

# IEEE History Center

ISSUE 111, November 2019



*IEEE History Center Historian Dr. Lisa Nocks at the U.S. Patent and Trademark Office event celebrating the 50th Anniversary of the Moon landings. The event was a collaboration among the U.S. PTO, IEEE-USA, the IEEE History Center, and the Entrepreneurship Group of IEEE Technical Activities.*

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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—once in hard copy (March) and twice electronically (July and November) by the IEEE History Center.

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By Michael N. Geselowitz, PhD

It has been another busy year at the IEEE History Center, with our focus on commemorating space travel (see page 6), and the continued expansion of our ongoing programs, such as REACH (page 5), the ETHW (page 6), and oral histories. In addition, 2019 saw the 200th Milestone dedication...the IEEE Milestones program reaches its own milestone.

As you can see from the Passionate about Preservation section (beginning page 3), most of our programs are about instilling pride in

IEEE members about the achievements carried out by them and their teachers, peers, and students, all under the umbrella of the world's largest professional technical association—IEEE—and engaging them in helping to preserve that heritage. The Milestones Program is a great case in point. It is perennially our most popular program, as evidenced by member feedback and support. It is hard to measure how many members of the public pass by the over 200 plaques (some Milestones have multiple plaques) and register what happened there...we hope it is many...

## HOW CAN THE HISTORY CENTER HELP YOU?

*A Handy Guide to Some of Our Programs and Contacts*

Engineering & Technology History Wiki: [https://ethw.org/Main\\_Page](https://ethw.org/Main_Page)

List of dedicated IEEE Milestones: [https://ethw.org/Milestones:List\\_of\\_Milestones](https://ethw.org/Milestones:List_of_Milestones)

How to Propose an IEEE Milestone: [http://ieemilestones.ethw.org/Milestone\\_Guidelines\\_and\\_How\\_to\\_Propose\\_a\\_Milestone](http://ieemilestones.ethw.org/Milestone_Guidelines_and_How_to_Propose_a_Milestone)

Milestone proposals in process: [http://ieemilestones.ethw.org/Milestones\\_Status\\_Report](http://ieemilestones.ethw.org/Milestones_Status_Report)

Oral History Collection: [https://ethw.org/Oral-History:List\\_of\\_all\\_Oral\\_Histories](https://ethw.org/Oral-History:List_of_all_Oral_Histories)

REACH Program (free online materials for teaching the history of technology): [https://reach.ieee.org/Support\\_for\\_scholars](https://reach.ieee.org/Support_for_scholars):

Fellowship in the History of Electrical and Computing Technologies:  
<https://www.ieee.org/about/history-center/fellowship.html>

Pugh Young Scholar in Residence:  
<https://www.ieee.org/about/history-center/internship.html>

Middleton History Prize (awarded to a book in the history of technology):  
<https://www.ieee.org/about/history-center/middleton-award.html>

## WAYS YOU CAN HELP HISTORY

As you read this newsletter, you will see the many success stories of the IEEE History Center and the ways it nurtures the heritage of the profession. As successful as the Center is, it relies on the support and contributions—financial, intellectual, and time and effort—of many people. We ask you to help further our work by:

**Proposing an IEEE Milestone**—Milestones recognize significant achievements in technology  
[ieemilestones.org](http://ieemilestones.org)

**Contributing a First-Hand History**—Written and oral histories help us chronicle important innovators and innovations [http://ethw.org/Oral-History:List\\_of\\_all\\_Oral\\_Histories](http://ethw.org/Oral-History:List_of_all_Oral_Histories)

**Authoring an article for the ETHW**—The Engineering and Technology History Wiki (ETHW) is an authoritative collection of historical information about technology's contributions to society  
[ethw.org/create](http://ethw.org/create)

**Supporting the History Center's mission with a donation.**

*However you can help, it is always deeply appreciated.*

## 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 technology from the point of view of someone who worked in the technical area or was closely connected to someone who did. 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 particular interest). Length: 500-1200 words. Submit to [ieee-history@ieee.org](mailto:ieee-history@ieee.org). Articles and letters to the editor may be edited for style or length.

but we know first-hand the excitement that a Milestone dedication brings to a Section. Many members come away from such ceremonies full of pride in IEEE and what it represents.

Just earlier this fall, much of the staff was able to attend the "Standardization of the Ohm" dedication as part of a week of activities in Glasgow, Scotland, UK. The dedication was timed to coincide with IEEE HISTELCON, the roughly biennial IEEE Region 8 history conference, and the IEEE History Committee met there as well. Thus, staff was able to first interact with the History Committee, the volunteers with whom we work most closely. Then we attended the dedication and mixed with IEEE UKI Section volunteers and members at the beautiful backdrop of the Hunterian Museum at the University of Glasgow. Remarks by current IEEE President José M. F. Moura certainly excited the crowd. Finally, we attended HISTELCON, with presentations by members from Europe and beyond who are excited by engineering history, and we were able to interact with them

in an intimate conference setting.

I think it is no coincidence that, at their meeting, the History Committee endorsed the strategic idea of a "Global IEEE History Museum," where the History Center will work toward making exhibits available to members worldwide by a combination of use of local IEEE facilities, partnerships with local museums, and traveling displays. Look for more information about this developing idea in 2020 and beyond.

Finally, the November newsletter is my annual opportunity to thank you, the IEEE members who are already engaged in history, for your financial support. As always, our programs are funded in large part through philanthropic donations to the IEEE Foundation (see back cover). I am grateful for your past generosity, and I hope that we have earned your continued support. Best wishes to you and yours for a happy holiday season, and a healthy and successful new year.

