IEEE JAMIESON IS 2006 PRESIDENT-ELECT

The Institute

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Kevin Passino teaches an engineering ethics class at Ohio State University.

Adding Ethics To Engineering Education

BY WILLIE D. JONES

IMAGINE THIS SCENARIO: you've just joined a company competing for a government contract to build a military bomber. But the plane would have to fly so fast that it pushes its envelope of safety. The project manager of your engineering team quits because he believes the design is not safe. The company asks you to take over his job. Knowing that your company's financial future depends on getting this contract, would you give the project the green light or refuse the promotion?

In handling such an ethical dilemma, engineers can't rely on instinct alone. They need training that can help them balance considerations such as the health, safety, and welfare of the public with technical concerns. Universities are no longer assuming that the new engineer will learn ethics on the job but are now offering instruction on the subject. The IEEE is also playing a role by promoting students' awareness of their professional responsibilities as engineers. In fact, the scenario above was presented to contestants in a student ethics competition first held [Continued on page 13]

MEDICAL RECORDS:

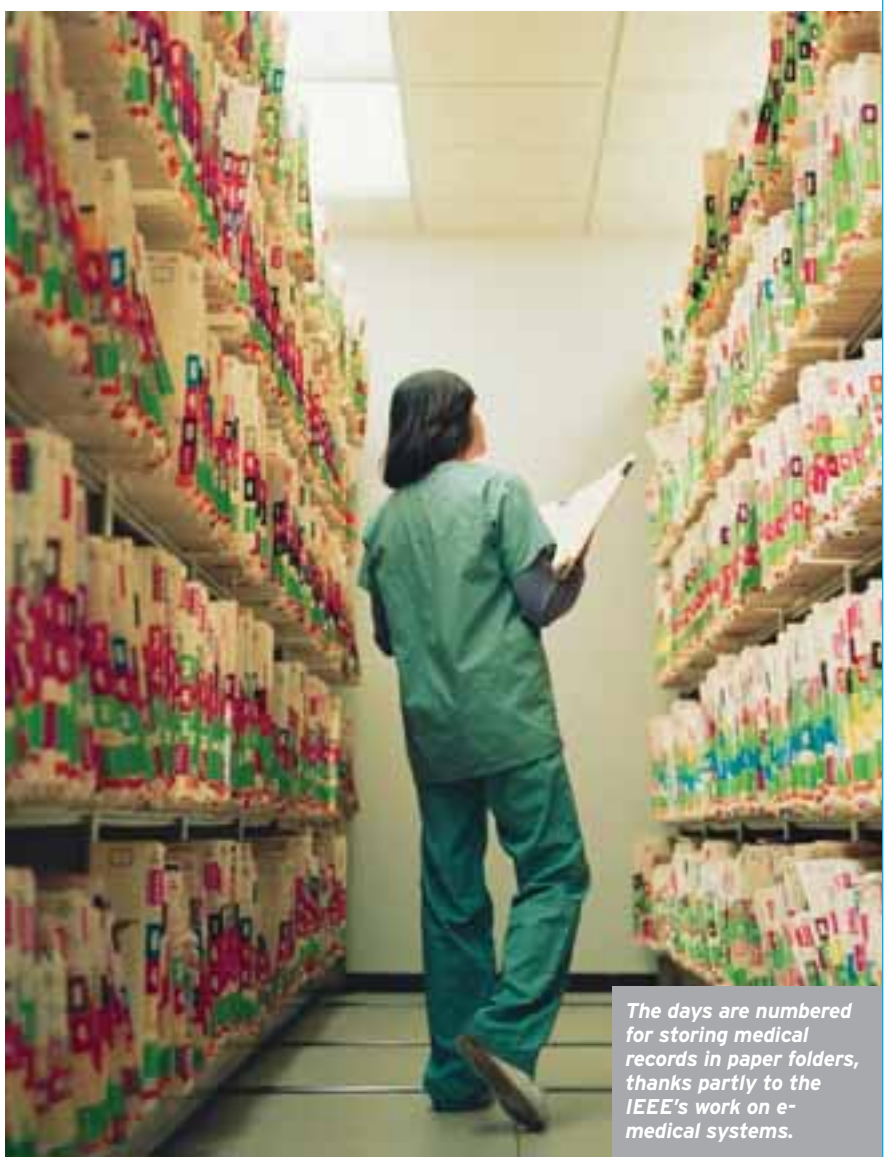
From Clipboard To Point-and-Click

BY TRUDY E. BELL

CALL THEM ELECTRONIC charts or electronic medical records: whatever the name, the days of patients' medical conditions and diagnoses being written illegibly on paper and stored in manila folders are numbered. Medical records, according to plans under way, are going electronic.

To help make that happen, the IEEE has joined forces with the American Medical Association and eight other major nonprofit medical and engineering societies to form an umbrella consortium, the Biotechnology Council. The council's primary goal is nothing less than standardizing everything from medical terminology to networking protocols so that medical records can be stored electronically and sent instantly anywhere in the world—with absolute privacy, security, and understandability.

In a few months, the first fruits of the Biotechnology Council's efforts—the council passed its first anniversary in November—will ripen. Its first technical conference, the Distributed Diagnosis and Home Health Care Conference on remote-monitoring technologies and policies, is scheduled for 3 and 4 April in Washington, D.C. The council also plans to hold a workshop on what it terms Bio- [Continued on page 11]



The days are numbered for storing medical records in paper folders, thanks partly to the IEEE's work on e-medical systems.

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THE INSTITUTE ONLINE

http://www.ieee.org/theinstitute

Look for these articles on 6 December

HISTORY The first 735-kilovolt power transmission system named an IEEE Milestone.

NEWS Actions taken at the November IEEE Board of Directors meeting.

FEATURED CONFERENCE The first joint meeting of the IEEE Robotics and Automation and Engineering in Medicine and Biology societies, the International Conference on Biomedical Robotics and Biomechantronics, will be held in Pisa, Italy, from 20 to 22 February 2006.

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NEWS

FROM AROUND THE IEEE & THE WORLD

LEAH JAMIESON
NEW PRESIDENT-ELECT

LEAH H. JAMIESON has been selected the 2006 IEEE president-elect by members of the IEEE. She will begin serving as IEEE president on 1 January 2007 (pending acceptance of the Teller's Committee election-tally report by the IEEE Board of Directors, which was to take place in mid-November). Jamieson is the second woman to be elected president of the IEEE; Martha Sloan held the office in 1993.

Jamieson, an IEEE Fellow, is the Ransburg Professor of Electrical and Computer Engineering, and associate dean of engineering for undergraduate education at Purdue University, in West Lafayette, Ind., where she has been a faculty member since 1976. She is the vice president this year of IEEE Publication Services and Products and was chair of the IEEE Technical Activities Board Periodicals Committee, as well as vice president of Technical Activities in 2003.

At Purdue, Jamieson co-founded and is a director of the Engineering Projects in Community Service (EPICS) undergraduate engineering design program, which was initiated at Purdue and adopted by 17 universities. EPICS matches teams of engineering students with local community-service programs to define, design, build, test, and support projects that improve the community. One example is Purdue's partnership with the Wabash Center Children's Clinic, in Lafayette, which works with the physically disabled. Purdue students helped deliver custom playgroup software, including interactive programs to teach the sign-language alphabet. For her work with EPICS, she was the co-recipient of the 2005 Bernard M. Gordon Prize given by the U.S. National Academy of Engineering to recognize innovation in engineering technology education.

Jamieson received a bachelor's degree in mathematics from the Massachusetts Institute of Technology, in Cambridge, and master's and doctoral degrees in electrical engineering and computer science from Princeton University, in New Jersey.

Of the IEEE members who voted in the election, 15 965 selected Jamieson, and 10 723 chose Gerald H. Peterson. James M. Tien received 9301 votes.

IEEE Xplore Adds New Features

SEARCHING FOR AN IEEE book? Want to buy a standard? You can now do such things through IEEE Xplore, thanks to features added in the digital library's latest upgrade. IEEE Xplore contains more than 1.2 million documents from IEEE journals, magazines, transactions, conference proceedings, and standards, as well as journals and conference proceedings from the Institution of Electrical Engineers in the United Kingdom.

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To try these new features, visit http://www.ieeexplore.ieee.org/Xplore.

IEEE Potentials Available to All Members Online

MEMBERS CAN NOW ACCESS the online version of *IEEE Potentials*, the peer-reviewed bimonthly magazine aimed at innovators and young professionals. The magazine, which had been available only to student members, presents general-interest articles that trace the latest in research and innovation. It also covers new developments in a wide range of engineering and technical topics, and it tackles workplace issues such as how to deal with a difficult boss.

There's no charge to members who access the online edition from IEEE Xplore, the digital library. Students in the United States and Canada will continue to receive print copies of *IEEE Potentials*, which is included with each membership. Students from other countries pay US $5 for a print subscription.

Herz Award to Honor Outstanding IEEE Employee

DO YOU WORK WITH an IEEE staff member who continually demonstrates leadership and makes outstanding contributions to the IEEE's success? Then consider nominating that person for the newly established Eric Herz Outstanding Staff Member Award, named for the former IEEE general manager and executive director who also is a longtime institute volunteer.

The first award will be presented next year. The deadline for submitting nominations is 31 January 2006.

The prize includes a US $5000 honorarium, a certificate, and reimbursement for the cost of travel to the award ceremony, which is scheduled for the final Board of Directors meeting of the year, in November.

Only full-time staff members of the IEEE with at least 10 years of service are eligible for the award, which is to be given every two years. The nominators and supporters must be IEEE volunteers. Members of the IEEE Board of Directors, the Awards Board, and the selection committee may not submit nominations.

For nominating forms, visit the IEEE Awards Web site at http://www.ieee.org/awards or send a message to awards@ieee.org.

Journals to be Digitized Dating Back to Volume 1, Number 1

THE IEEE IS IN THE PROCESS of digitizing the articles of all its journals, each dating back to its very first issue, so that researchers will have easier access to the historic, scholarly content.

The IEEE Electron Devices Society (EDS) is the latest society to put its archived journals online. The society recently uploaded more than 15 000 articles from its most influential publications: *IEEE Transactions on Electron Devices* (from 1954 to 1987), *IEEE Electron Device Letters* (1980 to 1987), and the *IEEE International Electron Devices Meeting Conference Proceedings* (1955 to 1987). Those articles, now part of the IEEE/IEE Electronic Library (IEL), make up about half of the society's collection. The other half, from 1988 to the present, is already available online.

The first phase of the two-year project began in June, and since then more than 12 000 papers and articles published in the *Proceedings of the IEEE* from 1963 to 1987 were uploaded as well [See "Digitizing Technology's History," p. 19].

The older issues are being added to an IEEE digital collection of 1.2 million documents that have appeared in 120 journals, 900 active standards, and the proceedings of 400 annual conferences. Articles can now be searched electronically for phrases and keywords—which is characteristic of the IEL.

Members Weigh In on IEEE Code of Ethics Revision

REACTING TO FEEDBACK from IEEE members and volunteers, the IEEE Ethics and Member Conduct Committee has modified its proposed revision of the first declaration of the IEEE Code of Ethics. The committee previously sought to replace the word "engineering" with "technological" in the code's first article, as reported in "Revision Proposed to IEEE Code of Ethics" [September 2005, p. 4], to recognize that IEEE members who are not engineers are also governed by the IEEE Code of Ethics.

The EMCC now proposes to remove any reference to "engineering" or "technological" in the code's first article. The declaration would state that IEEE members agree "to accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment." Originally, the code said that IEEE members agree "to accept responsibility in making *engineering* decisions" and so on.

The IEEE Board of Directors will consider the proposed revision at its February meeting. Two-thirds of the board must vote in favor of the change for it to pass.

Send any comments about the proposed revision to ethics@ieee.org. You can read the IEEE Code of Ethics at http://www.ieee.org/about/whatis/code.html.

Corrections

In "Dues Up Slightly" [September], the 2006 affiliation fee for society affiliate membership was incorrect. Affiliates—individuals who belong to one or more IEEE societies but are not IEEE members—pay an affiliation fee of US $60. The fee, which is set at half the basic IEEE member dues (currently $119), is, in practice, rounded up to the nearest dollar. Note, too, that society affiliates pay the $60 affiliation fee for each IEEE society they join, as well as the member dues charged by that society.

In "In Memoriam" [September], the locations of Jack St. Clair Kilby's universities were misstated. He earned a bachelor's degree from the University of Illinois at Urbana-Champaign and a master's degree from the University of Wisconsin, in Madison, both in electrical engineering.

Lights, Camera, Engineering Breakthroughs

MORE STORIES about IEEE-related technologies are making their way into short TV news programs produced by the American Institute of Physics. To this end, IEEE-USA started collaborating with AIP in November 2004.

Each month AIP's Discoveries and Breakthroughs Inside Science news service delivers a dozen 90-second spots to 108 subscribing stations. The spots aim to provide a realistic image of how professionals in engineering, math, science, and technology contribute to a better quality of life. They are meant to run during local news programs and can theoretically reach more than 80 million U.S. households.

