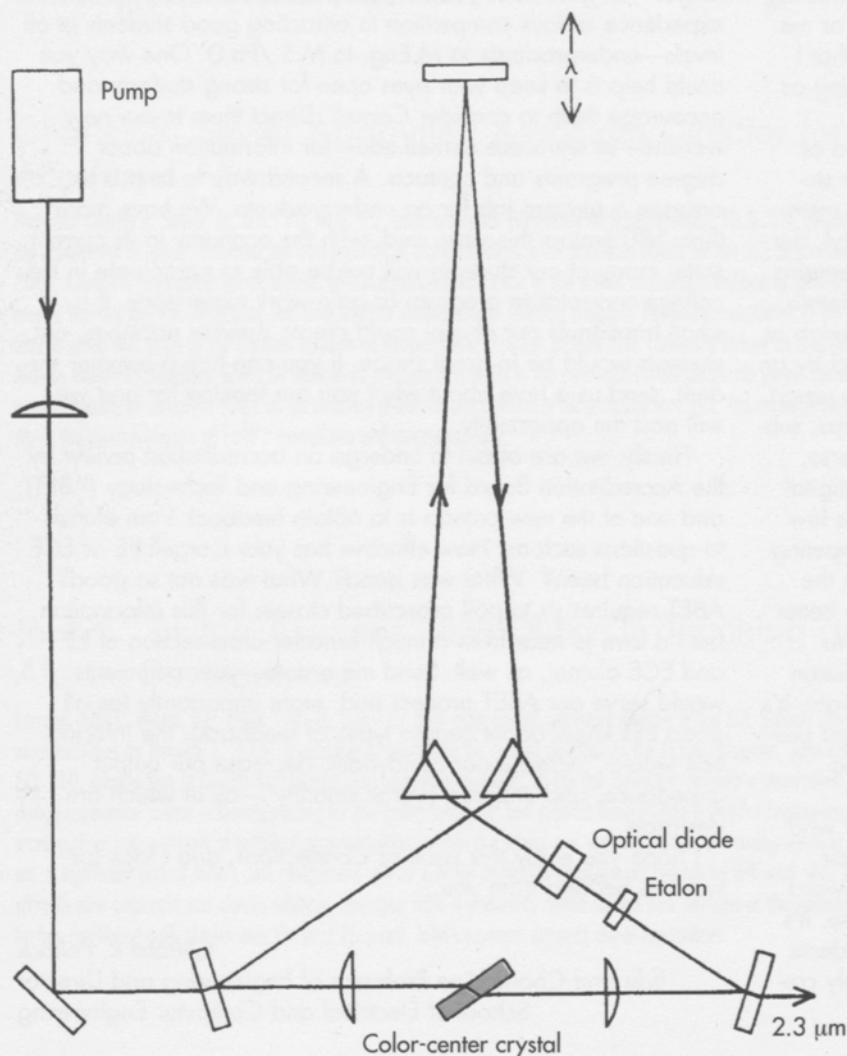


CONNECTIONS

A Report from the School of ELECTRICAL AND COMPUTER ENGINEERING • Cornell University

Optoelectronic Technology Research in the School of Electrical and Computer Engineering



This sketch depicts a color center ring laser in which the light radiation travels in a circle, thus forming a traveling wave. The color center crystal, typically two millimeters thick, is located at the focus of the laser cavity, where the intensity is high, thereby enhancing the rate of stimulated emission. After being collimated by the lenses, the laser beam is reflected through prisms for tuning. The laser is optically pumped by a second laser, in this case a powerful laser operating near a wavelength of one micrometer to provide operation in the near infrared. Photons from the pump laser are sufficient to place the color centers in the excited state so that lasing may take place. The crystal is mounted on the end of a copper finger fastened to a flask containing liquid nitrogen.

Sketch by Clif Pollock, courtesy of *Engineering Cornell Quarterly*.

This eleventh edition of *Connections* features the challenging research of our optoelectronic (OE) technology research group, relates the history of optoelectronic technology in the EE/ECE School, and considers the impact on the ECE School of new analytical and experimental techniques in the OE field. The "Positive Feedback" section contains news of recent alumni activities. Other items of interest to alumni are listed below in the table of contents. Please fill out the information coupon on the last page of this newsletter, clip it, and mail it to us. We want to hear what you are up to.

Simpson (Sam) Linke, editor

SUMMER 2002

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Frank DiMeo, Cornell University Photography

CLIFFORD R. POLLOCK

I'm finishing my first year as director of the School of Electrical and Computer Engineering. It would be an interesting contest to see who learned more this year—the students or me. We've learned different things, surely, but it's a fair bet that I had to master as many new concepts and ways of thinking as even our best students faced. It's been fascinating!

Most of you no doubt recall the hard work we required of you in earning your degree—well, this is still true for our students today. Even though we have hired 17 new faculty members in the last seven years (almost half the current faculty), our culture of rigorous instruction and challenging projects remains the same. Things have changed somewhat in the daily details, however. We no longer require students to come to Superlab at 7:30 a.m. for prelab work, as many of you did, followed by an afternoon at the bench and a long night of writing a lab report. The tribulations of an ECE student's life today are, perhaps, subtler. For example, one of the projects in our required course, ECE 314, Computer Architecture, involves designing a digital circuit for a game called Capture the Flag while using as few transistors as possible. Students test their designs by competing against each other (thus they can determine their rank in the class at any time). A complex design will play the game better but requires additional transistors. The students continue to improve their designs until the final moment of the submission deadline, after which they all sleep for several days straight. It's a neat system—the competition encourages teamwork and provides feedback and motivation for clever work, but it also absorbs almost every free moment in each student's life.

Do the students mind? Not at all! In fact, the professor who developed this class, Assistant Professor **Rajit Manohar**, won the college's top teaching award, the Tau Beta Pi Award for Teaching Excellence, the first time he taught the course. It's been my experience in the last 19 years that Cornell students rise to rigor and hard work and are capable of incredibly creative thinking—that's part of our culture.

Our school has had many accomplishments this year (detailed throughout this issue). True to our heritage, we have had a good year for awards and research results. We continue to teach stimulating students, we maintain a strong program of scholarship with our graduate students, and we attract top young faculty.

Despite our successes, the ECE School is facing certain challenges—as graduates you may be positioned to help us. We experience serious competition in attracting good students at all levels—undergraduate to M.Eng. to M.S./Ph.D. One way you could help is to keep your eyes open for strong students and encourage them to consider Cornell. Direct them to our new website—at www.ece.cornell.edu—for information about degree programs and contacts. A second way to help is to arrange a summer job for an undergraduate. We have more than 180 juniors this year, and, with the economy in its current state, many of our students will not be able to participate in the college cooperative program or gain work experience. If a small fraction of our alumni could create summer positions, our students would be in great shape. If you can hire a summer student, send us a note about what you are looking for and we will post the opportunity.

Finally, we are about to undergo an accreditation review by the Accreditation Board for Engineering and Technology (ABET), and one of the new criteria is to obtain feedback from alumni to questions such as: How effective has your Cornell EE or ECE education been? What was good? What was not so good? ABET requires us to poll proscribed classes for this information, but I'd love to hear from a much broader cross-section of EE and ECE alumni, as well. Send me a note—your comments would serve our ABET process and, more importantly (as all good EEs know about certain types of feedback), the information would “increase our bandwidth, decrease our output impedance, and improve overall stability”—all of which are desirable.

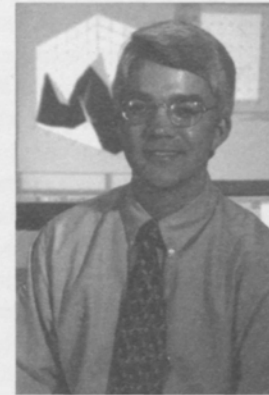
I hope you enjoy this issue of *Connections*, and I look forward to hearing from you.

Clifford R. Pollock

Ilda and Charles Lee Professor of Engineering and Director
School of Electrical and Computer Engineering

Stephen B. Wicker Appointed Associate Director for Research

Professor Stephen B. Wicker, B.S. '82 (University of Virginia), M.S. '83 (Purdue University), Ph.D. '87 (University of California, Los Angeles), all in electrical engineering, associate director of the ECE School, assumed the new position of associate director for research on January 1, 2002. This position was established to provide new faculty in ECE with a senior faculty member who will offer advice on funding agencies, input on proposals, and possible connections to bureaus such as the Defense Advanced Research Projects Agency and the U.S. Department of Defense. The position has a larger mission of coordinating research, supervising faculty members in establishing research centers in the school, and directing preparation of proposals to industry for grants of teaching equipment. Steve came to Cornell from the Georgia Institute of Technology in 1996 as an associate professor of electrical engineering and was promoted to professor on July 1, 1999. He teaches and conducts research in wireless information networks, digital communications systems, and error-control coding, with emphasis on the development and application of advanced technologies for data links and multiple-access protocols in wireless networks.