## IEEE VOLUNTEERS ACTIVELY PRESERVING HISTORY

In this issue, we continue our series profiling the history activities of IEEE units and learn how they preserve and promote the heritage of the profession.

### MANNED SPACE HISTORY: FORMER NASA CHIEF ENGINEER CHET VAUGHAN'S PERSPECTIVE

By T. Scott Atkinson, Life Member Coordinator, IEEE Region 5

Our Life Member's meeting on 26 July 2019 was special in that a number of luminaries from the IEEE were attendees, and the speaker was the former NASA chief engineer Chester Vaughan.

Chet's long career spans the whole duration of the space program. He started as a co-op at Langley NACA in 1955 and continued with Langley Research Center after graduation from VA Tech in 1959. He joined Space Task Group in 1961 and supported the Propul-



*Chet Vaughan and the audience*

sion and Power Division, Engineering Directorate until 1993, holding positions of Reaction Control Section Head, Thermochemical Test Branch Chief, and Propulsion and Power Division Chief. He was Deputy Director of the Engineering Directorate 1993-1995. Chet also had special assignments as Chief Engineer for NASA Associate Administrator, Acting Deputy Director, Marshall Space Flight Center. He also served on a large number of special failure-investigation boards.

He was the International Space Station Chief Engineer from 1995 until retirement

*Continued on Page 4*

### SUBSCRIPTION INFORMATION

The IEEE History Center newsletter is available free to all persons interested in technological history – whether engineers, scholars, researchers, hobbyists, or interested members of the public. It is published in hard copy in March, and in electronic form in July and November of each year.

To subscribe to the IEEE History Center's free newsletter, please send your name, postal mailing address, e-mail address (optional if you wish to receive the electronic versions), and IEEE member number

(if applicable – non-members are encouraged to subscribe as well) to [ieee-history@ieee.org](mailto:ieee-history@ieee.org)

Current and past issues of the newsletter can be accessed at [www.ieee.org/about/history\\_center/newsletters.html](http://www.ieee.org/about/history_center/newsletters.html)

The IEEE History Center is a non-profit organization which relies on your support to preserve, research, and promote the legacy of electrical engineering and computing. To support the Center's projects, such as the Engineering & Technology History Wiki, Milestones, and Oral History Collection, please click on [www.ieeefoundation.org/donate\\_history](http://www.ieeefoundation.org/donate_history)

from NASA in 1996. Then he worked with The Boeing Company in the Chief Engineer's Office in Houston on the International Space Station Program.

Chet's primary assignments during the Apollo era involved all aspects of the design, development certification, and flight support for the Reaction Control Systems on the Gemini on-

orbit and entry systems and the Apollo Command Module, Service Module, and the Lunar Module systems. He was honored with the NASA Engineer of the Year Award (1994), the NASA Exceptional Service Medal (1980,1981), and the NASA Outstanding Leadership Medal (1989).

## TWO REGION 5 STEPPING STONES HONOR NASA TEAMS IEEE JOINS IN 50TH ANNIVERSARY OF APOLLO 11 LANDING CELEBRATION



by Vincent Palughi

On July 27th IEEE Region 5 dedicated Stepping Stones to two NASA teams that have been crucial to The National Aeronautical Space Administration (NASA) programs. One award was presented for the creation of the Analytic Ephemeris Generator (AEG), which provided the rapid planning and real-time orbit predictor for early space programs. Subsequent advancement of the AEG is still used in manned space mission orbit predictions. The AEG plaque will be seen by all Space Center Houston visitors going for the Mission Control visit.



*AEG Plaque unveiling in JSC Mission Control Lobby - Dr. Ishaq Unwala, Arland Actkinson, Bruce Manners, Chris Sanderson, James Jefferies, Robert Shapiro, Dr. Thomas Harman, Dr. Zafar Taqvi, Scott Atkinson, Dr. Sabia Abidi, Michelle Krueger, Vincent Palughi. AEG achievers - Ken Young, Merritt Jones, Hal Beck, Bob Regalbrugge, Roger Reini and Bill Bridges.*

IEEE Region 5 Stepping Stone Award  
in  
Electrical Engineering and Computing  
ANALYTIC EPHEMERIS GENERATOR (AEG) 1964

In the office side of this Building 30, Mission Planning personnel developed the Analytic Ephemeris Generator (AEG), conceived by Dirk Brouwer (Yale U., 1962), into a vital space mission planning and real-time operations computer tool which was very instrumental in NASA's achievement of the world's first space rendezvous in 1965. Key development personnel: Alan Moore, Bill Reini, Ed Lineberry and Ed Kenyon.

July 2019



*The AEG Stepping Stone award plaque permanently displayed in Mission Control Building in Johnson Space Center.*

Another Stepping Stone honors work at the Electronic Systems Test Laboratory (ESTL). NASA and the Johnson Space Center was recognized for the development of the Electronic Systems Test Laboratory (ESTL) which supported the complexities of an entirely new communications technique – a unified voice/data carrier. Subsequent system configurations are currently providing the testing for newer technical advances in communication techniques.

