3MM: The Smallest Gauge

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3MM

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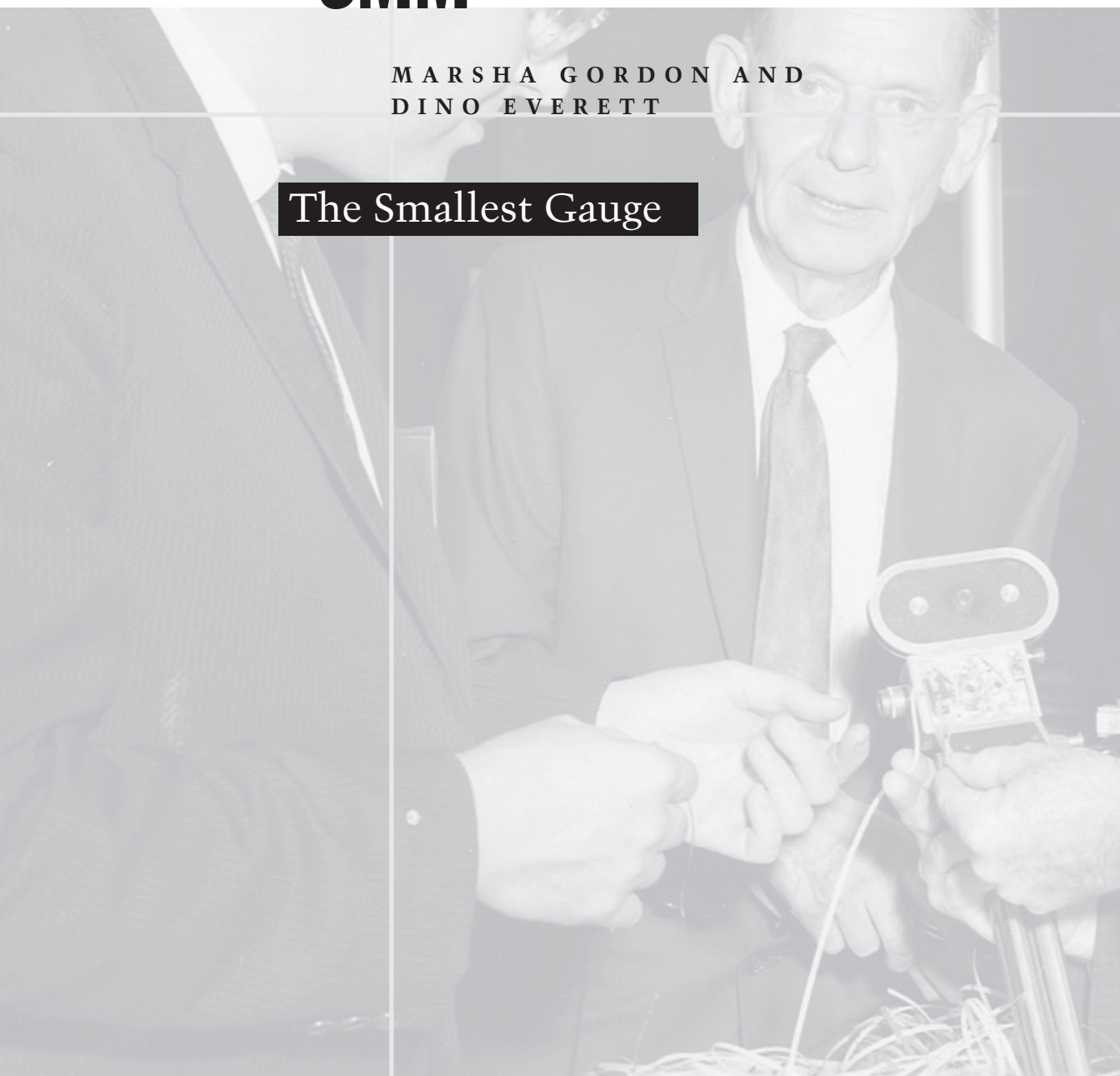
The Smallest Gauge



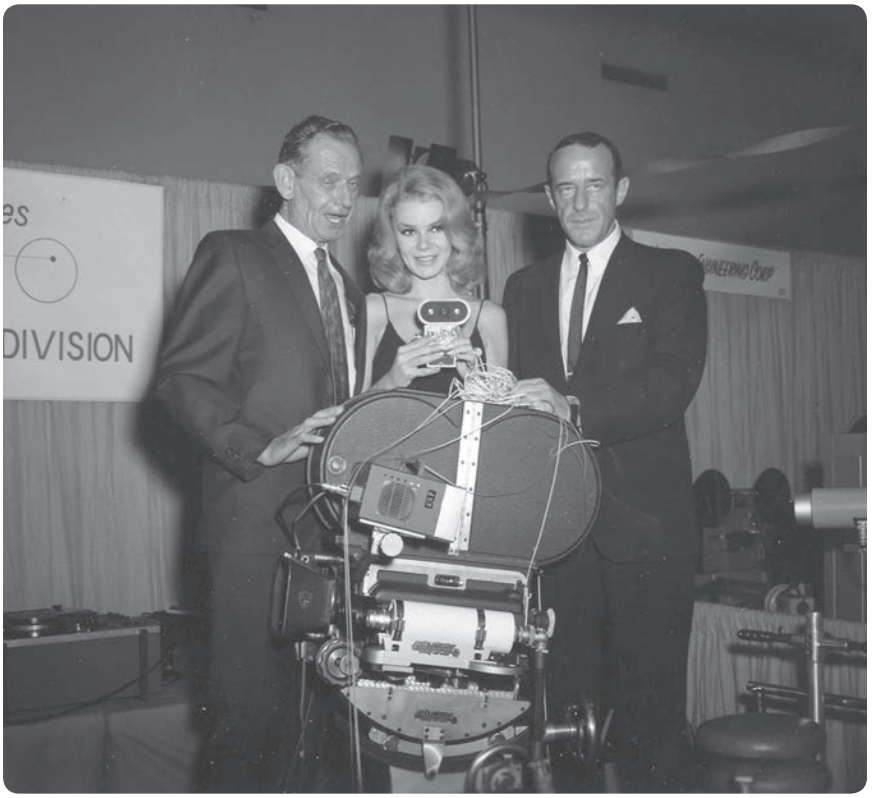


Figure 1. Eric Berndt (left), an unidentified woman holding a very small Cine-System 3 camera above a 35mm camera for contrast, and an unidentified man, circa 1960s. Courtesy of the Frank Mt. Pleasant Library of Special Collections and Archives, Chapman University.

