

# IEEE History Center

March 2016, *100<sup>TH</sup> ISSUE*



*Livingston Heritage Middle School social studies class makes use of ideas from an IEEE History Center conference on history of technology.*

Signals from the Director .....	2	Center Activities .....	4
History Committee Activities.....	3	New Oral Histories on the ETHW	
History Committee Chair's Message		RCA's Fabulous 45s Exhibit	
IEEE Organizational Units Invited to		REACH Gains Momentum	
Become Active in IEEE History		History Center Social on Twitter and Tumblr	
Staff Notes .....	4	Donor Honor Roll .....	6
Mary Ann Hellrigel Joins the Staff		Donor-Advised Funds Help the History Center	
New Research Assistant Jeffrey Huber		IRA Charitable Rollover Law	
		2015 Donor List	
		Bibliography.....	12

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 Geselowitz, Ph.D.

First of all, let me welcome you to 100th issue of the IEEE History Center Newsletter. From a twice-a-year mimeograph in the 1980s to our current three-times-a-year mix of laser-printed and electronic editions, we have kept our supporters and other interested parties apprised of our activities while also reviewing books and websites, showing mystery photos, and revealing historical insights. I hope you have enjoyed reading it as much as we have enjoyed writing it. Special kudos to the managing editor for the past almost twenty

years, History Center Research Coordinator Robert Colburn.

This year in particular we expect to have a lot to put in these pages; 2016 promises to be a banner year for the IEEE History Center. We have just welcomed a new staff member, Dr. Mary Ann Hellrigel, and a new History Committee Chair, Dr. Allison Marsh. Among the many exciting activities we will be carrying out are: continued enhancement of the Engineering & Technology History Wiki; a project to document the institutional history of IEEE since the centennial in 1984 (at that time a history from 1884 to 1984 was commis-

### 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 the "Donate Online" tab at [www.ieee.org/donate\\_history](http://www.ieee.org/donate_history) or [www.ieeefoundation.org/](http://www.ieeefoundation.org/)

### 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 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 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.

### THE IEEE HISTORY CENTER NEWSLETTER ADVERTISING RATES

The newsletter of the IEEE History Center is published three times per annum; one issue (March) in paper, the other two (July and November) electronically. The circulation of the paper issue is 4,800; the circulation of the electronic issues is 22,500. The newsletter reaches engineers, retired engineers, researchers, archivists, and curators interested specifically in the history of electrical, electronics, and computing engineering, and the history of related technologies.

	<u>Cost Per Issue</u>
Quarter Page	\$150
Half Page	\$200
Full Page	\$250

Please submit camera-ready copy via mail or email attachment to [ieee-history@ieee.org](mailto:ieee-history@ieee.org).

Deadlines for receipt of ad copy are 2 February, 2 June, and 2 October.

For more information, contact Robert Colburn at [r.colburn@ieee.org](mailto:r.colburn@ieee.org).

sioned; look for more details in the July newsletter); and an expansion of the oral history program. Also in 2016, the maturation of our relationship with our host and strategic education partner, Stevens Institute of technology, is leading to all sorts of opportunities (see Center Activities, beginning on p. 4). Of course, as already hinted at last issue, our major focus this year will be launching REACH, our new high-school history initiative that is a Signature Program of the IEEE Foundation. REACH, along with our other programs, is a major contributor to one of the "Core Values" on the new IEEE Strategic Plan: "Promoting public awareness and understanding of the engineering profession." We also hope to fulfill the IEEE Professional Staff Commitment to "increase operational efficiencies" and to work in

even closer collaboration with the IEEE History Committee to achieve our mutual goals.

Finally in 2016, the IEEE Foundation has committed itself to increasing its fundraising activities in order to better support our activities as well of those of other organizational units supporting IEEE's public imperative. We will be working extremely closely with them. Therefore, it is my pleasure, in this annual honor roll issue of the newsletter, to once again express my appreciation to you, our current loyal supporters who made all this possible in 2015. Thank you, and best wishes for 2016. We look forward to continuing to partner with you and keep you apprised of our results through our newsletters and other mailings.

## HISTORY COMMITTEE ACTIVITIES

### HISTORY COMMITTEE CHAIR'S MESSAGE

By Allison Marsh

As both an engineer and a public historian, I am very excited to take the reins of the History Committee this year. Keeping track of our history as an organization and sharing engineering accomplishments with the world helps everyone understand the importance of technology in everyday life.

