

Magic and Miracles

100 Years of Motion Imaging Science and Technology The Work of the Society of Motion Picture and Television Engineers

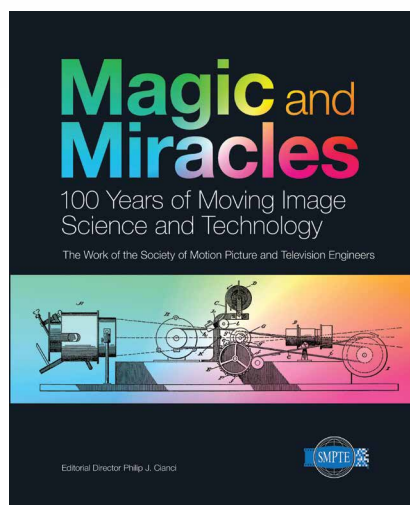
**"It's only when you stop, and look back, over a century that you see how far we've come. It's dazzling. It's astounding. It's magic."
from James Cameron's 2016 Honorary Membership acceptance speech**

A Long Time in the Making— Well Worth the Wait

Tradition, resilience, agility, and adaptability are organizational character traits that have enabled the Society of Motion Picture and Television Engineers (SMPTE) to thrive for more than 100 years on the leading edge of the development and standardization of motion imaging technology. To commemorate this achievement and document the remarkable work of the Society, SMPTE has published *Magic and Miracles: 100 Years of Moving Image Science and Technology*, an illustrated, full-color, deluxe edition book, which will be shipping in late January.

The Project Begins

During the early planning stages of activities to celebrate the Society's 2016 centenary, the idea of an



One hundred years of the Society's contributions to the motion picture, television, and media industries, presented in a lavishly illustrated 400-page 9 in. x 11 in. coffee table book, priced within the means of every SMPTE member.

expansive book was discussed. By the spring of 2014, a concept emerged from ad-hoc book committee meetings: to describe the history of the Society in a narrative

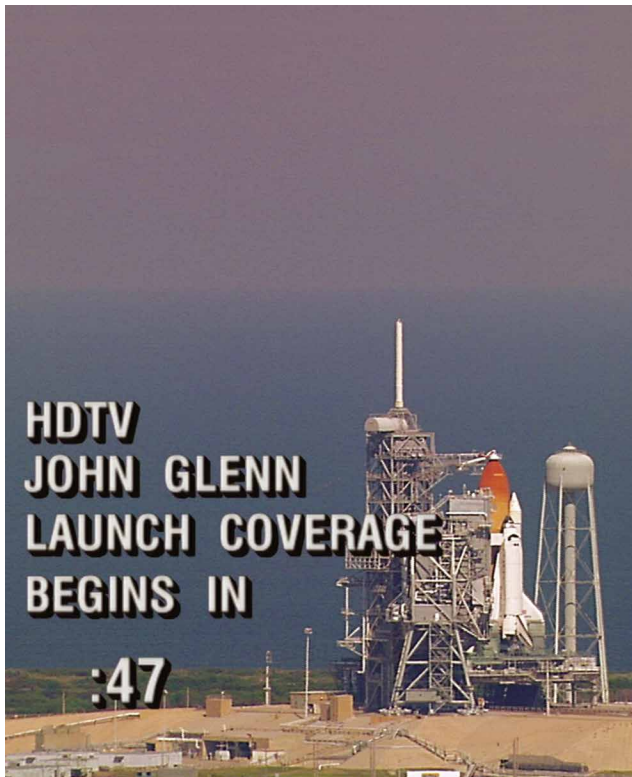
format, highlighting the contributions of SMPTE over its 100 years, to the development and standardization of technology used in the motion, television, media, and entertainment industries.

The editorial precepts that guided the book's development were to:

- Appeal to technical and nontechnical readers.
- Serve as a calling card for the Society beyond the media industry.
- Inspire the next generation of media system technologists which serves to attract technical talent to careers in the media industry.
- Reflect on the historical contributions made by the Society.
- Fill a technical history void in media studies.

The Production Process

Thoroughly documenting a century of the Society's accomplishments in a comprehensive and balanced history is, at the very least, difficult.



