IEEE

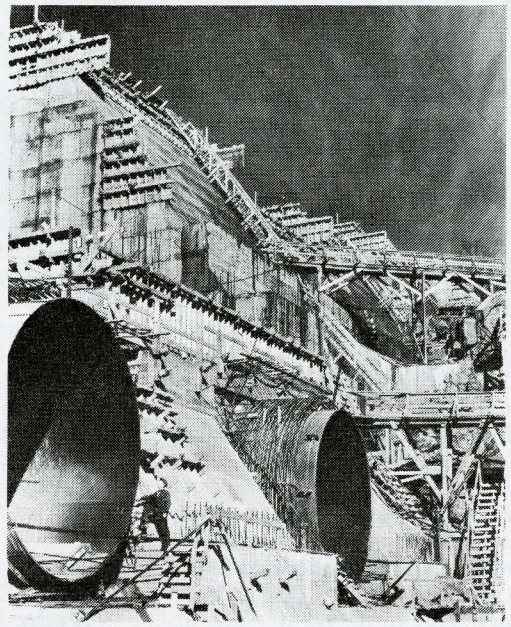
Center for the History of Electrical Engineering

Newsletter Number 19 Fall 1988

Oral History Guide in Progress

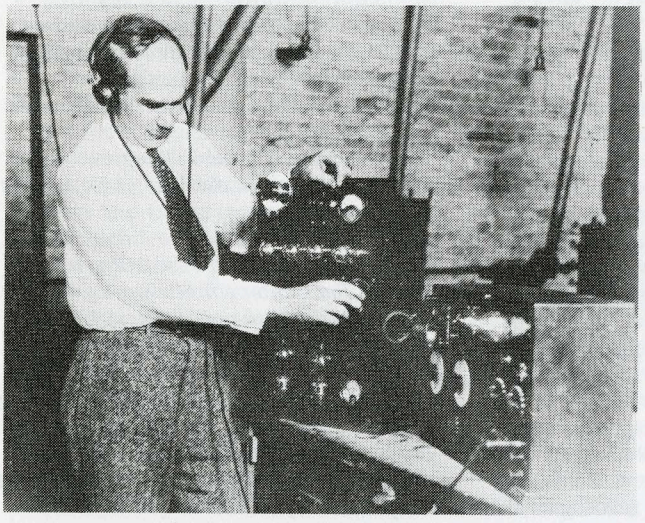
The Center for the History of Electrical Engineering is preparing a guide to oral history interviews relating to electrical science and technology. The guide is based on the results of a survey, conducted with support from the IEEE Life Member Fund, of 238 repositories in the U.S. Descriptions of more than 1,200 interviews have been entered into a database and editing and verification of the information has begun. It is planned to publish the guide late in 1989, but the Center staff will be happy to assist researchers with specific requests at any time during the project.

A brief listing of some of the interviews included in the guide illustrates the range of topics, individuals, and organizations tapped by oral history projects.



TVA

Construction of TVA's Norris Dam



Smithsonian Institution

Lee de Forest was interviewed for the Radio Pioneers project. He is shown here operating radio receiving apparatus in 1921.

Communications
Federal Communications Commission
KOA Radio, Colorado
National Federation of Telephone Workers
Pacific Northwest Broadcasting
Pacific Telephone and Telegraph Co.
Public Radio
Public Television's Roots
Radio Pioneers
Telephone Oral History Collection

Computing
Computers at MIT
Jay W. Forrester
Herman Goldstine
Carl Hammer
Grace Hopper
Kathleen Mauchly
Smithsonian Computer History Project
Thomas J. Watson, Jr.

Electric Light & Power
Thomas A. Edison Project
Minnesota Powerline Construction Oral History Project
Rural Electric Story
Tennessee Valley Authority

Electrical Engineering Education
James R. Killian, Jr.
MIT Physical Science Study Committee

Electronics
John Bardeen
Electronic Entrepreneurs
Hewlett-Packard Co.
Jack Kilby

Radar
Cavity Magnetron and Radar Development
Klystron Developments
Robert A. Watson-Watt

Research
Lawrence Berkeley Laboratory
Los Alamos Scientific Laboratory

Space Technology
Charles Stark Draper
Project Apollo
Project Gemini
Project Mercury
Skylab
Space Shuttle Interviews
Space Station Interviews
James Van Allen

Charles Stark Draper, a pioneer in inertial guidance systems.