Frank Dimko, Cornell University Photography

Charles E. Seyler Appointed Associate Director for Academic Affairs

Professor Charles E. Seyler, Jr., B.A. '70, M.A. '72, both in physics (University of South Florida), Ph.D. '75, physics and astronomy (University of Iowa), assumed the new position of associate director for academic affairs for the ECE School on January 1, 2002. Charlie is responsible for all aspects of undergraduate education in the school including coordinating faculty teaching assignments, maintaining the curriculum, and directing the undergraduate advising program. Following completion of his graduate study, Charlie spent two years at the Courant Institute of Mathematical Sciences of New York University before he transferred to the Los Alamos National Laboratory where he worked as a research scientist in the controlled-fusion group. He joined the electrical engineering faculty at Cornell in 1981 as an assistant professor and became a full professor in 1993. His research interests are primarily in the plasma physics of Earth's ionosphere and magnetosphere.



Jon Reis Photography

John C. Belina Assumes New Duties in Teaching and Alumni Development

Lecturer John C. Belina, B.S. ENGR. '74, M.Eng. '75, both from Cornell, assistant director of the ECE School, assumed new responsibilities on January 1, 2002. In addition to continuing his current direction of the M.Eng. program, John will teach course ECE 210, Introduction to Circuits for Electrical and Computer Engineers, in the fall semester; develop a stand-alone, culminating design-experience course in bioengineering for the spring semester; and support Accreditation Board for Engineering and Technology work such as improvement of technical communications within the school and implementation of training sessions for faculty advisers. A significant part of John's new assignment will be directed at alumni development, where he will work with Jamie Edgar, the school's new corporate and alumni relations manager. John is eminently suited for this task because of the widespread connections he has developed with alumni over the past 25 years. John's research interests are in biosciences.



David Ruether Photography, courtesy of Engineering Publications

Michal Lipson

B.A. '92, M.S. '93, Ph.D. '98 (Technion-Israel Institute of Technology), all in physics, joined the ECE School faculty in July 2001 as an assistant professor. From 1998 to 2001 she was a postdoctoral researcher in the Department of Material Science and Engineering at Massachusetts Institute of Technology where her research involved the physics and applications of silicon-based photonic structures for on-chip applications. Her teaching and research areas are in the field of nanophotonics with emphasis on optical nanostructures for short and long interconnect distances such as on-chip and chip-to-chip connections, and optical telecommunications.

The density of on-chip interconnect wiring is becoming a serious limiting factor for conventional scaling of very-large-scale integrated circuits (VLSI) on silicon. On-chip optics research can lead to a new technology that is free from conventional microelectronics limitations and can offer low-cost, scalable alternatives with high bandwidth and reduced power dissipation. Michal's research group is engaged in the development of such optically active nanodevices in the form of amplifiers, emitters, modulators, routers, and switches, thereby creating opportunities for production of complementary metal-oxide semiconductors (CMOS), compatible optical circuits, and novel interconnect architectures and designs for chip applications.

Michal is a member of the Materials Research Society, has over 18 publications in her fields of interest, and has given six invited talks in this country and abroad. She is a member of the Advisory Committee of the 2002 International Conference on Luminescence, and she serves as a reviewer for *Physical Review B*, the *Journal of Applied Physics*, and *IEEE Photonics Technology Letters*. When time allows, Michal and her family enjoy exploring the Ithaca area.

Anna Scaglione

M.Sc. '95, Ph.D. '99 (Università di Roma "La Sapienza," Rome, Italy), both in electrical engineering, joined the ECE School faculty in July 2001 as an assistant professor. During 1997 she was with the University of Virginia as a visiting research assistant, followed by an appointment from 1999 to 2000 as a post-doctoral research assistant in the Department of Electrical and Computer Engineering of the University of Minnesota, Twin Cities. From 2000 to 2001 she was an assistant professor in the Department of Electrical and Computer Engineering of the University of New Mexico. Her teaching and research interests lie at the intersection between statistical signal processing and communication theory.

Increased channel capacity by means of multiple transmitting and receiving antennas is being suggested to meet the demand for high-speed wireless links and the progressive saturation of the radio frequency bands. In order to achieve the information rate and/or the diversity rate afforded by this increased hardware capacity, appropriate precoding and modulation techniques are necessary. Anna's research group concentrates on the development of these techniques based on her specific interests in



Charles Harrington, Cornell University Photography



Richard Killen, Cornell University Photography

optimal modem design for broadband frequency-selective channels, equalization, time-varying channels, multicarrier systems, and transmitting and receiving diversity.

Anna has received a 2002 National Science Foundation Early Career Award for her previous research, and, with her coauthors, won the 2000 IEEE Signal Processing Transactions Best Paper Award. As a member of IEEE she serves as a reviewer for *IEEE Transactions on Signal Processing*, *IEEE Signal Processing Letters*, *IEEE Transactions on Communications*, *IEEE Communication Letters*, and *IEEE Transactions on Information Theory*. She is the author or coauthor of 16 refereed journal articles and 46 conference papers. For recreation, Anna enjoys music and theater, paints water-color sketches, and has an interest in travel; she particularly enjoyed a recent trip to Alaska.

Sergio D. Servetto

Lic. Inf. '92 (Universidad Nacional de La Plata, Argentina), M.Sc. '96, electrical engineering, Ph.D. '99, computer science (University of Illinois at Urbana-Champaign), joined the ECE School faculty in September 2001 as an assistant professor. From 1991 to 1994 he worked as a software developer for IBM in Buenos Aires, Argentina, and was a graduate research assistant at the University of Illinois at Urbana-Champaign (UIUC) from 1994 to 1999. Following his graduate studies, Sergio took a position as a research associate at the École Polytechnique Fédérale de Lausanne in Switzerland for two years until he came to Cornell. His research and teaching interests are in the general areas of networks, information theory, and signal-processing applications.

Sergio did his Ph.D. work on problems of video transmission over packet networks where he developed new protocols, new data-compression algorithms, and new middleware control tools. For his doctoral work he received a fellowship in 1998 and an outstanding thesis award in 1999, both from the Department of Computer Science at UIUC. But he says he found the network aspects of his work "orders of magnitude" more interesting than the video signal-processing aspects. He is particularly grateful to his former laboratory director in Switzerland and to the Swiss National Science Foundation for having encouraged and supported his first steps in exploring a number of coding problems in network communications of great personal interest. His work at Cornell will be centered around two main areas: mathematics of network communication systems and algorithms for large-scale wireless sensor networks. During the summer of 2002, his group will be deploying a network of programmable sensors to serve as a test bed for algorithm testing and development.

Sergio is a member of IEEE and is the author or coauthor of more than 10 journal articles, more than 20 conference articles, and 3 patent applications. He is currently writing a book, has made more than 20 invited presentations in his fields of interest in this country and abroad, and also has done consulting work for groups of investors. Sergio is married and has two sons (4 and 5 years old). He is a private airplane pilot, and he admits to an addiction to skiing.



Nicola Kountoupes, Cornell University Photography

OPTOELECTRONIC TECHNOLOGY IN THE ECE SCHOOL

"an introduction to stimulated emission devices such as maser, lasers, and optical devices based on linear and nonlinear responses to coherent fields, illustrated and elaborated by laboratory sessions on specific lecture material."

—Excerpt from Course Announcements, concerning a four-hour course that meets the requirement in the new curriculum

On a bright summer day in 1954, several EE faculty members were having their after-lunch coffee on the patio of the old Statler Club when they were joined by Professor **William Gordon**, Ph.D. '53. "I've just heard of a new technical development," Bill told the group. "I believe it will have an enormous impact on electrical engineering—perhaps as important as the invention of a completely new kind of electric-power generator. It's a microwave amplifier known as a 'maser,' an acronym for microwave amplification by stimulated emission of radiation. It looks like it might also be possible to use the same principle to amplify light, in which case I guess it would be called a 'laser.'"

The maser was invented in 1953 by Professor Charles H. Townes when he was the director of the Physics Department at Columbia University. In August 1958, Townes joined with Dr. Arthur L. Schawlow of Bell Laboratories to suggest the use of a resonant cavity to expand the maser concept toward optical frequencies. Townes and Schawlow each later received Nobel prizes for their work in optical physics. In May 1960, Dr. Ted Maiman of Hughes Laboratory announced his demonstration of the ruby laser, the device that was the forerunner of the enormous development that eventually occurred in the field of optoelectronics.

As strange as it may seem today, masers and lasers were met with general apathy in the fields of physics and engineering in their early days. Federal research for masers was mocked by skeptics as being a "means of acquiring support for expensive research." At Cornell in 1959 there was no mention of the new devices in any curriculum. In the next four years, however, several new faculty members with strong interests in optoelectronics arrived in the school. **Lee A MacKenzie**, B.E.E. '57, Ph.D. '61, joined the EE faculty as an assistant professor in 1961, followed in 1962 by **George J. Wolga**, B.E.P. '53, Ph.D. '57 (physics), from MIT. **Joseph M. Ballantyne**, B.S. '59 (Utah), S.M. '60, Ph.D. '64 (MIT), electrical engineering, and **Chung L. Tang**, B.S. '55 (University of Washington, in Seattle), M.S. '56 (California Institute of Technology), electrical engineering, Ph.D. '60 (Harvard), applied physics, joined the EE faculty in 1965 as associate professors. In the fall term of 1962 George offered course EE 4531, Quantum Electronics, described in the *Course Announcements* as a "detailed treatment of the physical principles underlying masers and lasers and an analysis of the operation and design of practical devices." In 1963 the course title was changed to Quantum Electronics I, and a new course—EE 4532, Quantum Electronics II—offered a continuation of the principles set forth in the previous course.

