IEEE

Center for the History of Electrical Engineering

Newsletter Number 17 Spring 1988

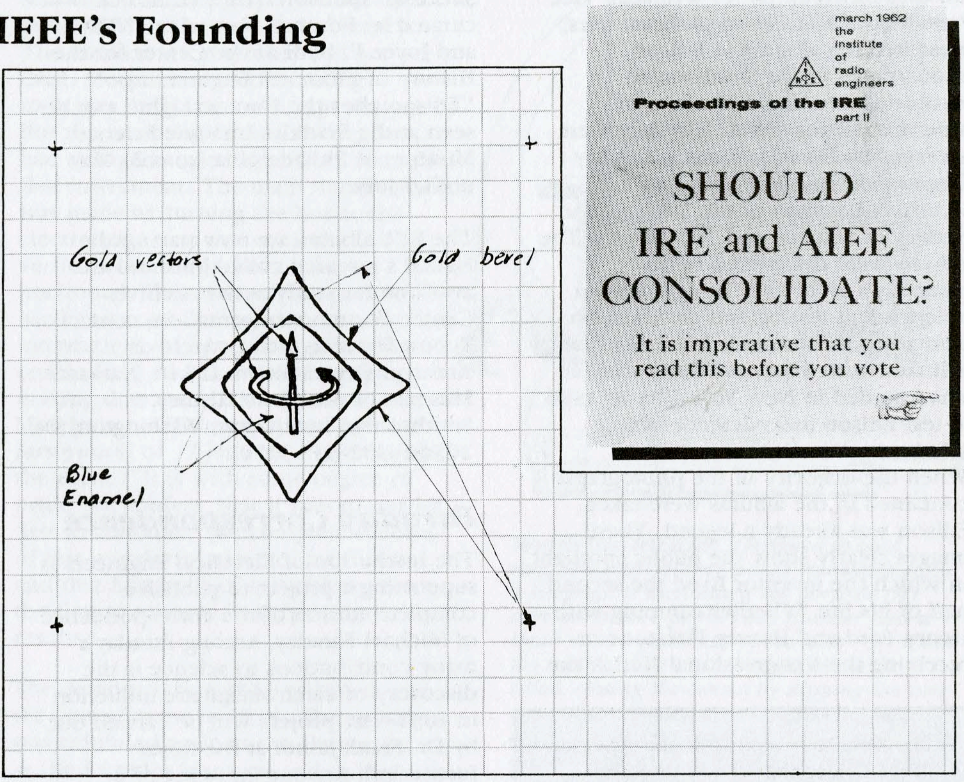
Collections Document IEEE's Founding

During the first part of the 20th century, the technical concerns of the American Institute of Electrical Engineers (AIEE), founded in 1884, and of the Institute of Radio Engineers (IRE), formed in 1912, seemed fairly distinct. Generally, the AIEE served those active in wire communications and electric utilities, while the IRE represented those working in radio and electronics. The two societies grew and prospered side by side, sometimes overlapping, but maintaining largely separate identities and interests.

The years after World War II, however, brought dramatic changes to the field of electrical engineering. Electrical technology was moving rapidly; radar, computers, television, solid-state electronics, and space exploration were burgeoning fields. The explosive growth of electronics affected both the AIEE and IRE. IRE membership rates soared, and the AIEE broadened its horizons as the scope of electronics moved into power, control, and communications. By the end of the 1950s, the AIEE was not a society of just power engineers—over 30% of its technical papers were in communications, electronics, or instrumentation.

With greater frequency, questions were raised in both societies about how appropriate it was for the increasingly interrelated fields of electrical engineering to be represented by two large, independent organizations. Merger was becoming ever more logical. Neither society adequately represented the whole breadth of electrical engineering. There was duplication of staff, publications, and activities.

The first step towards a solution came on college campuses; in 1950, the boards of both societies authorized the creation of joint student branches. In 1956, John D. Ryder and Morris Hooven, presidents of the IRE and AIEE respectively, devised a reciprocal membership plan on the national level. In 1958, AIEE president Latimer F. Hickernell and IRE president Donald G. Fink worked out additional arrangements for closer cooperation.



Signs of the times—the cover of the March 1962 issue of the IRE Proceedings *and Bernard Oliver's sketch for the new IEEE emblem. Oliver recalls, "The design was an attempt to combine in the simplest way the diamond badge of AIEE and the triangular badge of IRE with its symbol of electromagnetic induction."*

Early in 1961, IRE past president Ronald McFarlan and AIEE president Clarence Linder met with each other's board to explain their respective organizations. After these meetings, events moved rapidly. An eight-man joint ad hoc committee was appointed to discuss the specifics of a merger and, by October, the IRE board had authorized a resolution that merger with the AIEE go forward.