MIT Museum

Briefs . . .

Cavendish History Project

The Department of History and Philosophy at Cambridge University is planning a research project on the history of the Cavendish Laboratory and British physics during the late-nineteenth and early-twentieth centuries. Participants will include department professors Simon Schaffer, Andrew Warwick, and Jim Bennett. Their initial goal is to organize a database of biographical information on workers at the Cavendish from the laboratory's founding in 1871 to 1894, when changes in regulations concerning the admission of new researchers to the facility went into effect. A register of archival and published material relating to the Cavendish during the period 1871-1894 will also be compiled. In addition, the project staff plans to collect material pertaining to the role of Cavendish workers in the formation of research laboratories, such as the National Physical Laboratory, at other institutions during the period.

For further information, contact the Department of History and Philosophy of Science, University of Cambridge, Free School Lane, Cambridge, CB2 3RH, England.

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).

Museum Tour Planned

The Goodwill People to People Travel Program is sponsoring a European Technology Museum Tour for Engineers. The tour is scheduled for June 1989 and will be led by IEEE Life Senior Member Lawrence J. Kamm. Participants will visit six museums in four countries, including London's Science Museum, the Deutsches Museum in Munich, the Musée National des Techniques and Parc de la Villette in Paris, and the Verkehrhaus der Schweiz and Musée International d'Horlogerie in Switzerland. At each museum, staff members will meet with the group and act as guides through the exhibits.

The People to People program was founded by Dwight D. Eisenhower in 1956 to encourage world peace and understanding through exchanges between private citizens. For more information on the program or the museum tour, contact Thomas N. Carlson, International Coordinator, People to People, 15 South Harmony Drive, Janesville, WI 53545-2199 (800-543-0990) or Lawrence J. Kamm, 1515 Chatsworth Boulevard, San Diego, CA 92107 (619-224-3494).

Research Support Available from Hagley, AIP, CBI

The *Hagley Museum and Library* has announced its 1989-90 program of fellowships and grants for the study of business, economic, and technological history. Applications are invited for advanced-research, regional, and residential fellowships. Advanced-research fellowships support independent study in Hagley's fields of interest at its Center for the History of Business, Technology, and Society. Fellowships are offered for six to twelve months' work with a maximum stipend of $27,500. This award is limited to established scholars; degree candidates or those pursuing research leading to a degree are not eligible. The application deadline is 15 February 1989.

Dissertation fellowships are offered to support doctoral work. Up to two regional fellowships with stipends in the amount of $12,500 are available to applicants studying at universities in the District of Columbia, Maryland, New Jersey, and eastern Pennsylvania. A residential dissertation fellowship, with a stipend of $13,500, is open to students in doctoral programs at any university in the U.S or abroad. The recipient, however, must demonstrate the strong pertinence of Hagley's collections to the dissertation topic and spend nine to twelve months in residence at Hagley. All dissertation-fellowship recipients will participate in the programs of Hagley's Center for the History of Business, Technology, and Society. The deadline for regional and residential fellowship applications is 15 February 1989.

Grants-in-aid for short-term research in Hagley's imprint, manuscript, pictorial, and artifact collections are also being offered. These grants will not exceed $750 per month of study and are intended for two- to eight-week periods of research. Both degree candidates and advanced scholars are eligible. Applications for grants-in-aid will be accepted throughout the year.

For more information concerning Hagley fellowships or grants, contact the Executive Administrator, Center for the History of Business, Technology, and Society, Hagley Museum and Library, P.O. Box 3630, Wilmington, DE 19807.

The *AIP Center for History of Physics* is offering grants-in-aid for research in the history of modern physics and allied sciences. The grants of up to $2,000 can be used to reimburse expenses directly connected with research, and preference will be given to those who require funding to support research at the Center's Niels Bohr Library, to conduct oral history interviews, or to microfilm papers. Applicants must either be working toward a graduate degree in the history of science or have a record of publication in the field. The next deadline for applications is 31 December 1988.