In 1963 George Wolga began laser research with a grant from the Cornell Materials Science Center and built the first ruby laser and a helium-neon laser at Cornell, followed by an early version of a powerful CO₂ laser a year or so later. At an EE faculty colloquium one afternoon, George spoke about lasers and effectively demonstrated the power of his CO₂ device by roasting bits of Polish sausage in the beam. An

account of George's teaching and research in optoelectronics is given in the 1997 issue of *Connections*. In this same period, Chung Tang established his laboratory and began research on gas-laser spectroscopy, nonlinear optics, and femtosecond lasers (see Figure 1).

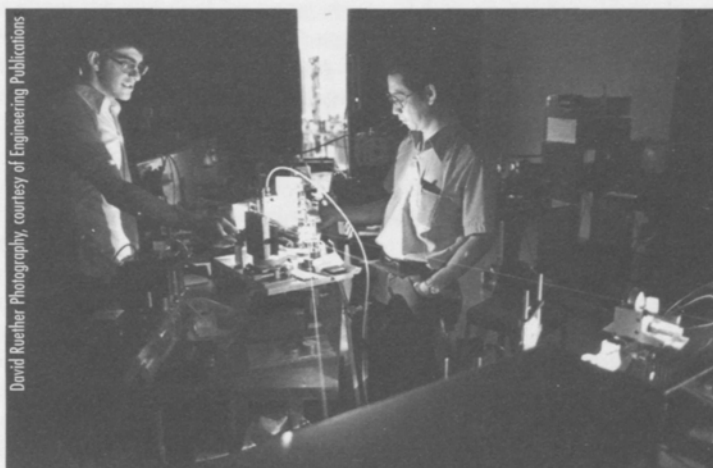


Figure 1. Professor Tang and a graduate student examine the operation of an electronically tuned continuous-wave dye laser.

Alumni of the late 1960s may recall two required senior courses, EE 4421 and EE 4422, Electrical Laboratory I and II, in which students could select a number of topics for study. In the very first lab session of EE 4421 in 1967, Lee MacKenzie offered an experiment based on an early commercial ruby laser contained in a two-foot-long oblong metal box with a six-inch-square cross section. This experiment was offered for several years as a topic in the laboratory.

By 1969 the optoelectronics area in the school had experienced significant growth. George Wolga developed course EE 4411, Quantum Theory and Applications, which became a required course in the 7th term of the Electrophysics Sequence. **Ross A. McFarlane**, B.Sc. '53 (McMaster University), M.Sc. '55, Ph.D. '59 (McGill University), joined the EE faculty as an associate professor and taught EE 4531-32. Joe Ballantyne introduced course EE 4533, Optoelectronic Devices, that considered a variety of devices with the aim of providing a physical understanding of some properties of solids that affect their use in optical systems. Chung Tang offered a new course, EE 4534, Nonlinear and Quantum Optics, that included discussion of optical parametric oscillators and other nonlinear optical devices. These four courses were listed as electives in the Electrophysics Sequence, and the entire five-course sequence was listed in *Course Announcements* under the general heading of "Electronics."

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Advanced Optoelectronic Study

Since the undergraduate Laboratory Sequence, established in 1971, did not contain laser or quantum electronic material, George Wolga and Ross McFarlane established a laser laboratory in the second-floor south wing of Phillips Hall and offered a new course EE 430, Introduction to Lasers and Optical Electronics. This four-hour course met the elective-with-laboratory requirement in the new curriculum and was described in the *Course Announcements* as "an introduction to stimulated emission devices such as masers, lasers, and optical devices based on linear and nonlinear responses to coherent fields, illustrated and elaborated by laboratory sessions on specific lecture material."

The *Course Announcements* of this period also stated that upper-class electrical engineering students could concentrate on a specific discipline chosen from a list of 13 different areas that included Quantum and Optical Electronics. This series of optoelectronic courses remained essentially unchanged for several years with teaching duties shared by Professors McFarlane, Tang, and Wolga. In 1976 a major undergraduate curriculum modification was introduced in the form of a required course in the fifth term, EE 306, Fundamentals of Quantum and Solid-State Electronics, devoted to an introduction to quantum mechanics and solid-state physics necessary for understanding lasers and modern solid-state devices. The course was developed by George Wolga who taught it as a required course until 1990 and as an elective until 1994. Hundreds of alumni who took that exacting course will have fond memories of George as well as some anecdotes suitable for inclusion in "More Tales From the Past" in *Connections*. In 1977 George also developed elective course EE 308 (later changed to EE 407), Quantum Mechanics and Applications, that offered a continuation of the material in EE 306. In this period George also began his research on the application of lasers to the analysis of combustion gases for improved combustion control. (See Figure 2).



Figure 2. Professor Wolga in his laser research laboratory.

Following Professor McFarlane's departure from Cornell, **Clifford R. Pollock**, B.S. '76, M.S. '79, Ph.D. '81 (Rice University), all in electrical engineering, joined the EE faculty as an assistant professor in 1983, assumed teaching duties with the optoelectronics group, soon established a laboratory for research on color center lasers, and achieved a breakthrough in the development of a NaCl color center laser (see Figure 3). In 1985 he offered a new course with laboratory, EE 530 (later changed to EE 427), Fiber and Integrated Optics, which detailed the physical principles of fiber optics, integrated optics, and applications to communications and sensing. In 1991, **Yu Hwa Lo**, B.S. '81 (National Taiwan University), M.S. '86, Ph.D. '87



Charles Harrington, Cornell University Photography

Figure 3. Professor Pollock amid components of his laser laboratory.

has potential for the creation of a new generation of semiconductors that may be applied to lasers, detectors, sensors, computer chips, compact discs, and many similar devices.

The current curriculum for junior and senior students in the school consists of a series of fundamental courses considered to be essential for all branches, with a wide variety of elective courses available for students who wish to specialize in a particular discipline. Throughout the 1990s and into the present time, optoelectronics has maintained its position as a specific area of study in the school. The titles of the course offerings have remained essentially unchanged for the past decade, but the course contents have experienced the necessary upgrades consistent with new developments in the technology and with interests of new members of the faculty in the optoelectronic group. Several new courses have been added to the elective list. In 2000, course ECE 533, Semiconductor Lasers, was introduced as a study of the principles and characteristics of this major class of optoelectronic devices. In the following year Professor **Sandip Tiwari**, Ph.D. '80, the Lester B. Knight Director of the Cornell Nanofabrication Facility, offered course ECE 535, Semiconductor Physics, concerned with the physics of materials and structures used in semiconductor electronic and photonic devices. Our latest member of the optoelectronics group, **Michal Lipson**, B.A. '92, M.S. '93, Ph.D. '98 (Technion-Israel Institute of Technology), all in physics, joined the faculty in July 2001 and has offered course ECE 696, Photonics, a seminar course that includes the fundamentals of photonics and surveys the primary advances in the field. In her research, Michal is investigating the physics and application of nanoscale photonic structures that, when developed, will provide the basic building blocks for optical circuits with all components integrated on a single chip. This new technology has the potential to revolutionize telecommunications, computation, and sensing.

Professors Ballantyne, Pollock, and Tang remain actively engaged in teaching and research in the field of optoelectronics. Their specific interests and recent accomplishments are described elsewhere in this issue.

(University of California, Berkeley), all in electrical engineering, joined the EE faculty as an assistant professor, assumed teaching duties with the optoelectronics group, and began research on semiconductor lasers and optoelectronic integrated circuits for fiber-optic communication. In 1998 his group developed and applied for a patent on a compliant universal substrate that may make it possible to grow pure single crystals of any semiconductor material on a given semiconductor base. The discovery

Sam Linke
Professor Emeritus
Electrical and Computer Engineering



Frank DiMeo, Cornell University Photography

JOSEPH M. BALLANTYNE

INTEGRATED OPTOELECTRONIC SYSTEM RESEARCH

Directed by Joseph M. Ballantyne

The tragic events of September 11 and the subsequent anthrax scare have caused great concern about the potential for terrorist acts of mass destruction by means of chemical agents such as poison gas and the use of biological agents to release infectious diseases. Possible countermeasures include the development of efficient electronic sensors to detect the microscopic particles present in the noxious substances used in chemical and biological warfare. Since integrated optoelectronic systems have shown considerable promise as improved replacements for currently inefficient sensors, extensive research efforts are underway to apply them in the development of aerosol detectors for pathogens and chemicals being used as biowarfare agents.