The joint merger committee, enlarged to fourteen members in 1962, devised recommendations to be presented to the membership of both societies later in the year. In the election that followed, 87% of the voting members of each society approved the merger. On 1 January 1963, the Institute of Electrical and Electronics Engineers was officially born.

The events and decisions leading to the founding of the IEEE are documented in the merger archives, part of the collections of the Center for the History of Electrical Engineering. Among the over 1,000 documents are meeting minutes, committee papers, news clippings, statistics, legal and financial documents, and correspondence on the merger. Topics covered include intersociety relations, the various merger committees and study groups, technical and organizational operations, publications, and individual views both for and against the merger. This document collection is supplemented by oral history interviews conducted with three members of the joint merger committee. These in-depth talks with Ronald McFarlan, John Ryder, and B. Richard Teare provide a unique personal perspective on the formation of the IEEE.

The merger archives are open to researchers by appointment. For further information, contact the Center for the History of Electrical Engineering.

Briefs . . .

Edison Photos Donated to Smithsonian

In a ceremony held on 11 February, Edison's birthday, James Williams, Vice President of ETL Testing Laboratories, presented ten albums of Edison photographs to the Smithsonian Institution's National Museum of American History (NMAH). They were accepted by Douglas Evelyn, Deputy Director of the NMAH, and Arthur Molella, Chairman of the Dept. of the History of Science and Technology. The albums were discovered in the company's archives. Though now an independent testing and certification laboratory in Cortland, NY, ETL's history is linked with Thomas Edison; the lab was founded in New York City in 1896 to test Edison incandescent lamps.

When the majority of the photographs contained in the albums were taken, Edison was already a legend. These images clearly show the public spotlight in which the inventor lived the second half of his life. Whether camping with Henry Ford and Harvey Firestone or receiving the Congressional Medal, the photographers were never very far away from the "Wizard of Menlo Park." But the albums also include photographs that give a glimpse into the family life of the Edisons.

The ETL photographs provided the impetus for the exhibit, "Edison after the Electric Light: The Challenge of Success," sponsored by ETL and co-curated by Bernard Finn of the NMAH and Joyce E. Bedi of the Center for the History of Electrical Engineering. "Edison after the Electric Light" can be seen at the Franklin Institute Science Museum in Philadelphia from 21 May until 3 July.

The ETL albums are now part of the NMAH's research collections and are available for study at the Archives Center. For more information, contact Robert Harding, Acting Archivist, Archives Center, Room C 340, National Museum of American History, Smithsonian Institution, Washington, DC 20560 (202-357-3270).

The *Newsletter* reports on the activities of the Center and on new resources and projects in electrical history. It is published thrice yearly by the Center for the History of Electrical Engineering, Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, NY 10017 (212-705-7501).

IEEE History Committee 1988

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Faraday Correspondence

The Institution of Electrical Engineers is supporting a project to publish a complete edition of the correspondence of Michael Faraday. Among Faraday's many contributions to science is the discovery of electromagnetic induction in 1831. The project will be carried out by Dr. Frank James at the Royal Institution. Anyone knowing of or possessing correspondence to or from Faraday is asked to contact Dr. James at RICHST, The Royal Institution, 21 Albemarle Street, London W1X 4BS, England.

IEEE Fellowship in Electrical History Awarded

The 1988-89 IEEE Fellowship in Electrical History, supported by the IEEE Life Member Fund, has been awarded to Michael A. Gunderloy, a Ph.D. candidate in the Dept. of Science and Technology Studies at Rensselaer Polytechnic Institute. Mr. Gunderloy is completing a dissertation on the computing activities of the National Bureau of Standards as a case study in the history of computing. He writes:

> The origins of electronic digital computing are only poorly understood. While we know a great deal about the internal development of the computer, the forces shaping this development are still obscure. Computing history is ready to look outside the technical facts into their social context in an exploration of the central interplay between the artifacts and their meanings. My dissertation will attempt to advance this understanding through a close study of the National Bureau of Standards (NBS) computing effort, in order to illuminate the solution to key issues in the development of the electronic digital computer.

Meetings . . .