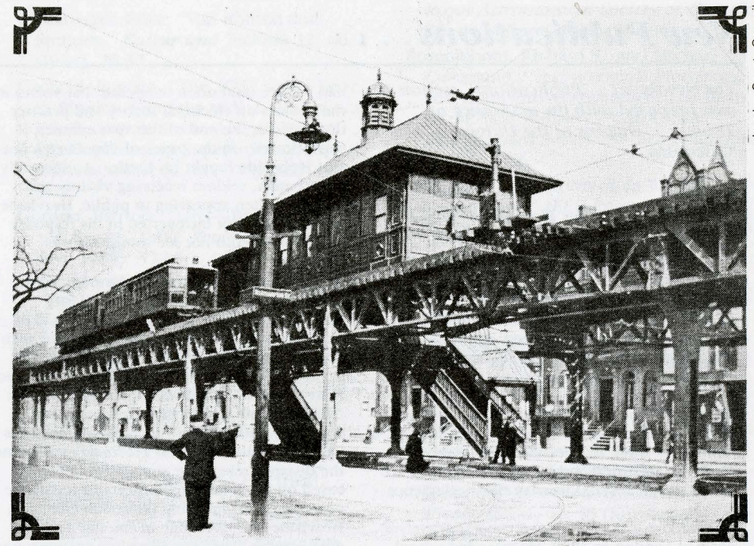
For more information on AIP grants, contact the Center for History of Physics, American Institute of Physics, 335 East 45th Street, New York, NY 10017.

The *Charles Babbage Institute* is accepting applications for the 1989-90 Adele and Erwin Tomash Fellowship in the History of Information Processing. The Fellowship is open to any graduate student whose dissertation topic will address some aspect of the history of computers and information processing, although priority will be given to doctoral candidates who have completed all of their degree requirements except the research and writing of a dissertation. The Fellowship carries a stipend of $6,000, with an additional $2,500 for tuition, fees, and research-related expenses such as travel to the Babbage Institute or other archival centers. The deadline for applications is 15 January 1989.

For further information, contact the Charles Babbage Institute, University of Minnesota, 103 Walter Library, 117 Pleasant Street S.E., Minneapolis, MN 55455.

The Boston 'El'

Craig Semsel



London County Council

A multiple-unit train approaches the Boston El's Northampton Street Station in 1905.

Urban transportation experienced major advances at the turn of the century, and Boston's elevated line incorporated several of these. For example, the line used a subway in the most congested area of the city. It was electrified, which meant a cleaner, more cost-effective system than lines with coal-fired steam trains. Cars could be operated independently, which gave them greater flexibility than locomotive systems. These innovations are still considered state of the art. They remain part of the system today, though the line itself has been extensively altered.

The growth of Boston's population and that of surrounding communities during the mid- to late-nineteenth century led to serious traffic congestion in the city's business district. In order to alleviate these problems, the Massachusetts legislature authorized a Transit Commission in 1891 to investigate possible solutions. The Commission delivered its recommendations to the legislature in April 1892. Based on these, the city decided to build an elevated line from Charlestown to Roxbury that would branch into two lines in the downtown area. Construction began on 23 January 1899 by the Boston Elevated Railway Co. and was completed in early June 1901.

In choosing equipment for the new railway, Boston looked at other urban railways and found that trains equipped for independent operation were being chosen over those pulled by locomotives. This "multiple-unit system," as it was called, was developed in the mid-1890s by electric railway pioneer Frank J. Sprague and was first used on Chicago's South Side Elevated in 1898. The multiple-unit system had many advantages over locomotive trains. For example, a train of any number of cars could be operated from one set of controls on any car. Since each car had its own motors and brakes, the cars had less weight per axle than a locomotive (a definite advantage for elevated lines), and the relation between car load and motors was in proportion with the number of cars. The multiple-unit system is still the one used today on subways and electric railways.

