IEEE History Center

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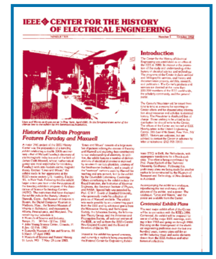
STATIC FROM THE DIRECTOR

If you are reading this, then, in a sense, the rest of my column is superfluous. That is because you should have noticed that, for the first time, the IEEE History Center is coming to you electronically! And that is the topic of my column. Changing norms of technology and communication, combined with a desire to more efficiently use our resources to carry out our work have led us to decide that this is the best way to reach our supporters and others interested in our mission. To learn more about how this new vehicle will better enable us to carry out that mission—to preserve, research and promote the history of IEEE, its members, their professions, and the related technologies, I urge you to click on **http://www.ieee.org/web/aboutus/history_center/about/newsletters.html**

As the specifics of the IEEE History Center's programs have evolved over the years, so has its newsletter: As you will see from the short accompanying photo essay, there have been several phases in its development. This issue represents the next stage. However, just as the core mission has not changed, the newsletter has continued to bring our supporters interesting coverage of those programs. You will see that this issue has the same sorts of information and features you are used to receiving from our print newsletter. There are, for example: An update on the IEEE Global History Network from Outreach Historian John Vardalas; an update on our conference from Senior Research Historian Rik Nebeker; a book review by Archivist and Institutional Historian Sheldon Hochheiser; "Things to See and Do' edited by Research Coordinator Robert Colburn; and one of Nebeker's always enjoyable 'EE in the Movies' columns.

I want to single out for kudos Robert Colburn, who serves as our newsletter managing editor, for managing the start of this transition in masterful fashion. Please note, however, that this is just a beginning. Going forward, this medium will make it easier and more efficient for us to add more content, have more frequent contact with you, and incorporate more interactive features. Therefore, as the newsletter continues to evolve in its current phase, we hope you will give us feedback to let us know what you do and do not like, and what changes you would recommend for the future. Such feedback is of course now even easier for you with the newsletter in electronic form.

Let me make one final point. We are, as always, extremely grateful to our benefactors whose generous support enables our programs to continue. Therefore, the March issue, which includes our Honor Role of Donors, will continue to go out in print form, so that we can express our gratitude in a more tangible form, as well as maintain greater privacy. Please note that our newsletters were also opportunities to remind you, our reader, that it is the gifts of individuals like you that fund a great deal of our programming, and to provide an opportunity through a return envelope to continue your support. This electronic newsletter gives you an even easier opportunity to click through directly to the IEEE Foundation website and donate on line. If this issue convinces you that we continue to earn your trust in our historical efforts on your behalf, then I hope you will avail yourself of the opportunity. Thank you again for your past and future generosity.



Issue #1: The one that started it all.

Issue #25: The History Center moves to Rutgers, & the Newsletter gets a facelift

Issue #48: The new Director has his first column, the Center gets a new brand (and note the IEEE logo), and the newsletter gets its next major redesign

Issue #65: The newsletter takes on its last look prior to today's change

IEEE History Center

The newsletter reports on the activities of the IEEE History Center and on new resources and projects in electrical and computer history. It is published three times each year by the IEEE History Center.

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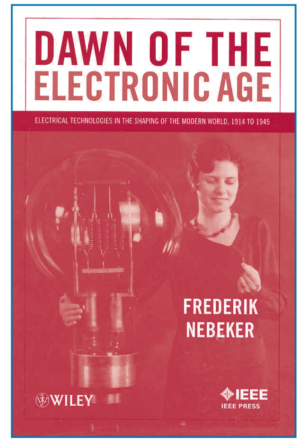
SENIOR RESEARCH HISTORIAN FREDERIK NEBEKER'S *DAWN OF THE ELECTRONIC AGE* PUBLISHED



The IEEE History Center is proud to announce the publication of Senior Research Historian Frederik Nebeker's book *Dawn of the Electronic Age*, which has been published by IEEE Press and Wiley. Much of the infrastructure of today's industrial world was established in the period from the outbreak of World War I to the conclusion of World War II. It was during those years that the capabilities of traditional electrical engineering – generators, power transmission, motors, electric lighting and heating, home appliances – became ubiquitous. Even more importantly, it was during this time that a new type of electrical engineering -- electronics – emerged. *Dawn of the Electronic Age* explores how this engineering knowledge and its main applications developed in various scientific, economic, and social contexts. It is available from Wiley at **www.wiley.com**

IEEE HISTORY CENTER TELEPHONES UPGRADED

The IEEE History Center has a new telephone system which will integrate it more closely with the IEEE Operations Center in Piscataway. It also allows Center staff to have their own extensions and voicemail. The new main number for the IEEE History Center is +1 732 562 5450. The individual extensions are:
Michael Geselowitz, Staff Director +1 732 562 6022; Senior Research Historian Frederik Nebeker +1 732 562 5557; Archivist and Institutional Historian Sheldon Hochheiser +1 732 562 5449; Outreach Historian and IEEE Global History Network Manager John Vardalas +1 732 562 5567; Research Coordinator Robert Colburn +1 732 562 5468.

NEWSLETTER SUBMISSION BOX

The IEEE History Center Newsletter welcomes submissions of Letters to the Editor, as well as articles for its "Reminiscences" and "Relic Hunting" departments. "Reminiscences" are accounts of history of a tchnology from the point of view of someone who worked in the technical area or was closely connected to someone who was. They may be narrated either in the first person or third person. "Relic Hunting" are accounts of finding or tracking down tangible pieces of electrical history in interesting or unsuspected places (in situ and still operating is of particularl interest). Length: 500-1200 words. Submit to ieee-history@ieee.org. Articles and letters to the editor may be edited for style or length.

