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Guest Editorial: The Educational Activities of the IEEE History Center

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Guest Editorial: The Educational Activities of the IEEE History Center

I. INTRODUCTION

FROM its inception, IEEE has had senior volunteers who were concerned with the history of their profession and its technology, and so a standing committee was established from the very beginning to report on historical matters to the IEEE Executive Committee. The role of the IEEE History Committee is to be responsible for “promoting the collection, writing, and dissemination of historical information in the fields covered by IEEE technical and professional activities, as well as information about the IEEE and its predecessor organizations.”

The IEEE History Committee currently comprises 15 distinguished engineers and historians from five countries. In recent years, the committee has largely carried out its mandate by recommending and overseeing historical projects for the IEEE History Center. The IEEE History Center—the staff arm for historical activities at IEEE—was founded in 1980 at the IEEE New York headquarters and in 1990 relocated to Rutgers University—New Brunswick Campus, NJ, which became a cosponsor.

We are involved in the IEEE History Center in various capacities: one (Sloan) as the immediate past Chair of the IEEE History Committee, another (Laker) as a past Member of the IEEE History Committee and current Chair of the IEEE Foundation’s Trustees of the IEEE History Center, and another (Geselowitz) as Staff Director of the IEEE History Center. We recognize that many members of IEEE and of the IEEE Education Society may know that the Center has traditionally carried out its activities through a number of programs in the areas of preservation, research, and outreach. What you may not realize is that a fourth program area, i.e., education, is equally important to the Center’s work, and we hope to set the record straight in this guest editorial.

The goals of dissemination—as stated in the IEEE History Committee’s charter—and outreach—as stated in the IEEE History Center’s mission (“to preserve, research, and promote the history of electrical engineering and computing”) are aimed at addressing a knowledge gap. The advances in IEEE technologies (e.g., power distribution, transportation, electric lights, communications, household appliances, computers, industrial equipment, research, and medical electronics) were arguably the most important events of the twentieth century. We feel that it is also safe to predict that IEEE technologies will help shape the twenty-first century.

There is, however, a widespread lack of realization and understanding of these facts. Few historians are trained in science,

and fewer still are trained in technology and engineering. Journalists cover technology poorly. Government leaders lack understanding of basic technological processes, and in democratic nations, their constituents are equally uninformed.

By preserving, researching, and promoting the history of its technologies, IEEE can increase public understanding of the role of engineering in society and help prepare better informed citizens, aid policymakers in understanding the implications of their technology-based decisions, and increase appreciation for the engineering profession and its members, thereby raising the morale of IEEE members. Outreach means reaching out not only to our fellow engineers, journalists, and decisionmakers—although these are important constituents of the IEEE History Center—but also to young people, to inform and educate them. These young people are the future citizens, leaders, and, in some cases, engineers. The sooner that they can be reached, the better; and the best way to reach them is through direct educational programs, whether formal or informal.

In the early years of the Center, its educational activities were mostly the indirect results of traditional outreach efforts. For example, public exhibits arranged in conjunction with institutions such as the Smithsonian certainly reached some young people. In recent years, however, the Center has been involved directly in the education of students from the university graduate level down to the pre-college audience.

II. GRADUATE-LEVEL ACTIVITIES

Since 1990, Center staff have taught classes at, and participated in, the other educational activities of Rutgers University. Rutgers’ History Department is considered a major source of top Doctorates of History in the United States. The History of Technology is a relatively new field in academia, and at many institutions, it is subsumed by the History of Science. By participating in graduate education at Rutgers, the IEEE History Center helps make the future academic historians aware of the importance of technology in the evolution of society and of the nature of the engineering enterprise, as opposed to the scientific enterprise. IEEE History Center staff supervise Rutgers’ history graduate assistants, attend and give presentations at departmental seminars, and sit on committees. The IEEE History Center staff are also active in professional societies, such as the Society for the History of Technology (SHOT), at whose meetings and in whose journals academic history is shaped. The IEEE Life Members Committee gives through SHOT an annual prize for the best paper on electrical history.