One of the best conduits for marking IEEE achievements is the Milestone program. With more than one hundred and fifty Milestones dedicated around the world, the bronze plaques and accompanying information on the web tell amazing stories of engineering success.

This year the History Committee is working to process all of the Milestone nominations that are currently in the pipeline and trying to cut down the time between nomination and final approval. Additionally, I will be reaching out to various section chairs to consider the possible nomination of some high profile

achievements. At its heart, the Milestones program is a grassroots effort where local sections identify and propose sites of achievement. There is a lengthy list of suggested Milestones on the Engineering & Technology History Wiki ([http://ieeemilestones.ethw.org/List\\_of\\_Achievements\\_Suitable\\_for\\_Milestones](http://ieeemilestones.ethw.org/List_of_Achievements_Suitable_for_Milestones)). I encourage IEEE members in all regions to review this list and acknowledge their place in history.

The bronze plaques identifying IEEE Milestones allow casual passersby to learn that history happened on that site. They can learn and be inspired by inventions and innovations. The Milestones website expands on the plaque citation and offers supplemental information, creating a wonderful resource for students who are researching electrical history.

The public outreach of the Milestones program helps shape positive opinions on the role of engineers in society. Promote your history today!

### IEEE ORGANIZATIONAL UNITS INVITED TO BECOME ACTIVE IN IEEE HISTORY

IEEE organizational unit officers are invited to appoint their historians, chairs of history committees, or milestone chairs as corresponding members of the IEEE History Committee. The intention is to foster communication across all of IEEE's history activities. Corresponding members receive History Committee agendas, minutes, and updates. Corresponding members are welcome to attend History Committee meetings and to participate in all discussions as non-voting members. However, the IEEE History Committee regrets that it does not have the budget to reimburse travel expenses for corresponding and other non-regular members. Travel expenses for liaison and corresponding members must be reimbursed by the corresponding member's sponsoring organizational unit (e.g. Region, Society,

etc.), or by other organizations.

For information on appointing corresponding members, please email [ieee-history@ieee.org](mailto:ieee-history@ieee.org)

IEEE organizational units are invited to use the Engineering & Technology History Wiki (<http://ethw.org>) website to research and to collect their history. Each organizational unit has a page for its history on the ETHW. A good example is the IEEE Benelux section history [http://ethw.org/IEEE\\_Benelux\\_Section\\_History](http://ethw.org/IEEE_Benelux_Section_History). IEEE members can easily log on using their IEEE web accounts.

Members can share their past experiences in designing, developing, testing, manufacturing, and commercializing new products and services by writing topic articles and first-hand histories.

A third form of historical activity is for organizational units



to propose IEEE Milestones in Electrical Engineering and Computing to honor technical achievements in IEEE's fields. The IEEE Milestone Program [http://ieemilestones.ethw.org/Main\\_Page](http://ieemilestones.ethw.org/Main_Page) is one of the most visible ways that IEEE celebrates the heritage of its profession. There are suitable achievements in all technical areas of IEEE worthy of such recognition. The

ETHW has a number of features to assist with the proposal of IEEE Milestones in Electrical Engineering and Computing, including a list of historical achievements suitable for proposal [http://ieemilestones.ethw.org/List\\_of\\_Achievements\\_Suitable\\_for\\_Milestones](http://ieemilestones.ethw.org/List_of_Achievements_Suitable_for_Milestones)

## HISTORY CENTER STAFF NOTES

### MARY ANN HELLRIGEL

The History Center is pleased to welcome Dr. Mary Ann Hellrigel as its newest staff member. She will serve as the Institutional Historian/Archivist, the position previously held by Sheldon Hochheiser.

Mary Ann has a bachelor's degree in History from Rutgers University, a Master's degree in Public History from UC-Santa Barbara, and a Ph.D. in History of Technology and Science from Case Western Reserve University. She has served as a Research Associate at the Thomas A. Edison Papers Project, and has taught history of technology at a number of universities around the country, including at our current strategic partner, Stevens Institute of Technology.

Mary Ann has widely published and presented papers on Edison and early electric power, and has consulted on related exhibits and documentaries. She is also active in the Society for the History of Technology, having served on several prize committees.

