What the Film Archive Can Tell Us About Technology in the Post-digital Era
Michael Punt

Figure 1
Un cerf-volant décoré. *La Nature* 1895.

The kinetograph and the cinématograph were not the works of individual genius, but emerged from the popular imagination that converged on a raft of concerns, ranging from the deeply philosophical to the outright flippant, that gave a particular meaning to hundreds of little pre-cinematic devices both invented and rediscovered in the nineteenth century. From what we know of it, that imagination has once again found a dynamic moment in the disorganized turbulence of an ill-defined and confused apparatus—gathered together under the rubric of electronic digital media—ranging from the networked home computer to microwave telephone technology, and "Bluetooth" interspecie communication. Yet, as digital media reaches for infinity and beyond (to quote Buzz Light Year) the cinematic imagination of the twentieth century shows no sign of running out of economic steam in the twentieth-first as, for example, the first *Lord of the Rings* film grossed £560 million plus, and the franchise is expected to generate around £3 billion in twenty years. The cinema, the flagship of the analogue era, has not simply survived, it has prospered in the digital revolution and, arguably, even set the economic and aesthetic agenda for how that technology is exploited as entertainment. So far, so good for cinephiles, but what of the cinema history? Worrying about the archive may seem a dull preoccupation when the barricades appear to be crumbling, but if we avoid the question, it is possible that, in the not too distant future, understanding the latest turns in film and cinema history will be incomplete if we do not preserve evidence of the technological trace of the imagination that has helped shape the reinvented cinema of today. If the intrusion into history of digital cinema has done anything, it has forced a consideration that the emphasis of the archive has shifted from the films themselves to the cinematic imagination in all its manifestations.

Of course, cinema history and film archives always have concerned themselves with architecture, costumes, distribution, documents, economics, government policy, legislation, posters, scripts, stills, and technology; but traditionally, the cinematic imagination over the past century has been interrogated primarily through the image. More often than not, this has meant the remains of films that, by a mixture of relentless work and good fortune, have been the preoccupation of archivists, scholars, and fans. As a consequence,
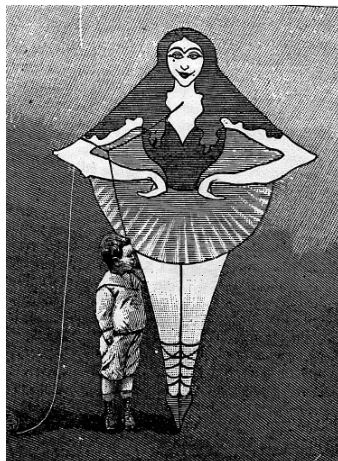
cinema history (the institutions) and film history (the material strips) invariably collapse into a single study, as perhaps they should. After all, separating the significance of a film (text) from the context of reception seems a conceptual impossibility given the last half century of film studies.

Subordinating the cinematic imagination to the image, however, forces a reading of the cinema, which involves certain losses that, as we begin to think hard about digital cinema and the electrochemical future, may not be sustainable. In particular, the discontinuity between the cinematic imagination as hardware and the cinematic imagination as software, which seems to mark the ways that we talk about the cinema in both the popular and academic domains, is challenged by the erosion of the software/hardware binary in electrochemical media. This paper is the beginning of an attempt to recover some of the continuity between these two cinematic imaginations so that we may begin to understand the past—especially the recent past—in relation to a reconceptualization of the relationship between software and hardware. To explore this further, I want to revisit early cinema and one technology that often is recognized in film history, but almost immediately is marginalized, Reynaud's *Pantomimes Lumineuses,* and to compare it with a twentieth-century medium that curiously also sits on the margins of history: the CD-Rom.

Our understanding of the invention of cinema has been driven almost exclusively by separating the history of the technology from the history of the image. Whether we begin with Javanese shadow puppets, the Robertson's phantasmagoria, or the nineteenth-century magic lantern, the story has been more or less the same: a cultural imperative for particular kinds of images (complete with movement and sound) responded to by entertainers, engineers, and inventors until a satisfactory compromise has been reached between the social demand and the economics of provision. The twentieth-century cinema, as we know it, is consequently seen as an ongoing process of the contingent stabilization of the outcome of these forces. Within this framework, conventional uses—some even would say a language—became established which facilitated the expression of creative imaginations given more or less a free hand. Perhaps less of a freed hand in the profit-driven side of cinema—the movies—and arguably more in the artistic expression of artist/filmmakers. Either way, it is the films—that is the software of the cinema that is considered to be the primary trace of human consciousness. What is excluded from this kind of history is the popular and individual imagination that is sustained by technology as hardware, and the act of engaging with technology (collectively and individually) as an extension of consciousness. In order to include this, it is necessary to revisit some basic questions about the relationship between technology and culture.

