DARA BIRNBAUM'S *TIANANMEN SQUARE: BREAK-IN TRANSMISSION:* A CASE STUDY IN THE EXAMINATION, DOCUMENTATION, AND PRESERVATION OF A VIDEO-BASED INSTALLATION

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ABSTRACT—This paper presents a methodology for the examination and documentation of a video-based installation as applied to Dara Birnbaum's 1989–90 *Tiananmen Square: Break-In Transmission*. Functional and aesthetic roles of compositional elements and electronic components are characterized. Background on relevant technologies is summarized. The results of the assessment indicate that the stability of the piece may be threatened due to media degradation, format obsolescence, hardware obsolescence, and a lack of centralized documentation. Recommendations for near-term and long-term preservation activities are offered. This article is a result of TechArchaeology: A Symposium on Installation Art Preservation.

TITRE—L'oeuvre de Dara Birnbaum *Tiananmen Square: Break-In Transmission*. Une étude de cas pour l'examen, la documentation et la préservation d'une installation vidéo. RÉSUMÉ—Cet article présente la méthodologie en vue de l'examen et de la documentation d'une installation vidéo, en utilisant comme exemple l'oeuvre de Dara Birnbaum, *Tiananmen Square: Break-In Transmission*, qui fut créée entre 1989 et 1990. On y élabore sur les rôles fonctionnels et esthétiques des éléments de la composition et des composants électroniques. Les points essentiels des technologies pertinentes sont aussi présentés. Les résultats de l'évaluation démontrent que la stabilité de l'oeuvre peut être compromise par plusieurs facteurs dont la dégradation du média, la désuétude du format ou de l'appareil, ou encore l'absence d'une documentation centralisée. Des recommandations sont proposées pour assurer la préservation à court et à long terme. Cet article est un résultat de TechArchéologie: un colloque sur la préservation des installations.

TITULO—*Tiananmen Square: Break-In Transmission (*Plaza de Tianamen: interrupción/irrupción en una transmisión). Un estudio de caso para examinar, documentar y preservar una instalación basada en videos. RESÚMEN—Este articulo presenta una metodología para el examen y la documentación de una instalación, según fue aplicada a la obra de la artista Dara Birnbaum: *Tiananmen Square: Break-In Transmission* (Plaza Tianamen: interrupción/irrupción en una transmisión). Se hace una identificación de los roles funcionales y estéticos de los elementos de la composición y de los elementos electrónicos. Se hace un resumen de fondo de las tecnología relevantes. Los resultados de la evaluación indican que la estabilidad de la pieza puede estar amenazada por la degradación de la cinta magnética y los discos ópticos en los cuales está archivada, por obsolescencia del formato, por obsolescencia del equipo (hardware), y por falta de documentación centralizada. Se hacen recomendaciones para la preservación a corto y largo plazo. Este artículo es el resultado del Simposio sobre Preservación de Instalaciones de Arte TechArchaeology.

1. INTRODUCTION: DARA BIRNBAUM

Throughout her career as an artist, Dara Birnbaum (b. 1946) has employed video appropriated from broadcast television in her work. Her career as a video artist began in the late 1970s, after she received academic degrees in architecture and painting. Early work, including *Technology/Transformation: Wonder Woman* (1978–79), *General Hospital/Olympic Women* (1978), and *Pop-Pop Video: Kojak/Wang* (1980), uses broadcast video that is re-purposed by the artist to analyze the language of television. She also integrates overtly political content into her work. *Canon: Taking to the Street* (1990) contains amateur video of a 1987 march protesting violence against women, making larger allusions to the power of street demonstrations, including the 1968 Paris uprising (Tuer 1997). Although much of Birnbaum's work is single-channel video, she has produced several multichannel installations, including *Rio Videowall* (1989), a 25 monitor permanent installation, and *Will-o'-the-Wisp* (1992), a 3-channel installation.

2. *TIANANMEN SQUARE: BREAK-IN TRANSMISSION*

2.1 WORKING METHOD

A five-channel installation, *Tiananmen Square: Break-In Transmission* (1989–90) incorporates the major themes of Birnbaum's work. Centered on the student and worker occupation of Beijing's Tiananmen Square in 1989, Birnbaum's installation samples a diverse range of broadcast imagery generated by the event. Four video segments present a singer performing the song "Wound of History," news coverage of the demonstrations, news coverage of the Chinese government–ordered shutdown of broadcasting by CNN and CBS, and video showing the persistence of communication through alternative modes like the fax machine. Figure 1 shows a frame from the "Wound of History" segment.

Birnbaum recorded these segments as they were broadcast on television. Her original "capture" medium was 3/4 in. U-matic videotape. The 3/4 in. videotapes were transferred to Betacam SP for editing. The original sound capture had stereo capabilities, though the broadcasted source materials were typically mono. During the editing process, the sound was somewhat "sweetened" and output to four channels (Birnbaum 2000a). "Sweetening" is a loosely defined term in audio-video editing that is generally taken to mean enhancing the sound track for clarity and impact using equalization or some other signal-processing devices. Likewise, some of the video was slightly manipulated to exaggerate certain effects. For example, the breakdown and loss of signal produced after the CNN and CBS shutdown was attenuated. Although the audio and video were manipulated during the editing process, the intervention was minor in accordance with Birnbaum's desire not to conceal the characteristic markers and limitations of television broadcast. Once the Betacam SP master was complete, it was sent to the 3M Corporation in Wisconsin for mastering onto laser disc (LD) (3M has since sold its laser disc operation to the Imation Corporation).

The laser disc format was the most successful of the many video disc formats to emerge in the late 1970s to the late 1980s. The LD manufacturing process involves the creation of a glass master from which the optical disc distribution copies are stamped. As is typical, this glass master for *Tiananmen Square: Break-In Transmission* was not retained. Birnbaum, however, retains the 3/4 in. U-matic cassettes from the original off-air recordings, and, most important, she retains the Betacam SP "disc master" used by 3M. Taped submasters (also on the Betacam SP format) are provided by the artist to the owners of the installation. Detailed descriptions of the videotape formats mentioned in this section are available elsewhere (Stauderman and Messier 1999).