## MICROWAVE EXHIBIT AT INTERNATIONAL MICROWAVE SYMPOSIUM

IEEE's Microwave Theory and Techniques Society (MTT-S) sponsored the 2019 International Microwave Symposium (IMS) which was held in Boston's Convention and Exhibition Center the week of June 2-7. An exhibit of historical items was organized by Dogan Gunes. The exhibit featured a restored 16 tube ring oscillator transmitter and associated receivers and indicator scopes from the World War II US Army SCR-268 radar. These items were provided by Ray Chase of the InfoAge Museum in Wall, NJ. Also on display was the microwave transmitter-

receiver unit from a US Navy shipborne type SU radar. The SU radar was designed by the MIT Radiation Laboratory and was built by the Submarine Signal Company of Cambridge, MA, which later became part of Raytheon. This unit was loaned by the National Electronics Museum in Linthicum, MD, where a complete SU radar is on permanent display. These and additional artifacts from MTT's permanent collection attracted many visitors during the conference.

## IEEE DAY: IEEE STUDENT BRANCH AT STEVENS INSTITUTE INVITES HISTORY CENTER STAFF TO SPEAK

The IEEE Student Branch at Stevens Institute of Technology is a very active one. This year, Isabelle Engel, President of the student branch, invited History Center Research Coordinator Robert Colburn to speak at the branch's IEEE Day 2019 celebration. Colburn's talk "*Sputnik, Student Loans, and the Race to STEM*" was in part a commemoration of the 50th anniversary of the Apollo Lunar landings, and in part connecting events in space with matters here on earth of direct interest to students. The substance of the talk was how the U.S. college student loan program was

born out of the reaction to the launch of *Sputnik 1* and particularly to the launch of the much larger *Sputnik 2* one month later. The talk closed with a quote from James Killian, President of MIT, and the first presidential science advisor. Killian's words are appropriate to the spirit of IEEE's mission, and to IEEE Day:

"...discover [science and technology's] inner power to make men and women a little more creative, a little more objective, and a little more humane."

## A HISTORY OF THE FUTURE

This term, historian Lisa Nocks is adding to the History Center staff's engagement with its host, Stevens Institute of Technology, by offering her seminar, "A History of the Future." The fully enrolled course offers students the opportunity to learn about people's ideas about the future at different points in history. Students develop a term project that includes the history and current state of some aspect of technology and its impact on society, and an informed speculation about how that technology may change, or what impact it will have on society by the year 2099. Students read and discuss topics ranging from ancient prophecies and belief in fortune-telling and spiritualism to speculation by literary figures, scientists, and engineers about what life would be like in the twenty-first century, articles and books by researchers and experts in computing, different areas of engineering, agriculture, and biomedicine, and finance to support their projects. Going



The Rural Postman

beyond the question, "Hey, where's my jet pack?" the course is designed to teach students to place technological developments in social context, by encouraging them to consider the reciprocal influences of engineering and invention with economics, politics, public health, environmental challenges, and even popular culture and mass media on society.

## REACH IS LOOKING FOR VOLUNTEERS

IEEE REACH ([reach.ieee.org](https://reach.ieee.org)), the History Center's free, on-line educational program, is looking for volunteers to present the IEEE REACH program to their IEEE Societies. IEEE REACH provides 7th-12th grade teachers with resources to incorporate the history of technology into their classrooms. The program's goal is to enhance technological literacy skills of all students and to help them appreciate technology's relevance. In addition, the program provides a pathway for students to generate an interest in STEM. The program includes inquiry units (lesson plans) that cover IEEE fields of interest using primary source materials, hands-on activities, and short videos that may be shown in or outside of the classroom. The latest program highlight video can be viewed here: <https://vimeo.com/ieeereach/toengineerishuman>

In today's advanced society, it is important that all students be technologically literate. REACH provides teachers with a way to teach all their students, not just those in STEM (Science, Technology, Engineering, Math) programs, the social context of technology, understand its implications, and how it is relevant to



High School Students in a classroom using REACH

their lives. The REACH program brings to life science, society, and technology in the classroom. It is hoped that REACH may also spark a student's interest in STEM where there previously was no interest. Through an IEEE volunteer effort, more IEEE members

can be made aware of the program and all that it offers. Once aware of the program, IEEE members can provide an added value to their local community by sharing the program with their local school districts. Currently, REACH has more than 800 subscribers from forty-six states and forty-two countries, with the potential to reach more than 500,000 students. We need your help to continue to expand the program and to ensure all students are technologically-literate and effective citizens.

Initially seed-funded by the IEEE Foundation and the generosity of donors, beginning in 2020, all funding for the program will depend solely on the generosity of its donors. To keep the program operational, a volunteer effort focused on presenting the program to IEEE Societies would both help increase donor interest in the program, and also provide an opportunity to learn which societies might want to underwrite

a unit in their specific area of expertise. Societies can also help by providing insight on economically-feasible hands-on activities for lesson units in their fields, and perhaps serve as experts in REACH videos tied to their industry.

Kelly McKenna, the REACH Program Manager can provide a PowerPoint and further details to any volunteer interested in presenting the REACH Program to their Society or other IEEE organizational unit. In addition, an in-person presentation by a History Center staff member could be arranged should a society provide an invitation to do so. Please contact Kelly McKenna directly with any questions, and with any interest in volunteering. Kelly may be reached at [k.mckenna@ieee.org](mailto:k.mckenna@ieee.org) We are grateful for you, the volunteers, for your time, your gracious donations, and any assistance to help IEEE REACH continue its mission – to ensure all students are technologically literate.