Originally, Boston's elevated ran from Sullivan Square in Charlestown to Causeway Street on the edge of downtown. From there it branched into two lines, one of which ran underground on two of the four tracks of the Tremont Street subway. The other branch continued on elevated tracks over Atlantic Avenue along Boston's waterfront. The two lines rejoined at Castle Street and continued along Washington Street until they reached the terminal at Dudley Street in Roxbury.

Service on the elevated began between Charlestown and Roxbury via the Tremont Street subway on 10 June 1901, and via the Atlantic Avenue branch on 22 August. Shortly after going into service, it became apparent that the subway was not an ideal route for the elevated trains. Although the arrangement was preferable to constructing a large elevated railroad structure on downtown Boston's narrow, crooked streets, the subway was designed for streetcar use, not for bulky multiple-unit trains. The weight of the three- and four-car trains soon wore out rails on the subway's sharp curves, requiring frequent rail replacement. There were numerous grade changes that, although acceptable for single streetcars, proved bothersome for the larger elevated trains. In addition, by confining streetcars to only two of the four subway tracks, congestion in the subway soon became intolerable.

On 12 December 1902, Boston voters approved plans to build a tunnel underneath Washington Street in downtown Boston for the use of the elevated trains. Construction began in 1904 and the tunnel was opened on 30 November 1908. The removal of the trains from the Tremont Street subway helped relieve streetcar congestion, and gave elevated passengers a more comfortable ride. Although the new tunnel had steep grades and curves, they were not as severe as those in the subway.

The elevated line has experienced many changes since the opening of the Washington Street tunnel. Extensions were opened from Dudley Street to Forest Hills in 1909 and from Sullivan Square to the town of Everett in 1919. The Atlantic Avenue branch was closed in 1938 due to lack of ridership, and later dismantled. The elevated was renamed the Orange Line in 1965 and the line to Everett was replaced and extended to Malden in the 1970s. More recently, in May 1987, a new route to Forest Hills was opened. The new lines have eliminated the need for elevated tracks, which are now being demolished. Apart from the Tremont Street subway, none of the original elevated line remains in service.

Even though the Orange Line no longer runs along its original route and is no longer an elevated line, it still retains many of the same turn-of-the-century innovations it had in 1901. The line runs undergroud in Boston's crowded downtown district, and service is still provided by multiple-unit electric trains. The line's original route may not have taken future changes in Boston's population into account, but the technology it employed has proven to be ideal for Boston's rapid transit needs.

Craig Semsel is an undergraduate student in History at Northeastern University in Boston. He has been the Research Assistant at the Center for the History of Electrical Engineering over the past two years, through Northeastern's Cooperative Education Program. This article is based on Craig's senior honors project on the history of Boston's elevated railway.

New Publications . . .

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

Books

Paul J. Nahin. *Oliver Heaviside: Sage in Solitude.* IEEE Catalogue No. PC0227-9. New York: IEEE Press, 1988. 320 pp.

"Heaviside," Nahin writes, "should be remembered for his vectors, his field theory analyses, his brilliant discovery of the distortionless circuit, his pioneering mathematics, and for his wit and humor" (p. 307). Nahin thus describes both Heaviside's personality and mathematics in his exploration of this brilliant but rather quirky and, in a number of ways, inaccessible individual. The result is a technical and personal biography set within the context of Victorian electrical science.

Heaviside was born in one of the less attractive parts of London in 1850. He attended school until he was 16, spent two more years in independent study at home, and then took his first—and only—job, as a telegraph operator for the Dansk-Norsk-Engelske Telegraf Selskab. A year after the company was taken over by the Great Northern Telegraph Co. in 1870, Heaviside was appointed Chief Operator, "no doubt by the influence of his uncle, Sir Charles Wheatstone" (p. 21), as one of his coworkers recalled. But his telegraph career ended in 1874 with his resignation from Great Northern. He spent the rest of his life working on mathematical problems pertaining to electricity.