BSHS-HSS Anglo-American Conference

The British Society for the History of Science and the History of Science Society will hold an Anglo-American Conference in Manchester, England, during 11-15 July. Sessions have been scheduled on ***The Business of Science and Technology: Recent Work on the History of Industrial Research, Science and the Military, The History of Computing,*** and ***Science-Technology Relations in Nineteenth-Century Britain.*** These will include the following papers of interest to *Newsletter* readers.

- Colin Hempstead, "Telegraphy: Science and Technology"
- Bruce J. Hunt, "Cable Telegraphy and British Field Theory"
- Alan Morton, "The Laser-Scanner Supermarket Checkout in the USA"
- Arthur Norberg, "Punching Cards to Magnetizing Cores: Industrial Research and Development's Role in Changing Machine Computation Methods, 1925-1955"
- Robert Seidel, "Shedding Light on Defense: The Military Response to the Laser"

For more information, contact J.V. Pickstone, Centre for the History of Science, Technology, and Medicine, Mathematics Tower, University of Manchester, Oxford Road, Manchester M13 9PL, England.

TICCIH

Preservation of the industrial heritage of electricity will be the topic of the November 1988 conference sponsored by the Belgian section of The International Committee for the Conservation of the Industrial Heritage. The conference will address the development of the production, distribution, and consumption of electricity and the preservation and presentation of this heritage to the public. Those interested in attending should contact TICCIH-Belgium, Permanent Conference Secretariat, c/o Bissegemphats 6, B-8620 Bissigem, Belgium.

Sesquicentennial of the Telegraph

One hundred fifty years ago, Samuel Morse and Alfred Vail began extensive promotion and improvement of Morse's telegraph. Morse had begun thinking about the telegraph several years earlier and he and Vail still faced just as many years more before Morse's system was put into actual use. But, at a public demonstration at Morristown, New Jersey, in January 1838, Morse and Vail unveiled a practical recording electromagnetic telegraph.

In October 1832, Samuel Morse was on his way home from Europe aboard the *Sully.* A shipboard conversation about the properties of electricity planted, as Morse said, "the crude seed which at once took root, and. . . grew into form. . ." By the time he arrived in New York, Morse had sketched out his rudimentary plans for a recording telegraph.

For the next two-and-one-half years, however, painting, politics, and poverty combined to keep Morse from building the instrument. Moreover, the materials needed were not readily available, as Morse pointed out: "The electro-magnet was not an instrument found for sale in the shops. . . Insulated wire was no where to be obtained, except in the smallest quantities, as bonnet wire of iron wound with cotton thread." So, he improvised, insulating copper wire by winding cotton thread around it, using that to wind the electromagnet (an iron bar from the blacksmith), removing the works from a wooden clock to move the paper, and arranging it all on a canvas stretcher nailed to the side of a table. The result was rather ungainly and none too reliable (see illustration), but, by the end of 1835, Morse was able to record on paper a message sent through a wire.

Finally settled, as professor of art and design at the University of the City of New York (now New York University), Morse worked on improving the telegraph. His colleague, Prof. Leonard Gale, became Morse's first partner. Familiar with the writings of Joseph Henry, Gale advised Morse to make two important changes to his apparatus; replace the single-cell battery with one of many cells and increase the number of turns of wire around the electromagnet. These modifications dramatically increased the distance messages could be sent.

On 2 September 1837, Alfred Vail, a student at the University, happened to see one of Morse's demonstrations of the telegraph; he soon became Morse's second partner. Vail's mechanical abilities and access to materials and funding through his father, owner of the Speedwell Iron Works in Morristown, NJ, were instrumental in developing a practical telegraph.

Two miles of wire were strung around a vacant room at the Speedwell Iron Works and the telegraph was set up for a public demonstration on 11 January. The familiar telegraph key did not yet exist; Morse's system of sending messages with saw-tooth type was used. But the receiving device, the register, had changed a great deal from Morse's first instrument. The main improvement was made by turning the horizontal electromagnet to the vertical and the vertical recording lever to the horizontal. This allowed the pencil then used to record the message to come into intermittent, as opposed to the former continuous, contact with the paper, making dots and dashes possible. The Morristown, NJ, newspaper, *The Jerseyman,* of 17 January 1838 recorded the event. "It is with some degree of pride, we confess, that it falls to our lot first to announce the complete success of this wonderful piece of mechanism, and that hundreds of our citizens were the first to witness its surprising results.

