Early Popular Visual Culture, Vol. 4, No. 3, November 2006, pp. 273–284

Routledge

DE FOREST PHONOFILMS

A reappraisal*

Leo Enticknap

This paper argues that existing research on the film industry's conversion to sound largely overlooks the contribution of Lee de Forest and the 'Phonofilm' system. Informed by research in De Forest's personal archive, it suggests that to a certain extent, the development and commercial exploitation of De Forest's technology contradicts one of the principal implicit assumptions made by historians of this period, that when technology became available which fulfilled certain economic and cultural criteria, its adoption quickly and inevitably followed. Rather, it was De Forest's refusal to conform to established and increasingly dominant business models that ensured Phonofilm's failure, even though the technology itself was very similar to that used by the major Hollywood studios in the eventual wholesale conversion.

Introduction

> Every now and again, the newspapers and trade publications hail some individual as having been the first to have 'invented' sound pictures.[1]

In my recent book *Moving Image Technology: From Zoetrope to Digital*, I argued that during a period spanning some four decades (1885–1925, approximately), moving image and audio recording technologies evolved through distinct sets of business practices and cultural models—ones that were essentially incompatible until a number of factors combined to enable their successful and widespread integration in the late 1920s.[2] The relatively little work done on pre-1925 synchronous film sound has tended to present the systems involved as milestones in a linear progression from the primitive and embryonic to a baseline standard, from which the combination of moving image and audio became an economically viable and culturally dominant technology.

Even authors who warn against adopting this model, such as Thomas H. Cripps, who asserts that 'it is inaccurate to divide silent film and sound film into separate epochs',[3] nevertheless proceed to do so, at least to some degree. Cripps, for example, points to an ongoing process of research and development that significantly predated the American film industry's conversion to sound in 1926–1932, approximately, the results of which being exploited by Hollywood when the economic conditions were right. Douglas Gomery's work over three decades following his doctoral research in the mid-1970s argues a similar position, but from the other side of the determinist fence. For Gomery, the widespread and rapid adoption of synchronous sound by the Hollywood film industry was part of the process of expansion and consolidation that created what we now call the 'classical' period in Hollywood history, in which a vertically integrated economic structure combined with a highly formalized mode of production enabled

ISSN 1746-0654 (print)/ISSN 1746-0662 (online)/06/030273-12

DOI: 10.1080/17460650601002370

American feature films to become what was arguably the most successful forms of mass media during the first half of the twentieth century. 'The coming of sound was so well managed that its studio system should be remembered not for formation, but pushing the film business to the top of the entertainment industries,' he wrote, thereby arguing that the technology itself was subordinate to its utilization within a pre-existing economic and cultural infrastructure.[4]

Donald Crafton, on the other hand, offers a thesis in which the impact of the conversion was maybe not as profound as the 'key moment' or 'big bang' historiography might lead us to believe, noting that 'what had begun as an experiment to establish a separate minor branch of film practice to be marketed to small theatres had ended up fundamentally altering some aspects of the whole Hollywood system', qualified this with the observation that 'the cinema remained primarily a storytelling medium' and that the conversion to sound did not fundamentally change what the film industry did or how it did it.[5]

The overwhelming majority of serious research into the development of film sound technology, therefore, places its historiographical emphasis on trying to explain why its adoption happened so quickly and decisively over a 4–6 year period (thereby implicitly accepting that for many purposes, the silent and sound film periods *are* separate epochs), despite the underlying technology having been invented and demonstrated successfully significantly earlier. It is not difficult to understand how this question became prioritized. Acoustic audio recording emerged at around the same time and in one instance (Edison) was initially developed by the same individuals as motion picture film. A number of sustained attempts were made to combine the two in order to produce and market synchronous sound films from the 1890s to the late 1910s: examples include Léon Gaumont's 'Phono-Cinéma-Théâtre' in France at around the turn of the twentieth century, Oskar Messter's Biophon in Germany, Cecil Hepworth's Vivaphone in Britain and Edison's Kinetophone in the United States. All these systems involved mechanically interlocking acoustic disc or cylinder technology to a film camera or projector, and all occupied a small but consistent niche market throughout this period; one which stubbornly refused to expand. Some of the historians who argue that the conversion to sound was primarily about economic determinism suggest that these systems were technically capable of superseding live musical performance as the principal form of accompaniment to feature films, but did not do so because of institutional resistance to their use. Rick Altman even goes so far as to suggest that a 'systematic producer campaign' took place against the adoption of these technologies.[6]