The processes that give rise to a particular technology might be difficult to account for but, by definition, it is never just "there" as part of nature—it has to be a product of human agency and, as such, should be open to explanation. This often has proved more difficult than we imagined, and aside from the convenience of technological determinism, we have resorted to ideas such as "invention" and "genius," along with determining accident, dreams, and good luck to help us out. On closer examination, however, these are simply excuses to ease the discomfort caused by inadequate attempts to explain how a technology comes into the world (let alone what happens to it afterwards). A discomfort which is not ameliorated when it quickly becomes apparent that, by and large, we are living in an accidental world in which the dominant technological solutions to overcoming the hardships of nature are seldom, if ever, the best. For example, heavier-than-air flight using fixed-wing structures has become a means of mass transportation that now involves a network of discrete industries, each of which enforces the deflection of the initial popular impulse to travel independently of the constraints of the earth. Almost without exception, any advanced technology that we think of becomes cumbersome and excessively elaborate when apparently minor problems are met with increasing complexity. With good reason, historians of technology have black boxes, kluges, and autonomous technology in their explanatory tool kit.

In a similar way, the massive inefficiency of theatrical exhibition that all but bankrupted Hollywood on several occasions during

Figure 2a
Mario Cobianchi Circling the Leaning Tower of Pisa, published by the *Record Press* in 1912.

Figure 2b
An illustration of a proposal for remote controlled Flight Using Television, in *Berliner Illustrite Seitung* in 1928.

the last century can be seen as the consequence of the insistence of screening the image by early promoters. This may have had as much to do with the apparently insatiable public appetite for actively and collectively participating in technology (by paradoxically consuming it as a spectacle) than a natural link between the cinema and theatre or screen entertainment. Some people have suggested that the cinema of the twentieth century, with all its real estate, might be a deflection of the technological imagination that drove the invention. Thomas Elsaesser has argued that the Lumière Brothers' *cinématographe* was the outcome of an attempt to match their commercial imperatives with their obsession with stereoscopy and the third dimension, rather than the pursuit of photographic realism. As he puts it, "[to this] ... scheme of counterfactual history, one could now add the 'dog that did not bark' theory of film history, where stereoscopy would have been, for almost a hundred years, the sort of clue partly missed when trying to reconstruct the prehistory of cinema."[1] Add to this the Lumières' obsession with carbon chemistry and their poly-dimensional approaches to experiments with three-dimensional and color photography, the *cinématographe* begins to take on the character of a technology whose meaning in relation to entertainment is shaped not by its inventors, but in the course of its entry into a particular public arena and appropriation by audiences and exhibitors.

The folk version of the history of the cinema excludes these and other possibilities, in part because, in the first place, scientific
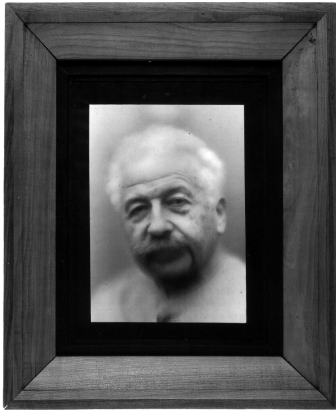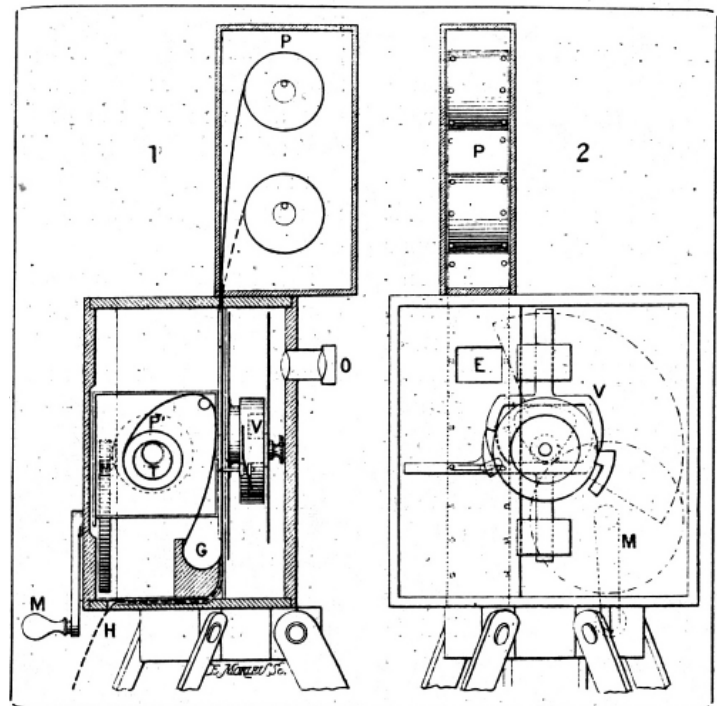