Digital Dawns



4.1 The Components of Success	190
4.2 Digital Audio	198
4.3 The Digital TV Revolution	202
4.4 Digital Cinema Arrives	218
4.5 Discussions in Depth	230

A SMPTE RP-428:6-2009 D-Cinema Digital Leader and Digital Projection Verifier.
 < The 29 October 1998 Launch of Space Shuttle Discovery (STS-95) was broadcast live across the US in HDTV, complete with HD commercials, HD program segments, and HD graphics.

Each Section opens with a full-page color image representative of the subjects to be covered (left). Table of contents. The opening spread to Section 4—Digital Dawns presenting the commencement of DTV services with the launch of STS-95 in October 1998, offset by the ensuing SMPTE RP 428:6 Cinema alignment signal (right).

To simplify the challenge, the book follows a chronological narrative through various topics of interest to the Society such as motion pictures, television, digital systems, content creation, and distribution. The book describes the adaptability and evolution of the Society in response to transformative and disruptive innovations, such as digital television, and the contemporary influx of information technology, just as it had with the development of sound and color for motion pictures earlier in its history.

Magic and Miracles is the result of a collaborative effort by Society members. Philip J. Cianci served as the project's editorial director. Committee members, Society members, and staff comprised an advisory board. In the tradition of anniversary publications by professional societies, a significant portion


of the content was provided by members, including contributions from (in the order of appearance): Mark Schubin, William Miller, John Belton, Stan Baron, David Wood, Mike Strein, Bill Werner, Dean Winkler, Douglas I. Sheer, Matthew Brennesholtz, Simon Gauntlett, Al Kovalick, Chris Lennon, John Footen, and Richard Welsh. Members of the *SMPTE Motion Imaging Journal* Board of Editors reviewed many of the submissions. Other article contributions provided by subject matter experts served to frame the backstory.

Supplemental sidebar materials, such as the development of standards, award recipients, technical notes, first-person accounts from the *SMPTE Transactions and the Journal*, and industry awards bestowed upon the Society, were

SECTION 1: A CENTURY OF SERVICE

SMPE Then SMPTE Now

Every industry has its society of Engineers, an association of men who are responsible for the form of structure of the mechanism used in their trade. ... The time is ripe ... for the establishment of a society of motion picture engineers, as is evidenced by the fact of their standards in the industry.
 C. Francis Jenkins, First SMPTE Presidential Address, 1916



The Raleigh Hotel in Washington DC was the site of the meeting where the Society of Motion Picture Engineers was created in July 1916.

As the second decade of the 20th century through the early years of the 20th century was an era of technical standardization, the motion picture industry was an anarchic free-for-all. The formation of the Motion Picture Patents Company (MPPC) in 1909 brought a semblance of technical stability to its patent-sharing membership, but other industrialists independently developed non-standardized systems to get around the MPPC. Industry stakeholders organized the National Independent Motion Picture Board of Trade in 1914, among its statements of purpose was a mission "to procure uniformity and certainty in the customs and usages of trade and commerce; to obtain a standardization of machines, films, appliances, and apparatuses." Francis C. Francis Jenkins, who was among the first to publicly present the question of motion pictures, was asked to chair the standards committee. However, the participants were weary and skeptical after years of litigation, and the effort failed.

As the second decade of the 20th century through the early years of the 20th century was an era of technical standardization, the motion picture industry was an anarchic free-for-all. The formation of the Motion Picture Patents Company (MPPC) in 1909 brought a semblance of technical stability to its patent-sharing membership, but other industrialists independently developed non-standardized systems to get around the MPPC. Industry stakeholders organized the National Independent Motion Picture Board of Trade in 1914, among its statements of purpose was a mission "to procure uniformity and certainty in the customs and usages of trade and commerce; to obtain a standardization of machines, films, appliances, and apparatuses." Francis C. Francis Jenkins, who was among the first to publicly present the question of motion pictures, was asked to chair the standards committee. However, the participants were weary and skeptical after years of litigation, and the effort failed.

With the imminent dissolution of the MPPC, as its patents were bound to be in violation of antitrust laws, by an action of the US Government, in the fall of 1915, the Motion Picture Board of Trade of America was established, again with Jenkins at the helm of the standards committee, which was formed in the spring of 1916. Ultimately, this second attempt failed.