NEWS FROM THE IEEE GLOBAL HISTORY NETWORK

The IEEE Global History Network (GHN) **www.ieeeghn.org** is a wiki-based site designed to accommodate a very diverse and rich set of historical content. Of considerable significance is the GHN's growing collection of archival documents. To date, much of this collection revolves around IEEE's institutional history. The History Center is currently converting much of IEEE's existing paper archives to an electronic format and making them accessible on the GHN. Because most of these documents are old and fragile, care must be taken in scanning. Online archival documents are only useful to the extent that they are cataloged and searchable. A system of meta-tags, created specifically for the GHN, is used to categorize each archival document on the GHN. IEEE's paper archival collection is large and it will be some time before we complete this project. Nevertheless we have made considerable progress. To date we have more than 1,300 archival documents on the GHN. Some of the documents are personal papers that date back to the 1860s. The sources of many of these documents are papers of past leaders of AIEE.

For example, in the papers of Frank Jewett (President AIEE, 1922-23) there is a very touching exchange between concerned members of AIEE about the sad plight of Oliver Heaviside, who had become penniless and destitute. Feeling that this pioneer in electromagnetic theory should not be abandoned by the engineering community, the Cincinnati Section initiated a discussion within AIEE about helping Heaviside. Jewett himself takes a personal interest in this matter. From these letters one discovers that despite his desperate situation, Heaviside, a proud man, had previously refused financial help. Along similar lines, but in a different set of papers in IEEE archives, there is set of correspondence during the early 1940s related to Nikola Tesla's poverty. Herbert Hoover is also writing to express concern about Tesla's condition.

Another interesting item in the GHN's archives is an unpublished piece, written, in 1928, by Charles Proteus Steinmetz. This document is remarkable in its relevance to current day technological and socio-economic preoccupations: the electric car. Steinmetz compares the strengths and weaknesses of gasoline powered and electric cars. Steinmetz then argues for an electric motor design that would make the electric car a viable competitor to the internal combustion engine.

"Steinmetz compares the strengths and weaknesses of gasoline powered and electric cars. Steinmetz then argues for an electric motor design that would make the electric car a viable competitor to the internal combustion engine."

The GHN's archives reveal that even great technological innovators may, on occasion, take up very mistaken scientific notions. Charles F. Brush, (1849 – 1929), winner of the AIEE Edison Medal, was pioneer in electrical technology. In a newspaper article, dated 10 September 1927, one discovers that Brush, after having spent ten years studying the properties of gravity, announced to the world that the basic laws of gravity were wrong.

INTERESTING REFERENCE REQUESTS – NEW THOMAS PYNCHON NOVEL MENTIONS SIMON RAMO

When the audio versions of books are being recorded, and the publishers want to make sure the pronunciation of technical terms and names of engineers are correct, the publishers turn to the IEEE History Center for help. Dr. Simon Ramo, the ARPANET, and a few other items of electrical and computer engineering history are mentioned in passing in the new Thomas Pynchon novel (due out in August). In order to assure the correct pronunciation, the publishers of the audio version contacted the Center because of the Center's oral history with Dr. Ramo.

THINGS TO SEE AND DO

THE 2009 IEEE CONFERENCE ON THE HISTORY OF TECHNICAL SOCIETIES

In August, the IEEE History Committee and the IEEE History Center will hold the eighth in a series of historical conferences. The 2009 IEEE Conference on the History of Technical Societies will take place in Philadelphia from Wednesday 5 August through Friday 7 August 2009. The theme of the conference will be the history of professional technical associations, a theme chosen because 2009 is the 125th anniversary of the IEEE. There will be 27 historical sessions over the three days of the conference, with more than 90 speakers from some 15 countries. In connection with the conference there will be an IEEE

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anniversary celebration on the evening of Thursday 6 August with a reception and banquet at the Down Town Club, adjacent to Independence Hall in the historic district of Philadelphia.

In addition to three days of historical sessions and the banquet, other activities are planned for conference attendees. On the first day there will be a special tour of the ENIAC Museum at the University of Pennsylvania. On the last day of the conference there will be an optional workshop on oral history, intended as an introduction for individuals or organizations interested in starting an oral-history program or learning more about the technique. Also on the last day of the conference there will be an special open house at the American Philosophical Society, which holds a large part of Franklin's library, most of Franklin's extant correspondence, and manuscripts of many important figures in the history of electrical and computer engineering, including Elihu Thomson and John von Neumann.

Technical co-sponsors for the conference include the Department of Electrical and Computer Engineering of Drexel University, the Department of the History and Sociology of Science of the University of Pennsylvania, and the IEEE Philadelphia Section. Additional information is available on the conference website: **www.ieee.org/go/historyconference**.