Among the film sound technology, its inventors and promoters that characterised the pre-conversion period, Lee de Forest and his 'Phonofilm' system stands out from the crowd in a number of important respects. First, the period of his research, development and attempts at commercial exploitation cover the transitional phase in the early 1920s, from when sound was not on Hollywood's agenda to the conversion being seriously underway. Second, the technical approach he used was fundamentally different from the acoustic methods of his predecessors: coming from a radio and telecommunications background, De Forest used electronic recording and amplification as the basis for the Phonofilm system. In other aspects, however, Phonofilm remained firmly routed in the exhibition practices of early cinema. The most notable manifestation of this is that the majority of the films made were single-reel shorts of vaudeville, music hall or actuality subjects, which were produced, distributed and marketed to exhibitors directly by De Forest's company.

In this article, I hope to show that the legacy of De Forest Phonofilms merits a more prominent role in the history of the film industry's conversion to sound as it links the cultural and business practices of its acoustic predecessors with those of the rapidly emerging Hollywood behemoth. In contrast to those who argue that technical specifics are generally subordinate to economic imperatives and cultural trends (the idea that technologies are developed and established as and when the need for them emerges), I believe that the technological advances made by De Forest represent a key reason why the conversion happened when and how it did, and that De Forest having played no direct role in its final stages illustrates the two-way nature of the relationship between technology and economics—one that has been such an important element of the development of mass media forms and institutions.

Existing perspectives on De Forest Phonofilms

Lee de Forest's work on film sound has not received significant attention from established film technology historians. Where it is mentioned at all, it is normally characterized as just one of many technically flawed economic failures along the route to *The Jazz Singer* and wholesale conversion, placed into the same category as its acoustic predecessors. The generally accepted story goes like this: Lee de Forest (1873–1961), an engineer born in Iowa and educated at Yale, came to prominence for his invention of the 'Audion' in 1906. This device (which would now be termed a vacuum tube or a triode thermionic valve) enabled an electrical audio signal to be amplified, thereby 'unlocking the door to progress and improvement in almost every phase of sound transmission, recording and reproduction', according to one of the earliest attempts to summarize the history of film sound technology, published in 1955.[7] Initially, its principal applications were in radio and telecommunications, from which De Forest made a considerable amount of money from the Audion and related patents throughout the late 1900s and 1910s. Towards the end of the First World War, he became interested in synchronous film sound, sold most of his radio patents to fund the research and development work ('I sold my birthright,' as De Forest put it[8]) and spent the period from 1918–1922 working on a variable density optical sound recording and reproduction system, the operation of which was designed to be synchronous with a moving image.

Between 1922 and 1926, De Forest attempted to market this system under the trade name Phonofilms in the United States, Europe and Australia. He established studios in New York and London, and made short sound films featuring well-known vaudeville and music hall acts of the day. While these achieved limited commercial success, he failed to persuade any of the major Hollywood studios to license the system. A protracted legal battle with his former business partner, Theodore Case, over the patent rights to a key component of the Phonofilm reproduction system, further weakened his position during 1925–1926. De Forest's lack of capitalization combined with Hollywood's imminent adoption of rival systems forced him to sell up in July 1926 and, apart from limited overseas activity for a couple more years, this was effectively the end of his involvement with the film industry.

Substantially identical variations of this narrative are given in most of the standard histories of Hollywood's conversion to sound. Gomery, covering De Forest on a mere

two pages of his 180-page monograph on the subject, concludes that 'Phonofilm could never overcome its reputation as a vaudeville novelty'.[9] Scott Eyman attributes the principal blame to De Forest's erratic business practices, arguing that 'it was obvious to Case that De Forest's ragged financing and catch-as-catch-can methods were never going to be the spark of an industrial revolution'.[10] Crafton broadly supports this conclusion, adding that De Forest's having earlier sold patents for relevant amplification technology put him at a competitive disadvantage and that Phonofilm's commercial association with radio was another factor that put him at odds with the Hollywood establishment.[11]