When film scholars and archivists refer to "small-gauge" film, they are specifying film more diminutive than what was, before the digital age, the 35mm width that was standard for theatrical production and exhibition. In the United States, "small gauge" typically refers to 16mm film, which was the medium of choice for nontheatrical filmmaking and distribution throughout the greater part of the twentieth century, or to 8mm and Super 8mm, the two formats used most frequently by home movie makers. Although these are by far the most common film gauges, film sizes and perforations were never uniform or standardized. As historian Kemp Niver has amply demonstrated, 70mm, 62mm, 50mm, 28mm, 24mm, 22mm, 17.5mm, 17mm, 13mm, 9.5mm, and other variations were all employed at various times, some more widely than others.[1]

Some of these commercially available formats were quite small. Take, for example, that used by Edison in his Home Kinetoscope, which made its commercial debut in 1912.[2] Home Kinetoscope film was 22mm wide, but the frame was closer in size to that of standard 8mm (which contains an image size of 3.3mm × 4.5mm) because there

Figure 2. Eric Berndt (center) demonstrating his Cine-System 3 camera, circa 1960s. The man on the right has a badge that reads "Patrick Pfeiffer, Texas Instruments." Courtesy of the Frank Mt. Pleasant Library of Special Collections and Archives, Chapman University.

were three rows of images across the width of the 22mm film. Billed as a space-saving format, "a single foot" of Home Kinetoscope film contained "210 pictures, seventy in each row," making "eighty feet of film" equivalent to "a thousand feet of commercial film."[3] A decade after Home Kinetoscopes hit the market, 1922 saw the release of Vitalux, which was a circular band of film 125mm tall and 440mm wide with twenty-three stacked rows of 6mm × 9mm images. In 1956, Pathé's Monoplex 4.75mm film was introduced in an attempt to cash in on the widescreen phenomenon. The width was created by cutting standard 9.5mm film vertically down the middle and projecting it horizontally, not unlike the method used by Paramount with its significantly larger VistaVision widescreen format. In the case of Pathé, creating a widescreen image from such a small original source resulted in a grainy and unimpressive projected image. Cutting the film down the center also resulted in a 1.51:1 aspect ratio, which was hardly the widescreen that was promised.[4] All of these small formats were commercial failures.

These formats were also far from small in comparison to what we believe to be the smallest film gauge of all, about which (perhaps appropriately!) little is known and still less survives: 3mm film, which is more precisely 3.2mm wide, and the equipment used to manufacture, develop, and project it. Such small-gauge film formats as these deserve our attention not only because of their uniqueness but because they are a reminder that so much of film history—and the men and women who often made significant contributions to that history—remains inadequately documented. What follows explores the short but fascinating life of 3mm film and gives details about its inventor, Eric M. Berndt, now a forgotten but key figure in film history, especially of the nontheatrical variety. His tiny invention represents a lost chapter in film's vast material history.

This article is part media archeology of a forgotten film format and part documentation of one way archivists might explore the paths taken by many film tinkerers, engineers, and experimenters of the past who, like Berndt, created film formats and equipment that failed to gain traction in the marketplace but that are justifiably part of film's complicated, unruly, and largely unwritten history. As Erkki Huhtamo observes, "media archaeology corrects our understanding of the past by excavating lacunas in shared knowledge," going "beyond accepted historical narratives, uncovering omissions, gaps, and silences."[5] We do no service to film history by ignoring the economic failures. As was the case with many of the smaller but still robust gauges that populated film's twentieth-century existence, they are informative by virtue of the reasons they were invented. Archivists and scholars should be encouraged to explore and use film historical artifacts as a means of better understanding them, giving them a useful and instructive second life, and perhaps sharing the inventors' love of making things.

BEFORE 3MM

Eric Max Berndt was born in Berlin, Germany, on October 31, 1903, to Max and Emma Gauert Berndt. He trained in motion picture technology at Siemens-Schuckert starting in 1918, immigrating to the United States in 1922. In New York City, Berndt worked as a still camera repairman for the Adam Archinal Corporation, then "as production supervisor for the Duplex Motion Picture Company, working on their 35mm step-printer and a small, 11mm camera and projector." Next, he was a designer "of special printers for use in making release prints for [Kislyn Color Corp.'s] lenticular additive color process," known as the Rudolph Berthon Process, from around 1929 to 1931. In 1931, at RCA's Photophone plant, he began designing an "experimental" 16mm sound film camera that was eventually abandoned as a consequence of the Depression and economic downturn.[6] It was during his time at RCA that he met John Maurer, with whom he would later go into business.

Berndt filed many patents over the course of his career. The company he founded in 1932, the Eric M. Berndt Company on 112 East 73rd Street in New York City, "produced the first professional sound-on-film 16mm motion picture camera and the first 16mm sound recorder" (July 1933), both widely adopted for industrial filmmaking and newsreels.[7] This all-in-one operation greatly simplified the technology that would facilitate educational and nonfiction filmmaking for years to come. With John Maurer, in 1934, he founded the Berndt-Maurer Corporation, which manufactured "sound cameras, galvanometers, recorders and other motion-picture apparatus."[8] In an October 1935 letter, F. O. Calvin, founder of the Kansas-based educational and industrial filmmaking Calvin Company, wrote that their new 16mm film looked so much like 35mm when it was projected that "we have had some difficulty in explaining and convincing" others that it was not a reduction print from 35mm. He gave "a great deal" of the credit for this technical feat to Berndt and his partner, Mr. Maurer.[9] Their agile camera system also facilitated some adventurous filming: "The first sound pictures taken in a mine more than a mile and a half beneath the surface of the earth were made in October 1936, at the Koppers Coal Company Mine, Grant Town, West Virginia, using a Berndt-Maurer 16mm sound-on-film camera."[10]