The Life Members have also funded since 1996 a graduate fellowship in electrical history, selected by the IEEE History

Committee and administered by the History Center. The fellowship provides one year of support for an advanced graduate student studying the history of electrical and informational sciences and technologies. The fellowship is often used for a year of writing the dissertation. The idea of the fellowship is to help ensure a future generation of high-quality academic historians of technology who are particularly sensitive to the issues involved with IEEE technologies. Recent winners have come from such universities as Cornell University and Pennsylvania State University. Dissertation topics have included the history of scanning electron microscopy and a study of the development in American corporations of management techniques for dealing with information processing.

III. UNDERGRADUATE-LEVEL ACTIVITIES

Since 1990, IEEE History Center staff have also taught Rutgers undergraduate survey courses on science and technology in American and world history as well as smaller seminars on electrical history. Although popular, surveys indicated that these courses were mainly taken by students in the humanities and social sciences as well as in the preprofessional fields, such as business. It is, of course, important to educate these individuals, who are tomorrow's voters and, perhaps, leaders. However, the History Center staff felt that service was also needed for the engineering undergraduates.

In recent years, engineering educators have come to realize that undergraduate engineering majors need a greater grounding in the social and historical context of their discipline. In 1995, the Accreditation Board for Engineering and Technology (ABET) revised its accreditation standards. The new standards, known as Engineering Criteria 2000 (EC2000), explicitly adopt the approach that has long been advocated by the IEEE History Committee. EC2000 states that "in the interest of making engineers fully aware of their social responsibilities and better able to consider related factors in the decisionmaking process, institutions must require coursework in the humanities and social sciences as an integral part of the engineering program. This philosophy cannot be overemphasized."

Different universities and their schools of engineering have responded in different ways. For example, one of us (Sloan) teaches at a technological institution—the Michigan Technological University (MTU). MTU revised its general education requirements and initiated a seminar for first-year students, called Perspectives on Inquiry, in 1999. Perspectives on Inquiry has many purposes, the most important of which is to ensure that new students become accustomed to analyzing issues from several perspectives. The course also provides an intense introduction to the higher expectations of college-level courses, acquaints students with one faculty member whom they can know well, and gives them substantial experience in writing and speaking. Enrollment is limited to 20 students per seminar; at MTU, all first-year students take this course, unlike at many universities, where similar seminars are either elective or restricted to honor students.

Seminars for first-year students have become more widespread since the Boyer Commission's report "Reinventing

Undergraduate Education: A Blueprint for America's Research Universities" was published in 1998. The commission named for Ernest L. Boyer, a past President of the Carnegie Foundation for the Advancement of Teaching, has advocated first-year seminars to help refocus research universities toward undergraduate teaching. A recent follow-up to the Boyer report, as reported in the Chronicle of Higher Education (<http://chronicle.com/weekly/v48/i28/28a01201.htm>, March 22, 2002), found that more than 80% of 123 responding research universities offer a first-year seminar, with 45% of these having half or more of their first-year students in such courses.

Each faculty member who teaches a section of Perspectives on Inquiry selects a focus and submits a proposal to the Perspectives on Inquiry review committee, which considers it. Typical topics include Antarctica, John Wayne movies, communications, fresh water, and constitutional issues. Technological topics include failure and systems thinking; historical topics include Thucydides and hockey history and culture.

For the past two years, Sloan has taught a Perspectives section titled Cryptography, Secrecy, and Security. Students who choose the course are primarily engineering and computer science majors but have included physics, technical writing, and surveying majors. The largest part of the course covers history of cryptology; then the course moves on to current cryptographic issues, including recent and pending legislation. Students read and discuss two books: David Kahn's *The Codebreakers*, the classic history of cryptology, and Neal Stephenson's *Cryptonomicon*, a high-tech thriller that also covers much of the cryptologic history of World War II. Students typically find Kahn's book difficult, but it provides a good introduction to college-level material. *Cryptonomicon* is more to their liking, but it also provides historical fiction and an introduction to current issues.