Figure 3
An attempt at 3D photography by the Lumière brothers using nine superimposed photographic plates [the Lumière brothers: Louis and Auguste]

Figure 4
Drawing of the Cinématographe.
La Nature June 1895

1   Thomas Elsaesser, "Louis Lumière—The Cinema's First Virtualist," in *Cinema Futures: Cain, Abel, or Cable,* Thomas Elsaesser and Kay Hoffmann, eds. (Amsterdam: University of Amsterdam Press, 1998), 59.

naturalism dominates our understanding of technology; and in the second, teleologies are a convenient and valuable shortcut to the present for most film academics not especially interested in the finer grain of early cinema history. However, this convenience tends, among other things, to lead us to make a number of fundamental errors by prioritizing the relationship between science and technology, and uncoupling software from hardware. This, together with a cultural predisposition to favor the visual, leads us almost inexorably to see the destiny of cinema technology as the handmaiden of the moving photographic image with integrated, synchronized sound. Based on a discussion of the image and realism, the cinema's first decade almost universally is regarded as a period of the aesthetics of astonishment and attraction, followed by a century of narrative integration. The moving image subordinates the technology, and becomes the representative of the cinematic apparatus. The shock effect (or otherwise) that it had on the audience is regarded as an image-driven effect rather than the other way around. As Gunning has insisted, "The audience's sense of shock comes less from the naive belief that they are being threatened by an actual locomotive than from an unbelievable visual transformation occurring before their eyes, parallel to the greatest wonders of the magic theatre."[2]

Revisiting the evidence from the standpoint of a history of technology or the history of "parascience," rather than the history of cinema, however, it is doubtful if the transformation occurring before the audience's eyes was unbelievable or magic theatre. Full (scientific) descriptions of the *cinématographe* had been in the public domain from at least as early as August 1895, and similar devices had been featured in popular science journals in the previous years. (Indeed, it is fair to assume that anyone sufficiently interested to pay to be astonished by the *cinématographe* hardly would have missed some of the hundreds of diversions and experiments that are said to inform the prehistory of the cinema). In the context of the popular preoccupation with telepathy and psychical phenomena, it is doubtful there was an illusion at all, much less a direct confrontation with the assertions of natural science. As some of the advertising suggests, the apparatus is a "membranous" medium (in the parapsychic sense) through which another plane—one that is both continuous and discontinuous with this world—can be accessed. In this interpretation, the "cinématographe séance," taken as an ensemble of hardware and software, confronts not realism but the expectations of scientific naturalism by presenting the believable as inexplicable—despite explanation—in exactly the way that G. A. Smith and the raft of mesmerists, telepathists, and clairvoyants did. Whether genuine or fraudulent, they offered the audience not tricks or illusions, but compelling demonstrations of an extended reality, or at the very least a set of metaphors to begin to discuss what such a reality might be like and to give contemporary form to the idea that scientific naturalism was only one explanatory system among many.

2   Tom Gunning, "The Aesthetics of Astonishment," *Art &Text* 34 (1989), 35.

In that arena in Britain in the mid-to-late nineteenth century, there was a characteristic convergence of an active curiosity about the uncanny as an alternative to the exclusivity of natural science, and a fascination with technology in theatrical entertainment. As the century drew to a close, increasingly the Society for Psychical Research (SPR) was confident that telepathy was a legitimate means of interaction between sensitized people (or those for whom the filters of reality were impaired). Public demonstrations of telepathy ranged from the scientifically controlled experiment to the "turn" in a variety show. The former stage medium and one-time secretary to Edmund Gurney of SPR, G. A. Smith began making films in Brighton some time after he was exposed as a fraud.[3] Although it was discovered that Smith was using a code, this did not reflect on other mediums who were thought to be genuine. His exposure, like many others, was not taken to mean that telepathy did not exist, but simply that, in this case, G. A. Smith was not (and never claimed to be) a true medium. However, in a climate of what can only be called "show trials," each fraudulent medium was exposed by the press, and the position of the SPR relative to science was gradually undermined. As a result, the struggle for the definition of reality, at least in official circles, was secured by scientific naturalists. However, the authority of science was not socially universal, and while the academy and the great and good appeared to see the swing of evidence away from psychical phenomena, this was not the case in the broader public domain. Subsequently, Smith open an amusement park at Anne's Wells that included the paraphernalia of theatrical spiritualism including the magic lantern. Apparently impressed by the demonstrations of the *cinématographe* and Robert Paul's work, he also began making films in 1896. From the amusement park, he distributed what apparently were called "living pictures" to exhibitors; the titles of which included ghost subjects such as: *The Corsican Brothers, Faust and Mephistopheles, Photographing a Ghost* and the *Gambler's Wife.*[4] The way that Smith embarked on film production not only reflects his early involvement with stage telepathy and clairvoyancy, but also is suggestive of the public appetite for what might be called technologies of the paranormal, despite the vigorous scientific skepticism.