Berndt headed to the West Coast in the late 1930s, opening the company's first Los Angeles location, a small "service shop" at 5515 Sunset Boulevard. After World War II, they would move to Beverly Boulevard.[11] With Walter Bach, he formed Berndt-Bach Inc. in California in 1940, which "manufactured and marketed a full line of Auricon 16mm sound cameras and recorders," another technology widely adopted by the film industry, television, and the military.[12] The Auricon—the first iteration of which, the CT-70, came out in 1940—was a significant innovation. It was a single-system camera that could record high-quality image and optical sound on the emulsion simultaneously.[13] There were many iterations of the Auricon system, including the 1949 Cine-Voice, an optical sound camera marketed to amateur filmmakers.[14] Berndt presided over that company until his resignation in 1960. His decision to retire was in part due to ongoing frustrations with labor unions combined with a desire to spend time working autonomously on projects without the pressures of running a company.[15] True to his nature even in retirement, Berndt would soon turn his ambitions to a new invention.

THE SMALLEST GAUGE

In the 1960s, Berndt developed and manufactured "a sub-miniaturized motion-picture camera using 3mm film."[16] He reported that the initial impulse behind the 3mm experiment was to make something "just for the fun of it." There were many potential

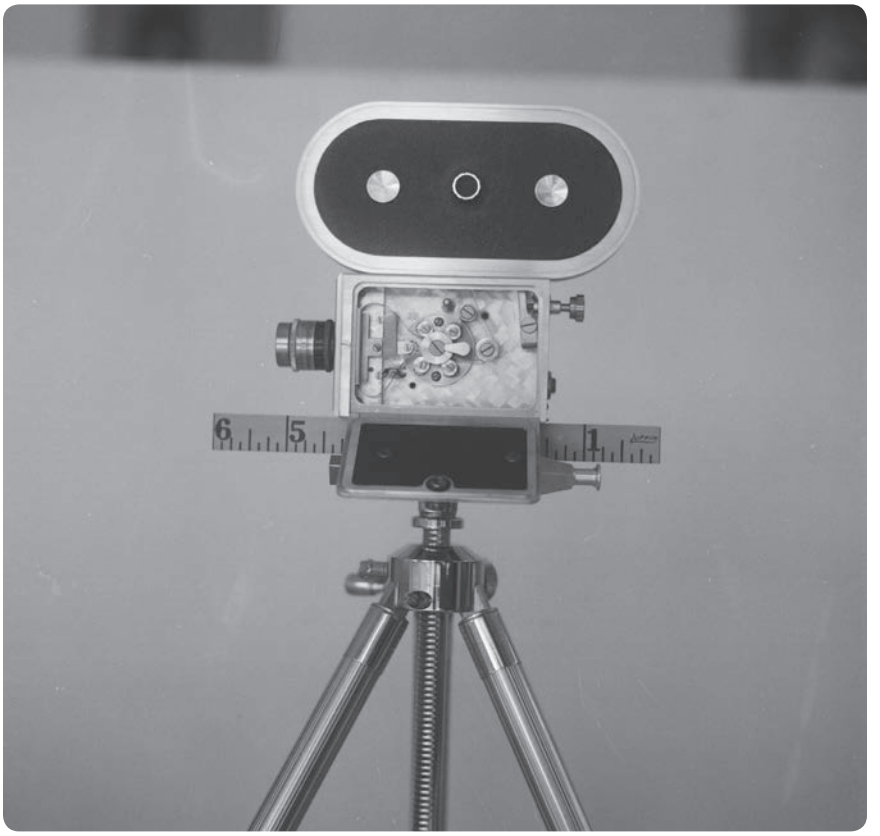


Figure 3. Eric Berndt's 3mm camera. Courtesy of the Frank Mt. Pleasant Library of Special Collections and Archives, Chapman University.

applications for 3mm film, though it was never intended for home use. Berndt claimed that he made it "for the space program" (more on this later).[17] After working on it for two years, Berndt announced that the system was fully prototyped, describing it in marketing material: "the Cine-System 3 is an actuality. The component parts have been built and proven in exacting tests. Optical qualifications, electronic demands, and physical configurations are flexible to a specific need."[18]

The Cine-System 3, according to the promotional materials, "is the miniaturization of *ALL* the component parts necessary for a completely integrated electronic and sound-on-film system utilizing a film width of .125 mils. (approximating 3mm.)." The system included "machines to cut and perforate the 3mm film from standard emulsions; a cine-camera weighing (with motor) approximately 12 ozs., . . . a daylight processing tank," and "an optical printer for the transfer of the image to 16mm film for projection on any standard 16mm projector."[19] The film was similar to 9.5mm in that it used a center perforation in between the frames. The 0.635mm × 1.59mm perforation combined

