

The Evolution of Sound Technology

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More than half a century after the coming of sound, film criticism and theory still remain resolutely image-bound. Early filmmakers' skepticism about the value of sound has been indirectly perpetuated by generations of critics for whom the cinema is an essentially visual art, sound serving as little more than a superfluous accompaniment. In recent years the reasons underlying this hegemony of the visual have continued to multiply. With each new visually oriented analysis, with each new image-inspired theory, film study's exclusive image orientation gains ground.

The source of the image's current dominance is closely linked to the vocabulary developed by three-quarters of a century of film critics. With few exceptions film terminology is camera-oriented. The distance of the camera from its object, its vertical attitude, horizontal movement, lens, and focus all depend quite specifically on the camera's characteristics and provide the field of cinema studies with a basic language. Another set of terms concentrates on the noncamera aspect of the film's visual component: film stock, punctuation, aspect ratio, lighting, special effects, and so forth. While these terms and many others constitute part of any introductory film course, the corresponding audio terms remain virtually unknown. The type and placement of microphones, methods of recording sound, mixing practices, loudspeaker varieties, and many other fundamental considerations are the province of a few specialists.

This general situation has been strongly reinforced by the concerns evinced by influential film critics over the last half-century. To choose only a well-known pair of examples, we find that Eisenstein and Bazin, considered from the standpoint of the sound track, appear strikingly similar in their interests. Though Eisenstein stresses montage and Bazin prefers long takes and deep-focus photography, both constantly emphasize the visual component of filmmaking. Like its vocabulary, film criticism's problematics have remained consistently visual in nature. Outside of a spate of reaction to the coming of sound, the concerns of the sound track have remained excluded from the nodal points of film criticism. In recent years this situation has grown even more one-sided, due to the strongly visual emphasis of recent French film theory. The strain which analyzes the film apparatus (be-

ginning with the work of Jean-Louis Baudry and Jean-Louis Comolli) usually defines film apparatus as camera and projector, with the mechanics of sound reproduction left on the margin. The justification for this approach is said to lie in the Western world's privileging of vision over all other senses; the cinema, it is claimed, is no more than a child of Renaissance perspective. According to this approach the spectator is placed, within the film as well as within the world at large, primarily by visual markers; even within the limits of this method of handling spectator placement, however, it is surprising that more emphasis has not been placed on the sound track's role in splitting and complicating the spectator, in contesting as well as reinforcing the lessons of the image track. Recent theory has been pushed even further in a visual direction by the adoption of Jacques Lacan's visual metaphors (first by Baudry and Christian Metz, then by virtually the entire Paris school). Developing a fascinating and logical tie between the "mirror stage" as described by Lacan and the film-viewing experience itself, these critics find themselves limited to visual language alone. Now, the mirror metaphor could easily be applied to sound as well as to vision (the Narcissus myth includes Echo as well, as I have pointed out in a recent review¹), but, given the image-consciousness already present in previous criticism and theory alike, the mirror analogy has been restricted to visual experiences. As a result, the ancillary role previously played by the sound track has been diminished still more. It is difficult to imagine how the auditory dimension of cinema might at this late date be reinstated.

Perhaps the most important single requirement for a revival of interest in the sound track is an increased sensitivity to problems of sound technology. Paradoxically, book after book chronicles the technological, economic, and artistic innovations which led to the coming of sound, yet subsequent developments have been neglected by all but a minuscule group of technicians. Everyone knows that Edison intended sound and image reproduction as a synchronized pair, and that various influences delayed for decades the acceptance of his original concept. Stress has repeatedly been placed on Lee De Forest's early invention of the audion tube and his later collaboration with Theodore Case and Earl Sponable. Economic historians have pointed out the importance of patent disputes with the German Tri-Ergon group and, in a general way, the dilatory effects of the capitalist system's profit-consciousness. In fact, nearly every history of the cinema devotes an entire chapter to the period stretching from Warners' experiment with sound-on-disc in *Don Juan* (August 1926) through Fox's highly successful use of sound-on-film in its *Movietone News* series to the supposed landmark of Warners' *Jazz Singer* (October 1927). As a general rule, these chapters go on to mention the 1928 *Lights of New York* ("the first completely dialogued full-length film") and the 1929 fascination with the musi-

cal, but in keeping with standard film history's preoccupation with "firsts" the chapter ends with no more than brief reference to the early experiments with sound conducted by King Vidor, Rouben Mamoulian, Ernst Lubitsch, and Walt Disney.