EE IN THE MOVIES

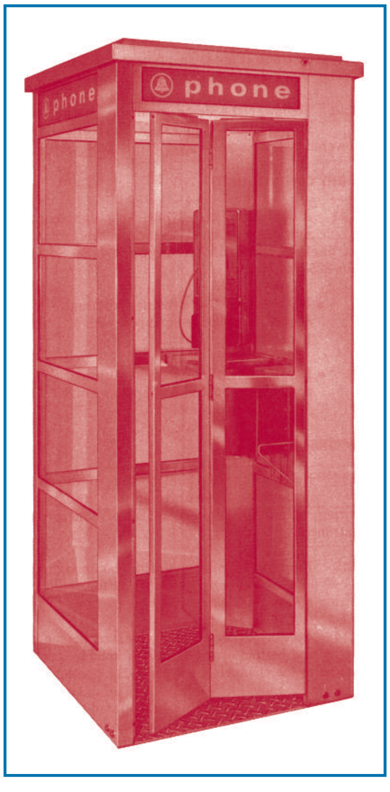
ELECTRICAL TECHNOLOGIES IN THE MOVIES: TELEPHONE BOOTHS

William Gray invented the automatic coin telephone in 1889, and in the first decades of the 20th century, pay phones became more and more common. In 1902 there were 81,000 across the United States, and in 1935 there were 650,000. Until the 1940s, these public phones were indoors, in train stations, drug stores, hotels, restaurants, and more. Sometimes they were mounted on a wall, giving the caller little privacy, but usually they were housed in telephone booths. The 1944 movie "Meet Me in St. Louis," starring Judy Garland, shows a call made in 1903 from a telephone booth in the Hotel Delmonico in New York City to a home in St. Louis. The 1968 movie "Funny Girl," starring Barbra Streisand, shows a call made from a phone booth in 1910 between Fanny Brice and Florenz Ziegfeld. Showing remarkable chutzpah in talking with the celebrated Ziegfeld, Brice puts the speaker of the telephone to the mouthpiece in order to cause feedback howling and to stop him from talking.

In 1912 AT&T introduced a standardized booth, the Number 1 type, made of wood and glass with a hinged door, and it remained the standard for 40 years. In the six Thin Man movies of 1930s and 1940s, as in countless other movies of those years, the calls made from restaurants or train stations are usually made from this booth. The 1940s was the first decade in which outdoor phone booths were common. These were wooden, and many were built for use on military installations during the war. One of these early outdoor wooden telephone booths can be seen in the 1989 movie "Driving Miss Daisy," the action of which starts in 1948.

It was in the 1950s that the glass and aluminum booth became usual. Melanie Daniels, played by Tippi Hedren, is in such a booth when she is attacked by seagulls in the 1963 Hitchcock movie "The Birds." The next year Stanley Kubrick's "Dr. Strangelove or How I Learned to Stop Worrying and Love the Bomb" shows Group Captain Lionel Mandrake, played by Peter Sellers, trying to call the U.S. president from such a booth. He doesn't have enough change, but persuades Colonel "Bat" Guano, played by Keenan Wynn, to shoot up a nearby Coke machine to get the necessary coins. In the 2007 movie "Across the Universe," Lucy, played by Evan Rachel Wood, gets trapped in such a phone booth during an antiwar demonstration in 1968.

The seagulls in "The Birds" do only minor damage to that phone booth. Not so, the Blues Brothers, in the 1980 movie of that name. They blow a phone booth up into the air, and then retrieve coins from the smashed remains. Arnold Schwarzenegger in the 1991 movie "Terminator 2: Judgment Day" gets coins in a simpler way, by driving his fist into the phone's coin box. An innocent way of getting coins from a public telephone is checking for forgotten coins in the coin return. Filmmakers have used this activity as a way to tell us something about the characters who do it, as Rizzo, played by Dustin Hoffman, in "Midnight Cowboy" (1969) or Schmidt, played by Jack Nicholson, in "About Schmidt" (2002).



Almost all pay phones until the mid 1960s had three coin slots, for nickels, dimes, and quarters. In 1965 the Bell System introduced the 1A1 pay phone, the first major change in the usual pay phone since the 1920s. It had one slot instead of three. The 1968 movie "The Odd Couple" shows Felix Unger, played by Jack Lemmon, using such a phone.

In 1974 AT&T stopped making enclosed phone booths, mainly because they were frequently vandalized, building instead open phone booths. We see this, and are reminded of what used to be, in the 1978 Superman movie: Clark Kent, needing urgently to change into Superman, stops in front of an open phone booth, looks at it wonderingly, and rushes into a nearby doorway to change.

The number of telephone booths reached one million in 1960 and peaked at about two million in the early 1990s. With the spread of cell phones, the number of public phones declined markedly. The disappearance of phone booths is commented on in the 2002 movie "Phonebooth", almost all of which takes place in a phone booth.

As always, we would be grateful for reports from readers of other interesting movie scenes that involve telephone booths. You may contact us at **ieee-history@ieee.org**.

TRANSATLANTIC TRANSFER OF TECHNOLOGY

TRANS-ATLANTIC TRANSFER OF COMPUTING TECHNOLOGY CORINNA SCHLOMBS IS 2009-2010 FELLOW IN ELECTRICAL HISTORY

The 2009-2010 IEEE Life Members' Fellowship in Electrical History has been awarded to Corinna Schlombs, who is currently completing her Ph.D. dissertation at the University of Pennsylvania on the international history of computing. Schlombs is studying the transfer of computing technology across the Atlantic in the two decades following World War II. She plans to publish her dissertation and to add a chapter on international standards, and a case study of data entry standards in the banking sectors of the United States and Germany. Among the university honors and awards Schlombs has received are fellowships and grants from the Newcomen Society, the Babbage Institute, the Deutsches Museum, and the National Science Foundation.

VACUUM TUBE NUMBERING

THE PROGRESSIVE DEVELOPMENT OF ELECTRON/ VACUUM TUBE BASES AND NUMBERS, GUEST ARTICLE BY HERMAN L. MILLER

This was written to describe briefly electron tube bases and numbers and make them less puzzling to people who must read about tubes, or deal with them without having years of experience using them. The topic is covered in Wikipedia, but I have enough more knowledge to justify writing this. I had help from an old RCA Tube Manual and from a type 80 and 6L6 tubes I had on hand.