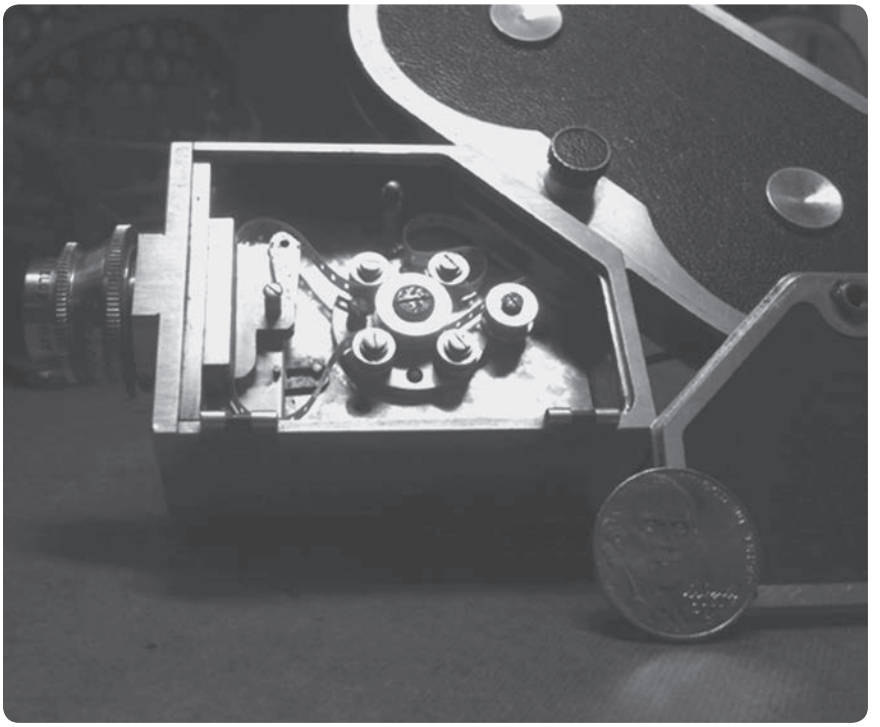


Figure 4. A view inside of Eric Berndt's 3mm camera, with a nickel to indicate scale. Courtesy of USC Hugh M. Hefner Moving Image Archive.

with the 0.32mm border on either side yielded a picture area with a 1:1.60 aspect ratio, which ironically was more widescreen than the previously mentioned Pathé Monoplex format. Though he built a 3mm projector for his own use, Berndt never intended 3mm to be projected in its native format. Because of its diminutive width, the 3mm film would have been too susceptible to breakage and scratching, and the image quality would never have been adequate for projection. Rather, the 3mm film was meant to be run through an optical printer and blown up to 16mm to be viewed on an area no larger than a 1960s-era television screen. Cine-System 3 was intended to be a practical system for economically recording moving picture information and was not envisioned as a source of entertainment or amateur cinema.[20]

Why invent such a small, seemingly impractical film format and apparatus? The 3mm system promised a "proven and dependable means for recording a synchronous electronic audio-visual image in places and on projects where size and weight are a critical factor, and where the need to study and evaluate is a post-operative necessity." The film contained a small magnetic stripe for sound recording.[21] Berndt explained that despite advances in miniaturization in many areas of electronic technology, this "has not been matched in the field of magnetic stripe cinematography," citing an "obvious need

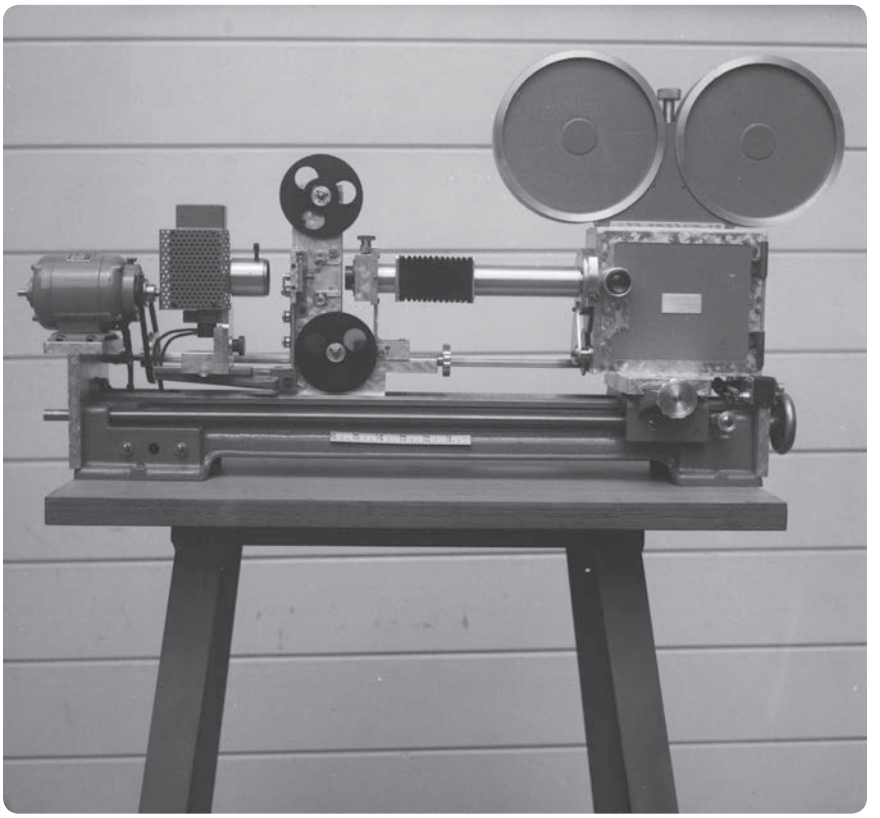


Figure 5. Eric Berndt's 3mm to 16mm optical printer, which would have been used to convert the nonstandard 3mm gauge into a standard format for projection purposes. Courtesy of the Frank Mt. Pleasant Library of Special Collections and Archives, Chapman University.

for such a development."[22] Berndt also claimed that the Cine-System 3 could "mount lenses for wide-angle or telephoto work," that its versatile uses ranged from "stop motion to extremely high speed photography," that it was "driven by a self-contained motor," and that "because the power requirements are so low, it can be operated by sharing another instrument source."[23]

Berndt's literature promoted a range of "applications, particularly in the fields of instrumentation and space technology. For kinescoping or continuous monitoring, where the cost of film is a factor (with the allied problems of handling and storage), Cine-System 3 will prove invaluable."[24] Although it was challenging, precise work to make the machine that made the 3mm film, it was theoretically economical in terms of stock costs, with every foot of film containing a plentiful 120 frames. To produce his 3mm stock, Berndt took unperforated 16mm film and slit it with a machine he tooled for this specific purpose. A one-hundred-foot roll yielded five hundred feet of film. Additionally, the camera ran three times slower than a 16mm camera, so a one-hundred-foot roll

would actually yield the equivalent of fifteen hundred feet of 3mm film.[25] According to his promotional literature, the picture area of the film was ".075 × .100 mils," and it had "a magnetic track of .012 mils with a response up to 3500 cycles."[26]