In a different context, the performance of modern information systems is becoming increasingly limited by data transmission within the systems, rather than by the speed of the transistors in the chips that perform the data processing. As data rates and system complexity increase, individual components become smaller and more tightly packed, the power required to send the data increases, problems of cross talk and noise become more severe, and manufacturing yield and reliability decrease. In addition, all aspects of performance and cost are limited by a characteristic of complex systems that requires the number of interconnections to increase as the distances between components in the system grow smaller. These problems can be eliminated or reduced by means of integrated optoelectronic systems that use photons instead of electrons to transfer data from one point to another within a system. In the conversion of electrical to optical signals, however, a significant problem is posed by the necessity for the conversion to be efficient and compatible with standard silicon-chip technology. Consequently, widespread use of optical data links for appropriate applications has been hindered by the cost, large size, and performance limitations of traditional laser-source modules.

High-performance semiconductor lasers are easily integrable, power efficient, and very small, but their noise properties are still under study and their output powers are usually 10 milliwatts or less. Diode-pumped solid-state lasers are much bulkier and less efficient than semiconductor lasers and therefore, although they have high spectral purity and low noise, are totally unsuitable for array and large-number applications. Both types of lasers are still expensive. A serious limitation of many conventional lasers is the difficulty of coupling substantial amounts of optical power to small, single-mode waveguides. They also may be unsuitable for monolithic integration with other optical devices such as modulators or amplifiers.

In the past decade a number of laboratories have given attention to the development of monolithic diode-ring lasers, and significant advances have been made in the theoretical understanding of these structures. Such devices have been developed in circular, oval, square, and triangular geometries, and some have shown single-mode and unidirectional operation. Diode-ring lasers also have been monolithically integrated with waveguides and amplifiers. Devices in the triangular geometry have shown a unique combination of high output power; single-mode operation with high-side mode-suppression ratios; unidirectional operation; low-

The Optoelectronic Technology Research Group in the School of Electrical and Computer Engineering consists of Professors **Joseph M. Ballantyne**, **Clifford R. Pollock**, **Chung L. Tang**, Assistant Professor **Michal Lipson**, and their graduate students. Professor **Sandip Tiwari**, who is concerned with electronic and optical semiconductor devices and compound semiconductors, also contributes to the research of the group. Optoelectronic research in the ECE School has been substantially augmented in recent months by the receipt of major funding from several agencies due to successful research proposals prepared by group members. Other faculty members with interest in optoelectronics include Professor **J. Peter Krusius**, who has special interest in optoelectronic devices and optical coupling between high-speed semiconductor lasers and detectors, and Professor **J. Richard Shealy**, who directs experimental production of new materials for high-efficiency lasers. The principal research areas of the optoelectronics group are described in the following three articles.

continued on page 8

threshold, unbonded, continuous-wave (cw) operation; and all-etched component, low-cost, reproducible, and manufacturable technology. The ability of these devices to simultaneously satisfy the requirements of high optical performance (low noise and high power), small size, and very low cost, is unique among diode-ring lasers and other planar-diode lasers. An important feature of these waveguide diode-ring lasers (WDRL) is their ability to operate in a pure traveling wave, unidirectional mode. No other semiconductor laser possesses this property, which is very important for noise considerations and for improving output power (see Figure 4).

Professor Ballantyne is a widely recognized authority in the areas of semiconductor growth of III-V compounds, optical properties of materials, and integrated optoelectronic devices. His list of developments include the first pseudomorphic lasers, the first monolithic integration of III-V and silicon devices, the first optical gratings by electron-beam lithography, the first transit-time photoconductor detectors in III-V materials, and the first single-mode, directional diode-ring lasers. In recent research he has concentrated on the design and fabrication of monolithically integrated optoelectronic circuits combining amplifiers, detectors, waveguides, and lasers, with particular attention given to the development and characterization of triangular waveguide diode-ring lasers.

Joe received a B.S. '59 in mathematics and a B.S.E.E. '59 in electrical engineering (University of Utah) and an S.M. '60 and Ph.D. '64 (Massachusetts Institute of Technology), both in electrical engineering. Following completion of his doctoral work he was a staff member for nine months at the M.I.T. Laboratory for Insulation Research. He joined the Cornell faculty as an assistant professor of electrical engineering in 1964, was promoted to associate professor in 1968, became a full professor in 1975, and served as director of the School of Electrical Engineering from 1980 to 1984. From 1984 through 1989 he held the position of Vice President for Research and Advanced Studies at Cornell. In 1977 Joe was instrumental in establishing the National Research and Resource Facility for Submicron Structures, now the Cornell Nanofabrication Facility (CNF), and served as acting director during its first year. He was director of the Semiconductor Research Corporation Center of Excellence in Microscience and Technology at Cornell from 1992 to 1999, and was the Lester B. Knight Director of CNF during part of the same period. Joe has been a visiting professor at the Technical University of Aachen, Germany; the University of California, Santa Barbara; and the University of California, San Diego. He also spent leaves of absence at Stanford University as a National Science Foundation senior fellow, and at the IBM Watson Research Laboratories as a research scientist. He has presented or published more than 200 research papers and holds several patents. He is or has been a consultant to twenty companies and an adviser to several universities. Joe is a fellow of the Institute of Electrical and Electronics Engineers (IEEE) and has served on national committees for the American Institute of Mining, Metallurgical, and Petroleum Engineers; the American Vacuum Society; and the IEEE. He is a member of honorary societies Eta Kappa Nu, Tau Beta Pi, Phi Kappa Phi, and Sigma Xi.

In addition to his other duties, Joe is the director and principal investigator of the interdisciplinary Center for Biochemical Optoelectronic Microsystems (CBOM) recently established at Cornell by the Defense Advanced Research Projects Agency (DARPA). The broad CBOM objectives are to search for new interactions between photons and biochemical warfare agents that might be useful in sorting these agents from other species present, and to develop new and existing photonic technologies for chip-sized systems to sort these agents. Several new technologies already have been demonstrated. A new proposal has been submitted to DARPA to develop ultra-violet semiconductor arrays for environmental test beds (UV SAFE T), which, if funded, will develop watt-level UV sources and integrate them into a cubic-inch-size aerosol detector that is projected to be much more efficient than current detectors and also will be capable of identifying the components of the detected biowarfare agent. Joe's research group will participate in the development of the optical sources for the proposed detectors.

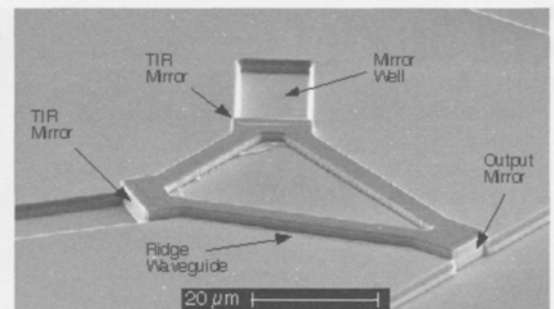


Figure 4. An example of a waveguide diode-ring laser (WDRL).
Courtesy of Michael Booth, Ballantyne Research Group, CNF 1998



Frank DiMeo, Cornell University Photography

Clifford R. Pollock

TUNABLE LASER RESEARCH

Directed by Clifford R. Pollock

In the early 1960s when lasers were in their solution-looking-for-a-problem stage, many imaginative suggestions were proposed as applications, including a "Buck Rogers's death-ray gun" and the frightful cutting tool in the movie *Goldfinger*—all of which required continuously stable performance and enormous power levels. Unfortunately, the first real-life devices were relatively unstable, and a laser with an output of one milliwatt was considered to be one of high-power capability. Current laser technology, the result of many years of intense research and development with various optical cavities including, gases, dyes, semiconductors, and solid-state crystals, has brought many early applications to reality. Tunable lasers provided wavelength dexterity and the ability to generate ultrashort pulses. The earliest tunable solid-state laser was the color center laser, which played an important role in providing a stable tunable continuous-wave device with output powers of several watts and operation in the pulsed mode that was used to characterize the first optical fibers.

The color center laser was discovered in 1974 at Bell Laboratories and was developed by a Cornell graduate, **Linn F. Mollenauer**, B.E.P. '59. The optical cavities of color center lasers are solid-state crystals of alkali-halides, usually of sodium chloride (NaCl) or potassium chloride (KCl), that have anion (halide-ion) lattice vacancies. If the crystal structure consists of a single electron trapped in an undisturbed lattice, the crystal is called an F center. If one of the neighboring alkali ions in the lattice is an impurity such as Li^+ , the crystal is called an F_A center. Other defects produce other F centers. The term "F center" is derived from the German word *farbe*, meaning "color," and refers to the strong colors—usually yellow, magenta, or blue—that occur when an impurity is introduced into the usually transparent crystals. These several types of color center lasers and their corresponding lattices allow coverage from the infrared to the entire visible tuning range of the spectrum (between 0.8 μm and 4 μm). Tunable coherent radiation over this unique wavelength region is important for studies in molecular and semiconductor spectroscopy, optical communications, and other specialized fields.