The demonstration at Morristown was the first of many in 1838. The apparatus was exhibited again at the University, at the Franklin Institute, and to the congressional Committee on Commerce. Morse also spent several months in Europe promoting the telegraph. But, while praise of the instrument was easily obtained, letters patent and funding for development were not. The U.S. patent for the telegraph was not issued until June 1840, and construction of an actual line waited until Congress appropriated $30,000 in March 1843. The first official message was sent over that experimental line between Washington, DC, and Baltimore in May 1844: "What hath God wrought?"

Special events

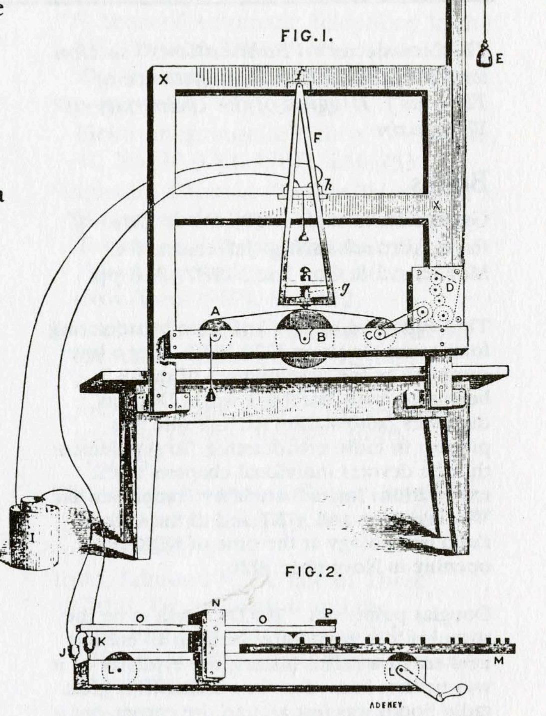
To celebrate the sesquicentennial of the telegraph, several special events have been scheduled throughout the year. These include the dedication of an Electrical Engineering Milestone for Morse and Vail's work at Speedwell and a special commemorative conference, sponsored, in part, by the IEEE Communications Society.

On 7 May, Samuel Morse and Alfred Vail's public demonstration of practical telegraphy at Morristown will be dedicated as an IEEE Electrical Engineering Milestone. The ceremony will be held at the building, now part of Historic Speedwell in Morristown, in which Morse and Vail conducted their experiments and demonstrations.

"Telecom at 150: Progress, Promises, and Policies" will be held on 21-22 June at the Merrill Lynch Conference Center in Princeton, NJ. This conference for key leaders in telecommunications will open with a session on "Historical Perspectives Relevant to Today."

For more information on either of these events, please contact the Center for the History of Electrical Engineering.

Morse, *Modern Telegraphy*, 1867



Morse's first telegraph. *Designed to send numbers representing words translated from a telegraphic dictionary, the portrule (M) carried metal type for each number past a tooth on the underside of the lever (O). When the tooth moved over the type, the lever tilted, closing the circuit by dipping the two ends of a wire at the end of the lever into cups of mercury (J and K). The electromagnet (b) thus activated attracted the iron bar on the triangular "pendulum" (F), drawing the pencil (g) across the paper. After the tooth crossed the peak of the type, the circuit would be broken when the lever returned to its horizontal position, the electromagnet would lose its magnetism, the pendulum would swing back to its original position, and the pencil would be drawn across the paper in the opposite direction. The clockwork mechanism (D) moved the paper along at a steady rate. The message would appear as a series of "V"-shaped points, connected by a straight line.*

New Publications . . .

The Newsletter's "Publications" section was prepared with the assistance of Thomas J. Higgins of the University of Wisconsin.

Books

George H. Douglas. *The Early Days of Radio Broadcasting.* Jefferson, NC: McFarland & Co., Inc., 1987. 248 pp.

This "informal history" of radio broadcasting focuses on the years 1920-1930. After a brief summary of the development of radio, beginning with Marconi's work, Douglas discusses radio station KDKA's role as a pioneer in radio broadcasting. To supplement this, he devotes individual chapters to the expectations for radio held by companies like Westinghouse and AT&T and to the state of radio technology at the time of KDKA's opening in November 1920.