The system was aimed toward very specific, focused tasks, especially those that demanded extensive (and therefore costly) filming or allowed limited space for a camera. According to a 1973 *Journal of the SMPTE* article, Berndt's 3mm system was being "used in a special cockpit photography application by the United States Air Force at Edwards Air Force Base."[27] When William C. Flaherty interviewed Berndt for his American Film Institute oral history in 1971 and 1972, the inventor mentioned numerous calls from Washington, D.C., about potential uses for 3mm, including a request for a "top secret" application that could place a 3mm camera in eyeglasses or a cigarette lighter. Berndt reports that he laughed and showed the government agent who was making the inquiry both a mass-market Japanese camera-lighter, which he had bought for his personal camera collection, and a full-page advertisement for commercially available camera glasses in *Business News* magazine.[28] When Berndt was pressed by the government agent to try to develop a glasses- or lighter-camera with the ability to capture sharp, close-up images for spying purposes, he balked: "You need a darn good lens. And you need the right aperture lens. Well, that lens is about the size of my finger, you know, as round as my thumb. Without a good lens, you can't do it."[29]

Berndt was also asked if his 3mm system could be used for bank surveillance. Given the rash of high-profile bank robberies in the 1960s and 1970s, and governmental mandates for banks to have surveillance cameras, this was an understandable request. However, Berndt maintained that this was not a viable application for 3mm because it was really intended for close-up photography—not for distance or for rapidly moving objects.[30] Berndt's imagined uses included cost-effective information storage and retrieval as well as shooting in confined spaces, which is why it seemed possibly efficacious for NASA or cockpit use. Berndt also envisioned 3mm being suitable for applications such as closed-circuit television, where it could be used for kinescopes, making it easily disposable because of its low cost ("if nothing happens") but also easy to blow up to Super 8mm or 16mm with the optical printer he built ("if something does happen").[31] He included in his test film (which is in the Hugh M. Hefner Moving Image Archive at the University of Southern California [USC]) a shot of a Franklin Roosevelt postage stamp to demonstrate the excellent detail when the 3mm image was blown up.

Classroom use could have been another potential application, though there is no evidence that Berndt had plans to enter the educational film field. In fact, the novelty of making and trying to market the smallest film gauge to date may be contextualized in

relation to the prior invention of the equally obscure 4mm format by none other than Berndt's former partner, John A. Maurer. This and other very small gauge films had some explicitly educational aims, as Ellis D'Arcy observed in a 1963 article.[32] He discussed 4mm sound film (0.1575 inch width), which D'Arcy credits as an early 1930s invention by one J. A. Maurer, presumably the same Maurer who was Berndt's former business partner around the same time. D'Arcy himself later modified Maurer's "single, picture only" 4mm film to create "single-perforation, double 4mm sound film" using standard 8mm stock.[33] Writing in 1972, D'Arcy claims that "the U.S. Air Force has been using 4mm for some time to record flight test information, and prints have been made with soundtrack."[34] He also notes that both Maurer and Eric Berndt showed 4mm photographic sound films at a Society of Motion Picture and Television Engineers (SMPTE) convention.

A NEEDLE IN A HAYSTACK

In 2012, a large box of uncataloged material was found in the equipment cage of the Hugh M. Hefner Moving Image Archive at USC. Having an interest in unusual film formats, archivist Dino Everett recognized the material as the 3mm Berndt equipment, which had accumulated a near-mythic reputation. A quick inventory found that the box contained two different cameras, the film slitter, the film perforator, the processing material, the optical printer, a small converted 8mm Bell & Howell projector, and other items, such as a surplus of daylight reels of varying sizes, a small setup for rewinding the reels, and an eyepiece to use alongside the camera. The most obvious omission was any sort of apparatus to use in tandem with the camera for recording sound.

Upon inspection, the film stock in Berndt's nominal 3mm system was actually 3.2mm wide, or precisely one-fifth of standard 16mm. That width happens to correspond to the sound tracks that producers of magnetic-striped 16mm film had been experimenting with, so Berndt already would have been familiar with that measurement.

Given that all of the equipment needed to test the format was present, Everett's first step was fairly easy, since Berndt simply miniaturized existing equipment formats. A one-hundred-foot roll of standard 16mm film could be placed onto the film slitter, which would then be fed onto

Figure 6. Frame enlargement from the only known surviving 3mm footage shot by Eric Berndt, circa 1960. Courtesy of USC Hugh M. Hefner Moving Image Archive.

five breakaway reels. This meant that the roll of silent film would produce three usable rolls of 3mm film, because it would be slit into five different rolls of 3.2mm film, two of which contained the perforations of the original 16mm. It just so happened that one of the slitter's rollers was seized, so it became necessary to spill one side of the slit perforations straight to the floor. The most difficult part of using the film slitter was getting the whole thing started. Although the unit was motorized, this only turned the reels on which the film would be taken up, not the rotary blades that actually slit the film. Everett had to slowly push the film through the blades until enough excess was slit to properly start wrapping it up on the five different reels. This setup took a considerable amount of time, as every reel had to be set and tensioned at a precise point or else risk breaks or buildup if one reel was taking up faster than another. Once set, the rest of the slitting was done in total darkness so as not to expose the film, at which point the film slitting was fairly straightforward and smooth. Once completed, one-half of each of the three good breakaway reels of film was placed inside a film can so as not to be exposed to any light.

The next step was operating the film perforator, which was also motorized. To do this, Everett took one of the breakaway reels with the film and put it into a rounded magazine that attached to the side of the perforator. The film could then pass over a sprocket wheel on either side of the punch to another magazine on the other side, where it was ultimately taken up onto one of the reels that would be used within the camera. In testing the perforator, Everett quickly noticed that the motor caused the film to move too quickly, resulting in frequent jams, which then caused double punches that elongated most of the perforated holes. To fix this, Everett opted for a manual approach by making a simple hand crank for the back that made it possible to slowly crank the film through the perforator, resulting in steadier motion and more precise results. Once the film was threaded through the perforator to the other magazine, a front plate could be placed, and the whole operation could be done with the lights on. Once the film was on the reels, it could be used with one of the 3mm cameras.