The assertion that was at the root of the antagonism between naturalism and extendedness became one aspect of the cinematic imagination, only to dissolve into debates about realism when the Society for Psychical Research lost its way[5] and the peripatetic cinematic séance began to court the urban white-collar market. It soon became "lodged" in the real estate of the natural world in cinemas in the UK, and Nickelodeons, and cinema chains elsewhere.[6] As the cinema ensemble adopted an increasingly positivist interpretation, its earlier concern with the animate was subsumed in a scientific discourse of artificial life. As others have remarked, this leaves academic film studies blushing as the economic engine

3   R. Pearsall, *The Table Rappers* (London: Michael Joseph, 1972), 131. Also in Roger Luckhurst, *The Invention of Telepathy* (Oxford: Oxford University Press, 2002), 73.

4   E. Barnouw, *The Magician and The Cinema* (Oxford: Oxford University Press, 1982), 89.

5   B. Inglis, *The Natural and The Supernatural: The History of the Supernatural* (Bridport, UK: Prism, 1992), 412.

6   R. Abel, *Ciné Goes to Town* (Berkeley: University of California Press, 1994), 30.

Figure 5
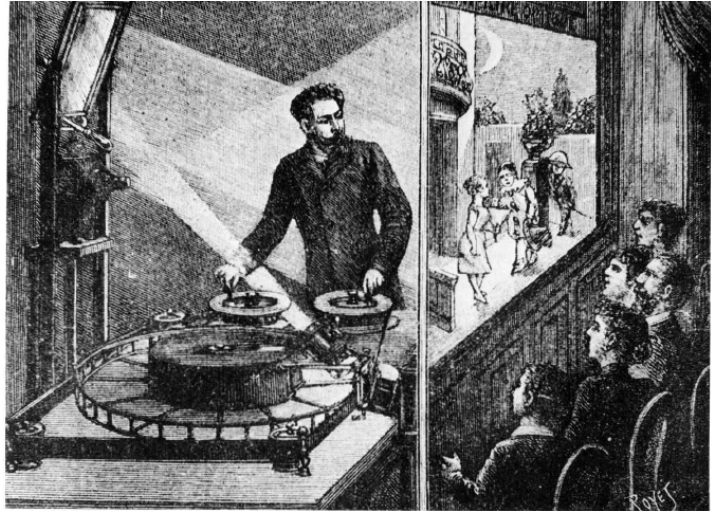Illustration of Reynaud's Théâtre optique.

Figure 6
Theatre praxinoscope.

of contemporary cinema, animation, is all but invisible in the film industry's bibliography. In retrospect, this neglect seems almost inevitable given that no less than Hugo Münsterberg (arguably our first theorist) insisted that spiritualism *was* mysticism, and that "phenomena" do not and never will exist.[7] In handing over hypnotism (and the hypnotic effects of experiences) to psychiatrists, the cinema became subject to a further integration with positivism in which the animated film could only be accounted for in its narrowest possible definition, that is: giving the appearance of life. In contrast, a technological history of the cinematic imagination comprises a galaxy of little machines with names invoking its earliest definition; to give life, to quicken, to vivify. The list is too long to recite in full, but the generally acknowledged steppingstones from *animatographe* to *zoetrope* nearly all contain references to life or the supernatural. They form the catalogue of technological metaphors for artificial life that atrophied as their usefulness *as metaphors* declined.

One exception to this etymology—all the more curious since it is thought to most clearly foreshadow the cinema—is the praxinoscope, whose name derives from two Greek words *praxi* ("act") and *scopein* ("see"). Based on the *zoetrope* ("wheel of life") the praxinoscope was patented in 1876 or 1877 by Emile Reynaud, a teacher of natural science, and subsequently developed in a number of forms; the "Praxinoscope Theatre," "La Toupie Fantoche," and a projection praxinoscope, patented around 1882. This formed the basis of the *Theatre Optique,* which opened at the Musée Grévin in Paris in the Cabinet Fantastique on October 28, 1892, and lasted for 12,800 performances attended by half a million visitors. The strips that formed the basis of the animated part of the show were hand-painted images on a flexible band (gelatin, glass, or "Crystalite"—there is some uncertainty). Reynaud himself operated the apparatus from behind a translucent screen framed by a proscenium arch, manually driving the band past the mirrors as well as changing the magic lantern

slides that provided the "backgrounds" for the action. (Earlier, he had used both steam and electricity to drive the bands but, it seems, preferred to use his own energies rather than machines). It was a seamless presentation in opulent surroundings, complete with music written especially for the performances and scored for the orchestra to ensure that the image and sound always were perfectly synchronized. The show was hugely successful but famously, before his death in 1918, he destroyed all but two of his picture bands—one of which was *Autour d'une Cabine.*