IEEE-USA is working with AIP to add segments that focus on engineering. IEEE Technical Activities, Corporate Communications, and *IEEE Spectrum* are providing story ideas and technical experts.

The broadcasts focus on practical innovations. Since the collaboration began, the news service has included stories about such items as a mechanical arm for stroke victims, a remote-controlled robot that can be sent into dangerous rescue sites, and mesh wireless networks, which ease overloaded communications networks.

To view sample video spots or find a TV station near you that airs them, visit http://www.ivanhoe.com/science. A limited number of DVDs with sample segments are available for U.S. IEEE volunteers to incorporate in presentations to middle schools and high schools. To order a DVD, contact Pender McCarter, IEEE-USA, at p.mccarter@ieee.org.

IEEE-USA is collaborating with the American Institute of Physics on Discoveries and Breakthroughs Inside Science television spots, such as this one, called "Screens of the Future."

E-newsletter Zeros In on Standards

FOR THOSE WHO want to know the latest on IEEE standards, there's now a free monthly newsletter that can bring the news to you and your computer. The *IEEE StandardsWire* carries key information about new and recently approved and revised standards, in addition to details about standards work that has just begun. The new publication replaces *The Standards Bearer Online,* which focused mainly on the actions of the IEEE Standards Board and not on what was going on with the standards themselves. *StandardsWire* provides readers a description of the standards that are being released and related products, as well as an explanation of how the standards and products will benefit industry.

A supporting Web site archives *StandardsWire* issues at http://standards.ieee.org/standardswire. The site also contains news releases from the IEEE Standards Association and information on recent actions taken by the IEEE Standards Association's board of directors. To subscribe to the newsletter, visit http://standards.ieee.org/standardswire/subscribe.html.

—Compiled by Shazia Memon

LETTERS

Get Involved

Robert Gluck's article ["Steering Students Toward Science and Engineering," September, p. 1] emphasizes engineering as it exists today. People in developing countries are "steering students towards engineering and science," while in the West we see a collapse of manufacturing and a lack of demand for Western engineers and scientists because of cheaper sources elsewhere.

The failure to adopt a national industrial policy in the United States will inevitably result in the country's deindustrialization and adversely impact the national standard of living. The IEEE should be neutral on such issues as steering students toward engineering and science, because such policies in low-income countries—while in the national interest of those countries—are not in the national interest of the United States and the countries of Western Europe.

Given the transnational character of the IEEE and the conflicting interests of globalization, the IEEE should remain strictly a technical society without advocating or encouraging anything that may affect the employment of its members.

STEVE AMES
Los Osos, Calif.

I felt very optimistic after reading Robert Gluck's article. I always felt that the IEEE needed to extend its efforts deeper into our educational system. The institute appears to have a good handle on college students and programs but seems to fall short with younger students.

A few years ago I became involved in a program at a local high school called For Inspiration and Recognition of Science and Technology (FIRST), which sponsors an annual international robotics contest for high school students and a Lego robotics contest for junior high students. FIRST is a multinational, nonprofit organization that aspires to transform culture by making science, math, engineering, and technology as cool to kids as sports. Our team, as well as others around the world, has been instrumental in steering students toward earning science and engineering degrees. When I became involved in the project, I knew that it would be something that the IEEE could help promote and even benefit from. Our team made a presentation to my local IEEE chapter in the program but was unable to spark any interest from the chapter's members.

After four years with this program, I am even more convinced that a relationship must develop between the IEEE and FIRST. As I read about the programs in this article, I hope to read about additional ones such as FIRST.

MATT FARMER
Paola, Kan.

Editor's note: The IEEE supports FIRST by encouraging its members to mentor students and help them build their robots. *The Institute* has helped publicize FIRST by publishing articles about the contest in its June 2004 and July 2005 issues.

Egyptian students design a model for the IEEE Future City Competition [September, p. 1].

"The institute appears to have a good handle on college students and programs but SEEMS TO FALL SHORT WITH YOUNGER STUDENTS."

–MATT FARMER

TELL US WHAT YOU THINK

We welcome letters from readers expressing opinions on matters of interest to IEEE members and to the technical community at large. Along with your name, please include your city and state, or province and country.

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Not-So-Great Expectations

From "Investing in Tomorrow's Engineers" [June, p. 4], we learned that the IEEE Board of Directors has approved US $98 000 to fund the Center for Preuniversity Engineering Education. If one looks at the statistics (pick a source, any source), it is clear that the IEEE's emphasis needs to be in grades four through eight, where children are most vulnerable to becoming lost to math and science.

The main problem is that preuniversity administrations and teachers in general have weak academic expectations of students, and these expectations reach an ultimate low by grades four through eight. I have children entering grades six, seven, and nine, and I have seen this with my own eyes.

MICHAEL YOUNG
Edmond, Okla.

Divided We Fall

While making people aware that the senior member grade is important ["Stepping Up to Senior Member," March, p. 19], I would also like to bring up the ongoing discussion regarding a graduate student member grade. In my opinion, separating the IEEE student members into two groups will not lead to a better environment within the student population.

We already know that graduates are usually more likely to submit proposals for papers and are more active at conferences. At the same time, undergraduates don't look at graduates as equal members in the student member grade. I prefer to look at what all the students have in common and not at what divides them. As a graduate student, I don't see any advantage to changing my grade and distinguishing myself from my younger colleagues.

MIROSLAV SKORIC
Novi Sad, Serbia

Undermining Engineering

I object to replacing the word "engineering" with the word "technological" in the IEEE Code of Ethics so that one of its declarations reads that IEEE members agree "to accept responsibility in making technological decisions consistent with the safety, health, and welfare of the public." It had read, "making *engineering* decisions..." ["Revision Proposed to IEEE Code of Ethics," September, p. 4].

I recognize that many engineering decisions are made by nonengineers, but I find this to be all the more reason to keep the word "engineering."

I have been an engineer for 31 years, and I still remember my struggle as an engineering student at Cairo University to get the needed UNESCO coupons (hard currency was not available to many Egyptians in 1973) to join the IEEE as a student member. This proposed change puts the IEEE stamp of approval on the practice of engineering by nonengineers, and then we wonder about the poor U.S. job market for engineers.

RAMEZ GERGES
Goleta, Calif.

RESPONSES TO SEPTEMBER'S QUESTION

What do you think of this decision?

The U.S. Supreme Court unanimously ruled that companies offering Internet file-sharing software may be sued for copyright infringement if they have encouraged their users to illegally download songs, movies, or television programs, even if the software has other, legal uses.

Certain Limits

I support the court ruling. Internet agencies that encourage illegal actions such as copyright violation should be held liable.

However, I am against restraining Internet usage by limiting the development of peer-to-peer software. I don't approve of firmware that prevents CD or DVD copying, even though without it there is a possibility of software, video, and audio piracy. If I buy a DVD, I should be able to copy it onto a hard disk or cut out portions of it and use them for academic or other purposes. In other words, I do not want to see enforcement methods that prohibit the fair use right to copy any kind of copyrightable material.

GEORGE GERRITY
Harden, Australia

Outrageous

This decision is ridiculous. While we're at it, let's allow auto manufacturers and car dealers to be sued for vehicular homicide, gun manufacturers for armed robbery, boat manufacturers for (real) piracy, and rappers for any felony committed by people who listen to them.

PORTER TAYLOR
San Antonio

Would the U.S. Supreme Court allow a bank to be prosecuted as an accomplice to a crime if a customer stores stolen goods in its safe? Decisions must be consistent with their applications—this one is not.

HARRY ANSTEY
South Perth, Australia

Free Distribution

In the United States, where it is legal to stockpile semiautomatic guns and ammunition, the idea that it is illegal to distribute software that could be used to steal copyrighted material is difficult to understand. I think that anyone that distributes copyrighted material knowingly (without the permission of the copyright owner) should be prosecuted, and companies that openly encourage such actions should be penalized.

However, software is a form of information, and it should be freely distributed. In Germany a similar situation arose with audiotapes, most of which were used to record copyrighted material. The solution was to tax blank tapes and transfer the money to a copyright clearinghouse, which distributed it to the copyright owners. Perhaps the United States should adopt a similar method with file-sharing software companies.

I. GLASER
Virginia Beach, Va.

A Sound Judgment

The decision is a good one. If you have a hardware store that sells large gripping pliers and one is used in a crime, it's not your fault. However, if you set up a display showing how to use the gripping pliers for home burglary, you're aiding and abetting. The court's decision is much better than the alternative: outlawing file-sharing software entirely—which would not be fair to the manufacturers of that software or to the people who use it in lawful ways.

ROBERT CLEMONS
Tokyo

A Reasonable Compromise

For once, the court acknowledged the development of new technologies. The copyright holders wanted the court to ban all software-sharing systems from the Internet. But the court realized that discouraging creative development would be worse than the possibility of some infringement of publishers' and artists' rights.

To encourage continued development of Internet technologies, the court compromised and allowed file sharing in a responsible way. It was probably a good decision. After all, aren't cooperation and compromise what the free market is all about?

ALMON CLEGG
Highland, Utah

Getting Into Semantics

It all hinges on the word "encouraged." If the court means *actively* encouraged, then it is reasonable to hold the software companies culpable to an extent. But if it means that the companies just didn't disable the material to keep it from being used illegally, then the ruling is unreasonable. In a situation like this, when an item or service can be used in legal or illegal ways, responsibility lies with the customer, who chooses which way to use that item or service.

NATHANIEL TAYLOR
Mesquite, Texas

Innocent Until Proven Guilty

Companies that encourage customers to use the downloading software in illegal ways should be punished if there is enough evidence to prove that they are involved. Manufacturing knives is not a crime, but encouraging someone to use them in a criminal manner can be. The person who uses the knife to commit a murder should be prosecuted, but the knife manufacturer should not be.

TARIK KHAN
Raleigh, N.C.

Misplacing the Blame

This ruling basically blames the tool and not the tool user for illegal activities, which is an unreasonable solution to copyright problems. Internet file-sharing software can be used for illegal purposes, but it also has many benefits. It is an advance in technology.

This court decision will not stop piracy and other illegal activities. It will only hamper innovation.

Since these are matters of national concern, a conference should be held to decide the appropriate measures needed to deal with the problem. Participants should include users, as well as software originators, and everyone in between, including financial experts.

MICHAEL DIVINS
Easton, Md.

Kill the Copyright Laws

The recent development of Internet file sharing has made it easy to copy information or music. Instead of continuously updating copyright legislation, perhaps we should do away with the entire concept.

Recently, some artists have started selling their own material, completely avoiding record companies. Previously, an individual artist was at the mercy of the record companies to get his or her creation published. Before the Internet, publishing your own work was expensive and difficult. Now, however, it is a realistic and even preferable option.

It might be difficult for record companies to go out of business, but new inventions can bring about such an outcome. It is time to abandon the outdated copyright concept. This court ruling will soon enough be outdated as well.

WILBUR DEHART
Dexter, Mich.

Man in Space

NASA Administrator Michael Griffin, an IEEE member, told the editorial board of *USA Today* in September that the space shuttle and the International Space Station were mistakes. The two projects, he said, are too expensive in terms of astronaut lives and dollars and haven't produced enough scientific knowledge. What do you think?

RESPOND TO THIS QUESTION by e-mail or regular mail. Space may not permit publication of all responses, but we'll try to draw a representative sample. Suggestions for questions are welcome. Responses will appear in the March issue of *The Institute* and are subject to editing for brevity.

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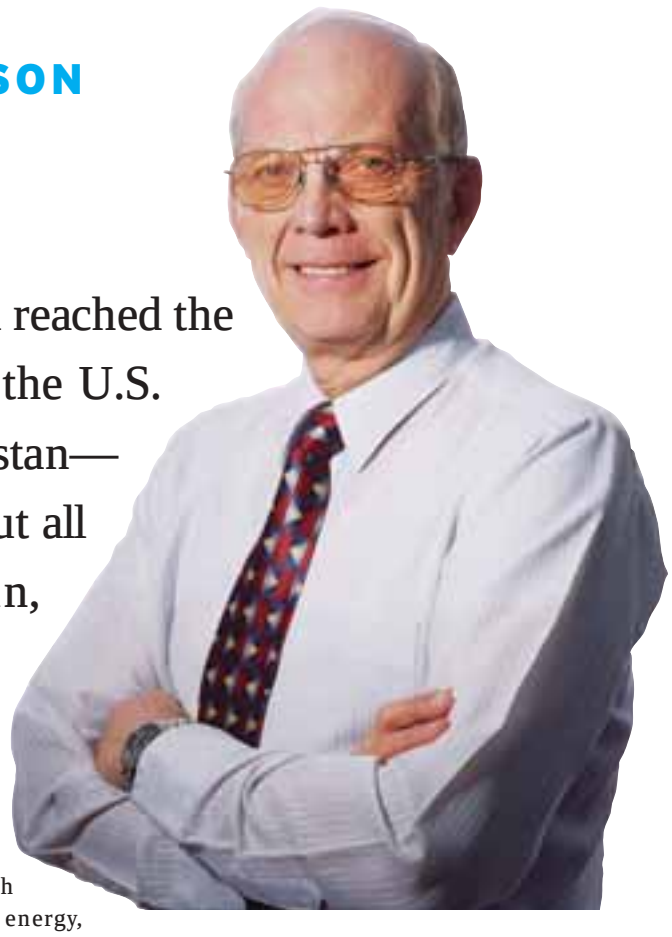
PRESIDENT'S COLUMN BY CLEON ANDERSON

2005: A Year for Optimism



We began 2005 cleaning up after the Asian Tsunami and reached the end of the year cleaning up after hurricane damage on the U.S. Gulf coast and earthquake devastation in India and Pakistan—events of extraordinary human suffering that brought out all the nattering nabobs of negativism. But for my last column, I would rather focus on the positive, some of the year's events that give us hope.