Color center lasers can be operated in continuous-wave (cw), pulsed, and mode-locked fashion. In single-mode cw operation, color center lasers have been made to function at very narrow linewidths (the feature in a laser that determines the degree of monochromatic light that can be achieved). Since there are no elements in the solid-state gain media to perturb the phase of the laser, the resulting high definition, coupled with broad tunability, has made the color center laser a powerful tool for spectroscopy and metrology. The broad tunability also allows for mode-locked operation, where many modes are forced to synchronize their phases. Tunable pulses as short as 50 femtoseconds (5×10^{-14} sec.) duration can be generated.

Since color center lasers operating at room temperature in the cw mode are unstable, they must be cooled to cryogenic temperatures. Thermal degradation can be minimized or eliminated at reduced temperatures, so the crystals are usually anchored to a cold finger maintained at the temperature of liquid nitrogen (77° K). In order to achieve efficient operation, the color center laser is usually pumped optically by an Nd:YAG (neodymium:yttrium aluminum garnet) laser operating in the near infrared. The color center cavity also must contain dispersive elements, such as a prism, in order to facilitate tuning and line narrowing.

Professor Pollock is an acknowledged leader in research and development of materials for new tunable lasers that have led to improved systems for fiber-optic signal transmission and communication. Among his many accomplishments Clif invented and developed a tunable NaCl laser, the most powerful stable color center laser ever discovered; he also participated in the creation of a new international standard for definition of the length of the meter by devising an infrared laser with an extremely narrow linewidth, and developed a tunable infrared laser for the production of ultrashort pulses of femtosecond (10^{-15} sec.) duration.

Clif received a B.S. '76, M.S. '79, and Ph.D. '81 (Rice University), all in electrical engineering. Following two years as a postdoctoral fellow at the National Bureau of Standards in Boulder, Colorado, he joined the faculty of the EE School in 1983 as an assistant professor and received a Presidential Young Investigator Award from the National Science Foundation in 1984. He was promoted to associate professor in 1987, served as a visiting scientist at the Naval Research Laboratory in Washington, D.C., in the spring of 1989, and in November 1993 was named the Ilda and Charles Lee Professor of Engineering. Clif served as associate director of the EE School from 1994 to 1997. He was named a fellow of the IEEE in the same

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year "for development and application of tunable solid-state infrared lasers to spectroscopy, optical communication, and metrology," and is a member of the Optical Society of America. Clif is author or coauthor of more than 75 refereed publications in his areas of interest; is the author of a textbook, *Fundamentals of Optoelectronics*, published in 1995; and holds five patents in related fields. In addition to development of new undergraduate courses, Clif teaches advanced courses in solid-state lasers and optoelectronics and directs the research of graduate students in those fields. Over the years he has won five major teaching awards in the School, and he was recognized as a Stephen Weiss Presidential Fellow at Cornell in 1997. On July 1, 2001, he became the director of the School of Electrical and Computer Engineering, his current position.

Clif directs an experimental research program in laser development and application. Activities include the generation of ultrashort optical pulses using advanced mode-locking techniques, the development of new solid-state lasers, and semiconductor diode pumping of solid-state lasers. Recent new work involves evanescent-coupled, fiber-optic devices; new lasers based on chromium-doped materials like zinc selenium and yttrium aluminum garnet (YAG); and the fabrication of thin-film waveguide amplifiers using optical composites.

An early development in Clif's laboratory involved the application of pulse-compression techniques using a soliton laser to produce 50-femtosecond pulses. The basis of this laser is the optical soliton, which is a wave that propagates without distortion. Solitons occur when a special nonlinearity exists in a system that counteracts the natural dispersion of the system. In glass optical fibers this nonlinear effect is called self-phase modulation. The soliton laser shown in Figure 5 is a color center laser coupled to a short length (0.3 meter) of optical fiber. When an intense pulse from the laser enters the fiber, it experiences a self phase modulation and is compressed and fed back into the laser where it is amplified and regenerated. This process is repeated every time the pulse makes a round trip in the cavity until extremely short pulses are formed. Such ultrashort pulses are useful for the investigation of ultrafast phenomena in semiconductor materials and optical fibers.

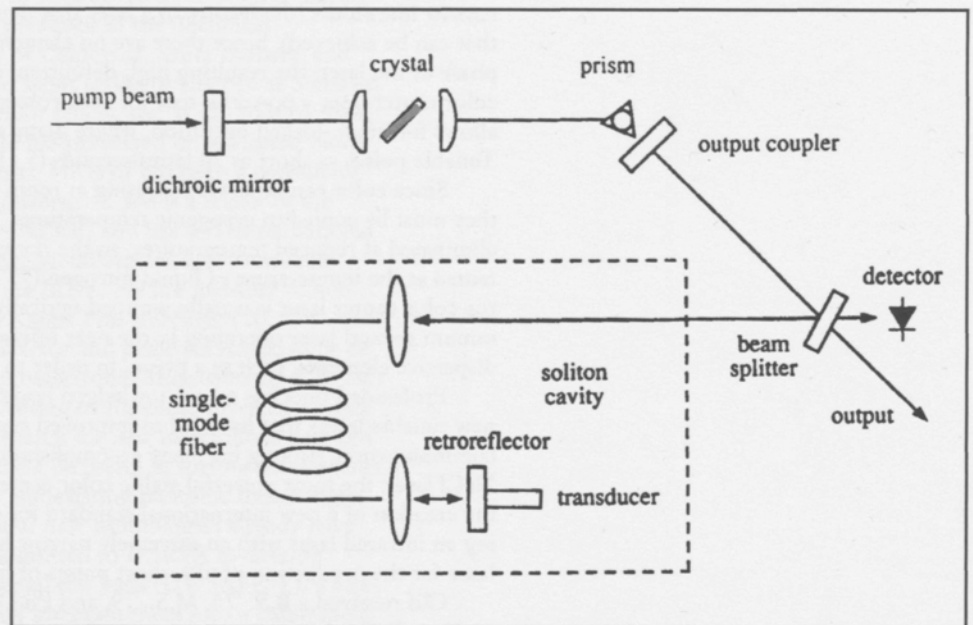


Figure 5. The soliton laser, a color center laser coupled to an optical fiber.

Sketch by Clifford Pollock, courtesy of Engineering Publications.



Chung L. Tang

OPTICAL PARAMETRIC OSCILLATOR RESEARCH

Directed by Chung L. Tang

Many alumni will recall that in the early days of radio, amplifier circuits could go into parametric oscillations due to the presence of a nonlinear reactance in the circuit that acted like a negative resistance, the equivalent of a signal generator. This sometimes useful phenomenon became particularly important in the development of microwave systems that used resonant cavities in the design of parametric microwave amplifiers and oscillators. The advent of the fixed-wavelength laser offered the exciting possibility of applying microwave techniques to an optical cavity to produce continuously tunable coherent sources of light. Subsequent technical developments have made the tunable laser into a practical device for many applications.

The first demonstration of optical parametric oscillation in 1965 was followed by a period of theoretical and experimental studies and intense efforts by a group of specialists whose attempts to develop a practical device were hampered by the lack of suitable nonlinear optical crystals. Unfortunately, the development of nonlinear optical materials is a very slow and tedious process, with the discovery of useful new materials often depending on luck. Experimental optical parametric oscillators (OPOs) in the early days tended to operate in the infrared region of the spectrum and contained crystals that suffered from severe optical damage problems. Extension to the shorter wavelengths was even more difficult due to the lack of nonlinear optical materials that could be phase-matched in the ultraviolet. The wavelength barrier was eventually broken, first at Cornell by the use of crystalline urea, followed in 1985 by the use of the optical crystal, β -barium borate (BBO). This work was the precursor to the subsequent development of many new nonlinear crystals now successfully applied in OPO technology. For tunable wavelengths in the ultraviolet and visible range from 500 nm to 1.2 μm (6×10^{14} Hz to 2.5×10^{14} Hz), a series of new borate crystals now have become available for OPO applications. From the deep red to about 4.5 μm , the nonlinear crystal potassium titanyl phosphate (KTP) can meet many of the key requirements for OPO applications. These crystals also have been used for applications in the femtosecond (10^{-15} sec.) time domain.

In the optical parametric process, a photon at the frequency ω_p from a laser pump, while propagating in a nonlinear optical crystal either spontaneously or by stimulated emission, breaks down into two lower-energy photons of frequencies ω_1 and ω_2 while conserving total photon energy. The basic source of tunability of an OPO is based on the fact that for a given ω_p there can be a continuous range of choices of ω_1 and ω_2 . The specific pair of frequencies that will result in any given situation is dictated by the momentum-conservation condition or the phase-matching condition that must be satisfied. Since the magnitudes of ω_1 and ω_2 depend on the orientation of the nonlinear optical crystal relative to the direction of propagation of the pump beam, the device can be tuned, for example, by rotating the crystal relative to the pump-beam propagation direction. With suitable nonlinear crystals and pump sources, virtually any wavelength ranging from the ultraviolet to the mid-infrared can now be reached with optical parametric oscillators.