2.2 NOTES ON PROVENANCE AND DOCUMENTATION

There are two editions and one artist's proof of *Tiananmen Square: Break-In Transmission*. Edition number 1 of 2 is owned by the Stedelijk Museum voor Actuele Kunst (Museum of Contemporary Art) in Ghent, Belgium. Edition number 2 of 2 is owned by Pamela and Richard Kramlich, private collectors in the San Francisco Bay Area. Birnbaum retains the artist's proof. The piece was commissioned through the Rhona Hoffman Gallery of Chicago and the Josh Baer Gallery of New York City. It was first exhibited at the Josh Baer Gallery in 1990 (the gallery is no longer in business). The Rhona Hoffman Gallery exhibited the piece February 1–23, 1991. Figure 2 shows a detail of the piece during exhibition at the Hoffman Gallery. The work was also exhibited in Boston at the Institute of Contemporary Art from December 9, 1992, to February 21, 1993.

The Kramlich edition was obtained through the Rhona Hoffman Gallery. Thea Westreich Art Advisory Services assists the Kramlichs in managing their collection and maintains a file of correspondence and technical specifications pertinent to the installation of the piece. For the exhibition *Seeing Time: Selections from the Pamela and Richard Kramlich Collection of Media Art* (October 15, 1999–January 9, 2000) at the San Francisco Museum of Modern Art (SFMOMA), the Kramlich edition was replicated using new equipment (creating what Birnbaum terms a second "artist's proof"). Following the exhibition, this

Fig. 1. Video still from "Wound of History," one of five simultaneous video channels. Dara Birnbaum, *Tiananmen Square: Break-In Transmission*, ©1990, five-channel video installation, with surveillance switcher and custom-designed steel suspension system. Installation dimensions variable. Courtesy of the San Francisco Museum of Modern Art

edition was disassembled and the equipment retained by the Kramlichs for the purposes of backup.

The creation of a second artist's proof for the *Seeing Time* exhibition raises questions pertaining to authenticity and authorship when it comes to technology-based installations. The concept of limited editions is generally applied to works of art that can be replicated, such as prints and photographs. Limiting an edition for such a work is designed to protect both the integrity of the artist and the interests of the collector from the indefinite production of potentially substandard work. A subset of a limited edition is the artist's proof. Artist's proofs are early works within an edition where technical and aesthetic adjustments are finalized. Therefore the piece exhibited at the SFMOMA is not an artist's proof in the conventional sense since the replication of the work took place almost 10 years after the edition was closed. In addition, the replication for *Seeing Time* required an artist-patron–authorized reinterpretation of the piece since some key technical components were no longer available due to obsolescence.

2.3 TECHARCHAEOLOGY

The edition examined for this article was the replicated version of the piece exhibited at the SFMOMA. For the two days of TechArchaeology, artists, curators, conservators, video-technology experts, and media art installers examined selected works on display in the SFMOMA's *Seeing Time* exhibition to sort out the inherent preservation challenges of technology-based art. *Tiananmen Square: Break-In Transmission* was examined by a working group led by Dara Birnbaum and the author. The ideas generated during this meeting, and subsequent discussion with other conservators and with Birnbaum, helped form the methodology underlying this article.

3. COMPOSITION OF *TIANANMEN SQUARE: BREAK-IN TRANSMISSION*

3.1 BASIC LAYOUT AND COMPONENTS

Tiananmen Square: Break-In Transmission is a five-channel video installation comprised of the following electronic components:

- 4 videodisc players (laser disc format)
- 4 liquid crystal display (LCD) flat screen video monitors, 2.7 in. diagonal screen size with four mounts and power transformers
- 1 cathode ray tube (CRT) color monitor, 25 in. diagonal screen size with wall mount
- 1 sequential switcher
- 8 loudspeakers

The installation presents the viewer with five "stations" located in front of each of the five video monitors. Four stations are centered on small (2.7 in. diagonal screen) LCD monitors. Mounted above each LCD monitor is a single videodisc player. At each LCD station a loudspeaker is mounted on either side of the small monitor. The LCD monitor, with associated videodisc player and each loudspeaker, is mounted on custom-designed armatures made from steel pipes that attach to the ceiling. The fifth station is in front of the large (25 in. diagonal screen) CRT monitor. This monitor is wall-mounted. Resting on top of the CRT is the sequential switcher. Figure 2 shows an LCD video station with two loudspeakers and a videodisc player. The CRT station is also visible on the left.

3.1.1 Layout of Video Components

Each LCD monitor presents one of four video segments described in section 2.1. The video segments have a duration ranging from two to six minutes, and upon conclusion each segment is repeated continuously. The source of video for each of the LCD monitors is its associated videodisc player. The larger CRT monitor shows video clips output by a sequential switcher. Positioned at the CRT station, the sequential switcher automates the taking of clips from each videodisc player. The clips have a duration of 7 to 12 seconds. The sampled clips are fed to the CRT in sequence, from LCD stations one through four. At the completion of the sequence, it is repeated continuously.

Fig. 2. Detail of installation, showing an LCD station and the CRT monitor at the left, Rhona Hoffman Gallery, Chicago, Ill., 1991. Dara Birnbaum, *Tiananmen Square: Break-In Transmission*, ©1990, five-channel video installation, with surveillance switcher and custom-designed steel suspension system. Courtesy of the Rhona Hoffman Gallery

3.1.2 Layout of Audio Components

The four LCD stations have their own audio tracks synchronized to the video. The source for the four audio signals is the individual videodisc players. Left and right audio output channels on each videodisc player are connected to the left and right loudspeakers at each station. The CRT station does not have audio playback.