This vocation soon placed Heaviside in an impressive and influential group that included William Thomson (later Lord Kelvin), William Preece, George Searle, George FitzGerald, Oliver Lodge, and James Clerk Maxwell. Nahin points out that the work of Thomson and Maxwell was especially important to Heaviside's professional development. Thomson's 1854 theory on submarine telegraphy was the starting point for Heaviside's own work on the subject and he was one of the first "Maxwellians," writing in 1888, "It will be understood that I preach the gospel according to my interpretation of Maxwell . . ." (p. 99)

The words "my interpretation" are revealing, however. Heaviside was very sure of his work and had little patience for those who could not or would not follow him. This trait is the foundation for two themes that Nahin develops—Heaviside's relationship with the technical press and his role in many of the major controversies of the time.

Heaviside lived for his work and his work lived in the technical press. Nahin discusses Heaviside's relationship with successive editors at *The Electrician*, in which many of his papers first appeared. Though Heaviside had a deserved reputation as a difficult person, some of these men, starting with Charles Biggs, championed Heaviside's work, even if they—and many of their readers—did not understand it. They also ensured that Heaviside had a voice (and often tempered that voice) in the debates on electrical theory and practice that raged at the end of the 19th century. It was primarily in the pages of *The Electrician* that Heaviside fought his battles. An intensely private man, seldom receiving visitors and even less often appearing in public, Heaviside was anything but introverted in his response to those who did not see things his way.

The first major clash, which lasted until the end of his life, was with William Henry Preece, Electrician and Engineer-in-Chief of the British General Post Office. It began with Preece's asserting the superiority of the "practical man" over the mathematician—and Heaviside was joined most notably by Oliver Lodge in rebutting those statements—and exploded with Preece's announcement of his "*KR*-law." This "law" was a formula to calculate the distance telephone signals could travel, based on the total capacitance and resistance of a circuit but ignoring induction effects. Heaviside was not alone in finding defects with Preece's "law," but when Preece suppressed publication of an opposing paper written by Heaviside and his brother Arthur, who worked for Preece at the G.P.O., the editor at *The Electrician* refused to publish many of Heaviside's attacks for fear of libel suits. Heaviside, however, had a much more effective method with which to answer Preece through the journal. He published his work on self-inductance that led him to what Nahin sees as "perhaps his most important discovery—the criterion for the distortionless transmission of signals over distributed parameter lines, and the seemingly paradoxical conclusion that induction aids the transmission of signals" (p. 147).

Heaviside's mathematics saw him through other disputes. For example, in what Nahin calls the Great Quaternionic War, Heaviside promoted the new vector algebra and calculus that he created with J. Willard Gibbs over the quaternion system championed by Scottish mathematical physicist Peter Tait. Then there was his rift with the Royal Society, based on its refusal to publish in the *Proceedings* Part III of Heaviside's "On operators in physical mathematics," his treatise on operational calculus. Nahin also chronicles Heaviside's support, based on his own mathematical analysis, of John Perry over Lord Kelvin in the age-of-the-earth controversy.

Nahin's study of Heaviside, therefore, shows the man and his work to be inseparable. Heaviside, intensely dedicated to his mathematics, was a man of contradictions, banning the world from his doorstep while reaching out to it from his writings. *Sage in Solitude* uses this dichotomy to bring Oliver Heaviside into focus in the context of his mathematics and *vice versa*. Readers may very well agree with George Searle's description of his long-time friend: "He was a queer old fish, but there was something very attractive about him" (p. 259).

Paul J. Nahin is an associate professor in the Electrical and Computer Engineering Dept. at the University of New Hampshire.

W.J. Reader. *A History of the Institution of Electrical Engineers 1871-1971.* London: Peter Peregrinus Ltd., 1987. 327 pp.

W.J. Reader's book provides an account of the IEE's first century. The first of the book's three sections, entitled "The Telegraph Engineers," briefly describes the emergence of telegraphy and electrical science and technology. Reader explains that at first telegraph engineers were considered highly-specialized civil or mechanical engineers by the engineering profession in general, but, as telegraphy developed, they began to regard themselves as a different breed of engineers. This led them to found a representative organization of their own, the Society of Telegraph Engineers, on 17 May 1871.