However, this account leaves some relevant questions unanswered. First, how similar were the technical characteristics of the Phonofilm system to those of Fox-Case and the competing technologies with which the conversion was eventually accomplished? Does the issue of audio quality support or undermine the position that Phonofilm failed—at least to some extent—because it was technically inferior to the emerging competitors? Second, was a systematic attempt made to market Phonofilm as a means of adding dialogue and sound effects to feature-length narrative studio films? In other words, did De Forest try to overcome the reputation for a vaudeville novelty, or was it his intention to build such a reputation? And if these issues do not explain Phonofilm's commercial failure to play a role in the eventual conversion, then what does?

In attempting to address these issues, I was fortunate to have the opportunity last year of researching in the archive of Lee de Forest's personal papers, now preserved at History San José in California. Material relating to Phonofilm was disappointingly thin on the ground: it consists essentially of four large scrapbooks of press cuttings mainly covering the period of De Forest Phonofilms' commercial operation between 1922–1926, two handwritten books of laboratory notes from the year he spent in Berlin in 1921–1922 working on the system, some correspondence relating to the legal action that resulted from Case's split with De Forest and the former's subsequent work for William Fox, and the manuscript of De Forest's memoirs, a heavily edited and abridged version of which was published as his autobiography, *Father of Radio*, in 1950.[12] However, these documents do reveal much of De Forest's personal perspective on the events under discussion and, therefore, I believe, go some way to addressing some of the issues raised by his foray into film sound.

Initial research and development

In an article published in 1923, De Forest wrote:

> My attention was focused on the field of talking moving pictures wholly by photographic recording in 1918. … [This was] a new and useful application for the Audion tube, one which I could expect to develop, largely by my own efforts, as distinguished from its application to long-distance telephony, where obviously the intensive efforts of a large corps of engineers, backed by a large business organization, were indispensable.[13]

Between 1918 and 1921, he worked on the project at his home in New York, making slow and steady progress. The technology underpinning Phonofilm marked a radical

departure from all the audio technology previously used in conjunction with film in two respects. First, it used a microphone to capture the signal, which was then amplified for recording and reproduction electronically, unlike the acoustic systems of the 1900s and 1910s, in which a horn was used to capture a signal that was then engraved on a wax disc or cylinder. Second, the Phonofilm signal was recorded as a photographic (optical) analogue waveform, exposed onto raw 35mm film stock, not as grooves in a wax surface. Unpublished biographical notes in the San José collection suggest that there were three principal technical problems he had to overcome: optimizing the sensitivity of the light source used to expose the sound record to electrical modulations in the input signal, developing a photosensitive cell that was sensitive enough to reproduce the modulations as the film passed between it and a light source (it was this piece in the jigsaw that would ultimately precipitate the dispute between De Forest and Case), and damping the intermittent movement of the film in the projector in order to reduce wow and flutter to acceptable levels. By August 1920, he claimed to have recorded and reproduced a clear enough signal that 'with what grim satisfaction I first definitely determined whether or not the film was being run backwards'.[14]

However, by the autumn of 1920, De Forest was rapidly running out of money and had revised his previously held view that film sound was an area of technology that was within the ability of a private inventor to bring to market. 'But today the solution demands not the ingenious inventor, but the engineering staff and unlimited financial resources of the Western Electric Company, or of RCA Victor,' he complained,[15] noting a month later that technical progress was continuing 'given just sufficient funds to continue the fight'.[16] On 27 November, he wrote: 'I believe I can win out, at least to the capitalization point',[17] but by the following summer he had come to the conclusion that Phonofilm had not developed to the point of commercial viability. Faced with a rapidly worsening financial situation, De Forest's solution was a novel one. In June 1921 he was approached by 'two German engineers from the firm of Eric Huth GmbH of Berlin' with a view to collaboration on optical sound technology.[18] While, maddeningly, De Forest does not name his German associates, it seems reasonable to speculate that there at least may be some connection to the work of engineers Josef Engel, Hans Vogt and Joseph Massole, inventors of the 'Tri-Ergon' process launched in Berlin just over a year later, in September 1922. Such speculation is strengthened by Tri-Ergon having developed a means of converting the intermittent motion of a projector mechanism into the continuous motion needed for sound reproduction—the patents for which they continued to exploit in the United States until a lawsuit in 1934. According to his notes, this was a major problem for De Forest at around the time he left the United States.