At first, electron tubes did not have bases, so connections were made to lead wires coming out of the glass envelope. This was not satisfactory, since tubes had a much shorter life than other electronic components because of filament wear out and developing gaseousness. About 1920, it was decided to use a four pin base having two pins about four millimeters in diameter connected to the filament, and two pins three millimeters in diameter connected respectively to the plate and grid of a triode, or to the two plates of a rectifier tube. The pins were hollow so that the wires from the tube envelope could be fed through them and soldered (at the factory). The pins were arranged in a fourteen millimeter square pattern on a Bakelite base, so the tube could not be inserted incorrectly into a socket. Sockets had spring contacts with the tube pins, and usually contacts to solder connecting wires. Bases were fastened to tube envelopes with cement. Soon after this time, a numbering system was established, starting at 200 to account for previous numbers. A very successful tube was the 201A triode with a battery powered filament. Another was the 210, a audio power amplifier with a heavy filament that could use AC current without significantly modulating the signal. A need was recognized for a separate cathode heated by an AC filament heater, so about 1926, a series of tubes was developed with 2.5 volt heaters (to be powered from a transformer) starting with the 227 triode then the 2?? screen grid tube, which had to have five and six pin bases, respectively. To avoid causing hum, there had to be thermal inertia in the cathode and this made AC radios take a minute or so to warm-up and start. The 280 tube had two plates to be connected to a 300 to 600 volt transformer secondary as a full wave rectifier, while its filament was connected to a five volt transformer secondary isolated from other windings to withstand 300 to 600 volts. About 1934, people stopped using the 2 in front of tube numbers so they were just two digit numbers for a while. Some tubes had the grid connection come out at the top, so it was isolated from the base pins, and usually it was connected to an radio or intermediate frequency transformer standing next to the tube.

About 1933, a series of tubes with 2.0 volt, 0.06 amp filaments was developed for use in radios powered by either a 2.0 volt lead storage battery or two dry cells with a rheostat to reduce the voltage. The plate voltage for these tubes was supplied by two 45 volt "B" batteries made up of 1.5 volt cells in series. The series included the 230 triode and 234 pentode and a power pentode.

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Later, in 1935, metal tubes came out, eliminated the need for separate shields, and were smaller than previous glass tubes. Metal tubes had smaller pins, two millimeters in diameter, and there were usually eight pins in a twenty millimeter diameter circle. There needed to be a center projection of the Bakelite base that permitted the tube to be turned until it plugged in correctly, a ridge matching a slot in the socket, a big improvement in convenience, and the location for the evacuation tip. This was named the "octal" base. Pin one was just left of the locating ridge, viewed from the bottom, and connected to the metal envelope for grounding as a shield. Pins two and seven were always the filament/heater connection. A completely new numbering system was started with the metal tubes: The first number(s) was the tube filament/heater voltage, followed by one or two letters that corresponded to that tube type, followed by a number that told the number of electrodes in the tube, e.g. 5 for a pentode. Soon, tubes that were electrically the same as metal tubes came out with glass envelopes and had the letter G after the numbers of their metal predecessors. These tubes had a partial flare of their glass envelope, so when that was eliminated to make them smaller, a T for tubular was added to the type number, as 1N5GT. The heater voltage was usually 6.3 volts with 0.3 amperes, but more current if more power was needed.

The 6.3 volt filament/heaters matched the storage battery voltage standard in cars at the time. Development of vibrators to simulate AC from the battery to drive a transformer for tube plate voltage made car radios practical, a big market. The same technology was used for radios in areas without 117 volt AC electric power. The 6.3 volt batteries could be recharged in a car, or taken to town for charging, or charged from a small wind powered generator mounted on a roof top.

"A completely new numbering system was started with the metal tubes: The first number(s) was the tube filament/heater voltage, followed by one or two letters that corresponded to that tube type, followed by a number that told the number of electrodes in the tube, e.g. 5 for a pentode."

The next development was to make a series of tubes with heater/filaments that all drew a current of 0.15 ampere, but used whatever voltage was needed to give the heater power needed for that tube. The tube heaters could all be connected in series, so the use of a filament transformer was eliminated and the radios could operate efficiently with either 117 volt line AC or DC power, a huge market. A rectifier converted the line AC to DC for plate supply at line voltage. Common cheap table model super heterodyne radios had just five tubes: a rectifier to power the tubes plates, a first detector-pentagrid converter local oscillator, an intermediate frequency amplifier, a second detector-audio amplifier, an audio power amplifier to drive a speaker.

During the mid 1930's a survey of power line voltages concluded that the average line voltage was about 117 volts, so that became a design standard, and there were tube filaments for that voltage. Some unscrupulous radio manufacturers used ballast tubes that had nothing but a filament, as a cheap way to add more tubes to their radios for advertising claims, while the buyer would not realize they were useless and wasted electricity.

"When tubes were used in computers with plate current cut off for long times, they often developed "sleeping sickness" and would not turn on. Special treatment of cathodes cured the problem, so a series of dual triodes, 5963, 5964, were adapted from the 6J6, 12AT7, etc."

About 1939, a new series of tubes for battery operation came out with 1.4 volt, 0.050 ampere filaments in a tubular envelope with an octal base, typified by the 1N5GT. The filament voltage matched a single zinc-carbon dry cell. In 1940, miniature glass tubes appeared with very different construction from earlier tubes. The tube base was part of the glass envelope and the pins were less than 2 mm diameter and manufactured into the glass base. The tube elements, (grids, cathodes and plates) were welded to the pins inside the envelope. The pins were arranged in a circle of seven plus an empty space for locating the tube in its socket. Later, tubes with nine pins plus an empty space appeared, so there were enough pins for pentagrid converters, or so two triodes could be in one tube. The problem with miniature tubes was that the pins bent too easily, so Bakelite socket simulators with funnel shaped pin holes that straightened the pins became available, either to mount on work benches or tube testers, or attached to a rubber sleeve that allowed one to grasp and pull a hot tube out of its socket.