## SPACE TRAVEL COMMEMORATION UPDATE

As we have been reporting in previous issues of this newsletter, the IEEE History Center has been busy celebrating the contributions of IEEE members to human space travel, and ensuring that the history of these technical achievements will be preserved. The bronze milestone plaques will be permanent reminders to the public of the importance of what took place, and the first-hand histories will be a permanent resource for scholars, researchers, media, and the public.

### Space-related Milestones dedicated:

- Project Diana, 1946,
- LURE Lunar Ranging Experiment, 1969,
- First Search and Rescue Using Satellite Location Technology, 1982
- Parkes Radiotelescope, first transmission from Moon, 1969

### Stepping Stones dedicated:

Region 5 dedicated two Stepping Stone plaques at the NASA/Johnson Space center on 27 July. There were 200 people in attendance. This has led to a collaboration between Johnson Space Center and the IEEE History Center to preserve and make available NASA archival materials.

### Cohosted Events and Public Visibility:

The US Patent and Trademark Office invited IEEE to be the sole exhibitor at its "Apollo 50: The Role of Intellectual Property in Space Commerce." IEEE-USA, the IEEE History Center, *IEEE Spectrum*, and IEEE Technical Activities Entrepreneurship group participated. Attendance was more than double (900+) what the USPTO was expecting, and the event was a tremendous success. The History Center provided a slideshow, and a notebook of patents (first pages) by IEEE members involved in space technology. IEEE-USA sponsored the Virtual Reality Moonwalk that IEEE developed initially for the Consumer Electronics Show.



*IEEE 2020 President-Elect Toshio Fukuda, past IEEE History Committee Chair David Burger, and Parkes Shire Deputy Mayor Barbara Newton at the dedication of the IEEE Milestone plaque for the Parkes Radiotelescope which received the transmissions from the 1969 lunar landing.*

### Preservation of member achievements:

Thirty-two First-Hand Histories from IEEE members who worked in space-related technologies received, plus two additional oral histories.

Among the highlights:

- Robert Briskman (Space communications, S-band system)
- David Flinchbaugh (Lunar laser experiments—a connection to the LURE milestone)
- James Murphy (Apollo guidance and navigation)
- Balraj Sockappa (steering equations for command module)
- George Yabroudy (signal processing and components)

The ETHW landing pages

[https://ethw.org/Human\\_Space\\_Travel\\_Primary\\_Sources](https://ethw.org/Human_Space_Travel_Primary_Sources) where these materials are collected, have been visited more

than 4,000 times. It is not too late to add your own first-hand history. Please contact Robert Colburn [r.colburn@ieee.org](mailto:r.colburn@ieee.org) to find out how.

The History Center has received an offer to make available photographs from the collection of Steve Jacobson (press photographer who covered the launches). History Center staff are working with him on rights and access.

### IEEE History Center Staff Lunch & Learns:

17 July – *Apollo 11*, (this had an overflow live audience and was livestreamed by IEEE.tv)

8 October – *Sputnik*, Student Loans, and the race for STEM

## 200<sup>TH</sup> IEEE MILESTONE DEDICATED

On 28 August 2019, the IEEE Santa Clara Valley dedicated the Conductive Polymer Self-Regulating Heat-Tracing Cable, invented in 1972, as the 200th IEEE Milestone. [https://ethw.org/Milestones:Polymer\\_Self-Regulating\\_Heat-Tracing\\_Cable\\_1972](https://ethw.org/Milestones:Polymer_Self-Regulating_Heat-Tracing_Cable_1972) Today the vast majority of electrical trace heating is now done by self-regulating heaters with more than 10 manufacturers all over the world making this type of heating cable.

The plaque citation reads:

*In 1972, Raychem Corporation patented and began producing the first commercially successful electric self-regulating heat-tracing cable. The conductive polymer in this cable revolutionized the temperature maintenance of process piping, which has had major applications in refineries and chemical plants, and made freeze protection of water pipes simple and energy efficient. By 2008, the firm had manufactured and sold one billion feet of this cable.*



Attendees at the 200th IEEE Milestone dedication

Having two hundred IEEE Milestone plaques—on every continent and in every region—makes IEEE and the profession tremendously visible to the public. The IEEE History Center staff extend their warm gratitude to all the IEEE volunteers who have researched and proposed milestones. We invite any IEEE

member to consider proposing an achievement within IEEE's fields of interest as a Milestone. Guidelines and more information on the process may be found at: [http://ieemilestones.ethw.org/Milestone\\_Guidelines\\_and\\_How\\_to\\_Propose\\_a\\_Milestone](http://ieemilestones.ethw.org/Milestone_Guidelines_and_How_to_Propose_a_Milestone)

## THIRTY NEW ARTICLES ON PETROLEUM HISTORY ADDED TO THE ETHW

The Elizabeth & Emerson Pugh Scholar in Residence at the IEEE History Center provides research experience for students in the history of technology and engineering, while enlisting the help of promising scholars for the Center's projects. The 2019 recipient of the Scholar in Residence was Francesco Gerali, a

scholar of the oil and gas industry and petroleum technologies. During his time at the center, Gerali submitted thirty articles to the Engineering and Technology History Wiki (ETHW), primarily dealing with 19th century petroleum technology. In addition to

encyclopedic articles covering many of the industry's core technologies like instruments, fuels, extraction and storage, several bibliographic articles, such as a list of worldwide petroleum museums, were posted to the site. To see a list of the articles

submitted, visit: <https://ethw.org/Category:Petroleum>

As the ETHW is a wiki, any IEEE member is welcome to create an account and add their research and professional contributions to the site.