It also turns out that Mary Ann was the 1993 – 1994 recipient of the IEEE Life Members' Fellowship in Electrical History, so her return to IEEE is particularly appropriate. She will report to the Center's Senior Director, Dr. Michael Geselowitz and be based at the Stevens office in Hoboken, NJ, USA. However, she will also be working closely with Digital Content Administrator Nathan Brewer on projects at the IEEE Archives, which are held at the IEEE Operations Center in Piscataway, NJ, USA.

### RESEARCH ASSISTANT JEFFREY HUBER JOINS THE HISTORY CENTER

Jeffrey Huber is a fifth-year undergraduate student in the Engineering department at Stevens Institute of Technology. He is at the tail end of his undergraduate career, expecting to earn a Bachelors of Engineering in Electrical Engineering in May 2016. Additionally, he is pursuing a Master of Engineering in Systems

Engineering with a concentration in Engineering Management, to be completed in December 2016. Following graduation, he will be working in BAE System's Electronic Systems Research & Development arm.

## CENTER ACTIVITIES

### DEEP KNOWLEDGE: NEW ORAL HISTORIES ON THE ENGINEERING AND TECHNOLOGY HISTORY WIKI

The Engineering and Technology History Wiki (ETHW) was launched in January of 2015 as a partnership between IEEE and six other major engineering societies to document the history of all disciplines of engineering and technology. The ETHW re-branded the IEEE History Center's former wiki, the IEEE Global History Network, and it has several new oral history collections. The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) has recently posted sixteen oral histories detailing the history of the mining and metallurgical profession, and the IEEE Robotics and Automation society has posted more than eighty of its oral histories. These oral history collections, as well

as the other oral history collections on the ETHW, can be viewed here: [http://ethw.org/Oral-History:List\\_of\\_all\\_Oral\\_Histories](http://ethw.org/Oral-History:List_of_all_Oral_Histories)

Additionally, the site is beginning to further harness Semantic Mediawiki's (SMW) capabilities. A series of extensions, SMW enables the creation of a semantic database using custom-defined properties of any piece of data available in articles. As History Center staff continues to process the collections, the SMW tools will display various relevant pieces of data in each article, allowing for easy browsing of similar articles and powerful queries. For more information on SMW, see: [https://www.semantic-mediawiki.org/wiki/Semantic\\_MediaWiki](https://www.semantic-mediawiki.org/wiki/Semantic_MediaWiki)

## RCA'S FABULOUS 45s EXHIBIT



Last September through January, visitors to Stevens Institute's Samuel C. Williams Library found perhaps the most colorful display ever mounted in the lobby. "RCA's Fabulous 45s" (an exhibit of RCA's 45-rpm record changer and records) appealed to people who grew up stacking records, making cassette mixtapes, loading CDs, or streaming MP3s. An expanded version of an exhibit staged at the David Sarnoff Library more than ten years ago, it was based on a productive collaboration between outreach historian Alex Magoun of the IEEE History Center and Phil Vourtsis,

retired engineer and the world's leading collector of 45-rpm record changers. Vourtsis' wonderful book on the subject contains Magoun's dissertation chapter on the 45-rpm record, a topic Magoun pursued because of his record-collecting and DJ activities. The subject was ideal for Stevens because the innovation of the 45 record and changer system involved mechanical, electrical, and chemical engineers as well as marketing, music, and executive managers. The story shows how engineering is shaped by market demand, inventive choices, unexpected events, competition from established and new alternatives, corporate promotion, consumer response, and popular culture. It also involves a practically infinite array of music on discs of all colors, a tiny sample of which from the 1940s to the 2000s was also displayed. Magoun looks forward to developing a new exhibit later this year on "Something from Nothing: The Many Uses of Vacuum Tubes."

## REACH GAINS MOMENTUM

### (Raising Engineering Awareness through the Conduit of History)

Significant progress has occurred over the past four months with the development of REACH. REACH was extremely well received at the 2015 National Council for the Social Studies annual conference as well as at the 2015 New Jersey Council's annual conference where Kelly McKenna, REACH Program Manager, and Michael Geselowitz, Senior Director of the IEEE History Center, presented REACH to Social Studies teachers from across the country. The end result was a substantial increase in the number of participants on the REACH academic advisory panel, which now boasts seventy-five members from twenty-two states. Participants include Social Studies teachers as well as Social Studies Coordinators and Education Administrators.