After visiting Berlin in July-September 1921, De Forest decided to relocate there in order to complete his research. The rationale he gave was purely financial:

> The observations I made of Berlin's conditions, living and monetary, have made a deep and significant impression upon me, and if business arrangements can permit, and if Mary can realize the relative present advantages of living there contrasted with New York, I believe we may spend most of the next succeeding years in Europe. … Here, both of us could be both busy and happy, and free from the ever harrowing spectre of debt, of large income spent faster than received, and with scarce anything but the bare necessities of life in return. Given an American income and a German out-go, with prices so scandalously low as at present. …[19]

He sailed from New Jersey on 4 October. By 15 February 1922, De Forest was living in a rented flat at Stormstraße 6, Charlottenburg,[20] and had rented accommodation nearby in which he established a laboratory. For the next year, he continued to refine the Phonofilm sound camera and projector. De Forest's laboratory notebooks covering his year in Berlin survive, and from his meticulous technical records it becomes clear that reducing wow and flutter and increasing the sensitivity of the photocell used for reproduction were his two main priorities. The entry for 23 May is typical:

1. Tried 3 + 4 steps pair [illegible]
   5 steps [illegible]
   625 volts [illegible] brighter
   Felt bag on camera—very quiet
2. Film off the teeth until past the slit—NO!
   [illegible] roller at all. VC19—3 steps only
   1 ft. distance from [illegible]—too faint in shots
3. [illegible] 4 steps—3ft distance. Very good—much > 2.
4. Same as 3—same level, but with both sides of tooth roller on film, running very tight. 3 ft. and not loud talk.[21]

In June and August 1922, De Forest held a series of demonstrations. In a syndicated article that appeared in a number of American newspapers, journalist Edward M. Thierry pronounced the synchronization to be 'perfect', but did not think the sound quality was a perceptible improvement on the acoustic systems in mainstream use at the time, describing it as 'scratchy, like a cheap phonograph'.[22] On 9 September 1922, De Forest returned to New York and during the winter/spring of 1922–1923 appears to have established his collaboration with Case. The latter, an engineer who had been working in the area of photosensitive materials since before the First World War, had developed the 'Thalofide' cell. This material produced an electrical signal in response to light stimulation that was significantly stronger than the selenium-based cells with which De Forest had been experimenting in Berlin, and was ideally suited for use in the Phonofilm projector.[23] By March 1923, De Forest was publicly acknowledging the importance of Case's contribution.[24]

Commercial exploitation, patent battle and decline

> George M. Cohan is to be Phonofilmed. No, dear, that is not a new form of facial massage …[25]

De Forest Phonofilms, Inc., was formed in November 1922.[26] The first public demonstration of Phonofilm in the United States took place on 15 April 1923 at the Rivoli Theater, New York, and consisted of a programme of musical shorts. The theatre's musical director, Hugo Riesenfeld, also began collaborating with De Forest. During the remainder of 1923, De Forest established studios in New York and went on a tour of Europe, accompanied by Riesenfeld, to promote the system in the United Kingdom and France. For the next two years, De Forest Phonofilms produced films in its New York and London studios that were rented, along with the reproduction equipment, to 34 cinemas on the American east coast and two in London. The London operation was fran-

chised to one C.W. Ellwell, an individual about whom little is known apart from De Forest's description of him as 'my old friend from Palo Alto days'.[27] He rented a disused studio in Clapham, south London, 'round about 1925' and preceded to follow the formula established by De Forest in New York of producing simply staged one-reel shorts featuring well-known music hall acts of the day.[28]

However, the venture remained chronically undercapitalized and ineffectively marketed. There were also serious questions over technical reliability and reproduction quality. De Forest was not able to increase his customer base and, as had prompted his move to Berlin in 1921, he started to run out of money. 'By 1925, outside financing was becoming essential,' he wrote,[29] following a decision of the Attorney General of New York to block a further stock issue, which De Forest believed was politically motivated, but his detractors concluded was due to concerns over De Forest Phonofilms' continued viability.[30] Furthermore, his relationship with Case started to unravel in the autumn of 1924.

