinct printers. With contact printing one has to distinguish between devices that transport the film frame by frame and hold for the exposure and those that do the exposure while transporting the films continuously. The main application for contact printing is the making of distribution copies—i.e., large amounts of identical copies. The only manipulation that can be done with contact printing is to vary the lightness and gradation of copies depending on the selected film stock and light intensity. Illumination may vary over time to balance deviating densities in the negative.[2]

With optical printing the two films do not touch, but the images are conveyed by means of optical systems. This can be done by projecting one film on the other, by filming the illuminated film with a regular camera, or by combinations of both approaches. It depends on the position of optics in relation to the two films and the light source. Therefore, an optical printer is the combination of a camera and one or more projectors, all of them with possibly altered optics. The decoupling of the two films allows for manifold manipulations as individual features of the images like framing, angles, etc. can be modified by changing the relative positions of projector, camera, and optics. Also objects like masks, filters, or prisms can be inserted between the facing devices and change the light. This

[1] Fred W. Jackman, "The Special-Effects Cinematographer," *AC* 13, no. 6 (October 1932): 43.

[2] For further details on contact printing see Roscoe C. Hubbard, "Printing Motion Picture Film," *TSMPE* 10, no. 28 (February 1927): 252–78.



(a) (b)

Fig. 5.1: Unidentified optical printer, dated 1911-1917.

openness has continuously exalted the imagination of those who developed and used optical printers such as Jackman who said that the device "does those myriad of things that dazzle you when you view the picture, and the possibilities are only limited to the imagination and ingenuity of the individuals operating these complicated machines."[3] Another reason to use optical instead of contact printing in the early days is that there are no established standards for film stock and aperture sizes. Printing a film in a different format requires scaling the image up or down.[4] After the implementation of first 35 mm and then 16 mm, this application generates reduction printers to make transfers between these two standards as a restrained version of the optical printer. Finally, Gordon Chambers from Eastman Kodak argues that copies done with an optical printer can be more true to the original than those done by contact printing presumably due to the risk of halation with the latter process.[5]

The beginnings of optical printers can be retraced by period publications as a general trajectory but specific devices are difficult to locate. An unidentified early printer is depicted on two photographs, found in the Hugh M. Hefner Archive of Moving Images at USC. On the back of one photo the device is dated "1911-1917" and described by an unknown author as "optical printer for my color film." All parts are assembled around a large wooden framework (fig. 5.1a). On one end two film spools are mounted under each other on the outside of the scaffold. Beneath it a transport mechanism is located that ends in a combination of smaller coils. This structure looks exactly like an elementary contact printer where two large reels hold the developed and the unexposed film that are merged in the movement and collected underneath (fig. 2.4). Where contact printers feature a lamp on the other side of the film movement, here we find a lens that points to the inside. The center of the frame is dominated by a large lamp house that has been changed on a second photo of the same device from the other side (fig. 5.1b). Between lamp house and the outer film transport there is another vertical board that holds a second transport mechanism and single spools above and below. The second photo reveals that both movements are chained together and driven by a hand crank. Between the lamp house and the inner board a condenser collects the light and directs it towards the inner film movement. It is not clear what kind

[3] Jackman, "Organization of a Special Effects Department," 1.

[4] Cowling also mentions a case where due to a ban on shipping of prize fight films between states optical printers were used to copy the respective films from one state to another on the boarder. See Herford Tynes Cowling, "For Trick Work: Mr. Fred A. Barber Announces the Perfection of a Wonderful New Optical Printer," *AC* 8, no. 12 (March 1928): 7

[5] See Gordon A. Chambers, "Process Photography," *Cinematographic Annual* 2 (1931): 224.

of adjustments this appliance allowed for. But it can be described as a derivative from a basic contact printer.[6] The lamp is stronger and the light more directed. The outer transport mechanism is only used for the unexposed film. Its second spool now merely redirects the film. The developed film obtains its own transport and is shifted inside. The thereby created distance is bridged by a lens that allows the camera aperture to 'look' at the illuminated second aperture. What astonishes is that the entire device is open and seems rather unsuitable for printing film. The reasons for this should be, first, that covers might have been removed for the photo and, second, that of course the orthochromatic film being only sensitive to blue light permitted to work with red light.

5.1 Optical Printing in the 1920s

There are a few people and companies that offer optical printers for sale in the 1920s. Often a dating is only vaguely possible and there is no information on how many of these devices were produced, who bought them, and how relevant they were for actual production practices. One of these printers is found in an undated small catalog with "Optical and Contact Motion Picture Printing Machines" by Oscar B. Depue from Chicago (fig. 5.2). As Depue presents another printer in fall 1927 (and such presentations at that time become common) it can be assumed that this optical printer is a few years older. The device is described as "strictly a trick printer" and offered with or without automatic light control for $9,000 or $8,000 respectively.[7] Depue's personal history in regard to motion pictures is telling. He becomes involved in the field even before its beginning when he meets Burton Holmes who travels the country with lantern slides from his own exotic travels in 1893. They start to work and travel together and soon become interested in the novelty of moving pictures. Depue over the years buys and builds several cameras. In 1897 he visits George Eastman in Rochester and asks for advise on how to build a film printer. From Eastman's recommendation and Depue's own knowledge emanates a simple contact printer that seems to be close to the basic structures for such purposes as described above. "The printer was mounted on a wall in a dark room, with a hole through the wall to admit the exposure light from a lamp in the next room. The lamp was mounted on a rod so that I could slide it nearer or farther away from the film to suit the density of the negative which was observed as it passed in front of a slit."[8] The first reason why Depue moves from contact to optical printing in the following years is the lack of standards for film stock. He has initially worked with 60 mm film and needs to print it on 35 mm stock. Such conversions are and remain the main argument for optical printing and in the early years seem to be more important than any trick work. Hubbard in 1927 writes that optical printing is "mainly used for educational or non-theatrical films"[9] as they are produced on 35 mm and then distributed on 16 mm or 28 mm. What distinguishes the Depue optical printer from the framework device above is first of all that camera (on the left) and projector (on the right) are placed on a common horizontal axis that permits to vary their distance. The entire assembly is made for this adjustability.

[6] See C. Francis Jenkins and Oscar B. Depue, *Handbook for Motion Picture and Stereopticon Operators* (Washington, DC: Knega, 1908), 40-42, Open Library: OL6996051M.

[7] Oscar B. Depue, *Optical and Contact Motion Picture Printing Machines* (Chicago, n.d.), MPE 18, Jonathan Silent Film Collection, FMPL.

[8] Oscar B. Depue, "My First Fifty Years in Motion Pictures," *JSMPE* 49, no. 6 (December 1947): 483.

[9] Hubbard, "Printing Motion Picture Film," 253.

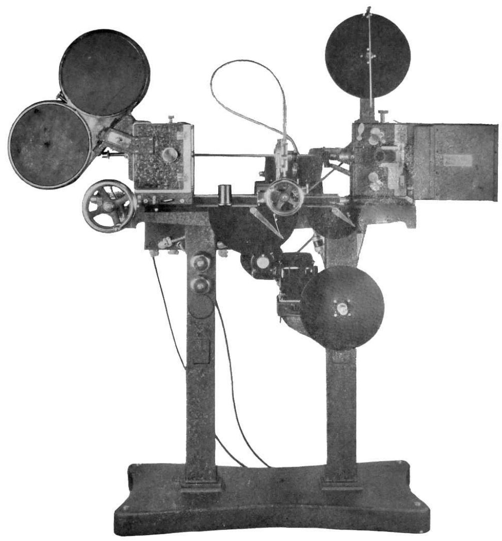


Fig. 5.2: Optical printer by Oscar B. Depue, 1927.

Another company, likewise not located in Hollywood, is Duplex Motion Picture Industries that is running a laboratory and developing and distributing the equipment needed to do so. The company expands in 1924 with a five-story building in Long Island City that is supposed to house the world's biggest laboratory for motion pictures at the time.[10] The wide range of offered products (perforators, contact printers, developing machines, projectors) is comparable to that of Bell & Howell. At the time of their expansion they are also involved in the two-strip Technicolor process that is used e.g. in Cecil B. DeMille's *The Ten Commandments* (1923).[11] This engagement is presented as an expression of the company's high standard in precision and its progressive ambitions. In 1927 Duplex introduces two versions of a new optical printer. The new devices follow a small reduction printer presented just recently but are now clearly labeled as trick printers. Already the previous reduction printer featured a flexible lens mount that permits further interventions in the reproduction process.[12] The new models differ in that the so called Type A is for 35 mm work while Type B can handle 35 mm and 16 mm. They have grown in size to literally give more space for image manipulations (fig. 5.3). The company's catalog remains somewhat vague in regard to the manipulation options and develops its vision from the basic feature of scaling when it holds out that "giants may walk with midgets."[13] When Duplex's Alfred B. Hitchins presents the new printers, he first explains that the need for format conversion has driven the development of optical printers. But as a second step, or on second sight, one cannot disregard that such assemblies offer much more to the skilled cinetechnician. "Directly we enter the field of optical printing, we open up a practically unlimited range of printing possibilities; every phase of trick and effect photography can be readily accomplished, limited only by the ingenuity of the operator."[14] This move to jump at the chance is at least with the development at Duplex manifest. The optical printers of 1927 are a clear commitment towards optical effects with all basic features needed to manip-

[10] See "Duplex Laboratory," *FD* 27, no. 4 (January 6, 1924): 2.

[11] See "Enormous Spectacle With Pleasing Color Features Startles Broadway," *FD* 27, no. 39 (February 17, 1924): 34.

[12] A photo of the device is printed in *Motion Picture News* 34, no. 2 (July 10, 1926): 167.

[13] Duplex Motion Picture Industries, Inc., *The Duplex General Catalogue* (Long Island City, NY), Jonathan Silent Film Collection, FMPL, 9.

[14] Alfred B. Hitchins, "Duplex Optical Printers," *TSMPE* 11, no. 32 (1927): 771.

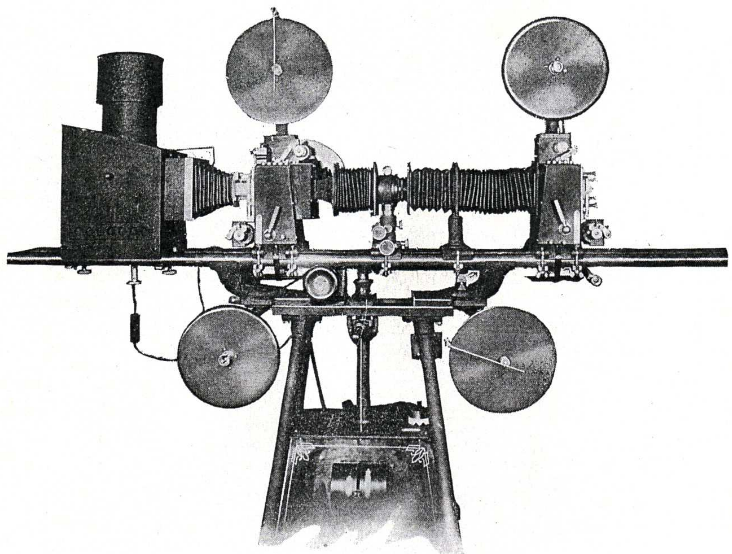


Fig. 5.3: Duplex Optical Printer Type A, 1927

ulate moving images. “A complete trick unit is built into the lens mount consisting of a matte box, multiple exposure device, circular and rectangular vignette, curtain shutter, and blade cut-out.”[15]

In April 1928 Carl Louis Gregory presents another optical printer at a SMPE meeting in Hollywood. The device has been developed by Fred A. Barber who has a family background in optics. Gregory just like Hitchins repeats the conceptual move from reduction to trick printing by naming his talk “An Optical Printer For Trick Work.”[16] The printer has three sliding heads on a lathe bed. The Depue printer featured a similar structure but did not actually use a lathe bed that should become the foundation of every later optical printer. Unlike the rails used by Duplex, which allow to slide and fix the heads, a lathe bed comes with a transmission that scales movements by the operator down to fractions thereof. The heads of the Barber Optical Printer not only slide forward and backward but can also be shifted up and down or sideways with a precision of “one eight-hundredth of an inch”[17] as can be read from micrometric indicators. Besides of the given lathe bed the optical printer incorporates a standard Bell & Howell 2709 camera (with a non-standard magazine). The second head carries an interchangeable mount for filters and masks. And the third head provides the projector head and lamp house. The projector head itself is a reconfigured old Prevost camera—just the same like the one Buster Keaton uses and finally ruins later that year in *The Cameraman* (1928). The movements of the camera and projector head can be interlocked variably for different purposes like advancing the film in different directions and such.

While Gregory focuses his presentation on the mechanical merits of the device, the following discussion with other experts from the field makes clear that the actual challenge of building an optical printer is not so much the mechanics but the optics. Present are among others Ralph G. Fear, Joseph Dubray, and—not clearly identifiable—Mr. Jones and Mr. Johnston. Dubray is chairman of the Educational & Research Committee of the ASC and a technical editor of the *American Cinematographer*, Fear is a technical supplier, owner

15 Ibid., 773.
16 Carl Louis Gregory, “An Optical Printer for Trick Work,” *TSMPE* 12, no. 34 (April 1928): 419–26.
17 Ibid., 422.

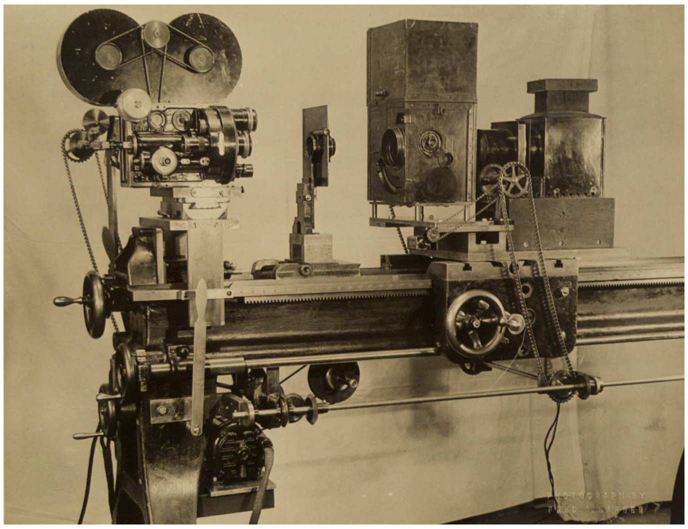


Fig. 5.4: Fred A. Barber Optical Printer, 1928

of the Cinema Equipment Company (1930 renamed as Fearless Camera Company), and worked on cameras for wide screen and sound production. Fear states that he himself and most studios worked on optical printers but were about to abandon them due to problems about obtaining appropriate lenses. At the time of Gregory's presentation Warner Bros seems to be known for having a functional device that came from Fear.[18] In an undated typescript on the optical printer Gregory writes that the device is supplied with a Goerz anastigmat, a standard lens combination to correct optical aberrations.[19] Other remarks are made on appropriate contrasts, issues with graininess, and the selection of film stocks. The discussion shows that Gregory and Barber—who both live at the East Coast where still most manufacturers reside—meet competent counterparts when they come to Hollywood.

One feature that is only mentioned in the unpublished description of the optical printer is the possibility to mount a small ground glass on the mid-head. This plane is oscillated by a motor to prevent the reproduction of grain patterns. The ground glass (in fact a small rear projection with the same oscillation that Willis O'Brien used, see p. 165) permits increased control and additional effects like unusual wipes. A main concern of Gregory seems to be to expand the possibilities of the technique. These are his arguments for the usage of optical printing that make up the major part of his talk:

> So many different things can be done with this machine that it is not possible to list them here. Listed below are some of the principal things which can be done with it:
>
> 1. Duplicate negatives can be made which are not distinguishable from originals as no printer marks show on these negatives.

[18] The year before Fear together with Frank E. Garbutt had received a patent for a quite unique variation of an optical printer "for Eliminating Granular Effects in Photographic Enlargements" by projection through a colloidal liquid. Ralph G. Fear and Frank E. Garbutt, Process of and Apparatus for Eliminating Granular Effects in Photographic Enlargements (Patent 1,642,772 [US], filed March 10, 1923, and issued September 20, 1927), Google Patents: US1642772

[19] See Carl Louis Gregory, *Specifications on Optical Printer*, undated typescript, MPE 67, Jonathan Silent Film Collection, FMPL.

2. Duplicate negatives can be made from non-standard negatives or prints and the frame line changed as desired.
3. Two or more negatives can be combined upon one film so that normal and ultra-speed may be shown side by side or a vision may be made from one negative and introduced into any other negative.
4. Negatives can be reproduced with the action slowed down or quickened to almost any extent. Normal action can be made from ultra-speed, thus giving normal and ultra-speed action from exactly the same view point.
5. Action can be suspended and held still at any point in the film and then continued, reversed, or repeated. This feature is very valuable for golf instruction films or for instruction in any other sport or for showing the action of machinery.
6. Any negative can be reversed to show the action backward, and this action can be slowed down or speeded up if desired.
7. Action can be repeated as many times as is required, and at the same time, reversed or the speed changed to suit any purpose.
8. All kinds of camera effects such as: fade-in, fade-out, iris-in, iris-out, lap dissolves of any length, or any other camera effect can be introduced onto negatives already taken.
9. Duplicate or multiple action of the same subject can be made to appear in the same scene. This can be in synchronism or different phases of the same action may be shown going on at the same time.
10. Double and multiple exposures from any number of original negatives can be made in absolute register.
11. Super-imposed titles may be made in any portion of a negative which has already been taken and developed.
12. Borders, frames, and masks may be introduced around any scene.
13. Close-ups can be made from semi-close-ups. Any part of any negative already taken can be enlarged or reduced.
14. The effect of moving up on a scene for a closer view or of moving back to include more of the scene can be made from one negative already taken.
15. X-ray views of machinery or any object in motion can be made showing both exterior and interior as if the machine were transparent.
16. Explanatory labels, animated lines, pointers, etc., can be introduced into negatives already made.[20]

Gregory mixes technical features, established elements of film language, and more specific examples of application here. To understand this we need to take a closer look at his position in the field. He did not develop the optical printer he presents; he is not a cinematographer or producer who will need such a device for his own work; he is an expert in the field with different functions. He was teaching photography for soldiers in World

[20] Gregory, "An Optical Printer for Trick Work," 423-24.

War I, published several books, and was head of a photo school in New York. He is primarily a spokesperson for special photography and cinematography who finds different positions to make a living from this role.[21] His position in relation to the optical printer becomes clearer from another typescript that advertises his concept of "a clinic for ailing films."[22] The clinic is Gregory's own small laboratory in New Rochelle where Barber recently installed his optical printer.[23] Together with Lawrence A. Fiferlik they offer services in rescuing negatives that show all kind of problems. In their self-definition they are the ones who understand film in a material way but bridge the gap to the immaterial which becomes quite vivid when Gregory writes about Barber and the optical printer. "With it he can make any film lay down and play dead, jump through hoops, roll over and even sit up and talk."[24] On their joint venture he states that "our hospital staff is no ordinary gang of film butchers. We're specialists with the accent on the special. We're looking only for jobs that nobody else can do."[25]

But being a specialist is only the first step. This is why Barber and Fiferlik need Gregory just as much as the American film industry needs him. At the SMPE meeting he starts with pointing at the recent technical achievements of filmmakers in Germany and, thereby, calls on national pride. This argument is found in detail in the longer, unpublished script for his talk.

> Our American technical staffs already knew how to do this camera trickery, but they did not realize what they could build with the tools they already possessed. The tremendous effectiveness of the tools at hand did not occur to them until these German pictures pointed the way and caused a reaction that has wrought a startling transformation in the technique of production not only in photography but in directing as well.[26]

In the same script he describes Barber as a technical expert who did not yet receive the recognition he would deserve as he has been working in the concealment of photographic laboratories. Gregory is the one who helps both, the individual experts and the entire industry and he sets an interesting parallel when he writes that the "transition from fact to fancy by means of photographic fabrication requires a rare duality of mind like that of Lewis Carrol, whose thoughts could shuttle back and forth between the exactitudes of pure mathematics and the fantastic fancies of Alice in Wonderland."[27]

As mentioned earlier, the optical printers presented in the 1920s apparently do not manage to be successful in the sense of sales and setting standards the way cameras, projectors, contact printers, and other devices do. This will only be the case with the Acme-Dunn Optical Printer after World War II. These early public optical printers have to be seen as evolving concepts rather than commodities. Gregory, as we have seen, does not primarily try to sell

---

21 For further details on Gregory's life and career see Charles "Buckey" Grimm, "Carl Louis Gregory," 1998, http://cinefan.tripod.com/CarlLouisGregory.htm.

22 Carl Louis Gregory, *[Film Clinic]*, untitled typescript advertising optical printer work, ca. 1928, MPE 67, Jonathan Silent Film Collection, FMPL.

23 Dr. Kinema, "The Clinic," *Amateur Movie Makers* 3, no. 5 (May 1928): 352.

24 Gregory, *[Film Clinic]*.

25 Ibid.

26 Carl Louis Gregory, "An Optical Printer for Trick Work" (typescript, 1928), MPE 68, Jonathan Silent Film Collection, FMPL, 1-2.

27 Ibid., 2.

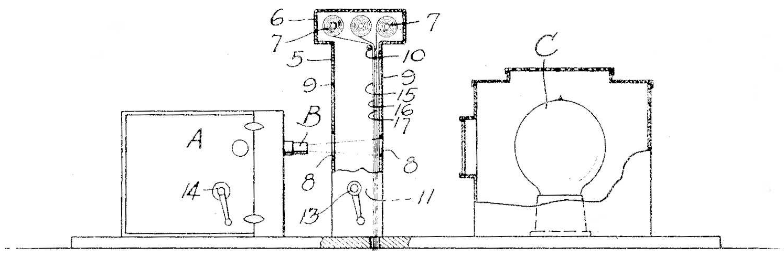
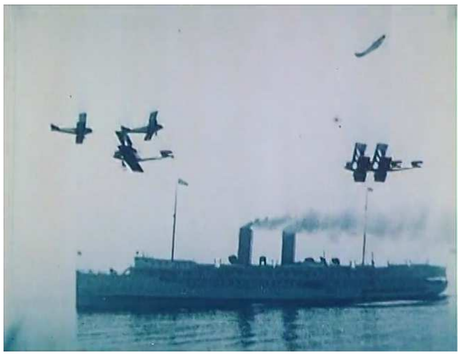


Fig. 5.5: Alvin V. Knechtel, Method of Producing Composite Moving-Picture Films, US Patent 1,627,976, filed August 25, 1924.

his optical printer but his knowledge and services. And one result from this noncommercial situation is that Duplex at some point turns its back to trick work and returns to simple optical printers for reduction prints.[28]

In contrast to these concepts of service providers a practitioner from film production named Alvin Knechtel already in 1924 drafts a slightly different concept of an optical printer. Knechtel's printer has the sole purpose of photographing multiple overlaying positive prints simultaneously (fig. 5.5). The negative to be exposed is isolated in a regular motion picture camera. The achievement of Knechtel's assembly lies in the combined transport of multiple (and possibly more than the three depicted) positives. Knechtel combines here characteristics of in-camera bi-packing, contact printing, and optical printing. The application of the device is restricted to the single purpose of overlaying multiple images. No scaling or manipulation of time is possible. Looking for versatility the printer is by far inferior to those described before. What makes it interesting is the field it derives from. As the patent unveils Knechtel is at the time an employee of Pathé Exchange, the independent production arm of Pathé France that later is merges into RKO Radio Pictures. Pathé produces a series of short films called Pathé Review of various genres. Between 1924 and 1927 Pathé presents films by Knechtel and his "process camera."[29] One of the preserved films with the programmatic title *Cockeyed: Gems from the Memory of a Nutty Cameraman* (1925) shows an unrelated succession of visual gags. Most of them are based on split screen methods that separate the temporalities of distinct image areas—like cars that seem to disappear when passing behind trees or whose parts move independently. Knechtel names the purpose of his invention in the patent text as "freak pictures of objects in motion."[30] While this seems to describe accurately the purpose of Knechtel's short movies, a closer look at *Cockeyed* shows that the visual vocabulary that is used is already quite diverse. The majority of shots uses split screen to play off object orders against visual ones (fig. 5.6b). These combinations of image fields can attain enchantment from movements of objects (mostly vehicles) in a static environment, movements of the camera itself, or the combination of physically unrelated sites. Such split screen shots can be produced with mattes and double exposures in the camera (fig. 2.5). But the complex timing of several shots suggests that these were produced in the laboratory rather than on location. The most complex shot from *Cockeyed* shows a biplane that is multiplied by double exposure (fig. 5.6a). But not only do we see the biplane several times at once as it could be produced with Knechtel's patented device

[28] See "Duplex Printer Model," *IP* 10, no. 8 (September 1938): 6–7.
[29] Pathé Review, *Season of 1927*, ad, January 9, 1927, 14.
[30] Alvin V. Knechtel, Method of Producing Composite Moving-Picture Films (Patent 1,627,976 [US], filed August 25, 1924, and issued May 10, 1927), 1, Google Patents: US1627976.



(a)

(b)

Fig. 5.6: *Cockeyed: Gems from the Memory of a Nutty Cameraman* (1925)

but we see the act of multiplication as the different image layers are started and paused independently. The preposterous air traffic is contrasted with the steadily passing ship in the lower half of the image.

The term 'optical printing' for this type of methods only seems to prevail from 1927 with the presentation of specialized devices while until then 'projection printing' seems to be more common. Gregory in 1926 describes projection printing in an overview over trick photography methods. He understands that the separation of the filmstrips means also a temporal decoupling. "The action on the original negative can thus be stopped, accelerated, retarded, or reversed on the positive, and by multiple masking and printing several successive phases of action on the same moving figure may be shown on the screen simultaneously."[31] The control of time rather than space is correctly identified as animation and Gregory not only names Knechtel as an exponent of the process but also animator Max Fleischer. Just as deviant usage of the hand crank was the first way to produce tricks with early motion picture cameras that later gave way for more complex visual operations, optical printing starts with time manipulations. The renaming from projection to optical printing then lays the focus more on the manipulations of the image itself.

Also in 1926, Alvin Knechtel (born 1901) is accepted as a member of the ASC which amounts to a notable appreciation of his work.[32] The Knechtels originally come from Canada but move to Detroit in 1915 where Alvin finds work at a film laboratory.[33] He quickly takes full control of producing his own industrial movies. In 1917 a trade directory already designates that he "specializes in experimental work."[34] He subsequently takes traveling assignments, sells footage as a free lancer, and finally joins Pathé as an "obscure but promising technician."[35] The company sends him to Los Angeles where he then starts working for First National. His Pathé fame even afford him screen credit for camera effects. In Hollywood he not only works on effects but also as an aerial cinematographer. On July 17, 1929, he dies in a plane crash, "a sacrifice upon the altar of the gods of Thrill," as his obituary notes.[36]

---

31 Carl Louis Gregory, "Trick Photography," *TSMPE*, no. 25 (September 1926): 106.

32 "Alvin V. Knechtel is Elected to ASC," *AC* 7, no. 8 (November 1926): 4, 24.

33 Census records from 1920 suggest that Alvin's father and an older brother also work at the Columbia Film Mfg. Co. as salesman and bookkeeper respectively which might explain his early employment.

34 *Motion Picture News Studio Directory* (New York: Motion Picture News, 1917), 168.

35 Arthur Edwin Krows, "Motion Pictures—Not For Theatres," *Educational Screen*, April 1941, 150.

36 "Our Brother Alvin Knechtel," *IP* 1, no. 7 (August 1929): 22; "Movie Men are Killed in Plane," *The Centralia, Washington, Daily Chronicle*, July 18, 1929, 6.

(a) (b)

Fig. 5.7: *Tarzan, the Ape Man* (1932): This shot with the expedition climbing is a combination of a matte painting showing the rock and the landscape underneath and live action footage in the center. The matte line is crossed twice, first when a black servant and second when Jane falls off the narrow path. The two falling persons are integrated into the painting not with additional mattes but simply as subtracted or added light respectively. This distinction can be achieved either by different methods—i.e., by using double printing or double exposure—or work steps—i.e., by double printing when doing either the intermediate positive or the dupe negative.

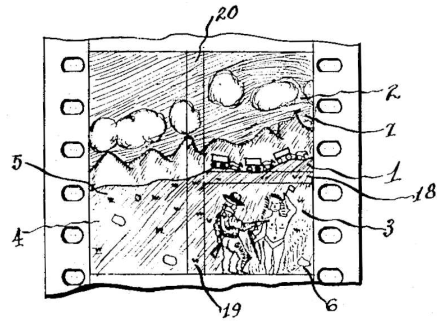
Warner is not the only studio in the late 1920s that operates an optical printer as it turns out later. There are two patent applications by Raymond J. Mammes, a graduate of the Chicago Art Institute who is doing matte paintings at MGM.[37] Both patents are filed in December 1927 and contain claims for doing projection printing with complementary static mattes. The first one effectively gives a description of a simple optical printer without naming it as such. Two cameras are mounted on a lathe bed facing each other with mechanically connected movements. The second camera encloses not only a developed negative but also a light source. According to Mammes's description, between the two camera arises an aerial image that can be modified optionally by a filter.[38] The second patent covers the production of precise counter mattes to avoid matte lines that can originate from overlapping or yawning mattes. A matte of arbitrary form is painted on a glass plane mounted in front of a camera. This setup is the same as with glass shots and reminds of he technique already used by Norman O. Dawn (p. 48). But to produce the two mattes, the glass is once lit from front and once from behind. The paint has to be actinic and opaque so that in the first case it reflects and in the second it blocks off the light.[39] Counter mattes later are done by means of simply printing a matte to receive its negative. The fact that Mammes rejects this obvious option indicates that printing as such (at least at MGM) has not yet reached enough precision and possibly suffers from jitters or spreads. The first patent likewise raises questions because an aerial image would require a collector lens in order to be captured by the camera or a screen that renders the projected image. In the patent it says that "there is no real projection of the scene from the negative film to the positive print but a mere exposure

[37] From the twenty ASC members in 1928 who are listed in the roster as "Special Process and Trick Photographers" five work at MGM and another five at Famous Players-Lasky (the coming Paramount Pictures). This might be seen as an indicator for MGM's activity in the field that hardly renders visible elsewhere at the time. "Membership of the A. S. C. to Date – Feb., 1928," *AC* 9, no. 1 (April 1928): 15–16

[38] Raymond J. Mammes, Method of Forming Composite Motion Picture Films (Patent 1,869,819 [US], filed December 12, 1927, and issued August 2, 1932), Google Patents: US1869819.

[39] Raymond J. Mammes, Reversible Mat (Patent 1,901,110 [US], filed December 27, 1927, and issued March 14, 1933), Google Patents: US1901110.

(a) *The Trail of '98* (1928)



(b) Raymond J. Mammes, *Method of Forming Composite Motion Picture Films*, US Patent 1,869,819

Fig. 5.8: Triple exposure practice at MGM in movie and patent.

of the lighted film to print upon the exposed positive film being reeled in the camera."[40] When there is no projection and the film is only illuminated the camera that holds it would not require a lens as it has in Mammes's patent.

These contractions might lead to the conclusion that the two patents—though accepted by the Patent Office—do not indicate the presence of an optical printer at MGM at the time of filling them. The patents could be understood as documenting certain concepts rather than productive devices or practices. There is no published reference regarding Mammes's possible accomplishment until the patents themselves are published in 1933. Then they are presented in the *International Photographer* in connection with MGM's production *The Trail of '98* (1928). The movie tells a dramatic story in the context of a historic gold rush and was mainly shot on location. But it does contain several Williams process shots, matte paintings and transitions with animated masks. One image resembles closely the example given in Mammes's first patent. It is a long shot that shows a slope with workers, houses and the water jets of hydraulic mining (fig. 5.8a). In the patent text the actual reference is transliterated as follows:

> The negative 1 may include a scene of action taking place in a mountainous region, such for example, as illustrating a wagon train passing over a hill, the negative 2 may include a scene taken many miles removed from the scenes shown on the negatives 1 and 3 and providing merely a background to give to the finished film the effect of the entire film having been taken at some historic point or in some country foreign to the United States, while the negative 3 may include a close up scene of a number of actors or the like which may be taken on a set in the motion picture studio.[41]

The threefold division between foreground action, painted landscape, and scaled background action is found in movie scene and the patent. Mammes paraphrases here the further development of the static matte painting scenes established in the early 1920s. This is done by the possibility to scale down a motion picture with ambient action that ostensibly animates the static painting. Multiple exposure (i.e., three or more) is a policy that in different variants becomes regular practice when using matte paintings in the 1930s.[42] Mammes's approach, therefore, can be seen as a counter project to that of Knechtel. While

[40] Mammes, Method of Forming Composite Motion Picture Films, 2.
[41] Ibid., 1-2.
[42] See e.g. the cave scene in *King Kong* described from p. 167.

Knechtel achieves higher technical complexity with his focus on cinematic means alone, Mammes takes actual production needs as a starting point and then involves the required resources.

5.2 Duplication Film Stocks

In his history of special effects, Turner names the introduction of duplication film stocks "in the early 'talkie' era"[43] as the crucial catalyst for the implementation of optical printing in the industry. As described above, in 1929 Eastman Kodak had split its original duplication film stock 1503 into two variations, hereinafter used as positive (Type 1355) and negative (Type 1505) stock (p. 73). Tests had shown that the contrast and gamma of exhibition prints were best when the gamma of the master positive was higher than that of the duplication negative. While with due diligence it was possible to avoid burned out highlights and flat shadows so typical for earlier duplication work, the increased graininess of the copies remained a problem. The research laboratory of Eastman Kodak, therefore, in 1932 conducts an extensive series of tests and presents the results in detail at the SMPE spring meeting.[44] Eastman Kodak here takes up observations made in laboratories of the industry since the introduction of the duplication film stocks and transfers these into a formalized series of tests. Various kinds of film stocks and developers are combined for the two steps of producing a master positive and a duplicate negative. The resulting graininess is measured by determining the distance between viewer and screen where grain is no longer perceived. The results confirm that the two distinct film stocks show better results than other Eastman film stocks. While this is in line with expectations, it is relevant here that Crabtree and Schwingel, the authors of the paper, on the one hand provide an insight into their work and on the other hand inform their customers about the correct procedures of using Eastman's products.

What comes as a scientific paper turns out to be a manual. And its late appearance suggests that the original introduction of the two film stocks had less impact on laboratory and production practices as at least Eastman Kodak had hoped for. The recommended practice foresees that from the original negative a master positive is made on Type 1355. The film stock has normal speed and a lavender base that prevents halation. The print with a gamma of about 1.85 should be made more dense than a regular positive so that highlights are rendered slightly gray to avoid possible later burnouts. The master positive is not only a necessary intermediate but it is the print that should be used to match different exposures of the original negative. The duplicate negative then is printed on Type 1505 which is yellow-dyed in order to reduce irradiation and keep the definition high. Printing here is likewise dense but the gamma at a low 0.55. Both printing steps are done optically but only the second one is usually used to do process work. The relatively long paper is not only printed in the *SMPE Journal* but also reprinted in three parts in the *American Cinematographer* later. This can be seen as an argument for the increased relevance of high quality duplication work.

A year after this guideline Eastman Kodak presents another duplicating positive stock, Type 1362, that compliments the existing Type 1355. Used as an alternative to make master positives with higher contrast and gamma it is usually only referred to as Duplicating Positive

43 Turner, "The Evolution of Special Visual Effects," 48.

44 See J. I. Crabtree and C. H. Schwingel, "The Duplication of Motion Picture Negatives," *AC* 13, no. 4 (August 1932): 8–9, 27.

Type B.[45] But only in 1936 the two original duplicating film stocks introduced in 1929 (as much as the addendum 1362) are replaced by stable (not to say final) products. The concept of using different stocks for master positive and duplicate negative stays unchanged. The main difference of the new Duplicating Positive Type 1362 and Duplicating Negative Type 1365 is their finer grain. The presentation by Ives and Crabtree accordingly concentrates on best practices.[46]

The introduction of a practice of duplicating film reveals a constant interdependency between market needs and research outcome. Eastman Kodak not only has to listen to customers but also to explain how to use the most recent products in order to cultivate respective practices. In this case the process requires about ten years and it needs a clear target defined in the very beginning. “A perfect duplicate negative would be one which would give prints identical in every respect with those obtainable from the original.”[47] Furthermore, characteristics are given that specify the target, which here are that duplicating film stock needs high latitude and resolution as much as fine grain. Though optical printers are mentioned to be used in the process of duplication work, optical printing as part of effects is never addressed or mentioned. What Eastman Kodak and the members of the company’s research laboratory are striving for is a perfect copy of the original negative. The reasons to make such a copy are first to protect the camera negative and second to increase quality of foreign distribution copies.[48] Optical effects are common practice in the studios but not a market that could be addressed reasonably. What the people involved in optical printing in this situation are doing is a twofold strategy. On the one hand, they seize the notion of a perfect copy but offer to improve the maybe not so perfect original as Gregory had suggested with his film clinic. On the other hand, they use the possibility to make virtually identical copies to interfere in the duplication process and alter the content of the image. The result might be technically a perfect copy but with new content.

5.3 RKO

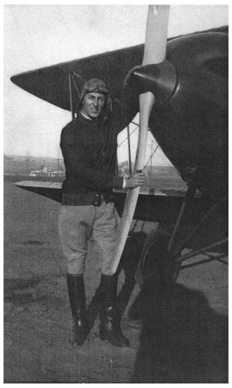
In contrast to the traveling matte processes of the 1920s but just like rear projection, optical printing is a technique that develops within the structures of the major studios. RKO Radio Pictures and its trick department play a central role in this development and the application of optical printing. This aspiration is documented in various articulations first of Lloyd Knechtel and later of Linwood Dunn. The latter works for the studio from shortly after its start in the late 1920s until its end in the 1950s. When I will focus on RKO and especially Dunn here, it does not mean that other studios or individuals do not contribute to the development of optical effects. But for one thing, other contributions are hardly traceable today with the documents available, for another thing, Dunn by articulating his work not only makes himself traceable historically but also contributes to optical printing in the making. Employees who are in charge of optical effects in the 1930s at the other studios are not easy to identify and follow. Even when in 1935 the Academy starts to com-

[45] *Motion Picture Laboratory Practice and Characteristics of Eastman Motion Picture Films* (Rochester: Eastman Kodak, 1936), 55-57.