IEEE MEMBERS have reasons to be optimistic, even excited, about the future. Indeed, this year has given us good news that points toward global prosperity through technological innovation.

First, energy is abundant on the planet. In January, an interesting new book, *The Bottomless Well: The Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy* (Basic Books, 2005), affirmed that "the price of oil remains high only because the cost of oil remains so low." Co-authors Peter W. Huber and Mark P. Mills continued, "We remain dependent on oil from the [Middle East] not because the planet is running out of buried hydrocarbons but because extracting oil from the deserts of the Persian Gulf is so easy and cheap that it's risky to invest capital to extract somewhat more stubborn oil from far larger deposits in Alberta, Canada."

In April, Ali Al-Naimi, Saudi Arabia's minister of petroleum and mineral resources, announced that Saudi oil reserves, thought to be 261 billion barrels, might be increased to more than 460 billion barrels. In addition, no one yet knows the size of the oil reserves in the Alaskan National Wildlife Refuge. They could be huge, too.

In June, U.S. President George W. Bush announced his intention to reinvigorate the nation's use of nuclear power. To date, France has led the world in demonstrating the efficient and environmentally friendly nature of nuclear energy. For large-scale power generation, hydrogen and nuclear power are the only two sources of energy that don't produce the greenhouse gases of fossil fuels. Indeed, this year even oil-rich Iran took notice and is working toward using nuclear energy instead of oil for electric power generation.

In 2005, a number of engineers were recognized for their contributions to society that went well beyond their laboratories. For example, as noted in the June issue of *IEEE Spectrum*, all nine members of China's Politburo Standing Committee are engineers. India's president, Abdul Kalam, is a renowned scientist with a background in engineering and satellite communications.

Further, Asia's universities are graduating, at all levels, more than five times as many engineers as U.S. universities. We are rapidly approaching the point where an undergraduate degree in engineering—especially in electrical and computer engineering—is the best entrée for the most highly skilled and learned arts, including the political arts and sciences.

This year, I dedicated IBM's RAMAC drive as an IEEE Milestone in Electrical and Computer Engineering. The milestone honors the first use of magnetic disk storage in a computer system. Developed in 1956 by IBM in San Jose, Calif., the Random Access Method of Accounting and Control drive was more than a meter high—a stack of fifty 24-inch disks with a capacity of 4.4 megabytes. Now, just 50 years later, the cost of magnetic disk storage has dropped to less than a dollar per gigabyte, and the space requirement is smaller by orders of magnitude. Flash memory promises even greater savings in size and cost as large-capacity virtual drives come about.

Huge amounts of memory—created to satisfy the needs of digital cameras and cellphones, and the insatiable need for digital imaging—have not only fueled today's Information Age but also have been the catalyst for developing the search engines necessary for data mining, research, and predictive science.

An explosion of engineering skill and technical knowledge, coupled with an abundance of energy, mass storage, and techniques for manipulating information, gives everyone good reason to be optimistic about the future. Now we can store, search, and use the data produced by strategically placed sensors, as well as by radio-frequency ID tags, GPS, and DNA, to remove uncertainty and make our world a safer place for all its inhabitants. Opportunities have never been greater for technological innovation in nanotechnology, biomedical science, and information technology.

The challenge is to take the abundance of data and information and to use technology to control and manage our response to natural disasters, to preserve human life, and to control (or at least understand) the environment in which we live. That is how we, as IEEE members, can fulfill the our Vision to advance global prosperity and promote community worldwide.

I thank the 2005 IEEE Board of Directors and all the other IEEE volunteers and staff for their important contributions to the institute. I am optimistic for the future. I know that in 2006 President Michael Lightner will continue to lead us with experience and skill toward the realization of the IEEE's vision. ●

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Piña Makes Chip Fabrication Affordable

BY JEAN KUMAGAI

IEEE Member César Piña with a sample integrated circuit wafer from his MOSIS lab.

THIS YEAR MARKS the 25th anniversary of a groundbreaking program that has introduced tens of thousands of engineering students to the real world of integrated circuit design. The program, run by a not-for-profit organization called MOSIS (Metal Oxide Semiconductor Implementation Service), manufactures working prototypes of the students' integrated circuit designs free of charge. Based at the University of Southern California's Information Sciences Institute, in Marina Del Rey, MOSIS also gives businesses, universities, and government labs a means of inexpensively producing prototypes.

Many chip designers have few options for getting their devices built, explains MOSIS's director, IEEE Member César Piña. Scheduling a run at a wafer fabrication plant would be prohibitively expensive for students, not to mention university and government researchers and startup companies. The smallest run possible is typically 12 wafers, which can cost more than US $50 000 after tallying up the cost of materials, photolithography, and fabrication, he says.

PIGGYBACK FABS MOSIS pools designs, putting on a single 20- or 30-centimeter wafer perhaps hundreds of individual IC chips [see photo]. MOSIS then contracts with established wafer fabricators, such as IBM Corp. or Taiwan Semiconductor Manufacturing Co., to process the wafer.

Students and some researchers who don't have outside funding pay nothing for the service. Other designers at start-ups as well as larger companies, government labs, and universities, share the cost of wafer fabrication. Even established companies that own a wafer fab use MOSIS to execute their prototypes, Piña says; it's cheaper than interrupting their own production runs. Over the years, a number of designs that later became huge commercial successes have come through MOSIS, including the world's first reduced instruction set computer-based (RISC) microprocessors.

Piña has been involved with MOSIS from the start. From 1980 to 1987, while at the Jet Propulsion Laboratory (JPL), in Pasadena, Calif., Piña led a project funded by the U.S. Defense Advanced Research Projects Agency to develop CMOS test structures for determining how well a MOSIS wafer was moving through the fabrication process. In 1990, he became the director of MOSIS. "I originally thought I'd stay for three or four years," Piña says, sitting in his seventh-floor corner office overlooking the harbor at Marina del Rey. "That was, well, a lot of years ago."

CONCEPT FOR PROTOTYPES The concept behind MOSIS was first put forward by Carver Mead and Lynn Conway. In their breakthrough text, *Introduction to VLSI Systems*, published in 1979, the two described how, with a simple set of design rules, any engineer could easily make a prototype of an IC. "All you'd need is access to a computer," Piña says. "Then you'd send your design to a fabricator and get the thing made." It was a revolutionary idea at the time, but as more chip designers realized the advantages, it took off.

Piña is familiar with revolutions: he was born and raised in Cuba and lived there through the tumultuous period when Fidel Castro and his followers prepared to wrest power from the ruling party.

As a boy, he was homeschooled by his father until he was nine because there were no decent schools in their Cuban town. Piña remembers poring over the comics while sitting on his father's lap. "He would read aloud to me, and I guess he would also sound out letters and words. One day I asked him to read something for me, and he said, 'Go ahead and read it yourself.' To my amazement, I could."

When Piña was in sixth grade, his father got a job at the U.S. naval base at Guantanamo Bay, and Piña began attending school there, alongside the sons and daughters of U.S. military personnel. He learned English so well that at the age of 16, he enrolled in the University of Michigan, in Ann Arbor, graduating with a bachelor's in aerospace engineering.

While in college, Piña met student Marilyn Wohl, and in 1958, they married and returned for a few months to a Cuba in turmoil. It was just before Castro came to power in February 1959. "I told my wife, 'You're lucky. Not everybody gets a revolution on her honeymoon.' "

In October 1958 the couple left Cuba for the United States. With the Cold War in full swing, there was a huge demand for engineers—but not ones from Cuba. "The only industry that didn't seem to care where I was from was semiconductors," Piña recalls. His first job was with Raytheon's semiconductor division, outside Boston. His education didn't exactly equip him for a job in the chip industry, but then the field was very new, so the learning curve wasn't too difficult. "I spent the first two weeks reading the June 1956 *Proceedings of the IEEE*—the special semiconductor issue—and [William B.] Shockley's *Electrons and Holes in Semiconductors*."

After he'd been at Raytheon a year, his wife persuaded him to relocate to the Midwest to be closer to her family. During the next two decades, his career mirrored the ups and downs of the chip industry; all of the chip companies he has worked for have either been sold or gone out of business. In Chicago, he worked for Hoffman Electronics, a small chip firm, for six years before taking a job with Continental Devices, a small semiconductor company near Los Angeles.

In 1971, Piña decided to branch out on his own, founding Regulus Semiconductor, which he named with great hope after a bright star in the constellation Leo. One of Regulus's products was an electronic interlock that wouldn't let a car start unless the driver's seat belt was fastened. "Nobody liked that," Piña recalls, and the idea died when Congress passed a law making such a device optional for U.S. cars. Four years later, with five small children at home, he was forced to sell the company and take a job with Micro Semiconductor, another small chip company in Los Angeles, where he worked for five years before joining JPL.

While at JPL, he earned a master's degree in applied mathematics from Claremont University, in California, and he has continued a collaboration with the school of mathematical sciences there. One area he's been exploring at MOSIS is the use of boundary layer methods and other mathematical techniques to understand semiconductor behavior. "For example, on a CMOS device, you have one region where the current changes very rapidly with respect to the voltage and another region where the current changes very slowly," Piña explains. The equations in each region can be solved separately and then "matched" or "blended" to obtain a single, continuous equation. The method is now being extended to include quantum effects, which have become significant as device dimensions decrease below 90 nanometers.

Though he never planned to stay so long, Piña has no desire to move on from MOSIS. "My wife always asks, 'When are you going to retire?' To be honest, I don't know what else I'd do that would be as interesting."

FOR MORE INFORMATION on MOSIS, visit http://www.mosis.org

FEATURE

IEEE Press Counts On New Strategic Plan

BY ERICA VONDERHEID

WITH EFFORTS to acquire books on more popular subjects and with more involvement by IEEE volunteers, a three-year strategic plan is under way in hopes of bringing new life to the IEEE Press. The plan calls for the Press to break even in 2008, after years of operating at a financial loss, and ends almost a year of uncertainty about its survival.

A STRONGER BASE IEEE Fellow Mohamed El-Hawary, Press editor in chief, is charged with the task of rallying volunteers, which he will do, he says, "by talking, talking, talking."

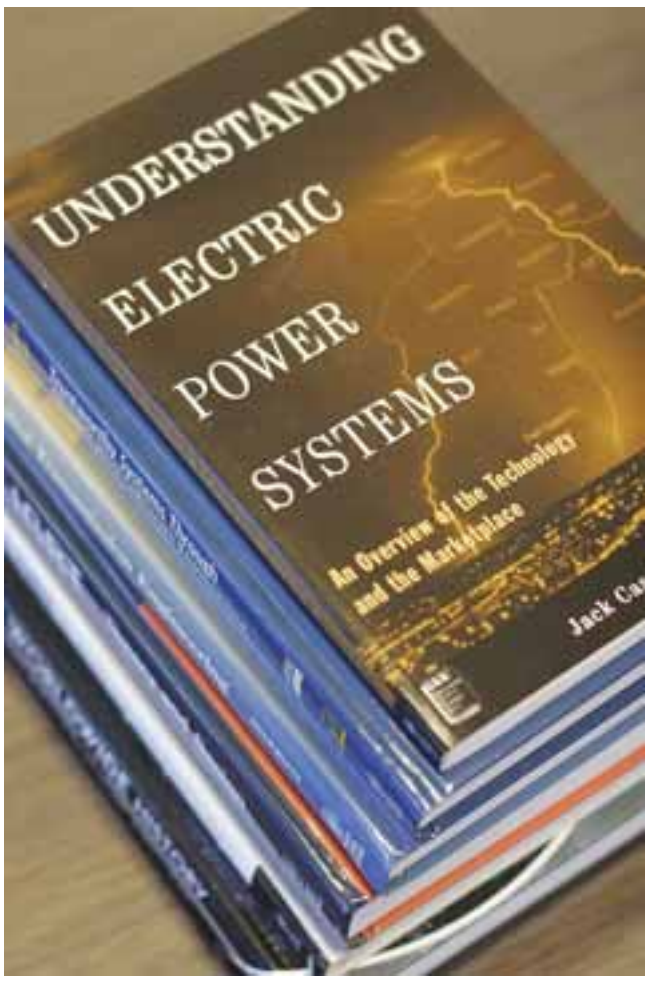
The IEEE Press has long relied on getting ideas for its books, and getting authors, from the large pool of IEEE members who are deeply involved in the latest technologies. "I'm on a first-name basis with many leaders on the technical side," says El-Hawary, who relies on these volunteers "to guide us on what books to publish." By being in closer contact and talking with them more, El-Hawary hopes to get better ideas for books and more help in guiding and supporting the IEEE's book-publishing business.