About 1941, the need to deal with ultra-high frequencies led to development of acorn tubes that had their connecting pins come out from the envelope in a radial pattern.

About 1941, Loctal tubes appeared that were the same size as tubular glass octal tubes, but constructed like miniature tubes with small pins that went through the glass envelope. There was a thin sheet metal "base" that was crimped to fasten it to the envelope and had a locater pin in the center with a "nubbin" that locked to a spring in the tube socket. The base also acted as a grounded shield between the pins, reducing the capacitance between them. Loctal seemed to be the ultimate tube design, but never gained the popularity that miniature tubes had, despite its suitability for applications subject to shock and vibration.

Shortly before World War II, the Army Signal Corps had tubes made with only the VT-- numbers on them that the Corps had assigned to obscure their actual type, so they would be less likely to be stolen. Television applications brought a need for "flyback" oscillators to generate high voltage and for horizontal deflecton ampliers, so tubes were made with plate connection at the top to isolate it, plus the capability for large plate currents at moderate supply voltage (high perveance). Transmitter tubes had been made with plate cap connections for many years.

After automobiles changed to 12 volt power systems, tubes were made with both 12 volt filaments and the ability to operate with just a 12 volt plate supply in an automobile, so no vibrator or transformer was needed.

Beginning around 1953, tubes for industrial use with higher quality were assigned four digit numbers. Often, these tubes had counterparts used for entertainment. When tubes were used in computers with plate current cut off for long times, they often developed "sleeping sickness" and would not turn on. Special treatment of cathodes cured the problem, so a series of dual triodes, 5963, 5964, were adapted from the 6J6, 12AT7, etc. The 5965 dual triode was developed specifically for cut-off use and could deliver larger current for faster pulse rise time than the adapted tubes. Transmitter tube type numbers were usually three digits, beginning with "8". Later, these were expanded to four digits, still beginning with "8".

The quality that made a tube useful as an amplifier was transconductance (Gm), the partial derivative of plate current with respect to grid to cathode voltage. Transconductance was structurally dependent on the spacing between grid wires, and their distance from the cathode, closer giving higher transconductance, but limited by voltage breakdown. Transconductance increased as plate current increased.

Tube manufacturers published data on their tubes in loose leaf notebook form for engineers and as tube manuals for amateur radio builders; there was the *RCA Tube Manual*, the *Radiotron Designers Handbook* and the *Radio Engineers Handbook* by Terman. During World War II the development of radar and nuclear instrumentation led to led to circuits to generate special pulse waveforms, monostable and bistable multivibrators. These designs were collected and published in the MIT Radiation Laboratory Series. Nuclear instrumentation was covered by Elmore and Sands.

Radios were constructed with tube sockets, transformers, tuning capacitors, and volume controls mounted on a horizontal chassis of sheet metal about 1.6 to 2 mm thick, originally zinc, but by 1937, aluminum. The rotor of tuning capacitors had to be electrically connected to the chassis at the chassis, to avoid de-tuning when touching the tuning knob. Some tubes in radio frequency circuits had to have a close fitting metal shield grounded to the chassis. The chassis was bent to a broad U shape and the tubes were mounted vertically above the chassis, as were transformers, (both tuned and power), tuning capacitors, and electrolytic capacitors. Wiring, resistors, capacitors, and inductors (chokes) were below the chassis.

When communications companies wanted to put more than one receiver in a tall cabinet, along with a speaker panel, switch panel and jacks, they standardized on panel increments of 1.75 inches, the most common panels being 7.0 and 8.75 inches. If the chassis was two or two and a half inches deep, that left 5.0 to 6.25 inches of space for tubes and transformers. Usually, there was so much heat generated in the cabinet that the door had to be left open or off, until fans became available to mount on the bottom panel to bring air in that went out at the top. Horizontal chassis obstructed air circulation. This could be improved by instead using vertical channel chassis, so the tubes mounted horizontally at the back, while other components were between the chassis and the front panel. The chassis (plural) formed a vertical chimney that air could flow through, and also it could flow unobstructed past the tubes. These chassis became available in the early 1950s.

Author Biographical Data

The author was born in 1924, in Detroit, Michigan. While in the Army Air Force, he completed the AAF Premeteorology "C" course at Washington University and the AAF Communications Officer Course at Yale University in 1944. After these, he served as a communications officer in the Army Airways Communications System in the Aleutian Islands. In 1948, he earned the Bachelor of Science in Engineering Physics degree and in 1951, Master of Science in Physics degree, both from the University of Michigan. He was employed as a physicist with Ethyl Corporation Research Laboratories in Ferndale, Michigan, with Dow Chemical in Midland, Michigan and Rocky Flats Colorado, Princeton University Plasma Physics Laboratory, Bendix Aerospace Systems in Ann Arbor, Michigan, and Commonwealth Associates in Jackson, Michigan.

BIBLIOGRAPHY

HUNT, SAMANTHA, *The Invention of Everything Else, Houghton Mifflin Company, 2008*

Guest book review by Emily M. Schneider, Ph.D.

Readers of the IEEE History Center newsletter will know that Nikola Tesla has long intrigued a wide range of individuals from professional engineers and independent inventors to historians and even fiction writers. In Samantha Hunt's intriguing and well informed new novel, *The Invention of Everything Else*, a sad but never quite defeated Tesla defies the world around him by insisting that "invention is nothing a man can own." The author deftly ties together many currents from Tesla's life and times into a carefully researched and imaginative narrative. She not only recreates the specific scientific contributions, as well as oddities, of her hero, but evaluates on every page the contradictions and complications of Tesla's intellectual and moral philosophies.