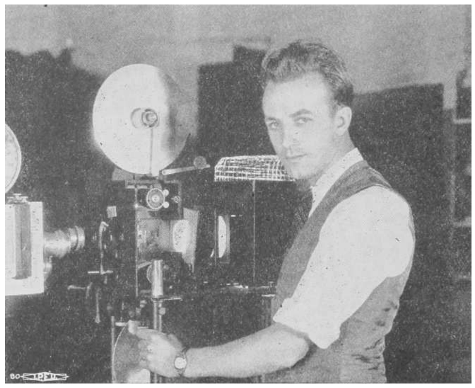
[46] C. E. Ives and J. I. Crabtree, “Two New Films for Duplicating Work,” *JSMPE* 29, no. 3 (September 1937): 317–25.

[47] Capstaff and Seymour, “Duplication of Motion Picture Negatives,” 223.

[48] *Motion Picture Laboratory Practice and Characteristics of Eastman Motion Picture Films*, 220.



(a) Alvin Knechtel



(b) Lloyd W. Knechtel

Fig. 5.9

pile "a complete technical history"[49] for each production of the major studios, a lot of the effects people are given credit but the optical printer operators are usually not among them.[50]

When Dunn is hired by RKO initially for two days only in 1929 to shoot matte paintings, the studio's trick department only consists of cameraman Lloyd Knechtel (the younger brother of Alvin) and matte painter Paul Detlefsen, the former assistant of Ferdinand Pinney Earle at MGM. Unlike at other studios Knechtel from the beginning receives screen credit for his work. Lloyd Knechtel (born 1907) followed his older brother and with delays repeats his career. In 1925 he works in Detroit at the film laboratory. The following year he joins Pathé News. And in 1927 he is with his brother at First National where he works with Fred Jackman on the *Rex the Wonder Horse* series.[51]

In 1929 Knechtel becomes head of special effects at RKO and one of the first things he does is to order an optical printer from the Cinema Machine Shop, run by Fred Hoefner and located three blocks away on Santa Monica Boulevard. Knechtel provides the concept and Hoefner builds the device.[52] There are no know details about the printer. Presumably it consists of a Mitchell camera and a projector head mounted on a lathe bed. It can be seen on a portrait of Knechtel published in 1930 (fig. 5.9b) and it is basically the same device that later Dunn will show in his trade journal articles. Therefore, we can assume that the trick department at RKO uses the same printer from 1929 until the early 1940s. According to Dunn it is constantly improved and modified and only replaced later by the Acme-Dunn Optical Printer. Improvements and additions are usually done by the studio's own workshop. The first accessory is designed by Knechtel and his chief mechanic William Leeds and manufactured by the miniature department of Don Jahraus.[53] It is a precision matte box that can be either used with the optical printer or a production camera. Its four blades can be accurately adjusted so that they cover the aperture to different degrees and in ar-

49 Academy of Motion Picture Arts & Sciences, "Technicians Credits: Complete Technical Production Credits on all productions completed since January 1, 1935," *Technical Bulletin* (Hollywood) 1935 (April 17, 1935): 1.

50 In an interview in 1993 Dunn talks about the strikes of 1933 he also mentions colleagues from other studios doing optical printing: John McCormick (Universal), Bob Hope (MGM), and Ralph Laura (Fox). None of these is clearly identifiable. See Dunn, *Interview with International Cinematographers Guild*

51 *International Motion Picture Almanac 1937-38* (New York: Quigley, 1938), Open Library: ia:international193738quig.

52 "Optical Printer for RKO," *IP* 1 (July 1929): 26.

53 Maurice Kains, "Hot Points," *IP* 2, no. 5 (June 1930): 130.

bitrary angles. It is first used for the short comedy *Humanettes* (1930) to show actor Benny Rubin who portraits sixteen characters to meet himself in split screen—a well known *doppelgänger* subject.[54]

The special effects department at RKO not only collects tools but also employees. Knechtel starts with painter Detlefsen. Shortly after Dunn joins as a cinematographer and Leeds as mechanic. The team is completed by two assistants, Cecil Love and Jack Thomas, and a clerk, Charles Kerlee.[55] At the end of 1930 the department moves into the new photographic building on the lot. With Vernon Walker another former collaborator of Fred Jackman at Warner Bros-First National joins the team. Detlefsen moves into the same building with enlarged staff.[56] The effects that are produced in 1929 and 1930 are still very simple. *Rio Rita* (Luther Reed, 1929), a prestiges and profitable musical production with a two-strip Technicolor finale, contains a few matte paintings and miniatures. *Night Parade* (working title: *Ringside*, Malcom St. Clair, 1930) is a movie about a boxer tempted by a girl to participate in a betting fraud. Again, the movie contains little effects work but the first matte shot that Linwood Dunn is doing as he later recalls in an interview.

> *Ringside* was the picture and Detlefsen was the artist. It was a night shot with the audience outdoors. We painted a lot of people in. They had a few real people scattered around so there'd be some motion and sometimes they'd put a few dummies in there, too. We'd paint the rest of the people in and we had a few little light effects to make them look like they were moving. At that time a matte painting was a double exposure.[57]

Another production Knechtel and Dunn work on at this time is *Danger Lights* (George B. Seitz, 1930), a railroad drama that contains miniature trains by Don Jahraus photographed by Dunn. Additionally, there are a few shots with superimposed clocks but the complexity of optical printing is still low.

Parallel, Lloyd Knechtel explains and legitimizes the process of optical printing first in the *International Cinematographer* and later in the ASC's *Cinematographic Annual*. Instead of contractors like Depue or Gregory, it is now a studio employee who argues in support of optical printing. For him the lap dissolve plays a key role in the implementation of the optical printer into production practices as it can be done during production or post-production. There are arguments for both options but finally sound makes lap dissolves in the camera impossible.[58] "And since this necessity has forced us to make all dissolves optically, we have found that this method is by far preferable; perfect timing of dissolves may be had, with the constant option of changing them to comply with all possible re-cutting of the production."[59] Precession is not primarily aspired but highly acclaimed when enforced by other means. This is valid for matters of timing and image composition as for laboratory work in general. The process of printing is differentiated by Knechtel as every step has individual requirements. The first positive print is done on lavender stock to lower the contrast. The duplicate negative then produced in the optical printer is made with duplication film stock (fine-grained, yellow-dyed, possibly Eastman Type 1503 though Dunn

54 Ralph Wilk, "Hollywood Flashes," *FD* 54, no. 49 (November 28, 1930): 6.

55 Lloyd Knechtel, *Cinematographic Annual* 2 (1931): 429.

56 Ralph Wilk, "A Little From 'Lots,'" *FD* 54, no. 53 (December 3, 1930): 7.

57 George Turner, "Linwood G. Dunn, ASC," *AC* 66, no. 12 (December 1985): 38.

58 William Stull, "Multiple Exposure Cinematography in Sound Pictures," *AC* 10, no. 9 (December 1929): 4, 39; Glenn E. Matthews et al., "Progress in the Motion Picture Industry," *JSMPE* 15, no. 6 (December 1930): 759–808.

59 Lloyd Knechtel, "Optical Printing," *Cinematographic Annual* 2 (1931): 268.

Fig. 5.10: Process shot from *Bird of Paradise* (1932) that combines Dolores del Rio on Hollywood's popular all-purpose island Santa Catalina and a smoking miniature volcano by means of optical printing.

four years later names DuPont Orthochromatic).[60] While Alvin Knechtel had focused on optical effects as an apparent appliance for amusement, Lloyd picks up the notion of Gregory's film clinic when he offers to "doctor up"[61] problematic scenes. His tool box provides improvements of contrast, magnifying or reducing shots, stop-motion, speeding things up, split screen, and double exposure. Optical printing, though, is not a general alternative for other processes but strives for a high integration of techniques as Knechtels makes clear.

> In a recent picture one scene combined, thanks to the optical printer, these components: The main action and the set itself were photographed in full scale on the stage, with dialogue. The sky was put in by means of a glass shot. The background—which contained considerable action—was put in by the Dunning process. The foreground was largely a miniature. And a part of the middle-distance was put in by simple double-exposure. All of these were combined into a single negative by means of optical post-treatment, and the result was absolutely undetectable as a composite—even by experts.[62]

The relationship with sound at that time remains complex as optical effects in several ways profit from the introduction of sound but also suffer from the predominant attention that sound receives. Knechtel, therefore, finishes his text with a statement that the "motion picture is, and always will be, primarily a visual art, and no tool that has yet been made available to the motion picture craftsman has in it greater potentialities for visual expression than the optical printer."[63]

The integration, addressed by Knechtel, becomes seizable around 1932. *Bird of Paradise* (King Vidor, 1932), a South Sea romance with Dolores del Rio and Joel McCrea and according to the Richard Jewell "one of the most cursed undertakings in the history of RKO,"[64] is produced on Honolulu (hindered by the worst storm for nearly two decades), on Santa Catalina Island offshore Los Angeles, at the studio's backlot 40 Acres in Culver City, and on the sound stages in Hollywood. Real and artificial locations coexist. The studio here tries to

60 Lloyd Knechtel, "Optical Printing," *IP* 2, no. 6 (July 1930): 12; Linwood G. Dunn, "Optical Printing and Technique," *AC* 14, no. 11 (March 1934): 444–46.
61 Knechtel, "Optical Printing," 268.
62 Ibid., 270.
63 Ibid.
64 Jewell, "A History of RKO Radio Pictures, Incorporated 1928-1942," 146.

(a) *Cimarron* (1931)

(b) *The Bird of Paradise* (1932)

Fig. 5.11: RKO trademarks in 1931 and 1932

weigh costs and advantages of several sites. Process work is not so much a cost factor but is used when it seems feasible—i.e., for static long shots (fig. 5.10) or where foreground and background merely have a loose connection like on ship decks. Responsibilities are split. Knechtel is in charge of matte shots and Vernon Walker handles Dunning shots (mostly for ship deck and volcano scenes).

At the same time the special effects work at RKO is reorganized. Several departments are merged into a single Camera Effects Department with Vernon Walker as head. The fact that Walker and not Knechtel heads the new organization might also be due to the increasing relevance of rear projection. Knechtel stays in charge of matte shots and optical printing effects while Dunn is doing routine works like lap dissolves, wipes, and dupes.[65] With his new role as department head Walker now also gets the screen credit. This might contribute to the leaving of Lloyd Knechtel who moves to London in the summer of 1933. Knechtel not only turns his back on RKO but also on optical printing. In London he is about to take a position at a laboratory that is the licensee of the Dunning process in the UK. At the same time he offers his services for Hollywood studios to shoot process backgrounds in Europe for rear projection.[66]

The newly organized department is chaperoned for many years by a composite image that it produces at this time—the remake of the studio's trademark that introduces all movies. The original trademark animation featured an outsized broadcasting radio tower on a globe (fig. 5.11a). In 1931, after the Pathé studio was fully merged into RKO, the animation is shortly replaced by a version that shows the Pathé rooster. But in 1932, as already described in the first chapter (p. 31), the tower returns in an enhanced version of the original animation (fig. 5.11b). This remake with its additional layers and grown complexity not only represents RKO as a whole but also the studio's reorganized effects department.

An alternative approach to optical printing comes with Serbian-American artist Slavko Vorkapich to the studio. Vorkapich, originally a painter, had arrived in Los Angeles in the early 1920s and worked in different positions in the movie industry. In 1928 he produces with Robert Florey and cameraman Gregg Toland the experimental short film *The Life and Death of 9413, a Hollywood Extra*. The $97 movie, which Brian Taves describes as "a surreal story rendered in an expressionist manner,"[67] wins the support of Charlie Chaplin

65 "RKO Trick Departments Consolidated."

66 "Tek-Nik-Town"; "Lloyd Knechtel," *Hollywood Reporter* 15, no. 33 (June 26, 1933): 20.

67 Brian Taves, "Robert Florey and the Hollywood Avant-Garde," in *Lovers of Cinema: The First American Film Avant-Garde, 1919-1945* (Madison, WI: U of Wisconsin Press, 1995), 97.

(a) *Manhattan Cocktail* (1928) (b) *The Wolf of Wall Street* (1929)

Fig. 5.12: Montage sequences by Slavko Vorkapich for Paramount Pictures

and is commercially distributed by United Artists. Taves has made clear that Vorkapich's co-authorship of the movie is questionable and that contemporary sources hardly mention him. Nevertheless, *Hollywood Extra* paves the way for Florey and Vorkapich for commercial engagements in the film industry. In August 1928, shortly after the release of the movie, Paramount signs Vorkapich for its special effects department.[68] Jobs at RKO and MGM will follow resulting in a decade long career directing what he calls 'transitional sequences' for feature productions. His first assignments at Paramount are a montage sequences for Dorothy Arzner's *Manhattan Cocktail* (1928) and Rowland V. Lee's *The Wolf of Wall Street* (1929). The skyline dance sequence combines low angle shots of dancing girls as shadows with metropolitan footage as a backdrop that is alienated in different ways. Cars move forward and backward, the camera dizzily flies between high rise buildings, and a shot of the Los Angeles City Hall from *Life and Death of 9413* is fragmented like seen through a kaleidoscope (fig. 5.12a). The usage of shadows is still close to the expressionistic motives of his own movie, which does not feature any advanced post-production work. This changes with Vorkapich's contribution to *The Wolf of Wall Street* (1929) a highly symbolic image of the stock exchange as a hand mill that devours the economic system (fig. 5.12b).[69]

Vorkapich is well aware that his approach to montage (as opposed to editing) with its influences from German and Soviet cinema needs explanation and authority in Hollywood. He describes cinema as a hybrid art form that is still looking for its own identity. "It is hybrid insofar as it imitates or borrows from literature, stage, painting and music: it is unclear and undecided as to its proper style and form."[70] He acknowledges that cinema conflates two lines of arts—those that can be described as static or spatial and those that are dynamic or temporal—and compares the suspension of the border in between with the scientific revolution of the theory of relativity. But while cinema manages to incorporate all forms of arts, it essentially returns to the oldest of all arts, dance. This art of motion is now no longer limited to the human body. It is freed from its anthropocentric roots. And, as Vorkapich argues, it requires research and development to cultivate a vocabulary of motion. Vorkapich here takes up a stance against a foundation of motion pictures in either storytelling or pictorial art: "a motion picture should be visually interesting even if we entered the theatre in

68 "Studio Gossip," *Exibitors Daily Review* 24, no. 36 (August 13, 1928): 3.

69 Both movies are apparently lost and Vorkapich's sequences only survived in his own archive and were published as part of the *Unseen Cinema* DVD series. It is possible that the his work was modified by Paramount for the release of the feature films.

70 Slavko Vorkapich, "Cinematics: Some Principles Underlying Effective Cinematography," in *Cinematographic Annual*, vol. 1 (1930), 29.

(a)

(b)

Fig. 5.13: *What Price Hollywood?* (1932)

the middle of the performance; we should be visually entertained even if we did not know the beginning of the story."[71] The entertainment he has in mind is a very physical one as he is aware that the bodies of the immobile spectators may react to the moving images as when on a ride in an amusement park.[72]

In an earlier more radical account Vorkapich goes so far to deny photography any artistic value for its lack of motion. "No matter how good-looking the actor or the actress is, and no matter how wonderful his or her acting, it will still be *only a photograph* of the actor and his acting, if at the same time there is no motion that has cinematographic value."[73] Where painters have many possibilities to be involved in their works the cinematographers—and Vorkapich claims this or a similar title instead of the still common designation cameraman—primarily have to focus on motions as expressive and vital means. At a meeting of the Academy's technicians branch in September 1934, which focuses on aspects of transitions for movie production, Vorkapich elaborates on his notion of a motion vocabulary. He names six types of images that cause "modifications in our organisms."[74] Vorkapich's somatic cinema is now less an artist endeavour but one that strives for scientific foundations, namely the psychology school of behaviorism, which believes in pattern reactions. Such patterns for Vorkapich in the movies are basic motions of the camera or the depicted objects. The examples he gives are all based on shocks or forms of disorientation or discomfort. But he assures that by combination and harmonic rhythms also positive emotions can be caused in the audience. By this claim for a scientific functionalism of form he dissociate himself from a free play of effects with affect or a "cinema circus."[75]

What Vorkapich has in mind here can be studied looking at his first assignment for RKO, two montage sequences for George Cukor's *What Price Hollywood?* (1932). The movie is a longtime pet project of David O. Selznick who hires Vorkapich when the latter leaves Paramount in the summer of 1932.[76] Waitress Mary Evans (Constance Bennett) makes friends with alcoholic director Max Carey (Lowell Sherman). While she becomes a popular actress, he destroys his career by drinking. The first Vorkapich sequence depicts Mary's

[71] Vorkapich, "Cinematics," 33.

[72] To make clear the peculiarity of Vorkapich's position it would be useful to compare it to that of Lewis W. Physioc whose references are rather in fine arts.

[73] Slavko Vorkapich, "Motion and the Art of Cinematography," *AC* 7, nos. 8/9 (November–December 1926): 19.

[74] Slavko Vorkapich, "The Psychological Basis of Effective Cinematography," *Technical Bulletin* (Hollywood) 1934, no. 10 (Transitions and Time Lapses 1934): 8.

[75] Ibid., 10.

[76] Ralph Wilk, "A Little From 'Lots,'" *FD* 59, no. 69 (June 21, 1932): 4.

Fig. 5.14: The prison scene from *No Other Woman* (released January 6, 1933) created by Vorkapich is an exception for his work at RKO because it involves image composition that exceeds bare double exposure.

transformation to a star (fig. 5.13a). It begins with a close-up of Mary raising her head visibly stirred as she realizes that her dream of being a Hollywood star is about to become reality. The image is overlaid with waves rising from the bottom followed by fireworks. A whole-body figure of Mary in radiant white grows likewise from the bottom looking up, arms pushed back. From several flares that suffuse the image one in the upper center prevails while Mary is replaced first by the displays of movie theaters with her name and, finally, the kaleidoscopic multiplication of a pair of clapping hands. Mary's advancement is symbolized by ascending motions of her head, her growing body, the ripples, and the fireworks mixed with pseudo-subjective images of flash lights and applause she faces in her new role. The second montage sequence towards the end of the movie is conceived as a mirror of the first. Max has just been bailed out by Mary after being in prison for inebriety. Long since he has lost his reputation and his job as a director. Accommodated in her house he gets up at night, looks in the mirror, and decides to commit suicide. His close-up is overlaid with optically distorted depictions of himself first as a successful director, then with a close pan over prison bars. Central water ripples appear. His head turns to the side and through a lap dissolve is replaced by a close-up of his feet walking, his hand opening a drawer, and seizing a gun. He points the weapon at himself and when he fires, we see a quick succession of high contrast images of himself mostly introduced by single, overexposed frames (fig. 5.13b). He falls down and the montage changes its subject when Mary finds him. Newspaper headlines describing her involvement in the drama are combined with newspapers falling down in slow motion. Finally, we see her whole-body image from the first montage again, but now shrinking, while Mary in close-up lowers her head. The predominant motion of the second half of the sequence is going down and has a similar striking symbolism as the risings of the first. The suicide montage had been the reason why Selznick involved Vorkapich when production photography was already completed but the ending of the story was still open.[77] Noteworthy here is at first how the burnout effect of the flashback—an ostensible defect of the reproduction process—is used as means of expression. The predominant impression though is that of matched movements that reflects Vorkapich's inclination for motion that conflates all elements in what he also describes as a symphony.

[77] See Ronald Haver and Thomas Ingalls, *David O. Selznick's Hollywood* (New York: Knopf, 1980), 92.

The next production Vorkapich works on at RKO is William A. Wellman's *The Conquerors* (1932) and this time he is involved from the beginning. The story of the film spans over sixty years what makes it an ideal case for bridging necessary time lapses between episodes with transitional sequences by Vorkapich. At the end there are nearly a dozen of them. As optical work with Vorkapich becomes more apparent than usual, one has to ask the question whether this is reflected by his position in the studio structures. In the case of *The Conquerors* the production records designate Vorkapich's function as a director listed right after Wellman (but at a much more modest salary of $300 per week, the same amount Walker earns as department head). He writes his own script for the transitions that is integrated into the screen play by Robert Lord. And he directs Knechtel and Walker as his cameramen. It cannot be reasoned out completely what effect Vorkapich has on the development of optical effects—at least in this specific situation at RKO. On the one hand, he represents a demand for optical effects as much as for the people and devices who can produce them. Furthermore, he makes such effects visible and attracts notice even among the public. This potentially can help to attract support. On the other hand, the montage sequences produced at RKO described so far have a low degree of technical requirements when it comes to compositing. The original shots basically remain intact as their combination does not involve static or traveling mattes. The optical printer is needed here for precise timing but not for manipulations within the images. This was different with the work he did at Paramount. The potential progress that comes with Vorkapich, therefore, is possibly aesthetical but not technical. At the same time his expressive style contradicts the aesthetic concept of most effects people who champion optical effects to primarily serve story and photography.

In February 1933 Vorkapich's employment at RKO ends when the studio decides not to renew his contract. The reason is that the studio on January 27 went into receivership where it would stay for the next seven years.[78] Vorkapich's patron David O. Selznick leaves RKO for MGM and hires Vorkapich again later that year to direct transitional sequences.[79] His name by this time has become synonymous with the montage concept that he has established with the result that—in a similar way as the Dunning process—script writers will use his name to designate the style or technique in general.

5.3.1 Linwood Dunn, the RKO Optical Printer, and Transitions

In 1933 Vorkapich and Knechtel both leave RKO and the subsequent loom of Linwood Dunn has to be read in this context. Knechtel had left him the optical printer and Vorkapich had shown the studio that it could be used for more than lap dissolves. RKO's optical printer is described by Dunn in detail in the first of two articles he publishes on his work in late 1934. The basic structure of optical printers is always the same since the late 1920s. But as Dunn points out enhancements have to be invented and enforced within the studio structures individually. Support has to be found by studio executives to invest effort and money in a device that is initially difficult to understand. An optical printer operator like Dunn has to establish a network that also involves his department head (here Vernon Walker) and a machinist designer (William Leeds). And he, finally, needs applications, movie productions that are in need of optical printing. "The efficiency and appearance of the printers in use

[78] Jewell, "A History of RKO Radio Pictures, Incorporated 1928-1942," 178.

[79] "Slavko Vorkapich dropped by Radio," *HR* 13, no. 15 (February 6, 1933): 1; "Vorkapich to MGM," *HR* 15, no. 27 (June 19, 1933): 1.

at any studio will tell the story of this cooperation," as he writes.[80] What makes advancements of optical printers difficult is the fat that such a device and its operator are primarily invisible and, according to Dunn's self-awareness, only find attention when problems can be traced back to optical printing. The situation he describes is that most production cinematographers know little about the optical printer. They are not even aware that most of their footage is later processed by it. This is especially the case when regular transitions (fades, lap dissolves, wipes, etc.) are done. While the unprocessed footage is directly printed from the original negative and edited, the optical printer operator needs an intermediate positive from which he makes a dupe negative. This negative is necessarily printed later and independently which easily causes divergent qualities and contrasts. The consequent shifts in gradation are then seen in production screenings though they can be avoided in the final release prints. Dunn's problem here is the lack of control he has when it comes to the work of the laboratory and he, therefore, writes that "a satisfactory system of duping"[81] is the basis for all successful optical printing.[82] This situation echoes the one with film stocks where duplication stocks are not developed for effects work but at the end make them more feasible. To avoid this problem, Dunn collects samples from the editor's print and sends them to the laboratory with his duplication negative for print matching. Dunn's general practice of duplication work roughly follows the suggestions made by Eastman Kodak for using their duplication films stocks though he combines Eastman's duplicating positive with the orthochromatic negative by DuPont. When he presents his work at the 1935 SMPE spring meeting, Dunn explains how he prefers to conform to studio practices (here the laboratory) instead of individualizing his work process. "For consistency and evenness I have tried to adjust my system so that the lavender develops the same speed as the ordinary daily production print, and the dupe negative develops the same speed as the production negative."[83] Optimization for Eastman Kodak consists of refinements of processes while for studio practitioners like Dunn it means assimilation to the rest of the studio first and foremost.

The design of the optical printer allows for vertical and lateral movements of the projection head and camera respectively. Both movements can be directed by motor or manually. Dials are used to exactly indicate positions as well as focus. Counters show the position of the film stock in projector and camera. An intercepting prism with viewfinder can be pushed into the light beam to control line-up and focus. The list of attachments that have been collected continues with built-in film-punch to mark single frames and an automatic wiping device.

What Dunn needs besides of his development network is a positive embodiment of his practice. His initial problem is that he only becomes visible when his work shows lapses. The second part of the article unfolds how this is possibly done. He distinguishes between "normal and trick Optical Printing"[84] and with the latter he means trick transitions that (unlike regular lap dissolve) are supposed to catch the attention of the audience. This is a consequent progression that only consists of a little step compared to the regular transitions he started with at RKO. (In a similar way people like Lloyd Knechtel or Raymond Mammes at MGM had started with the established technique of matte painting and then improved

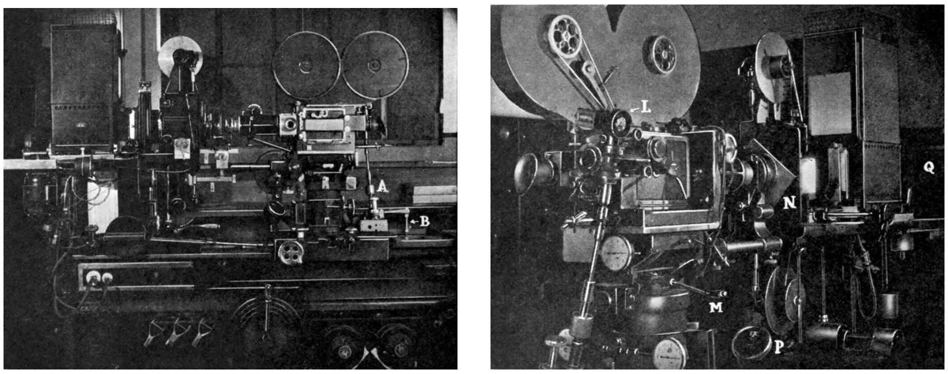
80 Dunn, "Optical Printing and Technique," 446.

81 Ibid., 444.

82 Studios differ here in the question whether effects departments have own laboratories at their disposal. At RKO this is not the case while e.g. Farciot Edouart at Paramount is equipped with an own laboratory. See Edouart, "The Transparency Projection Process," 39

83 Linwood G. Dunn, "Optical Printing and Technic," *JSMPE* 26, no. 1 (January 1936): 66.

84 Linwood G. Dunn, "Tricks by Optical Printing," *AC* 14, no. 12 (April 1934): 487.



(a) (b)

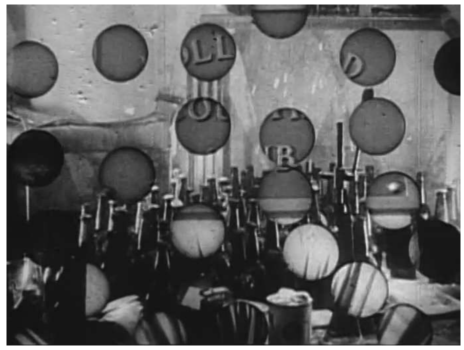
Fig. 5.15: RKO Optical Printer with attachments in 1934

on it with little animations.) Dunn names three productions of 1933 that include an entire catalog of trick transitions. The first one is the short comedy *So This Is Harris!* featuring the popular entertainer Phil Harris playing himself. RKO and director Mark Sandrich give the camera effects department a free hand in developing alternatives to regular lap dissolves. The decision to try out trick transitions for *So This Is Harris!* is likely only made after principal photography is completed in late 1932 as the (moderate) costs for photographic effects have doubled when production is finished in February 1933. But the results are so convincing that the trick transition venture is continued with Sandrich's musical feature *Melody Cruise*. Dunn here shares screen credit with Vernon Waker for 'Special Effects.' This is unusual (and will remain an exception) as credit only goes to the department heads. The movie becomes a big success when released in the summer of 1933 and critics of the daily press as much as trade journals recognize the originality of the trick transitions as a comment from the *American Cinematographer* shows."The outstanding feature of this film … is the special effects work. The film might be better described as a solo for optical printer accompanied by a film troupe. They have not only used every trick hitherto imaginable, but invented half a dozen new ones of their own. Just a few of the tricks include wipes, blends, whirls, melts, and the like."[85] The third production Dunn refers to in his article is the subsequent *Flying Down To Rio* (released December 29, 1933) where he continues his work.

Looking at the portfolio Dunn spreads out in the *American Cinematographer*, we can distinguish between three groups of transitions. The first one contains effects that Dunn himself describes as wipe-offs or wipe-overs. A wipe is a traveling usually horizontal split screen where shot A is masked progressively and shot B is respectively revealed while both retain their original positions. Wipes are not new at the time. The effect can be produced by complementary masks of different kinds. An early example can be found in Sam Wood's *Beyond the Rocks* (1922) for which supposedly a mask box was used. In that case the edges are blurred and the masks do not move in precise synchronicity. Wipes only become popular from the early 1930s with the use of 'masking films' instead of moved masks. The advantages of such a traveling matte are that its movement is precisely reproducible and that an exact counter matte can be printed from it. Hineline at the same time traces this

[85] Cited after Brosnan, *Movie Magic*, 54.

(a)



(b)

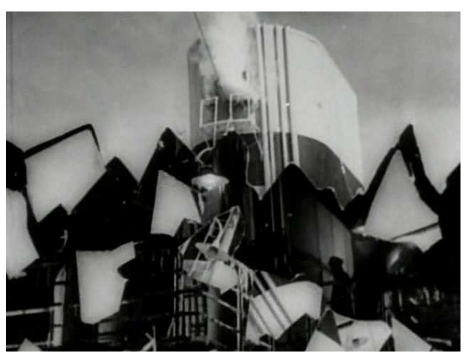
(c)

(d)

(e)

(f)

(g)



(h)

Fig. 5.16: Trick transitions made by Linwood Dunn in 1933.

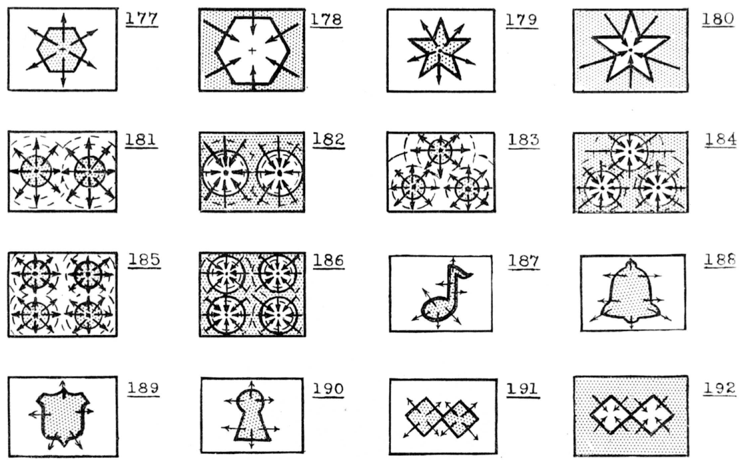


Fig. 5.17: Sixteen from nearly four hundred transitional effects ready to order from Technifilm Laboratories in New York in 1938 (Technifilm Laboratories, Inc., *The Book of Screen Effects*, New York, 1938)

method back to a patent from Reginald Stambaugh covering text animations for advertising animations.[86] But the patent is finally regarded as technically and legally irrelevant for production practices by the industry.[87]

Maybe the biggest advantage of photographic traveling mattes (as opposed to moving, physical mattes) for transitions are that they may contain any kind of form that not only moves but also can change shapes. The traveling matte is originally used for the Williams process (p. 64) to continuously combine foreground and background. In the context of transitions the same principle is used to change from one scene to another. This means that instead of using a mask of the constantly present but shapeshifting silhouette of an actor the mask changes from initial absence to a final covering of the entire image. The technically identical and well established process of double printing with complementary traveling mattes is reinterpreted by modifying the content of the films. The first group of transitions that Dunn presents is based on this approach. Forms may be scaled up (fig. 5.16a), the screen may be successively covered (fig. 5.16b), or dripping paint can be used (fig. 5.16c). Such transition mattes are easily photographed and can be reused. Dunn himself e.g. uses the dripping paint transition from *So This Is Harris!* again one year later for *Hips, Hips, Hooray!* (fig. 5.16d). He only flips the mask horizontally. J. A. Norling describes the process a few years later in detail[88] and independent laboratories soon offer hundreds of variations (fig. 5.17).

More complex to produce and entirely new is the second group of transition where the images are modified as a whole by shifts or rotations around different axis. Shifts appear in push-offs where image A seems to be pushed away by image B. This, usually horizontally, movement is done by two consecutive exposures with synchronized shifts by either camera or printer head. In the title sequence of *Flying Down To Rio* the actors are introduced in a series of close-ups with superimposed names. Transitions between the portraits show how one image disappears through a 90° rotation around the vertical axis and the following image appears in the same fashion (fig. 5.16e). Something similar already showed up in *So*

[86] See Hineline, "Composite Photographic Processes"; Reginald V. Stambaugh, Process of Making Motion Picture Films (Patent 1,226,135 [US], filed May 26, 1916, and issued May 15, 1917), Google Patents: US1226135.

[87] See *Notes on Stambaugh Patent*, typescript, box 6, file 20, Joseph and Katherine Westheimer collection of patents, MHL.

[88] J. A. Norling, "Trick and Process Cinematography," *JSMPE* 28, no. 2 (February 1937): 136–57.

Fig. 5.18: *International House* (1933)

This Is Harris! (fig. 5.16f) but there the rotation remains within the image plane. The turnovers in *Flying Down To Rio* are maybe the most striking transitional effects in the movie and accordingly raise curiosity. Dunn does not reveal how they are made exactly but the distortions require optical attachments that are no longer part of a standard optical printer setup. The change of method becomes evident from the notable decrease of image quality once the rotation has started.

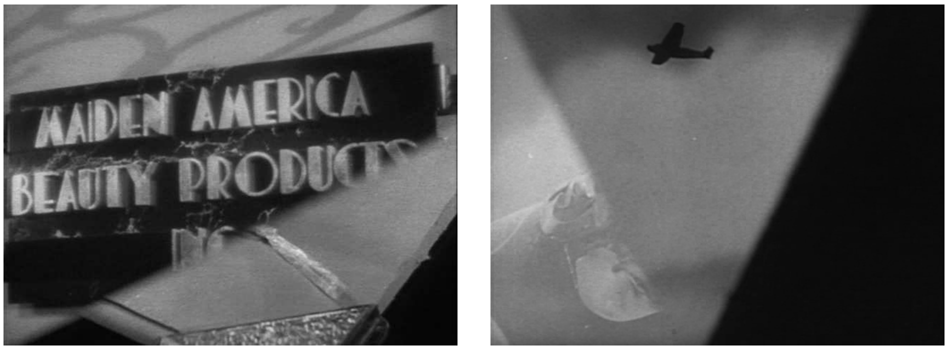
The third group of transitions contains combinations of the other two—i.e., image movements with traveling mattes. An example for this is a so called curtain wipe (image A slides up and reveals image B). The first image is shifted like in a push-off while the second image is printed in the residual space with a traveling matte. *Flying Down To Rio* contains a "postcard sequence" that introduces the Brazilian location in a series of shots that are each turned outward to unveil the following sight (fig. 5.16g). This effect requires an extra device that was especially designed for this purpose as Dunn remarks.[89] (The disappearing scenes freeze in the moment when they start to rotate. Therefore, it is likely that Dunn worked with paper prints for the animation.) It is often said that the development of optical printers beyond the basic setup highly depended on day by day production requirements. The Rio postcard sequence is an instance of this structure. The studio sends a small second unit to Brazil to collect local imagery. The scenes are shot without a storyboard or detailed script and are thus relatively incoherent. The final shooting script (finished after the return of the second unit) also does not contain anything that would shape the sequence. Instead of the eleven shots connected with the turning postcard transitions we only find this brief description:

> 118 EXT. RIO DE JANEIRO – DAY
> One SCENIC SHOT of the city from plane as in opening sequence.[90]

The same is the case with other trick transitions. The script usually only says "lap dissolve." This is a similar situation as with the Vorkapich sequences where the effects people are on their own. The reason for author, director, and editor to replace the usual lap dissolve with a trick transition is not to slow down the narration. A lap dissolve stands for a bypassed discontinuity in time and space. For such a break movements halt, dialog stops, and gently one image fades out while the other fades in. For comedies and musicals, like the three

89 Dunn, "Tricks by Optical Printing," 496.

90 Cyril Hume, H. W. Hanemann, and Erwin S. Gelsey, *Flying Down To Rio*, final script, August 25, 1933, box 282 S, RKO Radio Pictures Studio records, PASC.



(a) First of two consecutive radial transition from a table close-up to a company nameplate—followed by another to an office nameplate.

(b) Opposed radial wipe movements that result in double exposure on the left and straight black on the right side during transition.

Fig. 5.19: Radial wipes in *Hips, Hips, Hooray!* (1934)

movies that are under consideration here, this can slow down the pace of narration. A trick transition is a possibility for a cesura that does not withdraw speed. It is not a surprise that of all people Dunn is interested in this issue that has less to do with image composition but with temporal structures. When he started his movie career in the 1920s as a cameraman, he and his brother Lloyd worked parallel as musicians with Linwood playing saxophone.[91] This distinguishes him from others in the field who often have a background in visual arts and reminds of Vorkapich's choice of dance as a referential system.