For example, the IEEE Press depends on volunteers to handle a number of tasks, based on their knowledge and connections. Book authors are, of course, a necessity. But the Press also needs volunteers who can serve as editors of the book series that the Press publishes. Series editors identify potential authors, review manuscripts, enlist other expert reviewers, and make suggestions for improvement.

Volunteers also serve as liaisons to an IEEE society or technical council, where they use their knowledge of technology to unearth ideas for new books and identify authors. The Press will seek to revitalize this important group of volunteers. One idea is that society or council liaisons will be appointed to serve for two years instead of one, as in the past. This should give them more time to get to know in depth what's going on in the different technical areas they oversee. The liaison will also have the option for reappointment.

As for what it will publish, "we're going to concentrate on professional books where we've shown strength, while cultivating new growth areas in emerging technologies," says Ken Moore, director of IEEE Book and Information Services, the department that oversees the IEEE Press, in Piscataway, N.J. Accordingly, the Press will continue to publish books in its five most popular and commercially successful technical areas: power engineering, electromagnetic wave theory, digital and mobile communications, microelectronics, and biomedical engineering. The Press is also nurturing book series in new and emerging fields such as computational intelligence, which deals with adaptive mechanisms that facilitate the intelligent behavior of machines.

For each of these topics, the IEEE Press is looking for practical tutorials for engineers already in a field, as well as technology primers for newcomers. It has been publishing



15 to 30 titles a year, including professional tutorials for working engineers, textbooks for graduate students, analytical books that provide the mathematical and theoretical foundations of electrical engineering, and "soft" books on career management. Starting in 2006, the Press will publish between 20 and 30 books a year, with half—10 to 15 titles—aimed at working engineers.

BACK TO LIFE The strategic plan has been in the making for more than a year. At one point, the Press almost met its end. At its June 2004 meeting, the IEEE Publication Services and Products Board (PSPB), which oversees the institute's publishing activities, reviewed the status of the Press and did not like what it found. It determined that without significant changes, the Press would continue to operate at a loss, and the board voted to terminate the book-publishing program. But the IEEE Board of Directors was unwilling to give up the benefits of the program, and Arthur Winston, IEEE president at that time, asked PSPB to renew its efforts to save the program. PSPB established a committee made up of Press volunteers and others new to the program, such as former PSPB finance chair John Baillieul and 1999 IEEE President Kenneth Laker, to come up with a plan under which the Press could continue. Their work resulted in the present three-year plan to break even in 2008.

"Developing the strategic plan was a good exercise that showed the best of our volunteers' skills," Moore says. "The new volunteers brought fresh ideas and merged their thoughts with those from longtime IEEE Press board members."

The IEEE leadership was receptive to the strategic plan the committee delivered to the June 2005 PSPB meeting, thanks in part to a new copublishing proposal from John Wiley & Sons, in Hoboken, N.J.

"Wiley saw the value of the partnership with the IEEE, and its proposal makes the relationship more financially viable for us," Moore says. The new agreement will extend the relationship—which began in 2001—and the Wiley–IEEE Press imprint for another five years and increases royalties paid to the IEEE for each book sold. By approving the plan, adds Moore, "PSPB endorsed the IEEE Press, saying that it is a vital part of the IEEE community and that its mission will be supported."

An important part of the Press's title-acquisition strategy will be to leverage both the IEEE's and Wiley's global resources to cultivate Asia as a source of book authors, Moore says.

"As a global organization, we seek authors throughout the world, but we see this opportunity with Wiley as a good time to capitalize on the growing number of authors in Asia," Moore says. The agreement means that the Press will have more titles—and in turn more revenue—but will be able to concentrate its acquisition efforts on developing its current series.

The strategic plan also calls on the IEEE Press to explore new electronic products to accommodate readers' changing needs. Currently, IEEE Press books are available electronically through Wiley's Web site, at http://www.wiley.com. Customers can download either an entire book or one chapter at a time. Abstracts of Wiley–IEEE Press books are also posted on the IEEE Xplore digital library, allowing users to search for books and then click through to Wiley's site to purchase them.

But what customers see are just static copies of the printed books, with none of the extra bells and whistles an electronic format could offer, such as links to supplemental Web-based information, multimedia, or simulation software. The intent is to evolve from simple PDF pages of the print edition to electronic products that take full advantage of the electronic medium and IEEE Xplore, according to the IEEE Press strategic plan.

However, the IEEE Press has no plans to abandon the printed page. "Books carrying the IEEE logo are a physical token of the IEEE's mission to deliver all information our members need to do their jobs," Moore says. "As a leading professional organization, we recognize that engineers' research and work habits are changing, but when it comes time to select a study tool for a given topic, I think our engineers are always going to have books at the top of their list."

FOR MORE on the IEEE Press or how to submit book proposals, visit http://www.ieee.org/press

MEDICAL RECORDS

Continued from page 1

Economics, in Washington, sometime in August. Other activities and publications are planned as well.

Perhaps the Biotechnology Council's most important goal is "for patient medical records to be available 24/7—anywhere, anytime, anyplace in the world," says the council's chair, IEEE Senior Member Richard L. Doyle, former Division VI director. By focusing the expertise of some of the world's top engineering and medical organizations, the Biotechnology Council hopes to influence the creation of universal standards for electronic medical records. Among other goals, the council hopes to work with the new Office of the National Coordinator for Health Information Technology, an office founded last year within the U.S. Department of Health and Human Services. The coordination office wants the U.S. medical community to migrate to e–medical records within the next decade.

TOP CHALLENGES Advanced medical technology for treating patients may be pioneering new approaches in the 21st century, but most patients' records are still handled as they were in the 19th, handwritten on paper. They are then stored in file cabinets along with, say, X-rays on film and paper EKG printouts. According to a U.S. study earlier this year, fewer than a third of hospitals and well under a fifth of private-practice physicians use electronic medical records. True, most doctors and hospitals rely on computers to bill for services—but in many cases, that's it.

The fact that most medical records are still on paper and film leads to many problems. For example, ambiguous terminology or hard-to-read handwriting can lead to errors in other physicians' interpretation of the records or in the filling of prescriptions. Miscommunication has even led to surgery on the wrong body part or the wrong patient. What's more, in an emergency it can be difficult, if not impossible, to transmit paper records electronically for interpretation by specialists. And backup copies of paper and film are seldom made.

The council hopes to influence the creation of UNIVERSAL STANDARDS for electronic medical records

"The notion and concept of e–medical records have existed since the 1960s. So why haven't we had them before now?" asks Michael Rozen, IEEE senior member and the institute's representative on the Biotechnology Council. The delay, says Rozen, is due to three factors: "standards, interoperability, and privacy."

The absence of data-storage and networking standards for both medical equipment and administrative computers has

[Continued on page 12]

THE IEEE IN THE BIOTECHNOLOGY COUNCIL

In addition to the IEEE Standards Association and IEEE-USA, six IEEE societies and two councils are participating in the Biotechnology Council:

- Circuit and Systems Society
- Computational Intelligence Society (formerly the Neural Networks Society)
- Computer Society
- Engineering in Medicine and Biology Society
- Lasers and Electro-Optics Society
- Signal Processing Society
- Nanotechnology Council
- Sensors Council

MEDICAL RECORDS

Continued from page 11

been a major technology barrier. "In an integrated world, every medical machine should be able to communicate with other equipment, computers, and displays," Rozen says. Of equal importance, each patient and physician must be uniquely identified across machines, so "we know that 'Mary Smith' is the correct Mary Smith," he continues. Thus, standards are needed to authenticate both the patient and the requesting entity, to create an audit trail of those who have read or added to the file, and to maintain data integrity during transmission. Moreover, standards are needed for handling inputs from many devices used by physicians that were originally created for nonmedical uses, such as cellphones and PDAs.

INTEROPERABILITY The stumbling block the e–medical records community calls interoperability refers not so much to machines working together as to human beings understanding each other. "The medical language in each e–medical record must follow a structured terminology that has universal acceptance, so it can be unambiguously interpreted by any skilled personnel," Doyle points out. The word "cold," for example, can bring to mind a viral infection or someone with a temperature, "and there are 126 different ways of saying 'high blood pressure,' " adds Rozen, who is also chair of the IEEE-USA Medical Technology Policy Committee (MTPC).

For e–medical records to be completely interoperable, however, ambiguity must be removed between medical and lay terms. "Individual medical practitioners and their patients must understand each other across all specialties, which requires consistent terminology," Doyle says. And that is yet to be achieved.

Rozen's third factor, privacy, including the security of patient records in an electronic environment, is only part of the way to a solution. In the last five years, the United States and other countries have developed enough stringent safeguards that most of the population would "probably go along" with having medical records stored and transmitted electronically, says Rozen. Still, important questions remain. For example, can records be made absolutely hack-proof? Is it possible, for example, to ensure absolute confidentiality of a patient's psychiatric background, HIV status, genetic background, or similar sensitive information? Who should control access to the records?

THE IEEE'S ROLE The Biotechnology Council comprises 10 nonprofit organizations, including the American Institute of Chemical Engineers and the American Society of Mechanical Engineers, along with the IEEE and the American Medical Association. The IEEE's participation actually consists of contributions from 10 IEEE entities, including IEEE-USA's Medical Technology Policy Committee and the IEEE Standards Association [see sidebar, p. 11].

With electronic medical records, X-rays and MRI scans will be available to doctors using devices like a tablet computer as seen here.

Given the IEEE's long experience with networking and computer standards, Doyle observes, "we're the 800-pound gorilla in the corner." But to meet the needs of all manner of physicians, instrument and device companies, biotechnology organizations, hospitals, and insurance companies, to say nothing of patients, "the IEEE can't go it alone," he acknowledges. Hence, the Biotechnology Council has devoted its first year to setting up formal mechanisms for cooperation and funding among its members. The resulting consortium collectively represents more than a million physicians, engineers, and other professionals.

OPEN QUESTIONS Other knotty issues remain. How should the records be stored? "Should everything be in a central database, or could patients carry the records with them on an ID card, much like a driver's license, that could be scanned at every doctor's office?" asks Doyle. Who should administer the system, and how should records and users be identified and authenticated?

Then there is the gray area of just how much information should be consolidated. "If a patient has an artificial heart valve, should the record include the valve's manufacturer and serial number?" asks Doyle. "Should the records include all the digital X-rays and MRI scans, as well as test results from all physicians? Should all records of medical insurance claims be included?"

In the United States, at least, an example of an e–medical records system already exists. "VA [Veterans Administration] hospitals already own a pretty good e–medical records–keeping model," says Rozen. "VA patients have their medical records, blood tests, X-rays, and other imaging results stored electronically and accessible to any of the VA hospitals. The VA is now trying to bridge the gap between VA physicians and private physicians who are treating the same patient, by trying to provide them access to the VA record of the patient."

NEXT STEPS At this stage, "it is premature to think about [the Biotechnology Council] drafting white papers" representing the consensus of its 10 organizations, Doyle says. Nonetheless, the IEEE-USA MTPC was scheduled to release its own individual white paper before the year's end on challenges of and recommendations for interoperability.

It is also too early to add non–U.S. organizations to the council, although "world standards ultimately will be part of our activities," Doyle adds. "Some European nations are well advanced, and we can all benefit from their achievements. Moreover, Asia is among the fastest-developing regions in the world, and we need to share our knowledge with their officials."

In the long term, the influence of the Biotechnology Council on national policy will lie in the fact that "its constituent members have no axe to grind politically and no software to sell," Rozen points out. "This neutrality can provide legislators and regulators unbiased information to assist them in their deliberations." ●

Interoperability refers not so much to machines working together but HUMAN BEINGS UNDERSTANDING each other

FOR MORE INFORMATION

White papers by IEEE-USA on aspects of issues related to e-medical records appear at http://www.ieeeusa.org/policy/issues/EHealth

The Office of the National Coordinator for Health Information Technology's Web site is at http://www.hhs.gov/healthit; for more information see http://waysandmeans.house.gov/hearings.asp?formmode=view&id=2944

Statistics on the meager use of e-medical records by hospitals and private physicians can be found in "Use of Computerized Clinical Support Systems in Medical Settings: United States, 2001–2003," available from the U.S. Centers for Disease Control and Prevention at http://www.cdc.gov/nchs/pressroom/05news/medicalrecords.htm and at http://www.cdc.gov/nchs/about/major/ahcd/ahcd1.htm

ETHICS

Continued from page 1

this year by the IEEE Ethics and Member Conduct Committee (EMCC).

VARIED APPROACHES Not all students welcome the opportunity to learn about ethics. "You get all sorts of reactions, [including] those who think ethics courses are not entirely appropriate to a technical degree. They'll say, 'I thought I was studying technology and not the people issues,'" says Kevin Bowyer, an IEEE Fellow who heads the department of computer science and engineering at the University of Notre Dame, in Indiana. "But we try to show them that a lot of the things that go wrong in the workplace have people issues wrapped up in them."