By this point, the Thalofide cell was not the only component of Case technology integral to the De Forest Phonofilms package. Case had also developed an exciter lamp (i.e., a light source that varied in intensity according to the modulation of the input signal from a microphone, from which a permanent record could be captured on film) known as the 'Aeo-Light',[31] which represented a substantial improvement on the triode-valve-based recording system De Forest had been using. Having become disillusioned with the rapidly worsening financial situation at Phonofilms and De Forest's refusal to publicly acknowledge the nature and extent of his contribution, Case and his assistant, Earl Sponable, left De Forest, taking those two key technologies (the Thalofide cell and the Aeo-Light) with them. De Forest gives the following account of the split:

> Last year, when it became evident that the Case photo-electric cell did not give as clear reproduction as certain other types of cell with which we had been experimenting, the existing contract was terminated, and Case thought to force the company into another contract, which we refused. Notwithstanding our strong position as owners of the basic patents covering the methods of recording talking motion pictures, Case announced his intention of going ahead regardless and independently. It seems now that he is actually carrying out this intention, and has made arrangements with William Fox for this purpose.[32]

There is, however, no other evidence to support De Forest's claim that he, in effect, sacked Case. In fact, there is extant technical evidence that both Case's photoelectric cell and the Aeo-Light achieved better results than De Forest's technology, and that Case left because he felt constrained by De Forest's economic problems[33] (De Forest's aggressive promotion and self-publicity is an issue I will return to in conclusion). Following their departure from De Forest Phonofilms, Case and Sponable approached a number of Hollywood studio owners directly,[34] with the end-result being a sale of Case's patents to William Fox on 23 July 1926, and the formation of the Fox-Case Corporation. At this point, and not for the first time, De Forest found himself up against big business. On 4 August 1926, he filed a suit for patent infringement against Fox and Case in relation to more minor aspects of the film transport mechanism,[35] which resulted in an out-of-court settlement, the proceeds of which were promptly poured into keeping the ailing Phonofilm Corporation afloat, 'hopelessly, as in a rat hole'.[36] During this period he was

also embroiled in a patent dispute with Tri-Ergon over Phonofilm's use of the flywheel damping mechanism, while at the same time Fox and Case launched their own optical sound system, christened 'Movietone', along with rival studio Warner Brothers' Vitaphone system. With the 'talkie revolution' inexorably underway and being driven by the economic might of the vertically integrated Hollywood system, De Forest had little choice but to sell off his remaining Phonofilm interests to the London-based South African entrepreneur I.W. Schlesinger in November 1927. De Forest continued to work for Schlesinger for a few years afterwards, supervising the manufacture and installation of cut-price cinema reproduction systems for second-run houses. Thus Lee de Forest was written out of the mainstream history of cinema's conversion to sound, despite his technology being, at the very least, closely related to the optical sound technology on which the economic success of that conversion largely depended.

Conclusion

In the introduction to this article, I posed two questions that I argued are fundamental to clarifying the relationship between the economic and cultural factors involved in the adoption of sound. First, how fit was the technology for purpose? Was De Forest's claim to have invented a system that was essentially indistinguishable from what eventually became Fox Movietone accurate? If it was, that raises the question of whether we can accept De Forest's claim that he was a lone inventor beaten into submission by better financed business interests (analogous to, say, Philo Farnsworth and television) or, question 2, did he adopt an effective strategy in marketing the process?

Forming an objective assessment of anything De Forest said or did is extremely difficult because the man himself appears to have been a consummate self-publicist who was forever playing up his achievements and standing. His personal papers leave the reader in no doubt of his ability to make enemies. He repeatedly claimed credit for having kick-started the talkie revolution—for example, in this letter to the editor of the *Film Daily* in July 1928:

> In view of the fact that the whole motion picture industry seems to have at last gone crazy on the subject of sound motion pictures, I'm sure you'll be interested in reviewing again the transcript of a lecture of March 1923, when Phonofilm made its first public appearance. I think if you peruse this booklet, you will find there expressed five years ago the opinions which such men as Lasky, Christy, West and others are now so eager to give expression to.[37]