The lap dissolves mentioned in the scripts are blanks that can be exploited by the optical effects people. It is not replicable how decisions for specific types of transitions are made but symbols and metaphors usually play a key role. Postcards are sent, curtains pulled, and pages are turned. The asserted endless options of the optical printer seem to need some kind of constraint to incorporate the trick images into the narrative of the movie and images here are defined by language. The traveling images of the second and third group of trick transitions mostly remain intact or may be split into two parts. But there are also cases in which many more fragments appear like in a transition from *Melody Cruise* that can be described as a self-assembling puzzle (fig. 5.16h). Here optical printing reaches out for animation techniques and touches the parallel development of animation stands that use similar concepts as optical printers and rear projection. The history of animated movies in United States shares many protagonists with that of optical effects but is beyond the scope if this thesis and, therefore, only observed as a collateral line.[92]

RKO is not alone with its enthusiasm about trick transitions as a similar effect in *International House* (1933) by the studio's neighbor Paramount shows (fig. 5.18).[93] All the more it is surprising how fast this trend goes by. Mark Sandrich's next movie *Hips, Hips, Hurray!* (1934) after less than a minute features a symbolic traveling matte transition as mentioned above (fig. 5.16d). But this pouring paint effect remains the only transition that can be called symbolic while all that follow are abstract wipes. These wipes are still quite playful. They often occur in pairs—i.e., after each other (fig. 5.19a) or even overlapping with opposed

[91] Lloyd Dunn chose music and later became Vice President of Capitol Records. See Turner, "Linwood G. Dunn, ASC"

[92] Norman Klein e.g. here speaks here of "scripted spaces." See Norman M. Klein, *The Vatican to Vegas: A History of Special Effects* (New York: New Press, 2004)

[93] Dewey Wrigley who works on the movie publishes an article for amateurs explaining how to do simple transitions in the camera but also more complex jigsaw effects. See Dewey Wrigley, "When To Use Special Effects–and How," *AC* 14, no. 3 (July 1933): 100, 121

(a) Mary Pickford kissing herself in *Little Lord Fauntleroy* (1921)

(b) Colleen Moore reading about cross eyes in *Ella Cinders* (1926)

Fig. 5.20: Early split screen examples

movements (fig. 5.19b). But what distinguishes them from those seen the year before, is that they are pure motion without the claim to convey any idea by their forms. In *Top Hat* (1935), a musical also directed by Sandrich, we are back at regular lap dissolves and combinations of fade-out and fade-in. There is no documentation or explanation on how the shortly celebrated trick transition could disappear so quickly. One cue might be their very name. As mentioned before, 'trick' as an attribute for either movies or cinematography is often regarded as a dated and much too self-referential approach to optical effects. This rejection is repeated here with transitional effects. For such stylistic elements applies even more what Latour says about technologies in general, "there's no such thing as inertia."[94] If nobody actively wants them, they just disappear.[95]

5.3.2 Split Screens

Split screen is another application of combining two images that can be done in-camera or with the optical printer in post-production. An early example for such an effect is a scene from *Little Lord Fauntleroy* (Alfred E. Green and Jack Pickford, 1921) featuring Mary Pickford in two roles, as mother and son. This variation of the *doppelgänger* motif finds its visual climax in a split screen scene that features the son kissing his sleeping mother on the cheek (fig. 5.20a). Five years later Coleen Moore, in a split screen done by Hans Koenekamp, reads in a book about cross eyes and the composited shot evokes a comic effect from her own eyes moving independently (fig. 5.20b). In the first case the movie celebrates an unexpected and somewhat unbelievable moment. The audience knows that Mary Pickford plays two roles and they should be familiar with the possibility to combine shots of both by editing. They might even expect to see Pickford twice in one shot, as *doppelgänger* stories are common themes at the time, but what strikes here is that the two figures even seem to touch when the 'boy' bends over his mother and bows behind her head and, thereby, crosses the invisible matte line. In *Ella Cinder* (Alfred E. Green, 1926) a time shift between the two exposures is used to create a comic effect similar to the movies of Alvin Knechtel at the same time but it asserts the integrity of the image at the expense of the coherence

94 Latour, *Aramis, or The Love of Technology*, 86.

95 It only can be assumed that they drew too much attention and, therefore, wore off within a season. Transitional effects at the same time become a topic for movie amateurs. See Charles G. Clarke, "Wipe-off Splicer for 16mm Films," *AC* 15, no. 8 (December 1934): 364; Harry Walden, "Fades and Dissolves," *AC* 15, no. 8 (December 1934): 364, 379–80

Fig. 5.21: *Ace of Aces* (1933)

of Moore's mimic. In both examples the split screen becomes apparent (in different ways) because it is related to the narrative. Later *Brats* (James Parrott, 1930), a Laurel and Hardy short feature, derives comic effects from showing the actors as adults and playing their own children in one image. Similar as with other applications of optical effects, split screen follows trajectories that lead from production to post-production and from expressive to embedded effects. Lloyd Knechtel's 1930 precision matte box can be seen as a device that is located at a turning point of production practices as it is supposed to be suitable likewise for matting on the set as with the optical printer.

Split screen usually becomes invisible for the audience and is mainly used to "doctor up" shots with problems. Dunn mentions a scene from *Ace of Aces* (1932) where Richard Dix crashes his airplane that bursts in flames after he has climbed out of the wreckage. The scene is shot with a stuntman and an actually inflamed airplane. But later, when it becomes apparent that the flames become visible much too late, Dunn is asked to improve on the shot. He uses an invisible split screen that spans two different moments in order to dramatize the depicted incident (fig. 5.21). Compared to the upper left part with the fire the lower right part with the escaping pilot shows an earlier moment. In order to bring things in space closer together their time-displaced appearances are synchronized.

The technique is also valuable when working with wild animals. Paramount's answer to the popular Tarzan series, *King of the Jungle* (H. Bruce Humberstone and Max Marcin, 1934), tells the story of a boy who gets separated by his parents on an expedition in Africa and is subsequently raised by lions. In the beginning of the movie the little boy wanders around, climbs up and down rocks. The camera is constantly traveling, first with him and then also with a lion who spots and follows the boy. Only when the two are seen in one shot, the camera suddenly halts to allow for splitting and recombining of the images. First this is the case when the big cat rises behind a rock in the image background and then—after the boy has discovered the lion's offspring—when it approaches the lying boy (fig. 5.22a). In MGM's second Tarzan movie, *Tarzan and his Mate* (1934), split screen is used in combination with rear projection, color-separation process shot, and simple double exposures (p. 175). The split screen method integrates well with other process techniques and is a solution too obvious not to be used in many cases. In relation to traveling matte processes it represents a complementary topography: Space is here not differentiated between front and back but within the image itself, usually between left and right. As parts of an optical effects toolbox they are individually chosen depending on how space should be modified.

(a) Lion approaching a boy, separated by split screen in *King of the Jungle* (1933). The gradient of the soft matting line is visible as the fore-paws of the lion disappear towards the end of the shot.

(b) Chimpanzee hunted by a lion in *Tarzan and his Mate* (1934), this time with a traveling split screen from left to right. The different exposure of the two original images is still visible.

Fig. 5.22: Wild animals and split screens.

Another aspect of integration is that the split screen and especially the more complex traveling one is just another interpretation of a wipe-off transition. The difference lies in the nearly identical footage that is used for a traveling split screen. RKO's camera effects department fully adopts the technique with it's leopard movie *Bringing Up Baby* (1938). As we have seen, working with the leopard required the usage of optical effects (p. 205). The most complex scene of the movie is the one when David (Cary Grant) visits Susan (Kathrine Hepburn) in her apartment and meets the leopard for the first time. Nearly every shot in that scene uses a different technique. When David discovers the leopard in the bathroom the two are separated by a huge glass plane on the set. Subsequently, David's legs, when seen with the big cat, are enacted by a stand-in. Once we see a stuffed leopard. And finally, David, the leopard, and Susan subsequently leave the apartment into the hallway. In one long static shot, we see Grant walking from the apartment door to the elevator, which he enters to go down (fig. 5.23). He does not realize that through the open door he is followed by the leopard who finds himself in front of the just closed elevator doors. When Hepburn also rushes in the hallway, she tells the leopard to use the stairs what both of them do to catch up with Grant. The three actors are all photographed individually and the shots are then combined with traveling split screens. Dunn follows here the same approach as with the plane crash in *Ace of Aces*. But this time he uses three instead of two sources.

As we have seen, other studios have used the same approach earlier but what gives the optical effects of *Bringing Up Baby* relevance in retrospect is the fact that this is a rare case where original footage is still available. Dunn copied it and used it for his show reel of optical effects when he started to lecture on the topic from the late 1960s on. His lectures were attended by many people who were involved in the comeback of special effects since the 1970s. A scene that did not make it into the released version of the movie is even more telling in regard to production practices. Dunn's show reel contains two original and one composited shot with Major Applegate (Charles Ruggles) being surprised by the leopard inside the country house in Connecticut. In the first shot Ruggles enters the picture from the left, frantically closes the door and a window, turns around, jumps up, and runs off toward the right (fig. 5.24a). The second shot shows the leopard entering the room from the left where the trainer Olga Celeste awaits behind an improvised barricade. In her left she holds a rod, with her right hand she tries to direct the leopard. She jumps back, grabs

Fig. 5.23: Double split screen in scene 73 of *Bringing Up Baby* (1938)

a chair and lies it down twice to catch and hold the leopard's attention. The animal looks to the right where in the previous shot Charles Ruggles had disappeared. The composited shot shows Applegate how he tries to make the house secure from a leopard who is supposed to be outside, only to find out that the beast is already in and follows him. The barricade of the trainer anticipates the later position of the split screen. In order to make a convincing composite shot, the space and the actions have to be arranged accordingly. The leopard has to stay in his part of the image and it has to look at an actor who is not there. Celeste and Dunn have to integrate the leopard into the image in their own respective ways.

When RKO uses the hidden split screen method extensively for *Bringing Up Baby*, Linwood Dunn and his colleagues are not the only ones who are quite familiar with the technique. Right before Cary Grant works for the movie in fall and winter of 1937, he has finished another production with a likewise elaborate integration of invisible optical effects. *Topper* from the Hal Roach Studio is released in July 1937 and in August the *International Photographer* publishes an article by William Draper who, together with his department head Roy Seawright, is doing optical effects at the Roach Studio. The story of *Topper* itself is one of invisibility. Marion and George Kerby (Constance Bennett and Cary Grant), a couple as wealthy as hedonistic, dies in a car accident and returns as ghosts that can freely appear and disappear. Their constant changing of visibility and the effects they cause when acting in disguise are the visual motives that dominate the movie and that had to be implemented by Seawright and his team. When talking about the production later, invisibility becomes a trait that describes their work. "The direction was never made subject to the needs of the trick department. As a rule, the director would rehearse just as though there were no effects to be considered."[96] In most cases the effect of the appearing ghosts is produced so that the scene is shot with all actors constantly present. With optical printing later a part of the image is matted out with additional footage that shows only the empty set. The prerequisite for this is that neither the background nor the camera is moving. The interior green sets (fig. 5.25a) are most suitable here but other scenes were more difficult to solve as Seawright and Draper remark at the 1938 spring meeting of SMPE, where they give a detailed account of their accomplishments. In a night club scene towards the end of the movie with extras in the background hushed up jerks are noticeable. And one scene, the two effects

[96] William Vernon Draper, "'Topper' Tippoffs," *IP* 9, no. 7 (August 1937): 18.

(a) Reacting to an imaginary leopard.

(b) Olga Celeste directs a leopard.

Fig. 5.24: Split screen shot that was finally not used in the movie.

people present with a certain pride, is showing Bennett appearing on the passenger seat of a convertible—classical rear projection combined with a split screen lap dissolve. Combination and integration of existing tools and practices are the main point here. “It will be seen from the preceding that there was nothing particularly new in *Topper*. It was made, we might say, by doing what had to be done by the best available system known to the operators in charge.”[97] The sublimation of optical effects takes place by combining them with each other and with other production practices. This disappearance has to be visible as such which is also a constant theme in *Topper*. As a variation to the repetitive fading-in and -out, Marion Kerby in one scene strips herself invisible with a simple gesture that was painstakingly deployed through a hand-drawn traveling matte that follows her hands’ movements (fig. 5.25b).

This concept of integration goes beyond Gregory’s older notion of doctoring. Optical effects are no longer subordinate to a single field of production but try to define linkages to all kinds of operations on the studio lot. This becomes more overt in an article by Linwood Dunn entitled “Optical Printer Handy Andy,” published two months after the release of *Bringing Up Baby*. The shift he performs compared to his earlier articles is subtle and easily missed because Dunn still uses the same vocabulary. “The complicated job of putting a motion picture together involves so many factors in which there are possibilities of a slip up that the industry has experts and special devices of all sorts to take up the slack of error. The outstanding ‘studio doctor’ of them all, with a versatile adaptability to solving tough problems is the optical printer.”[98] The catalog of transitions Dunn presented four years before is replaced with a extensive list of how the optical printer is helpful for virtually all parties on the lot. Dunn names thirteen departments with specific examples that illustrate the abilities of his machine (and himself) and, finally, also refers to a ‘Landscape Department’ that cannot appreciate the optical printer for the plain reason that it does not exist. Trick transitions were a self assertive offer of a field that was striving for acceptance as an independent player. Earlier, Fred Jackman had recognized the intermediate character of the field when he writes that the “optical printer, however, must be fed by other departments as it creates no raw material, so to speak.”[99] The fact that Dunn writes still about being a doctor has now less to do with his position as a service provider but with the nature of his device and the constitution of the movie industry as an assembly of fields that develop in perpetual exchange. And on a larger scale Hortense Powdermaker,

97 Roy Seawright and William Vernon Draper, “Photographic Effects in the Feature Production ‘Topper,’” *JSMPE* 32, no. 1 (January 1939): 61.

98 Linwood G. Dunn, “Optical Printer Handy Andy,” *IP* 10, no. 5 (June 1938): 14.

99 Jackman, “Organization of a Special Effects Department,” 1.

(a)

(b)

Fig. 5.25: *Topper* (1937)

in her late 1940s study on Hollywood, picks up the self definition of constant crisis as the backbone of the business.[100] Crisis is meant here as the uncertainty whether a movie will make profit. But the question of success can be traced back to the production of scenes, single images, or dialogue lines. All of these are at the same time components for a production practice that is based on the division of labor and that still cannot be standardized like the components in other industries. A consolidated position in an industry that is only meta stable looks like the one Dunn has achieved and described here. Dunn will still make another attempt to reposition his field within the studio structures to witch I will come later.

5.3.3 *Citizen Kane* and Continuous Spaces

In October 1938 the ever changing management position at RKO is passed to George Schaefer as new corporate president. The studio is about to recuperate from its years in bankruptcy and Schaefer's wants to establish a new strategy of quality film making. As RKO at this point has a less impressive staff than other studios, he needs to hire new producers, writers, directors, and actors. Most of these people are under exclusive contracts with other studios and Schaefer, therefore, decides to work with talents from other fields like theater and radio. Among these Hollywood outsiders are the young but already notorious Orson Welles and his Mercury Theater who sing a contract with RKO in July 1939.[101] The production of *Citizen Kane* starts one year later after other proposed projects have failed. When the movie is released on May 1, 1941, it causes a sensation for several reasons. The first one is the obvious parallel of the story to the life of media magnet William Randolph Hearst who tries everything to avoid the release and eventually aspires to destroy the movie for good. The second reason is the style of *Citizen Kane* that is attributed to Welles and his cinematographer Gregg Toland collectively. The status of Toland, who remarkably also shares the final credit card with Welles, is without doubt. This being the case, Toland then writes about his achievements in two articles in the *American Cinematographer* in February and *Popular Photography* in June 1941.[102]

100 See Powdermaker, *Hollywood, the Dream Factory*, 32.

101 See Richard B. Jewell, "Orson Welles and the Studio System: The RKO Context," in *Perspectives on Citizen Kane*, ed. Ronald Gottesman (New York: G.K. Hall, 1996), 122-24.

102 Toland, "Realism for 'Citizen Kane'"; Toland, "I Broke the Rules in 'Citizen Kane'"; Reprinted with modified title: Toland, "How I Broke the Rules in 'Citizen Kane.'"

Linwood Dunn publicly only claims credit for his work on the movie two years later. The *American Cinematographer* had started a series of portraits of ASC members under the title "Aces of the Camera" in 1941 and complemented it later with non-production cinematographers, the "Unseen Camera-Aces." Dunn's portrait in this sequel is the first account of his biography (and will remain the main source until today). On *Citizen Kane* he remarks self-assuredly: "The picture was about 50% optically duped, some reels consisting of 80% to 90% of optically-printed footage. Many normal-looking scenes were optical composites of units photographed separately, and which could have been handled completely by straightforward methods."[103] This is in a way delicate as it not only challenges Toland's position in the production but also his often quoted resentments against dupes. The degraded quality of duplicate negatives had been the principal argument of production cinematographers against optical printing. If Dunn now claims that most of the celebrated cinematography for *Citizen Kane* did not come straight from Toland's Mitchell camera but from his optical printer, this is amounts to a substantial provocation.

In order to do more than a few standard optical effects on the movie, Dunn has to convince both Welles and Toland. The latter is not a regular RKO employee and is loaned from Goldwyn because Welles had seen his earlier work and wants to work with him. Toland brings along his entire team and camera equipment.[104] The camera crew, therefore, is in a similar way self-contained as Welles's Mercury Theater cast.[105] Dunn has told several times that Welles "discovered the optical printer, with the help of [the movie's editor] Robert Wise."[106] This suggests that Welles considers optical effects only later in the editing phase (and long after the departure of Toland) and then, as Dunn suggests, enthusiastically embraces the possibilities. This account seems to be influenced by *Citizen Kane*'s preeminent historical position. In another interview Dunn says that he had already been in contact with Welles for the challenging and finally aborted point-of-view project *Heart of Darkness*.[107] This would allow Welles and possibly Toland to plan with optical printing from the beginning. In one of his interviews with Peter Bogdanovich, Welles later comments on the effects: "My God, I was months and months and months turning down versions of them, day after day, until they got good enough. Trick work *can* be good enough, but you must be brutal about it. Just refuse it, refuse it, refuse it till it gets better."[108] It is unclear how this process looked like. The production records of *Citizen Kane* document tests but they are all related to the photography of Welles's ambitious make-ups. Principal photography starts in July 1940 and will continue until December. An extensive overage reports that sums up most of the changes charged for optical effects is filed in early October.[109] Like with *Bringing Up Baby* the general impression is that the work of the camera effects department is subject to many changes during the production process but that it is well integrated and not, as Dunn has suggested, only called in the last moment.

103 Cited after Walter Blanchard, "Unseen Camera-Aces II: Linwood Dunn, ASC," *AC* 24, no. 7 (July 1943): 268.

104 Carringer, *The Making of Citizen Kane*, 69.

105 Dunn assumes that Toland simply does not know enough about the state of optical effects to appreciate them because he is mainly free-lancing. Toland is actually working most of the time at the Samuel Goldwyn Studio but it is not clear what is the situation there in regard to optical effects. Ray Binger who had worked for Frank Williams earlier is associated with the studio at the time and has also worked with Toland on *The Long Voyage Home*, the movie that made Welles want to work with Toland.

106 *Linwood Dunn: An American Film Institute Seminar on His Work*, 17.

107 Dunn, Interview with Graham J. Shirley, 4.

108 Welles and Bogdanovich, *This is Orson Welles*, 79.

109 See *Citizen Kane*, production records, box 112 P, RKO Radio Pictures Studio records, PASC.

Fig. 5.26: Transition with stage and optical fades.

But what is Dunn precisely doing for *Citizen Kane*? First of all the movie contains a great amount of matte paintings by Mario Larrinaga and Fitch Fulton that have to be matted in. Then Dunn has a couple of scenes that became part of his show reel: the tracking shot through the night club skylight, the tilt up to the nursing home roof, the pan down with the sculpture of Kane's legal guardian Thatcher, the camera flight up in the opera house, a speech of Kane as watched by his political opponent Gettys, and the screening room with the reporters previewing the news reel. It is unclear why he chooses the screening room scene that—aside from its expressionistic light partly due to pushed development—seems to be straight photography. The speech scene is a static matte combination of two shots that now suggest a large location and feature an extreme depth of field. This scene is similar to the various matte painting scenes from which Dunn did not even select one. Probably he did no longer consider them to be interesting at this point. All other excerpts are actually concealed transitions between scenes.

When Welles sets his targets for the cinematography of *Citizen Kane*, he is well aware that 'realism' does not only need increased depth of field (p. 4) but also a continuous flow of images.[110] Already for *Heart of Darkness* his main technical concern was to avoid (visible) editing. This was the reason why he got in contact with Dunn. The transitions in *Citizen Kane* are multifaceted. One aspect of this is described also by Toland:

> A further innovation in this picture will be seen in the transitions, many of which are lap-dissolves in which the background dissolves from one scene to another a short but measurable interval before the players in the foreground dissolve. This is done quite simply, by having the lighting on set and people rigged through separate dimmers. Then all that is necessary is to commence the dissolve by dimming the background lights, effectually fading out on it, and then dimming the lights on the people, to produce the fade on them. The fade-in is made the same way, fading in the lighting on the set first, and then the lighting on the players.[111]

[110] See Toland, "I Broke the Rules in 'Citizen Kane.'"
[111] Toland, "Realism for 'Citizen Kane,'" 80.

Fig. 5.27: Opera tracking shot in *Citizen Kane* (1941).

The effect Toland describes can the observed in the nursing home scene when we return from a flash back of Kane's first marriage (the breakfast scene with swish pans that overlay the shot-counter-shot-cuts) to Jedediah Leland (Joseph Cotten) in his wheel chair (fig. 5.26). The camera tracks backwards from Kane at the breakfast table to a long shot of the entire room. First the light in that room is dimmed down, then Leland on the nursing home roof appears, and only then the flashback background is dissolved to that of the roof. Welles here is transferring a theater practice to the movie stage. We have to assume that this is happening quite consciously, as Toland suggested, but an anecdote has it that Welles only turns to the stage light dimmers because he does not know that fades in motion picture productions are either done with optical printers or directly in the camera. Let it be true, it only would prove Toland right who said about his motivation for working with the outsider: "I want to work with someone who's never made a movie. … That's the only way to learn anything—from somebody who doesn't know anything."[112] This 'realistic' approach to darken the room and not the image gives Welles a different access to the space. He can now treat foreground and background as independent spheres. If we follow the notion that *Citizen Kane* is not so much a movie with real innovations but one that sums up and intelligently unifies sound picture production practices, then the modular spaces of optical effects are reflected here. The segmentation that comes with process cinematography is not abandoned in favor of realism but made explicit on the sound stage.

The majority of scenes that Dunn later collects for his demonstration reel are of such nature. These are transitional effects but such that are supposed to not only keep up pace like the complex lap-dissolves but to be entirely invisible as such. When the reporter arrives at the archival library of Kane's former guardian Thatcher, the scene starts with a low angle shot of the banker's sculpture. The camera tracks down to the pedestal with the name and then backwards to reveal supervisor and visitor. The sculpture is a miniature while on the set only an empty pedestal is erected. In a frame by frame stitching together the two camera movements become virtually one.[113] Later, when Susanne Alexander Kane (Dorothy Comingore) premieres at the opera house, he has built for, the camera disassociate itself from her by flying up to the hanging sets above the stage until it comes to rest on two disapproving workers on the cat-walk (fig. 5.27). What looks like a continuous movement in a high rise building is actually a combination of two stages and one miniature. Dunn connects them with two vertical wipe-offs that are adjusted to the speed of the uniform camera movements.

These 'glued sets' in *Citizen Kane* are followed by similar ones in subsequent RKO productions. The need to produce foreign sceneries is now also driven by World War II. While it becomes impossible to do productions in war zones, the war simultaneously becomes an

[112] Cited after Welles and Bogdanovich, *This is Orson Welles*, 59-60.

[113] Dunn later said that the idea for the sculpture only occurred after the scene was shot. The already mentioned overage report in contrast describes Dunn's work as an alternative for a planned hanging miniature. Therefore, the sculpture was always supposed to appear here but the method to combine the miniature with the action was shifted from the set to post-production.

Fig. 5.28: *Once Upon A Honeymoon* (1942), Set 42, Scene 191

(a) Production still

(b) Still from the final movie

Fig. 5.29: *Around The World* (1943)

Fig. 5.30: *Around The World* (1943), Scene 298

important topic of a increasing number of stories. *Once Upon A Honeymoon* (Leo McCarey, 1942) with Ginger Rogers and Cary Grant is downright a tour of Europe under fire. The movie contains a lot of rear projection and miniatures. Optical printing is budgeted with three people for four weeks. To reproduce sites all over Europe on the sound stages in Hollywood has become business as usual. The one scene that Dunn himself finds interesting enough to put it in his show reel is a walk of Kathie O'Hara (Rogers) on the promenade deck of a ship leaving Europe (fig. 5.28). We see Rogers walking out on the deck from left to right. Behind her a projected ocean and in front of here two funnels that cover her shortly when she passes by. At the end of scene and ship she finds Baron Franz von Luber (Walter Slezak), the Nazi she carelessly married earlier. The encounter comes as a shock as she thought herself finally save. This shattered illusion has also to do with the artificiality of the leisured tracking shot that precedes it. As a matter of fact, the tracking of the shot is the result of Dunn's optical printing work. Originally there are three static shots of Rogers entering the picture from the left and (except for the last one) leaving in on the right. The points of entrance and exit are covered up by the funnels. Dunn then makes the same push-offs he had developed a decade earlier as a trick transition. But as the footage is shot exactly for this purpose, they remain invisible as transitions. We are supposed to believe that it is Kathie who transits and the optical effect again is transformed into an invisible effect.

The same effects are used one year later in *Around the World* (Allan Dwan, 1943) a movie about the band leader Kay Kyser, playing himself on tour doing global troop entertainment for the US Armed Forces. *Around the World* is as light as the entertainment it presents and lacks ambition in its imagery. The humorous story is regularly interrupted for musical acts and the scenes are highly resemblant of each other: Kyser and his band play on stage in front of a crowd of soldiers. The respective backdrops easily identify the locations with pyramids for Egypt and alike. The production records tell that RKO sent out a second unit to photograph audiences on occasion of actual concerts. But while this foreground looks and feels real the painted backgrounds with miniatures fall back behind the state of the art. Photorealism, though technically accomplishable, is not aimed-at conceivably because reality is not what audience at home and in the field desire. The stitched together tracking shot from *Once Upon a Honeymoon* is repeated here when at the finale in Monrovia the stage is virtually tripled. The scene starts with a static frontal long shot of the right stage. This image is pushed rightwards and—with the hiatus covered by a the trunk of a palm tree—makes way for the center stage and after another trunk the left stage. And as if the movie would now that we saw such tricks before and wants to dispel our suspicion, the following shot shows the center stage with Kyser alone only to pull back and reveal the entire (virtual) set (fig. 5.30).

5.4 The Acme-Dunn Optical Printer

The Acme-Dunn Optical Printer is considered to mark a significant change in the history of optical effects. This is not alone due to its features but also because of the way the device emerges. Linwood Dunn himself described the difference to his earlier optical printer at RKO in an interview.

> We were always adding to our printer at RKO, and from the original lathe bed, Mitchell camera and very simple projector we eventually built a very sophisticated optical printer, in spite of the studio. Whenever I wanted to add something

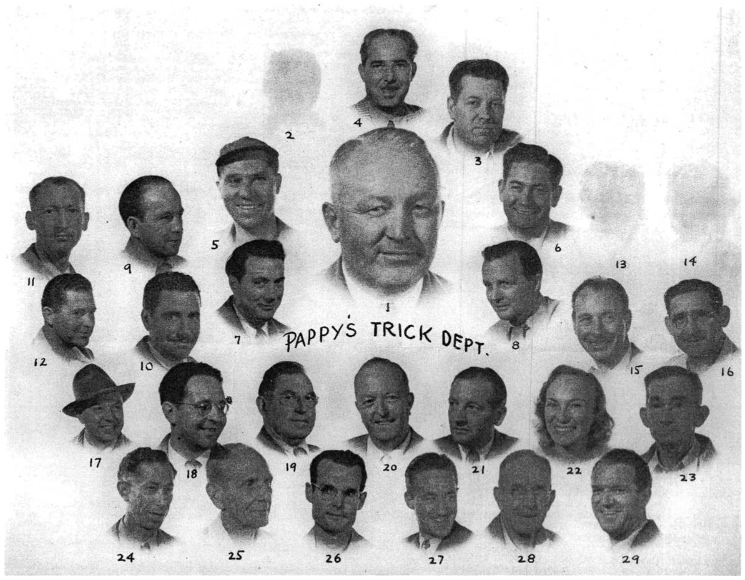


Fig. 5.31: RKO Trick Department in 1943: While usually only the heads of departments become visible (either through screen credits, awards, or trade journal publications), this is the rare case that an entire department with all members is represented—though only for the studio's internal newspaper.

> to the printer, I would have to wait until we had a particularly difficult trick shot. "Can you do this?," they would ask, and I would reply "Yes, but I'll need another knob on the printer to do it."—"How much will it cost?"—"Ooh," I'd pick a figure out of the air $350 maybe, write up an order, buy it and OK it, no problem. I'd take it to the shop and say "Now Joe, here's another $350. Let's continue building that new light device." Then, of course, Cecil Love and I—he's my right-hand man—would have lunchtime discussions about the ideal printer. I kept notes of all this and one day Eastman Kodak commissioned me to design a printer that could be ordered as a shelf item for the Photographic Unit in World War II. So that was the start of the Acme Printer.[114]

Meanwhile, we can divide the history of optical printers into three phases. The first stage is characterized by individual attempts of service providers to supply professional users with such devices. Dunn complains in the same interview that such devices were not developed by the same people who used them. from around 1930 this enforced the enhancement of machines in the studios by their operators with support from the studio's machine shops. During this period there seem to be no further initiatives to sell optical printers beyond the option of built-to-order. The funding by the studios is limited as their interest is in producing specific shots for their current productions but not the devices themselves. For this reason Dunn and other optical effects men have to translate their interests to improve their tools into what seems to be the studios' interest, the production of a specific image. To enter a third stage of development in the early 1940s, a different network is necessary that involves new actors. In the case of the Acme-Dunn Optical Printer these are technically speaking the United States Armed Forces that help to standardize machines and practices as Dunn himself declared later.[115]

[114] Dunn, Interview with Graham J. Shirley, 7.

[115] See Linwood G. Dunn, "Historic Facts about the Acme-Dunn Optical Printer," *AC* 62, no. 5 (May 1981): 479.

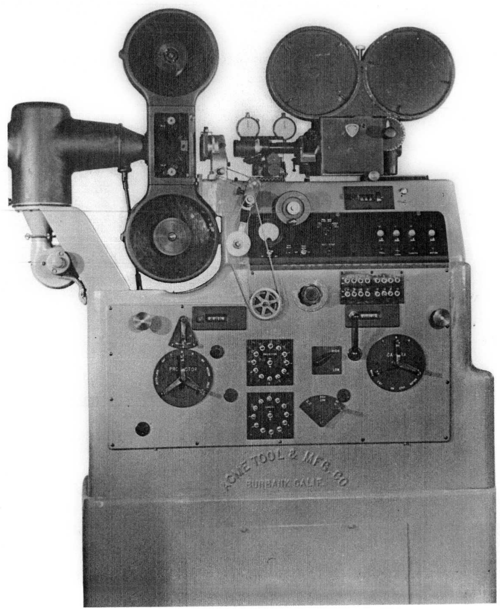


Fig. 5.32: The Acme-Dunn Optical Printer in 1943

5.4.1 A Military Industrial Network

According to Dunn's account, Eastman Kodak contacts him to design an optical printer. He then works with the Acme Tool & Manufacturing Company, a machine shop located in Burbank, to implement the device. Kodak in this case acts as a contractor for the US Navy in order to furnish a newly devised photographic laboratory at the Naval Air Station in Anacostia, DC, next to the US capitol. In order to understand how the Navy facilitates the production of a cinematic apparatus that is stable enough to persist for decades, we will have to retrace the way that carries the people from Eastman Kodak to Dunn.

The interest of the Navy in photography—and I will not always distinguish sharply between still and motion photography as one leads to the other here—increased with the possibility of aerial reconnaissance during World War I. But until the late 1930s the establishment and preservation of any photographic initiative was highly dependent on individuals and lacks institutionalization.[116] One of these photography apologists, Chief Petty Officer George Carroll, describes the situation in his personal recollections "Eyes of the Navy."[117] The usage of photography is, heretofore, triggered by such different requirements as intelligence, documentation, or simply the production of photo badges for identification purposes. Carroll in 1940 is Chief Photographer in the Navy Department Building in Washington, DC, and requested to furnish several photo setups like studios or laboratories. He suggests that the Navy needs a comprehensive strategy and central institution for its needs concerning still and motion photography and starts to develop ideas for a respective facility. In the next year, he is joined in his efforts by Donald Fraser, the newly appointed Head of Photographic Section at the Navy's Bureau of Aeronautics. The aviation branch of the Navy shortly after

116 See Ernest Rowlett Bryan, "An Administrative History of the US Naval Photographic Center, 1941-1951: With Recommendations for Reorganization" (PhD diss., American University, School of Social Science and Public Affairs, 1953), 20-34.

117 George Carroll, "Eyes of the Navy: A History of Naval Photography" (typescript, n.d.), Quackenbush Collection, Photograph Section, NHC.

is considered to be the right place to discuss such a venture as most previous photographic projects were located there. (This affiliation seems to echo the movie industry's bias to aviation dramas as described earlier.)

Fraser and Carroll start to sketch organizations and buildings but as the project grows it becomes obvious that a more systematic and also bureaucratic approach is needed to acquire institutional and financial support. On July 12, 1941, the Secretary of the Navy convenes a board to define the Navy's photographic needs. The members of the board review three submitted plans for possible photographic infrastructures. One is a training plan by Louis de Rochemont, the creator of *The March of Time* newsreel; another one is submitted jointly by several newsreel companies, of which some are associated with the major Hollywood studios; and most notably is a plan by a group around Hollywood director and Navy Reserve Lieutenant Commander John Ford and *King Kong* producer and Air Corps Reserve Captain Merian C. Cooper. The Ford-Cooper plan is the only one reviewed in detail and also followed in its main points. They argue that the Navy has to catch up with the high degree of integration of photographic techniques into the military field that has been reached in Nazi Germany meanwhile. They convey the impression that German officers screen daily rushes of the front-lines as instantaneous as directors and producers review the progress of a motion picture in the screening rooms of Hollywood. As a consequence the group names the three fields that will guide all actions towards still and motion photography in the Navy: reconnaissance, public relations, and internal training.[118] While the intelligence field is the one with the longest tradition and external communication—or "morale," as Ford et al call it—becomes a general liability, the emphasis, the group puts on training films, seems at least unusual at first glance. But the approaching war will prove them right as the education of a vast number of raw recruits will thoroughly inform the role of photography within the Navy.[119]

The board's report is endorsed by the Secretary of the Navy on August 29, 1941, which gives the Bureau of Aeronautics the sole authority to establish several smaller and one central photographic facility, which compromises all kinds of equipment and personnel to fulfill the Navy's needs. Until the new central laboratory is finished, training films are to be produced by a network of commercial contractors like the Jam Handy Organization in Detroit.[120] Carroll and Fraser at this point have the authority and basic concept they need to build their project. But it becomes apparent that the approved budget of $110,000 for a laboratory at Anacostia will hardly be sufficient. Carroll writes that the name of the facility is changed from "Central Photographic Laboratory" to "Photographic Science Laboratory" (PSL) to obtain Congressional approval for additional funds.[121] At the end it will cost $5,000,000. When they inquire the Bureau of Docks and Yards in October, which is in charge of constructions within the Navy, they are staved off because all architects are engaged in military, and that is, more urgent projects. They contact Eastman Kodak, apparently to get support in furnishing the laboratory, but the company also offers to undertake

118 See John Ford et al., *Comment and Summary on Proposed Naval Photographic Organization*, typescript, Edward John Long Papers (EJLP), 1941, box 2, Edward John Long Papers, OANHC.

119 The following year and without any traceable effect David O. Selznick places his own proposal on how to strengthen photography in the Navy. See David O. Selznick, *Tentative Plan for Establishment of Bureau of Photography, Navy Department*, memo, Edward John Long Papers (EJLP), September 17, 1942, box 3, Edward John Long Papers, OANHC

120 See *Record of Proceeding of a Naval Photographic Board Convened at The Navy Department, Washington, DC, for the Purpose of Considering and Reporting on Photograhic Needs of the Navy*, typescript, Edward John Long Papers (EJLP), July 23, 1941, box 2, Edward John Long Papers, OANHC.

121 George Carroll, *Condensed History of the US Naval Photographic Science Laboratory*, typescript, August 16, 1983, Quackenbush Collection, Photograph Section, NHC, 2.