The two cameras in the collection were completely different in design, but both were battery operated. Everett hooked up a small, button-operated nine-volt battery pack to one of the cameras. Because one of them used an internal loading of the film reels, and the other had the traditional external magazine loading, he opted to use the magazine model. This allowed for loading the film into the magazine in the dark, and then only loading the magazine onto the camera in the daylight. There were two lens options. One was a fixed-focus Wollensack f/2.5 13mm prime lens and the other a Kern-Paillard f/1.8 5.5mm lens of varying focus. Opting for the fixed-focus lens limited the variables involved in the initial testing.

Neither of the cameras was made with reflex viewing, which would allow the operator to look directly through the same lens that will capture the image on film. To facilitate using the Kern-Paillard adjustable-focus lens, Berndt had created a small setup in which the camera could be mounted next to a lensless eyepiece holder. The user would simply take the lens off the camera and mount it on the eyepiece, set the focus, then return the lens to the camera for actually taking the shot.

Once the film was loaded, Everett proceeded to do test shots outdoors. Using a common black-and-white reversal film, he and Lisa Marr, from the Echo Park Film Center, shot three fifty-foot rolls of 3mm film on the campus of USC and in downtown Echo Park. On two occasions, the camera jammed, with the result that the film got all bunched up. In hindsight, this was likely due to some of the sections where the perforator had double-punched the film, which caused larger than normal holes and pulled the film off the sprockets inside the camera. Otherwise, the operation of the camera was very smooth and precise.

Once the film was exposed, the decision was made simply to do a quick bucket processing to check out the results. Although the processing was uncontrolled, the results were quite good. The next step was to project the film, but upon closer examination, Everett noticed that the projector was missing a crucial part, which was the front pressure plate and lens assembly. This is the part that not only holds the film in place as it passes by the gate but enlarges the image to show up on the screen. Without it, the whole experiment was potentially useless.

Thankfully, Berndt had simply modified an existing Bell & Howell Model 625 8mm projector for his 3mm projector, so a replacement part could be found and then modified. Everett called upon a fellow tinkerer in the United Kingdom, Martyn Stevens, who had solved other unusual projector problems. His first attempt came close but introduced new obstacles. Modifying the 8mm projector had removed the original framing device, so when the film was projected with the new gate, it only revealed a sprocket hole front and center. The second obstacle was that the gate was positioned slightly off center from what would be considered the true optical center of the lens. Once these subtle quirks of the system were understood, Stevens fabricated a working part, and the film projected surprisingly well.

The modifications made on the projector allowed the film to travel along at the standard rate of 24 fps. Projecting a reel containing fifty feet of film lasted close to four minutes, meaning that a full one hundred feet of the 3.2mm would equal roughly the same as four hundred feet of 16mm film. This was obviously designed on purpose, since Berndt's original idea was to enlarge all of the 3.2mm film to 16mm by using the

small optical printer that he had built. In addition to the new film Everett had shot, USC had a small amount of Berndt's original footage, so Everett decided to splice the two together and project a sampling for a demonstration presentation on the format at the Association of Moving Image Archivists (AMIA) conference in Savannah, Georgia, in 2014.[35]

Although much of Berndt's literature discusses the potential benefits of the 3mm system, it leaves out some of the obvious flaws with film of that size. After physically working with the film itself, we discovered that it is extremely difficult to handle because of the system's miniaturization. Threading the raw stock in the perforator and then loading the camera is no easy task. Attempting to splice Berndt's original film to the newly shot film was extremely challenging. No matter how well the splice was made, inevitably it would catch when running through the projector. It does not seem as if the film was ever designed to be spliced, given that the original idea was to transfer all of the contents to 16mm. It is certainly hard to imagine an astronaut or someone inside an airplane changing the hundred-foot reels every ten minutes or so. In fact, it seems like it might take someone almost as long to change the reels as it would to shoot them!

CONCLUSION

Research and context remain an important part of understanding film historical artifacts, but there is a unique opportunity in the physical presence of film technology to go beyond the theoretical and discursive. These artifacts of film history and our technological past were made to be used, not relegated to the corners of archival storage. When working with unique archival material such as Cine-System 3 and other such failed formats, it is imperative to use them as originally designed. To do otherwise would be to suppress the very things that made them unique in the first place. For instance, consider the Vitaphone shorts that have been "restored" over the years: how many have actually had new disks cut and then presented to an audience with the sound track coming from a separate analog disk as the system was designed? Bringing the Vitaphone material to a new audience in a widely accessible format is important, of course, but not presenting it as it was originally manufactured reduces our understanding of the technology and of its place in film history.

The AMIA code of ethics states as one of its goals "to restore and preserve artifacts without altering the original materials, whenever possible."[36] Providing access to unique material on unusual formats via DVD or digital media is an important part of the archival mission, but doing so almost always comes at the cost of alteration and decontextualization. Simply scanning Berndt's Cine-System 3 film, for example, would

make the format appear like any other amateur-shot material that is viewed digitally. Gone would be the sense that this nonstandard format was actually designed to work in such a novel way. Exhibiting archival film, even one-of-a-kind material whenever the film is in good physical condition, is also necessary to dispel the myth that projecting film equals destruction. The Cine-System 3 was designed on some level to be projected or Berndt would not have gone through the trouble to engineer the apparatus for projecting it. Using the equipment that he engineered remains an important part of the original context of the format.