3.2 SIGNAL PATH, CONNECTIONS, WIRING, AND POWER

Figure 3 shows the signal path for one of the four audio-video channels. Audio-video signals originate from each of the four videodisc players. Left and right audio jacks on the videodisc player connect to input jacks on the left and right loudspeakers at each of the four stations. The audio cabling connects by using standard RCA plugs. The video output on each videodisc player connects to an RCA Y splitter. The split signal is routed to both the sequential switcher and one of the four LCD monitors. The video connections from the RCA Y splitter to the sequential switcher require RCA-to-BNC adapters. Video connections made from the videodisc player to the LCD monitors require RCA-to-minijack (also known as ministereo) adapters. Video connection between the sequential switcher and CRT monitor is made using coaxial cable and BNC connectors.

In general, Birnbaum prefers that the audio and video cables run inside the hollow metal armatures used to mount the speakers and the LCD monitors. However, as a practical matter, it is not possible to snake all wires and plugs through the armatures. External wires are then neatly bound to the armature. In past installations, electrical tape and nylon wire ties have been used to bind the wiring to the armature. While Birnbaum makes no attempt to conceal the workings of the installation, the appearance should be "clean" (Nielson 1993), with wires, cables, and plugs as unobtrusive as possible.

In all, eighteen components require alternating current (AC) power: eight speakers; four videodisc players; four transformers (AC to DC) for the LCD monitors; one CRT monitor; and the sequential

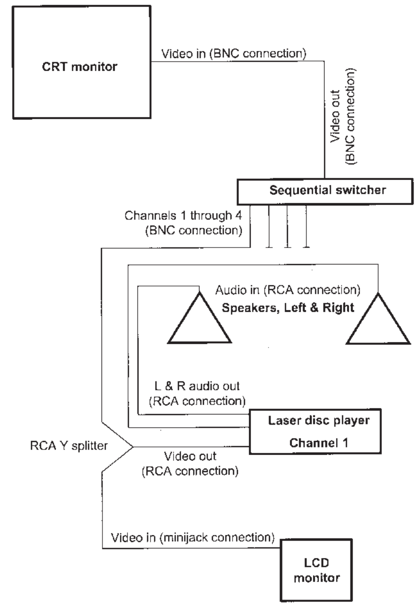

Fig. 3. Schematic circuit diagram for one of LCD monitor channels and the CRT monitor. Dara Birnbaum, *Tiananmen Square*: *Break-In Transmission*, ©1990, five-channel video installation, with surveillance switcher and custom-designed steel suspension system. Courtesy of the artist

switcher. All components use U.S. standard 120V, 60 Hz. Past installations have used a single power cord running along the exterior of each LCD armature. This cord terminates at a small outlet box, which sits behind each videodisc player. The power cords for the LCD transformers and videodisc players plug into the outlet box.

3.3 COMPONENT POSITIONING

The installation is comprised of five "stations" centered on the four LCD monitors and the single CRT monitor. The physical relationship between the stations is not fixed. Positioning the stations has always been the prerogative of the artist based on her interpretation of the particular exhibition space. According to Birnbaum, the key element in the positioning of components is to encourage the viewer to move through the exhibition space (Birnbaum 2000b). Although "passage" through the installation is important, the viewer should not perceive a specific "destination." Therefore each station receives equal compositional weight, and no single station is emphasized by more prominent positioning in the exhibition space. Birnbaum uses the architectural features of the exhibition space to promote movement through the piece. For the recent exhibit, *Seeing Time* at the San Francisco Museum of Modern Art, the piece was placed at the entrance of the exhibition, in close proximity to stairways and elevators that drove viewers through the installation. A detailed floor plan of the SFMOMA exhibit is presented in figure 4. Passage is also emphasized in the installation in the Kramlich residence, where it is centered on the main stairway, as illustrated in figure 5.

While there are no prescribed, measured relationships between the main components in the installation, there are fairly rigid aesthetic criteria that govern the composition (Vitale and Birnbaum 2000). Birnbaum wants the viewer to see, or at least be immediately aware of, the larger CRT monitor at all vantage points within the installation. The large monitor should emerge from the background upon the viewer's first engagement with the piece. Likewise, all vantage points should allow for most of the other compositional elements to be revealed. With some distance, the smaller monitors should appear as lights, with the video image indistinguishable. As much as possible, these "lights" should be peripherally apparent when the viewer is positioned in front of a single LCD monitor.

The four LCD stations are intended to actively engage the viewer. These monitors have a typical viewing distance of only 20 in. and the displays are hard to see at an angle. While these monitors place certain demands on the viewer, once engaged, he or she is presented with coherent narrative content. On the other hand, the CRT promises the viewer a more familiar experience derived from television. Its longer viewing distance and more conventional presentation invite a more passive form of engagement. However, unlike the LCDs, the CRT displays quick snatches of video with no discernible narrative content. The overall effect is increasingly disjointed since the CRT station has no dedicated audio track, making the jumbled cross talk among the four LCD stations very apparent.

Prior to display, Birnbaum has always worked out

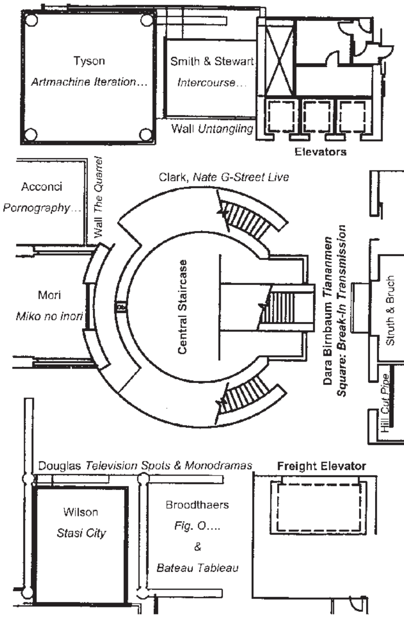

Fig. 4. Floor plan, detail showing central positioning of Birnbaum, *Tiananmen Square*, relative to other works and landings for elevators and staircase. *Seeing Time: Selections from the Collection of Pamela and Richard Kramlich Media Art* exhibition at the San Francisco Museum of Modern Art, 1999–2000. Courtesy of SFMOMA

the relationships between the main compositional elements. In past installations the speaker height has varied, just above or below the plane of the videodisc player. The horizontal armature and the mounts used for the LCDs allow a large degree of adjustment in the X, Y, and Z directions. This flexibility is often used for effect, avoiding a strictly linear or symmetrical presentation. In addition, the length of the armatures is entirely dependent upon the ceiling height, introducing another variable that is subject to change from one exhibition space to another.