Though this is hardly the place for a full-fledged history of sound technology during the last half-century, it will nevertheless prove useful to provide an outline of major developments and concerns.² The early history of sound film is marked by the limitations of the carbon and condenser microphones then in use. Nondirectional, fragile, sensitive to wind and other ambient noises, needing an amplification stage very close to the microphone, these mikes required very special recording conditions. Providing these conditions heavily influenced image recording as well as sound. Simply put, the problem lay in the difficulties of producing a high quality and complex sound track (including dialogue, music, effects) with an unselective microphone at a time when the technology of sound mixing practically forbade postmixing of multiple tracks without audible loss of quality. In fact, until approximately 1933 it was extremely rare for music and dialogue to appear simultaneously on the sound track unless they were recorded simultaneously. The latter solution of course presents other difficulties. The amount of reverberation generally required for dialogue varies greatly from that which is appropriate for music (dialogue needs the fast and relatively limited reverberation of familiar upholstered interior spaces, while we expect orchestral music to have the slow reverb provided by a large auditorium); similarly, dialogue and music require different amplification and thus are difficult to record with the same microphone(s). The industry's solution to this problem, already generally operational by late 1929, was to record the music separately—in an atmosphere conducive to proper music recording—then to play the recorded music back while the scene was being acted and its dialogue recorded. This so-called playback system had the immediate effect of separating the sound track from the image—a primary factor in the constitution of film ideology. By facilitating the matching of a performer with a sound which he or she had not necessarily created, the playback permitted immediate capitalization on the sound film's fundamental lie: the implication that the sound is produced by the image when in fact it remains independent from it.

While the playback system serves as an early model of the prestidigitation characterizing the later multiple-channel mixing of effects, dialogue, and music (first perfected in the late thirties), it was not able to solve the problem of outdoor synchronized dialogue recording. The early mikes continued to pick up unwanted noises in all but the most carefully selected outdoor sites (the new directional ribbon or velocity mikes were even more sensitive to wind pressure than the familiar carbon and condenser mikes).

Simply to move indoors, however, deprived the filmmaker of location photography. Here again, the relatively primitive state of sound technology determined the development of major aspects of image technology. In order to benefit from the controlled atmosphere provided by the new heavily insulated sound studios, without giving up outdoor scenes entirely, research in the area of back projection was accelerated, with acceptable results achieved as early as 1932. That the technique of back projection is modeled on that of the playback seems incontrovertible. In both cases the material prerecorded under special conditions (music needing special miking in a proper room, location photography involving movement and distances inconsistent with current sound practices) is inserted in the final recording by virtue of a hidden reproduction device (the playback speaker, the back projector). It is thus on the model of sound-track practices that Hollywood's habit of *constructing* reality (as opposed to *observing* it) is based.

Throughout the thirties, nearly every important technological innovation can be traced back to the desire to produce a persuasive illusion of real people speaking real words. Not only sound stages but camera blimps, microphone booms, incandescent lights (replacing the noisier arc lamps), and the development of highly directional microphones derive from a felt need to reduce all traces of the sound work from the sound track. This effacement of work, commonly recognized as a standard trait of bourgeois ideology, provides the technological counterpart to the inaudible sound editing practices developed during this period (blooping, cutting to sound, carrying sound over the cut, raising dialogue volume levels while reducing the level of sounds which don't directly serve the plot). These technological and technical contributions to inaudible sound editing of course parallel the well-known standards of invisible image editing developed during the same period. The technical aspects of this visual practice have received regular comment—match-cutting, cutting on movement, 180° rule, 30° rule, and so forth—but the technological aspects deserve to be more widely recognized: finer grain film to reduce graininess, faster film to reduce degree of artificial lighting, color film to simulate natural vision, coated lenses to reduce distortion and glare, more mobile cameras to reproduce variety of human motion. Indeed, many of these innovations, usually mentioned only from the image-improvement standpoint, have corresponding effects on sound reproduction. To mention only a few, the experiments in film stock carried out by Eastman, Du Pont, and others immediately before the war resulted not only in the faster panchromatic films, permitting the cinematographers of the period to increase depth of field, but also in definite improvements in the quality of sound-on-film recording. Fine-grain film stock, like Eastman's No. 1302 and Du Pont's No. 222, contributed markedly, as did the new coated lenses, to the increase in quality of sound recording during and after the war. (It is too

seldom remembered that sound technology during the thirties and forties is also image technology: all sounds, whether coded as variable density or variable area, were expressed in optical terms, and thus had to be recorded photographically on the film, and ultimately read by means of a lamp in the projector. Thus nearly every advance in image technology—film, lens, printer, lamp—resulted in a corresponding leap in sound quality.)