Fig. 5.33: Photographic Science Laboratory (PSL) at the US Naval Air Station at Anacostia, DC, after its completion in 1943.

the planing of the entire building. Eastman Kodak at this point has only done so for own facilities but now becomes the prime contractor for the formation of the PSL. At a meeting in Washington in early November, the company, furthermore, offers to accomplish all architectural work for a symbolic price of $1 for patriotic reasons.[122]

What helps even more to get governmental support than the allusion of being 'scientific,' is the attack on Pearl Harbor on December 7 and the subsequent entry of the United States into World War II. The previously evoked military-photographic inferiority turns into a real threat which expedites the progress of the PSL. About a week after the attack, Carroll and Fraser are in Rochester and Eastman Kodak's employees draft different plans for the laboratory. By December 24, 1941, the basic planing is finished and a contract is signed.[123] This contract together with the earlier approval of the PSL through the Secretary of the Navy and the Congressional budgetary support consolidates aims and entities of different types and parties. It encompasses the smaller preceding photographic projects within the Navy, the individual apologists of photography, the high-level officers that were told by Carroll how important photography was for the Navy when he was only supposed to take their picture, the Hollywood professionals who pair the will to crusade their profession with a fear of being overtaken by the enemy on alien terrain, Eastman Kodak who gets a government order and can show patriotism by offering architecture for free—just to name a few. All this enters the joint plan for a building that contains not only all conceivable applications of still photography but also an entire motion picture studio with sound stage, laboratories, screening rooms, a symphony orchestra, etc. organized in fifteen divisions with various subsections.[124]

Around the same time Lieutenant Commander Thorne Donnelly is appointed Officer in Charge of the PSL with Carroll as assistant. Donnelly has a background in the printing industry of Chicago and is well connected with business partners throughout the nation.

[122] A. Donald Fraser, *Recollections of the Founding of the Photo Science Laboratory at NAS Anacostia by Rear Admiral A. D. Fraser, USN (Ret.)*, typescript, Quackenbush Collection, Photograph Section, NHC, 2.

[123] Carroll, "Eyes of the Navy," chap. X.

[124] For an overview over parallel projects see Mame Warren, "Focal Point of the Fleet: US Navy Photographic Activities in World War II," *The Journal of Military History* 69, no. 4 (October 2005): 1045–79, JSTOR: 3397179.

Together with Carroll, Fraser, who cherishes Donnelly as a “first class go-getter,”[125] and the people of Eastman Kodak they try to collect all the equipment and personnel on their list. The shortage of materials due to war requirements and the high demands of the projected facility make this no easy job. In a lot of cases there is no straight way to get to the target because equipment cannot be delivered or—as in the case of sound recording—a governmental policy that prohibits leasing contradicts established business models. This acquirement phase runs parallel with the construction of the building that starts in February 1942.

Besides of more common equipment the list of requirements encloses several devices for optical effects and animation. These are not always clearly identifiable in the correspondence but are presumably contact printers for reproduction, optical printers for visual effects, and animation stands. Except for the contact printers none of these are shelf items but they have to be built to order. In general Eastman Kodak tries to order items first and returns the responsibility to the PSL whenever something is difficult to get. In the case of the optical printers this brings in the National Archives by means of local networks in Washington, DC. A contact is established in May and an agreement on the delivery of an optical printer for transitional effects for $8,000 is obtained in September 1942.[126] The person at the National Archives who is capable of providing such a device is Carl Louis Gregory who offered one of the first printers in the late 1920s and started to work for the National Archives in 1936. He is in charge there of doing archival prints and of creating the tools that are necessary to do so. Considering the later development of the Acme-Dunn Optical Printer one can raise the question whether the printer by Gregory was ever delivered. In fact its service is not documented and it is not shown in an extensive series of photographs that are made after the opening of the PSL to propagate its work. But in a private letter Gregory later complains that “I am building optical printers for the Navy, but as I am doing it in the shop of the National Archives it is classed as part of my regular work. I do not get paid anything extra for it. I have made two others, one for the Archives and one for the National Advisory Committee for Aeronautics.”[127] Though integrated in a public institution Gregory here still acts like a contractor who offers such specialized equipment on commission. This results in the conflict he describes.

Most technical and personnel resources for the PSL are found in the film industry of Los Angeles. Carroll had split his time for the first half of 1942 between Washington and Rochester. But from the fall he orientates more and more towards the West Coast. He works with Lieutenant Gordon Chambers, USNR, who was a representative of Eastman Kodak in Los Angeles before he joined to the Navy again. He is the person who not only links two but all three relevant groups here: the Navy, Eastman Kodak, and Hollywood.[128] Together with further in situ partners they recruit within six weeks some two hundred employees that are then trained by Kodak in Rochester before they take their positions in the Navy.

125 Fraser, *Recollections*, 3.

126 Collas G. Harris to Thorne Donnelly, letter, September 9, 1942, The National Archives and Records Administration, Register of Contracts, compiled 1926-1942, ARC Identifier 2749462, Records of the Bureau of Aeronautics, 1911-1965, NARA DC.

127 The National Advisory Committee for Aeronautics (NACA) is a federal agency for aeronautical research that will later be dissolved in the foundation of the National Aeronautics and Space Administration (NASA). Carl Louis Gregory to Eric Berndt, letter, July 16, 1943, Jonathan Silent Film Collection, FMPL

128 Chambers is also a member of the SMPE and its progress committee and held presentations on process photography and Eastman products like film stock at the conventions. See Chambers, “Process Photography”; Huse and Chambers, “New Eastman Emulsions”

When the Navy tries to order Model D contact printers from Bell & Howell in Chicago, the manufacturer has to dismiss the order due to a lack of material to build the devices. Through Chambers and his contacts in the movie industry Carroll learns that Universal Studios has six such printers in stock that are not in use at the moment. Carroll and Chambers travel to Los Angeles in late December 1942 to obtain these devices. While the studio is more than willing to support the Navy in this issue, the printers themselves turn out to be in too bad condition to be used directly. Universal refers Carroll and Chambers to the Acme Tool & Manufacturing Company in the Burbank vicinity. This is but one way that connects the Navy with Acme but the path that will lead to the optical effects printer produced by Acme is apparently different as Carroll describes.

> While Lt. Chambers and I were in the Hollywood area, we had an occasion to visit the RKO Motion Picture Studio, where we had a demonstration of a special transitional 35 mm–16 mm reproduction machine which was a combination of a 35 mm–16 mm camera and duplication printer.
>
> This machine was the only one in the motion picture industry. RKO studio management, offered to give the Navy their engineering drawings of the machine if the Navy had use for such a machine and wanted to build one.
>
> The machine at RKO studio was operated by Mr. Cecil Love who was an expert in the use of this machine. I talked with Mr. Love and was very much impressed with his knowledge as to what and how the machine could be used.
>
> Mr. Love stated that if the Navy built one these machines, he would be willing to enlist in the Navy for the duration of the war as a photographic specialist "P" operator of the machine in the Anacostia laboratory.
>
> Shortly upon my return to my office in the Navy Department, Washington DC, we accepted RKO's offer for the engineering drawings, authorizing the Acme Tool & Die [*sic*] Company in Burbank to construct one machine for the Naval Photographic Science Laboratory and furnishing them with the necessary WPB [War Production Board] priority allocation.
>
> We authorized the Los Angeles Navy Recruitment Station to enlist Mr. Cecil Love in the US Naval Reserve with the rating of a Chief Petty Officer, photographic specialist for duty in the US Naval Photographic Science Laboratory, Anacostia, DC.[129]

A reproduction printer to transfer original 35 mm film to 16 mm for distribution as apparently seen by Carroll at RKO was a quite reasonable piece of equipment for the PSL. And though the Acme-Dunn Optical Printer is capable of doing such transfers it is not the most relevant feature of that machine. Nor is the printer for the Navy a direct replicate from an existing printer at RKO based on existing drawings. Linwood Dunn, who is not mentioned in Carroll's account, had suggested that he was commissioned to design a new printer for optical effects. That a commission of that kind cannot be verified might be read as a private mandate of Dunn and Love to realize the "ideal printer,"[130] Dunn had mentioned. And Love's willingness to join the Navy under the condition that they will build the optical printer supports this reading. This means that at that time there are likely no engineering

[129] Carroll, "Eyes of the Navy," chap. X.
[130] Dunn, Interview with Graham J. Shirley, 7.

Fig. 5.34: Acme Tool & Manufacturing Company at its original location on San Fernando Road in Glendale offering "experimental work" and the development of patents.

drawings as Carroll suggests. Though this is the case with another piece of equipment: Already in August the Navy advised Eastman Kodak to order an animation stand from Acme based on drawings supplied by the Walt Disney Studios also located in Burbank. A second animation stand is ordered in October.[131] This shows that Acme is already part of the PSL network before and independent of the still looming optical printer.

But neither the exact historical sequel nor the Navy's perspective on the different involved optical printers can be reconstructed precisely from the available documents. (The Navy never relates the different devices to each other. They only occur as individual entities.) It is only possible to point to these voids and contradictions. Gregory at the National Archives in Washington might be skilled enough to fulfill the Navy's needs but possibly lacks the required infrastructure to provide a device that goes beyond a camera and a projector on a lathe bed. The printer he presented in 1928 was built not by him but by Fred Barber. A reduction printer, as described by Carroll, is not what the Navy gets from Dunn, Love, and Acme as their printer has many more features as I will show later. This is relevant as it not only increases the effort to build the machine but also raises the price the Navy has to pay for it. Dunn estimates the price of the first Acme-Dunn Optical Printer at $51,000 (compared to $8,000 for a printer from Gregory) though there is no evidence that the Navy actually paid this amount.[132] The timing and, thereby, the sequence of events is likewise uncertain. Carroll writes that he travels to Los Angeles late December 1942 to secure the Bell & Howell printers from Universal and then meets and hires Love. But according to RKO pay rolls Love already joins the Navy on November 28 (and returns only in October 1945).[133] There is not a single chain of reactions but rather a multifaceted network that becomes denser and more stable.

131 Thorne Donnelley, Contract NOy-5372, Photographic Equipment Procurement, Change of Source for Item 83, August 27, 1942, memo, The National Archives and Records Administration, Department of the Navy. Bureau of Aeronautics. Administrative Services Division. (1921 - 09/18/1947), NARA DC; Thorne Donnelley, Additional Animation Stand and Camera, Item #247, Contract NOy-5372, Authorization for, October 12, 1942, memo, The National Archives and Records Administration, Department of the Navy. Bureau of Aeronautics. Administrative Services Division. (1921 - 09/18/1947), NARA DC.

132 See Dunn, *Interview with International Cinematographers Guild.*

133 *RKO Pay Rolls.*

The Acme Tool & Manufacturing Company shows up in this network on several occasions. The company was founded in 1921 by Swiss immigrant Adolph Furer and originally located in the suburb of Glendale as a general machine shop. According to the company's official history they got involved in the movie industry when one day the still unknown Walt Disney stops by on his way to the studio and asks whether Furer could make some improvements on the studio's equipment. This was necessary as Bell & Howell, the original manufacturer, had been reluctant to answer the needs of Disney's animators.[134] This narrative resembles others where manufacturers are not interested in fulfilling specialized wishes of professional customers when at the same time they discover a growing amateur market. Disney becomes a regular client and Acme moves into the vicinity of the studio in Burbank. By 1940 the suburb behind the hills, north of Hollywood has turned into a boomtown fueled by the industries of motion pictures and military. The population nearly tripled during the 1930s. Adolph Furer had passed the company to his son Edward. The shop and its new boss see coverage in an article of the *Los Angeles Times* that reports about the boom in the San Fernando Valley. "Burbank even has its own 'Furer'—but he is an intensely loyal American one, Edward Furer, who is making photographic precision material for the government at his Acme Tool & Machine Co."[135] How closely related Furer is to the defense industry becomes apparent when he is accused of bribery the following year. The FBI investigates because Furer is suspected to have paid an employee of the Lockheed Corporation (also located in Burbank) by way of an independent salesman in order to get acceptance for overpriced tenders. Charges against all three men go to court. But in December 1942, when Acme becomes more deeply involved with the Navy, all charges are dropped without further explanation.[136]

The person who is actually designing the technical details and building the optical printer for the Navy is Acme's chief engineer Robert P. Shea who formerly worked for Disney. It is unclear when the printer is delivered though it should be in the second half of 1943. But with the delivery the development is not yet finished as letters from Love, who uses and tests the first device at the PSL, to Dunn in Hollywood show. The last of these letters is from March 1945 and most issues that Love mentions have to do with the take up and transport of the film.[137] Such change requests have to be executed by Shea at Acme but he uses Dunn to communicate them. The printer at the PSL is not the only one delivered by Acme during the war. Traceable is one device at the Army Signal Corps in the former Kaufman Astoria Studios, Long Island, and another one in Culver City at the former Hal Roach Studio that in 1942 turns into the so called First Motion Picture Unit (FMPU), a division of the Air Force Base Unit of the US Army Air Corps.[138] All three sites, PSL, the Army Signal Corps in Long Island, and FMPU, use the printers for the production of training films. The two Army sites give feedback to either Dunn or Love, who occasionally travels from Anacostia to New York. The person who is operating the printer at FMPU is Roy Seawright,

134 John Kiel, interview with Birk Weiberg, September 1, 2010; After World War II Acme started doing business under the name Photo-Sonics. See Photo-Sonics, Inc., "Company History: A Brief Synopsis," http://www.photosonics.com/company_history.htm.

135 Ed Ainsworth, "Southland Defense: Burbank Has Become a Hive of Aerial Industry," *LAT*, February 17, 1941,

136 See United States. District Courts and United States. Court of Claims and West Publishing Company and United States. Court of Customs and Patent Appeals, "United States v. Furer et al., No. 15609," *Federal Supplement*, National reporter system, no. 47 (October 10, 1942); "War Job Fee Fraud Charged: Trio Accused of Plot to Profit by Award of Tool Contracts," *LAT*, December 17, 1942, "US Dismisses War Fraud Conspiracy Case: Tool Contract Deal Charged," *LAT*, December 18, 1942,

137 *Love, Cecil – Correspondence 1944-1947*, 68.f-972, Linwood G. Dunn papers, MHL.

138 Linwood G. Dunn to the Academy of Motion Picture Arts and Sciences, Research Council, letter, January 6, 1945, file G4.095-1, box 541, Scientific or Technical [Awards], 1945, MHL.

Fig. 5.35: The first Acme-Dunn Optical Printer operated in room 265 of the PSL

who did optical effects before for Hal Roach. So similar to Love he is doing the same job—and in his case even at the same place—for a different client.[139] The exact number and whereabouts of the following printers are not always clear. One printer is delivered via the Coordinator of Inter-American Affairs to the CLASA Studios in Mexico City, where nobody knows how to use it. John Kiel of Acme/Photo-Sonics reports that another device was built to be used in England but never made it further than to a warehouse of the carrier in Glendale. Independent from Acme the Fried Camera Company is also commissioned to built an optical printer for the Army as an individual item without the ambition to start series production.[140]

The PSL building is finished in March but with complete equipment and personnel only opens in December 1943. On a floor area of 154 × 308 feet and three stories more than five hundred people are working in three shifts twenty-four hours a day, sometimes seven days a week. This fully air-conditioned edifice encompasses all needed infrastructure for graphic and photographic work as much as an entire motion picture studio with script writers, a sound stage with rear projection, animators, an orchestra and stage for music recording, screening rooms, the possibility to print and distribute the produced films, as much as a cafeteria.[141] The production of training and to a smaller degree propaganda films takes up most of the resources. Still photography is used to provide the press with images of the ongoing war and for reconnaissance or photo interpretation that takes places in an especially secured part of the third floor. The Acme-Dunn Optical Printer is located on the second floor in room 265 (fig. 5.35).[142]

139 Seawright in 1945 meets Love in Washington and expresses his satisfaction with the printer though he made little changes to it. Ironically Love reports to Dunn that Seawright expects them to win an Academy Award on the very date they actually get it. Cecil D. Love to Linwood Dunn, letter, March 15, 1945, 68.f-972, Linwood G. Dunn papers, MHL

140 See “California Defense Aid by R.F.C. Told,” *LAT*, February 2, 1941,

141 See Joseph A. Bors, “Navy Photo Science Laboratory,” *Popular Photography*, May 1944, 34–35, 87–89, Google Books: vWIzAQAAMAAJ; Helen R. Clifford, “United States Naval Photographic Science Laboratory,” *JSMPE* 43, no. 6 (December 1944): 405–13.

142 *Central Photographic Laboratory Equipment List*, typescript, The National Archives and Records Administration, April 6, 1942, General Correspondence, compiled 1925 - 1942, ARC Identifier 300288, Records of the Bureau of Aeronautics, 1911 - 1965.

With all this said, the question is if and how the Navy influenced the design of this optical printer. I had to describe this network in such an extensive manner and narrow the Acme printer down as there are no documents from the military field that discuss the device itself and its features. We can assume that it is mainly needed and used for the production of training films—i.e., that is has no function in more strictly military tasks as photo intelligence. Training films have to convey a lot of information in little time and tend to use info graphics combined with straight photography for that purpose. Hence the Navy (just as other military branches) employs a lot of animators.[143] In this regard the optical printer becomes an essential element of Navy film production but on the other hand the Navy apparently has no special requirements that depart from non-military but simply process orientated production practices. This is the reason why the Acme-Dunn Optical Printer after the war is used without known modifications in the commercial film industry. Dunn and Love, therefore, are not in a conflict of interests here. They can pursue their previous goals within this new framework. When Love joins the Navy, he is doing the same job as in Hollywood—complemented with the feeling of fulfilling patriotic duties.

If the Navy does not produce the Acme printer but facilitates it, we have to contrast it with Hollywood as a development environment. The film industry, as we have seen, either receives impulses of innovation from outside or gradually deploys innovation internally. With the notable exception of Warner's United Research Corporation research is conducted in close alignment with regular production tasks. This results in patterns, as described by Dunn, who improves on the RKO optical printer in small steps by claiming that these are necessary investments in an actual production. The machine, therefore, is as much informed by practical needs as it is composed rather than constructed. It lacks standardization as there is no organized exchange with others optical printer operators that could lead to a consolidated design. The fact that this, unlike with rear projection (p. 208), is not the case with optical printing indicates that the technique is too marginal within the production structures because it does not involve as many (human and non-human) participants as rear projection, a technique that is applied on the set. The motion picture studio that is deployed by the Navy, on the other hand, evolves through exactly the opposed logic. Due to the war the Navy has both, limited time and virtually unlimited money. Warren notes that "from 1938 to 1944 the US Navy's budget for photography grew from $138,000 to $50,000,000, and photographic personnel increased from 225 to 5,000."[144] But there is apparently no knowledge of motion pictures and the Navy can hardly build on its own history of photography here. With external partners the people at the Navy sketch an ideal studio in the same manner as Dunn and Love design their ideal optical printer at the RKO cafeteria. In this approach of an ideal studio, they assume that all elements needed for it are commercially available and if—as in the case with the optical printer—this is not the case the network assures that it will be. The construction of the PSL, therefore, can be seen as an authoritarian operation that stabilizes knowledge that emerges elsewhere. Such an action becomes an alternative strategy to standardization through a process of negotiations by industry associations.

143 The military in fact functions here as an instructor which will result in a boom of animated movies after the war.
144 Warren, "Focal Point of the Fleet," 1049.

5.4.2 Going Public

While access to the device is still limited to governmental bodies, Dunn does not wait to present the printer in public. This is happening in three steps. On October 18, 1943, he makes a presentation at SMPE's technical conference at the Hollywood Roosevelt Hotel. And he starts to establish the narrative that will define the further reception of the Acme-Dunn Optical Printer. "The optical printer has never to my knowledge been manufactured as a commercial product capable of efficiently handling all of the requirements of the modern motion picture studio and film laboratory."[145] Dunn ignores here the attempts by Gregory/Barber and others in the 1920s that, though not commercially successful, aimed for the same goal. He contrasts his product against the self-built studio devices that he will later call 'Rube Goldberg machines;' i.e., wildly tinkered constructions that inefficiently aim for chain reactions as drawn by the cartoonist of the same name.[146] This way he simplifies the previous situation in order to emphasize the reasonable progress that comes with the new device. If we deny Dunn and his partners for a moment the originality of being the 'first' who upgrade the optical printer to a commercial device and assume that Gregory and others in the 1920s basically attempt the same, then we can recognize that a crucial difference and one reason for the success of the Acme-Dunn Optical Printer is that Dunn makes this step explicit by *saying* that he is doing it.

The projector and camera are no longer described in detail as these are established devices. Only the elegance of their combination is new. Dunn designates the camera as a "Bell & Howell type,"[147] which practically means it is a replica.[148] Among the presented features of the optical printer are automatic slide-, and wipe-offs as well as virtual dolly and zoom shots—i.e., a dynamic re-framing of images with automatic readjustments of focus and aperture that follow camera movements. Another innovation are programmable speed shifts between projector and camera by the option to skip or repeat frames in either of the units. Thereby, a film cannot only be transfered to different speeds but also keep its original pace in case of a conversion between formats with different frame rates. All kinds of manipulations of projector and camera position come with precise indicators that allow better control and the reproduction of effects by documenting them on paper. These features appear mostly as such of comfort and quality of operation. This is in one line with Dunn's self-awareness of being a designer and not an inventor. "Governmental demands for optical printers have afforded me the opportunity to design what I have often visualized as a 'dream printer.'"[149] Being a good designer should not be undervalued as it is a precondition for the process of blackboxing. It goes along with the separation of the inventor into the roles of designer and engineer and the machine having an interface that is distinct from its inner construction. So the basic capabilities of optical printers do not change with the Acme machine but ease of applicability makes shots possible that were too laborious before. The universality that Dunn claims has also to do with the closure of the machine's body, the enclosed and branded casing (fig. 5.32), and the abstraction that comes with it. This high degree of blackboxing and abstraction provides for the all-purpose appli-

145 Linwood G. Dunn, "The New Acme-Dunn Optical Printer," *JSMPE* 42, no. 4 (April 1944): 204.
146 Dunn, "Historic Facts about the Acme-Dunn Optical Printer."
147 Dunn, "The New Acme-Dunn Optical Printer," 208.
148 According to John Kiel Acme had already "copied and improved" the classic Bell & Howell 2709 for Disney. Kiel, interview
149 Dunn, "The New Acme-Dunn Optical Printer," 205.

cability. A shorter version of Dunn's presentation appears also in the *American Cinematographer*.[150] And in fact this is the first presentation of an optical printer as a commodity since the Gregory-Barber printer in 1928.

Dunn's second step is a letter he writes in January 1945 to the AMPAS Research Council in which he puts his printer forward for a technical Academy Award. He describes the device as "the first commercially-built all-purpose optical printer, based on advanced major studio standards"[151] and names sites of installation for possible inspection as much as personal references at the Navy and Eastman Kodak. The network, which was necessary to built the device, is extended to those who already use it and, hence, serves as reassurance for its success. The commercial availability and its possible consequences are Dunn's main argument.

> The Acme-Dunn machine has greater capabilities than any machine I know of, embodying many radically new features, all incorporated into a compact, streamlined unit. It is now possible, (priority conditions permitting) for the smaller producing companies to secure a modern machine at a price attractive enough to make it worthwhile for them to install their own optical departments.[152]

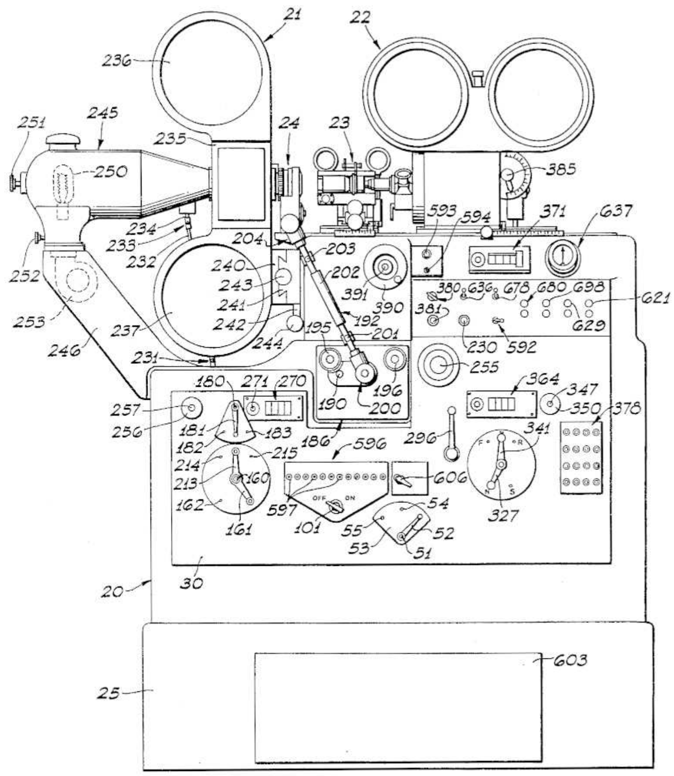
Dunn's application is successful and on March 15, 1945, the Academy awards him together with Cecil Love and Acme a Class III Award for Scientific or Technical Achievement. The Research Council in its argumentation follows Dunn closely.

> The Acme-Dunn Optical Printer is the first such semi-automatic, electrically controlled equipment designed and engineered for trick optical printing, incorporating features previously used with many simple and fast operating devices of new and radical design into a compact, streamlined unit. This machine exemplifies technical advancement necessary to keep pace with the ever increasing scope of the motion picture art.[153]

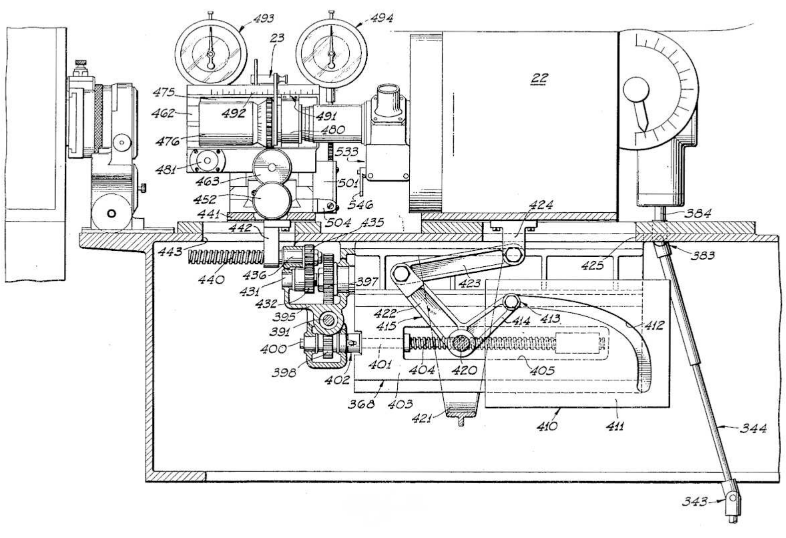
The wording of a "compact, streamlined unit" is taken over without changes and as it is completely independent from the new technical abilities of the machine is highly symbolic. The Academy honors the Acme-Dunn Optical Printer only as one out of ten Class III Awards in that year which means that it is honorably mentioned in the annual progress report. This implies that it is considered as a relevant innovation—but only for its own field of optical effects. This assessment will be proven wrong taking into account the later developments. For that reason in 1981 the Academy acknowledges an impact of the machine on the entire industry and upgrades the award to a regular Academy Award that comes with the iconic golden statue and a participation in the official ceremony.[154]

The Academy Award in 1945 is followed by the filing of a patent one year later that marks the third step of presentation. Authorship is basically the same as for the Academy Award only that Acme is now split into engineer Robert Shea, and manufacturing superintendent Oscar H. Jarosch. The patent text again emphasizes that the printer mainly optimizes existing techniques.

150 Linwood G. Dunn, "The New Acme-Dunn Optical Printer," *AC* 25, no. 1 (January 1944): 11, 29.
151 Linwood G. Dunn to the Academy of Motion Picture Arts and Sciences, Research Council.
152 Ibid.
153 *The Academy Awards for Scientific or Technical Achievement 1944* (Los Angeles), March 15, 1945, 3.
154 "Developers of Optical Printer Win Oscar for Special Effects," *NYT*, April 3, 1981,



(a)



(b)

Fig. 5.36: *Optical Printer with Automatic Electrical Control of Operating Mechanism*, US Patent 2,517,250, filed April 17, 1946

> Prior optical printers have been developed which are capable of producing all of the desired effects, but these machines, in general, have been manually operated at relatively slow speed and have lacked the speed, flexibility, and ease of operation necessary for handling the large volume of work and the many complex problems that are met in the modern motion picture studio and film laboratory.[155]

The text then guides through the machine starting with the power transmission and the options to manipulate it from the engine to projector and camera. It is possible to couple and decouple the two subunits automatically through a circuitry that is controlled by the dials and switches on the front of the printer. The machine is no longer simply transporting film, it is counting frames, and can be programmed to do so in different ways.[156] The only point where this distinction between inside and outside, between mechanics and abstract control becomes permeable is around the power take-off shaft that allows to connect optional accessory units (fig. 5.36a, part 192). Here something of the old tinkering appears again that gives a freedom of application that the closure of the machine tends to prohibit. Around the optics most of the precision indicators are located (fig. 5.36b, e.g. parts 493 and 494). These provide another form of abstraction because the images now are not only controlled through the view finder visually but manipulations can be put into writing. This means they not only can be reproduced or varied in case that tests should be improved. It also means that effects can be scripted or synthesized.[157] The automatic adjustment of focus and aperture to the distance of projector and camera, which Dunn advertised, is made possible by a hidden metal plate underneath the camera (fig. 5.36b, part 411). It contains a curved slot that synchronizes the movements of camera and optics. Being specific for one focal length, the very form of the curve represents a formula. This is just another way the machine is scripted. In order to use a different focal length the plate can be replaced just like loading another piece of software that controls this feature of the printer. So the Acme-Dunn Optical Printer by an analysis of its patent can be described as proto-digital. Improved versions of it will last until the early 1990s when the resolution of digital images is high enough to replace their analog predecessors.

155 Robert P. Shea et al., Optical Printer with Automatic Electrical Control of Operating Mechanism (Patent 2,517,250 [US], filed April 17, 1946, and issued August 1, 1950), Google Patents: US2517250.

156 A closer comparison with the early computers of Charles Babbage, Konrad Zuse, and Alan Turing would reveal a lot of similarities but is beyond the scope of this project.

157 Dunn's estate at the MHL contains a peace of graph paper on which he sketched the lurch of a submarine due to an explosion. The twisted loop he drew was then read off as horizontal and vertical shifts of the image.

6 Epilogue

WHOEVER MAY BE INTERESTED JULY 30, 1949

LIN DUNN NEW IDEA

I would like to submit to the studio an idea which I have given some serious thought, and which I feel can result in material financial benefit to our Company.

With the technical, administrative and economic experience that I have had working on trick-photography pictures, dating back well beyond King Kong, and particularly including over a year of work on Joe Young, I feel more than ever convinced that a fantastic trick picture, which would do well at the box office, could be made on a comparatively moderate budget. Checking back through the years, you will probably find that this type of film has generally done well, and now Joe Young seems to be getting off to a good start. However, I do feel that the high cost of this latter production makes its investment somewhat hazardous.

I believe that a good trick picture can be made on a surprisingly low budget, by the use of good organization, some very careful planning, and certain new ideas. I offer a few facts and thoughts to help support my statement:

1. We have available nearly all of the necessary facilities, now either idle, or in limited use.
2. Excellent technicians are now available, which are needed to augment the small crew we now have in our Department doing our regular routine work. Only a nucleus of few men would make up the basic staff, and then only increased as needed. Our work on this picture could be carried on right along with the Studio's regular special effects requirements, that is provided for changes when routine Studio work demanded it. This would definitely increase efficiency and lower the cost of each individual trick shot, as only actual time put in would be charged in either case.
3. The principals of the cast should be very carefully selected talented new people, whose salaries would be low enough so that they might be retained as stock players, and be available to fit in with the shooting schedule as they were required.
4. The script would be written to make the best of our existing Trick Department facilities. Each individual trick shot would be very carefully planned beforehand, and in this way there should be little or no lost motion or unnecessary expenditures. In addition, I have a story idea that would simplify and cheapen the animation work we would require. I also feel that the story should be written so that it would lend itself to a series of such fantasy picture, in that event that the idea should go over exceptionally well.

> 5. Responsibility for successful completion of this production should rest in the hands of a very small and smooth-functioning team.
>
> I would appreciate the opportunity to discuss this matter further, with the thought in mind of my obtaining the Studio's approval to devote more time and further study along the lines I have outlined. I would like to do preliminary work on the development of a story idea, and also give further study as to the appropriate cost of such production.
>
> I sincerely believe that, with the proper support from the Studio, a different type of fantasy picture can be developed, in a class by itself, which can be made on a budget allowing for substantial profit. Such a production should materially contribute to Studio prestige, and be definite challenge to competition in the Industry.[1]

Linwood Dunn had taken over the camera effects department at RKO after the death of Vernon Walker in 1948. He also uses the momentum of the Acme-Dunn Optical Printer to start his own business, Film Effects of Hollywood, a small effects house that he would run until Francis Coppola's Zoetrope buys it in 1980.[2] These two activities initially are hard to separate as Dunn rents out the facilities of RKO for his private business while the studio fades away until the mid-1950s. Other studios do not disappear like RKO but their structures change after an antitrust court decision against Paramount Pictures in 1948, which enforces the dissolution of the integrated production model.[3] With the end of the studio system comes a slow transition from dedicated departments to independent contractors for special effects that in fact reverses the development in the early 1930s when people like Williams and the Dunnings made way for those in the studios.

This is the situation in which Dunn writes his memo that apparently is never answered by somebody who "may be interested." It is a last initiative to find a sustainable support for optical effects within the studio system that goes beyond the application of what is already there. One takeaway from this study is that optical effects mainly emerge through the initiatives of small networks—i.e., individual persons with own companies and working groups that share related tasks. The larger systems—i.e., studios, manufacturers, and associations—seem to lack an interest in a more telic development as it can be found with technologies as sound and color. John Law and Michel Callon have described a similar structure in their analysis of the development of a military aircraft where they distinguish between local and global networks. The global network (in their case politicians) provides not just resources (like money) but it has to establish a "negotiation space," a hotbed where the local network (here with engineers and manufacturers) can establish itself. The local network in return needs to define an "obligatory point of passage," a gateway to communicate back to respond to the global network.[4] This point of passage is itself an assembly that may comprise people, matter, and concepts. With his memo Dunn tries to establish such a point when he explains for his studio management that he can translate the techniques, he

1 Linwood G. Dunn, New Idea, July 30, 1949, memo, 84-f.1134, Linwood G. Dunn papers, MHL.

2 "Developers of Optical Printer Win Oscar for Special Effects."

3 See US Supreme Court, *United States v. Paramount Pictures, Inc., 334 US 131*, court case, May 3, 1948, http://supreme.justia.com/us/334/131/case.html; Thomas Schatz, *Boom and Bust: The American Cinema in the 1940s*, vol. 6, History of the American Cinema (New York: Scribner, 1997), 323-28.

4 See John Law and Michel Callon, "The Life and Death of an Aircraft: A Network Analysis of Technical Change," in Bijker and Law, *Shaping Technology/Building Society*, 21–52.

wants to progress, into profitable movies. He already sketches the local network, he wants to build, but the global network at this time is too deeply involved with its own structural problems to respond. Earlier successful developments showed a constant interaction between the two networks when e.g. the Academy establishes research committees or the MPPDA induces the pooling of patents. In these cases the creation of negotiation spaces also allocates the manufacturers, which often have an unclear position between the studios and their effects departments. The crucial question then is how the local networks, once they are initiated, respond to the global networks that feed them. Here we can distinguish between two strategies. One is the reference to profitable movies as Dunn does and in what he follows Merian C. Cooper, the producer of *King Kong*. In his years as head of production at RKO from 1933 to 1935, Cooper unsuccessfully tried to assume authority over defining what a profitable movies is; i.e., for him a spectacle. He fights here against the much larger group of script writers and actors who (naturally) favor movies that focus on their stories. This conflict reached its climax when in December 1933 Cooper in a memo to RKO's Board of Directors demands movies with a "minimum of dialogue and a maximum of spectacle."[5] In contrast, Farciot Edouart at Paramount defines the effects he produces as invisible. He stands for profitable scenes but not movies and this way avoids a conflict over interpretational sovereignty. His passage point is primarily economical and the progress that results from it is correspondingly one of growth as screens and sets increase in size. Although Edouart was active in the field of optical effects before 1932, he only becomes visible when basic decisions regarding techniques and organizational structures are established and the focus is on growth of the same. Both strategies proof uneligible to expedite an independent development of optical effects. Instead significant steps are often made in the wake of other techniques like film stocks or sound that can mobilize larger networks. Furthermore, it is possibly helpful for these techniques that are either considered as primarily technical and only affect small groups—as in the case of film stocks—, or that they promise additional revenue at the box office—as in the case of sound and color.

A formative change in the matter of what a profitable movie is occurs with the block busters of the 1970s in the course of which special effects become the subject of newly established networks. This is it itself a complex development that not only encompasses George Lucas's Industrial Light & Magic but also Coppola's concept of an electronic cinema in the early 1980s.[6] Likewise, reading Dunn's memo from 1949 it is difficult not to think of contemporary chroma-key-productions, movies that neglect coherent sets in favor of blue-screen virtuality. The fragmentation of sets and images has increased to an amount previously unimaginable and a movie like *Sky Captain and the World of Tomorrow* (Kerry Conran, 1994) seams to follow all of Dunn's suggestions made half a century before—with the notable exception that stars are still indispensable. But also their role has changed. Laurence Olivier is already fifteen years dead when he 'plays' in *Sky Captain*. Actors just as landscapes may turn into stock footage with digital compositing. Dunn as a person who is actively involved in promoting and developing optical effects until his death in 1998 connects the fields of analog and digital effects. This becomes seizable in his lost memo. What I did not elaborate on and can only claim here is that analog optical effects anticipate a lot of traits of later digital technologies. But this connection becomes tangible looking at a late-analog show piece as Zbigniew Rybczyński's short film *Tango* (1980). In a painstaking process Rybczyński first directed and then isolated trivial short actions that are later assem-

5 Cited after Jewell, "A History of RKO Radio Pictures, Incorporated 1928-1942," 191.

6 See Thomas G. Smith, *Industrial Light & Magic: The Art of Special Effects* (New York: Ballantine, 1986); Michael Nielsen, "Hollywood's High Frontier: The Emergence of Electronic Cinema," *Journal of Film and Video* 36, no. 2 (1984): 31–42, 72, JSTOR: 20687603.

bled in a small room. With an optical printer this requires countless steps of adding and subtracting mattes and figures. The resulting movie features not only visible matte lines but also other mistakes like single frames with missing body parts.[7] But despite of these flaws Rybczyński's film augurs an aesthetic that is associated with digital compositing. Optical effects are what we might call proto-digital or the other way around digital techniques owe more to their apparent predecessors than we might think.