Douglas points out, "If KDKA was to be the stimulus that would give birth to an entirely new era in wireless history, the evidence of it was neither immediate nor dramatic. A great radio boom was just around the corner, but it did not come, as one might expect, in the months immediately following KDKA's debut. . .When KDKA began its regular programming in the fall of 1920 it was fully understood that the audience would be made up almost exclusively of knowledgeable amateurs, many of whom had been communicating with one another for years. . ." (pp. 23, 38)

Radio broadcasting really took hold in 1922, when scores of new stations received licenses from the Dept. of Commerce. The remainder of Douglas's book is devoted to examining the consequences of this boom. He discusses radio manufacturers and the new professions of announcer, sportscaster, and newsman. He looks at the rise of commercial broadcasting and networks and describes the movement to regulate the ether, culminating in the Radio Act of 1927 and creation of the Federal Radio Commission. He completes the book with chapters on the increasing popularity of radio, as seen by the different types of stations—educational, classical and popular music—that came into existence, in the need to lengthen the broadcast day, and in the phenomenally successful radio program, "Amos 'n' Andy."

George Douglas is at the University of Illinois.

Susan J. Douglas. *Inventing American Broadcasting 1899-1922.* Baltimore, MD: Johns Hopkins University Press, 1987. 363 pp.

Using what she terms "a historical approach that regards technology as socially constructed," Susan Douglas examines the years prior to the radio "boom" of the 1920s. Her study is one of myriad transitions that occurred between Marconi's reporting of the New York yacht races in 1899 to the opening of station KDKA in 1920. Douglas tells us that "three stories—how the invention was designed and refined, how inventions and organizations either succeeded or failed in exploiting the invention, and which aspects of the story the press covered and which it did not—must be interwoven for us to understand the process of technological assimilation and legitimation." (p. xix)

Douglas opens with a discussion of the most prominent radio inventors, and of the popular perception of these men as inventor-heroes. She points out that Guglielmo Marconi envisioned the wireless telegraph as a system of point-to-point communications, sending messages between individual receivers via dots and dashes. Reginald Fessenden, however, saw the importance of developing continuous wave technology capable of transmitting the human voice. But, even though he broadcast a Christmas Eve program from his Brant Rock, MA, laboratory in 1906, Fessenden, too, was interested in improving point-to-point communication. Among the inventors, Douglas asserts, it was Lee de Forest who realized the possibilities of broadcasting sometime during the winter of 1906-07.

Douglas chronicles the ups and downs of the inventors as entrepreneurs, especially noting the transfer of key patents from the hands of these individuals to those of corporation executives. Along with that played by the corporations, the role of the U.S. Navy in the development of wireless is closely examined. From a seeming lack of interest in radio to the takeover of all U.S. commercial radio stations during World War I, the Navy, and especially Stanford Hooper and Josephus Daniels, is credited with the rapid development of wireless technology in the 1910s.

The activities of amateur radio operators are not overlooked in *Inventing American Broadcasting.* As they grew in numbers and sophistication, the amateurs were at first lionized in the popular press. But as the airwaves became overcrowded, they were often accused, and sometimes guilty, of prankish interference. Exacerbated by the sinking of the *Titanic,* Congress passed the Radio Act of 1912 to legislate the ether, an important new concept. In addition to allocating specific wavelengths to specific activities in order to reduce interference, the Act also set strict regulations for the operation of shipboard wireless stations.

During the 1910s, radio underwent significant technological changes. De Forest's audion was transformed into a true vacuum tube by AT&T physicist Harold Arnold, Armstrong patented the regenerative circuit and the superheterodyne, Alexanderson improved his alternator, the loop antenna was designed, and crystal detectors were discovered. By 1917, however, control of this technology was in the hands of private corporations—and the amateurs.

While crediting the navy and corporations such as AT&T, General Electric, Federal Telegraph, and Westinghouse with advancing radio technically, it is Lee de Forest, the amateurs, and the popular press that Douglas sees as creating the concept of radio broadcasting. A partnership, however, made it a reality when Frank Conrad's amateur broadcasts attracted the attention of Westinghouse. As a result, Conrad signed on at company-sponsored radio station KDKA on 2 November 1920.

Susan J. Douglas is associate professor of media and American Studies at Hampshire College.

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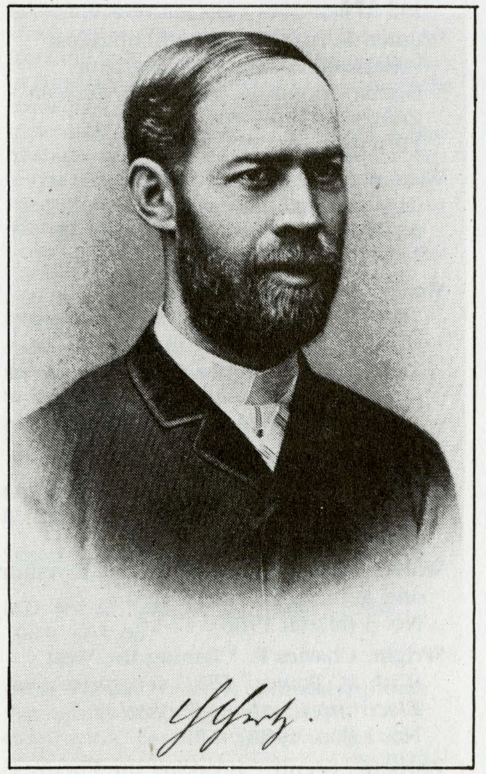
MTT Society Celebrates Hertz Centennial