Despite Birnbaum's subjective interpretation of her work within a given exhibition space, many compositional elements are fixed. For example, the steel armatures used to mount the LCD monitors, videodisc players, and speakers are more precisely determined. Figure 6 shows the basic design of the armatures, giving fixed dimensions where applicable. These armatures are usually made using 1 to 2 in. diameter steel pipe. In previous installations, the pipe has been painted matte black, gray, or gunmetal. In all

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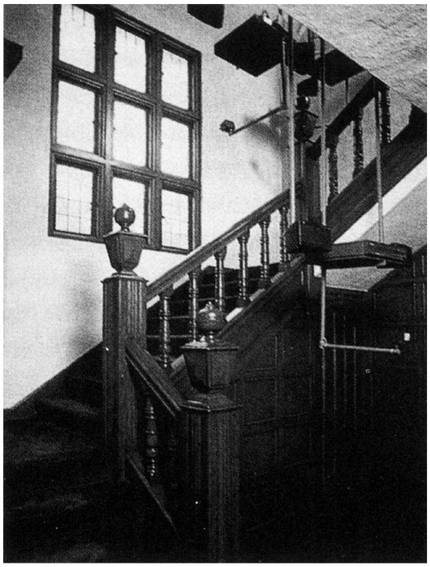

Fig. 5. Detail of residential installation, home of Richard and Pamela Kramlich, San Francisco. Dara Birnbaum, *Tiananmen Square: Break-In Transmission*, ©1990, five-channel video installation, with surveillance switcher and custom-designed steel suspension system. Photo courtesy of San Francisco Museum of Modern Art, Richard and Pamela Kramlich and Thea Westreich Art Advisory Services

cases, the armatures attach to the ceiling of the exhibition space and present the LCD monitors at eye level. The monitors are mounted to a horizontal section of the armature, projecting outward at a right angle to the vertical section. The horizontal extension of the armature is 21 in. The manufacturer-recommended mount for the LCD is fixed to the end of the horizontal section of armature. The vertical section of each LCD armature has a 16 1/2 in. x 17 in. platform to support the videodisc player. This platform is positioned approximately 8 in. to 14 in. above the LCD monitors. The large CRT monitor is typically wall-mounted, using the mounting system recommended by the monitor manufacturer.

3.4 ROOM LIGHTING, SOUND, AND VIDEO SEQUENCE

The installation is lit diffusely, typically without accents on any of the compositional elements. The light levels should be set similar to that for a "painting in a museum" (Birnbaum 2000a). In general, video and film are displayed at lower levels of illumination, though contemporary video equipment has the capability to carry at much higher light levels. Birnbaum feels the traditional, more dimly lit "black box" exhibition space for video and film encourages a certain passivity in the viewer, discouraging movement through the piece (Birnbaum 2000a).

Optimum sound levels have never been quantified and are very dependent on Birnbaum's interpretation of the exhibition space. The challenge is to ensure that each of the four sound tracks is clearly audible when the viewer engages its LCD monitor, while at the same time ensuring that no one sound track dominates when the viewer considers the piece as a whole. Optimally the four channels are balanced with one another, allowing some sound seepage from one LCD station to the other. However, when the viewer approaches a particular station, sound from the other stations should become increasingly peripheral. When the viewer moves in front of an LCD monitor, the sound from that station should be very clear, with only hints of the other stations. At

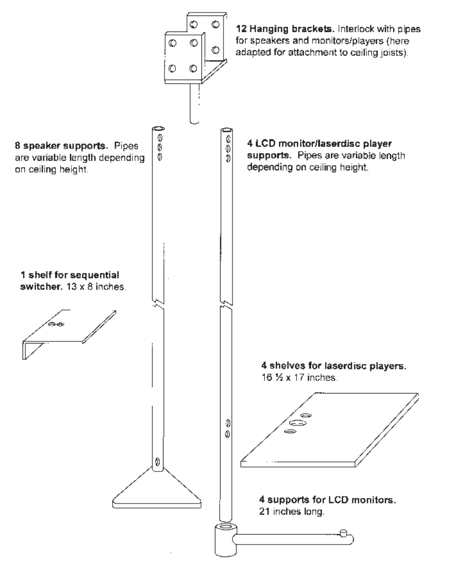

Fig. 6. Armature design for installation; armature is fabricated of coated steel. *Tiananmen Square: Break-In Transmission*, ©1990, Dara Birnbaum, five-channel video installation with surveillance switcher and custom-designed steel suspension system. Courtesy of the artist and Thea Westreich Art Advisory Services

this point, the sound level should be approximately that of a "clear conversation" (Birnbaum 2000a).

Birnbaum has a general preference for the sequence in which the viewer is presented the four LCD stations (Birnbaum 2000a). The first station should be the singer performing "Wound of History" (see fig. 1). For Birnbaum, the song sets up the "emotive baseline" for the entire installation. The footage of the demonstrations in progress follows the song. The next LCD station shows government authorities shutting down the CNN and CBS news broadcasts. The last station shows a continuance of communication by different means, particularly the fax machine. In cases where the piece can be approached from many directions (as in the *Seeing Time* exhibition, see fig. 4), the sequence is established based on a judgment of how the typical viewer would most likely approach the installation.

4. PLAYBACK HARDWARE AND MEDIA

4.1 BACKGROUND ON THE LASER DISC FORMAT

The installation's audio and video use the laser disc (LD) format. Laser disc is by far the most successful and popular of the many obscure laser and stylus-based videodisc formats brought to market in the early 1970s. The LD format was introduced in 1978 by Philips and MCA and promoted as the quality home theater alternative to Video Home System (VHS) and Betamax. Early on, the laser disc format became closely associated with the Pioneer Corporation through market dominance and innovative products (the term "laser disc" was originally a trademark of Pioneer). Laser disc offers a measure of interactivity since content can be indexed and played back in any sequence specified by the user. As an interactive means of presenting visual content, the laser disc format attracted the attention of educators, and many educational and cultural institutions adopted the technology.