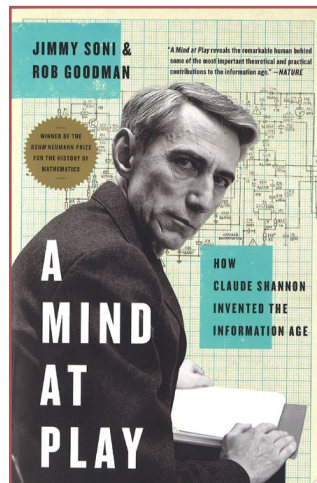
## A MIND AT PLAY IS 2019 MIDDLETON PRIZE BOOK

### 2019 MIDDLETON PRIZE ANNOUNCEMENT: *A MIND AT PLAY*

The IEEE History Committee has chosen the book *A Mind at Play: How Claud Shannon Invented the Information Age* by Jimmy Soni and Rob Goodman (Simon and Schuster, 2017) as the winner of this year's IEEE William and Joyce Middleton Electrical Engineering History Award.

One of the programs overseen by the IEEE History Committee is the IEEE William and Joyce Middleton Electrical Engineering History Award, established in 2014 by a gift from the estates of long-time IEEE leader William W. Middleton and his wife Joyce F. Middleton. The Middleton Award recognizes annually the author of a book (published within the previous three years) in the history of an IEEE-related technology that both exemplifies exceptional scholarship and reaches beyond academic communities toward a broad public audience. It carries a prize of US\$2,000. The 2015 inaugural winner was the book *Tesla: Inventor of the Electrical Age* by W. Bernard Carlson. Winners since then include: *The Innovators* by Walter Isaacson, and *Marconi: The Man Who Networked the World* by Marc Raboy.

In making its decision the IEEE History Committee believes



that *A Mind at Play*, by making Shannon's contributions to the Information Age known and accessible to the public, has increased understanding of how much of our modern world depends on Shannon's genius.

Jimmy Soni has served as an editor at *The New York Observer* and the *Washington Examiner* and as managing editor of Huffington Post. He is a former speechwriter, and his written work and commentary have appeared in *Slate*, *The Atlantic*, and CNN, among other outlets. He is a graduate of Duke University.

Rob Goodman is a doctoral candidate at Columbia University and a former congressional speechwriter. He has written for *Slate*, *The Atlantic*, *Politico*, and *The Chronicle of Higher Education*. His scholarly work has appeared in *History of Political Thought*, the *Kennedy Institute of Ethics Journal*, and *The Journal of Medicine and Philosophy*.

Jimmy Soni and Rob Goodman are also authors of *Rome's Last Citizen: The Life and Legacy of Cato, Mortal Enemy of Caesar*.

For more information contact the IEEE History Center at [ieee-history@ieee.org](mailto:ieee-history@ieee.org).

## IEEE LIFE MEMBERS' FELLOWSHIP IN HISTORY

### DAMILOLA ADEBAYO IS 2019 FELLOW IN HISTORY



Adewumi Damilola Adebayo, from Iwo, Osun state, Nigeria, is a PhD candidate in History at the University of Cambridge, where he is a Cambridge-Africa Scholar. He is a historian of Anglophone West Africa, particularly Nigeria, with thematic interests in economic history, science and technology studies, and international organizations. His doctoral research investigates the motivations, varied patterns, political and socioeconomic contexts, as well as the impact of electrification in Southern Nigeria, from the 1890s to the 1970s. The project examines the complex relationship between the ideas of socioeconomic development and exploitation in

the provision of colonial power infrastructure. The research explores the changes that were engendered in the way of life, and consequently, the way of thinking (modernity) of urban dwellers; as well as the influence of electricity on urbanisation and inequality in twentieth century Southern Nigeria.

Adebayo's research has been supported by grants from the Centre for Research in Arts, Social Sciences and Humanities (CRASSH), University of Cambridge, and the Joint Centre for History and Economics at Harvard University, among several others. He is the 2017 recipient of the Melvin Kranzberg Dissertation Fellowship of the Society for the History of Technology. He obtained his BA degree in History from the University of Ibadan, Nigeria, where he was a Grace Leadership Foundation Scholar; and an MA degree from the Graduate Institute, Geneva, Switzerland, as a Hans Wilsdorf Foundation Scholar.



## TOP SECRET: FROM CIPHERS TO CYBER SECURITY

Science Museum, London, United Kingdom  
Until 23 February 2020, with later dates elsewhere in the U.K.;  
free admission

By Alexander B. Magoun, Ph.D.

You approach the Science Museum's newest exhibit by going underground and down an aisle, beside an apparently unfinished space of black and white decor. You are going below the surface and behind the scenes to follow an episodic history of British information security and insecurity over the last hundred years. Curated by Liz Bruton and six teammates supported by dozens of museum staff and seven contractors, "Top Secret" is the culmination of a remarkable partnership with Government Communications Headquarters. GCHQ provided unprecedented access to its historic artifacts and its staff to celebrate its centenary. The exhibit's historic, contemporary, and puzzle sections serve the museum's interest in revealing the complex roles of codes and codebreaking in a democracy over time; they also serve GCHQ's interest in cultivating a new generation of cryptographers from within the United Kingdom to contain the threats from without.