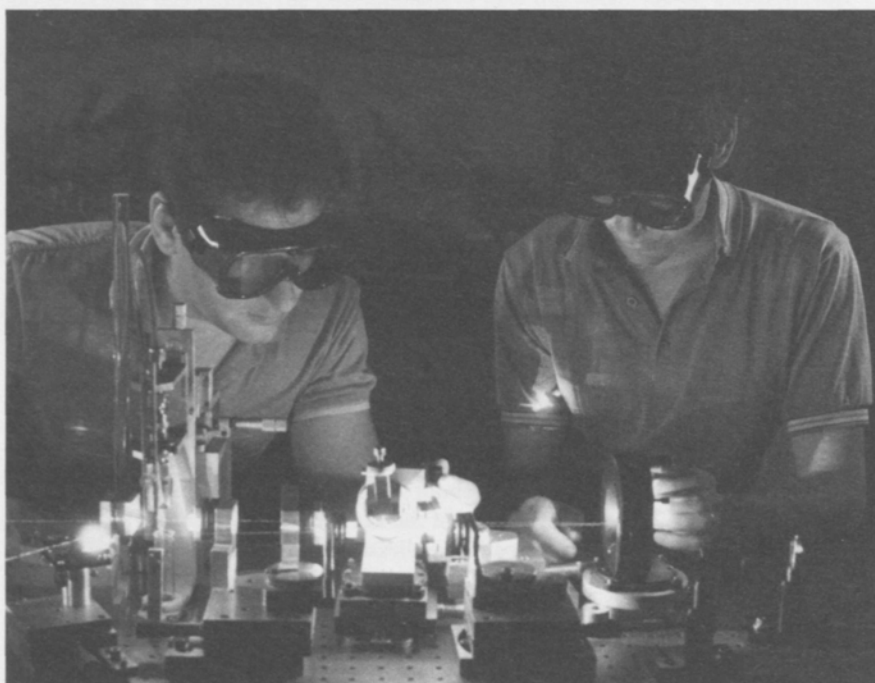
Professor Tang is known as a foremost authority on optical materials and processes that are suitable for applications in the generation, modulation, and detection of electromagnetic radiation from the infrared to the ultraviolet range of the spectrum. He was among the first researchers to characterize materials for optical parametric processes and continuously tunable lasers, and over the years he has made many fundamental contributions that have resulted in a wide variety of practical optical parametric devices. In recent years he has given attention to the physical and chemical processes in the femtosecond time domain with particular interest in the production of ultrashort pulses (see Figure 6). He has been in demand as a lecturer and has given invited talks on his specialties at numerous national and international institutions in this country and abroad.

Chung received a B.S. '55 (University of Washington, in Seattle), an M.S. '56 (California Institute of Technology), both in electrical engineering, and a Ph.D. '60

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(Harvard University) in applied physics. From 1960 to 1964 he was a principal research scientist with the Research Division of the Raytheon Company in Waltham, Massachusetts. He joined the Cornell faculty as an associate professor of electrical engineering in 1964, was promoted to full professor in 1968, and was named the Spencer T. Olin Professor of Engineering in 1985.

He is a member of the National Academy of Engineering, an academican of Academia Sinica, and a fellow of the IEEE, the American Physical Society, and the Optical Society of America. He was the winner of the 1996 Charles H. Townes Award of the Optical Society of America. He is a prolific contributor to literature in the optical and quantum electronics fields, including textbooks, reference volumes, and many articles in refereed journal and conference proceedings.



Charles Harrington, Cornell University Photography

Figure 6. Professor Tang's graduate students participate in optoelectronic research.

ENROLLMENT AND GRADUATION STATISTICS

Undergraduate Program

year	sophomores	juniors	seniors	degrees
99-00	136	146	124	107
00-01	157	169	130	116
01-02	132	195	151	153

M.Eng. (Electrical) Degrees

year	sophomores	juniors	seniors	degrees
99-00	18	7	39	64
00-01	36	7	37	80
01-02	29	11	57	97

M.S./Ph.D. Program

year	applicants	admissions	total enrollment	degrees
99-00	562	32	160	27 Ph.D., 19 M.S.
00-01	600	32	155	18 Ph.D., 14 M.S.
01-02	834	24	187	20 Ph.D., 6 M.S.

Note: Undergraduate students now affiliate with the school when the first term of sophomore math and physics is completed.

These figures indicate that over the past three years, the undergraduate program has increased moderately and enrollments in the M.Eng. (Elec.) and M.S./Ph.D. programs have remained unchanged on average.

Professor Emeritus **Charles Alexander Lee** died at age 78 on June 11, 2001 in Ithaca, New York, after an extended illness. After graduating with the B.E.E. degree in communications from Rensselaer Polytechnic Institute in June 1943, Charles spent three years in the U.S. Army Signal Corps as a communications and radar technician with service in the U.S., France, and Germany. From V-E Day until his discharge from the army, Charles served as an interpreter of circuit diagrams of German radars that had been captured when the war ended. In 1946, Charles entered graduate study at Columbia University and obtained his Ph.D. degree in physics under Nobel Laureate I.I. Rabi in 1953. He remained at Columbia for a year of postdoctoral work on molecular-beam analysis of the rotational and hyperfine structures of potassium chloride, and then joined the technical staff of Bell Laboratories where he collaborated and obtained patents with another Nobel Laureate, William Shockley, the inventor of the transistor. Charles came to Cornell as an associate professor of electrical engineering in 1967, attained full professorial rank in 1972, and retired as emeritus professor in July 1991.

During his 13 years with Bell Labs, Professor Lee made two extraordinary contributions that have shaped the technology we use and study today. At the time of his groundbreaking work, the fields of integrated circuits and optoelectronics were non-existent. His pioneering work helped initiate both fields and continues to guide developments in these important areas 40 years later.

Specifically, Charles developed and demonstrated the first diffused-base transistor in 1955 by introducing the concept of planar semiconductor processing that was a critical step for the invention of the integrated circuit by Jack Kilby a few years later, for which Kilby was awarded the Nobel Prize in Physics in 2000. In his 1956 paper, "A High Frequency Diffused Base Germanium Transistor," *Bell System Technical Journal*, pp. 23-34, Charles emphasized that the diffusion process gave precise control over the transistor feature size in the vertical direction and opened the way to development of transistors of unprecedented speed. The 500 MHz cut-off frequency of his germanium device of that time would still be state-of-the-art for a transistor with the 1.5 micron minimum feature size used in his experiments. A particular feature of this diffused-base design was the graded doping of the base. Such a gradient produces an internal electric field in the base that accelerates carriers, thereby enhancing the speed. This design is used today by IBM in its fastest silicon-germanium bipolar transistors.

Charles and his collaborators also carried out pioneering work on avalanche breakdown in semiconductors. Avalanche breakdown is used to make microwave oscillators and photodiodes with built-in amplification via avalanche gain. The silicon avalanche diode remains the detector of choice for photon counting today where low-noise avalanche gain is critical. The results of their 1964 keystone publication, "Ionization Rates for Holes and Electrons in Silicon," *Physical Review*, Vol. 134, A761, remain the gold standard against which almost all newer results have been evaluated for 30 years.

Although the Cornell School of Electrical Engineering was known for its outstanding undergraduate program, relatively little graduate research was being conducted until the late 1940s when Director **Charles R. Burrows** initiated a strong program of radio and solar astronomy research. Sponsored research in advanced areas of more traditional electrical engineering began in 1956 at Cornell when Professor **G. Conrad Dalman** joined the school and began directing studies in microwave theory and techniques. A similar research breakthrough occurred in 1967 when Professor Lee brought his knowledge of semiconductor theory and technical expertise to the school and attracted a number of young faculty members and graduate students to the field.

The major portion of Charles's 24-year academic career at Cornell was given principally to teaching junior, senior, and graduate courses in solid-state electronics and semiconductor devices and physics, and to directing the thesis research of his graduate students. His participation in the founding of the National Research and Resource Facility for Submicron Structures (now the Cornell Nanofabrication Facility) — in particular the establishment of the ion-implantation capability in the early facility — represents one of his prime contributions to the EE School. He continued

his earlier research on avalanche phenomena, including the development of the quasi-static theory of avalanche multiplication, as well as the production of the first Schottky barrier IMPATT diodes. In the early 1980s he was a co-inventor of the opposed-gate-source transistor, a new millimeter-wave transistor structure. Charles held 19 U.S. patents and authored and co-authored many articles that appeared in refereed journals and in conference proceedings.