Laser disc video is stored on 12, 8, or 5 in. optical discs. By far, 12 in. discs are most common. Discs can be either single- or double-sided, holding approximately 30 to 60 minutes of video per side (the discs in the Birnbaum piece are single-sided). From a materials standpoint, the construction of the disc is somewhat similar to that of the more familiar CD-ROM and DVD optical discs. Figure 7 shows a double-sided laser disc in cross section. The video signal is stored using a system of pits and lands impressed into a metallic layer, usually made of aluminum. The thin metallic data layer is adhered to a substrate usually made of acrylic or polycarbonate and is covered by a supercoat, protective layer. The laser from the playback device is either reflected off the lands or is scattered by the pits. The reflections from the lands are detected by a photodetector in the playback device.

While this system has much in common with more contemporary digital optical disc formats (CD-ROM and DVD), the LD video format is strictly analog, as the video signal is represented by slight variances in pit-to-pit spacing (Niland 1999). LD is a composite video format, meaning that luminance and chroma information are compiled into one signal. Image resolution for the NTSC laser disc format is 420 luminance scan lines horizontally by 480 luminance scan lines vertically and 70 chroma lines horizontally by 480 chroma lines vertically (NTSC is the National Television Standards Committee, which sets the standards for color television employed by the United States, Canada, and Japan). A typical luminance signal to noise ratio (S/N) for LD is 52. The frame rate is 30 frames per second. For the sake of comparison, the following table presents these data with that of other common

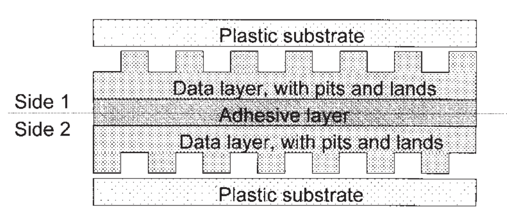

Fig. 7. The layers in a double-sided laser disc shown in cross section

video formats, including DVD (Herranen 1998).

While laser disc video is always analog, the LD audio can be one of many analog or digital formats. In practice, NTSC laser disc audio is generally digital stereo sampled at a rate of approximately 44,000 to 48,000 samples per second at 16 to 20 bits per sample. The digital sound data transfer rate is approximately 1.44 megabits per second (mbps). A typical signal-to-noise ratio might be in the range of 90–96. The output audio signal requires external amplification for playback.

Laser discs allow the stored content to be organized into separate "chapters" that can be indexed for near immediate recall. The Birnbaum laser discs contain five such chapters: one for each of the four video segments, with one chapter devoted to image and sound quality presenting standardized color bars and tones that allow for visual and aural synchronization among the monitors and loudspeakers. As each of the Birnbaum discs contains all four video tracks, the discs are interchangeable among the four LCD stations.

4.2 LASER DISCS' IMPENDING FORMAT AND HARDWARE OBSOLESCENCE

From the standpoint of physical longevity, optical discs (such as CD-ROMs and DVDs) are estimated to have a useful life of anywhere from 10 to 100 years, depending on the manufacturer, ambient storage conditions, and handling. This life expectancy compares very favorably with video stored on magnetic tape, which, given the same storage conditions, might last anywhere from 10 to 30 years (Van Bogart 1995). Unlike tape-based video, laser disc playback does not require any physical contact so the discs do not become "worn" during playback or even after long periods of "freeze frame" playback. Physical damage to the discs through handling or embedded dust and dirt are more pressing concerns, as these defects can alter the path of reflected laser light upon playback.

While laser discs are relatively stable given proper storage and handling, the viability of the format is seriously threatened. Its major threat appears to be the emergence of competing formats (Academy Advancing High Performance Audio and Video 1998). In particular, the digital video disk (also known as the digital versatile disk or DVD) poses a serious challenge to analog LD. DVDs' perceived advantages include lower production and distribution costs, higher-quality video and sound (see table 1), playback capability in computer DVD-ROM drives, more overall storage capacity, and more levels of interactivity (Messier 1998). At the consumer level, the DVD format can be recordable and rewritable, distinctly unlike the laborious and expensive mastering process required for producing laser discs. The laser disc market, which peaked in 1994 with $345 million in sales, suffered a 20% reduction in revenue upon DVDs' first availability in the marketplace in 1996 (Brass 1998).

The *Tiananmen Square* installation uses Pioneer LD-V2000 laser disc players. The LD-V2000 was a new model in 1989 and is no longer manufactured. Pioneer Electronics, the holder of numerous key LD patents, is still one of the only major suppliers of LD hardware. At this writing, the company still manufactures LD players, but the forecast for ongoing support is unclear at best. An article recently removed from Pioneer's own website (which purports to refute the death of the format) says that the format should be viable for "three to four years" and recommends transitioning to DVD using Pioneer's line of laser disc–DVD hybrid players (Wujcik 1996). In 1998 Pioneer President Kaneo Ito said it was his belief that "Laser disk will cease to be viable in no more than approximately 1 to 1 1/2 years" and that the manufacture of combination laser disc–DVD players could cease at that time. The Imation Corporation is possibly the only remaining vendor in the United States offering laser disc mastering.

4.3 PRESERVATION OUTLOOK FOR THE MASTER VIDEOTAPES

As mentioned in section 2.1, Birnbaum made the original off-air recordings using 3/4 in. U-matic videotape. The video was transferred to Betacam SP for editing. Birnbaum retains the original 3/4 in. U-matic tapes and the Betacam SP "disc masters." The

Table 1. A Comparison of Some Common NTSC Video Formats

	Laser disc	Broadcast television	VHS	DVD
Domain	Analog	Analog	Analog	Digital
Luminance, horizontal resolution (lines)	420	330	240	500
Luminance, vertical resolution (lines)	480	480	480	576
Luminance S/N ratio	52	55	No data	48
Chroma, horizontal resolution (lines)	70	70	40	250
Chroma, vertical resolution (lines)	480	480	160	240
Frame rate (frames per second)	30	30	30	30/24

owners of the two editioned copies have Betacam SP submasters.