Along with many historical persons—Tesla, Edison, Westinghouse, Century magazine's Robert Underwood Johnson and his wife Katherine—Hunt constructs a nucleus of fictional characters who give individual dimension to Tesla's conflicts. We meet eccentric widower Walter and his daughter Louisa, a skeptical young woman who works as a chambermaid in Tesla's New Yorker hotel. Walter's spectral oddball of a friend, Azor, builds a time travel machine on a deserted airfield in Far Rockaway, with the help of Arthur, a childhood acquaintance and current love interest of Louisa, who uses his mechanical engineering skills to help further Azor's dream.

Tesla's contempt for Edison's aggressive capitalism is tied to his empathy for Louisa's curiosity about AC electricity and its potential to return the dead to life. Louisa is eventually sobered by learning that Tesla's "death ray" shows respect for immortality only by emphasizing how brief and fragile life is, and how easily man may destroy it. The climax of the book borrows

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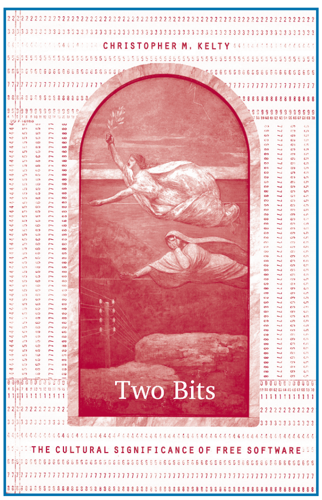
from the serial radio adventures beloved in popular culture, connecting Tesla's engineering innovations with their applications to human hunger to transcend boundaries. Samantha Hunt's novel is a truly unusual web of interlocking questions, raised, but not answered. Does invention belong not to one man, but to all? Do electric and magnetic fields have potential not only to improve life but to expand its borders? Do Tesla's chaotic and fantastic dreams cancel out his technological accomplishments? *The Invention of Everything Else* rewards the open minded reader by launching him in the vulnerable time machine of a wonderful story. The subscribers of this newsletter are well advised to add it to their reading lists.

Houghton Mifflin Company, Boston, **www.houghtonmifflinbooks.com**, $24.00, hardcover, ISBN-13/EAN: 9780618801121, ISBN-10: 061880112X, 272 pages. Also available in paperback.



KELTY, CHRISTOPHER, *Two Bits: The Cultural Significance of Free Software, Duke University Press, 2008*

Free Software (otherwise known as Open Source) is a defining principle of the modern networked world. Free software, notably Linux, Apache, and TCP/IP, forms much of the foundation of the Internet and provides the underlying skeleton on which it is based. Free software is something novel; it is the product of a new way of doing things relying on the collective work of a community of many individuals, and a new way of reaching technical stability rather than on a proprietary structure. Christopher Kelty, an anthropologist at Rice University has written an excellent study of this phenomenon, in which he successfully undertakes a dual approach to his subject—he presents free software in both historical and cultural contexts.

Culturally, in the first section of his book, he recounts how those involved in free software created a new type of community, which he has named a recursive public, and defines:

A recursive public is a public that is vitally concerned with the material and practical maintenance and modification of the technical, legal, practical, and conceptual means of its own existence as a public; it is a collective independent of other forms of constituted power and is capable of speaking to existing forms of power through the production of actually existing alternatives.

Thus the community is defined in both a technical and a moral way. Free software is simultaneously what the members of the community (who Kelty refers to as geeks) do, how they do it, and the identity of the community of which they are part. It represents a new way of doing things, both technically and organizationally, outside of corporate or other institutional control. For the most part, the community defines itself as evolutionary not revolutionary, and capitalist but not corporate.

After introducing this concept and discussing the characteristics of this geek community, Kelty moves to a set of five chapters that together form Part II of his book. Each provides a historical discussion of one of what he sees as the five components of free software.

In the first of these, "The Movement," he traces the transformation of free software into a large movement, beginning in 1998 when Netscape released the source code for its Netscape Navigator browser. At this time the alternate term "open source" came into vogue, because Netscape still owned the intellectual property even while it gave it freely to the geek public for their use and improvement. In the next chapter, "Sharing Source Code," Kelty steps back in time and traces the evolution of what came to be free software in the history of the UNIX operating system and the language C in which it was written. UNIX was a unique corporate/academic hybrid. It was created by Ken Thompson and Dennis Ritchie at Bell Labs around 1971 as a system that could be used on many different machines. But Bell labs could not commercialize it because of legal restrictions on AT&T's monopoly. Hence, AT&T licensed it freely to academic computer science departments, which adopted it as standard teaching pedagogy. A generation of computer scientists cut their teeth on UNIX, and with Bell Labs approval, wrote programs to add to it, to port it to new machines, and sometimes to fork it into different versions, the most popular of which was the University of California's BSD Unix. By the early 1980s, several competing and not completely compatible versions of UNIX had developed.

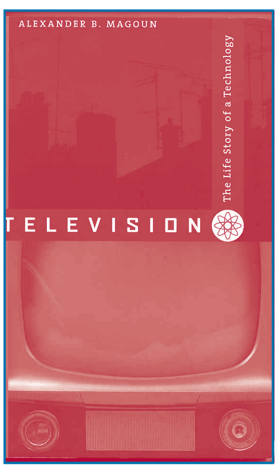
In the third of these chapters, "Conceiving Open Systems," Kelty discusses the rise of the alternate term "open systems" which came to mean the opposite of proprietary systems and top-down corporate control. But such open systems could be plagued by competing versions, and prove resistant to traditional standards setting. The failures in the 1980s to establish a single accepted version of UNIX created an opening for Microsoft, with its Windows and Windows NT to establish a dominant proprietary operating system in the 1990s. Microsoft was aided by a legal system that eased the path for a proprietary operating system to establish a standard. But the rise of the internet brought a resurgence of free software; the free software transfer protocol TCP/IP triumphed over the internationally approved software standard OSI because it had wider availability, modifiability, and finally serendipity, in that Tim Berners-Lee chose it as a component of the design of World Wide Web.