During the semester, students have several assignments. They write and act a skit based on some event in cryptologic history; the skit counts as a group paper. Individually, the students write a long informative paper on some historic topic and two shorter papers—an analysis of an expert's paper on the current status of codebreaking and a persuasive paper on a cryptologic issue of their choice. They also debate current cryptologic issues, taking sides determined by the instructor. Recent issues included the Digital Millennium Copyright Act, the FBI's Carnivore program, Senator Holling's proposed bill called the Security Systems Standards and Certification Act, cryptographic export controls, and cryptographic aspects of antiterrorist legislation. This past semester, as an experiment, we had an art show in which students could choose an artistic medium, including Web page design, to present some aspect of cryptology. Although many chose computer media, others painted pictures, built models, carved plaques, or sculpted.

The response of the IEEE History Center to the need for the broadening of the engineering curriculum has been twofold. First, using its unique combination of contacts in the engineering and historical communities, the History Center seeks to serve as a clearinghouse for information about innovative courses such as that designed by Sloan. Second, the Center decided to pilot its own program at Rutgers. In 1997 it began to teach once per year Introduction to Science, Technology, and Society, an extradepartmental interdisciplinary course.

Although under the rubric of the Faculty of Arts and Sciences (the IEEE History Center's institutional home at Rutgers), the course is taught on the engineering campus at a time convenient for engineering students and fulfills an upper-level humanities and social science distribution requirement for them. At the same time, the course can fulfill a minor requirement for arts and sciences majors, leading to a mixed class. In the class discussions, it is hoped that the engineering and nonengineering students come to see each other's points of view more clearly. The course enrollment is capped at 25 for practical reasons and has, of late, been fully enrolled with very positive student feedback. The minor program seems to be gaining momentum, with the number of current declared minors approaching double digits after fewer than five years.

IV. PRE-COLLEGE ACTIVITIES

Meanwhile, recognizing the importance of the History Center's educational activities, in 1999 IEEE reorganized the Center so that the staff reported through the Educational Activities Department (previously, they had done so through Publications). Compatible with the IEEE Educational Activities' recent increasing emphasis on reaching the broader public (particularly, pre-college youth) as well as with IEEE's overall goal to deliver products and services more broadly through use of internet technology, the latest initiative of the IEEE History Center has been to build an educational service for the pre-college audience—the IEEE Virtual Museum (VM). The IEEE VM was launched in February 2002 with initial funding from the IEEE Foundation, the IEEE Life Members Committee, and the Trustees of the IEEE History Center.

Originally proposed by one of us (Laker) to the IEEE Foundation as a program worthy of Foundation funding, the IEEE VM explores and presents the global and social impact of technology, and it demonstrates the relevance and significance of engineering and engineers to society through a focus on electrical and information technologies. Using the latest Internet-based techniques, it seeks to reach younger generations. In addition, the IEEE VM seeks to contribute to greater knowledge of science and engineering principles among this audience, under the principle "What *was* increases our understanding of what *is!*" Taking the audience through the exciting discoveries, inventions, and developments of the past, the VM takes the opportunity to use interactives and other techniques to show how the technologies actually work.

This combination of history and technology is unique both on the Web and in brick-and-mortar museums. The lack of an actual museum and the use of the Web enable the IEEE History Center to craft our specific message and to reach a broader audience

than could be accomplished with an actual museum. The VM opened with two exhibits—a general longer "backbone" exhibit on electrical history and a more typical exhibit on the history of sound recording. The next phase will involve the expansion of content. More important, the IEEE History Center will be reaching out to teachers, who will be the ones to guide students to the site as well as use it in the classroom. To do this, the Center will need to prepare instructional material that will make the site useful to teachers in the current standards-based pre-college educational environment and will be seeking sources of funding and partners to do so. In addition, although currently available only in English, the IEEE VM has built-in multilingual capability. Parallel sites—as well as other techniques for dealing with issues of bandwidth—are envisioned for the future.

V. CONCLUSION

It is our belief that as the world becomes increasingly reliant on technology, both education and a historical perspective will become more and more critical and that IEEE will have to remain alert to the needs of society in these areas. It will be extremely important to reach young people as early as possible to make them aware of how technology works and what its impact is on the past, present, and future. It will be particularly salient to try to reach these young people through programs using new technology.