Liberal use of photos and other visual elements add interest to chapter narratives. Chapters One of Section One—SMPE Then SMPTE Now—describes the motive forces that led C. Francis Jenkins and industry stakeholders to form a motion picture Engineering Society.

added to further explain topics as well as to highlight significant

Newsgathering Cameras

Theatrical Newsreel Cameras

The five theatrical newsreel companies operating through the '30s, '40s, and '50s each had an arsenal of either Wall, Bell & Howell, or Akeley 35-mm cameras. The Akeley "Gyro" tripod was to be seen beneath most all of these cameras. With both panning and tilting smoothed by gyroscopes, or the option of hand cranks and ball leveling, it was the mount of choice by all newsreel cameramen. Among other tools of the trade for these lensmen, the ubiquitous Bell & Howell 35-mm handheld Eyemo camera was always at the ready. Introduced in 1926, it featured a compact 100-ft. daylight load and spring-wound power exposing up to 35 ft. per single winding.

In July 1924, Theodore Case and Earl Sponable produced a sound newsreel interview with President Calvin Coolidge. Their system was used for the first completely all-sound newsreel released by Fox in October 1927, which predicted the exhibition of feature "talk-talking pictures" in theaters. Two years later, Fox Movietone News became the first to offer twice-weekly sound-on-film issues. In 1929, Fox Movietone recorded sound via the Aeslight modulator that recorded a variable density track. The "two-imp" was a gaseous discharge tube consisting of a nickel anode and a looped filament emitting an intense beam of light at the "no-signal" level.

Many Bell & Howell model 2709 cameras were modified to mount the Aeslight and its lens on the rear of the camera body to focus the soundtrack on the drive sprocket. Later, the West and Audio Akeley cameras were designed specifically for single-system operation with integral galvanometers and an emphasis on a silenced mechanical film



movement. Twelve-volt lead-acid batteries powered these camera motors. The batteries along with spares added considerable weight to a newsreel outfit.

Pathé News used Wall cameras exclusively. Their optical sound galvanometers contained a special mask in the exposing light beam that produced a class A-B push-pull negative sound track. The track was exposed 12 frames ahead of the picture aperture. The advantage of the class A-B track was that it resulted in a 6-dB improvement in noise reduction on the original single-system negatives.

Paramount initially entered the sound era with four Bell & Howell cameras modified with galvanometers and a profile distinguished with the drive motor mounted at the front. It also had a large exposed damping flywheel at the side to minimize wobble and flutter in the soundtrack.

All reels (as the newsreels were called) exposed either Dupont or Eastman Kodak black-and-white stock exclusively. Dupont Superior type 2 with an ASA of 125, Superior type 4 @ ASA 350, or Eastman Plus X @ ASA 80, Double X @ ASA 250, and XXX @ ASA 320 were the film stocks of choice.

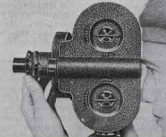
Bell & Howell Eyemo

The Bell & Howell Eyemo was the standard equipment supplied to military and combat cameramen during World War II and the Korean War. The Eyemo Standard Automatic Portable Camera, Design 71 (circa 1925), or Eyemo, was "Mr. Outside." Although it was not a part of the original Bell & Howell Standard 35-mm System, it was an important product. A 1954 advertisement stated, "More Eyemos have been sold... than all other makes of 35-mm movie cameras combined."



Newsreel Cameras in the Field (Left) Robert Donahue, Sr. at South Pole with Byrd Expedition, operating his "Pancake" Akeley camera for Pathé News (1926); (Center) Lou Hutt and Albert Mingalane at 1930 World Series with Paramount's modified Bell & Howell SS camera; (Right) Pathé News staff cameraman Karl Malkames the Author with Wall SS camera in 1982. (Images and text from Malkames, *SMPTE Journal*, 2004)

250



The Eyemo (Left) The original Eyemo, 1926; (Right) An Eyemo captures action in the Battle of the Bulge.

The Eyemo was introduced in 1925 and was patterned after the 16-mm Filmo Design 70 camera that had been introduced two years earlier, in 1923. In fact, except for the wider film gauge, the early Eyemos and Filmos were almost identical, and some parts (such as doors) could actually be interchanged. The Eyemo remained in production by Bell & Howell until around 1970.

At the beginning of World War II, there was such a demand for Eyemos for military use that some branches of the government and the services sent out requests to studios, cameramen, and supply houses asking for the services "for the duration" of many privately owned Eyemos. During the war, the Air Force used Eyemos as aerial combat and bomb-spotting cameras. Some of these were newly manufactured for this purpose to military model designations, while some were modifications of civilian models. Many of these were fitted to accept offset viewfinders of the Mitchell and Maier-Hancock type.