POSTSCRIPT: AFTER 3MM

Berndt was a lifelong tinkerer, engineer, and inventor. Among his many patents, for example, was the one granted on March 10, 1942, for a "Driving Connection for Film-Handling Apparatus Employing Removable Film Magazines" (No. 2,275,497) and another granted June 19, 1962, for a "Magnetic-Sound-Track Motion Picture Apparatus" (No. 3,040,134). Although his foray into 3mm would not bear fruit, after his retirement from Berndt-Bach in 1960, that project would be just one of his inventive pursuits. In the 1960s, Berndt also developed "a 16mm magnetic recording camera, the Multi-Trax recording and reproduction system, and . . . [also achieved] . . . the perfection of a true Super-16mm camera and printer."[37] The Multi-Trax recorder, which Berndt worked on with Jonathan Miller, allowed for five sound tracks to be placed on the edge of a 16mm filmstrip, enabling the projectionist to switch between different languages.[38]

In 1972, the SMPTE awarded Berndt the Eastman Kodak Gold Medal "for his development of 16mm sound recording equipment within the economic means of educational and independent film makers at a time when professional equipment was beyond the resources of most such organizations."[39] Two years later, in 1974, Berndt received the SMPTE John Grierson International Gold Medal Award "for outstanding pioneering achievements in the development, design and manufacture of the equipment and systems for small-format films, including 16mm, 8mm and 4mm [*sic*]. His early work in camera and optical sound recorders contributed greatly to the professional acceptance of small-format film, particularly in the area of documentary film production where flexibility and portability of equipment were of prime consideration."[40] When Berndt died on October 24, 1975, his *Journal of the SMPTE* obituary noted that he had been a member of the society since 1927.[41]

In addition to his significant technical contributions to the field, Berndt was an avid and important collector of early film equipment. He was a perennial tinkerer and

Figure 7. Actor Louis Hayward holds the Cine-System 3mm camera, presumably at Eric Berndt's home, in front of a case containing Berndt's historic film equipment collection. Courtesy of the Frank Mt. Pleasant Library of Special Collections and Archives, Chapman University.

collector at heart, personally restoring his collection of more than one hundred cameras, while also working on "attempts to build a better camera."[42] With Irving Browning, he cofounded the Society of Cinema Collectors and Historians in 1954.[43] He became the Honorary Curator of the Motion Picture Section of the Hollywood Museum in 1965, and he curated major exhibitions of his equipment collection for SMPTE conventions in the 1960s.[44]

The *Los Angeles Times* referred to Berndt's collection, which he kept at his Studio City home at 12549 Kling Street, as "one of the most extensive camera collections

CINEMATIC BACKDROP—Camera maker Eric Berndt shows some of his collection of cameras, many of which he invented. The collection dates back to 1870 and will be displayed today through Friday at Century Plaza Hotel in Los Angeles at a convention of film engineers.
Times photos by Al Markado

Figure 8. Eric Berndt was profiled in this May 6, 1968, *Los Angeles Times* article in advance of an exhibition of his historic motion picture equipment collection.

in the world."[45] In 1933, he purchased "the Pathé camera which was used to photograph *The Birth of a Nation*" directly from Billy Bitzer, the film's cinematographer.[46] Berndt's collection included "the first home movie camera developed in 1899, the Edison home projector, and the first 16mm movie camera. He also had the first Jenkins camera, the Selig camera [. . .], the original script of the first Technicolor film, *The Gulf Between* [1917], the Williamson Brothers' script of the first underwater movie, and Dr. Lee de Forest's camera."[47] According to a *Journal of the SMPTE* overview of his career published in 1973, Berndt's collection "was acquired by Universal Studios, which also acquired the Mogens Skot-Hansen pre-cinema collection."[48] In 1971, the *Los Angeles Times* referred to Berndt as Universal's "in-house antique curator."[49]

All of Berndt's extant papers now reside at Chapman University in California, but the motion picture equipment has been scattered. The 3mm equipment discussed here was given by Berndt to Professor Emeritus Herb Farmer at USC prior to Berndt's passing in 1975.[50] Jonathan Miller, with whom Berndt had worked on the 16mm Multi-Trax system, acquired Berndt's papers and camera collection through Berndt's widow, Virginia, in addition to other early film ephemera.[51] Miller later sold it as "The Jonathan Collection" on the open market around 1984. The majority of Berndt's motion picture technology items (of which many first belonged to Carl Louis Gregory) were purchased by Universal Studios; the remaining material was purchased by a Los Angeles dentist named Dr. Ralph Graham. At some point, Dr. Graham donated his portion of the collection to Chapman University, which included twenty-two pieces of Berndt's own personal equipment, such as Multi-Trax prototypes and 16mm sound cameras.[52]

Researching and using the material related to Eric Berndt's Cine-System 3 demonstrates that motion picture history extends beyond mere content. To fully appreciate a history that is as complex as the invention and development of moving images, it is not only the technological advancements but also the failures that need to be explored and understood. Often this requires actually using equipment to be able to discuss and understand it. As we descend more deeply into a modern plug-and-play mind-set, the ability to do such tinkering and hands-on learning will rely more and more upon rapidly vanishing knowledge bases. Coupled with the erratic fashion in which film equipment, films, and the paper trails documenting them have landed in archives (and trash bins) over the years, it is clear that the writing of film's diverse history would benefit greatly from looking to the margins as well as the center, with archivists sharing their unique holdings, such as the Cine-System 3, not only through research but also through demonstration.

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coedited with Dr. Allyson Nadia Field. Marsha is a cofounder of Home Movie Day Raleigh and of the infamous Bastard Film Encounter.

NOTES

The authors presented an early version of this article, along with a screening of 3mm film on a 3mm projector, at the 2014 Association of Moving Image Archivists conference in Savannah, Georgia, as part of the "Fatally Flawed Film Format" session. We would like to thank Lance Morrison of North Carolina State University, a research assistant who helped dig for information on 3mm, truly a needle-in-the-haystack task. Buckey Grimm also shared his personal storehouse of knowledge about archival collections during the writing of this essay.