U-matic is a composite videotape format introduced in 1971. The format has a very large installed base of professional users, such as news-gathering organizations. It is the first successful videocassette format. Major industry backers of the format included Sony, JVC, and Panasonic. Betacam SP is an analog component format introduced by Sony in 1986 on the heels of the demise of its Betamax format. Another format aimed at professional video applications, Betacam SP is popular among news-gathering agencies for field acquisition and postproduction.

Like laser disc, both U-matic and Betacam SP are "threatened" formats. Sarah Stauderman, in her *Video Format Identification Guide* (Stauderman and Messier 1999), defines threatened formats as follows: "The playback machines are available; however, either the tape format itself is unstable or has less integrity than other available formats, or it is known that a more popular or updated format will be replacing this one in a short period of time." The advent of newer digital formats, especially those targeting news-gathering organizations and other professionals engaged in field acquisition of video, are rapidly displacing U-matic and Betacam SP, as playback hardware for these formats becomes increasingly scarce.

Impending format obsolescence is only part of the problem, as magnetic tape is an inherently unstable medium with a life expectancy of only 10–30 years, given proper handling, minimal playback, and storage at relatively dry and cool conditions of 68°F and 40% RH (Van Bogart 1995). The stability problems of magnetic tape have been examined in depth and are commonly attributed to hydrolysis of the binder medium used to affix the metallic pigments to the tape substrate (Van Bogart 1996). The stability problems facing magnetic tape are not merely theoretical or hypothetical: a recent conservation survey of a media center's video holdings revealed that 20% of the 3/4 in. U-matic tapes in the collection do not play back due to the chemical and physical breakdown of the tape (Messier 1997).

4.4 LCD MONITORS

The installation originally used four Sony FDM-330 liquid crystal display monitors known as "Watchman." These monitors had a screen size of 2.7 in. (measured diagonally) and were capable of displaying video input to the NTSC standard of 30 frames per second with a horizontal resolution of 320 lines. While the name "Watchman" persists, Sony has not manufactured these particular monitors for close to 10 years. Attempts to obtain technical specifications on the product from Sony for this report were fruitless. Despite an apparent willingness to help, Sony technical personnel do not have ready access to information on products the company no longer manufactures.

The Sony monitors were used in the early exhibitions of *Tiananmen Square: Break-In Transmission* at the Josh Baer Gallery (1990) and Rhona Hoffman Gallery (1991). The FDM-330s were obsolete by the time of the next exhibition at Boston's Institute of Contemporary Art (December 1992). This exhibition used another model LCD display, most likely manufactured by Panasonic. As mentioned in section 2.3, the SFMOMA's *Seeing Time* exhibition replicated the piece. According to Matt Biederman and Steven Dye of the SFMOMA installation staff, finding LCD monitors that matched the original FDM-330s proved impossible. Working with Birnbaum, Biederman and Dye finally settled on monitors manufactured by the Citizen Corporation (Biederman and Dye 2001).

Specific models of LCD monitors are driven into rapid obsolescence owing to the recent pace of technological and manufacturing innovation. This situation has been especially true in the last 10 years as the demand for flat screen displays for portable computers has increased dramatically. The current swift rate of development belies the fact that LCD technology is not especially new. LCDs are grounded in principles first described in the late 19th century. This early experimentation showed that the crystalline structure of certain materials can be precisely altered through small changes of temperature, pressure, and current and that these changes are fully reversible when the influence of the variable is removed.

In 1963, the RCA Corporation was the first to exploit this principle to display information, using an applied voltage to alter the refractive index of liquid crystals, thus altering the light-scattering and transmission properties of the material. RCA used applied voltage to alter the orientation of linear crystals along their axis, effectively causing the crystal to twist. These so-called twisted nematic (TN) displays alter the transmission or reflection of polarized light, depending on the crystal orientation. TN displays are made by arranging these linear crystals in a grid controlled by horizontal and vertical bands of electrodes. Independently addressable picture elements, known as pixels, are formed at points of overlap between the horizontal and vertical bands of electrodes. There are substantial limitations in this method, since addressing individual pixels in the matrix requires voltage to be applied to an entire row and column of electrodes. This addressing method is known as "passive matrix." Passive matrix TN displays are typically used for low-information-density, monochromatic displays such as watches and calculators. In 1973, the Westinghouse Electric Corporation created the first active matrix display in which individual pixels could be uniquely addressed through localized voltage changes without engaging the other pixels in the matrix. This more-refined level of control is based upon associating a thin film transistor (TFT) with each pixel. While TFT displays are still based on the inherently monochromatic twisted nematic method for selectively blocking transmitted light, color is achieved though dividing each pixel into thirds and applying red, green, and blue filters. Active-matrix TFT displays are used in applications requiring high information density and rapid changes, such as portable computers, camcorders, and digital cameras. The original Sony LCD monitors used in *Tiananmen Square: Break-In Transmission* were most likely active-matrix TFT displays. The disadvantage in active-matrix TFT displays is the high manufacturing cost inherent in associating a single transistor with an individual pixel. Introduced a decade after the TFT, supertwist nematic (STN) displays rely on the simpler and easier to manufacture passive matrix method. STN displays use liquid crystals that have a dramatically enhanced twist response as compared with earlier TN displays. This higher level of response correlates to higher levels of contrast as transmitted light is more effectively transmitted or blocked. As with TFT, color in STN displays is achieved through the use of the additive color filters. Compared to TFT, STN typically has slower response time, though innovations in the early 1990s allow STN screens to be used effectively for the display of video.

While LCD technology is significantly advanced, it is by no means a "mature" technology, as new applications, increasing demand, better manufacturing methods, and competing display systems influence its development. The pace of development and the resulting cycles of obsolescence are reflected in the Birnbaum piece where the LCD monitors have changed three time in the past 10 years.