Finally, to come back to my conjecture of the image as collective, it has shown that the studio system was very pragmatic when it comes to the question how to create motion pictures—understood as complete films as well as single shots. The question whether an image was assembled by means of physical construction, by pre-cinematic imaging techniques like painting or photography, or by optical effects, was decided on the basis of availability, efficiency, and quality. The photographic image here is at the same time the superordinate matter of concern, which unleashes and guides processes of construction, and an equal element among others within the very same processes. It interacts, it is origin and target of translations, with humans, machines, texts, animals etc. It may trigger developments because of its merits or deficiencies. This convertibility seems to contradict the idea of images as semiotic entities, as signs, because it does not provide solid positions and functions. But this is only the case as long as we conceive semiotic linkages as fundamentally different from others. Latour has shown with his example of speed control how it practice the boundaries blur (p. 21). And as we have seen, it is the same with production practices in Hollywood at least in regard to the use or non-use of optical effects.

From this point we can look again at our first image, the suicide scene from *Citizen Kane*, and ask for a second time why Bazin from all the techniques, which Welles, Toland et al put forward to produce this image, disdains the montage of distinct image elements. I have described Bazin's demand as an ontological realism. He insists on a physical linkage between action and image. Vinzenz Hediger, in his examination of Bazin's realism concept, has outlined this point as follows. "The photograph is not an artificial sign but the proceeding of reality by other means or in another medium."[8] Hediger then makes a somewhat adventurous step when he takes Bazin's term of "transfer of reality" and replaces it with the theological term of transubstantiation. Bread and wine in the Eucharistic liturgies are not signs that refer to Christ, they *are* his body and blood just as for Bazin the photographic image *is* reality. Hediger underpins his thought experiment with reference to Bazin's early interest in the theologist Pierre Teilhard de Chardin that reminds of the influence that Charles Péguy had on Latour.[9] In their Catholic roots Bazin and Latour at the end are closer than it had seemed. They not only share an affection for what they each consider as 'reality,' they also are both at odds with images though they accept them as part of the very same reality.

Bazin notoriously distinguishes between directors who either believe in images or reality.[10] And Latour falls short when he neglects images as mediators. This is contradictory to his otherwise rigorous analytical descriptions of translations and transformations. What

7 See Siegfried Zielinski and Peter Weibel, eds., *The State of Image: The Media Pioneers Zbigniew Rybczyński and Gábor Bódy* (Nürnberg: Verlag für moderne Kunst, 2011).

8 Vinzenz Hediger, "Das Wunder des Realismus: Transsubstantiation als medientheoretische Kategorie bei André Bazin," *montage AV* 18, no. 1 (2009): 78.

9 See Henning Schmidgen, "The Materiality of Things?: Bruno Latour, Charles Péguy and the History of Science," *History of the Human Sciences* 26, no. 1 (2013): 3–28.

10 See André Bazin, "The Evolution of Film Language," in *What is Cinema?*

Bazin could learn from Latour is to cherish construction as a necessary and literally realistic act, one that makes relations. These relations I tried to study by describing how different actors meet to produce images and depending on the effect these images in combination with others have (on the audience, the market, the critics, but also on themselves) they might meet again. Such a process of establishing and maintaining networks is essential in all technical ventures. But through the leveling capacity of photography to apparently erase material differences by physical means, it is the image itself that provides the occasion and aim of gathering. This is how we can understand the image as collective.

Appendix

List of Figures

Bibliography

Books

Abbott, L. B. *Special Effects: Wire, Tape, and Rubber Band Style*. Hollywood: ASC, 1984.

Allen, Robert Clyde, and Douglas Gomery. *Film History: Theory and Practice*. New York: Alfred A. Knopf, 1985.

Alpers, Svetlana. *The Art of Describing: Dutch Art in the Seventeenth Century*. Chicago: U of Chicago Press, 1983.

Andrew, Dudley. *André Bazin*. Morningside ed. New York: Columbia UP, 1990.

Archer, Steve. *Willis O'Brien: Special Effects Genius*. Jefferson, NC: McFarland, 1993.

Balio, Tino. *The American Film Industry*. Rev. ed. Madison, WI: U of Wisconsin Press, 1985.

———, ed. *Grand Design: Hollywood as a Modern Business Enterprise, 1930-1939*. Vol. 5. History of the American Cinema. New York: Scribner, 1995.

Baynes, Ken, and Francis Pugh. *The Art of the Engineer*. Guildford: Lutterworth, 1981.

Bazin, André. *Orson Welles: A Critical View*. Translated by Jonathan Rosenbaum. 1950. New York: Harper & Row, 1978.

———. *Bazin at Work*. Edited by Bert Cardullo. New York: Routledge, 1997.

———. *What is Cinema?* Edited and translated by Tim Barnard. Montréal: Caboose, 2009.

Belliger, Andréa, and David J. Krieger, eds. *ANThology: Ein einführendes Handbuch zur Akteur-Netzwerk-Theorie*. Bielefeld: Transcript, 2006.

Belton, John. *Widescreen Cinema*. Cambridge, MA: Harvard UP, 1992.

———. *American Cinema/American Culture*. 3rd ed. Boston: McGraw-Hill, 2009.

Bendick, Jeanne, and Robert Bendick. *Making the Movies*. New York: Whittlesey House, McGraw-Hill, 1945.

Benjamin, Walter. *The Work of Art in the Age of Its Technological Reproducibility, and other Writings on Media*. Edited by Michael William Jennings, Brigid Doherty, and Thomas Y. Levin. Cambridge, MA: Belknap/Harvard UP, 2008.

Bennett, Bruce, Marc Furstenau, and Adrian Mackenzie, eds. *Cinema and Technology: Cultures, Theories, Practices*. Basingstoke: Palgrave Macmillan, 2008.

Bennett, Colin N. *The Handbook of Kinematography: The History, Theory, and Practice of Motion Photography and Projection*. London: Kinematograph Society, 1911. Open Library: OL7134277M.

Bernstein, Steven. *The Technique of Film Production*. London: Focal, 1988.

Bijker, Wiebe E. *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. Cambridge, MA: MIT Press, 1995.

Bijker, Wiebe E., and John Law, eds. *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Cambridge, MA: MIT Press, 1992.

Birchard, Robert S. *Cecil B. DeMille's Hollywood*. Lexington, KY: UP of Kentucky, 2004.

Bloor, David. *Knowledge and Social Imagery*. 2nd ed. 1976. Chicago: U of Chicago Press, 1991.

Bogdanovich, Peter. *Who the Devil Made It: Conversations with Robert Aldrich, George Cukor, Allan Dwan, Howard Hawks, Alfred Hitchcock, Chuck Jones, Fritz Lang, Joseph H. Lewis, Sidney Lumet, Leo McCarey, Otto Preminger, Don Siegel, Josef von Sternberg, Frank Tashlin, Edgar G. Ulmer, Raoul Walsh*. New York: Alfred A. Knopf, 1997.

Booker, Peter Jeffrey. *A History of Engineering Drawing*. London: Chatto & Windus, 1963.

Bordwell, David. *Narration in the Fiction Film*. Madison, WI: U of Wisconsin Press, 1985.

———. *On the History of Film Style*. Cambridge, MA: Harvard UP, 1997.

Bordwell, David, Janet Staiger, and Kristin Thompson. *The Classical Hollywood Cinema: Film Style & Mode of Production to 1960*. New York: Columbia UP, 1985.

Bordwell, David, and Kristin Thompson. *Film Art: An Introduction*. 8th ed. Boston: McGraw-Hill, 2008.

Bowser, Eileen. *The Transformation of Cinema, 1907-1915*. Vol. 2. History of the American Cinema. New York: Scribner, 1990.

Brady, Frank. *Citizen Welles: A Biography of Orson Welles*. New York: Scribner, 1989.

Brainard, Lucy Abigail. *The Genealogy of the Brainerd-Brainard Family in America: 1649-1908*. Hartford: Case, Lockwood & Brainard, 1908.

Broos, Ben, Albert Blankert, and Arthur K. Wheelock. *Vermeer: Das Gesamtwerk*, edited by Arthur K. Wheelock. Stuttgart: Belser, 1995.

Brosnan, John. *Movie Magic: The Story of Special Effects in the Cinema*. Rev. ed. London: Abacus, 1977.

Brown, James Robert. *Smoke and Mirrors: How Science Reflects Reality*. London: Routledge, 1994.

Brown, Karl, and Kevin Brownlow. *Adventures with D. W. Griffith*. London: Faber & Faber, 1988.

Brownlow, Kevin. *The Parade's Gone by …* 1968. London: Columbus, 1989.

Bulleid, H. A. V. *Special Effects in Cinematography*. London: Fountain, 1954.

Carringer, Robert L. *The Making of Citizen Kane*. Rev. ed. 1985. Berkeley: U of California Press, 1996.

Carroll, Noël. *Philosophical Problems of Classical Film Theory*. Princeton, NJ: Princeton UP, 1988.

———. *Theorizing the Moving Image*. Cambridge, UK: Cambridge UP, 1996.

Cavell, Stanley. *The World Viewed: Reflections on the Ontology of Film*. Enlarged ed. Cambridge, MA: Harvard UP, 1979.

Cerra, Julie Lugo, and Marc Wanamaker. *Movie Studios of Culver City*. Charleston, SC: Arcadia, 2011.

Chase, Donald. *Filmmaking: The Collaborative Art*. Boston: Little, Brown, 1975.

Christeson, Frances Mary, and Helen Mae Christeson. *Wild Animal Actors*. A. Whitman, 1935.

Clark, Frank P. *Special Effects in Motion Pictures: Some Methods for Producing Mechanical Special Effects*. New York: SMPTE, 1966.

———. *Technologies in the Laboratory Handling of Motion Picture and Other Long Films*. New York: Society of Motion Picture and Television Engineers, 1971.

Clarke, Charles G. *Professional Cinematography*. 2nd, rev. ed. Hollywood: American Society of Cinematographers, 1968.

Cowie, Peter. *The Cinema of Orson Welles*. New York: Da Capo, 1973.

Cox, Arthur. *Optics: The Technique of Definition*. 2nd ed. London: Focal, 1943.

Crafton, Donald. *The Talkies: American Cinema's Transition to Sound, 1926-1931*. Vol. 4. History of the American Cinema. New York: Scribner, 1997.

Croy, Homer. *How Motion Pictures Are Made*. New York: Harper & Brothers, 1918. Open Library: OL23439710M.

Croy, Otto R., and P. C Smethurst. *The Secrets of Trick Photography*. Boston: American Photographic, 1937.

Culhane, John. *Special Effects in the Movies: How they do it*. New York: Ballantine, 1981.

De Lauretis, Teresa, and Stephen Heath, eds. *The Cinematic Apparatus*. New York: St. Martin's, 1980.

DeAngelis, Gina. *Motion Pictures: Making Cinema Magic*. Minneapolis: Oliver, 2004.

Deleuze, Gilles, and Claire Parnet. *Dialogues*. Translated by Hugh Tomlinson and Barbara Habberjamn. 1977. New York: Columbia UP, 1987.

Dench, Ernest Alfred. *Making the Movies*. New York: Macmillan, 1919.

Depue, Oscar B. *Optical and Contact Motion Picture Printing Machines*. Chicago, n.d. MPE 18, Jonathan Silent Film Collection, FMPL.

Dunn, Linwood G., and George E. Turner, eds. *The ASC Treasury of Visual Effects*. Hollywood: American Society of Cinematographers, 1983.

Duplex Motion Picture Industries, Inc. *The Duplex General Catalogue*. Long Island City, NY. Jonathan Silent Film Collection, FMPL.

Eames, John Douglas. *The Paramount Story*. London: Octopus, 1985.

Eastman Kodak Company. *Eastman Duplicating Film: Its Properties and Uses*. Rochester, January 1927.

Erb, Cynthia. *Tracking King Kong: A Hollywood Icon in World Culture*. 2nd ed. Detroit: Wayne State UP, 2009.

Fielding, Raymond, ed. *A Technological History of Motion Pictures and Television: An Anthology from the Pages of the Journal of the Society of Motion Picture and Television Engineers*. Berkeley: U of California Press, 1967.

———. *The Technique of Special Effects Cinematography*. 3rd ed. 1965. London: Focal, 1972.

Fielding, Raymond. *A Bibliography of Theses and Dissertations on the Subject of Film, 1916-1979*. School of Communication, University of Houston, 1979.

———. *The Technique of Special Effects Cinematography*. 4th ed. 1965. London: Focal, 1985.

Finch, Christopher. *Special Effects: Creating Movie Magic*. New York: Abbeville, 1984.

Flückiger, Barbara. *Visual Effects: Filmbilder aus dem Computer*. Marburg: Schüren, 2008.

Flusser, Vilém. *Towards a Philosophy of Photography*. Translated by Anthony Mathews. 1983. London: Reaktion, 2000.

———. *Into the Universe of Technical Images*. Translated by Nancy Ann Roth. 1985. Minneapolis: U of Minnesota Press, 2011.

Fry, Ron, and Pamela Fourzon. *The Saga of Special Effects*. Englewood Cliffs, NJ: Prentice-Hall, 1977.

Gale, Arthur Loran, and Russell C. Holslag. *Making Better Movies*. Amateur Cinema League, 1932.

Gale, Lilian R., ed. *Motion Picture Studio Directory and Trade Annual 1921*. Motion Picture News, 1921.

Garnett, Tay, and Fredda Dudley Balling. *Light Your Torches and Pull up Your Tights*. New Rochelle, NY: Arlington House, 1973.

Geyer-Werke AG. *Was der Produzent, was der Regisseur vom Dunning-Verfahren wissen muß!* Geyer plant chronicle, Stiftung Deutsche Kinemathek, Berlin. Berlin, n.d. [1931].

Giesen, Rolf. *Special Effects Artists: A Worldwide Biographical Dictionary of the Pre-Digital Era with a Filmography*. Jefferson, NC: McFarland, 2008.

Giesen, Rolf, L. B. Abbott, and Hans Helmut Prinzler. *Special Effects: King Kong, Orphée und Die Reise zum Mond*. Ebersberg: Edition 8 1/2, 1985.

Goldner, Orville, and George Turner. *The Making of King Kong: The Story Behind a Film Classic*. South Brunswick, NJ: A. S. Barnes, 1975.

Gomery, Douglas. *The Hollywood Studio System*. London: British Film Institute, 2005.

Gottesman, Ronald. *Perspectives on Citizen Kane*. New York: G. K. Hall, 1996.

Grant, J. B. *ASC 25th Anniversary*. Hollywood: American Society of Cinematographers, 1946.

Gregory, Carl Louis. *A Condensed Course in Motion Picture Photography*. New York: New York Institute of Photography, 1920. Open Library: OL7066740M.

———. *Motion Picture Photography*. 2nd ed. Edited by Herbert Couchman McKay. New York: Falk, 1927.

Greimas, Algirdas Julien. *Structural Semantics: An Attempt at a Method*, translated by Daniele McDowell, Ronald Schleifer, and Alan Velie. Lincoln, NE: U of Nebraska Press, 1983.

Grint, Keith, and Steve Woolgar. *The Machine at Work: Technology, Work and Organization*. Cambridge, UK: Polity, 1997.

Grosskopf, Claus. *Josef Behrens: Erfindungen 1918-1947: Rückprojektionen, Kinematographie, Optik, Maschinenbau*. Berlin: Gebr. Mann, 2007.

Gunning, Tom. *D. W. Griffith and the Origins of American Narrative Film: The Early Years at Biograph*. Urbana, IL: U of Illinois Press, 1991.

Hampton, Benjamin B. *History of the American Film Industry from its Beginnings to 1931*. New York: Dover, 1970.

Happé, L. Bernard. *Basic Motion Picture Technology*. London: Focal, 1971.

———. *Your Film & the Lab*. New York: Hastings House, 1974.

Hardy, Arthur C., and Fred Hiram Perrin. *The Principles of Optics*. New York: McGraw-Hill, 1932.

Haskin, Byron, and Joe Adamson. *Byron Haskin*. Metuchen, NJ/London: Directors Guild of America / Scarecrow, 1984.

Haver, Ronald, and Thomas Ingalls. *David O. Selznick's Hollywood*. New York: Knopf, 1980.

Hawks, Howard, and Scott Breivold. *Howard Hawks: Interviews*. Conversations with Filmmakers Series. Jackson: UP of Mississippi, 2006.

Hawks, Howard, and Joseph MacBride. *Hawks on Hawks*. Berkeley: U of California Press, 1981.

Hayes, R. M. *Trick Cinematography: The Oscar Special-Effects Movies*. Jefferson, NC: McFarland, 1986.

Hepburn, Katharine. *Me: Stories of My Life*. New York: Knopf, 1991.

Hoadley, Ray, and Roman Freulich. *How They Make a Motion Picture*. New York: Thomas Y. Crowell, 1939.

Hughes, Edan Milton. *Artists in California, 1786-1940*. 3rd ed. Sacramento: Crocker Art Museum, 2002.

Hulfish, David Sherrill, ed. *Cyclopedia of Motion-Picture Work: A General Reference Work on the Optical Lantern, Motion Head, Specific Projecting Machines, Talking Pictures, Color Motography, Fixed Camera Photography, Motography, Photo-Plays, Motion-Picture Theater, Management and Operation, Audience, Program, etc*. Chicago: American School of Correspondence, 1911. Open Library: OL7243260M.

———. *Motion-Picture Work: A General Treatise on Picture Taking, Picture Making, Photo-Plays, and Theater Management and Operation*. Chicago: American School of Correspondence, 1913. Open Library: OL23320711M.

Hunt, Rockwell Dennis. *California and Californians*. Vol. 4. Chicago: Lewis, 1926. Handle: 2027/uc1.31822000614131.

Hutchison, David. *Film Magic: The Art and Science of Special Effects*. New York: Prentice-Hall, 1987.

Imes, Jack. *Special Visual Effects: A Guide to Special Effects Cinematography*. New York: Van Nostrand Reinhold, 1984.

International Motion Picture Almanac 1937-38. New York: Quigley, 1938. Open Library: ia:international193738quig.

Jacobs, Lewis. *The Rise of the American Film: A Critical History: With an Essay, Experimental Cinema in America, 1921-1947*. New York: Teachers College, 1968.

Jenkins, C. Francis. *The Boyhood of an Inventor*. Washington, DC: National Capital, 1931.

Jenkins, C. Francis, and Oscar B. Depue. *Handbook for Motion Picture and Stereopticon Operators*. Washington, DC: Knega, 1908. Open Library: OL6996051M.

Jenkins, Reese V. *Images and Enterprise: Technology and the American Photographic Industry 1839 to 1925*. Baltimore: Johns Hopkins UP, 1987.

Jewell, Richard B. *RKO Radio Pictures: A Titan is Born*. Berkeley: U of California Press, 2012.

Jewell, Richard B., and Vernon Harbin. *The RKO Story*. New York: Arlington House, 1982.

Jones, Bernard Edward. *The Cinematograph Book: A Complete Practical Guide to the Taking and Projecting of Cinematograph Pictures*. London: Cassell, 1915.

———. *How to Make and Operate Moving Pictures: A Complete Practical Guide to the Taking and Projecting of Cinematograph Pictures*. New York: Funk & Wagnalls, 1916.

Jones, Charles Reed, ed. *Your Career in Motion Pictures, Radio, Television*. New York: Sheridan House, 1949.

Kerr, Paul. *The Hollywood Film Industry: A Reader*. London: Routledge & Kegan Paul in association with the British Film Institute, 1986.

Khan, B. Zorina. *The Democratization of Invention: Patents and Copyrights in American Economic Development, 1790-1920*. New York: Cambridge UP, 2005.

Kiesling, Barrett C. *Talking Pictures: How They Are Made, How to Appreciate Them*. Richmond: Johnson, 1937.

Kimball, H. R. *Motion Picture Sound Engineering: A Series of Lectures Presented to the Classes Enrolled in the Courses in Sound Engineering Given by the Research Council of the Academy of Motion Picture Arts and Sciences*. Hollywood: Van Nostrand, New York, 1938.

King, Rob. *The Fun Factory: The Keystone Film Company and the Emergence of Mass Culture*. Berkeley: U of California Press, 2009.

Kinnard, Roy, ed. *The Lost World of Willis O'Brien: The Original Shooting Script of the 1925 Landmark Special Effects Dinosaur Film, with Photographs*. Jefferson, NC: McFarland, 1993.

Klein, Norman M. *Seven Minutes: The Life and Death of the American Animated Cartoon*. London: Verso, 1993.

———. *The Vatican to Vegas: A History of Special Effects*. New York: New Press, 2004.

Koszarski, Richard. *An Evening's Entertainment: The Age of the Silent Feature Picture, 1915-1928*. Vol. 3. History of the American Cinema. New York: Scribner, 1990.

Kümmel-Schnur, Albert, and Christian Kassung, eds. *Bildtelegraphie: Eine Mediengeschichte in Patenten (1840-1930)*. Bielefeld: Transcript, 2012.

Lasky, Betty. *RKO: The Biggest Little Major of Them All*. 2nd ed. Santa Monica: Roundtable, 1989.

Lastra, James. *Sound Technology and the American Cinema: Perception, Representation, Modernity*. New York: Columbia UP, 2000.
Latour, Bruno. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard UP, 1987.
———. *We Have Never Been Modern*. Cambridge, MA: Harvard UP, 1993.
———. *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA: Harvard UP, 1999.
———. *Aramis, or The Love of Technology*. Cambridge, MA: Harvard UP, 2002.
———. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford UP, 2005.
Latour, Bruno, and Peter Weibel, eds. *Iconoclash*. Karlsruhe/Cambridge, MA: ZKM/MIT Press, 2002.
———, eds. *Making Things Public*. Karlsruhe/Cambridge, MA: ZKM/MIT Press, 2005.
Latour, Bruno, and Steve Woolgar. *Laboratory Life: The Social Construction of Scientific Facts*. Beverly Hills: Sage, 1979.
Lescarboura, Austin Celestin. *Behind the Motion-Picture Screen*. 2nd ed. 1919. New York: Scientific American, 1921. Open Library: OL7205396M.
———. *The Cinema Handbook: A Guide to Practical Motion Picture Work of the Nontheatrical Order, Particularly as Applied to the Reporting of News, to Industrial and Educational Purposes, to Advertising, Selling and General Publicity, to the Production of Amateur Photoplays, and to Entertainment in the School, Church, Club, Community Center and Home*. New York: Scientific American, 1921.
Lewis, Howard T. *The Motion Picture Industry*. New York: D. Van Nostrand, 1933.
Lindsay, Vachel. *The Art of the Moving Picture*. Rev. ed. 1915. New York: Macmillan, 1922.
Lutz, Edwin George. *Animated Cartoons: How They Are Made, Their Origin and Development*. New York: Charles Scribner's Sons, 1920. Open Library: OL6622808M.
———. *The Motion-Picture Cameraman*. New York: Charles Scribner's Sons, 1927.
MacGowan, Kenneth. *Behind the Screen: The History and Techniques of the Motion Picture*. New York: Delacorte, 1965.
Maltin, Leonard. *Behind the Camera: The Cinematographer's Art*. New York: New American Library, 1971.
Mast, Gerald. *Bringing Up Baby: Howard Hawks, Director*. New Brunswick, NJ: Rutgers UP, 1988.
McAlister, Micheal J. *The Language of Visual Effects*. Los Angeles: Lone Eagle, 1993.
Morton, Ray. *King Kong: The History of a Movie Icon from Fay Wray to Peter Jackson*. New York: Applause, 2005.
Motion Picture Laboratory Practice and Characteristics of Eastman Motion Picture Films. Rochester: Eastman Kodak, 1936.
Motion Picture News Studio Directory. New York: Motion Picture News, 1917.
Motion Picture Producers and Distributors of America. *Annual Report*. New York, March 27, 1933.
Mumford, Lewis. *Art and Technics*. New York: Columbia UP, 1952.
———. *The Myth of the Machine: Technics and Human Development*. New York: Harcourt, Brace & World, 1967.
Naumburg, Nancy. *We Make the Movies*. New York: W. W. Norton, 1937.
Neale, Stephen. *Cinema and Technology: Image, Sound, Colour*. Bloomington: Indiana UP, 1985.
Neibaur, James L. *The RKO Features: A Complete Filmography of the Feature Films Released or Produced by RKO Radio Pictures, 1929-1960*. Jefferson, NC: McFarland, 1994.
Netzley, Patricia D. *Encyclopedia of Movie Special Effects*. New York: Checkmark Books, 2001.
Nilsen, Vladimir S. *The Cinema as a Graphic Art*. New York: Hill and Wang, 1959.
Nornes, Markus. *Cinema Babel: Translating Global Cinema*. Minneapolis: U of Minnesota Press, 2007.
Nowotny, Robert A. *The Way of All Flesh Tones: A History of Color Motion Picture Processes, 1895-1929*. New York: Garland, 1983.
O'Connor, Jane, and Katy Hall. *Magic in the Movies: The Story of Special Effects*. Garden City, NY: Doubleday, 1980.
Pierson, Michele. *Special Effects: Still in Search of Wonder*. New York: Columbia UP, 2002.
Polzer, Joachim, ed. *Zur Geschichte des Filmkopierwerks – A Short History of Cinema Film Post-Production*. Vol. 8. Weltwunder der Kinematographie. Beiträge zu einer Kulturgeschichte der Filmtechnik. Potsdam: Polzer, 2006.

Powdermaker, Hortense. *Hollywood, the Dream Factory: An Anthropologist Looks at the Movie-Makers*. Boston: Little, Brown, 1950.

Rickitt, Richard. *Special Effect: The History and Technique*. New York: Billboard, 2000.

Riegl, Alois. *Problems of Style: Foundations for a History of Ornament*, edited by David Castriota, translated by Evelyn Kain. 1893. Princeton, NJ: Princeton UP, 1992.

Robinson, Jack Fay. *Bell & Howell Company: A 75-Year History*. Chicago: Bell & Howell, 1982.

Rogers, Pauline B. *The Art of Visual Effects*. Boston: Focal, 1999.

Rorty, Richard, ed. *The Linguistic Turn: Recent Essays in Philosophical Method*. Chicago: U of Chicago Press, 1967.

Rosen, Philip, ed. *Narrative, Apparatus, Ideology: A Film Theory Reader*. New York: Columbia UP, 1986.

Rosten, Leo Calvin. *Hollywood: The Movie Colony, The Movie Makers*. New York: Harcourt, Brace & Company, 1941.

Rotha, Paul. *Celluloid: The Film To-day*. London: Longmans, Green, 1931.

Ryan, Roderick T. *A History of Motion Picture Color Technology*. London: Focal, 1977.

Sadoul, Georges. *L'invention du cinéma: 1832-1897*. Vol. 1. Histoire générale du cinéma. Paris: Denoël, 1946.

Salt, Barry. *Moving into Pictures: More on Film History, Style, and Analysis*. London: Starword, 2006.

———. *Film Style and Technology: History and Analysis*. 3rd ed. 1983. London: Starword, 2009.

Schatz, Thomas. *The Genius of the System: Hollywood Filmmaking in the Studio Era*. New York: Henry Holt, 1996.

———. *Boom and Bust: The American Cinema in the 1940s*. Vol. 6. History of the American Cinema. New York: Scribner, 1997.

Schechter, Harold, and David Everitt. *Film Tricks: Special Effects in the Movies*. New York: H. Quist, 1980.

Sedgwick, John, and Michael Pokorny. *An Economic History of Film*. London: Routledge, 2005.

Seeber, Guido. *Kamera-Kurzweil: Allerlei interessante Möglichkeiten beim Knipsen und Kurbeln*. 6th ed. Berlin: Union, 1930.

———. *Der Trickfilm in seinen grundsätzlichen Möglichkeiten*. 1927. Frankfurt/M.: Deutsches Filmmuseum, 1979.

Seldes, Gilbert. *The Movies Come from America*. New York: Scribner, 1937.

Sennett, Mack, and Cameron Shipp. *King of Comedy*. San Francisco: Mercury House, 1990.

Shapin, Steven, and Simon Schaffer. *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton, NJ: Princeton UP, 1985.

Shorris, Sylvia, and Marion Abbott Bundy. *Talking Pictures: With the People who Made Them*. New York: New Press, 1994.

Sklar, Robert. *Movie-made America: A Cultural History of American Movies*. New York: Vintage, 1975.

Slide, Anthony. *Silent Topics: Essays on Undocumented Areas of Silent Film*. Lanham, MD: Scarecrow, 2005.

———. *D. W. Griffith: Interviews*. Jackson, MS: UP of Mississippi, 2012.

Smith, Thomas G. *Industrial Light & Magic: The Art of Special Effects*. New York: Ballantine, 1986.

Soares, André. *Beyond Paradise: The Life of Ramon Novarro*. Jackson, MS: UP of Mississippi, 2010.

Sperling, Cass Warner, Cork Millner, and Jack Warner Jr. *Hollywood be Thy Name: The Warner Brothers Story*. Rocklin, CA: Prima, 1994.

Spottiswoode, Raymond. *Film and Its Techniques*. London: Faber & Faber, 1951.

———. *The Focal Encyclopedia of Film & Television Techniques*. London: Focal, 1969.

Staiger, Janet, ed. *The Studio System*. New Brunswick, NJ: Rutgers UP, 1994.

Stanley, Roy M. *World War II Photo Intelligence*. New York: Scribner, 1981.

Stephens, E. J., and Marc Wanamaker. *Early Warner Bros. Studios*. Charleston, SC: Arcadia, 2010.

Sylbert, Richard, and Sylvia Townsend. *Designing Movies: Portrait of a Hollywood Artist*. Westport, CT: Praeger, 2006.

Talbot, Frederick Arthur Ambrose. *Practical Cinematography and Its Applications*. London: William Heinemann, 1913. Open Library: OL7220960M.

Talbot, Frederick Arthur Ambrose. *Moving Pictures: How They Are Made and Worked*. New ed. 1912. Philadelphia: Lippincott, 1914. Open Library: OL23320757M.

Thielmann, Tristan, and Erhard Schüttpelz, eds. *Akteur-Medien-Theorie*. Bielefeld: Transcript, 2013.

Thompson, Kristin, and David Bordwell. *Film History: An Introduction*. 3rd ed. New York: McGraw-Hill, 2009.

United States. Patent Office. *Official Gazette of the United States Patent Office*. 395:713. Washington, DC: The Office, June 17, 1930. Handle: 2027/wu.89048465140.

———. *Official Gazette of the United States Patent Office*. Vol. 399. 4. Washington, DC: The Office, October 28, 1930. Handle: 2027/wu.89048465116.

———. *Official Gazette of the United States Patent Office*. Vol. 410. Washington, DC: The Office, September 22, 1931. Open Library: ia:officialgazette410unit.

———. *Official Gazette of the United States Patent Office*. 493:206. 2. Washington, DC: The Office, August 9, 1938. Open Library: ia:officialgazette492unit.

Vaz, Mark Cotta. *Living Dangerously: The Adventures of Merian C. Cooper, Creator of King Kong*. New York: Villard, 2005.

Vaz, Mark Cotta, and Craig Barron. *The Invisible Art: The Legends of Movie Matte Painting*. San Francisco: Chronicle, 2002.

Vidor, King, Nancy Dowd, and David Shepard. *King Vidor*. Vol. 4. The Directors Guild of America Oral History Series. Metuchen, NJ: Scarecrow, 1988.

Walker, Brent. *Mack Sennett's Fun Factory: A History and Filmography of His Studio and His Keystone and Mack Sennett Comedies, with Biographies of Players and Personnel*. Jefferson, NC: McFarland, 2010.

Wallace, Edgar. *My Hollywood Diary*. London: Hutchinson, 1932. Open Library: ia:myhollywooddiary00edga.

Ward, Richard Lewis. *A History of the Hal Roach Studios*. Carbondale: Southern Illinois UP, 2005.

Wasko, Janet. *Movies and Money: Financing the American Film Industry*. Norwood, NJ: ABLEX, 1982.

Watts, Stephen, ed. *Behind the Screen: How Films Are Made*. London: Arthur Baker, 1938.

Welles, Orson, and Peter Bogdanovich. *This is Orson Welles*. New York: HarperCollins, 1992.

Wellman Jr., William. *The Man and His Wings: William A. Wellman and the Making of the First Best Picture*. Westport, CT: Praeger, 2006.

Wheeler, Leslie J. *Principles of Cinematography: A Handbook of Motion Picture Technology*. London: Fountain, 1953. Open Library: ia:principlesofcinema00whee.

Williams, Raymond. *Television: Technology and Cultural Form*, edited by Ederyn Williams. 1974. London: Routledge, 2003.

Woodbury, Walter E. *Photographic Amusements: Including a Description of a Number of Novel Effects Obtainable with the Camera*. New York: Scovill & Adams, 1897. Open Library: OL22889606M.

———. *The Encyclopædic Dictionary of Photography: Containing over 2,000 References and 500 Illustrations*. New York: Scovill & Adams, 1898.

Wray, Fay. *On the Other Hand: A Life Story*. New York: St. Martin's, 1989.

Wright, Lewis, and Russell Stuart Wright. *Optical Projection: A Treatise on the Use of the Lantern in Exhibition and Scientific Demonstration*. 5th ed., re-written and brought up-to-date by Russell S. Wright. London: Longmans, Green, 1920.

Zielinski, Siegfried. *Zur Geschichte des Videorecorders*. Berlin: Spiess, 1986.

Zielinski, Siegfried, and Peter Weibel, eds. *The State of Image: The Media Pioneers Zbigniew Rybczyński and Gábor Bódy*. Nürnberg: Verlag für moderne Kunst, 2011.

Articles

"26 'Wizard of Oz' Shorts Planned by Ray Smallwood." *FD* 56, no. 6 (July 7, 1931): 4.

"A New Printer." *Motion Picture Herald* 103, no. 11 (June 13, 1931): 22.

"A New Type of Background Projector." *IP* 8, no. 5 (June 1936): 10.

Abbott, P. M. "Equipment Used for Motion Pictures," *The Annals of the American Academy of Political and Social Science* 128, no. 217 (November 1926): 34–45.

Academy of Motion Picture Arts & Sciences. "Proceedings of the Research Council; Quarterly Meeting, December 15, 1932." Supplement No. 19, *Technical Bulletin*, December 23, 1932.

———. "Technicians Credits: Complete Technical Production Credits on all productions completed since January 1, 1935." *Technical Bulletin* (Hollywood) 1935 (April 17, 1935).

———. "The Academy Awards for Scientific or Technical Achievement," *Technical Bulletin* (Hollywood) 1937 (March 4, 1937).

"Academy Report." *IP* 11, no. 4 (May 1939): 19–24.

"Academy Sound School a Success." *AMPAS Bulletin*, no. 26 (October 30, 1929): 2–3.

"Acme Installs Latest Film and Sound Printers." *AC* 28, no. 3 (March 1947): 99–100.

"After 52 Years With Paramount: Edouart Given 4 1/2-Days Exit Notice." *Variety*, October 13, 1967, 1, 4.

Ainsworth, Ed. "Southland Defense: Burbank Has Become a Hive of Aerial Industry." *LAT*, February 17, 1941.

Akrich, Madeleine. "The De-Scription of Technical Objects." In Bijker and Law, *Shaping Technology/Building Society*, 205–24.

Aldrich, Clarence N. "Back-Projection Tricks For Home Movie-Makers." *AC* 23, no. 8 (August 1942): 356–57, 370, 372.

Alton, J. "Improvement for Process Department." *IP* 18, no. 11 (December 1946): 7.

"Alvin V. Knechtel is Elected to ASC." *AC* 7, no. 8 (November 1926): 4, 24.

Ash, Jerome H. "Using a Process Background in 16mm Pictures." *AC* 15, no. 4 (August 1934): 176–77.

———. "Optical Tricks You Can Do." *AC* 17, no. 3 (March 1936): 119, 130.

"Attempts to Control Double Exposure Method." *AC* 3, no. 1 (September 6, 1922): 4.

"Background Device." *Cine-Technician* 3, no. 10 (June–July 1937): 75–76.

Baker, Friend F. "Inventor Describes His Process." *IP* 4, no. 9 (October 1932): 4–5.

Ball, J. A. "Theory of Mechanical Miniatures In Cinematography." *TSMPE*, no. 18 (May 1924): 119–26.

Barlatier, Andre. "Photography and 'Spirits.'" *AC*, June 1923, 5–6, 22–23.

Barleben Jr., Karl A. "Thoughts on Projection Printing." *IP* 6, no. 10 (November 1934): 16–18.

Barleben, K. A. "More about Optical Printing." *American Photography* 26, no. 2 (February 1932): 107–11.

Barnhill, W. A. "Photographic Assemblages or Composites." *Commercial Phot.* 6 (November 1930): 70.

Barry, Richard. "Five Dollar Movies Prophesied." In Slide, *D. W. Griffith: Interviews*, 23–27.

Barth, W. "A Film Emulsion for Making Direct Duplicates in a Single Step." *JSMPE* 27, no. 4 (October 1936): 419–30.

Bartholowsky, J. H. "Plastic Matte Shots." *IP* 12, no. 9 (October 1940): 7.

Baudry, Jean-Louis. "Ideological Effects of the Basic Cinematic Apparatus." In Rosen, *Narrative, Apparatus, Ideology*, 286–98.

Bazin, André. "The Technique of Citizen Kane." In *Perspectives on Citizen Kane*, edited by Ronald Gottesman, translated by Alain Piette and Bert Cardullo, 229–37. 1947. New York: G.K. Hall, 1996.