A requirement that engineering school graduates demonstrate "ethical awareness" was written, in 2000, into the criteria U.S. schools must meet to maintain their accreditation. Since then, the schools have tried different approaches to ethics instruction. A few have made ethics classes mandatory; at others, they are electives. Still others weave ethics discussions into standard engineering courses to achieve what they call ethics across the curriculum.

Teams participate in an IEEE student ethics competition at Rowan University, in Glassboro, N.J.

Texas A&M University, in College Station, and the University of Virginia, in Charlottesville, are among the handful of schools where instruction in engineering ethics is mandatory. First-year engineering students at the University of Virginia, for example, must take an introductory course in the engineering school's Department of Science, Technology, and Society, where ethics and social issues facing the practicing engineer are discussed. However, the primary focus is on improving the students' writing and presentation skills.

These skills come in handy in years two and three, when technology is placed within a larger world in such courses as Technology and Social Change in 19th-Century America; Religion and Technology; and Technology, Aggression, and Peace. And in a two-semester course with a thesis, seniors are asked to examine ethical questions that may crop up when a system is first being designed or a research project is just getting under way. The goal is for students to come away with an ability to recognize and analyze the role that technology plays in important contemporary issues, to appreciate perspectives that differ from their own, and to apply these skills in solving engineering problems. The course also focuses on late-stage ethical issues. These turn up when a system is further along in design—or has already been built.

Many schools offer freestanding ethics courses as electives to fulfill a humanities or writing requirement, while some introduce ethics in the senior year, as, for example, a one-credit section of a required design course. At Texas Tech University, in Lubbock, the faculty is of at least two opinions. Each engineering department has developed its own method of presenting ethics. The civil engineering department, for example, does it in a two-credit-hour engineering ethics course. The electrical engineering department presents seminars and workshops on ethics, but oddly enough, students aren't obligated to attend.

TEACHING TEACHERS Some schools believe it best to weave the discussion of ethics into the standard engineering curriculum. But one challenge has been teaching the engineering faculty how to present the topic, with which they may not be familiar, along with the [Continued on page 14]

ETHICS *from page 11*

technical material. As Kevin Passino, an IEEE Fellow who teaches a required engineering ethics course at Ohio State University, in Columbus, puts it, "We can jump up and down and say ethics is important [to engineering education], but if there are no faculty willing to teach the subject, it's not going to happen." Notes Jimmy H. Smith, director of the Murdough Center for Engineering Professionalism at Texas Tech, "[That's] why we've developed materials to help them discuss ethics."

Smith, along with instructors at Texas Tech, the Illinois Institute of Technology, Western Michigan University, and Notre Dame, worked to develop teaching materials and to hold workshops for engineering faculty, thanks to grants from the U.S. National Science Foundation (NSF). The workshops are aimed at easing the concerns of teachers about conducting ethics discussions or about the difficulty of shoehorning such discussions into already overcrowded syllabi.

Notre Dame's Bowyer, who also teaches a required ethics course, has led NSF-sponsored workshops such as Teaching Ethics and Computing, so instructors will be comfortable dealing with ethical concepts in their lectures. "I hope it isn't the case that [a required course] is the only place we talk about this," he says. "To collect this material for a single course and then not touch on it in any other course sends students the wrong message—that ethical and professional considerations are something that can be compartmentalized."

THE INSTITUTE'S ROLE The IEEE is doing its part to help improve students' understanding of their ethical duties as professionals. Last January, the institute introduced the ethics competition developed by the EMCC. The competition provides students with experience in applying these concepts to situations that might arise in the workplace. The competition requires two- or three-person student teams to apply ethical concepts to a case study that focuses on any of several issues: public safety and welfare, conflict of interest, ethical dilemmas related to research, or faulty engineering practice.

The committee provides the materials that set forth the problem and guide the teams in their decision making. Materials include the IEEE Code of Ethics and case studies. The first (and only, to date) competition was held at Rowan University, in Glassboro, N.J., during Region 2's (Eastern United States) Student Activities Conference in April. [See "Temple University Wins First IEEE Ethics Competition," July 2005.]

Gerald H. Peterson, a member of the EMCC who helped develop the ethics contest, reports that representatives of nearly all IEEE regions have expressed interest in holding student competitions. Peterson notes too that the contest is applicable worldwide.

Says Member Shreekanth Mandayam, an associate professor of electrical and computer engineering at Rowan, "Such competitions are probably one of the best ways to teach ethics. The contests can be fun; they get students to think creatively, and the students try to win."

The IEEE also discusses ethics with students at its Student Professional Awareness Conferences, or S-PACs. Organized by student branches, these meetings bring together students and experienced engineers to talk about, among other topics, professional ethics and responsibility, and engineers and public policy.

The S-PAC Web site (http://www.ieeeusa.org/volunteers/committees/SPAC) contains information on how to organize such a conference. It also has a list of volunteer speakers organized by topic and region and regional contacts who can be called on for advice. Speakers are available who can deliver talks on topics including "Individual and Corporate Responsibility," and "Shades of Gray: Practical Solutions to Ethical Dilemmas."

One such speaker, Walter L. Elden, a life senior member, shared his insights on ethics and the engineering profession earlier this year at S-PACs at the Florida Institute of Technology, in Melbourne, and the University of Central Florida, in Orlando. He says he tries to make the students aware of their responsibility to be more than just "widget designers." He wants to "focus their attention on how their creations will be used so they will consider, 'Hey, maybe there are some consequences in design that I haven't thought about.'"

Voices of Innovation: The IEEE's Oral History Collection

BY ROBERT COLBURN
IEEE HISTORY CENTER

THERE IS NOTHING quite like learning about a technological breakthrough from the person who made it happen. A first-person account of how the inventor of the laser, Charles Townes, realized while sitting on a park bench that chromium found in rubies could focus light molecules into a high-energy beam adds an exciting facet to engineering knowledge. Likewise, reading the explanation by one of the Internet's creators, Paul Baran, of why he set up the routing architecture the way he did adds a little extra to an engineer's understanding of present-day technology. These are just two of the electronics pioneers whose oral histories—written transcripts of interviews with technology's best and brightest—are on file at the IEEE History Center.

"Oral histories are special, because you're reading a personal account," says senior research historian Rik Nebeker of the IEEE History Center, located on the campus of Rutgers University in New Brunswick, N.J. "These people lived through something important, and they're telling us how they experienced it. Details that otherwise would not get into the historical record—blind alleys, mistakes, and disappointments—often are found in oral histories."

The IEEE History Center has developed more than 400 oral histories, a collection highly regarded by IEEE members and technology scholars and historians, according to Nebeker. More than half of these histories are in documents that can be downloaded from the History Center's Web site, and more are being added all the time. Transcripts of the rest are on file at the center's offices.

Oral histories often are part of a collection, such as the IEEE Merger History Interviews, which were conducted in 1979 to capture the details behind the merger of the IEEE's predecessor societies: the American Institute of Electrical Engineers and the Institute of Radio Engineers. Another collection, the Japanese Oral History Interviews, was a joint project between the IEEE History Center and the history committee of the Institute of Electrical Engineers of Japan to capture the reminiscences of prominent Japanese engineers.

The RCA Engineers Interviews focus on the pioneering engineers who worked at RCA back when it was known as the Radio Corporation of America, and who developed many of the systems needed for television. In the Frederick E. Terman Associates collection, colleagues and former students reflect on the work of that influential Stanford University professor, one of the founders of Stanford Industrial Park, an important seed for the sprouting of Silicon Valley. To celebrate the 50th anniversary of the wartime founding of the Massachusetts Institute of Technology's Radiation Laboratory, Rad Lab Interviews include a series of oral histories collected in 1991 that deal with the work of the lab on wartime radar.

Oral histories may also offer a lively, inside view of events with unexpected insights seasoned with the engineer's humor and perspective, points out Nebeker. Such interviews provide the backbone—and often the voice and human element—for many historical articles and books. For example, IEEE oral histories were instrumental in the writing of *The Marconi Century* [Marconi Foundation, 2004], which I wrote. The book describes the work of the innovators behind the telecommunications achievements of the last 100 years. Oral histories also played an important role in the writing of *Profiles in Engineering Leadership* by Greg Swedberg [Eta Kappa Nu, 2004], a collection of biographical sketches depicting eminent members of Eta Kappa Nu, the engineering honor society.

With engineers from all over the world represented, the IEEE History Center's oral history collection reflects the IEEE members' technical and geographical breadth.

The oral history of radio pioneer Alfred Goldsmith, pictured here in 1938, is one of the 400 available from the IEEE History Center's collection.

Among the histories in the center's collection are those of the radio pioneer Alfred Goldsmith [see photo], an Institute of Radio Engineers founder, and Russian television innovator Vladimir Zworykin. Those interested in early computing can learn about it through the words of German computer trailblazer Conrad Zuse and Italian microchip inventor Federico Faggin. If you're curious about the entrepreneurial spirit, you can read the oral history of William Hewlett of Hewlett-Packard or of implantable pacemaker inventor Wilson Greatbach. Internet enthusiasts can peruse the tales of Internet pioneers Vinton Cerf, Robert Kahn, and Leonard Kleinrock and British World Wide Web inventor Tim Berners-Lee.

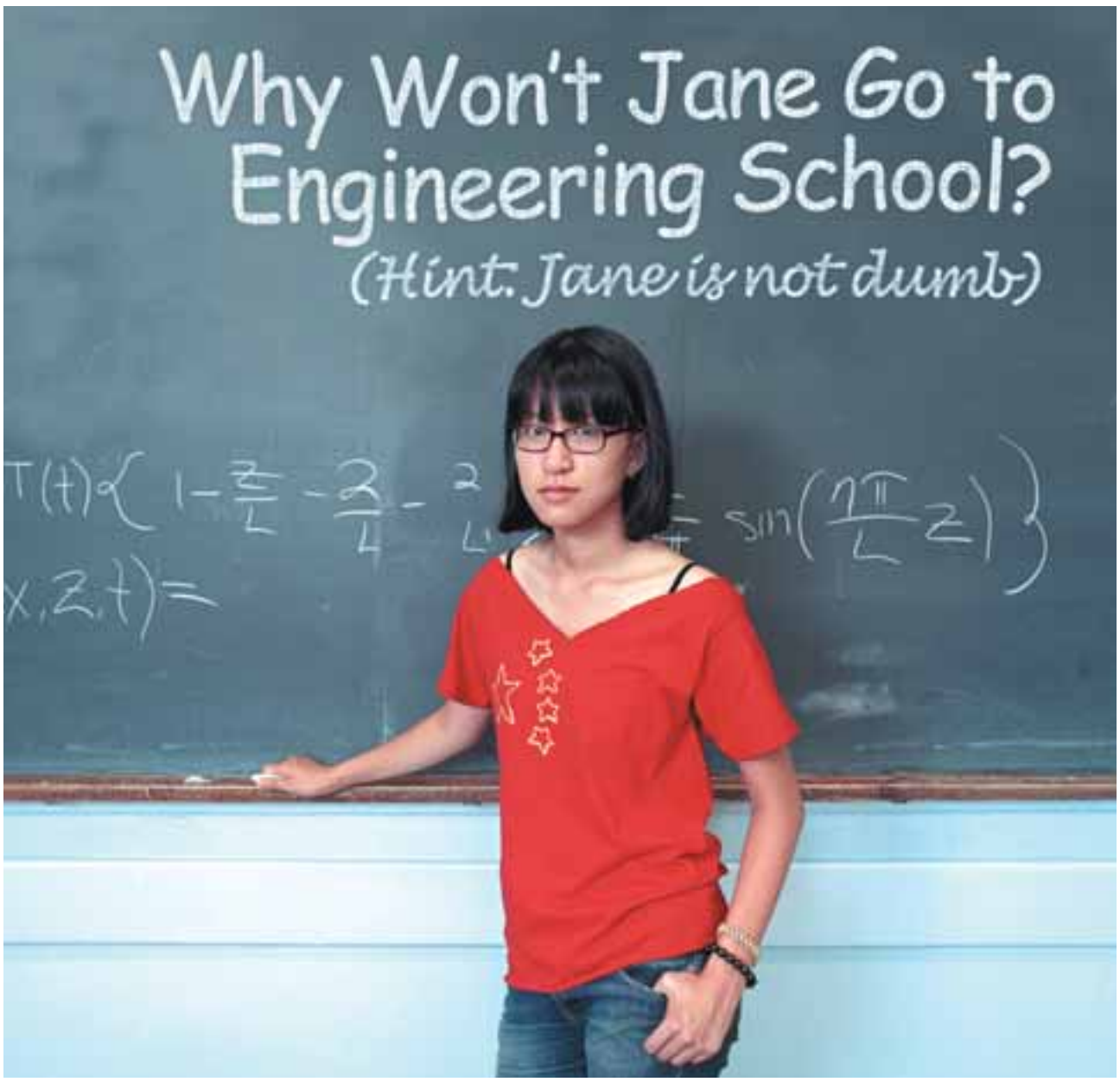
In 2004, volunteers in the United Kingdom and Republic of Ireland Section began conducting oral histories of prominent defense scientists and engineers such as radar engineer Kenneth Slater and command and control systems pioneer Ralph Benjamin. These interviews are part of the IEEE History Center's collection.