In terms of sound quality, the average film of the mid-forties, whether in Hollywood, France, or England, represented a significant improvement on the original efforts of the late twenties. In more general terms, however, the films of the forties remained the direct descendants of those earlier films. Every step of the process had been improved—from microphones to printers, from amplifiers to loudspeakers—yet the fundamental optical recording and printing technology remained basically the same. Not until after the war, thanks in part to German wartime technology, did the sound recording industry in general and the film sound track in particular take a quantum leap forward with the perfection of magnetic recording techniques. As with all important technological developments, however, the magnetic recording revolution met with immediate economic resistance. There was no question that magnetic recording was easier, used lighter, more mobile equipment, cost less, and produced decidedly better results; theaters, however, were not equipped to play films which substituted a magnetic stripe for the traditional optical sound track. Just as Hollywood delayed the coming of sound for years, it has for economic reasons delayed the coming of better sound for decades. Over a quarter of a century after the general availability of magnetic recording technology, very few theaters (usually only the high priced, first run, big city variety) are equipped with magnetic sound equipment. Ironically, for years the average amateur filmmaker working with super-8 sound equipment has possessed better and more advanced sound reproduction facilities than the neighborhood cinema.

Nevertheless, Hollywood was able to capitalize on the new technology in another way. Though filmmakers around the world continued to use optical sound for distribution prints, they very early began to do all their own recording in the magnetic mode (by the end of 1951, 75 percent of Hollywood's original production recording, music scoring, and dubbing was being done on magnetic recording equipment). Finishing what the playback had begun, magnetic recording divorced the sound track still further from the image and from the image's optical technology. Now, any number of sound sources could easily be separately recorded, mixed, and remixed independently of the image (thus simplifying the manipulation of stereophonic sound, now often coupled with the new wide-screen formats).

Ironically, the very technology that permitted Hollywood and other studio systems all over the world further to separate the production of sound

and image tracks encouraged independent filmmakers to tie the recording of the two tracks more tightly together. As inexpensive as they are portable, magnetic recorders were soon made a part of the standard *cinéma vérité* kit. Perceiving the ideological roots of Hollywood's split between image and sound (re)production, the partisans of direct sound developed a theory of the naturalness of direct, unedited recording, of this method's ideologically uncontaminated nature. Though these theories are contestable on many grounds, they had an enormous effect, particularly in France. Jean-Luc Godard and other practitioners of the New Wave were soon abandoning Hollywood's characteristic directional microphones and selective amplification in favor of the direct transcription of all ambient sounds by means of a single omnidirectional centrally located mike. No doubt this approach neglects the extent to which the human ear selects sounds, but it certainly had the important effect of foregrounding the artificiality, i.e., the constructed nature, of sound practices in studio-produced classical narrative films the world over.

Of all those influenced by Godard and *le direct*, no one has had such an important technological influence as Robert Altman. Experimenting from the very first with multiple-channel mixing (e.g., *M.A.S.H.*), Altman has since *Nashville* adopted the eight-track technology developed by the popular recording industry. In many ways, this was an obvious development, since film sound has regularly profited from parallel developments in related sound industries (radio, phonograph, tape, etc.), yet this borrowing was longer in coming and promises to bear still more fruit than most of the others. Over the past quarter of a century the popular recording industry has been one of the most profitable in the entire entertainment complex, and thus has benefited from technological developments far surpassing those made available to the cinema over the same period. At present, it is not at all uncommon for twenty-four separate tracks to be used in the constitution of the final sound track for an inexpensive record or tape. The standards of mixing technology have thus grown rapidly, to the point where they far surpass those typical of the film industry. Whereas nearly all previous productions had necessitated a mechanical connection between the microphone and other sound apparatus (whence the sound boom required for sound takes since the early thirties), Altman introduced the use of radio mikes broadcasting to the separate tracks of an eight-track system, using two or three times the basic eight when necessary. This frees the actor entirely from the tyranny of the microphone, and also, thanks to microphone technology developed for other purposes, permits Altman to restrict each channel to a single, carefully controlled input (usually a single character's voice). Each track can then be dealt with separately in any of the ways in which sound signals have traditionally been handled (filtered, reverb added, amplified, etc.), so that the final mix can do anything from reproducing the exact sound actually heard from a