Educators strongly believe in the value of REACH and in the free lesson resources it will provide. Evidence of this can be found in new alliances formed between the IEEE History Center and two New Jersey high schools, Manalapan High School and Madison High School. The educators and administrators of these schools will provide insight and guidance on the design format and focus areas for two REACH pilots. As revealed in the last newsletter, the first pilot will highlight the technologies tied to early maritime navigation and how these technologies pushed forward global exploration. The second will focus on technologies associated with mass communication, such as the printing press, radio, the internet and social media, and how such technologies affected social change at certain times in history. Adam Angelozzi, Principal of Manalapan High School articulates, "The IEEE History Center at the Stevens Institute of Technology has engaged in a thoughtful and collaborative effort to develop curriculum resources that provide guidance to educators in helping students to understand the impact that technological advancements have had on the history of the world."

The IEEE *Institute* also reported on REACH, "Once the pilot

is completed, the program will expand to schools across the country, according to REACH program manager Kelly McKenna." In addition the article highlighted that REACH will also be available worldwide. "Although the Center is developing REACH to meet U.S. National Council for the Social Studies standards, the resources will be available to instructors around the world." As Kelly McKenna states, "The resources will be accessible on the REACH website, which is currently in development. A beta version of the website is expected to debut in April."



*Michelle Lilley, Supervisor of Social Studies, and Principal Adam Angelozzi of Manalapan High School, look forward to using IEEE History Center REACH materials in their curricula.*

The positive response from the education community has aided in the momentum of REACH and certifies REACH fills an educational gap and provides a valuable resource to teachers. More importantly REACH offers to students, as well as teachers, an opportunity to gain a broader understanding of the relationships among science, technology, and society and develop an appreciation of how engineers and creative problem solving have played a role throughout history. It's an exciting time for REACH and the IEEE History Center. A Video About REACH can be seen here: <https://www.youtube.com/watch?v=5vmMxJrt3F4>

You can support REACH by clicking on <https://www.ieeefoundation.org/donate> and choosing "IEEE REACH Fund" at the "Designation" box.

## IEEE HISTORY CENTER SOCIAL ON TWITTER AND TUMBLR

The IEEE History Center is bringing history to increasing numbers of people via social networking tools such as Twitter and Tumblr. Follow the activities of the IEEE History Center and others involved in the history of engineering on its Twitter feed at <https://twitter.com/ieeehistory>.

The IEEE History Center maintains a blog on Tumblr in which interesting images related to the history of technology are posted. Featured in Tumblr's history and science categories,

the blog has approximately 154,000 followers as of January 2016 and more than 216,000 total social interactions. To date, six of the posted images have been featured on Tumblr's *radar*, a feature that allows the Tumblr staff to promote selected images to all logged-in users. These posts receive significantly more social interactions, the highest reaching 12,000. To follow the blog or to view the images, go to <http://engineeringhistory.tumblr.com/>.

## DONOR HONOR ROLL

### DONOR-ADVISED FUNDS CAN HELP THE HISTORY CENTER

By Stan Retif, IEEE Foundation

The IEEE Foundation continually seeks opportunities that streamline the giving process. Goals include assisting donors in helping to advance the mission of Foundation programming, such as the History Center, while also helping meet the respective donor's philanthropic objectives. We strive to keep donors aware of philanthropic opportunities.

Donor-advised funds, a philanthropic mechanism largely unknown less than two decades ago, have recently been coming into favor. The first donor-advised funds were established soon after the Great Depression, but it wasn't until 1969 that the United States Congress established the legal structure governing their use. By the 1990s, donor-advised funds became a vehicle of choice for many donors; today they account for more than three percent of all charitable giving in the United States.

According to the National Philanthropic Trust, "A donor-advised fund, is a philanthropic vehicle established at a public charity. It allows donors to make a charitable contribution, receive an immediate tax benefit and then recommend grants from the fund over time. An easy way to think about a donor-advised fund is like a charitable checking account: a donor contributes to the fund as frequently as they like and then recommends grants to their favorite charity when they are ready."

The basic components of a normal Donor-Advised Fund include:

A donor makes an irrevocable contribution of personal assets;  
The donor immediately receives the maximum tax deduction allowed by the IRS;

The donor names the fund account, advisors, and any successors or charitable beneficiaries;

The contribution is placed into a donor-advised fund account where it can be invested and grow tax free;

At any time afterward, the donor can recommend grants from the account to qualified charities.

Attracting philanthropic support grows more competitive each year, and it is important for nonprofits to be flexible in accommodating donors' wishes. The IEEE Foundation and

the History Center will continue to build philanthropic partnerships that are mutually beneficial. Visit the IEEE Foundation Donor Advised Fund webpage to learn more: <http://bit.ly/DonorAdvisedFunds>.