———. "The Life and Death of Superimposition." In *Bazin at Work*.

———. "The Virtues and Limitations of Montage." In *What is Cinema?*, translated by Hugh Gray, 41–52. 1953. Berkeley: U of California Press, 2004.

———. "The Evolution of Film Language." In *What is Cinema?*

———. "The Myth of Total Cinema." In *What is Cinema?*, 13–20.

Beggs, E. W. "Lighting by Tungsten Filament Incandescent Electric Lamps for Motion Picture Photography." *TSMPE*, no. 26 (May 1926): 94–106.

Behlmer, Rudy. "Tarzan: Hollywood's Greatest Jungle." *AC* 68, no. 1 (January 1987): 39–48.

Bell, Donald J. "A Letter from Donald Bell." *IP* 2, no. 1 (February 1930): 18–21.

Belliger, Andréa, and David J. Krieger. "Einführung in die Akteur-Netzwerk-Theorie." In *ANThology*, 13–50.

Belton, John. "Bazin is Dead! Long Live Bazin!" *Wide Angle* 9, no. 4 (1987): 74–81.

———. "CinemaScope and Historical Methodology." *Cinema Journal* 28, no. 1 (1988): 22–44. doi:10.2307/1225015.

———. Review of *On the History of Film Style*, by David Bordwell. *Film Quarterly* 52, no. 4 (1999): 55–57. doi:10.2307/1213786.

Bender, O. "Das Mehrfachkopieren von Kinofilmen." *Kinotechnik* 21, no. 10 (October 1939): 241–43.

"Biggest Stage on Earth Devoted to Special Effects Process Work." *AC* 10, no. 1 (April 1929): 20–21, 35.

Binotto, Johannes. "Rück-Sicht auf Darstellbarkeit: Zur Ästhetik und Aussagekraft der Rear Projection." *Filmbulletin* 55, no. 2 (March 2013): 37–43.

Blaisdell, George. "Fine Grain Films Make Strong Advance." *AC* 20, no. 11 (November 1939): 486–88.

Blanchard, Walter. "Production Economies with Process Photography." *AC* 15, no. 3 (July 1934): 110–11, 118–.

———. "How About Your Transitions?" *AC* 17, no. 2 (February 1936): 75, 83.

———. "Aces of the Camera XIII: Gregg Toland, ASC." *AC* 23, no. 1 (January 1942): 15, 36.

———. "Aces of the Camera XVIII: Farciot Edouart, ASC." *AC* 23, no. 6 (June 1942): 256, 269–70.

———. "Unseen Camera-Aces II: Linwood Dunn, ASC." *AC* 24, no. 7 (July 1943): 254, 268, 270.

Bluemel, Walter. "Composition in Practice. Part I." *IP* 6, no. 7 (August 1934): 20–22.

———. "Composition in Practice. Part II." *IP* 6, no. 8 (September 1934): 18–19, 28.

Boone, Andrew R. "Prehistoric Monsters Roar and Hiss for Sound Film." *Popular Science*, April 1933, 20–21, 106.

Bordwell, David. "The Introduction of Sound." Chap. 23 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 298–308.

———. "*Citizen Kane* und die Künstlichkeit des klassischen Studio-Systems." In *Der schöne Schein der Künstlichkeit*, edited by Andreas Rost, translated by Ingo Fließ, 117–49. Lecture presented in 1994 was only published in German translation. Frankfurt/M.: Verlag der Autoren, 1995.

———. "Foreground, Background, Playground." March 30, 2010. http://www.davidbordwell.net/blog/2010/03/30/foreground-background-playground/.

Bordwell, David, and Janet Staiger. "Technology, Style, and Mode of Production." Chap. 19 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 243–61.

Bordwell, David, and Kristin Thompson. "Toward a Scientific Film History?" *Quarterly Review of Film Studies* 10, no. 3 (Summer 1985): 224–37.

———. "A Salt and Battery." *Film Quarterly* 40, no. 2 (1986): 59–62. doi:10.2307/1212357.

———. "Salt II." *Film Quarterly* 40, no. 4 (1987): 61–63. doi:10.2307/1212271.

———. "Technological Change and Classical Film Style." In Balio, *Grand Design*, 5:109–41.

Bors, Joseph A. "Navy Photo Science Laboratory." *Popular Photography*, May 1944, 34–35, 87–89. Google Books: vWIzAQAAMAAJ.

Bosco, W. G. C. "Aces of the Camera: Vernon L. Walker, ASC." *AC* 25, no. 3 (March 1944): 82, 94, 98.

———. "Aces of the Camera: Paul Eagler, ASC." *AC* 27, no. 3 (March 1946): 86, 104–6.

Bosco, W. G. Campbell. "Unseen Aces of the Camera: Hans (Koney) Koenekamp." *AC* 25, no. 1 (January 1944): 12.

Bowker, Geoffrey C. "What's in a Patent?" In Bijker and Law, *Shaping Technology/Building Society*, 53–74.

Boyce, Bill. "A Shipload of Backgrounds, Etc." *IP* 7, no. 11 (December 1935): 10.

Brautigam, Otto. "Double Exposures of the Early Days." *AC* 3, no. 7 (October 1922): 13, 17.

———. "Double Exposures of the Early Days." In Dunn and Turner, *The ASC Treasury of Visual Effects*, 83–86.

Bristol, William H. "An Electrical Synchronized and Resynchronizing for Sound Motion Picture Apparatus." *TSMPE* 12, no. 35 (1928): 778–89.

Broggie, Roger. "New Teague Walking Device." *IP* 9, no. 2 (March 1937): 31.

"Browning to Represent Dunning Process in East." *Film Daily* 56, no. 6 (July 7, 1931): 2.

Burdick, Harry. “Intensive Preparation Underlies Toland’s Achievements.” *AC* 16, no. 6 (June 1935): 240, 247.

Butement, C. “How to Build a 9.5 MM. Printer.” *Home Movies* 2 (December 1933): 252–53.

“California Defense Aid by R.F.C. Told.” *LAT*, February 2, 1941.

Campbell, Arthur. “A Fireproof Process Screen.” *AC* 14, no. 10 (February 1934): 406, 424–25.

———. “Optical Printer ‘Whirls’ Made By Any Camera.” *AC* 15, no. 1 (May 1934): 38.

Campbell, Arthur J. “Making Matte-Shots.” *AC* 15, no. 8 (December 1934): 347, 355.

Capstaff, J. G., and M. W. Seymour. “Duplication of Motion Picture Negatives.” *AC* 7, no. 9 (December 1926): 9, 21–22.

———. “Duplication of Motion Picture Negatives.” *AC* 7, no. 10 (January 1927): 9, 20.

———. “Duplication of Motion Picture Negatives.” *TSMPE* 10, no. 28 (1927): 223–29.

“Carl Louis Gregory.” *JSMPTE* 57, no. 2 (August 1951): 176–77.

Carringer, Robert L. “Orson Welles and Gregg Toland: Their Collaboration on ‘Citizen Kane.’” *Critical Inquiry* 8, no. 4 (1982): 651–74. JSTOR: 1343191.

“Carroll Dunning Returning.” *IP* 3, no. 2 (March 1931): 34.

“Carroll H. Dunning.” *JSMPTE* 84 (December 1975): 1000.

Carroll, Lee. “Problems in Rear Projection.” *IP* 11, no. 7 (August 1939): 5–8.

Cavell, Stanley. “Leopards in Connecticut.” *The Georgia Review* 30, no. 2 (1976).

———. “Leopards in Connecticut.” In *Pursuits of Happiness: The Hollywood Comedy of Remarriage*, 111–32. 1976. Reprint, Cambridge, MA: Harvard UP, 1981.

Chambers, Gordon A. “Process Photography.” *Cinematographic Annual* 2 (1931): 223–27.

———. “Process Photography.” *JSMPE* 18, no. 6 (June 1932): 782–87.

“Charge Patent Infringement.” *Variety*, February 25, 1925.

Chevalier, H. “The ‘Special Effects’ Department.” *Photographic Journal* 77, no. 11 (November 1937): 607–17. Google Books: CVvDYjB9Fd8C.

Chrisman, J. Eugene. “What Isn’t Possible?: Through the ‘Dunning Process’ Greta Garbo Could Play opposite Valentino.” *Motion Picture* 40, no. 4 (November 1930): 30–31, 105.

Clark, Dan. “Can Cinematography Be Taught in Schools?” *AC* 4, no. 3 (June 1923): 13, 21.

Clark, Daniel Bryan. “Composition In Motion Pictures.” *Cinematographic Annual* 1 (1930): 81–90.

Clarke, Charles G. “Wipe-off Splicer for 16mm Films.” *AC* 15, no. 8 (December 1934): 364.

———. “Cinematography in the Hollywood Studios: Putting Clouds into Exterior Scenes.” *JSMPE* 39, no. 2 (August 1942): 92–96.

———. “How Desirable Is Extreme Focal Depth?” *AC* 23, no. 1 (January 1942): 14, 36.

Claudy, C. H. “Motion Picture Magic: Playing Tricks on Time.” *Scientific American* 112, no. 20 (1915): 454–55. Handle: 2027/mdp.39015024547088.

Clifford, Helen R. “United States Naval Photographic Science Laboratory.” *JSMPE* 43, no. 6 (December 1944): 405–13.

“Close-Ups: Guy Bennett, Operative Cameraman.” *IP* 11, no. 3 (April 1939): 5–6.

“Close-Ups: Paul Lerpae, Special Effects First Cameraman.” *IP* 11, no. 8 (September 1939): 21–22.

“Coast Suit on Patent Starts.” *FD*, March 4, 1926.

Colton, Helen. “Stocking Studios with Stock Shots.” *NYT*, April 9, 1950.

Comolli, Jean-Louis. “Machines of the Visible.” In De Lauretis and Heath, *The Cinematic Apparatus*, 121–42.

“Co-operative Research Laboratory Needed.” *IP* 12, no. 12 (January 1941): 8–9.

Coulter, Harry. “Illusions and Effects.” *Cinema Progress* 2, no. 2 (June 1937): 18–20.

Coward, H. Gordon. “The Stills Problem Solved.” *AC* 5, no. 9 (December 1924): 7, 23.

Cowling, Herford Tynes. “For Trick Work: Mr. Fred A. Barber Announces the Perfection of a Wonderful New Optical Printer.” *AC* 8, no. 12 (March 1928): 7, 22, 24.

Crabtree, J. I. “The Graininess of Motion Picture Film.” *Transactions of the Society of Motion Picture Engineers*, no. 24 (1927): 77–.

Crabtree, J. I., and C. H. Schwingel. “The Duplication of Motion Picture Negatives.” *AC* 13, no. 4 (August 1932): 8–9, 27.

———. “The Duplication of Motion Picture Negatives.” *AC* 13, no. 5 (September 1932): 13, 23.

———. “The Duplication of Motion Picture Negatives.” *JSMPE* 19, no. 1 (July 1932): 891–908.

Craik, Bert. “Optical Printing – Its Uses.” *Cine-Technician* 1, no. 4 (February 1936): 94–95.
Crespinel, William T. “History of Bi-Pack Photography.” *IP* 18, no. 11 (December 1946): 5–6.
Criticus. “Producers and Technicians.” *IP* 2, no. 7 (August 1930): 23–26.
Cuntz, Michael. “Aktanten – Shiften – Programme oder: Wie Latours ANT Greimas verschiebt.” Edited by Erika Linz. *Sprache und Literatur* 40, no. 2 (2009): 21–44.
Danks, Adrian. “Being in Two Places at the Same Time.” In *B is for Bad Cinema: Aesthetics, Politics, and Cultural Value*, edited by Claire Perkins and Constantine Verevis, 65–84. State University of New York Press, 2014.
DeMille, Cecil B. “Motion Picture Directing.” *TSMPE* 12, no. 34 (April 1928): 295–309.
———. “How a Motion Picture is Put Together.” *IP* 7, no. 4 (May 1935): 10–11.
———. “A Director Looks at ‘Process-Shots.’” *AC* 17, no. 11 (November 1936): 458–59.
“Den Kühen ihre Farbe zurückgeben: Von der ANT und der Soziologie der Übersetzung zum Projekt der Existenzweisen.” Interview with Bruno Latour by Michael Cuntz and Lorenz Engell. *Zeitschrift für Medien- und Kulturforschung*, no. 2 (2013): 83–100.
Depue, Oscar B. “A Daylight Optical Reduction Printer.” *TSMPE* 10, no. 28 (February 1927): 242–51.
———. “My First Fifty Years in Motion Pictures.” *JSMPE* 49, no. 6 (December 1947): 481–93.
Descartes, René. “Treatise on Man.” In *The Philosophical Writings of Descartes*, translated by John Cottingham, Robert Stoothoff, and Dugald Murdoch, 1:99–108. 1664. Cambridge, MA: Cambridge UP, 1985.
“Developers of Optical Printer Win Oscar for Special Effects.” *NYT*, April 3, 1981.
Dickinson, Desmond. “Desmond Dickinson Talks on Back Projection.” *Cine-Technician* 3, no. 9 (April 1937): 4–5, 2.
“Dodge Dunning Home.” *IP* 3, no. 5 (June 1931): 20.
“Double Exposure Patent Test Case Planned.” *FD* 46, no. 20 (October 23, 1928): 1, 4.
“Double-Exposure Patent Suit is Set for Hearing on Coast.” *FD* 69, no. 2 (January 3, 1936): 1, 4.
Draper, W. V. “I’d like to Build …” *IP* 12, no. 5 (June 1940): 8–9.
———. “Inventor at Work.” *IP* 12, no. 6 (July 1940): 16–17.
Draper, William Vernon. “Tailor Made Wipes.” *IP* 8, no. 6 (July 1936): 27–28.
———. “‘Topper’ Tippoffs.” *IP* 9, no. 7 (August 1937): 18–19.
Dubray, Joseph. “Movie Make-Up.” *AC* 8, no. 12 (March 1928): 8, 27.
———. “Visual Education.” *AC* 9, no. 11 (February 1929): 17–18.
Dubray, Joseph Albert. “The Evolution of the Motion Picture Professional Camera.” *Cinematographic Annual* 1 (1930): 55–79.
Dunn, Linwood G. “Optical Printing and Technique.” *AC* 14, no. 11 (March 1934): 444–46.
———. “Tricks by Optical Printing.” *AC* 14, no. 12 (April 1934): 487, 496.
———. “Optical Printing and Technic.” *JSMPE* 26, no. 1 (January 1936): 54–66.
———. “Optical Printer Handy Andy.” *IP* 10, no. 5 (June 1938): 14–16.
———. “Explaining ‘Montage.’” *AC* 23, no. 8 (August 1942): 359, 364, 366.
———. “The New Acme-Dunn Optical Printer.” *AC* 25, no. 1 (January 1944): 11, 29.
———. “The New Acme-Dunn Optical Printer.” *JSMPE* 42, no. 4 (April 1944): 204–10.
———. “Historic Facts about the Acme-Dunn Optical Printer.” *AC* 62, no. 5 (May 1981): 479.
Dunn, Linwood G., and Academy of Motion Picture Arts and Sciences. “An Evening of Special Visual Effects.” Transcript. October 9, 1978. MHL.
“Dunning Has Three-Color Process Now Ready to Go.” *AC* 19, no. 10 (October 1938): 406, 416.
Dunning Process Company. “Outdoor Action Background.” Advertisement. *IP* 1, no. 7 (August 1929): 14.
———. “Dunning Process.” Advertisement. *IP* 2, no. 7 (August 1930): 28.
Dunning, C. Dodge. “Composite Photography.” *TSMPE* 12, no. 36 (September 1928): 975–79.
———. “Composite Photography.” *AC* 9, no. 11 (February 1929): 14, 16.
Dunning, Carroll H. “Patents vs. Patents vs. Practice.” *AC* 10, no. 1 (April 1929): 18, 35.
———. “Some Problems Related to Composite Photography.” *AC* 10, no. 3 (June 1929): 9, 20, 23.
———. “Typical Problems in Process Photography.” *TSMPE* 13, no. 38 (May 1929): 298–302.

———. “Dunning Process and Process Backgrounds.” *JSMPE* 17, no. 5 (November 1931): 743–48.

“Dunnings Enter Industrial Field.” *IP* 4, no. 8 (September 1932): 29.

DuPar, Edwin B. “Special Effects.” *Warner Club News*, January 1942, 15, 22.

“Duplex Laboratory.” *FD* 27, no. 4 (January 6, 1924): 2.

“Duplex Printer Model.” *IP* 10, no. 8 (September 1938): 6–7.

Dupy, O. L. “Some Applications of the Selsyn Motor: The Interlocking Principle as Utilized in Motion Pictures.” *Motion Picture Projectionist* 5, no. 9 (July 1932): 6–7, 29–30.

Earle, Ferdinand P. “Screen Renaissance Through Motion Painting.” In *The Blue Book of the Screen*, 345–48. Hollywood: Blue Book of the Screen, 1923. Open Library: ia:bluebookofscreen00unse.

“Eastman Issues Super Sensitive Panchromatic Negative Type Two.” *IP* 3, no. 2 (March 1931): 4–5.

Eastman Kodak Company. “A Question Answered.” *JSMPE* 22, no. 1 (January 1934): 80.

“Eastman Research Lab Opened in Hollywood.” *AC* 10, no. 2 (May 1929): 23.

Edouart, Alexander Farciot. “The Work of the Process Projection Equipment Committee of the Research Council, Academy of Motion Picture Arts and Sciences.” *JSMPE* 33, no. 3 (September 1939): 248–53.

Edouart, Farciot. “Economic Advantages of Process Photography.” In *Technical Bulletin*, 1–10. Supplement No. 9. Hollywood: Academy of Motion Picture Arts & Sciences, July 20, 1932.

———. “The Transparency Projection Process.” *AC* 13, no. 3 (July 1932): 15, 39.

———. “Using Projection in Photography.” *Motion Picture Projectionist* 5, nos. 10, 11 (August 1932): 21, 22, 34, 22, 23.

———. “Special Laboratory for Transparencies.” *AC* 15, no. 5 (September 1934): 205, 212.

———. “Paramount Triple-Head Transparency Process Projector.” *JSMPE* 33, no. 2 (August 1939): 171–84.

———. “The Evolution of Transparency Process Photography.” *AC* 24, no. 10 (October 1943): 359, 380, 382, 386.

———. “The Paramount Transparency Process Projection Equipment.” *JSMPE* 40, no. 6 (June 1943): 368–73.

———. “High-Efficiency Stereopticon Projector for Color Background Shots.” *AC* 25, no. 10 (October 1944): 332–33, 352.

———. “High-Efficiency Stereopticon Projector for Color Background Shots.” *JSMPE* 43, no. 2 (July 1944): 97–105.

———. “The Paramount Transparency Process Projection Equipment.” *International Projectionist* 19, no. 9 (August 1944): 7.

———. “25 Years of Progress.” *AC* 26, no. 11 (November 1945): 368–69, 378, 402.

“Edwina Booth, 86: Actress Who Won Fame Due to Illness.” *NYT*, May 24, 1991.

Engell, Lorenz, and Bernhard Siegert. Editorial. *Zeitschrift für Medien- und Kulturforschung*, no. 2 (2013): 5–10.

“Enormous Spectacle With Pleasing Color Features Startles Broadway.” *FD* 27, no. 39 (February 17, 1924): 34.

Triangle Magazine. “Enter the Cina-Luminist.” June 2, 1917.

“Expansion With a Big ‘E.’” *IP* 2, no. 1 (February 1930): 34–35.

Factor, Max. “Movie Make-Up.” *AC* 9, no. 3 (June 1928): 22–23.

“Fantastic Dr. Cyclops.” *IP* 12, no. 2 (March 1940): 17.

Fear, Ralph G. “Projected Background Anematography: A New Method of Making Composite Photographs.” *AC* 12, no. 9 (January 1932): 11–12, 26.

Fielding, Raymond. “Special-Effects Cinematography: A Bibliography.” *JSMPTE* 69, no. 6 (June 1960): 421–24.

———. “Norman O. Dawn: Pioneer Worker in Special Effects.” *JSMPTE* 72, no. 1 (1963): 15–23.

Fink, Daniel A. “Vermeer’s Use of the Camera Obscura: A Comparative Study.” *The Art Bulletin* 53, no. 4 (1971): 493–505. doi:10.2307/3048905.

“First Rear Projection Specifications.” *IP* 11, no. 2 (March 1939): 21–24.

“Flatlight Screen Moves.” *FD* 74, no. 126 (December 15, 1938): 3.

Flückiger, Barbara. “Timeline of Historical Film Colors.” http://zauberklang.ch/filmcolors/.

———. “Timeline of Historical Film Colors: Prizma II.” http://zauberklang.ch/filmcolors/timeline-entry/1235/.

Frayne, J. G., M. Abribat, W. P. Bielicke, L. Busch, G. A. Chambers, A. A. Cook, J. A. Dubray, et al. "Progress in the Motion Picture Industry." *JSMPE* 20, no. 6 (June 1933): 459–99.

Frayne, J. G., M. Abribat, L. Busch, F. E. Cahill Jr., G. A. Chambers, A. A. Cook, C. Dreher, et al. "Progress in the Motion Picture Industry." *JSMPE* 19, no. 2 (August 1932): 117–59.

Frayne, J. G., F. G. Albin, W. H. Bahler, L. E. Clark, E. W. Engstrom, R. E. Farnham, J. L. Forrest, F. L. Hopper, and G. E. Matthews. "Progress in the Motion Picture Industry: Report of the Progress Committee for the Year 1938." *JSMPE* 33, no. 2 (August 1939): 119–57.

Frayne, J. G., W. H. Bahler, L. N. Busch, R. E. Farnham, J. L. Forrest, F. L. Hopper, G. E. Matthews, and V. E. Miller. "Progress in the Motion Picture Industry: Report of the Progress Committee." *JSMPE* 31, no. 2 (August 1938): 109–43.

Friedl, Fritz von. "Neue Trickmöglichkeiten?" *Kinotechnik* 8, no. 17 (1926): 448–49.

Fulton, John P. "How We Made the Invisible Man." *AC* 15, no. 5 (September 1934): 200–201, 214.

Garbutt, Frank E. "Laboratory Technique for Sound Pictures." In *Recording Sound for Motion Pictures*, 1st ed., edited by Lester Cowan, 180–95. New York: McGraw-Hill, 1931.

Geib, E. R. "The High Intensity Arc in Projection." *Projection Engineering* 3, no. 5 (May 1931): 14–15.

Gibbons, Cedric. "The Set As An Actor." *AC* 12, no. 10 (February 1932): 30.

Gibson, C. Carter. "Special Effects." *Warner Club News*, November 1939, 8.

Gillette, C. S. "Testing Motion Picture Machines for Naval Use." *AC* 5, no. 6 (September 1924): 21–25.

The Literary Digest. "'Glass Work': The Lastest Movie Trick." February 2, 1924, no. 5, 22.

"Glossary of Technical Terms Used in the Motion Picture Industry." *TSMPE* 13, no. 37 (May 1929): 48–64.

Goldsmith, A. N. "Problems in Motion Picture Engineering." *JSMPE* 23, no. 6 (December 1934): 350–55.

Goldsmith, Alfred N. "Technical Aspects of the Motion Picture." *JSMPE* 25, no. 3 (September 1935): 254–58.

Gomery, Douglas. "Economic Struggle and Hollywood Imperialism: Europe Converts to Sound." In *Film Sound: Theory and Practice*, edited by Elisabeth Weis and John Belton, 25–36. New York: Columbia UP, 1985.

Goodman, Ezra. "Production Designing." *AC* 26, no. 3 (March 1945): 82–83, 100.

Gregory, Carl Lewis. "'Trick' Photography Methods Summarized." *AC* 7, no. 3 (June 1926): 9, 16–17, 20–22.

Gregory, Carl Louis. "Trick Photography." *TSMPE*, no. 25 (September 1926): 99–107.

———. "Instruction in Motion Picture Photography." *TSMPE* 10, no. 28 (February 1927): 303–8.

———. "An Optical Printer for Trick Work." *TSMPE* 12, no. 34 (April 1928): 419–26.

———. "Optical Printer for Trick Work." *Motion Picture Projectionist* 2, no. 4 (January 1929): 7, 16–17.

———. "The Early History of Wide Films." *AC* 10, no. 10 (January 1930): 5, 29.

Griffin, Herbert. "Background Process Projector." *International Projectionist*, July 1936, 13.

Grimm, Charles "Buckey." "Carl Louis Gregory." 1998. http://cinefan.tripod.com/CarlLouisGregory.htm.

———. "Carl Louis Gregory: Life through a Lens." *Film History* 13, no. 2 (2001): 174–84. JSTOR: 3815424.

Gross, Foster. "Cinematography Now in Transitional Stage." *AC* 6, no. 4 (July 1925): 6.

"Hammeras in California." *FD* 38, no. 26 (October 31, 1926): 13.

"Hammeras Sells Patent." *FD* 38, no. 78 (December 31, 1926): 1.

Hammeras, Ralph. Untitled advertisement. In *The Film Year Book*, 9th ed., 286. New York: Film Daily, 1927.

———. "An American Cameraman in American Studios." *IP* 7, no. 5 (June 1935): 20, 24.

"Handschiegl Gets Patents on Photographic Process." *FD* 54, no. 76 (March 30, 1928): 2.

"Handschiegl Process." *Weekly Variety*, September 8, 1926.

"Hans F. Koenekamp." *AC* 2, no. 1 (February 1, 1922): 51.

Harcus, W. C. "Making a Motion Picture." *JSMPE* 17, no. 5 (November 1931): 802–10.

Hardy, Arthur C. "The Depth of Field of Camera Lenses: With Special Reference to Wide Film." *AC* 11, no. 12 (April 1931): 12–14.

Harmer, Paul R. “Glass, Miniature and Projection Combined.” *IP* 6, no. 10 (November 1934): 12–13.

———. “The Mathematics of Motion Picture Miniature.” *IP* 6, no. 2 (March 1934): 8–10.

Harrison, Hartley. “Problems of Background Projection.” *AC* 14, no. 9 (January 1934): 353, 386.

Haskin, Byron. “Making Modern Matte-Shots. Article I.” *AC* 20, no. 11 (November 1939): 493–95, 526.

———. “The Development and Practical Application of the Triple-Head Background Projector.” *JSMPE* 34, no. 3 (March 1940): 252–58.

Hawkins, L. A. “Research in Industry.” *AC* 9, no. 2 (May 1928): 35–38.

Hearon, Fanning M. “The US Naval Photographic Services Depot.” *JSMPE* 45, no. 4 (October 1945): 294–96.

Hediger, Vinzenz. “Das Wunder des Realismus: Transsubstantiation als medientheoretische Kategorie bei André Bazin.” *montage AV* 18, no. 1 (2009): 75–107.

Hennion, Antoine, and Bruno Latour. “How to Make Mistakes on So Many Things at Once—and Become Famous for It.” In *Mapping Benjamin: The Work of Art in the Digital Age*, edited by Hans Gumbrecht and Michael Marrinan, 91–97. Stanford, CA: Stanford UP, 2003.

Hensel, Thomas, and Jens Schröter. “The Akteur-Netzwerk-Theorie als Herausforderung der Kunstwissenschaft.” *Zeitschrift für Ästhetik und Allgemeine Kunstwissenschaft* 57, no. 1 (2012): 5–18.

Hewlett, E. M. “The Selsyn System of Position Indication.” *General Electric Review* 24, no. 3 (March 1921): 210–18.

Hickman, K. C. D. “Hollywood and the Motion Picture Engineers.” *TSMPE* 11, no. 29 (July 1927): 34–44.

Hill, George. “Back Projection.” *Cine-Technician* 14, no. 1 (January 1948): 29–31.

———. “Effects Department.” *Cine-Technician* 14, no. 1 (January 1948): 22, 24–15.

Hineline, H. D. “Composite Photographic Processes.” *JSMPE* 20, no. 4 (April 1933): 283–300.

Hitchins, Alfred B. “Miniatures and Models for Motion Picture Use.” *AC* 3, no. 8 (November 1922): 13, 23–24.

———. “Duplex Optical Printers.” *TSMPE* 11, no. 32 (1927): 771–74.

Hoffman, Judi. “The Discourse of ‘Special Effects’ Cinematography in the Silent American Cinema.” *Post Script* 10, no. 1 (Fall 1990): 30–49.

———. “The Norman O. Dawn Collection of Cinematic Effects.” *The Library Chronicle of the University of Texas at Austin* 20, no. 3 (1990): 97–121.

Hollis, A. P. “The Film Prayer.” *Visual Education* 3, no. 1 (January 1922): 41.

“Hollywood Startles Eskimo Actors.” *NYT*, August 6, 1933.

“Hollywood’s Service Army.” *IP* 10, no. 3 (April 1938): 11–13.

Popular Mechanics. “How the Moving-Picture Camera Lies: By Fibbing Scientifically and Artistically it Adds Last Touch of Realism to Screen.” December 1923, no. 6, 878–81. Google Books: LNoDAAAAMBAJ.

“How ‘Trader Horn’ Was Made.” *Photoplay* 39, no. 5 (April 1931): 30, 129.

Howard, T. “The Optical Printer and Its Applications.” *British Kinematography* 5, no. 3 (July 1942): 77–86.

Hubbard, Roscoe C. “Printing Motion Picture Film.” *TSMPE* 10, no. 28 (February 1927): 252–78.

Huse, Emery. “The Characteristics of Eastman Motion Picture Negative Films.” *AC* 17, no. 5 (May 1936): 190–92, 202–.

Huse, Emery, and Gordon A. Chambers. “Eastman Supersensitive Motion Picture Negative Film.” *Projection Engineering* 3, no. 12 (December 1931): 21–23.

———. “Eastman Supersensitive Panchromatic Type Two Motion Picture Film.” *IP* 3, no. 2 (March 1931): 5–6.

———. “New Eastman Emulsions: Advance Technical Data on Sensational New Emulsions.” *IP* 10, no. 11 (December 1938): 23–25, 27.

———. “Three New Eastman Negative Emulsions: Background X, Plus X, and Super XX.” *AC* 19, no. 12 (December 1938): 487–90, 525.

Hutchins, G. F. “Dimensional Analysis as an Aid to Miniature Cinematography.” *JSMPE* 14, no. 4 (April 1930): 377–83.

“‘Ideal’ in 4 Tongues under Dunning Process.” *Film Daily* 55, no. 1 (January 2, 1931): 1.

“Imagining New York City of 1980.” *IP* 2, no. 10 (November 1930): 30–31.

“Improved Mount for Process Projector.” *AC* 15, no. 2 (June 1934): 70–71.

"In Memoriam: Linwood Dunn, ASC." *AC* 79, no. 7 (July 1998): 126.

"In re Application of Arthur E. Reeves Court of Customs and Patent Appeals." *The United States Patents Quarterly*, 1934.

Ives, C. E., and J. I. Crabtree. "Two New Films for Duplicating Work." *JSMPE* 29, no. 3 (September 1937): 317–25.

Ives, C. E., and E. Huse. "Notes on Making Duplicate Negatives." *TSMPE* 12, no. 34 (April 1928): 382–89.

Ives, C. E., L. E. Muehler, and J. I. Crabtree. "Making a Fade-Out by after Treatment." *JSMPE* 20, no. 1 (January 1933): 65–78.

"Jackman Develops Color Process and Will Extend Plant to Handle." *AC* 19, no. 2 (June 1938): 229.

"Jackman Returns To Business." *AC* 18, no. 4 (April 1937): 137, 145, 147.

Jackman, Fred W. "Comedy 'Kicks' Require Courage and Skill." *AC* 3, no. 9 (December 1922): 5–6, 23.

———. "The Special-Effects Cinematographer." *AC* 13, no. 6 (October 1932): 12–13, 42–44.

———. "Organization of a Special Effects Department." In *Technical Bulletin*, 1934:1–3. 10. Hollywood: Academy of Motion Picture Arts & Sciences, September 28, 1934.

———. "Patents and the Cinematographer." *AC* 14, no. 9 (January 1934): 358, 380.

———. "'Process-Shot' Economies Made 'Captain Blood' Possible." *AC* 17, no. 2 (February 1936): 48–49, 61–62.

———. "Process Engineering: Special Effects Cinematography From an Engineering Viewpoint." *AC* 18, no. 6 (June 1937): 232, 244.

———. "The Evolution of Special-Effects Cinematography from an Engineering Viewpoint." *JSMPE* 29, no. 3 (September 1937): 293–302.

Jacobsen, Philip A. "Tailor Made Fades and Laps with a Cine Special." *AC* 26, no. 1 (January 1945): 12–13.

Jahraus, Don. "Making Miniatures." *AC* 12, no. 7 (November 1931): 9–10, 41.

Jenkins, C. Francis. "The Engineers and His Tools." *JSMPE* 15, no. 2 (August 1930): 260–62.

Jenkins, Reese V. "Technology and the Market: George Eastman and the Origins of Mass Amateur Photography." *Technology and Culture* 16, no. 1 (1975): 1–19. doi:10.2307/3102363.

Jennings, Gordon. "How Miniatures are Photographed." *AC* 15, no. 2 (June 1934): 60–.

———. "Special-Effects and Montage for 'Cleopatra.'" *AC* 16, no. 8 (December 1934): 350, 354.

Jewell, Richard B. "How Howard Hawks Brought Baby Up: An Apologia for the Studio System." In Staiger, *The Studio System*.

———. "Orson Welles and the Studio System: The RKO Context." In *Perspectives on Citizen Kane*, edited by Ronald Gottesman. New York: G.K. Hall, 1996.

Jones, L. A. "Photographic Reflecting Power of Colored Objects." *AC* 9, no. 3 (June 1928): 9–11.

Jones, Loyd A. "Light Filters, Their Characteristics and Applications in Photography." *TSMPE* 9, no. 30 (August 1927): 135–81.

———. "The Photographic Reflecting Power of Colored Objects." *TSMPE* 11, no. 31 (1928): 564–81.

———. "Rectangle Proportions in Pictorial Compositions." *JSMPE* 14, no. 1 (January 1930): 32–49.

Jones, Loyd A., and J. I. Crabtree. "Panchromatic Negative Film for Motion Pictures." *TSMPE* 10, no. 27 (January 1927): 131–78.

Kains, Maurice. "Hot Points." *IP* 2, no. 5 (June 1930): 130.

Kalmus, Herbert T. "Technicolor Adventures in Cinemaland." *JSMPE* 31, no. 6 (December 1938): 564–85.

Katti, Christian S. G. "Mediating Political 'Things,' and the Forked Tongue of Modern Culture: A Conversation with Bruno Latour." *Art Journal* 65, no. 1 (2006): 94–115. doi:10.2307/20068453.

Kelley, William Van Doren. "Trick Photography." *TSMPE* 10, no. 27 (January 1927): 128–30.

———. "Handschiegl and Pathéchrome Color Processes." *JSMPE* 17, no. 2 (August 1931): 230–34.

Kellogg, Ray, and L. B. Abbott. "Some Special Photographic Effects Used in Motion-Picture Production." *JSMPTE* 64, no. 2 (February 1955): 57–61.

Kemp, Wolfgang. "Für eine Kunstgeschichte der Komplexität." *Texte zur Kunst* 2, no. 2 (1991): 89–101.

Kiel, John P. "Film Registration Systems Used in Process Photography." *JSMPTE* 71, no. 1 (July 1962): 493–94.

Kinema, Dr. “The Clinic.” *Amateur Movie Makers* 3, no. 5 (May 1928): 352.
Knechtel, Alvin Victor. “Trailing the Tropics With a Tripod.” *Motion Picture Magazine* 22, no. 12 (January 1922): 43, 91–92.
Knechtel, Lloyd. “Optical Printing.” *IP* 2, no. 6 (July 1930): 12.
———. *Cinematographic Annual* 2 (1931): 429.
———. “Optical Printing.” *Cinematographic Annual* 2 (1931): 267–70.
Knott, Charles E. “Some Observations on the Back-Projection Process.” *Cine-Technician* 1, no. 4 (February 1936): 109–10.
Koenig, William. “The Organization and Activities of the Research Council of the Academy of Motion Picture Arts and Sciences.” *JSMPE* 29, no. 5 (November 1937): 484–88.
Korman, Gene. “Solving the Stills Problem.” *AC* 5, no. 3 (June 1924): 4, 17.
Kountz, Carl. “A Laboratory on Location.” *IP* 2, no. 9 (October 1930): 18, 20.
Krows, Arthur Edwin. “Motion Pictures—Not For Theatres.” *Educational Screen*, April 1941, 150–52.
Kruse, J. Henry. “New Projector for Background Process Shots.” *IP* 5, no. 5 (June 1933): 23.
Kümmel-Schnur, Albert. “Patente als Agenten von Mediengeschichte.” In Kümmel-Schnur and Kassung, *Bildtelegraphie*, 15–38.
Kuplent, Friedrich. “Wozu die Kopiermaschine auch gut ist.” *Film für Alle* 4, no. 8 (August 1930): 218–21.
———. “Ich bringe Ihnen die Pläne und Erklärungen für das optische Kopierverfahren.” *Jahrbuch des Kino-Amateurs*, 1934, 55–65.
———. “Optisches Kopieren.” *Film für Alle* 8 (February 1934): 44–47.
Kutzleb, Leopold. “Der ‘Handschiegl Prozess,’ ein neues (?) Trickverfahren.” *Kinotechnik* 8, no. 17 (1926): 443–44.
———. “Neues von französischen Apparatebau.” *Kinotechnik* 12, no. 2 (June 5, 1930): 298–300.
———. “Das Dunning-Aufnahmeverfahren.” *Kinotechnik* 13 (July 3, 1931): 230–32.
———. “Ueber Nachsynchronisieren.” *Kinotechnik* 13, no. 9 (May 5, 1931): 163.
———. “Der gegenwärtige Stand der Bildkombinationsverfahren.” *Kinotechnik* 15, no. 6 (March 20, 1933): 99–104.
———. “Spezial-Projektor für das Hintergrund-Projektionsverfahren.” *Kinotechnik* 15, no. 14 (July 20, 1933): 287.
———. “Neues zum Hintergrundprojektionsverfahren.” *Kinotechnik* 17, no. 6 (March 20, 1935): 97–98.
———. “Neueres über Bildkombinations-Verfahren.” *Kinotechnik* 18 (1936): 162–65, 180–82, 210–13.
———. “Neueres über Bildkombinations-Verfahren.” *Kinotechnik* 18, no. 11 (June 5, 1936): 180–82.
———. “Neueres über Bildkombinations-Verfahren.” *Kinotechnik* 18, no. 13 (July 5, 1936): 210–13.
———. “Neueres über Bildkombinations-Verfahren.” *Kinotechnik* 18, no. 10 (May 20, 1936): 162–65.
Lastra, James. “Standards and Practices: Aesthetic Norm and Technological Innovation in the American Cinema.” In Staiger, *The Studio System*, 200–225.
Latour, Bruno. “Drawing Things Together.” In *Representation in Scientific Practice*, edited by Michael Lynch and Steve Woolgar. Cambridge, MA: MIT Press, 1990.
———. “Technology is Society Made Durable.” In *A Sociology of Monsters: Essays on Power, Technology and Domination*, edited by John Law, 103–31. London: Routledge, 1991.
———. “On Actor-Network Theory: A Few Clarifications.” *Soziale Welt* 47, no. 4 (1996): 369–81.
———. “How to Be Iconophilic in Art, Science, and Religion?” In *Picturing Science, Producing Art*, edited by Caroline A. Jones and Peter Galison, 418–40. New York: Routledge, 1998.
———. “Why has Critique Run out of Steam?: From Matters of Fact to Matters of Concern.” *Critical Inquiry* 30, no. 2 (2004): 225–48. doi:10.1086/421123.
———. “From Realpolitik to Dingpolitik.” In Latour and Weibel, *Making Things Public*, 14–44.
Law, John, and Ruth Benschop. “Resisting Pictures: Representation, Distribution and Ontological Politics.” In *Ideas of Difference: Social Spaces and the Labour of Division*, edited by Kevin Hetherington and Rolland Munro, 158–82. Oxford: Wiley-Blackwell, 1997.