The contact information for the IEEE History Center is 39 Union Street, New Brunswick, NJ 08901-8538; telephone: +1 732 932 1066; fax: +1 732 932 1193; e-mail: history@ieee.org. The Center's Web pages (http://www.ieee.org/history_center) contain much useful information on how IEEE members can help support the IEEE History Center and otherwise get involved in its activities.

The IEEE Virtual Museum can be visited directly at <http://www.ieee.org/museum>. We invite you to look at our resources and to give us feedback, and we look forward to working with members of the IEEE Education Society to fulfill IEEE's educational mission.

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Michael N. Geselowitz received the S.B. degrees in electrical engineering and in anthropology from the Massachusetts Institute of Technology (MIT), Cambridge, in 1978 and 1980 and the M.A. and Ph.D. degrees in anthropology from Harvard University, Cambridge, MA, in 1982 and 1987, respectively.

He was an Electronics Engineer for the Department of Defense and has held teaching and research positions relating to the social study of technology at MIT, Harvard, and Yale University, New Haven, CT, including a stint as Assistant Collections Manager/Curator at Harvard's Peabody Museum of Archaeology and Ethnology. Immediately prior to joining IEEE in 1997, he was Group Manager at Eric Marder Associates, a New York market research firm, where he supervised Ph.D. scientists and social scientists undertaking market analyses for Fortune 500 high-tech companies. He is Staff Director of the IEEE History Center, New Brunswick, NJ, and is also a registered Patent Agent. His research focus has been on the history and social relations of technology.

Martha E. Sloan (M'69–SM'76–F'91) received the B.S.E.E. degree with great distinction, the M.S.E.E. degree, and, in 1973, the Ph.D. degree from Stanford University, Stanford, CA. She also received the M.S. degree from the University of Southern California, Los Angeles, and an honorary doctorate from Concordia University, Montreal, QC, Canada.

She is a Professor of Electrical and Computer Engineering at Michigan Technological University, Houghton, MI. She is the author of three textbooks and more than 60 technical papers.

Dr. Sloan is a Fellow of the Association for Computing Machinery (ACM) and the Society of Women Engineers (SWE) and a recipient of numerous awards, including the ASEE Frederick Emmons Terman Award, the IEEE Computer Society Richard E. Merwin Award, and the SWE Distinguished Engineering Educator Award. She has served as President, Treasurer, and Vice President of the IEEE Computer Society and as President, Treasurer, and Executive Vice President of the IEEE.

Kenneth R. Laker (S'70–M'73–SM'78–F'83) received the B.E. degree in electrical engineering from Manhattan College, Riverdale, NY, in 1968 and the M.S. and Ph.D. degrees from New York University in 1970 and 1973, respectively. In 2000, he received the Honorary Doctorate of Electronics and Computer Engineering from the Technical University of Crete, Chania, Greece.

He was a member of the founding Board of Directors of AANetcom, Allentown, PA, until its sale to PMC-Sierra in 2000. Currently, he is the Alfred Fittler Moore Professor of Electrical Engineering at the University of Pennsylvania, Philadelphia, and Cofounder, President, and CEO of DFT MicroSystems in Yardley, PA. His work in microelectronic filters has contributed four textbooks, more than 90 scientific articles, and six patents.

Currently, Dr. Laker is a member of Advisory Boards for Safeguard Scientifics in Wayne, PA, and Optelics in Somerville, NJ. The awards he has received include the 1994 AT&T Clinton Davisson Trophy for his patent in switched capacitor circuits and the 1998 IEEE Circuits and Systems Darlington Award for the paper "Integrated Circuit Testing for Quality Assurance in Manufacturing: History, Current Status, and Future Trends," which was published in IEEE Transactions on Circuits and Systems—II: Analog and Digital Signal Processing (August 1997). He has served the IEEE in numerous leadership positions, including IEEE President in 1999, and is currently serving as Chair of the Foundation's Trustees of the IEEE History Center.