*Should you have questions regarding Donor-Advised Funds or any planned giving vehicle, the IEEE Foundation recommends that you consult your financial advisor. If the Foundation can be of assistance, please contact Stan H. Retif, Chief Development Officer, IEEE Foundation, at [s.retif@ieee.org](mailto:s.retif@ieee.org).*

## THANK YOU TO OUR HISTORY CENTER DONORS!

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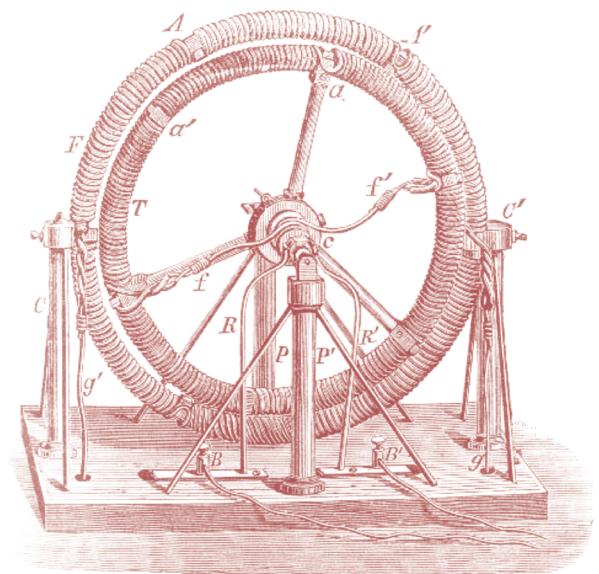


Image courtesy of Smithsonian Institution



## IRA CHARITABLE ROLLOVER LAW REINSTATED

At IEEE, we know that philanthropy is personal. We also know that, for many, a strategic financial approach to philanthropy can maximize impact while also supporting your personal financial goals. Therefore, we want you to be aware that the IRA charitable rollover law has been reinstated in 2016 and will remain in effect thereafter.

*Individual retirement account* (IRA) owners over the age of 70½ may transfer to qualifying charities, including the History Center Funds of the IEEE Foundation, up to \$100,000 per year from their IRA, which counts toward one's required minimum distribution for the year while at the same time avoids taxes. What a great way to support IEEE and IEEE Foundation AND

maximize the impact of your IRA!

If you are interested in this unique opportunity to support the IEEE History Center, or if you have questions, please contact IEEE Foundation at +1 732 465 5871 or [donate@ieee.org](mailto:donate@ieee.org).

Are you ready to make a tax-free contribution that will support the history and legacy of IEEE? You can download our sample request letter at <http://ieeefoundation.org/file/ira-rollover-sample-letter.docx> and submit to your financial institution. Please remember to share this with us as well so we can properly acknowledge your contribution.

## Transform lives

Bring the promise of technology – and the knowledge and power to leverage it – to people around the globe. **Donate now to the IEEE Foundation and make a positive impact on humanity.**

- Inspire technology education
- Enable innovative solutions for social impact
- Preserve the heritage of technology
- Recognize engineering excellence

## IEEE Foundation



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Learn more about the IEEE Foundation at [ieeefoundation.org](http://ieeefoundation.org).  
To make a donation now, go to [ieeefoundation.org/donate](http://ieeefoundation.org/donate).



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 [http://www.ieee.org/about/history\\_center/index.html](http://www.ieee.org/about/history_center/index.html).

## 2015 DONOR LIST

## IEEE HISTORY CENTER PRESERVATIONISTS CIRCLE

The Preservationists Circle acknowledges the philanthropic spirit of the individuals, corporations, and organizations who have supported IEEE History Center throughout their career and lifetime. Members of the Circle have made significant contributions to the History Center at crucial stages in its founding and development. These Philanthropists' donations to IEEE History Center Endowment total \$10,000 or more since 1 January 1995.

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The IEEE History Center gratefully recognizes the generosity and support of the individuals, corporations, and organizations listed here. Your support enables us to fulfill our mission to further the preservation, research, and dissemination of information about the history of electrical science and technology. All listings acknowledge gifts made to IEEE Foundation funds dedicated to the support of the IEEE History Center during the calendar year 2015.