MAKING HISTORIES An oral history begins when a technical society or other IEEE unit, such as a section, calls the History Center's attention to an electrical or computer engineering pioneer whose memories and experiences should be preserved. Or a group may request that an oral history be included in a project celebrating the group's anniversary or as part of a history book it proposes to publish. For example, when the IEEE Communications Society celebrated its 50th anniversary, it commissioned a series of oral histories called the IEEE Communications Society Interviews.

Once a candidate for an oral history is identified, a History Center staff member arranges to visit the engineer and researches the field that person worked in, a process that includes reading oral histories of colleagues in the same field. The interview, which is taped, can last anywhere from 90 minutes to many hours spaced over three days. The History Center staff edits a transcript of the interview for flow and consistency, then sends it to the subject, who can make clarifications or add more details that could make the piece more interesting to historians.

The completed transcript is then published in a book, newsletter, or monograph—a long, scholarly paper on a single subject—and posted online. Not only professional historians but journalists, biographers, and IEEE members interested in the history of engineering and technology also find the IEEE oral histories useful.

Transcripts of the IEEE History Center's oral histories can be downloaded from http://www.ieee.org/organizations/history_center/oral_histories.html.



BY MOSHE KAM

THE CAMPAIGN TO ATTRACT women to American law schools had really taken off in the early 1970s. The American Bar Association and state legislatures in the 10 largest states took it upon themselves to double the percentage of female lawyers in a decade. The slogan for the campaign was "20 Percent by 1980."

Civil leaders, entertainers, and politicians took part in the well-financed campaign to inform girls and young women about the virtues of the legal profession. They highlighted the contributions made by lawyers, judges, and legal scholars to programs involving equality, social justice, and welfare. They publicized the professional and economic rewards of becoming a patent lawyer or a judge. The long-running TV series "Defender of the Damned" highlighted the life and times of Gladys Towles Root, the controversial 1920s Los Angeles lawyer. It was a runaway hit during the 1974 to 1978 seasons, and gave rise to the equally successful TV series on the life of the first black female lawyer in the United States, Charlotte E. Ray.

There were numerous lectures in schools, and public events were held in large and small towns alike. Lawyers and judges descended on schools in their local communities to make presentations to eager female students and to provide the ever-so-needed "human side" of the story. Governors declared "Woman Jurist Day" in state after state. Bus, newspaper, radio, and TV ads promoted "legal summer camps" for girls, heavily subsidized by local bar associations and large corporations. By the time U.S. President Reagan introduced Sandra Day O'Connor to the nation in 1981 as the first woman to be appointed to the U.S. Supreme Court, the leaders of the campaign could point to great successes everywhere.

The percentage of female lawyers doubled in three years (from 9.5 percent in 1971 to 20.1 percent in 1974). By 1981 it was 35.8 percent, certainly better than the original plan of "20 Percent by 1980." By 1996, the percentage climbed to 44.4. Strong gains for women were recorded in the leadership of the legal profession—the percentage of women among the ranks of federal judges, law school full professors, and law firm partners has been rising steadily. Although some claims about discrimination and a salary gap between men and women in the law persist, there is no doubt that the scene has changed dramatically since the beginning of the public crusade.

If, after reading this, you are puzzled about some of my facts or have somehow missed the reruns of the ever-popular "Defender of the Damned," I have a good explanation: the numbers I quoted on the percentages of women professionals in the legal profession are correct, and Gladys Root and Charlotte Ray were indeed significant historical figures; however, the rest of the story is fabricated.

There was no ABA campaign, no bus ads, no summer camps, and no "Woman Jurist Days." In the legal and medical professions, the phenomenal rise of women to prominence (if not yet equality with men) occurred with very little institutional inducement. It was the result of social change, the rise of new political movements, increased political freedom, new legal rights, economic pressures, and changes in technology. Women identified opportunities in these fields and fought to be admitted. No degree of conservatism expressed by the Old Boys network or artificial barriers to admission proved to be real obstacles.

When female graduates of law schools were refused entry to the bar in the late 19th century, they created their own support groups and arranged political campaigns to fight rejection. There were battles in the legislatures of Massachusetts, Minnesota, and many other states. Societies of "sisters-in-law" sprung up everywhere, and intense action by activists has continued for more than a century. The number of women in medicine and law is projected to stabilize in about a decade, at close to 50 percent.

ENGINEERING STANDSTILL Which brings us to our profession: engineering. The participation of women in engineering, in spite of some increases in the last two decades, continues to be anemic. Between 1983 and 2000 the percentage of female engineers in the U.S. workforce rose from 5.8 percent to just 10.9 percent. The percentage of women receiving bachelor's and master's degrees in engineering has hovered at around 20 percent for several years (the Ph.D. fraction is about 17 percent). No matter how we look at these numbers and at related statistics, the conclusion is that we are not moving toward parity; by and large, we are not moving at all.

Not that we aren't trying. The efforts to understand why young women do not choose engineering as a career path and the various programs designed to reverse the course are numerous. Between 1993 and 2003 the U.S. National Science Foundation awarded 211 grants under the Diversity in Science and Education program. Most of the grants addressed the disinclination of young women to choose engineering. A summary of the NSF-sponsored studies is said to include "helpful tips...about how to best encourage girls in pursuing science and engineering education and careers." Yet those tips did not make any fundamental change. On average, 10 new Ph.D. dissertations are devoted to this subject every year.

One would expect that with such a growing volume of new work in this area, we would already have discovered some con-

vincing explanations and one or two useful remedies. It has not happened. Quite a few organizations—including the IEEE Women in Engineering group, the American Society of Engineering Education, and the National Academy of Engineering—are devoted in full or in part to attracting girls and young women to engineering, and these organizations maintain a healthy number of Web sites and other programs.

The annual "Introduce a Girl to Engineering Day" was born in 2001. A major Public Broadcasting System station, Boston's WGBH, has joined the effort and developed thoughtful public television documentaries and hands-on campaigns on engineering aimed at girls. All major engineering associations, including the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the IEEE have launched or participated in similarly motivated efforts. If we are still failing, it is not for lack of programs, Web sites, goodwill, research, or budgets. Something else is amiss.

ARE WE WRONG? Let me propose a hypothesis: our basic assumptions on the intelligence and perception of girls and young women are wrong. With very few exceptions, the enthusiastic planners of campaigns to attract women to engineering (and the associated literature) all assume that what we really need is to make these uninformed females "see the light." In other words, like missionaries who know that only one religion (theirs) is right, we reach out to the pagans to save them from their collective folly. If we could only show these women how important/humane/economically rewarding or intellectually satisfying it is to be an engineer, they will understand that their future is in, say, bridge design or microwave amplifiers. If we could only persuade young ladies who now enroll happily in law schools and medical schools, in programs in accounting, pharmacology, and dentistry, to enter the much more valuable occupations of civil and electrical engineering, then our sacred mission would be accomplished.

It is not difficult to discover what is wrong with that picture. As wage differentials erode and discrimination recedes, women enjoy a much wider range of opportunities. If a woman has the intellectual ability and persistence required in engineering school, she is also welcome in other challenging programs. Unlike the engineering classroom that has preserved many of its 1950s qualities, the alternative programs often offer a friendly and inviting atmosphere, modern teaching methods, and a much more immediate connection to real-world applications.

VANISHING APPEAL Reform attempts not withstanding, engineering school continues to be a dreary and stressful affair. Typical curricula still struggle to include "all that is important," and as a result they are overstuffed and unattractive. More study subjects are likely to be crammed into the heavy course list; fewer obsolete old favorites are likely to be retired. The post-university workplace is not much better. Compared with the fields of education or health care, the ethos of the engineering workplace—long hours, high stress, competitiveness, a "one size fits all" mind-set—is uninviting. This is especially true for women, who still carry child-rearing duties in our society much more heavily than men.

The lackluster engineering education experience and the often unaccommodating (and increasingly unstable) engineering workplace have affected men as well as women. During the last 20 years, enrollment in U.S. engineering programs has lagged significantly behind the overall growth in college and university enrollments. There were demographic changes as well—engineering students in the United States are increasingly recruited from communities that struggle to lift themselves into the middle class (most notably, first-generation college attendees and first- and second-generation immigrants). The news about offshoring of engineering jobs, whether accurate or not, has not helped.

Clearly, some of the appeal of engineering as a key to upward mobility has vanished, and it is not surprising that young successful women, even those who have taken the right classes and are prepared for engineering schools, are not that impressed with the opportunity. When we also tell them (as we do) that in order to be an engineer one must be "a fan of science and math" and "juggle projects, lab exercises, and reading assignments" they take one last look at us and flee. In the table below I show how the popular CollegeBoard Web site describes several college study majors. The lawyer-to-be will "engage in intense discussion of thorny legal problems." The computer engineer? She will "spend lots of time solving tough math problems." Take your pick.

Young women are not dumb. The problem is not that they need to change.

CAREER RUNDOWNS AT WWW.COLLEGEBOARD.COM

SUBJECT	IT HELPS TO BE	ARE YOU READY TO?
LAW	Fascinated by the relationship between law and society	• Engage in intense discussion of thorny legal problems • Study actual court cases • Join your school's legal studies association
BROADCAST JOURNALISM	Quick of mind and sharp of tongue	• Learn how to find and interview sources • Write radio and TV scripts • Record and edit sound
COMPUTER ENGINEERING	A problem solver and a team player who is able to work independently. You'll spend hours solving problems on your own and as part of a team.	• Spend lots of time solving tough math problems • Take courses in electricity, circuitry, and electronic materials early on to prepare for engineering courses • Intern off campus
ELECTRICAL ENGINEERING	A fan of science and math who is curious about the way things work	• Juggle projects, lab exercises, and reading assignments • Spend hours building detailed, complicated systems • Design your own gadgets or software • Try, try, and try again when at first a project doesn't succeed

The problem is that *we* need to change. In the view of many young people, women especially, engineering represents a collection of majors that promise hard work during college, often in a tense and demanding atmosphere, with the prospect of ultimately gaining a stressful job of questionable permanence. What will help us most is not to say that this ain't so, but to make it so that it ain't.

COURSE CHANGE We have put enough money and effort into ads and Web sites. We have a cabinet full of trend studies that made very little difference, and lists upon lists of unhelpful tips from carefully written dissertations and long observational treatises. It is time to change direction.

Here are two ideas to start the process: whether we like it or not, the current engineering curriculum has demonstrated itself to be strongly oriented toward males. As unfashionable and unseemly as it may sound, the time may have come to try consciously to develop an engineering curriculum aimed deliberately at young women. This may sound heretic. However, when everything else fails (and I would argue that everything else has indeed failed), it may be time to address the curriculum problem directly rather than ignore it and try to hide it in glitzy propaganda campaigns (which women do not fall for anyway). One likely outcome may be that this new reengineered curriculum would also appeal to many talented men who are repelled by the same deficiencies of the current curriculum that have driven most women away.

Second, we need to work with industry and experts in occupational choices, labor, economy, psychology, and popular culture to develop new engineering workplace models. These models would be designed to be in better harmony with the tastes, sensitivities, lifestyle, and family obligations of the modern, educated middle-class woman. I realize this too may sound a bit out of style; after all, we are supposed to enjoy full equality and exhibit unquestionable sameness by now. However, the reality is that with only 10 percent of engineers who are women, the engineering workplace is anything but equal. In other professions and occupations the workplace evolution has occurred naturally, shaped by market forces and social pressures. In engineering we may have to give it a little push.

If we (professional organizations, federal funding agencies, research institutions, colleges and universities, the engineering industry) insist on trying again and again the same formulas, studies, and campaigns that have disappointed us for 30 years, we are certain to get exactly the same unsatisfactory results. In that case it would be much more practical to acknowledge that engineering is for men only, and move on to the next problem. ●

Moshe Kam is vice president of IEEE Educational Activities, and the Robert G. Quinn Professor of Electrical and Computer Engineering at Drexel University in Philadelphia.

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Digitizing Technology's History

IEEE Proceedings Is Going Online, Simplifies Searchability

BY EVAN KOBLENTZ

AS NASA SAFETY ENGINEERS prepared to return one of the grounded U.S. space shuttles to orbit earlier this year, what their peers had done in previous years was much on their minds. How had the shuttles been made safe when they first began flying decades ago?

For answers, they called on *Proceedings of the IEEE*, literally. NASA contacted managing editor Jim Calder and asked him to send a number of safety-related papers published in the early 1980s, which he gladly did. One topic stands out—a discussion of extravehicular activity. Though no mission outside the vehicle had been planned before the Space Shuttle Discovery was lofted into orbit on 26 July, an extravehicular trip was needed to repair damage that had occurred during liftoff to tiles critical to the shuttle's safe reentry.

Now, however, you don't need a direct line to the managing editor to obtain the older papers from *Proceedings*, a monthly that publishes research, tutorials, and reviews of electrical and computer engineering technology. In July, the remaining full text of about 12 000 articles dating from 1963 to 1987 was digitized; the more recent issues had been digitized earlier. This makes it possible to search all issues of *Proceedings* from 1963 to the present by using IEEE Xplore, the institute's digital library.