One hundred years ago, the widely-held belief that electromagnetic forces acted instantly between objects at a distance collapsed when Heinrich Hertz proved that all forms of electromagnetic radiation were propagated as waves at a finite velocity—the speed of light. With the completion of this series of experiments, begun in 1886, Maxwell's theory was verified. Hertz's work with what came to be called radio waves will be the focus of two special events during the IEEE Microwave Theory and Techniques Society International Microwave Symposium to be held in New York City on 25-27 May.

A special session of historical papers will be held during Symposium. Scheduled speakers include

- James E. Brittain, "The Legacy of Hertz: Some Highlights in Microwave History from 1895 to 1945"
- Robert S. Elliott, "The History of Electromagnetics as Hertz Would Have Known It"
- Helmut Friedburg, "Heinrich Hertz at Work in Karlsruhe"
- John D. Kraus, "Heinrich Hertz—Theorist and Experimenter"
- Charles Susskind, "Heinrich Hertz: A Short Life"

Burndy Library



Heinrich Hertz

The session will be videotaped and several of the papers will be reprinted in the May 1988 issue of the IEEE *Transactions on Microwave Theory and Techniques.*

The Hertz celebration will also include a unique exhibit designed to show Hertz's experimental method. Organized by John H. Bryant, an adjunct research scientist at the University of Michigan at Ann Arbor, the exhibit will present Hertz's experiments chronologically, using a set of replicas of his original apparatus on loan from London's Science Museum. By combining the artifacts with text, graphics, and an illustrated catalogue, written by Bryant, the exhibit will offer visitors a chance to follow Hertz's thinking and progress, his successes and failures.

Like many of his contemporaries, Hertz was intrigued by the questions on the nature of light, electricity, and magnetism first raised by Michael Faraday and elaborated on by James Clerk Maxwell. In "A Dynamical Theory of the Electromagnetic Field," published in 1865, Maxwell wrote, ". . .we have strong reason to conclude that light itself (including radiant heat, and other radiations if any) is an electromagnetic disturbance in the form of waves propagated through the electromagnetic field according to electromagnetic laws." He developed this idea in his 1873 *A Treatise on Electricity and Magnetism*, in which he brought together the elements of his theory in a single work. Part of this theory implied the existence of electromagnetic waves other than light which would be generated by any acceleration of electrical current. These waves would travel through space at the same speed as light, but at different wavelengths.