The second section, entitled "The Power Engineers," briefly describes the changes in electrical engineering as telephony and electric lighting began to replace telegraphy as the keystone of the profession. Reader traces the evolution of the organization into the Society of Telegraph Engineers and Electricians in 1880 and then the Institution of Electrical Engineers in 1889. Early events in the IEE's history covered in this section include the tremendous increase in membership at the turn of the century and the resulting changes made to the society's organizational and membership structure. The section continues with a description of the IEE during the early twentieth century. Among the topics Reader discusses are the influence of the IEE over government decisions concerning power production and supply during World War I, and how the IEE's work with government eventually led to the IEE receiving its Royal Charter in 1921.

In describing the IEE's activities between the wars, Reader focuses on the society's promotion of technical education and the free exchange of ideas among its members. Reader moves on to discuss the IEE during World War II and the 1950s. He contrasts the considerable growth of the IEE's membership during World War II with the decline in membership during World War I. He concludes the section by discussing the problems faced by the IEE Council during the 1950s in adjusting to the post-war era.

The third and final section, entitled "The Electronics Engineers," opens with a chapter describing the organizational changes that were made at the IEE to accommodate the increasing number of electronics engineers within its ranks. Reader also describes the prominent role business has come to play in the electronics industry. The final two chapters look at the recent past of the IEE and speculate on its future.

As Rollo Appleyard did in his 1939 history of the IEE, Reader concludes the book with many useful appendices. These provide statistical data on the IEE's membership, finances, sectional and divisional organization, and short biographies of IEE Presidents from 1939-1986.

W.J. Reader has been a freelance historian since 1965.

Other Recent Books

Robert M. Hazen. *The Breakthrough: The Race for the Superconductor.* New York: Summit Books, 1988. 271 pp.

Johannes M. Pennings and Arend Buitendam. *New Technology as Organizational Innovation: The Development and Diffusion of Microelectronics.* Cambridge, MA: Ballinger Publishing Co., 1987. 308 pp.

Hans Queisser. *The Conquest of the Microchip.* Cambridge, MA: Harvard University Press, 1988. 185 pp.

Articles

Arms, William Y. "Andrew Plus Personal Computing at Carnegie Mellon." *Abacus* 5, no. 4 (1988): 30-43, 49.

Bell, Trudy E. "Piloting the IEEE Through a Critical First Year." *IEEE Spectrum* 25, no. 10 (Oct. 1988): 42-44.

Bray, W.J. "In the Beginning: Memoirs of a Telecommunications Engineer." *British Telecommunications Engineering* 7 (July 1988): 111-121.

Brown, C.N. "Early Days of Electric Lighting." *IEE Review* 34, no. 6 (June 1988): 223-225.

Bryant, Jane. "Public Safety Credited with Three Milestones (in Land-Mobile Radio)." *Mobile Radio Technology* 6, no. 7 (July 1988): 48-54.

Carlson, W. Bernard. "Academic Entrepreneurship and Engineering Education: Dugald C. Jackson and the MIT-GE Cooperative Engineering Course, 1907-1932." *Technology and Culture* 29, no. 3 (July 1988): 536-567.

Christiansen, Donald. "A New Home for *Electronics*." *IEEE Spectrum* 25, no. 9 (Sept. 1988): 29.

Cove, Graham, "Batteries—Past, Present, and Future." *Physics Teacher* 19 (1988): 141-145.

Dagnino, Umberto. "Centennial of the Establishment of Electric-Utility Rates in Italy." *L'Elettrotecnica* 75, no. 2 (1988): 119-144.

Dew-Hughes, D. "Superconductivity: Scientific Phenomenon to Engineering Reality." *Proceedings of the Institution of Mechanical Engineers* 202, no. C3 (1988): 147-159.

Eden, Richard C. "The Development of the First LSI GaAs Integrated Circuits and the Path to the Commercial Market." *IEEE Proceedings* 76, no. 7 (July 1988): 756-777.

Fraser, D.A. "Electrical Engineering Education Twenty-Five Years On—The Influence of Developments in Semiconductor Technology." *International Journal of Electrical Engineering Education* 25 (1988): 219-227.

Fraunberger, Fritz. "Von Röhren und Strahlen." *Kultur und Technik* 12, no. 1 (1988): 28-37.