The fourth chapter, "Writing Copyright Licenses," covers the successful efforts to solve the legal issues that intellectual property law posed to free software with the development of copyright licenses, sometimes known as "copyleft licenses," that adapted existing law to the new form. The most prominent of these was the GNU General Public License. The fifth and final historical chapter, "Coordinating Collaborations" covers the final component of the movement, the harnessing of a large number of volunteers to work freely on a large software project. These communities are not goal oriented. It recounts the triumphs of two major and universally used free software programs, Linux (the dominant version of UNIX), and the Apache web server.

The third and final section of the book, "Modulations," returns to cultural analysis, discussing the spread of the principles of free software to other areas, notably the Connexions open source textbook module movement, where the open material is no longer a computer program, and then the broader "Creative Commons" movement that created a legal system for this mode of collaboration. Kelty himself was a participant in these activities. He notes how Connexions and similar projects seek to replace not just the book but the entire publishing process. This leads to a struggle to redefine the source of authoritative knowledge today, much as the rise of publishing in the 17th and 18th century led a similar redefinition in the past. Finally, he notes that much of the interactivity of Web 2.0, such as Facebook or You Tube, is not a recursive public, since the infrastructure is controlled by the site owners who ultimately have control over the content, and seek to exploit it to make a profit.

So, by combining history and anthropology, Kelty has produced a study that helps the reader understand the rise of free software and its cultural significance, while raising issues of current interest rarely done in a more conventional historical approach.

Available from Duke University Press, Durham NC 27701, 919-688-5134 Fax: 919-688-2615. **http://dukeupress.edu**. Paper, $23.95. ISBN 0-8223-4264-2, 378pp, index.



MAGOUN, ALEXANDER B., *Television: The Life Story of a Technology, The Johns Hopkins University Press, 2008.*

In 2004, Greenwood Press inaugurated a series titled "The Life Story of a Technology," hardcover books designed to give a broad overview of the history of an important technology in approximately two hundred pages. The Johns Hopkins University Press has subsequently published most of these volumes in paperback. Alexander Magoun's survey of television is one of fifteen volumes in the series so far and one of the best

Magoun has been executive director of the David Sarnoff Library for more than a decade, and thus custodian of the professional papers of RCA founder David Sarnoff, and the records of the famed RCA Laboratories. From this background, he brings a wealth of knowledge to the task of capturing almost a century of television history.

Magoun divides the life cycle of television into six chapters, though for the most part, he limits his story to developments in the U.S.A. In "Conception 1873-1911" he traces the early development of some of the underlying science and technology. In "Birth of a Technology or Invention 1911-1928" he describes the television systems devised by 1928 by four men who others have at times been credited with the invention, explaining the separate contributions of Philo T. Farnsworth, Vladimir Zworykin, Charles Jenkins, and John Logie Baird. In "Parenthood, Television's Innovation 1928-1941," he describes the development and initial deployment of a complete system for television broadcasting, including standards setting, programming, and broadcasting, largely under the leadership of David Sarnoff, the head of the Radio Corporation of America. Here he emphasizes the importance of visionary leadership and systems engineering in the transformation of an invention into a networked technology with mass applicability. In "Working for a Living, Television's Commercialization, 1941-1966" he describes the rapid rise of television as a mass medium in the decades following World War II. He highlights RCA's consistent expenditures on both programming and research and development as a solution to a "chicken and egg" problem, noting for example, the enormous funds RCA spent for more than a decade on color television between the adoption by the U.S. Federal Communications Commission of RCA's compatible system in 1954, and the wide spread acceptance of color television. In "Children of the Revolution 1947-1987," he describes the development of a whole variety of second generation technologies including cable TV, solid state cameras, and video recording, and shows how and why technological leadership passed from the U.S. and RCA largely to a group of Japanese companies. Finally in "The Digital Generation and the End of Television," he brings the life cycle to an end, with the gradual replacement of analog television broadcast on fixed schedules by a relatively small number of private or government outlets, by a new multiplicity of systems he groups under the rubric video, where digital electronic moving images come into our contemporary lives through a multiplicity of platforms including the internet, cell phones, and DVD Players.

Even in such a sweeping survey, Magoun finds time to raise several larger themes, including the relative strengths and weaknesses of lone inventors such as Farnsworth as compared to corporate inventors such as Zworykin, and the complex interplay between the proponents of a technology and their wider society and culture.

There are many sources once can turn to for more detailed examination of one aspect or another of the long history of television and Magoun lists most of these in his extensive bibliography. But for the full scope of almost a century of television in its cultural context can Television: *The Life Cycle of a Technology* is highly recommended.

Available from the Johns Hopkins University Press, Baltimore MD, 1-800-537-5487, fax: 410-516-6998. **http://www.press.jhu.edu**, $25.00 ISBN 0-8018-9072-1, 193 pp, index.