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## NEW BOOK FROM THE IEEE HISTORY CENTER PRESS

### *Enrico Fermi's IEEE Milestone in Florence*

edited by

Gianfranco Manes and Giuseppe Pelosi



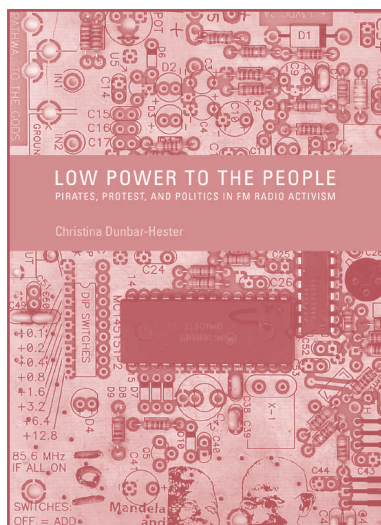
Nobel laureate Enrico Fermi developed the quantum statistics that would be named after him while teaching at the School of Engineering of the University of Florence. The Fermi-Dirac statistics were a fundamental contribution to semiconductor physics and to the development of electronics. (The two original 1926 papers are reproduced in full in this book.) This book commemorates the dedication in December 2015 of a Milestone in Electrical Engineering and Computing by IEEE at the University of Florence in commemoration of Fermi's contribution.

The U.S. version of the book, published by the University of Florence, and copublished in the U.S.A. by the History Center Press, is now available on Amazon.com. At the request of the University of Florence, the US book price has been set to cover production costs and not to produce royalties for the History Center Press.

Available from Amazon.com in hard copy.

[http://www.amazon.com/Enrico-Fermis-IEEE-Milestone-Florence/dp/1522870903/ref=sr\\_1\\_1?s=books&ie=UTF8&qid=1453476582&sr=1-1&keywords=fermi+milestone](http://www.amazon.com/Enrico-Fermis-IEEE-Milestone-Florence/dp/1522870903/ref=sr_1_1?s=books&ie=UTF8&qid=1453476582&sr=1-1&keywords=fermi+milestone)

DUNBAR-HESTER, CHRISTINA,  
*Low Power to the People: Pirates, Protest, and Politics in FM Radio Activism*, MIT Press, 2014

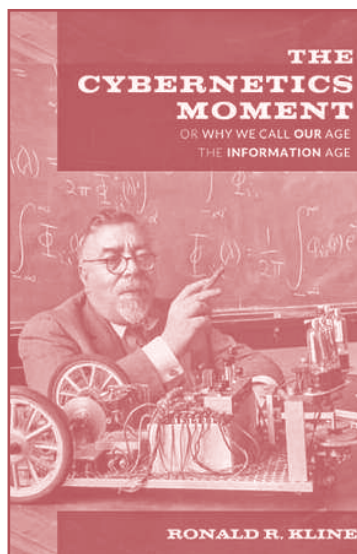


Some of the most interesting history of technology these days is coming out of media studies departments. Dr. Christina Dunbar-Hester, a professor of Journalism & Media Studies at the Rutgers University School of Communication & Information does not disappoint. While at one level a fascinating story about the cultural and political effects of the decision by the U.S. Federal Communications Commission to issue non-commercial low-power FM licenses in 2000, this book does not shy away from discussing the technological

context and results of this political move. Furthermore, it concludes with a well-reasoned discussion of the implications for the resurgence in FM for broader questions of the introduction of new/old technologies, and the role of non-centralized communication technologies in society. The book is highly recommended for anyone interested in these issues.

Available from The MIT Press, Cambridge, MA, USA, +1 800 358 0343, fax +1 617-625-6660, <http://mitpress.mit.edu>, \$36.00, hardcover, ISBN 978-0-262-02812-7, xxvi+271 pp., bibliography, index, b&w illustrations.

KLINE, RONALD,  
*The Cybernetics Moment: Or, Why We Call Our Age the Information Age*, Johns Hopkins University Press, 2015



As mentioned in a previous issue, 2014 marked the 120th anniversary of the birth and 50th anniversary of the death of Norbert Wiener, the founder of the field of cybernetics. These occasions have led to renewed interest in cybernetics—whose fortunes have waxed and waned—and in its founder. An IEEE conference was held on “Norbert Wiener in the 21st Century” in Boston in 2014, and a second IEEE conference is planned for Melbourne, Australia for 13 - 15 July 2016; the focus

Continued on Page 14 **13**



of the new conference is “Thinking machines in the Physical World” (<http://21stcenturywiener.org/>).