Law, John, and Michel Callon. "Engineering and Sociology in a Military Aircraft Project: A Network Analysis of Technological Change." *Social Problems* 35, no. 3 (1988): 284–97. doi:10.2307/800623.

———. "The Life and Death of an Aircraft: A Network Analysis of Technical Change." In Bijker and Law, *Shaping Technology/Building Society*, 21–52.

Leigh, E. P. "Back Projection." *Brit. J. Phot.* 87 (March 29, 1940): 158–60.

Leisen, James Mitchell. "Some Problems of the Art Director." *TSMPE* 12, no. 33 (April 1928): 71–80.

Lerpee, Paul. "Travelling Matte Tricks with 16 MM. Negative." *AC* 16, no. 8 (August 1935): 352–53, 362, 364.

Linden, Edwin G. "Glass Shots in Color." *IP* 8, no. 4 (May 1936): 22.

"Lloyd Knechtel." *Hollywood Reporter* 15, no. 33 (June 26, 1933): 20.

Lodge, John E. "Camera Wizards of the Movies bring New Realism to the Screen." *Popular Science*, August 1936, no. 2, 22–24, 109.

Luhr, William, and Peter Lehman. "'Would you mind just trying it': An Interview with Special Effects Artist Linwood Dunn, ASC." *Wide Angle*, 1976, 78.

"Making Our Trademark." *RKO Studio Club News* 4 (December 1941): 29.

Photoplay. "Making Rain While the Sun Shines." December 1918, no. 1, 56.

Matthews, Glenn E., M. Abribat, J. A. Ball, J. Boolsky, W. Clark, J. B. Engl, R. E. Farnham, et al. "Progress in the Motion Picture Industry." *JSMPE* 15, no. 6 (December 1930): 759–808.

Matthews, Glenn E., M. Abribat, L. Busch, W. Clark, A. A. Cook, C. Dreher, R. E. Farnham, et al. "Progress in the Motion Picture Industry." *JSMPE* 17, no. 6 (December 1931): 906–53.

"Max Handschiegl." Obituary. *TSMPE* 12, no. 34 (April 1928): 574.

McCulloch, Campbell. "Boo! It's Only Hollywood!" *Photoplay* 39, no. 4 (March 1931): 84, 122–23.

McKay, H. C. "Printing Magic." *Movie Makers* 6, no. 1 (January 1931): 20–21, 42–44.

"Medicine: Trader Horn's Goddess." *Time*, 1934.

Mees, C. E. Kenneth. "History of Professional Black-and-White Motion-Picture Film." *JSMPTE* 63, no. 4 (October 1954): 134–37.

"Membership of the A. S. C. to Date – Feb., 1928." *AC* 9, no. 1 (April 1928): 15–16.

Menzies, William Cameron. "Pictorial Beauty in the Photoplay." *Cinematographic Annual* 1 (1930): 173–81.

Mescall, John. "'Pan-Focus' For Your Home Movies." *AC* 22, no. 12 (December 1941): 576, 593.

"Metropolitan Special Effects Department." *IP* 2, no. 5 (June 1930): 126.

"MGM's Effects Stage." *IP* 10, no. 1 (February 1938): 26.

Miller, Harold, and E. C. Manderfeld. "35-mm Process Projector." *JSMPE* 51, no. 4 (October 1948): 373–84.

Milne, Lorus J. "Transitions." *AC* 26, no. 3 (March 1945): 94, 96, 104.

Milner, Victor. "Fade Out and Slowly Fade In." *AC* 4, no. 6 (September 1923): 4, 23–24.

"Mitchell Background Projector." *AC* 28, no. 11 (November 1947): 391, 419.

Mohr, Hal. "A Lens Mount for Universal Focus Effects." *AC* 17, no. 9 (September 1936): 370–71.

Mole, Peter. "The Tungsten Lamp Situation in the Studio." *TSMPE* 11, no. 31 (September 1927): 582–90.

"Montage: A Look into the Future with Slavko Vorkapich." *Cinema Progress* 2, no. 5 (December 1937/1938): 18–21, 34.

Morgan, Daniel. "Rethinking Bazin: Ontology and Realist Aesthetics." *Critical Inquiry* 32, no. 3 (2006): 443–81.

"Movie Facts and Fancies." *Boston Evening Globe*, September 9, 1922, 12.

Popular Mechanics. "Movie Magic in the Making." December 1934, no. 12, 801–8, 126A. Google Books: yt8DAAAAMBAJ.

"Movie Men are Killed in Plane." *The Centralia, Washington, Daily Chronicle*, July 18, 1929, 6.

———. "Movie 'Trick Shots' Printed from Straight Film." May 1928, no. 5, 707. Google Books: 1N8DAAAAMBAJ.

———. "Movie Tricks that You Can Do." March 1936, no. 3, 388–91, 114A. Google Books: ztsDAAAAMBAJ.

"Mr. Garnett sees the World." *NYT*, May 1, 1938.

Mulvey, Laura. "A Clumsy Sublime." *Film Quarterly* 60, no. 3 (2007): 3. doi:10.1525/fq.2007.60.3.3.

"Navy Establishing New Photo Laboratory at Washington Air Station." *Phot. Trade News* 7 (February 1943).

"New Economical Trick Shot Camera." *IP* 9, no. 4 (May 1937): 5–6.

"New Photographic Process is Launched." *AC* 7, no. 5 (August 1926): 23.

"New Process to Cut Cost." *FD* 37, no. 38 (August 15, 1926): 12.

"New Theatre Light Control System: Lighting Operator in Front of Curtain Controls Theatre Lights Through Series of Knobs." *Projection Engineering* 1, no. 3 (November 1929): 14–15, 31.

"News from the Dailies." *Variety*, June 24, 1925.

Nielsen, Michael. "Hollywood's High Frontier: The Emergence of Electronic Cinema." *Journal of Film and Video* 36, no. 2 (1984): 31–42, 72. JSTOR: 20687603.

Norling, J. A. "Trick and Process Cinematography." *JSMPE* 28, no. 2 (February 1937): 136–57.

O'Brien, Willis H. "Miniature Effects Shots." *IP* 5, no. 4 (May 1933): 38–39.

Oliver, Myrna. "Obituaries; Linwood Dunn; Film Effects Expert." *LAT*, May 22, 1998, 5.

"Optical Printer for RKO." *IP* 1 (July 1929): 26.

"Optische Umkopiermaschine 'Arri.'" *Kinotechnik* 16, no. 5 (March 5, 1934): 86.

Ornstein, William. "G. E. Develops New 'Curtain Light Operator' for Theater." *FD* 50, no. 17 (October 20, 1929): 11.

Ostrowska, Dorota. "Magic, Emotions and Film Producers: Unlocking the 'Black-Box' of Film Production." *Wide Screen* 2, no. 2 (2010). http://widescreenjournal.org/index.php/journal/article/view/22.

"Our Brother Alvin Knechtel." *IP* 1, no. 7 (August 1929): 22.

Palmer, Ransom. "Fades, Lap-Dissolves and Other Tricks." *AC* 26, no. 8 (August 1945): 366.

Palmer, W. A. "Printers from Projectors." *Camera Craft* 41 (January 1934): 39–41.

———. "The Optical Printer." *Camera Craft* 43 (November 1936–December 1963): 544–46, 595–8.

Parsons, Louella O. "In and Out of Focus: The Artist and the Screen." *The Morning Telegraph* 99, no. 53 (February 26, 1922): 6.

Perry, Harry. "Eliminate Death from Air Cinematography." *AC* 5, no. 8 (November 1924): 8.

Photo-Sonics, Inc. "Company History: A Brief Synopsis." http://www.photosonics.com/company_history.htm.

Physioc, Lewis W. "Simplicity and Motion Pictures." *AC* 8, no. 7 (October 1927): 6, 18, 24–25.

———. "Pictorial Composition: Short Cuts to Results Through Study of Methods of Those Who Have Achieved Success." *AC* 9, no. 2 (May 1928): 20–21.

Physioc, Louis W. "Photography Among The Fine Arts." *AC* 9, nos. 6/7 (September 1928): 15, 22–23.

———. "Cinematography an Art Form." *Cinematographic Annual* 1 (1930): 21–28.

Pohlmann, G. "Die optische Kopiermachine als Hilfsmittel für den Kameraman [Optical Printer as an Aid to the Cameraman]." *Kinotechnik* 14, no. 3 (February 5, 1932): 45–48.

Polito, Sol. "The Mountain Comes to Mohammed." *AC* 22, no. 6 (June 1941): 264–65, 298–9.

"Pomeroy Leaving Param't on January First." *Motion Picture News* 38, no. 23 (December 22, 1928): 1860.

"Pomeroy May Join British International: Settles Contract Troubles With Paramount And Will Go Abroad." *Motion Picture News* 39, no. 9 (March 2, 1929): 613.

Ponting, C. "Printing-In Clouds." *Amat. Photographer* 95 (November 14, 1945): 767–68.

Popovici, G. G. "Backgound Projection for Process Cinematography." *JSMPE* 24, no. 2 (February 1935): 102–9.

Powell, J. "Projection Printing." *Defender Trade Bull* 21 (May–June 1937): 13–16.

Prindle, Wright, Neal and Bean. "The Dawley Patent." *AC* 10, no. 1 (April 1929): 4–5, 34.

"Process for Stills." *IP* 9, no. 9 (October 1937): 28.

"Process Progress." *IP* 11, no. 1 (February 1939): 7.

"Producers Pool 46 Patents as First Step to Wholesome Action." *Motion Picture Herald* 124, no. 12 (September 19, 1936): 56.

"Ray Mammes' Invention." *IP* 5, no. 5 (June 1933): 17.

Read, Paul. "A Short History of Cinema Film Post-Production: A Summary as the Basis for Future Research." In Polzer, *Zur Geschichte des Filmkopierwerks – A Short History of Cinema Film Post-Production*, 8:41–132.

Read, Paul. "'Unnatural Colours': An Introduction to Colouring Techniques in Silent Era Movies." *Film History* 21, no. 1 (2009): 7–46. JSTOR: 27670755.

"Rear Projection Big Advance." *IP* 10, no. 3 (April 1938): 30–33.

"Rear Projection in the Studio." *Ideal Kinema and Studio* 7 (June 15, 1933): 81.

"Rear Projection Standards." *IP* 11, no. 5 (June 1939): 18, 20.

"Rear Projector." *IP* 10, no. 5 (June 1938): 16.

Rella. "They Say …" *IP* 12, no. 11 (December 1940): 21.

Popular Mechanics. "Re-Making the World for the Movies." April 1936, no. 4, 546–49, 144A, 146A. Google Books: lNsDAAAAMBAJ.

Research Council, Academy of Motion Picture Arts and Sciences. "Process Projection Specifications." *International Projectionist* 14, no. 5 (May 1939): 17–18, 24–27.

———. "Process Projection Specifications: A Report by the Research Council, Academy of Motion Picture Arts and Sciences." *International Projectionist* 14, no. 6 (July 1939): 18, 26–27.

———. "Process Projection Specifications." *International Projectionist* 14, no. 7 (August 1939): 16, 23–25.

Research Council of the Academy of Motion Picture Arts and Sciences. "Recommendations on Process Projection Equipment." *JSMPE* 32, no. 6 (June 1939): 589–609.

"Research in Hollywood." *Projection Engineering* 4, no. 11 (November 1932): 9.

RKO Studio Club. "Presenting the Trick Department." *RKO Studio Club News*, December 1943, 38–39.

"RKO Trick Departments Consolidated." *AC* 13, no. 6 (October 1932): 45.

Roberts, Laurence J. "The Mitchell Camera: The Machine and Its Makers." *JSMPTE* 91, no. 2 (February 1982): 141–52.

Ryan, Roderick T. "Carl Louis Gregory." *JSMPTE* 82 (December 1973): 1008.

Salt, Barry. "Statistical Style Analysis of Motion Pictures." *Film Quarterly* 28, no. 1 (1974): 13–22. doi:10.2307/1211438.

———. "Reply to Bordwell & Thompson." *Film Quarterly* 40, no. 4 (1987): 59–61. doi:10.2307/1212270.

Salt, Barry, and Ernest Callenbach. "Peppery Salt." *Film Quarterly* 39, no. 2 (1985): 61–64. doi:10.2307/1212342.

Schallert, Edwin. "Interference: Exclusive Review of Paramount's Talkie." *Motion Picture News* 38, no. 17 (October 27, 1928): 1270.

Schmidgen, Henning. "The Materiality of Things?: Bruno Latour, Charles Péguy and the History of Science." *History of the Human Sciences* 26, no. 1 (2013): 3–28.

"Schoedsack tells the making of Dr. Cyclops." *AC* 21, no. 4 (April 1940): 158.

Schüttpelz, Erhard. "Der Punkt des Archimedes: Einige Schwierigkeiten des Denkens in Operationsketten." In *Bruno Latours Kollektive: Kontroversen zur Entgrenzung des Sozialen: Kontroversen zur Entgrenzung des Sozialen*, edited by Georg Kneer, Markus Schroer, and Erhard Schüttpelz, 234–58. Frankfurt/M.: Suhrkamp, 2008.

———. "Elemente einer Akteur-Medien-Theorie." In Thielmann and Schüttpelz, *Akteur-Medien-Theorie*, 9–67.

Scott, Wilton. "Making Clouds To Order Pays." *AC* 17, no. 3 (March 1936): 101–2.

Seawright, Roy, and William Vernon Draper. "Photographic Effects in the Feature Production 'Topper.'" *JSMPE* 32, no. 1 (January 1939): 60–72.

Seitz, John F. "Can a School Teach Cinematography?" *AC* 4, no. 4 (July 1923): 5.

Sersen, Fred W. "Making Matte Shots." *AC* 10, no. 4 (July 1929): 31.

———. "Making Matte Shots." *Cinematographic Annual* 2 (1931): 87–92.

———. "Special Photographic Effects." *JSMPE* 40, no. 6 (June 1943): 374–79.

Popular Mechanics. "Sharpening the Navy's Camera Eyes." March 1945, no. 3, 40–42, 154, 156. Google Books: it8DAAAAMBAJ.

Shay, Don. "Willis O'Brien: Creator of the Impossible." *Cinefex*, no. 7 (January 1982).

Shea, Robert P. "Procedures of Registration in Process Photography." *JSMPTE* 64, no. 10 (October 1955): 559–60.

Sherlock, James A. "Making Clouds Roll By." *AC* 17, no. 8 (August 1936): 344, 357.

"Sight Replaces Cue System in New Lighting Control: Selsyn Adapted to Light Regulation—Dimming and Changes Controlled From Board Located in Front Curtian—Pre-Setting Feature." *Motion Picture News*, November 2, 1929, 58, 83.

Singer, R. "Trick Optical Work." *Tech. cinémat.* 5 (April 1934): 74–77.

"Slavko Vorkapich dropped by Radio." *HR* 13, no. 15 (February 6, 1933): 1.

Slifer, Clarence. "Miniature Photography at Night." *AC* 15, no. 2 (June 1934): 82, 94–97.
"Special Effects at RKO." *IP* 12, no. 11 (December 1940): 4.
Sprungman, O. I. "Smoothing Scene Transitions." *AC* 20, no. 12 (December 1939): 551–54.
Staiger, Janet. "Dividing Labor for Production Control: Thomas Ince and the Rise of the Studio System." *Cinema Journal* 18, no. 2 (1979): 16–25. doi:10.2307/1225439.
———. "The Hollywood Mode of Production: Its Conditions of Existence." Chap. 8 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 87–95.
———. "The Producer-Unit System: Management by Specialization after 1931." Chap. 25 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 320–29.
Stalder, Felix. Review of *Pandora's Hope: Essays on the Reality of Science Studies*, by Bruno Latour. *The Information Society* 16, no. 3 (2000): 245–47. doi:10.1080/01972240050133698.
"'State Fair' is Film Triumph." *IP* 5, no. 1 (February 1933): 20.
Stevens, George. "From Larpae to Jackman to Chance." *AC* 33, no. 12 (December 1952): 538.
Stoller, H. M. "Synchronization and Speed Control on Synchronized Sound Pictures." *TSMPE* 12, no. 35 (1928): 696–708.
"Studio Gossip." *Exibitors Daily Review* 24, no. 36 (August 13, 1928): 3.
Stull, William. "Multiple Exposure Cinematography in Sound Pictures." *AC* 10, no. 9 (December 1929): 4, 39.
———. "The Movies Reach College." *AC* 10, no. 3 (June 1929): 16, 29.
———. "Multiple Exposure Cinematography in Sound Pictures." *JSMPE* 14, no. 3 (March 1930): 318–22.
———. "Warner Brothers' New Camera." *AC* 11, no. 8 (December 1930): 11, 30.
———. "The Baker Process." *AC* 13, no. 5 (September 1932): 14, 25.
———. "The Dieterich Process for Composite Photography." *AC* 13, no. 11 (March 1933): 9, 32–33.
———. "Improvising Camera Tricks." *AC* 15, no. 8 (December 1934): 346, 354–55.
———. "Producers Pool Composite Process Patents." *AC* 17, no. 11 (November 1936): 461, 466–68.
———. "Process Shots Aided by Triple Projector." *AC* 20, no. 8 (August 1939): 363–66, 376.
———. "Technical Progress in the Past Year." *AC* 20, no. 1 (January 1939): 8–10, 46.
———. "Amateur Progress in 1939 Exceeded Professional. Part II." *AC* 21, no. 2 (February 1940): 77–78.
"Subway Express." *Film Daily* 55, no. 73 (March 29, 1931): 10.
"Sues 8 Producers." *FD* 36, no. 63 (June 14, 1926).
"Suit over Invention." *FD*, February 26, 1926.
Taha, Nadine. "Patent in Action: Das US-amerikanische Patent aus der Perspektive der Science and Technology Studies." *Zeitschrift für Medienwissenschaft*, no. 1 (2012): 36–48.
Tannura, P. "Movie Tricks Explained." *AC* 25, no. 7 (July 1944): 231.
Taves, Brian. "Robert Florey and the Hollywood Avant-Garde." In *Lovers of Cinema: The First American Film Avant-Garde, 1919-1945*, 94–117. Madison, WI: U of Wisconsin Press, 1995.
"Teague." *IP* 9, no. 6 (July 1937): 18–19.
"Teague Expands." *IP* 9, no. 7 (August 1937): 19.
Teague Process General Service Studios. "Teague Photographic Transparency Equipment." *IP* 8, no. 11 (December 1936): 34.
"Technical Progress in 1935." *AC* 16, no. 12 (December 1935): 512–13, 523–24.
"Technical Progress in the Industry During 1936." *AC* 17, no. 12 (December 1936): 502–3, 510–11.
"Technicians Discuss 'Citizen Kane.'" *Cine-Technician* 7, no. 34 (November 1941): 134–38, 149.
"Tek-Nik-Town." *IP* 5, no. 6 (July 1933): 36–37.
Terzo, Fred. "Special Effects." *Warner Club News*, September 1939, 12.
Terzo, Fred, and George Fenaja. "The Impossible becomes Possible." *Warner Club News*, September 1939, 3–4.
Thalberg, Irving. "Technical Activities of the Academy of Motion Picture Arts and Sciences." *JSMPE* 15, no. 1 (July 1930): 3–16.
Photoplay. "The Great Pyramids Move to Hollywood And the Egyptian Mummy Comes to Life!" December 1932, no. 1, 48–49.
Popular Mechanics. "The Latest Movie Magic." April 1933, no. 4, 586–88. Google Books: E-IDAAAAMBAJ.

"The MPPA Research Laboratory." *AC* 9, no. 2 (May 1928): 34.
"The New Acme-Dunn Optical Printer." *IP* 16, no. 2 (March 1944): 18.
"The Selsyn Motor." *Projection Engineering* 3, no. 1 (January 1931): 22.
"The Week's Headlines." *Film Daily* 39, no. 1 (January 2, 1927): 12.
Theisen, Earl. "The Story of Bell & Howell." *IP* 5, no. 9 (October 1933): 6–7, 24–25.
———. "In the Motion Picture Prop and Research Department." *IP* 6, no. 7 (August 1934): 4–5, 23.
———. "In the Realm of Tricks and Illusions." *IP* 6, no. 5 (June 1934): 8–11.
———. "The Evolution of the Motion Picture Story. Part I." *IP* 8, no. 3 (April 1936): 16–17, 22–23.
———. "The Evolution of the Motion Picture Story. Part II." *IP* 8, no. 4 (May 1936): 12–13, 27.
Theisen, W. E. "William Van Doren Kelley." *JSMPE* 24, no. 3 (March 1935): 275–77.
Thompson, Kristin. "Implications of the Cel Animation Technique." In De Lauretis and Heath, *The Cinematic Apparatus*, 106–19.
———. "Initial Standardization of the Basic Technology." Chap. 20 in Bordwell, Staiger, and Thompson, *The Classical Hollywood Cinema*, 262–80.
Tiffany, E. J. "The New Mitchell Background Projector." *AC* 24, no. 10 (October 1943): 363, 370.
Toland, Gregg. "Practical Gadgets Expedite Camera Work." *AC* 20, no. 5 (May 1939): 215–18.
———. "I Broke the Rules in 'Citizen Kane.'" *Popular Photography* 8, no. 8 (June 1941): 55, 90–91.
———. "Realism for 'Citizen Kane.'" *AC* 22, no. 2 (February 1941): 54–55, 80.
———. "How I Broke the Rules in 'Citizen Kane.'" In *Perspectives on Citizen Kane*, edited by Ronald Gottesman. Reprint, New York: G. K. Hall, 1996.
"Transparency Backgrounds by Roy Pomeroy's Process Make 'Location' Unnecessary." *Variety*, October 10, 1928, 4.
Turner, George. "Linwood G. Dunn, ASC." *AC* 66, no. 12 (December 1985): 34–42.
———. "Linwood Dunn, ASC, named for special award." *AC* 71, no. 2 (February 1990): 65–66.
Turner, George E. "The Evolution of Special Visual Effects." In Dunn and Turner, *The ASC Treasury of Visual Effects*, 15–82.
Turnock, Julie. "The Screen on the Set: The Problem of Classical Studio Rear Projection." *Cinema Journal* 51, no. 2 (Winter 2012): 157–62. doi:10.1353/cj.2012.0000.
Tuttle, Fordyce, and D. A. Young. "Illumination in Projection Printing of Motion Pictures." *JSMPE* 19, no. 1 (July 1932): 842–64.
Ty. "From Ty's Hollywood Notebook." *IP* 5, no. 4 (May 1933): 28–29.
United States. District Courts and United States. Court of Claims and West Publishing Company and United States. Court of Customs and Patent Appeals. "United States v. Furer et al., No. 15609." *Federal Supplement*, National reporter system, no. 47 (October 10, 1942).
"US Dismisses War Fraud Conspiracy Case: Tool Contract Deal Charged." *LAT*, December 18, 1942.
Usai, Paolo Cherchi. "The Color of Nitrate: Some Factual Observations on Tinting and Toning Manuals for Silent Films." In "Spring/Summer," *Image* 34, nos. 1-2 (1991): 29–38.
Van Trees, James, Jr. "Optical Printing." *IP* 14, no. 5 (June 1942): 18.
Vaughn, William S., and Fordyce Tuttle. "Curved Gates in Optical Printers." *JSMPE* 14, no. 6 (June 1930): 663–66.
"Vernon Walker Finds New York Hot." *IP* 2, no. 9 (October 1930): 45.
Vincendeau, G. "Hollywood Babel: The Multiple Language Version." *Screen* 29, no. 2 (1988): 24–39.
Vivié, J. "Tricks Used in Providing Backgrounds for Movie Sets." *Photographe*, no. 439 (1937): 230–34.
"Vorkapich Is the Boss of 'Montage' Business." *The Milwaukee Journal*, December 26, 1937, 3.
"Vorkapich to MGM." *HR* 15, no. 27 (June 19, 1933): 1.
Vorkapich, Slavko. "Motion and the Art of Cinematography." *AC* 7, nos. 8/9 (November–December 1926): 10–11, 19, 19.
———. "Cinematics: Some Principles Underlying Effective Cinematography." In *Cinematographic Annual*, 1:29–33. 1930.

———. "The Psychological Basis of Effective Cinematography," *Technical Bulletin* (Hollywood) 1934, no. 10 (Transitions and Time Lapses 1934): 8–11.

Wagner, William. "Why Our Film Capital is Air-Minded." *IP* 2, no. 5 (June 1930): 30, 32.

Walden, Harry. "Fades and Dissolves." *AC* 15, no. 8 (December 1934): 364, 379–80.

Walker, Vernon. "Special Process Technic." *JSMPE* 18, no. 5 (May 1932): 662–65.

Walker, Vernon L. "Vernon L. Walker, ASC." *AC* 12, no. 10 (February 1931): 29.

———. "Saunders Cellulose Screen Reduces 'Hot Spot.'" *AC* 13, no. 6 (October 1932): 11.

———. "Use of Miniatures in Process Backgrounds." *AC* 15, no. 4 (August 1934): 154, 162.

———. "Rhythmic Optical Effects for Musical Pictures." *AC* 17, no. 12 (December 1936): 504, 514.

Wall, E. J. "Some Patents for Trick Photography." *TSMPE* 11, no. 30 (August 1927): 328–33.

Wallace, Ernest L. "Patents as Related to Photography." *AC* 9, no. 12 (March 1929): 25–26.

Waller, Fred. "Illusions in Cinematography." *TSMPE* 11, no. 29 (July 1927): 61–71.

———. "The Needs of a Trick Photographer." *TSMPE* 11, no. 32 (September 1927): 663–66.

"Wanger Pic Important for Process Work." *IP* 10, no. 12 (January 1939): 16, 18.

"War Job Fee Fraud Charged: Trio Accused of Plot to Profit by Award of Tool Contracts." *LAT*, December 17, 1942.

Warren, Mame. "Focal Point of the Fleet: US Navy Photographic Activities in World War II." *The Journal of Military History* 69, no. 4 (October 2005): 1045–79. JSTOR: 3397179.

Weiberg, Birk. "Classical Hollywood as an Epistemological Network." *Journalism and Mass Communication* 2, no. 2 (February 2012): 421–27.

Wellman, Harold E. "Composite Process Photography." In Dunn and Turner, *The ASC Treasury of Visual Effects*, 211–20.

Westerberg, Fred. "Considering Focus Depth Problems." *IP* 2, no. 10 (November 1930): 6–7, 46.

Westheimer, Joseph. "Principles of Special Photographic Effects." *JSMPTE* 63, no. 6 (December 1954): 217–22.

"What is the Academy doing?" *AMPAS Bulletin*, no. 14 (September 18, 1928): 1–2.

"What They Use in Hollywood." *Cinematographic Annual* 1 (1930): 549–75.

Wilk, Ralph. "A Little From 'Lots.'" *FD* 54, no. 53 (December 3, 1930): 7.

———. "Hollywood Flashes." *FD* 54, no. 49 (November 28, 1930): 6.

———. "A Little From 'Lots.'" *FD* 59, no. 69 (June 21, 1932): 4.

Wilkinson, James R. "Motion Picture Laboratory Practices." *JSMPE* 39, no. 3 (September 1942): 166–85.

Williams, Frank D. "Trick Photography." *TSMPE* 12, no. 34 (April 1928): 537–40.

———. "Inventor Describes New Process." *IP* 4, no. 8 (September 1932): 10.

"Wizard of Miniatures." *IP* 12, no. 2 (March 1940): 16, 26.

Wolter, Konrad. "Neue Trick-Möglichkeiten." *Kinotechnik* 1, no. 2 (1919): 10–12.

Woods, Frank. "The Academy of Motion Picture Arts and Sciences and Its Service as a Forum for the Industry." *JSMPE* 14, no. 4 (April 1930): 436–40.

Wooldridge, A. L. "$97 Movie Made in Hollywood Kitchen." *Modern Mechanix*, November 1928, 150–152.

Worrall, G. H. "New Background Process Projector." *International Projectionist* 14, no. 3 (March 1939): 20.

———. "New Background Projector for Process Cinematography." *JSMPE* 32, no. 4 (April 1939): 442–44.

Wright, William Huntigton. "Eastern Magic." *Motion Picture Classic*, January 1923, 49–50.

Wright, William Lord. "A Question That Is Never Answered." *Motion Picture Magazine* 10, no. 7 (August 1915): 94.

Wrigley, Dewey. "When To Use Special Effects–and How." *AC* 14, no. 3 (July 1933): 100, 121.

Patents

Artigue, Pierre. Means for Producing Animated Shadowgraphs. Patent 1,263,355 (US), filed August 23, 1915, and issued April 16, 1918. Google Patents: US1263355.

Artigue, Pierre. Method and Apparatus for Producing Composite Motion Pictures. Patent 1,669,407 (US), filed October 2, 1923, and issued May 15, 1928. Google Patents: US1669407.

Artigue, Pierre. Method of Making Motion Pictures. Patent 1,742,680 (US), filed November 12, 1925, and issued January 7, 1930. Google Patents: US1742680.

Artigue, Pierre. Method of Making Motion Pictures. Patent 1,764,490 (US), filed November 12, 1925, and issued June 17, 1930. Google Patents: US1764490.

Baker, Friend F. Process of Double Exposure. Patent 1,610,410 (US), filed December 2, 1925, and issued December 14, 1926. Google Patents: US1610410.

Ball, Joseph A. Method of Making Composite Color Pictures. Patent 1,641,566 (US), filed September 16, 1926, and issued September 6, 1927. Google Patents: US1641566.

Behrens, Joseph. Verfahren zur Aufnahme beweglicher Lichtbilder. Patent 323,939 (DE), filed November 16, 1918, and issued August 12, 1920.

Bodde, Bernard M. Translucent Projection Screen. Patent 2,133,076 (US), filed November 22, 1935, and issued October 11, 1938. Google Patents: US2133076.

Bodde, Bernard M. Manufacture of Translucent Screens. Patent 2,202,370 (US), filed November 22, 1935, and issued November 22, 1940. Google Patents: US2202370.

Bodde, Bernard M. Manufacture of Translucent Screens. Patent 2,242,567 (US), filed November 22, 1935, and issued May 20, 1941. Google Patents: US2242567.

Bodde, Bernard M. Translucent Picture Projection Screen and Manufacture Thereof. Patent 2,257,999 (US), filed August 20, 1938, and issued October 7, 1941. Google Patents: US2257999.

Bodde, Bernard M. Projector. Patent 2,336,978 (US), filed August 3, 1940, and issued December 14, 1943. Google Patents: US2336978.

Bodde, Bernard M. Projection Screen. Patent 2,372,173 (US), filed March 6, 1944, and issued March 27, 1945. Google Patents: US2372173.

Bodde, Bernard M. Translucent Screen. Patent 2,368,099 (US), filed August 2, 1943, and issued January 30, 1945. Google Patents: US2368099.

Bodde, Bernhard M. Projection Screen. Patent 2,216,901 (US), filed May 17, 1938, and issued October 8, 1940. Google Patents: US2216901.

Bodde, Bernhard M. Picture Projection Screen and Method of Making the Same. Patent 2,245,896 (US), filed February 12, 1938, and issued June 17, 1941. Google Patents: US2245896.

Brainerd, Lura S. Apparatus for Making Motion-Pictures. Patent 1,301,538 (US), filed February 3, 1915, and issued April 22, 1919. Google Patents: US1301538.

Brainerd, Lura S. Method of Making Motion-Pictures. Patent 1,296,471 (US), filed January 18, 1915, and issued March 4, 1919. Google Patents: US1296471.

Brainerd, Lura S. Method of Producing Moving Pictures. Patent 1,307,846 (US), filed June 9, 1915, and issued June 24, 1919. Google Patents: US1307846.

Briel, Conrad G. Method of Producing Composite Pictures. Patent 1,863,827 (US), filed October 12, 1931, and issued June 21, 1932. Google Patents: US1863827.

Briel, Conrad G. Method of Producing Composite Pictures. Patent 1,863,826 (US), filed October 12, 1931, and issued January 21, 1932. Google Patents: US1863826.

Briel, Conrad G. Method of and Apparatus for Producing Composite Pictures. Patent 2,025,327 (US), filed April 25, 1931, and issued December 24, 1935. Google Patents: US2025327.

Briel, Conrad G. Method of Producing Composite Pictures. Patent 2,028,862 (US), filed October 12, 1931, and issued January 28, 1936. Google Patents: US2028862.

Callcott, William. Apparatus for Producing Scenic Effects. Patent 45,449 (US), filed December 13, 1864. Google Patents: US45449.

Capstaff, John G. Projection-Printer. Patent 1,361,012 (US), filed April 12, 1920, and issued December 7, 1920. Google Patents: US1361012.

Dawley, Herbert M. Articulated Effigy. Patent 1,347,993 (US), filed July 27, 1920, and issued February 26, 1920. Google Patents: US1347993.

Dawley, J. Searle. Art of Making Motion-Pictures. Patent 1,278,117 (US), filed August 17, 1914, and issued September 10, 1918. Google Patents: US1278117.

Dawley, J. Searle. Method of Preparing Films for Kinetoscope. Patent 1,463,802 (US), filed September 8, 1919, and issued August 7, 1923. Google Patents: US1463802.

Dawn, Norman. Cinematographic-Picture Composition. Patent 1,269,061 (US), filed June 8, 1917, and issued June 11, 1918. Google Patents: US1269061.

Dischner, Friedrich Julius. Process for the Production of Photographs with Any Desired Background. Patent 858,162 (US), filed December 26, 1905, and issued June 25, 1907. Google Patents: US858162.

Douglas, Leon F. Method of Masking Photographic Film While Exposure is Being Made. Patent 1,508,509 (US), filed July 15, 1922, and issued September 16, 1924. Google Patents: US1508509.

Douglas, Leon F. Method of Masking Photographic Film While Exposure is Being Made. Patent 1,543,065 (US), filed July 15, 1922, and issued June 23, 1925. Google Patents: US1543065.

Douglas, Leon F. Camera Attachment. Patent 1,755,105 (US), filed March 13, 1928, and issued April 15, 1930. Google Patents: US1755105.

Draper, William Vernon. Transition of Scenes on a Motion Picture Film. Patent 2,133,085 (US), filed July 11, 1936, and issued October 11, 1938. Google Patents: US2133085.

Dunning, Carroll Dodge. Method of Producing Composite Photographs. Patent 1,613,163 (US), filed April 17, 1926, and issued January 4, 1927. Google Patents: US1613163.

Dunning, Carroll H. Method and Means of Producing Composite Photographs with Sound Accompaniment. Patent 1,858,767 (US), filed October 1, 1928, and issued May 17, 1932. Google Patents: US1858767.

Earle, Ferdinand P. Method of Producing Composite Motion Pictures. Patent 1,575,478 (US), filed June 3, 1925, and issued March 2, 1926. Google Patents: US1575478.

Edouart, Alexander Farciot. Film Spool. Patent 1,882,413 (US), filed July 12, 1930, and issued October 11, 1932. Google Patents: US1882413.

Edouart, Alexander Farciot. Shuttle Pressure Plate. Patent 1,888,527 (US), filed September 2, 1930, and issued November 22, 1932. Google Patents: US1888527.

Farrand, Clair L. Power Supply for Plural Motor Interlock Systems. Patent 2,055,124 (US), filed April 18, 1935, and issued September 22, 1936. Google Patents: US2055124.

Farrand, Clair L. Printing. Patent 2,045,129 (US), filed September 28, 1933, and issued June 23, 1936. Google Patents: US2045129.

Farrand, Clair L. Plural Motor Interlock System. Patent 2,074,686 (US), filed April 18, 1935, and issued March 23, 1937. Google Patents: US2074686.