He also spent most of his professional life embroiled in legal disputes over patent infringements (alleged and actual), including one lawsuit against the engineer Edwin Armstrong (who later made his reputation as the inventor of FM radio), which lasted from 1916 until 1934. De Forest also appears to have held some rather extreme political views. Following his first visit to Berlin in the summer of 1921, he opined that the Germans' 'pig-like brains' would prevent them from ever becoming a major political force again;[38] praised the 'noble Fascists' of Mussolini when invited to film an interview with him in the spring of 1927;[39] and made repeated antisemitic remarks throughout the manuscript of his memoirs (most of which were edited out of the version published after the Second

World War in 1950). Given the extent of Jewish involvement in the Hollywood film industry, these latter sentiments may have as much to do with Phonofilm's failure to secure a backer as any technical or legal issue. During the 1950s, living in retirement in Hollywood, he made a number of attempts to persuade the studios to make a biographical feature film about him, even hiring the scriptwriter Marshall Neilan to produce a treatment and promote it to studio executives. The De Forest papers also contain correspondence related to his intensive lobbying to be awarded a special Oscar (which he eventually was, in 1959) and Nobel Prize for science (which he was not). There is also a thick pile of letters to political figures ranging from local government officials to the President on issues as many and varied as rubbish collections from outside his Hollywood Boulevard home to the release of Alger Hiss ('such an arch-traitor to the United States!') from jail.[40] This letter to Senator William F. Knowland of California is typical:

> Federal housing, as now proposed, will result in housing chiefly the indigent, the least worthy of our citizens, the over-prolific, and therefore the class which will naturally vote, and continue to vote, for that government which houses them—all at the cost of the hard-working, the thrifty, from whom alone you will collect the taxes necessary for that vast, vote buying extravagance.[41]

Given the forcefulness of his personality and his tendency to polarize the views of those with whom he came into contact, it is difficult to unpick the hyperbole from the reality of the extent to which Phonofilm was technically and commercially viable. Kellogg's article pointedly omits to mention any of the patent and contractual disputes that were undoubtedly a contributory factor in Phonofilm's demise (probably because De Forest was still alive when he wrote it) in concluding that:

> The Phonofilm system was used in numerous theatres, with sound films made under Dr. de Forest's direction; but he did not succeed in interesting the established American picture producers. Perhaps the industry was prospering too well at the time, but judging from the initial coolness of film executives to the technically greatly improved systems a few years later, it is easy to imagine that numerous imperfections which undoubtedly existed (as, for example, defective film motion, limited frequency range, and loudspeakers that gave unnatural voices, and perhaps, too, demonstration films that were uninteresting) contributed to the loss of the impressiveness needed for doing business.[42]

Were there really 'numerous imperfections' that represented a genuine barrier to Phonofilm's commercial success? Not according to Crafton, who argues that: 'The Phonofilm system was functionally identical to Case's Fox Movietone system of 1927 and the Powers Cinephone of 1928—which were technically and commercially satisfactory—so the explanation is not purely mechanical inferiority.'[43] De Forest also claims that there was no substantive technical difference between Phonofilm and Movietone, claiming that there was little to choose between his and Fox's newsreel of Charles Lindbergh's arrival in New York, 'both having been made with identical apparatus and methods'[44] (we do know, however, that there were some technical differences: e.g., De Forest Phonofilms used a speed of 22fps, while Fox Movietone ran at 24). Yet on the importance of Case's contribution to the Phonofilm recording and reproduction

technologies, De Forest contradicts himself. In his 1923 article for the *SMPE Journal*, he describes the Thalofide cell as 'unquestionably the complete answer' to achieving the pre-amplification needed to make optical sound reproduction viable,[45] yet his later action for patent infringement against Fox and Case after the latter's departure in 1924 claimed that De Forest had developed superior photosensitive cell technology to Case's. Independent assessments of the audio quality of Phonofilm varied. After the first Phonofilm demonstration in London on 14 June 1923, the *Daily Express*'s reviewer's response was that the audio was 'a little throaty and inclined to mumble its responses occasionally, but it is strong and resonant enough to fill the largest hall'.[46] This last point is important, given the inherent limitations possible in the amplification of an acoustic signal—ones that De Forest had been trying to overcome with the electronic approach. Yet, ultimately, press coverage of Phonofilm screenings from 1922–1926 gives us little meaningful technical information for the simple reason that the journalists writing it had no experience of any similar technologies with which to compare Phonofilm.