For *Tiananmen Square: Break-In Transmission* these changes have not meant progress. Birnbaum believes that the original Sony monitors were superior to later replacement models in terms of clarity and brightness. Not only was the quality better but Birnbaum was also attracted to the term "Watchman" for its talismanic appeal (Birnbaum 2000b). Unfortunately, such miniature LCD monitors are mostly relegated to the lower end of the consumer market. Consequently, the significant strides in the technology that are readily integrated into high-end consumer devices have very little impact on cheaper, smaller, commodity-item LCDs. At this point, there is very little choice when it comes to selecting replacement LCD monitors that fit the design and size requirements of the installation.

4.5 CRT MONITOR

The original cathode ray tube color monitor used in the installation is the NEC PMC 2571-A. The original monitors are still in use in both editions of the installation. NEC has not made this monitor in almost 10 years. The PMC 2571-A was marketed as a professional video monitor, with high-end features that included an 8-pin connection for direct connections to 3/4 in. U-matic VCRs, specialized filters to enhance the sharpness of composite video, a pass-through connection for the video signal, and a built-in stereo amplifier, integrated stereo speakers, and left and right audio output. The monitor has 400 lines of horizontal and vertical resolution, which, according the original NEC specifications, is 30% better than conventional television monitors. The dimensions of the monitor are 23 1/4 in. vertically, 25 3/16 in. horizontally, with a depth of 20 1/2 inches. The diagonal screen measurement is 25 in. The monitor weighs 87 lbs.

Unlike the situation with LCDs, CRT technology is "mature." Since the 1960s, the installed base and manufacturing capacity for CRT televisions and computer monitors has been huge and growing at a constant rate. Only recently has the dominance of CRTs been challenged as LCDs are gradually being used in high-end computer systems and television. LCD, plasma, and other flat panel display technologies are making rapid strides and can be expected to significantly displace CRTs for most applications by the end of the decade. However, the high price of these alternatives ensures that quality CRTs (like the PMC 2571-A) will be available in the near term.

4.6 SEQUENTIAL SWITCHER

A sequential switcher is an electronic component that is connected to multiple video sources such as cameras, VCRs, or, in the case of *Tiananmen Square: Break-In Transmission,* laser disc players. The switcher outputs only one signal at a time, working through the multiple input signals at a predetermined interval and sequence. For *Tiananmen Square: Break-In Transmission*, the four video signals from the LD players are sampled by the sequential switcher and output for durations of 7–12 seconds for display on the CRT monitor.

For the most part, sequential switchers are integrated into security systems, where the output of multiple cameras is periodically displayed on a single monitor located within a centralized guard station or recorded by a videotape recorder. Sequential switchers can also integrate audio switching, though this feature is not standard and adds to the cost. Since the CRT station in *Tiananmen Square: Break-In Transmission* does not have sound, this feature is unnecessary.

Initially, *Tiananmen Square: Break-In Transmission* used the Panasonic WJ-525 sequential switcher. The video input on this device allows for connection to up to 14 composite video input sources, using BNC connections. The switching interval is adjustable between 1 and 30 seconds. The device measures 1 3/4 in. high, 18 7/8 in. wide, and 9 7/16 in. deep. It weighs 6.8 lbs. The WJ-525 was first brought to market in 1981 and is no longer manufactured by Panasonic. Presently, similar devices with nearly identical functionality are readily available.

4.7 LOUDSPEAKERS

The eight speakers used in the installation are Teledyne Acoustic Research Powered Partners loudspeakers, model AR-570. The loudspeakers are "powered," meaning they integrate an amplifier (necessary since the audio signal from the laser disc players is not amplified), delivering 30 watts of power. As such, the speakers require AC power, though they can be adapted for use with 9–25 volts of DC power. The loudspeakers are capable of delivering approximately 109 dB sound pressure levels at 1m, relatively powerful for their small size. The signal to noise ratio is >85dB. Woofer diameter is 4 in., tweeter diameter is 1 in. The speakers are triangular, with the back of the speakers at the apex and the front forming the base. They are 6 1/8 in. high by 10 1/2 in. across the face and 7 5/8 in. deep. Each speaker weighs 8 lbs. The speakers have rotary volume and bass and treble controls. They connect to the laser disc left and right audio out jacks using standard RCA connectors.

Acoustic Research is no longer affiliated with Teledyne and is now a subsidiary of the Recoton Corporation. Recoton owns other audio component companies, including Advent and Jensen. At some point, the Powered Partners line of loudspeakers shifted from Acoustic Research to Advent, and, until very recently, Advent manufactured the loudspeakers as the AV-570. At present it appears the loudspeakers are no longer being manufactured, though they are still available through retailers. While the future of the AV-570 is unclear, quality amplifier-integrated loudspeakers (some accepting both digital and analog signals) are widely available for use with personal computers. Such speakers, however, are unlikely to have the same triangular appearance and overall dimensions as the AV-570.

5. RECOMMENDATIONS AND CONCLUSIONS

While the condition of *Tiananmen Square: Break-In Transmission* is currently stable, its long-term preservation is threatened on several fronts. The major threats can be summarized under the following headings:

5.1 THREATS

5.1.1 Format Obsolescence

Laser disc, Betacam SP, and the 3/4 in. U-matic formats have been supplanted by newer formats and are no longer supported by manufacturers.

5.1.2 Hardware Obsolescence

While there is a large installed base of playback equipment for the formats listed above, the ongoing production of the equipment is unclear or has stopped altogether.

Even though LCD technology will continue to develop for high-performance displays, obtaining small, high-quality analog LCD monitors has proven difficult, as the market seems to be moving away from this niche.

While powered speakers will continue to be manufactured (especially for use with computers), the unique triangular design of the AV-570s will be difficult to match, now that this model is no longer manufactured.

The nearly 60-year dominance of the CRT for the display of visual information seems to be coming to an end as higher resolution and less bulky technologies gain momentum.