Garfield, Eugene. "The 1987 Nobel Prize in Physics: Citations to K.A. Muller and J.G. Bednorz's Seminal Work Mirror Developments in Superconductivity." *Current Contents*, no. 18 (2 May 1988): 3-11.

Gordon, Patricia. "Lifts—Past, Present and Future." *IEEE Review* 34, no. 1 (Jan. 1988): 37-40.

Grunblatt, G., and D. Phillips. "Superconducting Magnets." *Elektron* 5, no. 5 (May 1988): 4-6.

Hartley, M.G. "The International Journal of Electrical Engineering Education Celebrates its Quarter Century." *International Journal of Electrical Engineering Education* 25 (1988): 197-208.

_____."Trends in Electrical Engineering Education: A 25-Year Retrospective." *International Journal of Electrical Engineering Education* 25, no. 3 (July 1988): 209-218.

Johnston, Stephen L. "Aircraft Warning System Opana, Oahu." *Wiliki o Hawaii (Engineer of Hawaii)* 24, no. 2 (July 1988): 1.

Kales, David. "(Gordon Gould:) Laser Pioneer Completes 30-Year Odyssey for his Patents." *Laser Focus/Electro Optics* 24, no. 5 (May 1988): 96-99.

Kelly, Kevin. "Should We Break Up Edison's System?" *News in Engineering* (July 1988): 18-19, 22.

Khlyustikov, L.N. "On the 250th Anniversary of the Discovery of Electrical Conductivity." In Russian. *Uspekhi Fizicheskikh Nauk* 155, no. 1 (May 1988): 129ff.

Kogan, Y.M. "Electrification in the USSR over the Last 70 Years." *Thermal Engineering* 34, no. 11 (1987): 589ff.

Kraus, John D. "Grote Reber, Founder of Radio Astronomy." *Journal of the Royal Astronomical Society of Canada* 82, no. 3 (June 1988): 107-114.

Martin, D.J. "Radar 1935-45: Ten Years that Changed the Face of the War." *Journal of the Institution of Electronic and Radio Engineers* 58, no. 2 (March/April 1988): 67-73.

Owen, Edward L. "The Induction Motor's Historical Past." *IEEE Potentials* 7, no. 3 (Oct. 1988): 27-30.

Perry, Tekla S. "The Longest Survivor Loses its Grip (:The End of Television Set Production at Zenith)." *IEEE Spectrum* 25, no. 8 (August 1988): 16-20.

"Plastics in Vacuum Cleaners." *Philips Technical Review* 44, no. 2 (April 1988): 43.

Reber, Grote. "A Play Entitled 'The Beginning of Radio Astronomy'." *Journal of the Royal Astronomical Society of Canada* 82, no. 3 (June 1988): 93-106.

Rosenbloom, Richard S., and Michael A. Cusumano. "Technological Pioneering and Competitive Advantage: The Birth of the VCR Industry." *California Management Review* 29, no. 4 (Summer 1987): 51-76.

Safir, Aran. "Invention of an Electronic Retinoscope." *IEEE Engineering in Medicine and Biology Magazine* 7, no. 2 (June 1988): 59-60.

Santo, Brian. "The End of an Era for *Electronics*." *IEEE Spectrum* 25, no. 10 (Oct. 1988): 51-53.

Shaw, F. "A Day in the Life of a Radio Officer in the 1930s." *The Marine Observer* 58, no. 300 (April 1988): 78-80.

"Trolley News (on the San Jose Trolley Corp., the Baltimore Street Car Museum, and the Derby Horse Railway)." *Locomotive & Railway Preservation*, no. 15 (July/August 1988): 12-14, 52.

Voelcker, John. "Deco Radios." *IEEE Spectrum* 25, no. 10 (Oct. 1988): 40-41.

Weldon, James O. "The Early History of U.S. International Broadcasting from the Start of World War II." *IEEE Transactions on Broadcasting* 34, no. 2 (June 1988): 82-86.

Wright, Charles R. "The Great AC/DC War." *IEEE Potentials* 7, no. 2 (May 1988): 31-34.