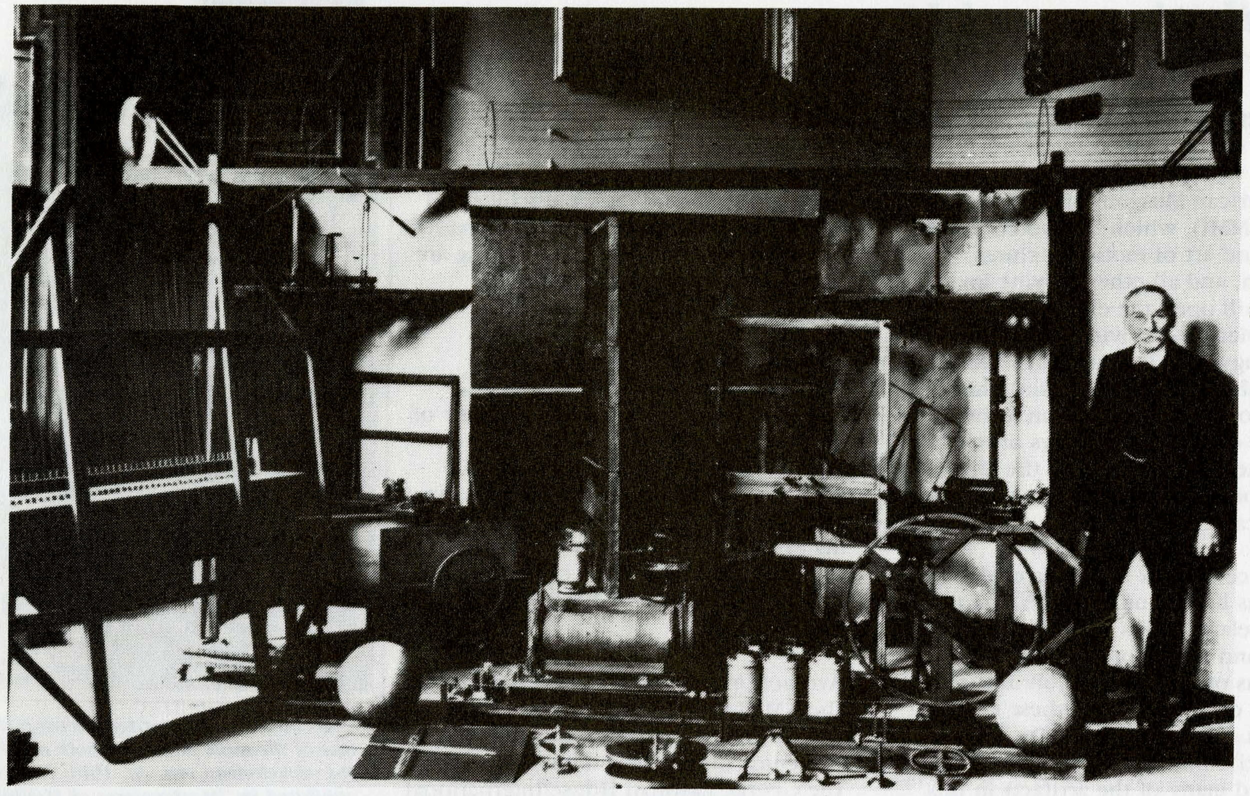
In setting out to prove these ideas, Hertz not only had to find a way to detect such waves, but first had to devise a method of generating them. He then had to be able to measure their wavelength in order to compute velocity, the product of wavelength and frequency. He began his experiments simply, with a pair of "Riess" or "Knochenhauer" spirals—wire coils equipped with a spark gap. When he discharged a Leyden jar through one of the coils, he observed sparking in the second. He knew that the spark gap acted as a switch and that the discharge of a Leyden jar was oscillatory. But when he found a neutral point in this secondary conductor, he determined that the oscillations obtained were regular. Hertz now had a basic source of electromagnetic waves and, in the second coil, a rudimentary receiver.

He modified his basic experimental set-up, replacing the Leyden jar and Knochenhauer spirals with an induction coil and spark gap to generate the waves and a wire loop fitted with a small spark gap to detect them. With these key elements of apparatus, he continued his experiments using what he called "this new class of oscillations." He discovered the ability of ultra-violet light produced by an electrical spark to cause reciprocal sparking in another conductor. He investigated effects both on and caused by insulators. He set up experiments to test the idea that the waves were all propagated at a finite velocity. At first, his results seemed to point to an infinite velocity of propagation, and then to a faster rate in air than in wire. But, to Hertz, these ideas made no sense.

The breakthrough came during further experiments with waves in wires. In the course of measuring the results of tests with various configurations of wires, he noticed that he was able to observe the actions of very short waves. He repeated his earlier experiments using a wavelength of about 60cm (just under 2 ft.) and found the velocity of propagation of the waves in wires to very nearly equal that in air. He then conducted experiments on the polarization, reflection, diffraction, and refraction of the waves, similar to those experiments traditionally carried out on light. His final set of experiments verified the theory that electric waves were also waves of magnetic force.

Hertz supplemented the reports of his experimental researches with theoretical papers on his work. All of these writings were gathered together in 1893 in one volume, *Untersuchungen uber die Ausbreitung der Elektrischen Kraft*. The book was translated into English the following year and given the title, *Electric Waves, being Researches on the Propagation of Electric Action with Finite Velocity through Space.* In the introduction, Hertz summarized the importance of his work.

> . . .the propagation in time of a supposed action-at-a-distance is for the first time proved. This fact forms the philosophic result of the experiments; and, indeed, in a certain sense the most important result. The proof includes a recognition of the fact that the electric forces can disentangle themselves from material bodies, and can continue to subsist as conditions or changes in the state of space. The details of the experiments further prove that the particular manner in which the electric force is propagated exhibits the closest analogy with the propagation of light; indeed, that it corresponds almost completely to it. The hypothesis that light is an electrical phenomenon is thus made highly probable. . . .
>
> . . . From the outset Maxwell's theory excelled all others in elegance and in the abundance of the relations between the various phenomena which it included. . . But as long as Maxwell's theory depended solely upon the probability of its results, and not on the certainty of its hypotheses, it could not completely displace the theories which were opposed to it. . . . [I]n this connection we can best characterise the object and the result of our experiments by saying: The object of these experiments was to test the fundamental hypotheses of the Faraday-Maxwell theory, and the result of the experiments is to confirm the fundamental hypotheses of the theory.