> This is what Brian Coe has to say about Reynaud:
> The praxinoscope was very popular, especially in the theatre form, and Reynaud followed up an idea covered by his first patent—the projection praxinoscope. ... All three models of the praxinoscope were demonstrated to the Societe Francaise de Photographie in 1880.

Had Reynaud's achievements ended with the production of these delightful toys, he would have earned his place in the history of the moving picture—but he did not stop there.

> Coe concludes by honoring Reynaud as:
> ... being the first person publicly to present animated moving pictures on a screen by the use of long, transparent bands of images. However, his pictures, delightful though they were, lacked the realism which could only come with the successful analysis and reproduction of movement by means of photography.[8]

As I have suggested above, it is not at all certain that realism was what was so appealing about the *Pantomimes Lumineuses.* It seems much more plausible that, given the significance of the machine in the ensemble, a cinematic imaginary that was much more ambiguous towards realism could be found in the Musée Grévin. Reynaud could have used photography, and indeed made two photo-scene bands in order to save time (but only when he was under enormous pressure to provide new stories). In 1899, at the moment when he was at his most popular and production was most stressed, Gaumont began screening actualities as part of the performances in the Musée Grévin theatre, and according to Richard Abel, at the same time other fixed sites opened up in Paris to complement the existing sites run by the Lumieres, Pathe, and Mélièse.[9] Reynaud would have seen these on his way to and from the theatre, but this sort of cinema was clearly not the entertainment that Reynaud (or his audience) envisaged. He advertised his performance at the Musée Grévin as *Pantomimes Lumineuses,*and although it used a drawing of what seems like a "live" dancer, and the actual séance involved a back projection system, most members of the audience would have had a clear idea of the technological arrangement involved since Gaston Tissandier,

7   B. Inglis, *The Natural and The Supernatural,* 13.

8   B. Coe, *The History of Movie Photography* (Westfield, NJ: Eastview Editions, 1981), 37.

9   R. Able, *Ciné Goes to Town,* 15.

had published a descriptive account in *La Nature* in 1882 under the title "Le praxinoscope de projection," (p. 357). Given the public fascination with technology there could be no mystery especially since, by 1888, an illustration, engraved by Louis Poyet, detailing the apparatus also formed part of the publicity for the show. (There is a reference to this as early as 1880, but this seems unlikely).

In short, there was no mystery, no magic theatre, or smoke and mirrors—and no photographic realism, except as a later and temporary expedient. There was an identifiable operator, the concealed star of the show, whose manipulative and inventive skills met the audience's desires and expectation at the interface of a screen: a membrane between two intelligences, neither of which were at that moment totally committed to scientific naturalism. The *Theatre Optique* was not telepathy to be sure, nor is there any evidence to suggest that it pretended to be. But by not disavowing apparatus, the operator and the evidently manufactured image and cued live musical accompaniment provided a perfect diagram of Alberti's famous view of the world and its representation: the double pyramid as a schema for telepathic interaction. The *Pantomimes Lumineuses* was neither realist nor naturalist, nor was it anti-naturalist, it was the cinematic imagination in which the technological hardware and software were not differentiated, and which was ambivalent in its advocacy of the necessary and sufficient conditions for life as positivists understood it.

Such counter-history spun around an apparently minor player might seem to be something of a self-indulgence. After all, we have the cinema we have: *Harry Potter, James Bond, Lord of the Rings, Daredevil,* and we have a cinema of resistance (or cinemas of resistances). It may seem that a distinction between a cinema of attraction or a cinema of quasi-naturalism may be a fine hair to split, or a differentiation between an aesthetics of astonishment or an aesthetics of the disembodiment may simply be the rhetoric of academia; but history does matter if only to the extent that the history that we have shapes our interaction with the present that we understand ourselves to be experiencing. "There are times," wrote Raymond Williams, "when there is so high a tension between experience and description that we are forced to examine the descriptions, and seek beyond them for new descriptions, not so much as a matter of theory but as literally a problem of behaviour." [10] Without this tension, however, the distinction between the lived and the articulated collapses, and we resort to the quasi-anecdote.