SERCHINGER, REINHARD, *W. Walter Schottky: Atomtheoretiker und Elektrotechniker, GNT-Verlag, 2008.*

In the first half of the 20th century the German physicist Walter Schottky made several vital contributions to the development of electronics. Born in Zurich in 1886, he studied physics at

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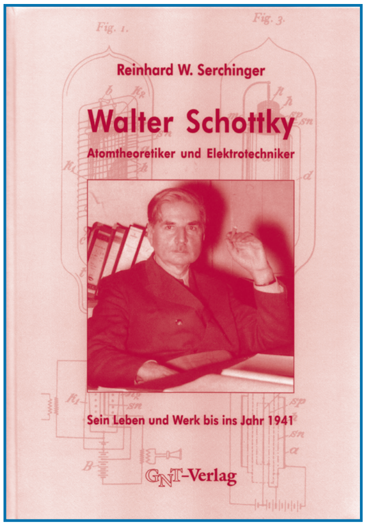

several German universities, and he did research under the direction of Max Planck. From his student days he worked on the scientific investigation of the new technology of electronics. In 1914, while investigating the emission of electrons in a vacuum tube, he discovered what became known as the Schottky effect, and in the years from 1915 to 1919 he invented a screen-grid tube and several multi-grid tubes. From 1920 to 1927 he taught at the University of Würzburg and at the University of Rostock. From 1927 until shortly before his death in 1976 he worked for the Siemens company as an industrial researcher. Schottky did a great deal of work on semiconductors, and a type of lattice vacancy is today known as the Schottky defect. He studied metal-semiconductor contacts, and diodes based on such contacts are called Schottky barrier diodes.

Reinhard Serchinger has written an impressive scientific biography of Schottky, covering both his life and his work from 1886 until 1941. In his long career at Siemens, Schottky was given freedom to pursue topics of his own choosing, and he made numerous contributions to solid-state physics and thermodynamics as well as to electronic technology. Serchinger's book places Schottky's work both in the context of contemporary physics and in the context of the industrial research of the Siemens company.

The GNT-Verlag is a publisher of scholarly books on the history of science and technology, with many titles on the history of physics and the history of electrical technologies. This biography of Schottky is handsomely produced with about two dozen illustrations. References are given as chapter endnotes, and there is an index.

Available from GNT-Verlag, Schloßstraße 1, D-49356 Diepholz, Germany; **www.gnt-verlag.de**, hardcover, 50 euro, ISBN 978-3-928186-88-9, 685 pp.

BOOK NOTES:

Fans of "crostic puzzles" who are also fans of engineering and its history, rejoice! For over25 years, Paul Green has created for the IEEE Communication Magazine puzzles whose clues and answers are drawn from IEEE's technologies, mainly in the communications field. Now the IEEE Communication Society (ComSoc) has collected 300 of them into a handsome soft-bound edition entitled *Communicrostics*. Puzzle aficionados will enjoy the challenges, and also enjoy seeing how the current event clues change over time (e.g., from 1982—"Last FCC attempt to define computation/communication boundary"; of course, the historical entries are evergreen). The book can be ordered from ComSoc on-line at **http://www.comsoc.org/puzzlebook**.

And while on the topic of ComSoc: In honor of the Communication Society's 50th anniversary in 2002, the IEEE History Center helped the Society prepare a special issue of its magazine. The contents of the magazine, along with additional supporting material, such as full oral history transcripts, have been maintained on the Center's web pages since that time. ComSoc also took the material created by the History Center and added some additional society information to create and publish a short book, *A Brief History of Communications*. Now the IEEE Thailand Section, in cooperation with ComSoc and the IEEE Thailand Communications Chapter, has translated *A Brief History of Communications* into Thai and republished it. The Thailand Section is also the one that translated and published in book from sections of the IEEE Virtual Museum web site (see Newsletter #74, July 2007), so they are to be commended for their commitment to history and to traditional media.

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IEEE FOUNDATION PLANNED GIVING DONOR RECOGNITION GROUP RENAMED

The IEEE Foundation is pleased to announce that it has renamed its planned giving donor recognition group to affiliate the group to the IEEE and make it more prominent; the Goldsmith League will now be known as the IEEE Goldsmith Legacy League. Members of the IEEE Goldsmith Legacy League are forever generous. They build for tomorrow by leaving legacy gifts to benefit future generations of engineers. Many members of the League have included a bequest in their will or trust document. Some have named the IEEE Foundation as beneficiary of a life insurance policy, retirement plan or charitable remainder trust. Others have made outright gifts from their IRA during their lifetime.

The League is named for Alfred N. and Gertrude Goldsmith in recognition of their extraordinary commitment to the IEEE. During his lifetime, Alfred N. Goldsmith made a significant personal commitment to furthering the goals of the profession. He was one of the founders of the Institute of Radio Engineers (IRE), a predecessor society of the IEEE, Editor of the Proceedings of the IRE for fourty-two years, and a member of the IRE board for fifty-one years. He perpetuated his commitment to the profession after his death by providing a significant bequest to the IEEE Foundation through his estate. Gertrude honored her husband's legacy in the engineering community by leaving a generous portion of her estate to the IEEE Foundation. Together Alfred N. and Gertrude (Maude) Goldsmith's philanthropic vision seeded the IEEE Foundation's ability to support IEEE's mission.

As was true in the past, members of this IEEE Goldsmith Legacy League will receive the IEEE Foundation Focus newsletter and are recognized annually in the Honor Roll of Donors. Going forward, the benefits offered to this special group have been expanded to include: a keepsake coin, certificate of membership, invitation to attend the annual IEEE Honors Ceremony, recognition on the "Wall of Fame" and eligibility to receive personal estate and tax planning information. To join or learn how you can make a planned gift, please visit **www.ieeefoundation.org** and click on the planned giving tab, or contact the IEEE Development Office by telephone at +1 732 562 3860 or by email at **donate@ieee.org**.

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