ENG Cameras and Acquisition

The use of film for television news gathering came to an end with the introduction of shoulder-mounted — albeit quite heavy — cameras from RCA, Ikegami and Ampex in the late 1960s and early 1970s. Over time, shoulder-mounted cameras, and then camcorders, became lighter, more compact and captured greater quality, higher resolution pictures, soon adding color, time base correction and synchronous sound. The Ikegami HL-33, RCA TK-45 and Thomson Microcam were portable two-piece color cameras introduced in the early 1970s. For field work, a separate video recorder was required to record the camera's video output; this was either a portable 1-hr. reel-to-reel VTR, or a portable 3/4-in. U-Matic VCR. Typically, the two camera units would be carried by the camera operator, while a tape operator carried the portable recorder.

With the introduction of the RCA TK-76 in 1976, camera operators were able to carry on their shoulders a one-piece camera containing all

the electronics to output a broadcast-quality composite video signal. A separate videotape recording unit was still required. This two-piece recording mode survived until the early 1980s, when "camcorders" — the merging of a camera and recorder as a single unit — were brought to the market. When RCA left the business, the void was filled by Sony, Panasonic, Ikegami and Philips. Portable lenses were also developed, as an entire industry arose to meet the needs of news shooters, ranging from batteries to camera-mounted lights and ultra-light tripods and body braces.



THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

THE NEW TK-76C

251

Journal and Transaction excerpts and numerous photographs. In this two-page spread about News Gathering Camera Karl Malkames (left) and Eyemo and first TV cameras used for news acquisition leading to the proliferation of Electronic News Gathering (right).

Society accomplishments. When all the materials were assembled, the book had grown to more than 600 pages!

A Three-Book Set

As a result, the original goal of a single book expanded to a set of

three distinct works. The first book, *The Honor Roll and Honorary Members of the Society of Motion Picture and Television Engineers*, includes profiles of each of the Society's Honorary Member; it was presented as a keepsake gift to attendees of the 2016 Centenary Gala. The second book

will be the hard cover *Magic and Miracles*. And the third book, *The History of the Society of Motion Picture and Television Engineers*, is written from the Society's perspective, focuses on the growth and evolution of SMPTE, and incorporates the abundance of material unearthed during the research of *Magic and Miracles*, and will include references and footnotes. It will be published as an on-demand paperback, targeted for release in October 2018.

Every Society Member Should Own a Copy

The nearly 400 pages of *Magic and Miracles: 100 Years of Moving Image Science and Technology* highlight the work and contributions of the Society, and its members and sustaining entities, in the narrative context of the motion picture, television, and media industry's history. A book of this



EMMY 1992-1993

SMPTE 259M: 10-Bit 4:2:2 Component and 4fsc Composite Digital Signals — Serial Digital Interface (SDI)

National Academy of Television Arts and Sciences (NATAS) Emmy® Award for Technology and Engineering for development and standardization of Digital Serial Interface (SDI) technology for television (1992-1993). In Plant Digital Serial Interconnection Technology for Television to Sony, Tektronix, Thomson CSF, and SMPTE (Joint Award). The standard describes a serial digital interface for 525/60 and 625/50 digital television equipment operating with either 4:2:2 component signals or 4fsc composite digital signals.

SMPTE 259M defines four operating data rates and compliant equipment supports at least one of these data rates.

- Level A — 143 Mbps NTSC
- Level C — 270 Mbps 525/625 Component (4:3 aspect ratio)
- Level B — 177 Mbps PAL
- Level D — 360 Mbps 525/625 Component (16:9 aspect ratio)

The Physical Interface — The Serial Digital Interface (SDI) was designed for transmission of serially encoded digital video data over 75 ohm impedance coaxial cable using ECL (Emitter-Coupled-Logic) on BNC terminating connectors. In 2006, SMPTE ST 297 defined an optical interface standard covering all SDI rates from 143 Mb/s to 3 Gbps.



Accepting the Emmy Award on Behalf of SMPTE Engineering Vice President Ken Davies (R) and Peter Symes (L) Chairman of the Working Group on Studio Video Systems.

Each award from the Motion Picture and Television Academies is highlighted. Pictured here: The 1992-1993 NATAS Emmy for the SMPTE 259M Serial Digital Interface standard.


nature—with hundreds of color photos, illustrations, and diagrams—will find a home on every member's coffee table to enjoy for years to come.