I wish that I had understood it so clearly when, in 1995, I published a pessimistic account of the future of a brave new medium—the CD-ROM—based on a survey that I conducted. It was the response of a disappointed artist. Putting it in the vernacular jargon: having consumed (and I confess produced) the vaporware of CD-ROM, as a new creative and revolutionary medium, I now was faced with the reality of the technology as "shovelware": the spark

10 R. Williams, *The Long Revolution* (New York: Columbia University Press, 1961), 73.

Figures 7a, b, c
Stills from *Mike Does Baywatch*,
(video/60 mins, 1996). ©2003 Michael Punt.

of the post-Gutenberg era, had turned into an ugly dump for undigested data. Still a little sore that the revolution had not happened, and the vaporware was still filling the ether, a year later I set out to make a video on the basis of that survey. I called the film *Mike Does Baywatch,* and apart from that moment of intertextual comedy in the title, it carries all the traits of my own history of cinematic resistance; that is it lasts for sixty minutes, nothing much happens, the camera does not move, and it sits malevolently in the cassette waiting for electromagnetic atrophy.

The film shows me on the left of the screen sitting at a computer examining a pile of CD-ROMs, trying to make them work, while on the right there is a VCR and television monitor playing a version of *Baywatch.* It was one of those projects that obeyed strict ground rules: a continuous shot lasting the length of the television program comprising the unrehearsed, but familiar, action of surveying CD-ROMs. I had hoped that the telephone might have interrupted me or the cat, which lived under my desk lamp, might have strolled in for its fifteen minutes of fame, or some of those things that seem to frustrate you when you need to be left undisturbed might have added interest. Alas, not on this occasion; all that happens is that there are many deep sighs of frustration, much throwing of discs and, on a number of occasions, the computer crashes and has to be restarted. The gap between the description of CD-ROMs and the experience is too painfully set out to be interesting and, as a consequence, few people (if anyone) have ever watched it.

The research that inspired the film came from a laser disc project that I was invited to join by Thomas Elsaesser at the University of East Anglia, and later in Amsterdam in 1992. By that time, I had taught for nearly a decade the first B.A. Interactive Arts course to be validated. My students had sent the first image through Transpac, and I had participated in major exhibitions of "electronic art." Consequently, I had something of an advantage as I watched the emergence, ascendance, and hesitation of CD-ROMs in the marketplace. I noticed almost from the outset that the cinematic imagination was implicated in CD-ROMs. To begin with, Sony and Matsushita, among others, having felt that they lost out in the Betamax/VHS battle, bought into Hollywood partly in the expectation that the significant back libraries would be essential if their format was to become the industry standard. Second, 1994–1996 was the centenary of cinema, and everyone was a little self conscious of it. Finally, the individualistic fan discourse of the movies provided a glamorous vision of rugged individualism that was essential for the promotion of the "tele-cottage" industries that were emerging in response to a collapsing manufacturing economy. As it became clear that there was a gulf between the descriptions I was reading and the reality of the experience—particularly as it contrasted to the cinema—I wondered what was going on between the apparatus and the imagination.

Driven by the insight that film theory and cinema theory were unequal guests at the same feast, I wondered if the future of the CD-ROM as an emergent medium was blighted because it was so entrenched in a poorly articulated theoretical and historical context. For a variety of reasons (which I listed), by the mid-90s, it was obvious that, if the medium survived, it would be as a data storage technology. But what was even more puzzling was that, as a medium, it was in the process of becoming as much an orphan of history as Reynaud's *Theatre Optique*. In the shadow of its failure to fulfill its early promise, it is easily forgotten that, after its period of emergence as a file system standard in 1986, CD-ROM technology was regarded as a medium of political liberation, particularly as an escape from the media oligopolies, as typified by Hollywood, that controlled the access to mass audiences. In the early years, virtually anyone who felt that they had something important to say recognized that here was a platform on which to organize information in ways that could circumvent the in-house politics and ideas of the media industry. Secondly, an emerging interest with interactivity, based largely on an accelerating diffusion of the personal computer, encouraged many of us to think about new formal informational structures as alternatives to those that two decades of Althusser, Barthes, Braudel, Derrida, Foucault, and Lacan (to name a few from France in alphabetical order) had taught us to treat with suspicion.