5.1.3 Media Degradation

The original off-air recordings and the edited masters are vulnerable since magnetic tape has a very poor life expectancy of only 10–30 years when stored at ambient temperature and relative humidity.

5.1.4 Documentation

Through participation in interviews and the TechArchaeology symposium, Dara Birnbaum has a proven ability to articulate her intentions for the piece in a manner that is both clear and insightful. In large part, this article is based on these interactions. Still lacking, however, is a document that spells out Birnbaum's specific requirements for the composition and parameters for acceptable change when components fail. Without such guidance, any required change could result in perceived or actual degradation of the artistic intent.

A centralized, accessible, and authoritative repository of technical specifications, measurements, materials, installation photographs, installation history, and correspondence pertaining to the piece does not exist. Assembly of this type of information will be increasingly valuable for future installations.

5.2 NEAR-TERM RECOMMENDATIONS

The magnetic tape masters and Birnbaum's off-air recordings should be remastered using a more contemporary format, possibly using a more stable storage medium. The original masters and remasters should be stored in a secure location under conditions that meet the ISO 18923:2000 standard (ISO 2000) for the extended-term storage requirements for magnetic tape (23°C at 20% RH, 17°C at 30% RH, and 11°C at 50% RH). The remastering process should be documented, especially if restoration based on subjective criteria is required.

Electronic components that have sculptural qualities (in addition to their functional properties) need to be specifically identified by the artist in collaboration with the installation's owners, who would then have the option to seek out suitable replacements. For example, the distinctive shape of the AV-570 loudspeakers may be worth preserving, and, if so, the time to acquire replacements is fast drawing to a close.

5.3 LONG-TERM RECOMMENDATIONS

A centralized, authoritative list or catalog of all documentation pertaining to the installation should be established. At present, art historical and conservation research is difficult since there are many repositories that hold photographs, interviews with the artists, technical specifications, and equipment manuals that pertain to the piece. An easily updatable list of these repositories and a detailed inventory of their holdings would significantly streamline future preservation-related work.

Working with conservators, curators, technical experts, and the owners, the artist should develop an absolute generic version of the piece. This version should be as pure a distillation of the piece as possible, identifying critical physical and electronic components and dispensing with everything else. It should be extensively documented. The positioning of the key compositional elements, sound levels, and video output quality should be empirically measured and recorded. Through the documentation, this version can serve as a template against which subsequent display can be compared.

The TechArchaeology model for discussion of the preservation of media-based art should be expanded. Meeting the challenges inherent in preserving electronic art requires collaboration across a wide range of disciplines, including curators, technical experts, and artists. While conservation methods applied to electronic art will always be grounded in commonly held standards of practice and ethics, these new challenges will require new approaches. The development of these new approaches will require the dedication of resources for education, research, and the exchange of ideas.

5.4 CONCLUSIONS

The obsolescence of the laser disc format, the eventual obsolescence of CRT monitors, and the scarcity of replacement Acoustic Research loudspeakers will present a challenge for the long-term preservation of *Tiananmen Square: Break-In Transmission*. Such rapid cycles of hardware and software obsolescence are the inevitable effects of technological innovation within a highly competitive market. The preservation of almost any work of art that incorporates electronic technology, especially consumer electronics, will ultimately depend on strategies designed to document and manage the eventual replacement of gear like the NEC PMC 2571 and the Pioneer LD-V2000.

The obvious preservation strategy would seem to be the acquisition of multiple, redundant replacement parts. Although they are no longer being manufactured, at this writing the AR-570 loudspeakers used in Birnbaum's piece are still available, presenting a soon-to-close window of opportunity. There is no question this strategy should be implemented to the extent possible, though the limitations of the strategy should not be underestimated.

Perhaps a less obvious strategy is to contemplate the preservation of the piece without a CRT monitor, LCDs, AR-570s, or laser disc players. Eventually even the most well-preserved monitor or LCD screen from ca. 1990 is going to appear dated and somewhat primitive, just as breakthrough technologies such as phonographs, vacuum tubes, and room-sized videotape recorders now have primarily antiquarian value. Eventually such vintage gear, whether or not it is original to the piece and functional, may seriously interfere with and possibly undermine the intent of the artist. An example might be the large CRT monitor used in *Tiananmen Square: Break-In Transmission*. The monitor appears to be a deliberate evocation of contemporary television and the news media. Arguably it is this evocation of television and the medium's passive and disjointed viewing experience that is Birnbaum's intention. The CRT monitor was effective at fulfilling Birnbaum's intention in 1990 and will continue to work well for a number of years hence. However, CRT technology is on its way out, eventually to be replaced by LCD or, more likely, plasma display panels (PDP) or some other display technology. The medium of television will adapt and integrate whichever new technology predominates. Eventually, the NEC PMC 2571 monitor will cross a line: no longer a meaningful reference to contemporary television and the news media, it will become a technological relic evoking perhaps nothing more relevant than nostalgia, at best. At this point, the preservation of the piece and the preservation of original materials may present opposing goals.

The notion that the preservation of *Tiananmen Square: Break-In Transmission* may actually be undermined by a base reliance on its core technological components can certainly be applied to other work that incorporates electronic media. On its face, the problem is obvious: technology ages rapidly, and, when obsolete, it is replaced. However, within the context of art conservation, this practical reality will present a host of unique challenges for the conservator. Indeed, one of the underlying premises of Western art conservation is that materials are the embodiment and ultimate manifestation of artistic intent. The materials of the artist, whether canvas, paper, or photographic negative, are vital, tangible links to the artist. Distanced from the original materials, we perceive our experience of a work of art to be eroded and diminished—unmoored from the artist and the point of artistic creation.

Therefore if we opt for mapping the terrain where the preservation of artistic meaning supersedes the goal of materials preservation, conservators need to do more work by building substantial and credible justification. Such work cannot be done in isolation but needs to be reflective of informed dialogue with the artists, technical experts, curators, scholars, and collectors. While the dialogue must be inclusive, these issues of meaning, interpretation, and materials are central to the professional practice of art conservation. Conservators should be prepared to take the lead.

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