In addition to teaching in his areas of specialty, Charles also taught broader undergraduate laboratory courses, served as a class adviser, and was a member of the school's Graduate Committee, the school's Policy Committee, the college's Admissions Advisory Committee, and the Program Committee of the Submicron Facility. From 1976 to 1979 he was a participant in a program to enhance graduate studies at Howard University and at North Carolina Agricultural and Technical State University. His research at Cornell was supported extensively by federal and corporate agencies, and he was a frequent consultant to industrial laboratories. He was a Life Senior Member of the Institute of Electrical and Electronic Engineers (IEEE) and a member of the American Physical Society. Charles was elected to the engineering honorary societies Tau Beta Pi and Eta Kappa Nu, and the scientific research society Sigma Xi, and was a member of the American Association for the Advancement of Science. Following his retirement he continued to do research and contribute to the literature in his fields of interest, and he collaborated with Professor Emeritus G. Conrad Dalman on a textbook entitled *Microwave Solid-State Devices, Circuits and Their Interactions* (John Wiley, 1994). Charles had firm interests in music, chess, and photography. The latter pastime was intimately related to his work, and indeed he often stated that his research was his favorite hobby.

An inherently modest man, Charles was widely known and admired for his exemplary honesty and integrity, and for his infinite patience, calm demeanor, and good humor. He was always willing and able to share his knowledge of the latest theories and techniques (as well as the latest chess moves) with his colleagues, both within the school and from other departments, and, of course, with his many graduate and undergraduate students. He mentored younger faculty and prodded graduate students gently. He encouraged his students to question authority and showed them that scientific research is a game to be enjoyed rather than a life-and-death struggle to the top. His teaching has helped them to wind up on the right side of most questions, if not always the winning one. Many could say they truly loved him for his friendly presence, wise counsel, technical expertise, and especially for the twinkle in his eye.

Charles Lee's friendly presence, wise counsel, and technical expertise will be greatly missed. He will be long remembered as a devoted teacher and adviser, a dedicated scholar, a highly respected colleague, an intellectual companion, and a good friend.

David Ruether Photography, courtesy of Engineering Publications



As we go to press, we are saddened to report the death of two additional retired members of the ECE faculty. Professor Emeritus **Ralph Bolgiano Jr.** died at age 80 on May 11, 2002 in Ithaca, New York, after a brief illness. Ralph received the B.S. degree from Cornell in 1944, served in the U.S. Army Signal Corps during World War II, returned to the campus to earn the M.E.E. in 1947, and after several years in industry entered graduate study at Cornell and received the Ph.D. degree in 1958. He joined the EE faculty in that year as an associate professor and became a full professor in 1965 and retired as professor emeritus on July 1, 1990. Memorial donations for the Ralph Bolgiano Fund in the College of Engineering Library should be directed to: Marsha Pickens, 251 Carpenter Hall, Cornell University, Ithaca, NY 14853.



David Ruelher Photography, courtesy of Engineering Publications

Professor Emeritus **Stanley W. Zimmerman** died at age 94 on May 13, 2002 in Ithaca, New York, after a brief illness. Following 15 years with General Electric Company, Stanley joined the EE faculty as a full professor in 1945 in charge of the High Voltage Research Laboratory. He retired as professor emeritus on July 1, 1973.



courtesy of University Photo Science Department

Full accounts of their distinguished careers at Cornell will appear in the next *Connections*.

We extend our profound sorrow and condolences to:

Professor **Donald T. Farley, Jr.** and family on the death of his wife, Professor **Jennie T. Farley**, on June 19, 2002, after a prolonged illness.

Professor **Ronald R. Kline** and Mrs. Kline on the tragic loss of their daughter, Margot Marcotte, in February 2000.

Lisa Steinberg Friedman, B.S. ENGR. '84, and family, on the sorrowful loss of her husband, Andrew Friedman, during the September 11 disaster. Andy was vice-president for institutional equities trading at Carr Futures.

*"And gladly wolde he lerne,
and gladly teche."*

Geoffrey Chaucer, THE CANTERBURY TALES



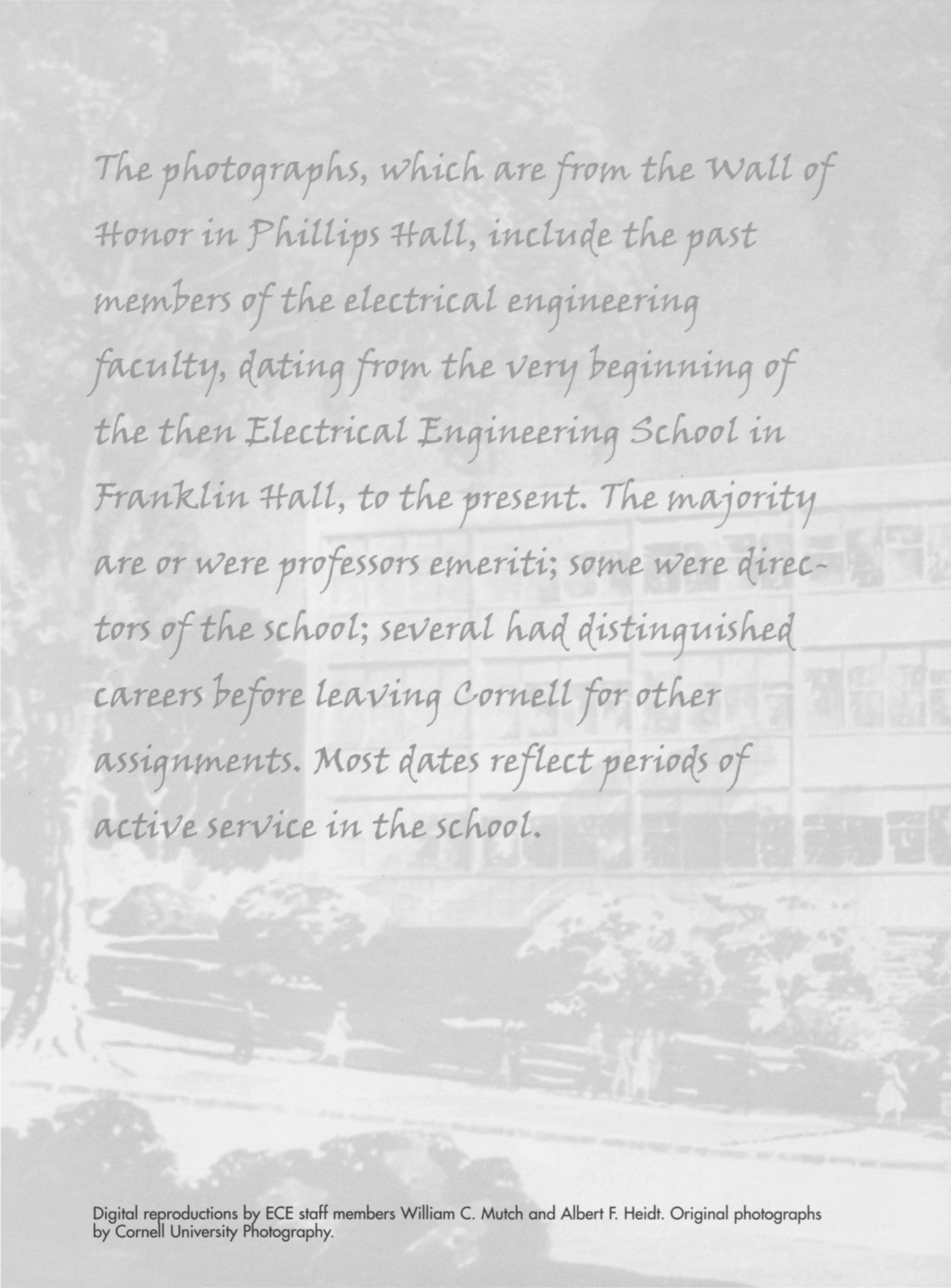


FACULTY HONOR ROLL

COLLEGE OF ENGINEERING

SCHOOL OF ELECTRICAL AND
COMPUTER ENGINEERING

CORNELL



The photographs, which are from the Wall of Honor in Phillips Hall, include the past members of the electrical engineering faculty, dating from the very beginning of the then Electrical Engineering School in Franklin Hall, to the present. The majority are or were professors emeriti; some were directors of the school; several had distinguished careers before leaving Cornell for other assignments. Most dates reflect periods of active service in the school.