A timeline introduces Lysander of Sparta as a pioneer in cryptographic technology, and a beginner's guide explains codes and ciphers and their use before 1914. Younger visitors may stay engaged, after an introduction to "Alice," by looking for her in ten locations around the exhibit. Then visitors decide with which theatre-like set to begin their tours. Start with the mortal consequences of telephone intercepts during World War I and Captain A. C. Fuller's scrambling of voice over wire through his Fullerphone, in front of a wall-sized battlefield map overlaid with color coded lines. Or see how Captain H. J. Round triangulated the location of German Zeppelin bombers from their wireless signals in a structure resembling the nose of an airship.

The centerpiece is, to be sure, Bletchley Park during World War II. The museum team has provided perhaps the finest explication of those operations, housed in and around green frame walls resembling the huts built on the estate's grounds. Texts of reasonable length, charts, and artifacts from public and private collections lay out the decoding process and the people responsible, hut by hut. Included are not only surviving pieces of the Colossus computer and the first and last iterations of the Enigma machines, which are compared to the far more complex Lorenz encryption machines, but also an original German Enigma setting sheet and Tommy Flowers' diary. The people who developed these techniques and technologies were human beings, a point made by Flowers's note that, on the Monday after he spent the weekend making Colossus operate for the first time, he took his children to see *Peter Pan*.

Flowing into the postwar/Cold War era, GCHQ has exhibited for the first time its 5-Unit Controlled (5-UCO), an unbreakable, one-time tape, Vernam cipher encryption machine for international teletype communications, along with more recent systems. Also on show is the evolution of secure telephones: Winston Churchill to Harold Macmillan during the Cuba Missile Crisis, up to Margaret Thatcher and Queen Elizabeth II, who used a "crypto key" inserted in an ISDN phone in the 1990s. A more colorful display explains the Portland Spy Ring that operated out of a London suburban home in the late 1950s. A collage of newspaper clippings wraps the outside a room decorated with similar floral patterns on the wallpaper and carpet. The spies' microdots struggle for attention with the kitchen décor and have less to do with cryptography than other aspects of spycraft.

Less visited and more pertinent to recent debates over the supervision of national intelligence agencies is journalist Duncan Campbell's exposé in 1987 of Project Zircon. GCHQ and Thatcher's government had concealed this expensive spy satellite from Parliament in violation of an agreement. Campbell and the GCHQ historian appear life-size on monitors during interview clips that discuss the unsettled conflict in a democracy between the public's right to know, the need for secrecy for the sake of national security, and the government's fear of embarrassment.

This leads to the section on GCHQ today. Here are more video interview clips of current staff on why they joined GCHQ and what projects they work on, including terrorism and international human trafficking. A Lego™ model of the Cheltenham "doughnut" headquarters and other non-classified items humanize an organization kept legally secret until a generation ago. Also on display are the micro-plastic and metal bits of a thoroughly shredded GCHQ device and the *Guardian's* 2013 laptop on which it stored Edward Snowden's controversial downloads from the U.S. National Security Agency, with which GCHQ partners. A "My Friend Cayla" interactive doll equipped with speech recognition and a Fisher Price interactive "I Talk, Listen & Learn" plush animal make visitors aware of the corporate surveillance inherent in the Internet of Things; the government's Cyber Streetwise and Cyber Aware campaigns receive their due.

Adjacent to current events is a puzzle room where visitors can suss out patterns and meaning from noisy texts or backgrounds placed on walls and low tables. The success of Bruton and her team in reaching for a broad audience is evident on a Sunday in September. For more than two hours the crowd, largely younger, grew steadily with females at least matching males in numbers and engagement with the past, present, and future of cryptography.

## FILM REVIEW: *THE BIT PLAYER* (CLAUDE SHANNON DOCUMENTARY)



By Brian Berg

I saw a screening on August 2 of *The Bit Player* at the Computer History Museum (CHM) in Mtn. View, CA USA. It was quite an impressive film. Interviews with Shannon, including an extensive one in the early 1980s at his home, formed the basis of much of the film by way of a key one being reproduced using actors. John Hutton played Shannon - he has extensive acting chops on stage (including as King Lear; some info here: <https://cupresents.org/2016/02/24/john-hutton-returns-csf/>)

and on film (various, including a small part in Spielberg's *Lincoln* as Massachusetts Senator Charles Sumner). It was a brilliant way to tell Shannon's story as it portrayed his in-person eccentricities - and there is no significant actual footage of this aspect of Shannon. This was accompanied by interesting animations and discussion of his seminal paper and famous Master's thesis in order to convey the gravity of his importance, along with portions of the 1952 "Theseus" Maze-Solving Mouse film. The film was concluded with just-discovered brief footage of Shannon juggling on a unicycle - that was fantastic to see!

More info, presented in an excellent and sophisticated fashion, is at [www.TheBitPlayer.com](http://www.TheBitPlayer.com). The panel that discussed the film after the screening (including Writer/Producer/Director Mark Levinson) noted that there would be a screening of the film in San Francisco in September. I do not know where else it will be shown in the future. The website shows the CHM screening as the film's third. It's the quality of film that I could easily and eagerly watch a second time even as soon as next month. Do study the website as it is brilliantly executed.

*The Bit Player* was commissioned by the IEEE Information Theory Society and funded thanks to donations to the IEEE Foundation. For more information, visit: <https://thebitplayer.com/>

## IEEE HISTORY CENTER PROGRAMS OF SUPPORT FOR SCHOLARS

### FELLOWSHIP AND INTERNSHIP SUPPORT FROM THE IEEE HISTORY CENTER

The IEEE History Center offers two programs of support annually for scholars pursuing the history of electrical engineering and computing: an internship for an advanced undergraduate, graduate student, or recent Ph.D., and a dissertation fellowship for an advanced graduate student or recent Ph.D. The internship and the dissertation fellowship are funded by the IEEE Life Members Committee. The internship requires residence at the IEEE History Center, on the campus of Stevens Institute of Technology in Hoboken, New Jersey, USA; there is no residency requirement for the dissertation fellowship.