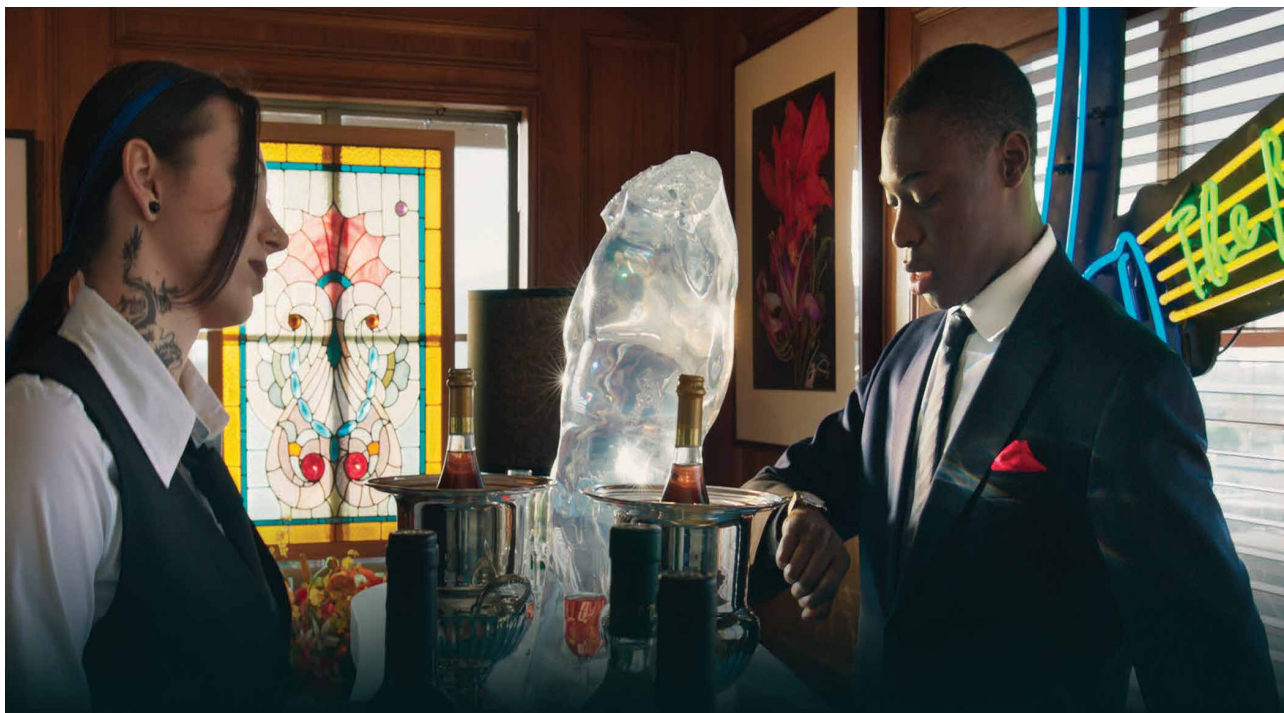
About the Editorial Director



Philip J. Cianci's involvement in HDTV began at Philips Research in 1984 and continued at ESPN during the construction and commissioning of the

all-HD Digital Center. He was the editor (2005–2007) of the *Transition to Digital Broadcast Engineering* magazine e-newsletter. Following the authoring of two Focal Press published books in 2012, McFarland published *High Definition Television – The Creation, Development and Implementation of HDTV Technology*, which documents the global deployment of HDTV. He is assisting the Smithsonian Institution in developing an HDTV archive. Living a dual existence in the parallel universes of creativity and technology, he is forging a body of work exemplifying the intelligent fusion of

technology and art at his Frog Hill Creative Sanctuary. His recent work was inspired by his participation in the development and deployment of HDTV. For additional information visit: www.philipcianci.com and www.HDTVarchiveproject.com. 



AVAILABLE NOW from the
ACADEMY SCIENCE & TECHNOLOGY COUNCIL

High-quality, professionally-produced, royalty-free cinematic material for testing and evaluation of next-generation cinema imaging technologies – such as expanded frame rates, brightness, dynamic range, and color gamuts. The material comprises a single scene shot repeatedly under controlled conditions, at multiple resolutions and frame rates.

Oscar statuette ©A.M.P.A.S.®



Oscars.org/NGCT