In relation to the commercial aspects of Phonofilm, a widely syndicated press article written by De Forest in April 1922 (i.e., when he was still working in Berlin) reveals much about how he envisaged the system being used:

1. To make political treaties and commercial agreements by picturing the contracting parties and their verbal agreements on the same film;
2. To make uncontestable wills by picturing the testator as he indicates his bequest, proving legality by appearance, action and voice;
3. To prepare for future generations the simultaneous voice and gestures of great statesmen, actors and singers;
4. To broadcast campaign speeches, propaganda, etc.;
5. To preserve the speech and appearance of children at various ages;
6. To teach foreign languages by bi-lingual conversations and objects.[47]

'To add synchronised dialogue, music and effects to narrative feature films' is notably absent from this list, suggesting that although De Forest had taken a radically different technical approach from his acoustic predecessors, he was essentially following in their footsteps as far as its exploitation is concerned. If proof of this were needed, it can be found in the fact that although Phonofilm represented two significant technical breakthroughs—enabling sound films of infinite length to be produced and enabling shots to be edited in synchronization with the picture—none of the films made by De Forest's company exceeded 24 minutes in length (and most were under 10) and the majority consisted of long, static shots.

Perhaps in the end it did just come down to personalities and as De Forest's personal archive at History San José reveals, his was certainly a unique personality! His individualistic approach to technical innovation is immediately apparent (hence his recollection that he was drawn to work on film sound in the first place because he felt it was one of the few remaining applications for vacuum tube amplification that could be developed by a lone inventor without the need for backing from a large corporation) and the accumulation of patent and contract litigation that built up throughout his career runs Edison a close second. Ultimately, it was his former associate, Theodore Case, who took optical sound technology to Fox and made it work commercially. Ultimately, therefore, the story of De Forest Phonofilms does not invalidate the linear cause-and-effect model through which the film industry's conversion to sound is predominately

understood: but it does provide a slightly more nuanced understanding of what drove it by examining a technology that, basically, 'made it', but whose inventor did not. A press report of a promotional Phonofilm screening in Paris in 1923 predicted that 'the time must come when the frequenters of a cinema in any western town will think the voiceless picture of today as worthless as a Confederate dollar is'.[48] She turned out to be right (unlike De Forest in his assessment of the Germans), but ironically De Forest was not trying to make the voiceless picture worthless. And I suspect that he would not have minded the return of the Confederate dollar.

Note on contributor

Leo Enticknapp was appointed as a lecturer in cinema at the Institute of Communications Studies, University of Leeds, in November 2006. This paper was researched and written while he was at University of Teeside. *Address*: Institute of Communication Studies, University of Leeds, Houldsworth Building, Leeds L52 9JT, UK. [email: ldge@enticknap.net]

Notes and references

* I would like to thank Jim Reed and his colleagues at History San José for their extensive help, support and hospitality during my research visit from 6–9 September 2005. I would also like to thank the History Research Group at the University of Teesside, which funded the trip.

1. Mieling, Rudolph (1929) *Sound Projection*, Mancall, New York, p. 1.
2. Enticknap, Leo (2005) *Moving Image Technology: From Zoetrope to Digital*, Wallflower Press, London, pp. 98–119.
3. Cripps, Thomas H. (1997) *Hollywood's High Noon*, Johns Hopkins University Press, Baltimore, MD, p. 98.
4. Gomery, Douglas (2005) *The Coming of Sound*, Routledge, London/New York, p. 152.
5. Crafton, Donald (1997) *The Talkies: American Cinema's Transition to Sound, 1926–1931*, University of California Press, Berkeley, CA, p. 18.
6. Altman, Rick (n.d.) 'The sound of sound: A brief history of the reproduction of sound in movie theatres [online], Available at: http://www.geocities.com/Hollywood/Academy/4394/altman.html (accessed 23 November 2003).
7. Kellogg, Edward W. (1955) 'History of sound motion pictures', *Journal of the SMPTE*, vol. 64 (June), reprinted in Fielding, Raymond (ed.) (1967) *A Technological History of Motion Pictures and Television*, University of California Press, Berkeley, CA, p. 176.
8. Lee de Forest, unpublished autobiographical notes, San José collection, box 2, vol. 3, p. 954.
9. Gomery, *The Coming of Sound*, p. 30.
10. Eyman, Scott (1997) *The Speed of Sound: Hollywood and the Talkie Revolution, 1926–1930*, Simon & Schuster, New York, p. 52.
11. Crafton, *The Talkies*, p. 69.
12. De Forest, Lee (1950) *Father of Radio*, Wilcox & Follett, Chicago, IL.
13. De Forest, Lee (1923) 'The Phonofilm', *Transactions of the SMPE*, no. 16, pp. 61–75.
14. De Forest, autobiographical notes, vol. 3, p. 896.