Unpublished Manuscripts

Shoucair, F.S. "Volta, Ampere, Ohm and Kirchhoff: Electrical Engineering's Forgotten Immortals." 44 pp., Dept. of Electrical Engineering, Brown University, Providence, RI, 1987.

New Publication Available from the Center

The Center for the History of Electrical Engineering has published *Recent Titles in Electrical History: A Selective Bibliography, 1982-1985*. The 54-page bibliography lists nearly 900 books, articles, and theses arranged by subject and indexed by author. The core of *Recent Titles* is a compilation of the "New Publications" sections of the Center's *Newsletter*. Historical articles published by the IEEE during its Centennial in 1984 are also included, along with citations from a number of other sources.

Recent Titles in Electrical History is available from the Center at a cost of $5.00, prepaid. Please send a check or money order made payable to "IEEE" to *Recent Titles*, Center for the History of Electrical Engineering, IEEE, 345 East 47th Street, New York, NY 10017.

1988 Friends of the Center

The Friends of the IEEE Center for the History of Electrical Engineering further the study and understanding of electrical engineering's history and impact on society through support of the Center's programs. The number of Friends has doubled this year and we would like to thank each of the more than 400 of you who have contributed to the Friends Fund of the IEEE Foundation. The roster of Friends, as of 30 September, follows.

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Exhibitions and Museums. . .

Scientific Instruments at Uppsala University

Sven Widmalm
Uppsala University

In the autumn of 1739, a shipment of scientific instruments from London arrived in Uppsala. The instruments were to be used by Samuel Klingenstierna, then professor in geometry, for demonstrating experiments to students. The role of experimental physics in the university curriculum was thereby officially recognized, even though it would take another decade before a professorship in the subject was established.

Dept. of Physics, Uppsala University

Knut Angström at work. The pyrheliometers on his desk are now in the Cabinet of Physics.

When Klingenstierna became the first professor of experimental physics in Sweden in 1750, Newtonian science had finally gained official approval, since the new chair was to be devoted especially to "Newton's discoveries in physics." Klingenstierna conducted experiments mainly in electricity, a tradition successfully continued by his pupil, Johan Carl Wilcke, who was employed at the Academy of Sciences in Stockholm. In Uppsala, Klingenstierna's immediate successors, Samuel Duraeus and especially Zacharias Nordmark, vastly increased the university's collection of instruments. In the mid-1790s, Nordmark made a suggestion, quite novel at the time, that the collection should be used not only for educational purposes, but also for scientific research.

Compared to the Continent or Britain, the development of laboratory-based physical research was slow in Sweden. During the first half of the nineteenth century, the physicists in Uppsala educated students and performed research on a small scale, now in the backwater of the "second scientific revolution." From the 1860s, the situation changed, due, for example, to the work of Anders Jonas Angström, and his son Knut. Physical research in Uppsala now gained esteem for its excellence in precision measurement, based on advanced instrument technology.

Today, some of these instruments, collected over the first 150 years of institutionalized experiments in physics in Sweden, are on display at the Department of Physics at Uppsala University. Among them are items such as a well-preserved air pump, several machines for electrical experiments, and a chromatic compound microscope by Culpeper—all circa 1740. From the later years, we have a beautiful set of Coulomb brass conductors for the demonstration of the distribution of electric charge (1831), one of the first commercially-produced Daguerre cameras (by Giroux, ca. 1840), several early electrical motors and galvanometers, early X-ray tubes, and, of course, instruments pertaining to the photometric work of the Angströms, such as Anders Jonas's spectrometer from 1862 and several of Knut's pyrheliometers from the early-twentieth century.

The instrument collection at Uppsala University is described by Arne Eld Sandström in "The Uppsala Cabinet of Physics" (*Kungliga Vetenskapssamhaellets I Uppsala Aarsbok* 25, 1983-84). The latest issue of *Kosmos* (1987, edited by Torsten Lindqvist), a publication of Svenska Fysikersamfundet (Swedish Association of Physicists), is dedicated to the history of physics; it may be ordered from Almqvist & Wiksell Periodical Co., Box 638, S-101 28 Stockholm.

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