Users can search through full texts and look for keywords or phrases, or they can search by abstract, author, document title, index terms, or the year an article was published. The IEEE Foundation has given US $250 000 to fund the digitization of issues dating back to 1913, an exercise that is not yet complete.

Most searches are not matters of life or death like NASA's, but clearly an article's accessibility is not just an academic issue, says Calder. "There is a practical component to every article, and that practical component may last longer than we realize," he says.

"To EEs and computer engineers, the *Proceedings* represents a crucial part of their professional heritage and technical identity," notes *Proceedings* editor in chief Fawwaz Ulaby. "Its pages contain the very foundations of the revolutionary innovations that form the electronic world of today, affecting every aspect of our way of life, from the way we transact business to the way we communicate and travel."

Most articles fall into one of seven categories: circuits and devices; computers; communications; signals, systems, and control; electromagnetics; energy, power, and industry; and engineering and human environment. But nearly every issue has an article of historical significance.

"The more I read through *Proceedings*, the more incredible people I find as authors. There are, without exaggeration, a thousand significant authors included in this collection," Calder says.

For example, in January 1949, Claude E. Shannon, considered the founding father of information theory, wrote "Communication in the Presence of Noise," which many historians credit as having defined information technology as a distinct field of research. Three decades later when IBM introduced the modern architecture of the AT model of its personal computer and Apple introduced its Macintosh, Hewlett-Packard cofounder William Hewlett and microchip coinventor Robert Noyce each wrote an article about the importance of PCs for the March 1984 issue of *Proceedings*. Hewlett's was "The Design and Development of a Family of Personal Computers for Engineers and Scientists," and Noyce's, "A Processor Family for Personal Computers."

This is just one of the issues whose articles have been recently digitized and made available through the IEEE Xplore digital library.

Noyce's peer Jack St. Clair Kilby, inventor of the IC, wrote about the military applications of microprocessors in "Minuteman Integrated Circuits—A Study in Combined Operations" [December 1964]. Gordon Moore, of Moore's Law fame and cofounder of Intel, looked to the future in his "Trends in Silicon Device Technology" [February 1969] and "Microprocessors and Integrated Electronic Technology" [June 1976]. He also had an eye for history in "The Role of Fairchild in Silicon Technology in the Early Days of 'Silicon Valley'" [January 1998]. Fairchild was the silicon semiconductor company he cofounded in 1957, an early player in California's Silicon Valley.

Transistor inventor William Shockley, who was Noyce's and Moore's boss early in their careers, also took a historical approach when he contributed "The Path to the Conception of the Junction Transistor" [July 1976]. Kenneth Wilson, a physicist awarded the Nobel Prize for work on phase transitions in bulk matter, called on the U.S. National Science Foundation to fund work on networks and supercomputers in "Science, Industry, and the New Japanese Challenge" [January 1984], which promoted work that led to the Internet.

Other highlights of the newly updated online archive cover communications devices. In "Optical Masers—Workhorse or Playboy: The Present Status and Prospects for Optical and Infrared Masers" [March 1963], physicist Charles Townes wrote about the microwave ancestor of the laser. Charles Sandbank, a pioneer in fiber-optic communications, coauthored "New Interconnection Techniques for Multichip and Hybrid Integrated Circuits" [December 1964], which discussed ways of making semiconductor connections, and also wrote "The Evolution Toward High-Definition Television" [April 1985].

Standards for television also had an airing in *Proceedings*. Donald Fink, Philco scientist and former president of the Institute of Radio Engineers, one of IEEE's predecessor societies, and later general manager of the IEEE, wrote "Perspectives on Television: The Role Played by the Two NTSCs in Preparing Television Service for the American Public" [September 1976]. (NTSC stands for National Television System Committee, the group responsible for TV and video standards in the United States.) In June 1984, Vladimir Zworykin wrote about the first all-electronic TV camera he had invented in "The Iconoscope—A Modern Version of the Electric Eye."

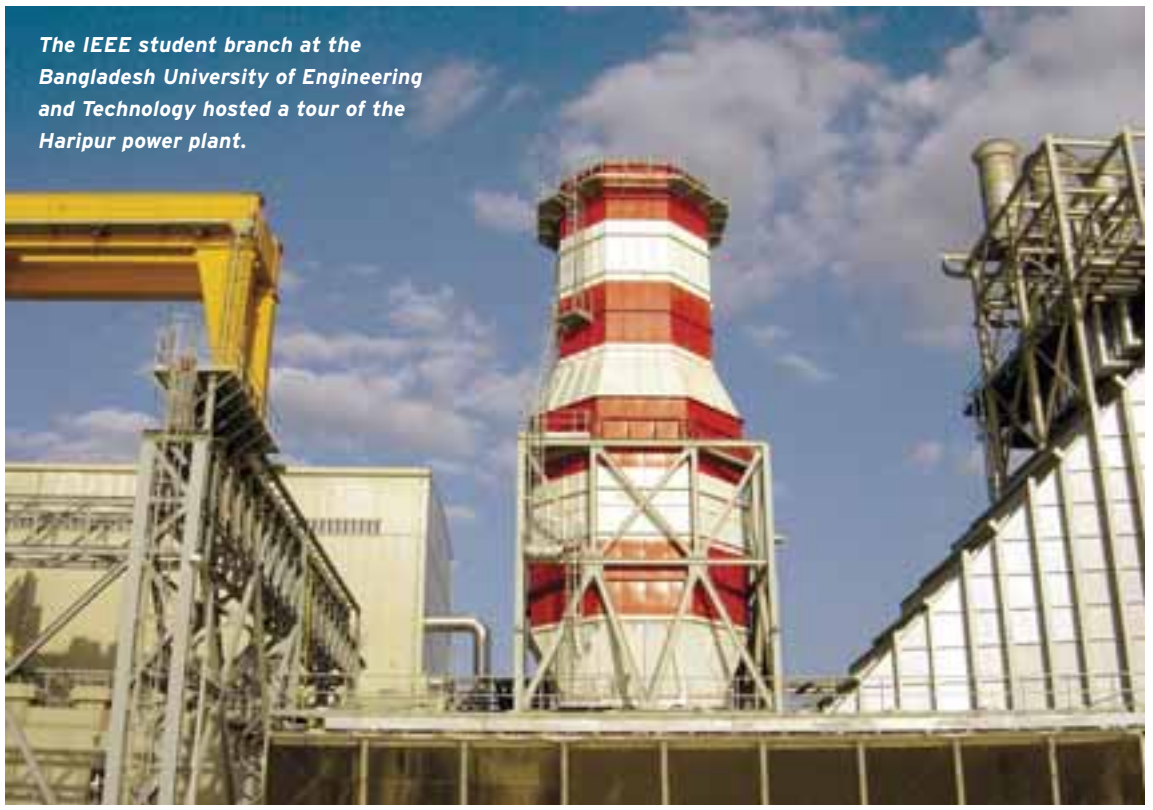
Karl Jansky, known as the father of radio astronomy, told what had been on his mind when he was investigating radio signals that did not originate on Earth in his "Electrical Disturbances Apparently of Extraterrestrial Origin" [June 1984]. And J.R. Pierce, who was director of electronics research at Bell Telephone Laboratories, foresaw the importance of satellite communications in his "Trans Oceanic Communication by Means of Satellites" [December 1984], and then discussed telecommuting in "Communication As an Alternative to Travel" [April 1999].

Issues from 1913 to 1962 will be posted next in IEEE Xplore, with all *Proceedings* expected to be digitized by mid-2006. Archives may also be digitized from the Boston-based Society of Wireless and Telegraph Engineers and the New York City–based Wireless Institute, which merged in 1909 to form the Institute of Radio Engineers. Authors from that early period include Lee DeForest, Thomas Edison, and Guglielmo Marconi.

Proceedings of the IEEE is available through IEEE Xplore to members with a subscription and to subscribers to the IEEE/IEE Electronic Library, which provides access to all IEEE online publications. To view the tables of contents of *Proceedings* in IEEE Xplore, visit http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5.

Organize Tours to Technical Facilities

BY KATHY KOWALENKO



The IEEE student branch at the Bangladesh University of Engineering and Technology hosted a tour of the Haripur power plant.

Engineers are an inquisitive lot; they like to know how things work. The IEEE's local organizations can help feed that curiosity by arranging tours of nearby technical facilities, such as manufacturing and electric power plants, satellite ground stations, and telecommunications facilities. Members—and nonmembers, who are also welcome to come along—learn about equipment they may have wondered about, and they may also have the opportunity to meet with an organization's top management, which sometimes can even lead to a new job.

Senior Member Ghatt Khazami sees the tours not only as educational but also as a way for his chapter to boost its membership. Nonmembers who take the tours have been impressed enough to wind up joining the institute, he says. Khazami has arranged several tours as chair of the Florida West Coast Section's IEEE Power Engineering and Industry Applications societies' combined chapter. Most of his tours are free; if food is provided, a nominal fee is charged.

The section arranges about four tours a year of facilities in and around Tampa, Fla. This year's visits included a couple to manufacturing plants, General Electric's instrument transformer plant in Tampa and its power transformer plant in nearby Bradenton. Each tour draws an average of 30 people.

The engineers aren't the only ones who benefit from the tours, adds Senior Member Tom Blair, the combined chapter's vice chair and the section's membership development chair. The companies get to know some of the local engineering talent, he notes. "It's a good networking opportunity both ways," he says. "And the engineers get to learn about the businesses and the technologies involved in running the facilities."

CHOOSING A SITE It's usually the job of the chapter chair, a section's membership development chair, or the counselor of a student branch to organize visits, which should have an engineering or technology bent. But it's not a one-person job, according to Blair.

"Organizing a tour is a team effort, from choosing the venue, picking the date, and contacting the company to arrange things to publicizing the event on our Web site and in our newsletter and taking registrations," Blair says. Most organizers take registrations via an online form, but some use the telephone or e-mail.

Members are asked to suggest venues, but more often than not the organizers end up scouring local newspapers looking for announcements of a "grand opening" of a new plant, high-tech upgrades to existing facilities, or local engineering issues being discussed in articles. Tour organizers also tap their co-workers, friends, and relatives for ideas on places to visit.

Senior Member Alan Storms decided on a tour of the Brayton Point Power Plant, in Somerset, Mass., after reading unflattering newspaper articles about the operation of this largest fossil fuel–burning plant in the Northeast. Storms is the membership development chair of the Providence (R.I.) Section, which has about 1500 members. "I disagreed with the treatment Brayton was getting in the press, so I wanted our members to see for themselves how the plant was run," he says. "The tour was educational; there was no attempt to try to influence anybody."

It turned out to be the section's most popular trip, attracting 45 members and guests. The visitors learned what it takes to run a coal-burning plant, the impact of the U.S. Clean Air Act on the company's operations, and how the plant was trying to meet the government's emission limits. Many on the tour came away with a more positive view of the plant, according to Storms.

For another visit, Blair, of the Florida West Coast Section, found out through friends that the Bay News 9 TV station in nearby St. Petersburg had recently installed robotically controlled cameras to replace ones operated by humans, so he organized a visit to the studio.

"The station manager gave us a tour of the control room and showed us how its robotic cameras work," says Blair. "Members of the general public would not get to see this."

TIMING IT RIGHT Scheduling the tour at the right time of day, and occasionally even the right time of year, can affect attendance. For example, Florida West Coast's Khazami holds most of his tours on weekday evenings to accommodate members' work schedules. But the Hong Kong Section's Graduates of the Last Decade group, better known as the GOLD group, has found that Saturdays work best for its members.

"More members can join the tours without having them clash with their work schedule," says Ken Tsz Kin Chan, the section's GOLD chair. He's also not afraid to schedule visits to the same place more than once. In the past year, Chan has led three groups of about 25 people each to CLP Power Hong Kong Ltd., the region's major power utility. They've checked out the company's no-dig cable-laying technology, the environmentally friendly operations of its Green Substation, and the Power Quality Center.

The IEEE student branch at the Universidade Estadual Paulista in Bauru, Brazil, has attracted a goodly number of attendees by scheduling a plant visit as a special event during the school's Engineering Fair Week, a celebration to recognize contributions made by engineers to society. The branch chartered a bus for three days in May to take 38 students to southern Brazil, where they visited the Itaipu hydroelectric plant, the largest in the world, and its Furnas electricity distribution plant. In August, the group visited the Barra Grande sugar and alcohol factory in Lençóis Paulista, which produces electricity from sugar cane waste.

"Students like these visits because they get to see the real world," says Natalia Reolon dos Santos, the student

Tours are NOT ONLY EDUCATIONAL but also a way to boost membership

branch's chair, who spent three months organizing the visits. "They're also in contact with professionals, people they probably wouldn't have the opportunity to meet until after they graduate."

For students, plant tours offer an inside look at how technologies they're learning about in school are applied in real life. "Tours give students an opportunity to enhance their practical knowledge of the exciting work going on in the fields they're studying," says Adnan M. Qureshi, chair of the newly formed IEEE student branch at the Institute of Space Technology, Islamabad, Pakistan. Through the branch's "A Day With an Engineer" program, the six visits this year attracted a total of about 150 student members. One tour went to the country's telecommunications and aerospace facilities, which are off-limits to members of the general public.