As the expectations among an artistic left for the CD-ROM as a new democratic publishing medium stalled around the issue of distribution, proposals for new kinds of information design in libraries, museums, and art galleries received enthusiastic support from the establishment accountants bent on reducing overheads at the expense of experience. However, those with a cultural investment in the artifact, comprising the artistic avant-garde and the reactionary traditionalists, treated such ideas with suspicion, remembering, for example, the intellectual benefits derived from their own freedom to browse among real things and let the accidents (or the power of attraction of the relevant, depending on which side of the psychoanalytical fence you sat) happen. Given such strange bedfellows and contradictory attitudes to a possible medium, CD-ROM was almost entirely discussed in the press as a technology that would change the way we lived while, at the same time, large-scale commercial developers were at a loss to know what to use it for. As I wrote in 1994:

> Exciting new culturally transforming telematic technologies may have captured the popular imagination for brief moments, but new entertainment patterns and preferences have not immediately followed this fascination and they have been consigned to the margins—which can often mean art and academia. Virtual reality, interactive television and particularly CD-ROM, have shown signs of "hyperbole fatigue" as the technologically led expectations of producers have been unfulfilled. Despite the now extensive list of

Figure 8
Illustration from Broderbund's *Just Grandma and Me*. ©Broderbund, The Learning Company, and Edmark Software Help.

titles published, running into tens of thousands world wide, CD-ROM remains relatively small compared with other publishing media, and there is a general agreement among commentators that the best products are "childware," (with Broderbund's Living Books taking the prizes) but that it has yet to find a media specific way of catering to the "grown up" market.[11]

The reason for the success of Broderbund obviously lay in their access to distribution, but more important, was the design concept that Mark Schlichting presented at Siggraph in May 1993. There were three key design principles for their products: no manuals and no reading to make it work, all instructions had to be spoken onscreen—no waiting not even for a second because children would not wait even that long before clicking again, and no wrong answers to the onscreen questions.

1 Nobody wants to read the manual—software should work with nonreaders (children three years old and up). Interface testing must be done with naive users. Kids don't need to be able to read to use—a Living Book "agent" comes onscreen, and gives spoken instructions.

2 Nobody wants to wait—this is critical for acceptance by kids. Some original CD titles flopped because they were just too slow. Tests showed that, if the delay was more than a second, kids would click again expecting a response—sometimes less than a second.

3 Everybody wants to be in control. There are no "wrong answers" in Living Books—this keeps it fun.[12]

What was so exceptional about this design approach was that it proposed a user-led scheme for a media platform that was situated in a history of technology. As we know, the custodians of this history have tended to be engineers concerned mainly with the processes and sequences through which technical problems were resolved, and seldom noticed what happened after the invention left the workshop, and even less what happened after that.

Technologically, the CD-ROM was understood as a stage in the rehearsal of fascinating engineering solutions concerned with data warehousing and compression. Some of the consequences of these solutions were later carried over to other storage media including DVD with exceptional success. Half a megabyte of data was spectacular in the 1990s, storage capacity has since increased exponentially on a two-year cycle, so that we are reaching a tetra-byte standard on the home computer and, we learn, there are 250 megabytes of data stored for every man, woman, and child on earth (about 300 books-worth of data which means most of it will go unread). Consequently, its technological redundancy was guaranteed while its media potential was overlooked, but for the

11 M. Punt, "CD-Rom, Radical Nostalgia," *Leonardo* 28:5 (1995): 388.

12 For a full description, see www. silicon valley.siggraph.org/text/MeetingNotes/ LivingBooks/html.

odd insight from exceptional artists working almost alone in the field, and perhaps Schlichting's almost throwaway holistic analysis that saved Living Books. For example, Broderbund's Living Book *Grandma & Me* supports three languages: English, Spanish, and Japanese. Everything on a page is interactive—clicking on a character results in spoken dialog. The ability to store lots of high-quality speech is one of the biggest advantages of using CD-ROM.[13]

If, earlier, we had looked at the *Theatre Optique* more closely in our cinema history, we may have spotted an equivalent in CD-ROM. Both point to an underexplored trajectory of machines in which the software and hardware are almost undifferentiated. This may be a condition that we must get more used to recognizing as electrochemical technologies become more biological. It may not be too much to suggest that the problem of the CD-ROM and history outlined here foreshadows a problem of human memory that becomes ever more insistent as technologies are developed in response to a cultural infatuation with history.

The CD-ROM now is the preferred method for backing up data, both personally and commercially. Its platform is nearly as universal as the overhead transparency, so that it can be used in teaching, and of course it is used to store all that music downloaded from the Internet. Moreover, smart software now catalogues all that saving and storing, and automatically "burns" it on another disc. It has become a "data dump" for shovelware which may not sound like success for a technology that was going to change the way we bought, stored, read and thought about books, films, and art. But cheap, high-density storage media in which the hardware and the software are undifferentiated means that we are less and less obliged to remember anything. Put more poetically, it also means that, unless you are responsible for a film archive, you never have to decide what to forget.