Farrand, Clair L. Synchronous Motor and Method of Constructing Same. Patent 2,075,893 (US), filed April 18, 1935, and issued April 6, 1937. Google Patents: US2075893.

Fear, Ralph G., and Frank E. Garbutt. Process of and Apparatus for Eliminating Granular Effects in Photographic Enlargements. Patent 1,642,772 (US), filed March 10, 1923, and issued September 20, 1927. Google Patents: US1642772.

Gibbons, James A. Method of Photography. Patent 1,980,795 (US), filed September 22, 1931, and issued November 13, 1934. Google Patents: US1980795.

Gilbert, Charles Allan. Manufacture of Motion Picture Films. Patent 1,279,099 (US), filed April 20, 1915, and issued September 17, 1918. Google Patents: US1279099.

Gillette, Clyde F. Composite Photographic Process. Patent 1,982,211 (US), filed September 2, 1931, and issued November 27, 1934. Google Patents: US1982211.

Gillette, Clyde F. Photographic Process. Patent 1,982,210 (US), filed September 2, 1931, and issued November 27, 1934. Google Patents: US1982210.

Gillette, Clyde F. Composite Picture. Patent 2,028,975 (US), filed September 2, 1931, and issued January 28, 1936. Google Patents: US2028975.

Goetz, Hans. A New or Improved Process of Producing Photographic Silhouettes. Patent 169,233 (GB), filed June 16, 1920, and issued September 16, 1921.

Goetz, Hans. Improvements in the Production of Photographic Silhouettes and Combination Photographs. Patent 147,621 (GB), filed July 8, 1920, and issued October 10, 1921.

Goetz, Hans. Verfahren zur Herstellung photographischer Silhouetten. Patent 286,283 (DE), filed June 1, 1913, and issued November 4, 1922.

Goetz, Hans. Verfahren zur Herstellung photographischer Silhouetten. Patent 362,951 (DE), filed May 5, 1918, and issued November 4, 1922.

Gregory, Carl Louis. Composite Photography. Patent 2,164,770 (US), filed November 6, 1936, and issued July 4, 1939. Google Patents: US2164770.

Griffith, D. W. Method and Means for Taking Moving Pictures. Patent 1,554,210 (US), filed November 17, 1921, and issued September 22, 1925. Google Patents: US1554210.

Griffith, David Wark. Method and Means for Taking Moving Pictures. Patent 1,476,885 (US), filed November 17, 1921, and issued December 11, 1923. Google Patents: US1476885.

Hall, Walter L. Method of Making Pictures. Patent 1,372,811 (US), filed December 23, 1918, and issued March 29, 1921. Google Patents: US1372811.

Hammeras, Oscar R. Method of Making Motion Pictures. Patent 1,540,213 (US), filed March 3, 1923, and issued June 2, 1925. Google Patents: US1540213.

Handschiegl, Max. Cinematographic Film Coloring Machine. Patent 1,295,028 (US), filed April 30, 1918, and issued February 18, 1919. Google Patents: US1295028.

Handschiegl, Max. Process of Producing Colored Moving-Picture Films. Patent 1,316,791 (US), filed April 9, 1918, and issued September 23, 1919. Google Patents: US1316791.

Handschiegl, Max. Film Polishing Machine. Patent 1,334,655 (US), filed September 9, 1919, and issued March 23, 1920. Google Patents: US1334655.

Handschiegl, Max. Film-Coloring Process. Patent 1,546,129 (US), filed May 12, 1923, and issued July 14, 1925. Google Patents: US1546129.

Handschiegl, Max. Color-Transfer Machine. Patent 1,581,342 (US), filed June 19, 1923, and issued April 20, 1926. Google Patents: US1581342.

Handschiegl, Max. Simplified Double Exposure Method. Patent 1,697,315 (US), filed April 26, 1926, and issued January 1, 1929. Google Patents: US1697315.

Handschiegl, Max. Method and Apparatus for Trick Motion-Picture-Film Production. Patent 1,802,944 (US), filed April 26, 1925, and issued April 28, 1931. Google Patents: US1802944.

Handschiegl, Max. Double Exposure Process. Patent 1,860,737 (US), filed September 30, 1925, and issued May 31, 1932. Google Patents: US1860737.

Handschiegl, Max. Process of Making Double Exposure. Patent 1,840,669 (US), filed January 2, 1923, and issued January 12, 1932. Google Patents: US1840669.

Handschiegl, Max. Trick Method of Producing Composite Negatives. Patent 1,840,670 (US), filed October 11, 1926, and issued January 12, 1932. Google Patents: US1840670.

Handschiegl, Max. Production of Pedrigreed Negatives. Patent 1,899,032 (US), filed December 27, 1926, and issued February 28, 1933. Google Patents: US1899032.

Haskin, Byron C. Composite Photography. Patent 2,169,045 (US), filed November 23, 1936, and issued August 8, 1939. Google Patents: US2169045.

Haskin, Byron C. Miniature Ship. Patent 2,164,651 (US), filed January 25, 1938, and issued July 4, 1939. Google Patents: US2164651.

Haskin, Byron C. Composite Photography. Patent 2,198,815 (US), filed April 11, 1938, and issued April 30, 1940. Google Patents: US2198815.

Haskin, Byron C. Composite Photography. Patent 2,200,358 (US), filed April 11, 1938, and issued May 14, 1940. Google Patents: US2200358.

Haskin, Byron C. Composite Photography. Patent 2,337,327 (US), filed March 11, 1941, and issued December 21, 1943. Google Patents: US2337327.

Hewlett, Edward M., and Waldo W. Willard. Means for Accurately Reproducing Angular Movements. Patent 1,559,524 (US), filed September 15, 1921, and issued October 27, 1925. Google Patents: US1559524.

Hewlett, Edward M., and Waldo W. Willard. Position Indicator. Patent 1,551,393 (US), filed September 15, 1921, and issued August 25, 1925. Google Patents: US1551393.

Hewlett, Edward M., and Waldo W. Willard. Control System for Ordnance. Patent 1,612,118 (US), filed September 27, 1921, and issued December 28, 1926. Google Patents: US1612118.

Hewlett, Edward M., and Waldo W. Willard. System for the Transmission of Angular Movements. Patent 1,612,117 (US), filed September 15, 1921, and issued December 28, 1926. Google Patents: US1612117.

Hunter, Rudolph M. Art of Producing Photographic Negatives. Patent 656,769 (US), filed March 19, 1897, and issued August 28, 1900. Google Patents: US656769.

Jackman, Fred W. Composite Motion Picture. Patent 1,926,722 (US), filed September 8, 1931, and issued September 12, 1933. Google Patents: US1926722.

Jackman, Fred W. Composite Picture. Patent 1,945,193 (US), filed May 4, 1931, and issued January 30, 1934. Google Patents: US1945193.

Jackman, Fred W. Mounting for a Flexible Translucent Motion Picture Screen. Patent 1,960,632 (US), filed October 11, 1932, and issued May 29, 1934. Google Patents: US1960632.

Jackman, Fred W. Sound Accompaniment for Composite Motion Pictures. Patent 1,979,937 (US), filed May 23, 1931, and issued November 6, 1934. Google Patents: US1979937.

Jackman, Fred W. Color Separation for Composite Motion Pictures. Patent 2,013,886 (US), filed May 6, 1931, and issued September 10, 1935. Google Patents: US2013886.

Jackman, Fred W. Composite Motion Pictures. Patent 2,015,272 (US), filed May 6, 1931, and issued September 24, 1935. Google Patents: US2015272.

Jackman, Fred W. Composite Motion Pictures. Patent 2,004,987 (US), filed January 8, 1934, and issued June 18, 1935. Google Patents: US2004987.

Jackman, Fred W. Composite Motion Pictures. Patent 2,004,986 (US), filed May 25, 1931, and issued June 18, 1935. Google Patents: US2004986.

Jackman, Fred W. Composite Picture. Patent 2,014,435 (US), filed October 12, 1931, and issued September 17, 1935. Google Patents: US2014435.

Jackman, Fred W. Focusing Device for Cinematographic Apparatus. Patent 2,008,020 (US), filed November 15, 1932, and issued July 16, 1935. Google Patents: US2008020.

Jackman, Fred W. Composite Motion Picture. Patent 2,064,206 (US), filed January 23, 1934, and issued December 15, 1936. Google Patents: US2064206.

Jackman, Fred W. Composite Photography. Patent 2,030,300 (US), filed October 25, 1933, and issued February 11, 1936. Google Patents: US2030300.

Jackman, Fred W. Method and Means for Producing Composite Pictures. Patent 2,045,084 (US), filed December 26, 1931, and issued June 23, 1936. Google Patents: US2045084.

Jackman, Fred W. Method of Making Translucent Picture Projection Screen. Patent 2,071,344 (US), filed September 7, 1932, and issued February 23, 1937. Google Patents: US2071344.

Jackman, Fred W. Translucent Projection Screen. Patent 2,071,342 (US), filed June 17, 1935, and issued February 23, 1937. Google Patents: US2071342.

Jackman, Fred W. Apparatus for Trick Photography. Patent 2,147,038 (US), filed November 25, 1935, and issued February 14, 1939. Google Patents: US2147038.

Jackman, Fred W. Manufacture of Plastic Sheets. Patent 2,184,672 (US), filed June 17, 1935, and issued December 26, 1939. Google Patents: US2184672.

Jackman, Fred W. Photography. Patent 2,173,518 (US), filed April 4, 1936, and issued September 19, 1939. Google Patents: US2173518.

Jackman, Fred W., and Hans F. Koenekamp. Method of Making Composite Photographs. Patent 1,939,304 (US), filed June 12, 1929, and issued December 12, 1933. Google Patents: US1939304.

Jelinek, Stephan. Method of Making Cinematographic Exposures. Patent 1,933,854 (US), filed August 31, 1929, and issued November 7, 1933. Google Patents: US1933854.

Jennings, Henry Gordon, Paul Lerpée, and Arthur Zaugg. Means for Producing Special Effects in Motion Picture Photography.

Patent 2,051,526 (US), filed August 13, 1934, and issued August 18, 1936. Google Patents: US2051526.

Jensen, Rasmus Olaf Jonas. Screen for Showing Projected Images in Lighted Rooms and for Short Exposure Photography. Patent 1,824,353 (US), filed September 22, 1927, and issued September 22, 1931. Google Patents: US1824353.

Kelley, William Van Doren. Photographic Film. Patent 1,879,806 (US), filed February 14, 1931, and issued September 27, 1932. Google Patents: US1879806.

Kelley, William Van Doren. Composite Photography. Patent 1,912,582 (US), filed October 20, 1930, and issued June 6, 1933. Google Patents: US1912582.

Kelley, William Van Doren. Film, Plate and the like. Patent 1,897,846 (US), filed April 8, 1930, and issued February 14, 1933. Google Patents: US1897846.

Kelley, William Van Doren, and Carroll H. Dunning. Motion Picture Film. Patent 1,431,309 (US), filed February 10, 1919, and issued October 10, 1922. Google Patents: US1431309.

Kelley, William Van Doren, and William Wallace Kelley. Method of Producing Composite Photographs. Patent 1,859,589 (US), filed March 1, 1928, and issued May 24, 1932. Google Patents: US1859589.

Knechtel, Alvin V. Method of Producing Composite Moving-Picture Films. Patent 1,627,976 (US), filed August 25, 1924, and issued May 10, 1927. Google Patents: US1627976.

Koenekamp, Hans F. Composite Motion Pictures. Patent 1,980,806 (US), filed August 17, 1932, and issued November 13, 1934. Google Patents: US1980806.

Koenekamp, Hans F. Composite Motion Picture. Patent 2,004,992 (US), filed October 30, 1933, and issued June 18, 1935. Google Patents: US2004992.

Mammes, Raymond J. Method of Forming Composite Motion Picture Films. Patent 1,869,819 (US), filed December 12, 1927, and issued August 2, 1932. Google Patents: US1869819.

Mammes, Raymond J. Reversible Mat. Patent 1,901,110 (US), filed December 27, 1927, and issued March 14, 1933. Google Patents: US1901110.

Michalke, Carl Joseph August. Synchronizer for Electric Machines. Patent 649,942 (US), filed December 31, 1897, and issued May 22, 1900. Google Patents: US649942.

Mitchell, George A. Printer. Patent 1,584,185 (US), filed September 5, 1922, and issued May 11, 1926. Google Patents: US1584185.

Mitchell, George A., and Friend F. Baker. Method of Making Composite Pictures. Patent 1,897,494 (US), filed January 17, 1927, and issued February 14, 1933. Google Patents: US1897494.

Mohr, Harold L., and Albert W. Tondreau. Photographic Apparatus. Patent 2,177,737 (US), filed October 31, 1936, and issued November 13, 1939. Google Patents: US2177737.

Newcomb, William Wallace. Composite-Picture Machine. Patent 1,133,311 (US), filed December 11, 1914, and issued March 30, 1915. Google Patents: US1133311.

O'Brien, Willis H. Means for Producing Motion Pictures. Patent 1,897,673 (US), filed April 16, 1928, and issued February 14, 1933. Google Patents: US1897673.

O'Brien, Willis H. Composite Picture. Patent 2,029,500 (US), filed September 13, 1933, and issued February 4, 1936. Google Patents: US2029500.

O'Brien, Willis H. Method of Production Color Effects in Photography. Patent 2,127,829 (US), filed April 28, 1936, and issued August 23, 1938. Google Patents: US2127829.

O'Brien, Willis H. Method of Production Motion Pictures. Patent 2,501,958 (US), filed July 23, 1945, and issued March 28, 1950. Google Patents: US2501958.

Osann, Norman. Double-Exposure Process. Patent 1,698,448 (US), filed August 25, 1924, and issued January 8, 1929. Google Patents: US1698448.

Owen, William O. Production of Insets on Moving Pictures. Patent 1,397,602 (US), filed November 11, 1920, and issued November 22, 1921. Google Patents: US1397602.

Owens, Freeman H. Optical Printer. Patent 1,692,347 (US), filed November 12, 1926, and issued November 20, 1928. Google Patents: US1692347.

Owens, Freeman H. Optical Printer. Patent 1,752,753 (US), filed November 12, 1926, and issued April 1, 1930. Google Patents: US1752753.

Owens, Freeman H. Optical Printer. Patent 1,755,487 (US), filed November 22, 1926, and issued April 22, 1930. Google Patents: US1755487.

Owens, Freeman H. Optical Printer. Patent 1,786,220 (US), filed November 12, 1926, and issued December 23, 1930. Google Patents: US1786220.

Owens, Freeman H. Continuous Printer. Patent 1,814,525 (US), filed July 18, 1927, and issued July 14, 1931. Google Patents: US1814525.

Owens, Freeman H. Motion Picture Printing Apparatus. Patent 1,817,320 (US), filed November 26, 1929, and issued August 4, 1931. Google Patents: US1817320.

Owens, Freeman H. Motion-Picture-Film-Printing Apparatus. Patent 1,803,404 (US), filed October 2, 1926, and issued May 5, 1931. Google Patents: US1803404.

Owens, Freeman H. Optical Printer. Patent 1,789,112 (US), filed July 7, 1926, and issued January 13, 1931. Google Patents: US1789112.

Owens, Freeman H. Optical Printer. Patent 1,801,450 (US), filed November 12, 1926, and issued April 21, 1931. Google Patents: US1801450.

Owens, Freeman H. Optical Printer. Patent 1,822,417 (US), filed May 14, 1929, and issued September 8, 1931. Google Patents: US1822417.

Owens, Freeman H. Projection Printer. Patent 1,836,038 (US), filed September 10, 1926, and issued December 15, 1931. Google Patents: US1836038.

Owens, Freeman H. Optical Printer. Patent 1,852,894 (US), filed July 18, 1927, and issued April 5, 1932. Google Patents: US1852894.

Owens, Freeman H. Optical Printer. Patent 1,884,167 (US), filed June 10, 1929, and issued October 25, 1932. Google Patents: US1884167.

Owens, Freeman H. Optical Printing Apparatus. Patent 1,849,549 (US), filed July 9, 1930, and issued March 15, 1932. Google Patents: US1849549.

Owens, Freeman H. Printing Apparatus. Patent 1,843,172 (US), filed July 13, 1927, and issued February 2, 1932. Google Patents: US1843172.

Owens, Freeman H. Film Printing Apparatus. Patent 1,896,246 (US), filed July 13, 1927, and issued February 7, 1933. Google Patents: US1896246.

Owens, Freeman H. Optical Printer. Patent 1,921,835 (US), filed March 28, 1929, and issued August 8, 1933. Google Patents: US1921835.

Owens, Freeman H. Optical Printing Apparatus. Patent 1,950,092 (US), filed July 9, 1930, and issued March 6, 1934. Google Patents: US1950092.

Paramount Productions, Inc. Procédé de copie de films cinématographiques, tireuse pour l'application de ce procédé et les films en résultant. Patent 782,297 (FR), filed March 11, 1935, and issued June 1, 1935.

Paramount Publix Corporation. Improvements in Projection Printing Apparatus for Kinematograph Films. Patent 437,068 (GB), filed October 17, 1934, and issued October 23, 1935.

Paramount Publix Corporation and Roy Jobbins Pomeroy. Verfahren zur Herstellung von zusammengesetzten Bildern auf einem kinematographischen Film. Patent 559,597 (DE), filed August 24, 1930, and issued September 21, 1932.

Paramount Publix Corporation and Roy Jobbins Pomeroy. Verfahren zur Korrektur der Durchlässigkeit eines mit einer durchlässigen Farbschicht gefärbten durchsichtigen Bildes (Diapositivs oder Dianegativs) für das Licht seiner eigenen Färbung. Patent 584,848 (DE), filed August 24, 1930, and issued September 25, 1933.

Pollock, Gordon B. Method of Making Composite Pictures. Patent 1,737,021 (US), filed November 23, 1926, and issued November 26, 1929. Google Patents: US1737021.

Pomeroy, Roy J. Method of Making Composite Photographs. Patent 1,673,019 (US), filed December 19, 1925, and issued June 12, 1928. Google Patents: US1673019.

Pomeroy, Roy J. Method of Making Composite Pictures. Patent 1,686,987 (US), filed February 7, 1927, and issued October 9, 1928. Google Patents: US1686987.

Pomeroy, Roy J. Method of Making Composite Pictures. Patent 1,715,510 (US), filed February 7, 1927, and issued June 4, 1929. Google Patents: US1715510.

Pomeroy, Roy J. Correction of Color Transparencies. Patent 1,776,269 (US), filed December 19, 1925, and issued September 23, 1930. Google Patents: US1776269.

Pomeroy, Roy J. Method of Making Composite Photographs. Patent 1,755,129 (US), filed July 14, 1926, and issued April 15, 1930. Google Patents: US1755129.

Pomeroy, Roy J. Method of Making Composite Photographs. Patent 1,755,130 (US), filed July 14, 1926, and issued April 15, 1930. Google Patents: US1755130.

Pomeroy, Roy J. Composite Photographic Method and Apparatus. Patent 1,818,354 (US), filed December 19, 1925, and issued August 11, 1931. Google Patents: US1818354.

Pomeroy, Roy J. Method of Making Composite Pictures. Patent 1,788,740 (US), filed February 7, 1927, and issued January 13, 1931. Google Patents: US1788740.

Pomeroy, Roy J. Procédé de correction des transparents colorés. Patent 701,387 (FR), filed January 7, 1931, and issued March 16, 1931.

Pomeroy, Roy J. Procédé d'obtention d'images composites. Patent 700,997 (FR), filed January 5, 1931, and issued March 10, 1931.

Pomeroy, Roy J. Method of Making Composite Pictures. Patent Re. 20,867 (US), filed February 7, 1927, and issued September 20, 1938. Google Patents: USRe20867.

Pomeroy, Roy J. Drafting Machine. Patent 2,413,376 (US), filed May 9, 1944, and issued December 31, 1946. Google Patents: US2413376.

Pomeroy, Roy J., and Carl v. Olson. Automatic Clutch Trip for Film Drives. Patent 1,928,434 (US), filed January 9, 1929, and issued September 26, 1933. Google Patents: US1928434.

Pomeroy, Roy J., and Paramount Publix Corporation. Correction of Photographic Dye-Color Transparencies. Patent 367,401 (GB), filed August 14, 1930, and issued February 15, 1932.

Pomeroy, Roy J., and Paramount Publix Corporation. Method of Making Composite Photographs. Patent 365,134 (GB), filed August 14, 1930, and issued January 14, 1932.

Scholl, Edward. Mask Set for Multiple Exposure in Moving-Picture Cameras and Process of Making the Same. Patent 1,572,315 (US), filed February 21, 1923, and issued February 9, 1926. Google Patents: US1572315.

Schüfftan, E. Making Motion Pictures. Patent 1,606,483 (US), filed September 15, 1923, and issued November 9, 1926. Google Patents: US1606483.

Schüfftan, Eugen. Making Moving Pictures. Patent 1,569,789 (US), filed September 15, 1923, and issued January 12, 1926. Google Patents: US1569789.

Schüfftan, Eugen. Method of Apparatus for Producing Composite Motion Pictures. Patent 1,606,482 (US), filed February 27, 1925, and issued November 9, 1926. Google Patents: US1606482.

Schüfftan, Eugen. System of Taking Photographic and Cinematographic Pictures. Patent 1,601,886 (US), filed November 6, 1925, and issued October 5, 1926. Google Patents: US1601886.

Schüfftan, Eugen. Apparatus for Composite Cinematography. Patent 1,613,201 (US), filed July 6, 1925, and issued January 4, 1927. Google Patents: US1613201.

Schüfftan, Eugen. Method and Apparatus for Making Composite Motion Pictures. Patent 1,627,295 (US), filed July 6, 1925, and issued May 3, 1927. Google Patents: US1627295.

Schüfftan, Eugen. System of Taking Photographic and Cinematographic Pictures. Patent 1,636,112 (US), filed August 9, 1926, and issued July 19, 1927. Google Patents: US1636112.

Schüfftan, Eugen. Art of Making Motion Pictures. Patent 1,690,039 (US), filed September 15, 1923, and issued October 30, 1928. Google Patents: US1690039.

Seeber, Guido. Verfahren zum Erzeugen von Kombinationsbildern. Patent 407,593 (DE), filed March 2, 1923, and issued December 19, 1924.

Seitz, John F. Method of Making Motion-Picture Films. Patent 1,576,854 (US), filed December 12, 1922, and issued March 16, 1926. Google Patents: US1576854.

Seitz, John F. Method of Making Motion Pictures. Patent 1,616,237 (US), filed May 25, 1922, and issued February 1, 1927. Google Patents: US1616237.

Seitz, John F. Method of Making Motion-Picture Films. Patent Re. 17,125 (US), filed December 12, 1922, and issued November 6, 1928. Google Patents: USRe17125.

Seitz, John F. Camera and Method of Photography. Patent 1,787,023 (US), filed November 22, 1926, and issued December 30, 1930. Google Patents: US1787023.

Seymour, Francis. Apparatus for Producing Scenic Effects. Patent 486,606 (US), filed January 23, 1892, and issued November 22, 1892. Google Patents: US486606.

Seymour, Francis. Machine for Printing Photographs. Patent 1,669,027 (US), filed July 16, 1926, and issued May 8, 1928. Google Patents: US1669027.

Shea, Robert P., Oscar H. Jarosch, Linwood G. Dunn, and Cecil D. Love. Optical Printer with Automatic Electrical Control of Operating Mechanism. Patent 2,517,250 (US), filed April 17, 1946, and issued August 1, 1950. Google Patents: US2517250.

Sontag, Hugo. Process for Photographing Objects with Projected Backgrounds. Patent 1,053,887 (US), filed March 4, 1912, and issued February 18, 1913. Google Patents: US1053887.

Spray, Joseph H. Composite Printing Apparatus for Motion Picture Film. Patent 2,153,211 (US), filed March 21, 1935, and issued April 4, 1939. Google Patents: US2153211.

Spray, Joseph H. Composite Printing Apparatus for Motion Picture Film. Patent 2,153,212 (US), filed February 18, 1936, and issued April 4, 1939. Google Patents: US2153212.

Stambaugh, Reginald V. Process of Making Motion Picture Films. Patent 1,226,135 (US), filed May 26, 1916, and issued May 15, 1917. Google Patents: US1226135.

Teague, George J. Camera-Actuating Means. Patent 1,262,284 (US), filed December 21, 1915, and issued April 9, 1918. Google Patents: US1262284.

Teague, George J. Means for Producing Animated Cartoons. Patent 1,292,149 (US), filed March 22, 1916, and issued January 21, 1919. Google Patents: US1292149.

Teague, George J. Changeable Sign. Patent 1,655,524 (US), filed March 10, 1926, and issued January 10, 1928. Google Patents: US1655524.

Tondreau, Albert W. Focusing Device for Motion Picture Camera. Patent 2,005,014 (US), filed April 19, 1932, and issued June 18, 1935. Google Patents: US2005014.

United Research Corp. A Method of and Apparatus for Producing Composite Motion Pictures. Patent 397,969 (GB), filed May 4, 1932, and issued September 7, 1933.

United Research Corp. Method of and Apparatus for the Production of Composite Motion Pictures and Sound Accompaniments Therefor. Patent 397,979 (GB), filed May 23, 1932, and issued September 7, 1933.

Walker, Joseph B. Process for Producing Multiply Exposed Motion Picture Film. Patent 1,503,731 (US), filed May 3, 1922, and issued August 5, 1924. Google Patents: US1503731.

Walker, Walter D. Method of Superimposing a Foreground of Image upon a Background in Photography. Patent 1,928,579 (US), filed February 18, 1927, and issued September 26, 1933. Google Patents: US1928579.

Warner Bros Pictures, Inc. Improvements in or Relating to Composite Motion Pictures. Patent 392,398 (GB), filed May 18, 1933.

Warner Bros Pictures, Inc. Improvements in or Relating to Composite Motion Pictures. Patent 392,034 (GB), filed May 11, 1933.

Warner Bros Pictures, Inc. Method of and Arrangement for the Production of Composite Motion Pictures. Patent 394,477 (GB), filed May 20, 1932, and issued June 29, 1933.

Watson, A. C. Method of Producing Visual Effects. Patent 1,828,236 (US), filed August 27, 1929, and issued October 20, 1931. Google Patents: US1828236.

Watson, George R. Photographic Duplicating and Enlarging Apparatus. Patent 1,204,098 (US), filed November 14, 1913, and issued November 7, 1916. Google Patents: US1204098.

Williams, Frank D. Method of Taking Motion Pictures. Patent 1,273,435 (US), filed May 22, 1916, and issued July 23, 1918. Google Patents: US1273435.

Williams, Frank D. Method of Printing Motion Pictures. Patent 1,464,054 (US), filed July 20, 1922, and issued August 7, 1923. Google Patents: US1464054.

Williams, Frank D. Method of Motion-Picture Composition. Patent 1,589,731 (US), filed March 8, 1924, and issued June 22, 1926. Google Patents: US1589731.

Williams, Frank D. Method of Motion-Picture Composition. Patent Re. 17,330 (US), filed March 8, 1924, and issued June 18, 1929. Google Patents: USRe17330.

Williams, Frank D. Picture Process. Patent 1,827,924 (US), filed April 9, 1928, and issued October 20, 1931. Google Patents: US1827924.

Williams, Frank D. Process of Printing Motion Pictures. Patent 1,861,515 (US), filed April 18, 1927, and issued June 7, 1932. Google Patents: US1861515.

Williams, Frank D. Production of Silhouettes for Composite Motion Pictures. Patent 1,955,993 (US), filed November 3, 1931, and issued April 24, 1934. Google Patents: US1955993.

Williams, Frank D. Composite Picture Mat. Patent 2,024,081 (US), filed August 30, 1932, and issued December 10, 1935. Google Patents: US2024081.

Wyckoff, Alvin, and Max Handschiegl. Art of Coloring Cinematographic Films. Patent 1,303,836 (US), filed November 20, 1916, and issued May 13, 1919. Google Patents: US1303836.

Wyckoff, Alvin, and Max Handschiegl. Machine for and Art of Coloring Cinematographic Films. Patent 1,303,837 (US), filed November 20, 1916, and issued May 13, 1919. Google Patents: US1303837.

Filmography

Missions of California, 1907, Norman O. Dawn
Un accident d'auto, Gaumont, 1907, Louis Feuillade
Princess Nicotine, Vitagraph, 1909, Paul Panzer, Gladys Hulette
The Eternal Law, Lusobra, 1910, Lura Sophia Brainerd
The Drifter, 1913, Norman O. Dawn
Intolerance, Triangle, 1916, D. W. Griffith
Oriental Love, 1916, Norman O. Dawn
His Foothill Folly, Triangle, 1917, Reggie Morris
Mickey, Mabel Normand, 1918, F. Richard Jones, James Young
Sahara, J. Parker Read Jr., 1919, Arthur Rosson
Astray from the Steerage, Mack Sennett, 1921, Frank Powell
Little Lord Fauntleroy, Mary Pickford, 1921, Alfred E. Green
Robin Hood, Douglas Fairbanks, 1922, Allan Dwan
Beyond the Rocks, Famous Players-Lasky, 1922, Sam Wood
Manslaughter, Paramount, 1922, Cecil B. DeMille
The Hunchback of Notre Dame, Universal, 1923, Wallace Worsley
The Ten Commandments, Paramount, 1923, Cecil B. DeMille
He Who Gets Slapped, MGM, 1924, Victor Sjöström
The King of the Wild Horses, Hal Roach, 1924, Fred Jackman
The Thief of Bagdad, Douglas Fairbanks, 1924, Raoul Walsh
Black Cyclone, Hal Roach, 1925, Fred Jackman
Cockeyed: Gems from the Memory of a Nutty Cameraman, Pathé Exchange, 1925, Alvin Knechtel
The Big Parade, MGM, 1925, King Vidor
The Lost World, First National, 1925, Harry O. Hoyt
Lady Robinhood, Robertson-Cole, 1925, Ralph Ince
A Lover's Oath, 1925, Ferdinand P. Earle
Ben-Hur: A Tale of the Christ, MGM, 1925, Fred Niblo
Ella Cinder, John McCormick, 1926, Alfred E. Green
The Devil Horse, Hal Roach, 1926, Fred Jackman
Torrent, MGM, 1926, Monta Bell
No Man's Law, Hal Roach, 1927, Fred Jackman
The Gaucho, Elton, 1927, F. Richard Jones
The King of Kings, DeMille, 1927, Cecil B. DeMille
Time to Love, Paramount, 1927, Frank Tuttle
Silver Comes Through, Robertson-Cole, 1927, Lloyd Ingraham
Sunrise: A Song of Two Humans, Fox, 1927, F. W. Murnau
Interference, Paramount, 1928, Roy J. Pomeroy, Lothar Mendes
The Michigan Kid, Universal, 1928, Irvin Willat
The Trail of '98, MGM, 1928, Clarence Brown
The Life and Death of 9413, a Hollywood Extra, 1928, Robert Florey, Slavko Vorkapich
Noah's Ark, Warner, 1928, Michael Curtiz, Darryl F. Zanuck
Sins of the Fathers, Paramount, 1928, Ludwig Berger
The Wolf of Wall Street, Paramount, 1929, Rowland V. Lee
The Divine Lady, First National, 1929, Frank Lloyd
The Four Feathers, Paramount, 1929, Merian C. Cooper, Lothar Mendes, Ernest B. Schoedsack
Night Parade, RKO, 1929, Malcom St. Clair
Africa Speaks, Walter Futter, 1930, Walter Futter
Anna Christie, MGM, 1930, Jacques Feyder, Clarence Brown
Brats, Hal Roach, 1930, James Parrott
The Dawn Patrol, Warner, 1930, Howard Hawks
Moby Dick, Warner, 1930, Lloyd Bacon
Check and Double Check, RKO, 1930, Melville W. Brown
Half Shot at Sunrise, RKO, 1930, Paul Sloane
Liliom, Fox, 1930, Frank Borzage
The Pay-Off, RKO, 1930, Lowell Sherman
Just Imagine, Fox, 1930, David Butler
Subway Express, Columbia, 1931, Fred C. Newmeyer
Beau Ideal, RKO, 1931, Herbert Brenon
Cimarron, RKO, 1931, Wesley Ruggles
Man of the World, Paramount, 1931, Richard Wallace
Trader Horn, MGM, 1931, W. S. Van Dyke
The Last Flight, First National, 1931, William Dieterle
Suicide Fleet, RKO, 1931, Albert S. Rogell
Dr. Jekyll and Mr. Hyde, Paramount, 1931, Rouben Mamoulian

The Mummy, Universal, 1932, Karl Freund
Shanghai Express, Paramount, 1932, Joseph von Sternberg
The Lost Squadron, RKO, 1932, George Archainbaud
Tarzan, the Ape Man, MGM, 1932, W. S. Van Dyke
The Crowd Roars, Warner, 1932, Howard Hawks
What Price Hollywood?, RKO, 1932, George Cukor
County Hospital, Hal Roach, 1932, James Parrott
Bird of Paradise, RKO, 1932, King Vidor
The Most Dangerous Game, RKO, 1932, Irving Pichel, Ernest B. Schoedsack
Chandu the Magician, Fox, 1932, William Cameron Menzies, Marcel Varnel
The Conquerors, RKO, 1932, William A. Wellman
Island of Lost Souls, Paramount, 1932, Erle C. Kenton
The Invisible Man, Universal, 1933, James Whale
State Fair, Fox, 1933, Henry King
King of the Jungle, Paramount, 1933, H. Bruce Humberstone, Max Marcin
Christopher Strong, RKO, 1933, Dorothy Arzner
King Kong, RKO, 1933, Merian C. Cooper, Ernest B. Schoedsack
Today We Live, MGM, 1933, Howard Hawks
International House, Paramount, 1933, Edward A. Sutherland
Melody Cruise, RKO, 1933, Mark Sandrich
Three Cornered Moon, Paramount, 1933, Elliott Nugent
So This Is Harris!, RKO, 1933, Mark Sandrich
Flaming Gold, RKO, 1933, Ralph Ince
Ace of Aces, RKO, 1933, J. Walter Ruben
Eskimo, MGM, 1933, W. S. Van Dyke
Alice in Wonderland, Paramount, 1933, Norman Z. McLeod
The Son of Kong, RKO, 1933, Ernest B. Schoedsack
Flying Down To Rio, RKO, 1933, Thornton Freeland
Anne of Green Gables, RKO, 1934, George Nichols
Hips, Hips, Hooray!, RKO, 1934, Mark Sandrich
Tarzan and His Mate, MGM, 1934, Cedric Gibbons
Cleopatra, Paramount, 1934, Cecil B. DeMille
I Dream Too Much, RKO, 1935, John Cromwell
She, RKO, 1935, Lansing C. Holden, Irving Pichel
The Last Days of Pompeii, RKO, 1935, Ernest B. Schoedsack, Merian C. Cooper
Dante's Inferno, Fox, 1935, Harry Lachman
Top Hat, RKO, 1935, Mark Sandrich
The Bride Comes Home, Paramount, 1935, Wesley Ruggles
Captain Blood, Warner, 1935, Michael Curtiz
Follow the Fleet, RKO, 1936, Mark Sandrich
Swing Time, RKO, 1936, George Stevens
San Francisco, MGM, 1936, W. S. Van Dyke
The Plainsman, Paramount, 1936, Cecil B. DeMille
Shall We Dance, RKO, 1937, Mark Sandrich
Captains Courageous, MGM, 1937, Victor Fleming
Topper, Hal Roach, 1937, Norman Z. McLeod
Stand-In, Walter Wanger, 1937, Tay Garnett
Carefree, RKO, 1938, Mark Sandrich
Gold Is Where You Find It, Warner, 1938, Michael Curtiz
Bringing Up Baby, RKO, 1938, Howard Hawks
Men with Wings, Paramount, 1938, William A. Wellman
Spawn of the North, Paramount, 1938, Henry Hathaway
Trade Winds, Walter Wanger, 1938, Tay Garnett
Topper Takes a Trip, Hal Roach, 1938, Norman Z. McLeod
The Hunchback of Notre Dame, RKO, 1939, William Dieterle
Gunga Din, RKO, 1939, George Stevens
Geronimo, Paramount, 1939, Paul Sloane
Dr. Cyclops, Paramount, 1940, Ernest B. Schoedsack
Our Town, Sol Lesser, 1940, Sam Wood
Aloma of the South Seas, Paramount, 1941, Alfred Santell
I Wanted Wings, Paramount, 1941, Mitchell Leisen
The Devil And Daniel Webster, RKO, 1941, William Dieterle
Tom, Dick and Harry, RKO, 1941, Garson Kanin
Citizen Kane, RKO, 1941, Orson Welles
Once Upon a Honeymoon, RKO, 1942, Leo McCarey
Reap the Wild Wind, Paramount, 1942, Cecil B. DeMille
The Navy Comes Through, RKO, 1942, Edward A. Sutherland
The Sky's the Limit, RKO, 1943, Edward H. Griffith

Air Force, Warner, 1943, Howard Hawks
Around the World, RKO, 1943, Allan Dwan
Mighty Joe Young, RKO, 1949, Ernest B. Schoedsack
Androcles and the Lion, RKO, 1952, Chester Erskine, Nicholas Ray

Curriculum Vitae

Birk Weiberg
Zweierstrasse 15
8004 Zurich
Switzerland
birk@keyframe.org
OrcID: 0000-0002-0568-0864
ResearcherID: M-5015-2016

Education

PhD Studies	2009 - 2014	University of Zurich, Switzerland Art History
Postgraduate Diploma	2001	Karlsruhe University of Arts and Design, Germany Media Arts
Master Degree	1998	Karlsruhe University of Arts and Design, Germany Art History and Media Theory

Professional Experience

2008 - 2014	Research Associate, Department Art & Media, Zurich University of the Arts
2001 - 2008	Freelance Video Editor, Designer, and Developer