Museum of Science and Industry, Chicago

Hertz's original apparatus, photographed at the Bavarian Academy of Science in Munich, October 1913. The gentleman is unidentified.

Light and electromagnetic waves were part of the same continuum, traveling through space at the speed of light.

At the close of the MTT Symposium, the Hertz exhibit will be mounted at the MIT Museum, 265 Massachusetts Avenue, Cambridge, MA 02139 (617-253-4444) through 1988.

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Exhibitions and Museums...

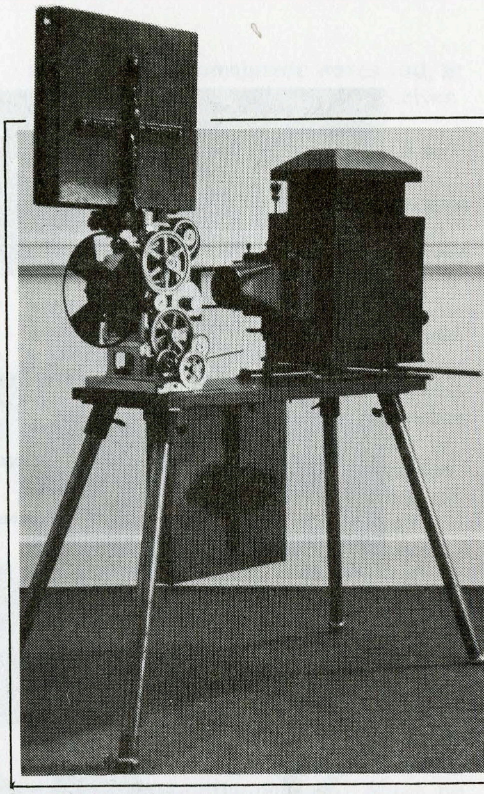
"Masterpieces of Moving Image Technology"

The American Museum of the Moving Image (AMMI), which is devoted to the history and art of motion pictures, television, and all other moving image media, will open the exhibition, "Masterpieces of Moving Image Technology," on 10 September 1988. The exhibit includes some sixty historic artifacts of film and television technology, from pre-cinema optical toys of the early-nineteenth century to the latest SONY compact CCD (charge-coupled-device) camera.

While recent work by media critics and historians has begun to emphasize the web of relationships that link motion picture and television programming, historians of technology continue to treat the development of these two media as discrete projects. Dr. Richard Koszarski, AMMI's Curator of Film, has organized many of the artifacts in this show in non-traditional groupings which underscore common solutions to shared technical problems—problems often generated by programming demands or audience requirements not unique to either medium. The development of color, for example, is illustrated by the CBS Field Sequential Television system and the early Kinemacolor motion picture process, both of which were additive processes employing synchronized color wheels on both camera and projector/receiver. Later color developments are also shown, including Technicolor and RCA's first "shadow mask" CRT receiver. Newsgathering and sound recording are also treated as common problems addressed by both technologies.

A special section of the exhibit highlights the career of C. Francis Jenkins. First president of the Society of Motion Picture Engineers, Jenkins was one of the few pioneers to make important contributions to both media. Jenkins's early Phantoscope projector, his Prismatic Disc system of image scanning, and one of his commercial television receivers of 1930 will be shown.

Artifacts in the exhibit are drawn from the AMMI collections, various private and corporate lenders, and many other museum collections, including those of the George Eastman House/International Museum of Photography, the Henry Ford Museum and Greenfield Village, the Edison National Historic Site, the Franklin Institute, the Stanford University Museum of Art, and the Smithsonian Institution. "Masterpieces of Moving Image Technology" will be on display through March 1989. For more information, contact Richard Koszarski, Curator of Film, American Museum of the Moving Image, 35th Avenue at 36th Street, Astoria, NY 11106 (718-784-4520).


American Museum of the Moving Image

The Powers #6 Cameragraph projector was one of the most popular booth machines of the nickelodeon era, ca. 1910. It will be exhibited in "Masterpieces of Moving Image Technology" at the American Museum of the Moving Image.

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