In Bangladesh, Asif Islam Khan, chair of the IEEE student branch at Bangladesh University of Engineering and Technology (BUET) reports that plant tours can boost students' career prospects because companies use the tours as recruitment opportunities.

"Companies often recruit students who are about to graduate to full-time positions," Khan says. "And sometimes, students are asked to work part-time at the company while they're going to school."

Tours that BUET arranges usually draw about 40 students. So far this year, student members have visited the Talibabad earth satellite station, the Haripur power plant, and the offices of SITA, an international society devoted to aeronautical telecommunications. "The tours are at the heart of making the IEEE BUET branch popular among students," Khan says. "And the tours help them become enthusiastic about the different fields of electrical engineering."

The Itaipu hydroelectric plant and dam [shown] was one of the stops on a three-day tour of different facilities in southern Brazil organized by the IEEE student branch at the Universidade Estadual Paulista in Bauru, Brazil.

Support the IEEE Foundation With an Estate Gift

BY KAREN GALUCHIE

THERE ARE MANY WAYS members give back to the IEEE. Some donate their time by holding volunteer executive positions, writing articles for IEEE publications, or teaching young students about engineering. Others donate money to the IEEE Foundation, the IEEE's philanthropic arm, which supports projects that promote public awareness of engineering's long-reaching effects, bring the excitement of scientific discovery to young students, foster technological innovation, and preserve history.

Last year, more than US $1 million was donated to the foundation. Nearly $100 000 of that amount came from members who had designated contributions from their estates upon their deaths. For example, Life Fellow Charles "Bud" Eldon, 1985 IEEE president, has earmarked a gift in his will for the foundation. He has a number of reasons for doing so.

"My diverse assignments for the IEEE and for the foundation have made me extremely proud of their many contributions," he says. "Both offer innumerable opportunities for IEEE members and for society at large to understand and benefit from our technology—and to learn about those who have created it."

After IEEE Member Jaclyn Spear served a one-year stint as an IEEE-USA Congressional Fellow, she made a bequest in her will to the IEEE-USA Government Fellows Program. IEEE-USA sponsors fellowships for members to spend a year in Washington serving as advisors to the personal staff of a senator or representative, or to the professional staff of a congressional committee. Fellows learn firsthand about the public policy process through their personal involvement.

"Through this gift, I know I will be helping to ensure that other IEEE members are afforded the same opportunity that I had to participate in the unique experience of serving as an advisor to the U.S. Congress," Spear says.

If the IEEE has made a difference in your life and if you believe in the importance of furthering the scientific and educational goals of the institute, consider making a planned gift to the foundation through your estate. Typically, gifts are included in:

- **WILLS AND LIVING TRUSTS:** These allow you to bequeath a fixed sum or a percentage of your estate to the foundation, a specific IEEE program, or an IEEE entity, such as a society, for which you have a special affinity. Or consider arranging for the foundation to receive the amount left in your estate after all other bequests have been made.
- **RETIREMENT PLANS:** Designating nonspouse beneficiaries—such as children—as the heirs of a U.S. retirement plan makes them subject to estate taxes and also responsible for paying income tax on the funds they withdraw from the plan. To avoid this double taxation, which can add up to as much as 70 percent of the assets, consider naming the foundation as the beneficiary. You can make gifts to your heirs from other assets not subject to income tax.
- **LIFE INSURANCE:** If you have a life insurance policy, consider transferring the policy's ownership to the foundation or naming it as a beneficiary. Or think about purchasing a new policy and naming the foundation as the owner and beneficiary.
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Whatever your goals, the IEEE Foundation's Development Office will work with you to ensure that your charitable objectives correspond to your financial, tax, and estate plans. Contact the development office at +1 732 562 3860 or by e-mail: supportieee@ieee.org.

THE GOLDSMITH LEAGUE

Named for Alfred N. and Gertrude Goldsmith, the Goldsmith League is composed of individuals who have left gifts in their wills to the IEEE or the IEEE Foundation or who have expressed the intention to do so.

Alfred N. Goldsmith, a founder of the Institute of Radio Engineers, one of the IEEE's predecessor societies, made a personal commitment to further the goals of the profession during his lifetime. He perpetuated that commitment by providing a bequest to the IEEE Foundation, presented after his death in 1974. His wife, Gertrude, who died in 1988, honored her husband's wishes, making the IEEE Foundation the beneficiary of a generous portion of her own estate. Together their gifts furnished significant seed money for the foundation's support of philanthropic activities.

Membership in the league is open to any individual who makes a bequest or expresses the intention to make a bequest to the IEEE or the IEEE Foundation. Details of the bequest are kept confidential; donors who wish to remain anonymous will not be included in the published list of Goldsmith League members.

MEMBER RECOGNITION

Communications Expert Receives Gennai Prize

BY SHAZIA MEMON

IEEE SENIOR MEMBER Fuji Ren's work to develop software that interprets people's facial expressions and, from that, their emotions has earned him the Gennai Prize from the Ozaki Foundation of Japan.

The foundation presents this award for creative research or invention in the fields of electronics, information, or telecommunications. The prize consists of a certificate of merit and 500 000 Japanese yen (approximately US $4500).

A professor and the chair of the Department of Information Science and Intelligent Systems at the University of Tokushima, in Japan, Ren has applied his research to so-called affective computing, which deals with communication between people and computers. One practical application of his research has been to give people with impaired speech the ability to express their feelings more clearly through a computer that can recognize their facial expressions and voice patterns.

He hopes that by incorporating emotion in the human-computer interaction, his work will benefit the health-care industry and social services. "When I look at the recent developments in communication technology, I feel more and more that there is a necessity for emotion to work its way in," he says.

To that end, he's created a mental state transition system that allows researchers to simulate changes in a person's mental and emotional state through software. This is the software that analyzes a person's facial expressions, words, and speech patterns to recognize emotion.

TEAMWORK Ren credits the research team he formed in 2001 at the university's Faculty of Engineering with helping him create the system. The six-person team focused on aspects of the human mind and the development of a program that could carry out the process of emotional

Fuji Ren

communication. The group, which eventually grew to 46 students, analyzed information contained in brain waves, voice and speech patterns, and facial images. It also evaluated statistical data based on the latest results of neurological and psychological studies. The program the group designed uses the data to recognize human emotion and then relays the results to a computer.

Ren donated the prize money to his university because it helped him "develop our project, and I wanted to set a good example for our students," he says. "They give me energy and make me stay interested in my research."

Seeing the number of his students expand and their interest grow over the years has motivated Ren to continue his work. Currently he leads four research projects that are trying to establish additional methods of communicating emotion and delve further into the world of natural-language processing. The latter field involves the study of the problems inherent in the processing and manipulation of natural language as it is spoken by humans for general-purpose communication, as opposed to computer-programming jargon.

Ren received bachelor's and master's degrees in computer science in 1982 and 1985, respectively, from the Beijing University of Posts and Telecommunications. In 1991 he received a doctorate in natural-language processing from Hokkaido University, in Sapporo, Japan.

IN MEMORIAM

Berthold Sheffield
Communications Pioneer

BY DONALD CHRISTIANSEN

THOSE OF US WHO KNEW Berthold Sheffield well could be confident that any job he undertook would be done with great diligence and attention to detail.

Bert, an IEEE life senior member, was born in Heilbronn, Germany, in 1910, and came to the United States with his parents when he was 13. As a youth he read accounts of Heinrich Hertz's and Guglielmo Marconi's works, and at 19 was personally congratulated by RCA Chairman David Sarnoff when he won the Sarnoff scholarship for fledgling radio operators. He often recalled trying times as a radio operator aboard a freighter that plied its way in rough seas between Norfolk, Va., and New York City.

When Bert joined RCA in 1937, he hardly imagined that it would be a relationship that would last nearly four decades. During that time he earned a degree from the Polytechnic Institute of Brooklyn (now Polytechnic University) and did graduate work in mathematics and modulation theory.

Whenever his ideas were in conflict with those of his colleagues, he would clearly express them—but always in a circumspect and gentlemanly manner. Asked to review a book or technical manuscript, Bert would read it thoroughly and, if questions of authenticity or accuracy arose, he would be sure to carefully document his concerns. On more than one occasion, he had been heard to say "I'd better speak to the author directly on this one," wanting no deterioration of communication through an intermediary.

His projects at RCA were wide ranging, including many in the field of satellite communications. But the one that most fascinated him resulted in his design for the first centralized traffic control system for a railroad using radio to operate both signals and switches. The successful installation, which took three years, was made for the Orinoco Mining Co., in Venezuela, a transporter of iron ore from mine to ore-carrying ships on the Orinoco River and, ultimately, to U.S. Steel refineries in Pennsylvania.

When he retired from RCA in 1973, Bert consulted for the RCA Space Center and others, including MCI and Western Union. He also taught telecommunications

Berthold Sheffield

BERTHOLD SHEFFIELD 95
DIED 17 August 2005
MEMBER GRADE Life Senior Member (Member since 1930)
EDUCATION Bachelor's degree in electrical engineering from the Polytechnic Institute of Brooklyn, New York
FIELDS OF INTEREST Modulation theory, control systems, statistics, and probability
VOLUNTEER ACTIVITIES Eta Kappa Nu National Board of Directors, 1972-1974; Member, Outstanding Young Electrical Engineer Committee, 1964-2005, Chairman, 1966-1970; Advisor, Jointure Committee on Community Education, Montgomery Township, N.J.
AWARDS 1986 Distinguished Adjunct Professor Award, College of New Jersey; 1981 Eta Kappa Nu Distinguished Service Award; 1993 Eta Kappa Nu Eminent Member Award

courses at Mercer County Community College, in West Windsor, N.J., and the College of New Jersey, in Ewing. His teaching skills were recognized by his students and by the College of New Jersey when it honored him with the Distinguished Adjunct Professor Award in 1986.

Bert joined the IEEE as a student member in 1930. He published numerous papers and contributed to several books.

He was active as a member of Eta Kappa Nu, the electrical engineering scholastic honor society. Many of us knew him best as a colleague on the Eta Kappa Nu Outstanding Young Electrical Engineer Award and Vladimir Karapetoff Award committees, where his conscientious evaluation of candidates was unmatched.

His colleagues may disagree as to whether "gentleman engineer" or "engineers' engineer" best fits Bert. The point is moot. Either is apt.

Donald Christiansen, an IEEE Fellow, editor emeritus of IEEE Spectrum, *and an Eta Kappa Nu Eminent Member, served with Sheffield on many of the society's committees.*

Nominations Needed For IEEE Awards

The IEEE Awards Board invites IEEE Sections, Societies, and individual members to submit nominations for medals, recognitions, and prize papers that will be presented in 2007. The deadline for the board to receive nominations is 1 July 2006.

IEEE MEDAL OF HONOR
For an exceptional contribution or an extraordinary career in the IEEE fields of interest.
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IEEE EDISON MEDAL
For a career of meritorious achievement in electrical science, electrical engineering, or the electrical arts.
Sponsor: Samsung Electronics Co.

IEEE FOUNDERS MEDAL
For outstanding contributions in the leadership, planning, and administration of affairs of great value to the electrical and electronics engineering profession.
Sponsor: IEEE Foundation

IEEE RICHARD W. HAMMING MEDAL
For exceptional contributions to information sciences, systems, and technology.
Sponsor: QUALCOMM, Inc.

IEEE JUN-ICHI NISHIZAWA MEDAL
For outstanding contributions to material and device science and technology, including practical application.
Sponsor: The Federation of Electric Power Companies, Japan, and Semiconductor Research Foundation

IEEE ROBERT N. NOYCE MEDAL
For exceptional contributions to the microelectronics industry.
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IEEE DENNIS J. PICARD MEDAL FOR RADAR TECHNOLOGIES AND APPLICATIONS
For outstanding accomplishments in advancing the fields of radar technologies.
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IEEE SIMON RAMO MEDAL
For exceptional achievement in systems engineering and systems science.
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IEEE JOHN VON NEUMANN MEDAL
For outstanding achievements in computer-related science and technology.
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IEEE HONORARY MEMBERSHIP
For meritorious service to humanity in IEEE's designated fields of interest.
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For outstanding and exemplary contributions by an industrial entity, governmental or academic organization, or other corporate body, which have resulted in major advancement of electrotechnology.
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IEEE ERNST WEBER ENGINEERING LEADERSHIP RECOGNITION
For exceptional managerial leadership in the fields of interest to the IEEE.
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IEEE SERVICE AWARDS

IEEE RICHARD M. EMBERSON AWARD
For distinguished service to the development, viability, advancement, and pursuit of the technical objectives of the IEEE.
Sponsor: IEEE Technical Activities Board

IEEE HARADEN PRATT AWARD
For outstanding service to the IEEE.
Sponsor: IEEE Foundation

IEEE PRIZE PAPER AWARD

IEEE DONALD G. FINK AWARD
For outstanding survey, review, or tutorial paper in any of the IEEE transactions, journals, magazines, or proceedings.
Sponsor: IEEE Life Members Committee

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