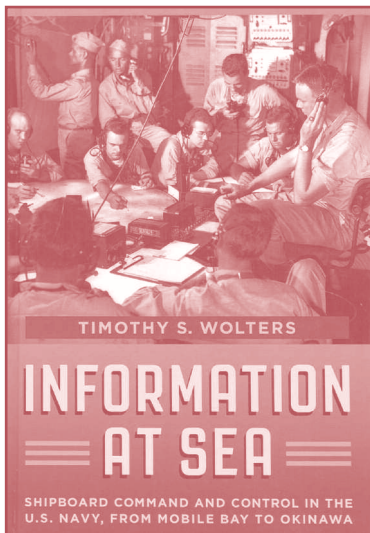
One of the speakers at the 2014 conference was Dr. Ronald Kline, the Bovay Professor in History and Ethics of Engineering at Cornell University. A senior historian of technology who has written on wide range of topics concerning the growth and social impact of modern technological systems (and a former Director of the IEEE History Center!), Dr. Kline is perhaps uniquely situated to take on so large and complicated topic as cybernetics. That is why among the conferences and other recent revivals of interest surrounding Norbert Wiener, we are excited to note Kline’s contribution to the moment, *The Cybernetics Moment: Or, Why We Call our Age the Information Age*. Kline does not gloss over cybernetics’ controversies or challenges—including its Cold War context—but, as the subtitle suggests, he documents its contributions to subsequent scientific and engineering developments.

Readers unfamiliar with Wiener and his work are well advised to start with this well-written and thorough book. Those who are already familiar will still find much that is new and informative in the thorough research and reasoned interpretations.

Available from the Johns Hopkins University Press, Baltimore, MD, USA, [www.press.jhu.edu](http://www.press.jhu.edu), \$54.95, hardcover, ISBN 1-4214-1671-9, xi + 336 pp., bibliography, index, b&w illustrations.

## WOLTERS, TIMOTHY S.

*Information at Sea*, Johns Hopkins University Press, Baltimore, 2013



Towards the end of the Middle Ages, European powers realized that ships offered a unique strategic and tactical advantage. On land cannons had limited mobility, but on water they could be deployed with great ease. As floating gun platforms, naval vessels could project a nation’s power across the globe in ways inaccessible to even the largest land forces. Furthermore, with a powerful navy, a nation could command the world’s oceans, and hence command trade on a global scale. By the end of the 16th century, the floating gun plat-

form transformed the face of naval battles. Ships began to fight at greater distances from each other. The scale of this geographical dispersion stayed constant until the later part of the 19th century. Then a series of radical innovations not only dramatically increased the geographical scale naval combat, but they also created the need for faster and more sophisticated information processing and transfer, both within ships and between ships.

Using the experience of the U.S. Navy, Timothy S. Wolters, in his book *Information at Sea*, presents the reader with a fascinating

and thoughtful history of this transformation in the period between the end of the civil war and World War II. Wolters is ideally suited to take us on this historical journey. He is a professor of history and a former Ramsay Chair of Naval Aviation History at the Smithsonian. As an “engineer-qualified submariner” and a Captain in the U.S. Naval Reserve, he also brings a first-hand appreciation of naval command and control. He contends that naval historians have been so focused on the ships and the commanders, that they have overlooked the history of the human-machine complex developed to coordinate seaborne forces. The development of the social and technical innovations underlying this coordination was just as crucial to success as the ships and their commanders. Wolters’s prime objective is to take the reader inside the black-box of naval command and control.

The strength of Wolters’s narrative is its portrayal of the close coupling between organizational change and technical innovation. The most difficult problem faced by the naval commanders was the coordination, in real-time, of ever more geographically dispersed seaborne forces. Technology lay at the heart of this dispersion. Huge gains in ship speeds and more powerful armaments greatly expanded the spatial field of naval combat. At the same time, “radio”, as Wolters explains, “was the first technology to provide commanders with real-time information from beyond the horizon. ... In other words, the battle space expanded while time available to make decisions shrank.” To handle the rapid flow of information from this new communications technology, new layers of technical expertise were introduced between the raw data and the ship’s commander. Commanders never lost their ultimate authority, but gone were the days when a commander would make battle decisions with very limited input from his subordinates. Wolters’s discussion of this devolution demonstrates quite convincingly that technological improvements in command and control required important social changes within the ship.