#### The IEEE Life Member Fellowship in the History of Electrical and Computing Technology

The IEEE Life Members Fellowship in the History of Electrical and Computing Technology supports either one year of full-time graduate work in the history of electrical science and technology at a college or university of recognized standing, or up to one year of post-doctoral research for a scholar in this field who has received his or her Ph.D. within the past three years. This award is supported by the IEEE Life Members Committee. The stipend is \$25,000 with a research budget of up to \$3,000.

Reimbursable research expenses include economy class travel to visit archives, libraries, historical sites, or academic conferences, either to hear papers or to present one's own work. Hotel stay, meals while travelling, copying costs, reprints of scholarly articles, and books directly pertaining to research are reimbursable. Any research trip expected to cost more than \$1,000 must be approved in advance by IEEE History Center Staff. Examples of non-reimbursable expenses include, but are not limited to: licensing fees for images for book version of thesis (book publisher should pay for those), computers or computer peripherals, digital cameras, clothing, and office supplies (paper, pens, printer cartridges, CDs, memory sticks, etc.).

Recipients are normally expected to take up the Fellowship in the July of the year that it is awarded. Fellowship checks are normally mailed to the Fellow quarterly in July, October, January, and April. For Fellows in the southern hemisphere who follow the southern hemisphere academic year, arrangements can be made to mail the checks in December (two quarters worth), March, and June.

Candidates with undergraduate degrees in engineering, the sciences, or the humanities are eligible for the fellowship. For pre-doctoral applicants, however, the award is conditional upon acceptance of the candidate into an appropriate graduate program in history at a school of recognized standing. In addition, pre-doctoral recipients may not hold or subsequently receive other fellowships, but they may earn up to \$5,000 for work that is directly related to their graduate studies. Pre-doctoral fellows must pursue full-time graduate work and evidence of satisfactory academic performance is required. These restrictions do not apply to post-doctoral applicants.

The Fellow is selected on the basis of the candidate's potential for pursuing research in, and contributing to, electrical history. Application forms are available on-line at [http://www.ieee.org/about/history\\_center/fellowship.html](http://www.ieee.org/about/history_center/fellowship.html). The deadline for completed applications is 1 February. This completed application packet should be emailed to [ieee-history@ieee.org](mailto:ieee-history@ieee.org) or mailed to the Chair, IEEE Fellowship in the History of Electrical and Computing Technology Committee, IEEE History Center at Stevens Institute of Technology, Samuel c. Williams Library, 3rd Floor, 1 Castle Point on Hudson, Hoboken, NJ 07030-5991. Applicants will be notified of the results by 1 June.

The IEEE Fellowship in Electrical Engineering History is administered by the IEEE History Committee and supported by

the IEEE Life Members Committee.

### **Elizabeth & Emerson Pugh Young Scholar in Residence**

Scholars at the beginning of their career studying the history of electrical technology and computing are invited to contact the Center to be considered for the Pugh Young Scholar in Residence at the Center's offices on the Stevens Institute of Technology campus in Hoboken, New Jersey, USA.

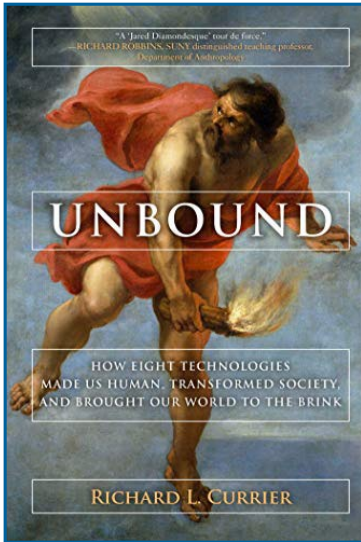
The residency seeks to provide research experience for graduate students in the history of electrical and computer technologies, while enlisting the help of promising young scholars for the Center's projects. The Young Scholar generally works full-time for two months at the History Center on a Center project that is connected to his or her own area of interest. This time is usually during the summer, but other arrangements will be considered. Residents are also encouraged to consult with the Center's staff and its associates, and guided to research resources in the area. The residency is designed for those near the beginning or middle of their graduate careers, but advanced undergraduates, advanced graduates, and, on rare occasions, recent Ph.D.s will also be considered. Special consideration is often given to scholars from outside the United States who might not otherwise have an opportunity to visit historical resources in the United States.

The stipend is US\$5,000, but additional funds may be available to defray travel costs, depending on the intern's circumstances.

There is no formal application form. To apply, please mail curriculum vitae showing your studies in electrical history, a three- to five-page page (single or double spaced) writing sample, along with a cover letter describing the sort of project you would be interested in doing (see contact information below). The deadline for contacting the IEEE History Center is 1 March.

IEEE and Stevens are AA/EO employers. Women and minorities are encouraged to apply for all positions. The IEEE History Center is cosponsored by the Institute of Electrical and Electronics Engineers, Inc. (IEEE)—the world's largest professional technical society—and Stevens Institute of Technology. The mission of the Center is to preserve, research, and promote the legacy of electrical engineering and computing. The Center can be contacted at: IEEE History Center, Stevens Institute of Technology, 1 Castle Point on Hudson, Hoboken, NJ 07030-5991, +1 732 562 5450, [ieee-history@ieee.org](mailto:ieee-history@ieee.org), [http://www.ieee.org/about/history\\_center/index.html](http://www.ieee.org/about/history_center/index.html).