specific point to constructing a highly contradictory set of signs which utterly splits the hearing subject. By manipulating his sound, whether through microphone location, signal deformation, or editing strategies, Altman—and the many others who now follow this system—is in a position to manipulate his auditor independently from his spectator. When the two sets of positioning signals are combined in the viewing/hearing subject, the full possibilities of cinema's audiovisual collaboration may clearly be sensed.

One final development deserves mention, because it represents the most recent progress in solving an old problem. When there was only one microphone input for the sound track, the problem of ground noise already existed. Indeed, throughout the thirties and forties, one of the main concerns of sound engineers was that of ground noise reduction. Many solutions were proposed and indeed put into effect, but none capable of solving the problems endemic to the multiple tracks and frequency ranges possible in current equipment. Recently, however, the Dolby system (not surprisingly, an innovation of the popular recording industry) has been applied to film sound with very favorable results. Basically, the Dolby system reduces distortion by artificially amplifying and then reducing low-volume sounds (compensating for differences in frequency range), thus returning the sounds to their original volume but in the process reducing ground noise. Used for the final track of *Nashville*, the Dolby system was first used throughout production in *Star Wars*, and since then for a number of other expensive Hollywood features, including Michael Cimino's *Deer Hunter*. Indeed, now that the film industry has at last begun to take its cue from the area which represents the state-of-the-sound-art—popular recording—it is to be expected that new technology will continue to be made available. Whether or not local theaters will ever be equipped with the sound systems necessary to use these innovations to their fullest must remain a separate—and economically problematic—question.

Just as attention to the technology of sound has largely been concentrated on the innovations leading up to the coming of sound, so reflection on the role of the sound track is concentrated in the years immediately following the sound revolution.

In order to understand the source of early suspicion of sound, as well as the subsequent disenfranchisement of sound in the realm of theoretical speculation, we must consider the role which sound—and especially language—had played during the heyday of the silent film. The earliest days of the cinema were marked by a practical and all-consuming desire for simple survival, but as soon as the new art found the leisure to contemplate its own position it felt compelled to differentiate itself from its renowned parent, the theater. Hugo Münsterberg constantly opposes the virtues of the cinema

to those of the stage, while Vachel Lindsay devotes a chapter of his *Art of the Moving Picture* to "Thirty Differences Between the Photoplays and the Stage."³ Later we find Eisenstein and many others attempting to put away the threat to the cinema's individuality represented by theater.⁴ Theories of montage in particular valorize the very areas in which cinema easily outshines the stage. Increasingly, self-conscious filmmakers attempted to reduce the effect of intertitles, shunning direct transcription of dialogue in favor of commentary whose graphic design often carried as important a message as its semantic content. The coming of sound could hardly have represented a welcome innovation to such a world, devoted as it was to surpassing film's competitor and parent, the theater.

For the coming of sound represents the return of the silent cinema's repressed. It is thus hardly surprising that sound should be seen by silent filmmakers more as a threat than as an opportunity. Repeatedly warning against the temptation to return to the theatrical model, represented by the dominance of synchronized sound and especially of dialogue, early critics of sound devised two strategies which lie at the root of nearly all subsequent reflection on the sound track. Eager to relegate language and theatricality once more to the shadows whence they came, these early critics initiated two fallacies whose power and durability are effectively grounded in their repressive function. The first of these I shall term the *historical fallacy*. A proper theory of sound cinema, one might expect, would begin with the observation that sound films are composed of two simultaneous and parallel phenomena, image and sound. Such, however, has rarely been the case. From the very first, critics who had lived through the coming of sound took the historical process (whereby an art which once lacked sound had the capabilities of sound reproduction added to it) as an adequate model for theoretical reflection. Instead of treating sound and image as simultaneous and coexistent, the historical fallacy orders them chronologically, thus implicitly hierarchizing them. Historically, sound was added to the image; ergo in the analysis of sound cinema we may treat sound as an afterthought, a supplement which the image is free to take or leave as it chooses.