As Wolters explains, the aircraft carrier in the Pacific revealed serious vulnerabilities in the U.S. Navy’s system of command and control. The logic of the floating gun platform had been extended to air power. Combatant navies could thus use fighter aircraft to attack each other’s fleet. Radar, which had become the commander’s new “eyes,” proved crucial to defending American ships against Japan’s determined air attacks. The use of radar further deepened reliance on a greatly expanded cadre of technically sophisticated mid-level officers who also shared in data analysis and problem solving. But in the early years of WW II, the effectiveness of this human-machine complex to coordinate battle naval forces against air attacks proved inadequate. The aircraft carrier was the single most important asset in the fleet. As the sinking of the aircraft carrier *Hornet* illustrated, the radar data overwhelmed a ship’s technical and organizational capacity to provide timely tactical information. “Our fighter direction”, wrote Nimitz, “in both practice and in action against small groups has been good but a fighter direction against a larger number of enemy groups ... is problem not yet solved.” Protecting aircraft carriers was absolutely central. A new approach was needed. The “Combat Information Center” (CIC) emerged as the answer.

The development and deployment of the CIC is the climax of Wolters’s narrative. Its experience in the early years of the Pacific Front convinced the U.S. Navy’s mid-level technical officers that



there was an urgent need for a place on the ship that could merge large amounts of diverse battle data into one coherent tactical view. Admiral Nimitz made it the priority. The data fusion had to cover a geographic scale far beyond visible horizon; and it had to be in real-time. A Navy Tactical Bulletin described the CIC's purpose to be the place where the evaluation "of all available information, by trained personnel, would allow for the quickest dissemination of such information to flag and commanding officers, to other control station concerned, over interior communications circuits and to other ships and aircraft via external communications facilities." The CIC required the insertion of even more highly skilled, technical personnel into the command and control process. The Navy characterized the CIC "as the most drastic and rapid change in our shipboard experience." Wolters examines, in great detail, the technological and organizational facets of this dramatic change.

In opening up the black box of command and control, Wolters expands our understanding of the factors behind the success of the U.S. Navy during WW II. "American forces", writes Wolters, "consisted of planes, ships, ordnance, and radars technologically superior to anything the Japanese could bring to bear. Although rarely mentioned by historians another critical advantage was the CIC. [It] enabled [the American] task force to defend itself against air attack with an effectiveness that simply would not have been attainable earlier in the war."

Wolters' story ends with WW II. But the CIC had important consequences for the future of shipboard command control. CIC

set the stage for the digitization of naval warfare. Though the CIC had been successful, technological advances in the immediate postwar years made it clear that the CIC, as it was, could not cope with the new generation of ships, jet aircraft, and nuclear submarines. Wolters titled his chapter on the CIC "Creating the Brain of the Warship." The 1950s, the "Brain" had to be automated. The U.S. Navy embarked on an ambitious program to digitize data acquisition, communication, and processing. The computer provided the real time tactical information and fire control. From the knowledge and experience gained from CIC emerged the Naval Tactical Data System (NTDS).

For all those interested in naval history or the history of technology, we strongly recommend Timothy S. Wolters, "Information at Sea". For all those interested in delving deeper into the postwar developments in shipboard command and control, we recommend going to the Engineering and Technology History Wiki ([www.ethw.org](http://www.ethw.org)) and search under NTDS. This site contains a wealth of information on the subject.

This book is wonderful example of the very positive impact of the IEEE Life Members Fellowship. In 2002-2003, this fellowship helped support the author's Ph.D. dissertation research, on which this book was based.

Available from Johns Hopkins University Press, Baltimore, MD, 800-537-5487 (in U.S. and Canada), +1 410-516-6965 (All other customers), <http://www.press.jhu.edu>, Hardback, 336 pages, 16 b&w illus., ISBN:9781421410265, September 2013, \$54.95. Also available as an ebook.

## KEIO UNIVERSITY MAKES USE OF HISTORY CENTER CRYPTOGRAPHY MILESTONE

Keio University has published a collection of its past entrance examinations for use by Japanese high school students in preparing for them. The IEEE History Center is proud that the book excerpts material from its supporting material for the IEEE Milestone the Invention of Public-Key Cryptography, 1969 [http://ethw.org/Milestones:Invention\\_of\\_Public-key\\_Cryptography,\\_1969\\_-\\_1975](http://ethw.org/Milestones:Invention_of_Public-key_Cryptography,_1969_-_1975)



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