Your contributions to the **IEEE History Center Fund** preserve the heritage of the profession and its contributions to humanity. We invite you to find out more about the Center and its programs at <https://www.ieee.org/about/history-center> and more about the Engineering & Technology Wiki ([ethw.org](http://ethw.org))



CURRIER, RICHARD L., *Unbound: How Eight Technologies Made Us Human, Transformed Society, and Brought the World to the Brink*, Arcade Publishing, New York, NY, 2015.

Distinguished anthropologist/educator turned popular author Richard Currier has done what many of us dream of doing: written an early-20th-century-style “big history,” in the tradition of H. G. Wells’ *Outline of*

*History* (1920) or Hendrik Willem van Loon’s *Story of Mankind*

(1921). Reviewers have also compared it to the more recent work of Jared Diamond. Of interest to the readers of this newsletter, in this case the author sees technology as the driving force in history, in fact, as the defining feature of humankind. Starting with when our earliest hominid ancestor threw the first spear, Currier has selected eight technological inflection points that he believes explain all of history (spoiler alert: the last one is the digital revolution brought about in the late 20th century by IEEE members).

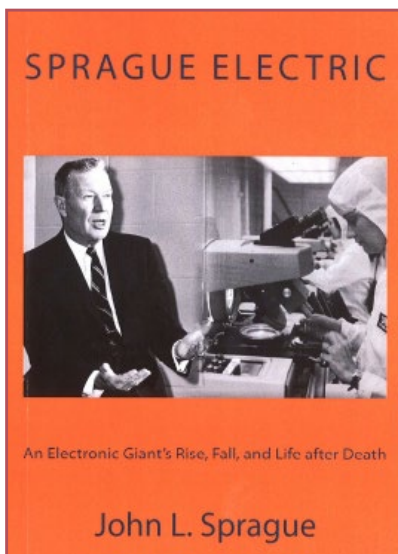
Readers may not be persuaded by Currier’s specific choices or even his overall theory, but that is part of the fun of a work like this, and they will certainly learn a lot about the human past. The book is well written and engaging, and the work is thoroughly researched and clearly referenced for those want to follow the trail further, whether in agreement or in refutation.

Available from Amazon ([https://www.amazon.com/Unbound-Eight-Technologies-Human-Brought-ebook/dp/B012T-N04Y2/ref=sr\\_1\\_1](https://www.amazon.com/Unbound-Eight-Technologies-Human-Brought-ebook/dp/B012T-N04Y2/ref=sr_1_1)) in hardback, paperback, or kindle editions, prices vary); xix + 376 pages including endnotes

## FROM THE IEEE HISTORY CENTER PRESS

### *SPRAGUE ELECTRIC: AN ELECTRONIC GIANT’S RISE, FALL, AND LIFE AFTER DEATH*

by John L. Sprague



The rise of the Sprague Electric Company from a high-tech kitchen-table startup is representative of much of the U.S. electronics industry. Sprague Electric began in 1926 in the Quincy, Massachusetts kitchen of a young naval officer, Ensign Robert C. Sprague, and became a thriving manufacturer employing thousands of workers. Its broad product line of electronic components achieved

international sales and a reputation for the highest quality. There were more than 50,000 Sprague components on every *Apollo* mission, and more than 25,000 aboard every Space Shuttle. The company later declined, went

through a series of acquisitions, and eventually dissolved.

*Sprague Electric* provides a valuable business and technological history, a story of corporate success, and a cautionary tale of what to avoid. Told by company insider John Sprague, *Sprague Electric* gives the reader a front-row seat.

The *Sprague Electric* story reveals the value of investment in research and development, and also the effects of raw material supply chains on product lines. It is a story of a company’s relations with the small New England mill town of North Adams, Massachusetts where its factories were located, and how labor relations — initially cordial— later soured. It is a story of how a vulnerable company weathered the stresses of the Great Depression and triumphed, only to be brought down by the recessions of the 1970s and 1980s.

It is a history of acquisitions, mergers, and spin-offs— some of them botched— and of the strategic and tactical mistakes that eventually caused the company to vanish. Yet, *Sprague Electric’s* successor companies continue its legacy in the electronic components industry. Corporations formed from its different business units and operations are now located around the world. The principal manufacturing plant of Sprague Electric is now an acclaimed art museum.

Available from **Amazon.com** in hard copy and on Kindle.

[http://www.amazon.com/Sprague-Electric-Electronics-Giants-after/dp/150338781X/ref=sr\\_1\\_2?ie=UTF8&qid=1429202871&sr=8-2&keywords=sprague+electric](http://www.amazon.com/Sprague-Electric-Electronics-Giants-after/dp/150338781X/ref=sr_1_2?ie=UTF8&qid=1429202871&sr=8-2&keywords=sprague+electric)



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Donations to the IEEE History Center Fund may be designated for general use to support IEEE history activities, to support collection and posting of Oral History interviews of important innovators, and to build the History Center endowment.

You may donate online at [https://www.ieeefoundation.org/donate\\_history](https://www.ieeefoundation.org/donate_history) or by mail at: IEEE History Center at Stevens Institute of Technology, Samuel C. Williams Library, 3rd Floor, 1 Castle Point on Hudson, Hoboken, NJ 07030 USA



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