By adhering to the historical fallacy, early critics succeeded admirably in marginalizing sound. With the rapid universalization of sound technology, however, the force of the historical argument necessarily subsided; once the silent era faded into the background the primacy of the silent image no longer appeared self-evident. Another argument was called for, a strategy tied not to film's history but to the medium's very essence. Thus was born the *ontological fallacy*. The version of the ontological fallacy regularly applied to cinema claims that film is a visual medium and that the images must be/are the primary carriers of the film's meaning and structure. Already present in capsule form during the early years of sound, this argu-

ment reaches its height in Arnheim's "New Laocoön" and Kracauer's *Theory of Film* ("films with sound live up to the spirit of the medium only if the visuals take the lead in them," p. 103). Today the primacy of the image continues to be taken as a given. Witness, for example, Gianfranco Bettetini: "The essence of the cinema is basically visual, and every sonic intervention ought to limit itself to a justified and necessary act of expressive integration."⁵ Now, what is at issue here is not whether the image is essential to a definition of cinema but whether or not notions of a form's essence provide a proper and sufficient basis for legislation of that form's activity and for description of its structure. Instead of developing a logical method of describing the actual characteristics of a composite form, the ontological fallacy represents a clever strategy for dissembling sound film's composite nature—in short, for repressing yet again the scandal of theatrical language. No matter that the practice of fifty years of filmmaking has clearly established the dominant position of dialogue, along with the initial position of the screenwriter, no matter that the most characteristic practice of classical film narrative should be the normally redundant technique of pointing the camera at the speaker, no matter that critics commonly quote a film word-for-word but rarely illustrate their comments with frame enlargements (usually preferring the better quality but largely irrelevant production still).

In short, the historical and ontological fallacies are the prescriptive arguments of silent filmmakers intent on preserving the purity of their "poetic" medium. That such strategies should have been devised is understandable; that they should have provided the model for a descriptive theory is entirely unacceptable. By perpetuating an image-oriented stance, film criticism has failed to provide either the theory or the terminology necessary for proper treatment of sound cinema as it exists (and not as early theoreticians predicted it would develop—we must not forget that the same Arnheim who willingly invoked the authority of Lessing claimed that the future of sound film lay in animated cartoons!).

In order to deal intelligently with the sound track we need a new beginning. We need to start, for once, not with the self-serving pronouncements of silent film directors and fans but with the phenomenon of sound film itself, analyzing its practices and its possibilities rather than prescribing its supposed duties and drawbacks.

Notes

1. Charles F. Altman, "Psychoanalysis and Cinema: The Imaginary Discourse," *Quarterly Review of Film Studies*, 2, no. 3 (August 1977):257–72.

2. This summary is heavily dependent on many of the items listed in Claudia Gorbman's excellent bibliography, especially Edward W. Kellogg, "History of Sound Motion Pictures," repr. from *Journal of the Society of Motion Picture Engineers* in Raymond Fielding, ed., *A Technological History of Motion Pictures and Television* (Berkeley: University of California Press, 1967).

3. Hugo Münsterberg, *The Film: A Psychological Study* (New York: Dover, 1970; orig. 1916); Vachel Lindsay, *Art of the Moving Picture* (New York: Liveright, 1970; orig. 1915).

4. Sergei Eisenstein, *Film Form: Essays in Film Theory*, ed. and trans. Jay Leyda (New York: Harcourt, Brace, 1949), pp. 15ff.; René Clair, *Réflexion faite: Notes pour servir à l'histoire de l'art cinématographique de 1920 à 1950* (Paris: Gallimard, 1951), pp. 116 and passim; René Clair, *Cinéma d'hier, cinéma d'aujourd'hui* (Paris: Gallimard, 1970), pp. 33, 60, 78, and passim; Lev Kuleshov, *Kuleshov on Film: Writings by Lev Kuleshov*, trans. Ron Levaco (Berkeley: University of California Press, 1974), pp. 56ff.

5. Gianfranco Bettetini, *The Language and Technique of the Film* (The Hague: Mouton, 1973), p. 111.