15. De Forest, autobiographical notes, vol. 3, pp. 873–874.
16. De Forest, autobiographical notes, vol. 3, p. 899.
17. Lee de Forest, autobiographical notes, San José collection, box 28, loose typewritten manuscript, p. 672.
18. De Forest, autobiographical notes, typewritten manuscript, p. 676.
19. De Forest, autobiographical notes, typewritten manuscript, p. 680.
20. Postcard from De Forest's wife, San José collection, box 18.
21. San José collection, Berlin lab books, box 27, book covering 23 May–20 December 1922.
22. Various newspaper articles, 2–6 June 1922, cuttings in San José collection, box 25, scrapbook 3.
23. Case's account of the development of Thalofide can be found in Case, Theodore W. (1922) 'Thalofide cell: A new photoelectric substance', *Journal of the Optical Society of America*, no. 6, p. 398.
24. E.g., in the *Baltimore American*, 26 March 1923, cutting in San José collection, box 25, scrapbook 3.
25. *New York City Journal*, 31 May 1923, cutting in San José collection, box 25, scrapbook 3.
26. De Forest, autobiographical notes, vol. 3, p. 927.
27. De Forest, autobiographical notes, vol. 3, p. 964.
28. For an account of the Clapham operation, see Wood, Leslie (1937) *The Romance of the Movies*, William Heinemann, London, pp. 254–259.
29. De Forest, autobiographical notes, vol. 3, p. 970.
30. De Forest, autobiographical notes, vol. 3, p. 971.
31. US patent no. 1,816,825 (filed 28 May 1927, granted 4 August 1931).
32. Undated typescript (probably late 1925), 'Re: Fox/Case suit', San José collection, box 18.
33. Kellogg, 'History of sound motion pictures', pp. 178–179.
34. One bizarre result of Case's attempt to gain financial backing independently of De Forest was a demonstration film, probably made in late 1925 or early 1926 in Case's laboratory, titled *Gus Visser and his Singing Duck* by the archive which later preserved it. The film features Visser, a vaudeville star of the era, singing a romantic ballad from the Broadway musical *The Midnight Rounders of 1921* while holding a duck, which he appears to repeatedly bugger with his right index finger in order to elicit 'quacks' at regular intervals during the performance.
35. *The New York Times*, 4 August 1926, cutting in San José collection, box 26, scrapbook 2.
36. De Forest, autobiographical notes, vol. 3, p. 985.
37. *Film Daily*, 5 July 1928, cutting in San José collection, box 18.
38. De Forest, autobiographical notes, vol. 3, p. 922.
39. De Forest, autobiographical notes, vol. 3, p. 981.
40. Letter, Lee de Forest to George Killinger, United States Parole Board, 12 November 1952, San José collection, miscellaneous notes, box 3.
41. Letter, De Forest to Knowland, 12 April 1949, box 35.
42. Kellogg, 'History of sound motion pictures', p. 178.
43. Crafton, *The Talkies*, p. 69.
44. De Forest, autobiographical notes, vol. 3, p. 984.
45. De Forest, 'The Phonofilm'.
46. *Daily Express*, 15 June 1923, San José collection, box 25, scrapbook 3.
47. *Daily NEA Service*, 25 April 1922, San José collection, box 25, scrapbook 3.
48. *The New York Telegraph*, 27 May 1923, San José collection, box 25, scrapbook 3.