The technological discontinuity between the nineteenth century and twentieth century, with all that steam, levers, and gears which seems to have been replaced with electricity, solenoids, and "chips" may be a trick of periodization. However, viewed electrochemically, we not only make clear the circular repetitions because the hundreds of little optical toys that are forgotten and recovered from the nineteenth century in cinema history are duplicated in the proliferation of little digital memory devices from reminder alarms, PDAs, memory sticks, phones, digital cameras, library catalogues, Web pages, etc. of the twenty-first. Digital storage systems also repeat some aspects of the fascinations with the paranormal as an antagonism to the scientific naturalism of an earlier century when we learn (sometimes through high-profile show trials) that discarded files in the PC wastebasket are recoverable by a simple keystroke in the forensic laboratory: every thing leaves a trace, nothing is ever lost, and, given the motivation, dead data always can be resurrected. In this history of technology and counter-science, the invention of

13 See www.siliconvalley.siggraph.org/text/
MeetingNotes/LivingBooks/html.

the cinema is not especially important—it is merely the crease in this particular Rorschach test which reveals the cinematic imagination as infinitely extendible, and the past in every detail always is available to the present.

Conclusion

Revisionist histories of the invention of the cinema have, if nothing else, made room for a subject effect in the shaping of cinema technology. There is much more work to be done with regard to the invention of the cinema, and until we can properly account for Reynaud and the host of other "toys" and precursors to the *cinématographe,* without infantilizing the nineteenth century audience, or dismissing great engineers and philosophers as lone figures who did not impact on a wider public, we cannot fully claim to understand the films of the first decade of the cinema—films which, for many viewers, become more puzzling and complex with every viewing. To be sure, part of the fascination with the early cinema is that it is such an evasive topic insisting at every turn that another factor must be added into the equation if we are to answer some of the historical questions that it poses. Perhaps, unfortunately, the questions posed by the first decades and the wrangle over the cinema of attraction or a cinema of quasi-naturalism, or an aesthetics of astonishment versus an aesthetics of the disembodiment, will remain a wrangle because our data is incomplete. This may be the best lesson that the story of the story of cinema can tell. This may be the point where, as cinema does or does not go digital, as academics we can be proactive.

This incompleteness of early cinema history derives from three main causes: the first is that, until recently, the history of technology has been allowed to become established outside the core debates about the function of history and, as a consequence, technology has been endowed with a spurious autonomy, and its "subject effect" has been largely discussed in terms of a sociology of its impact. The second is that the hypersensitivity to the image (and including sound as one of its attributes) in film studies has skewed the discussion toward realism (and antirealism), and all but obliterated the significance of technological solutions in relation to dominant philosophical problems that were prevalent in popular literature. In particular, a consideration of the resistance to scientific naturalism in the last half of the nineteenth century which gave social meaning to the raft of technologies that are affiliated with the cinematic imagination has been recast as a story of infantile engineering incompetence. One consequence of this is that animation, the engine of Hollywood—the one that actually keeps the cinemas open—is all but invisible in the film industry's bibliography. Finally, the methodological convenience of separating the history of hardware from the history of software diminishes the impact that a widespread excitement caused by paranormal phenomena had on the cinematic imagination in the 1890s, and dispatches some significant data to

the margins. In particular, the necessary ideological intolerance of scientific naturalism was not symmetrical with the inclusiveness of its archenemy, spiritualism—or its strange relation, technology.

For some of us, the CD-ROM was a disappointment. It promised such creative liberation and, apart from some brilliant exceptions, has delivered so little that has been socially transforming. In truth, there were, and will continue to be, some spectacular uses of the medium by filmmakers, artists, and designers, but insufficient to suggest a need for an explicit archival policy just to preserve the best. This, in my view, does not close the debate since, as I have suggested, the separation of hardware and software becomes increasingly unsustainable as we review the history of the audio-visual, and contemplate the future of the coming electrochemical, and electrochemical/biological media. From this perspective, it seems impossible to explain what contemporary Hollywood offers without a full understanding the subject effect—empowerment, irony, resistance, etc.—that electrochemical technologies such as personal computers, CD-ROMs, DVDs, and video cameras bestow on the kinds of people for whom the cinema started out as a technology of extension, and will sustain the momentum of a cinematic imagination to the extent that they will spend £3 billion on a raft of artifacts in the next twenty years to maintain the idea that there is far more to life than what we know. Whatever else we may do about digital cinema, and whatever it becomes, we should attend to archiving the past, especially the recent past, in relation to a reconceptualization of the relationship between software and hardware.