1. Kemp Niver, "Motion-Picture Film Widths," *Journal of the SMPTE* 77, no. 8 (1968): 814–19. See also Richard Patterson, "Highlights from the History of Motion Picture Formats," *American Cinematographer* 54, no. 1 (1973): 40–43+. Both Niver and Patterson mention 3mm, but only in passing.
2. For more on Edison's invention, see Ben Singer, "Early Home Cinema and the Edison Projecting Home Kinetoscope," *Film History* 2, no. 1 (1988): 37–69.
3. "Edison Shows His Home Kinetoscope," *New York Times,* March 18, 1912, 11.
4. For more on 4.75mm, including a useful photographic illustration of the format, see Guy Edmonds, "Amateur Widescreen; or Some Forgotten Skirmishes in the Battle of the Gauges," *Film History* 19, no. 4 (2007): 401–13.
5. Erkki Huhtamo, *Illusions in Motion: Media Archeology of the Moving Panorama and Related Spectacles* (Cambridge, Mass.: MIT Press, 2013), xvii, 16.
6. Details about Berndt's career are from "Awards Presentation 1974," *Journal of the SMPTE* 83, no. 12 (1974): 969; Kenneth Fanucci, "He Designs and Collects Cameras but Skips Movies," *Los Angeles Times,* May 5, 1968; Roderick T. Ryan, "Eric M. Berndt," *Journal of the SMPTE* 82, no. 2 (1973): 98; and in Berndt's indispensable oral history conducted by William C. Flaherty, October 22, 1971–March 31, 1972, American Film Institute, Louis B. Mayer Oral History Collection.
7. "Awards Presentation 1974." Berndt gives a 1934 date in his oral history with Flaherty.
8. Ibid.
9. Ryan, "Eric M. Berndt," 98.
10. Ibid.
11. Flaherty, Berndt oral history, 184, 206.
12. "Awards Presentation 1974."
13. Flaherty, Berndt oral history, 185.
14. Ibid., 214–15. See also Charles Tepperman, *Amateur Cinema: The Rise of North-American Amateur Filmmaking, 1923–1960* (Berkeley: University of California Press, 2014).

15. Ryan, "Eric M. Berndt." Berndt discusses the trouble the company had with workers in Flaherty, Berndt oral history, esp. 233–36.
16. Ibid. Patterson, "Highlights from the History," 64, dates 3mm's invention to 1960 but provides no documentation. We have been unable to locate any patent registration for 3mm.
17. Flaherty, Berndt oral history, 236–37.
18. Cine-System 3, Eric Berndt File, Herb Farmer Papers, USC Hugh M. Hefner Moving Image Archive. The duration of time is mentioned in Flaherty, Berndt oral history, 245.
19. Cine-System 3, Eric Berndt File, Herb Farmer Papers, USC Hugh M. Hefner Moving Image Archive.
20. Though Berndt's optical printer exists, there are no known examples of any 3mm film blown up to 16mm, so we can, at this juncture, draw no conclusions about what the end results looked like. It would, however, be possible to use the printer to enlarge some of what is left of the original film shot by Berndt himself.
21. Flaherty, Berndt oral history, 245.
22. Ibid.
23. Ibid.
24. Ibid.
25. Ibid., 237–38.
26. Cine-System 3, Eric Berndt File, Herb Farmer Papers, Hugh M. Hefner Moving Image Archive, USC.
27. Ryan, "Eric M. Berndt." We have not found any evidence of how and when 3mm might have been tested or used by the American military.
28. Flaherty, Berndt oral history, 240.
29. Ibid., 241.
30. Ibid., 247.
31. Ibid., 238.
32. Ellis W. D'Arcy, "Facts and Factors for Small-Format Films," *Journal of the SMPTE* 72, no. 9 (1963): 673. See also biographical notes, "John A. Maurer," *Journal of the SMPTE* 81, no. 3 (1972).
33. D'Arcy, "Facts and Factors," 675.
34. Ibid., 676.
35. Dino Everett and Marsha Gordon, "Obsolete Film Formats in the Digital Age: 3mm, the Smallest Gauge," paper presented at the Association for Moving Image Archivists annual conference, Savannah, Ga., October 2014.
36. AMIA, "Code of Ethics," http://amianet.org/about/code-of-ethics.
37. Flaherty, Berndt oral history, iii.
38. "5 Language Film—A Learning Tool," *New York Times,* August 8, 1967.
39. Thomas King, "A Report on the 112th Technical Conference," *Journal of the SMPTE* 82, no. 2 (1973): 104.
40. "Awards Presentation 1974." We are unsure if the "4mm" referenced here should actually be "3mm," if it refers to Berndt's system, or if this is a reference to Maurer's 4mm system.
41. "Obituary" for Eric M. Berndt, *Journal of the SMPTE* 84, no. 12 (1975): 1000.
42. Fanucci, "He Designs."

43. Ryan, "Eric M. Berndt," 98.
44. "Awards Presentation 1974," 969. See also information about the "106th Technical Conference," *Journal of the SMPTE* 78, no. 8 (1969): 643.
45. Fanucci, "He Designs."
46. Ryan, "Eric M. Berndt."
47. "103rd Technical Conference and Equipment Exhibit," *Journal of the SMPTE* 77, no. 4 (1968): 377.
48. Ryan, "Eric M. Berndt." Ryan notes that, at the time of the writing, the collection was on loan to the California State Museum of Science and Industry in Los Angeles.
49. "Studio to Show Film Hardware," *Los Angeles Times,* May 22, 1971.
50. For more on Herb Farmer, see Dino Everett and Jennifer Peterson, "When Film Went to College: A Brief History of the USC Hugh M. Hefner Moving Image Archive," *The Moving Image* 13, no. 1 (2013): 33–65.
51. This information about the history of Berndt's materials derives from an e-mail exchange with researcher Buckey Grimm that took place in 2014 and is documented on the first page of the catalog created to help sell the Jonathan collection. The catalog is available in the Chapman University holdings.
52. The twenty-two pieces are detailed in the original catalog prepared by Jonathan Miller. No one at Chapman knows exactly when the collection arrived. It was first given to the film school, where it sat for a number of years untouched. It was finally sent from the film school to Special Collections in 2005 (accession number 2005.002r), at which time none of the equipment remained. Likewise, Berndt's remarkable collection of books related to the history of motion pictures dating back to the 1600s seems to have vanished. Herb Farmer at USC had Berndt's personal card catalog, which is available online (http://uschefnerarchive.com/project/motion-picture-history-book-list/); however, the books are nowhere to be found, even though there is documentation in Berndt's file in the Herb Famer Papers that alludes to them being donated to the USC library.