FACULTY HONOR ROLL



Harris J. Ryan 1889-1905



Vladimir Karapetoff 1902-1948



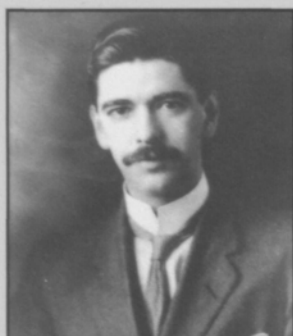
John G. Pertsch 1909-1929



William C. Ballard 1910-1952



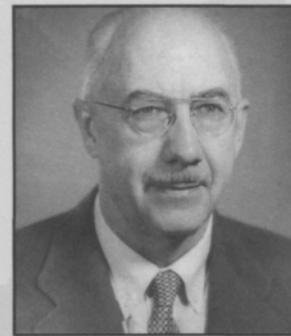
Robert F. Chamberlain 1910-1952



Alexander Gray 1916-1921



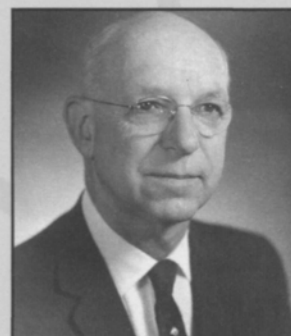
Joseph G. Tarboux 1919-1952



Lawrence A. Burckmyer 1922-1962



Paul M. Lincoln 1922-1939



True McLean 1923-1966



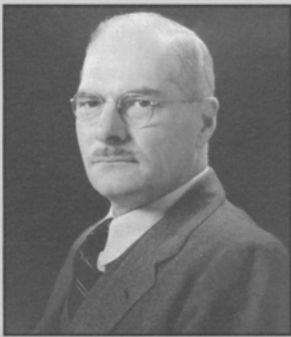
Everett M. Strong 1924-1967



Walter W. Cotner 1925-1964



Wilbur E. Meserve 1926-1968



Burdette K. Northrup 1929-1957



Howard G. Smith 1931-1974



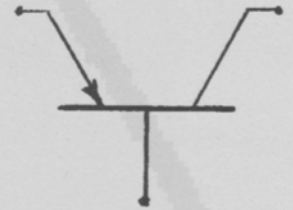
Lawrence B. Spencer 1937-1978



William A. Lewis 1939-1944



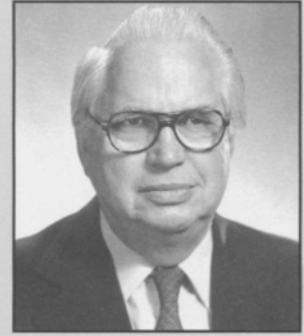
Casper L. Cottrell 1941-1963



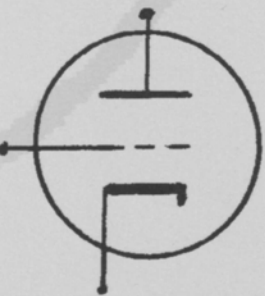
A. Berry Credle 1941-1957



Robert E. Osborn 1941-1963



Paul D. Ankrum 1942-1982



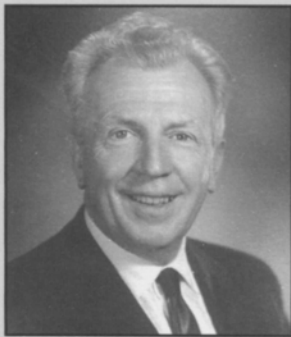
William H. Erickson 1942-1982



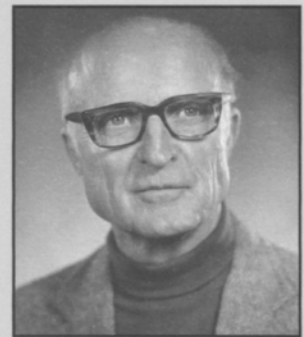
Michel G. Malti 1943-1962



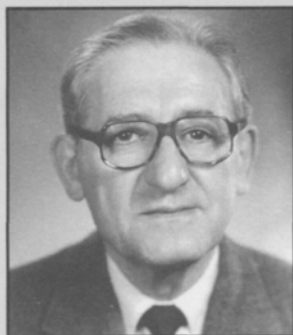
Charles R. Burrows 1945-1956



Stanley W. Zimmerman 1945-1973



Nelson H. Bryant 1946-1985



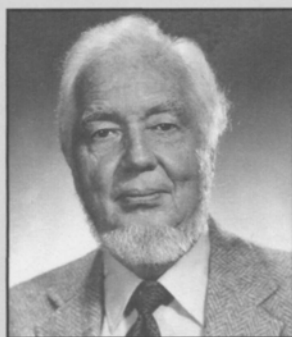
Simpson (Sam) Linke 1946-1986



Benjamin Nichols 1946-1988



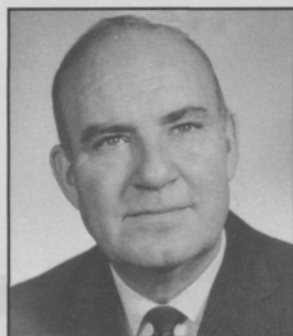
Clyde L. Ingalls 1947-1971



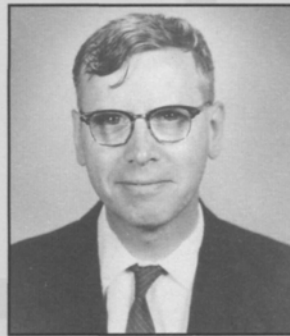
Henry S. McGaughan 1947-1983



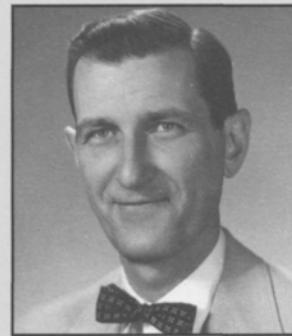
Malcolm S. McLroy 1947-1955



Joseph L. Rosson 1947-1986



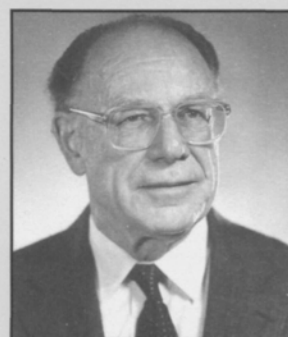
Henry G. Booker 1948-1965



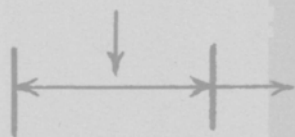
William E. Gordon 1948-1966



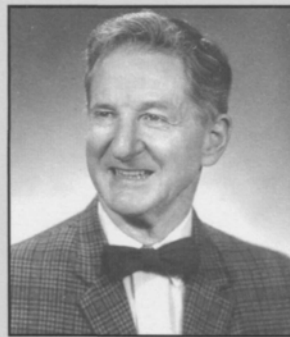
Walter R. Jones 1948-1954



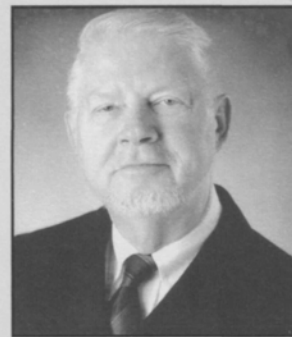
Norman M. Vrana 1949-1990



G. Conrad Dalman 1956-1987



Ralph Bolgiano Jr. 1958-1990



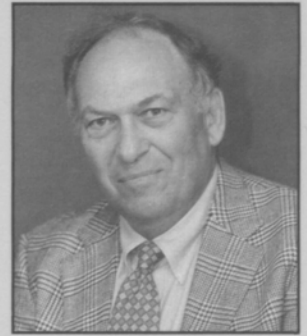
Paul M. McIsaac 1959-2000



Ravindra N. Sudan 1959-2002



Hwa Chung Tornng 1960-1999



George J. Wolga 1961-1996



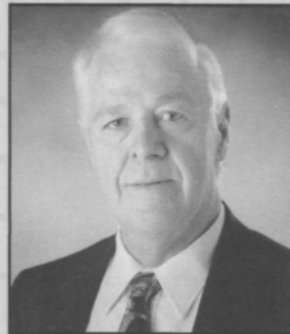
Myunghwan Kim 1962-1988



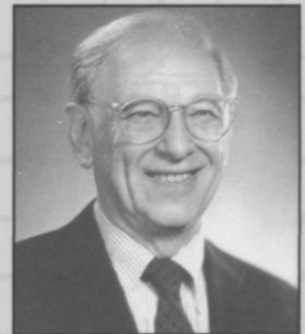
Chrisopher Pottle 1962-1998



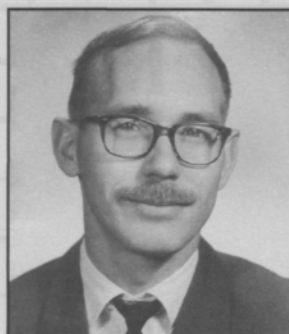
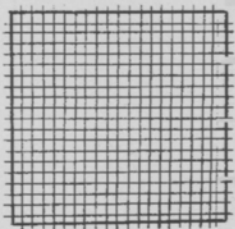
Richard L. Liboff 1964-2002



John A. Nation 1965-2000



Herbert J. Carlin 1966-1986



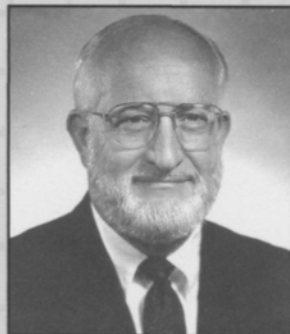
Neil M. Brice 1967-1974



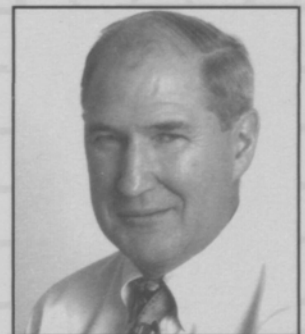
Charles A. Lee 1967-1991



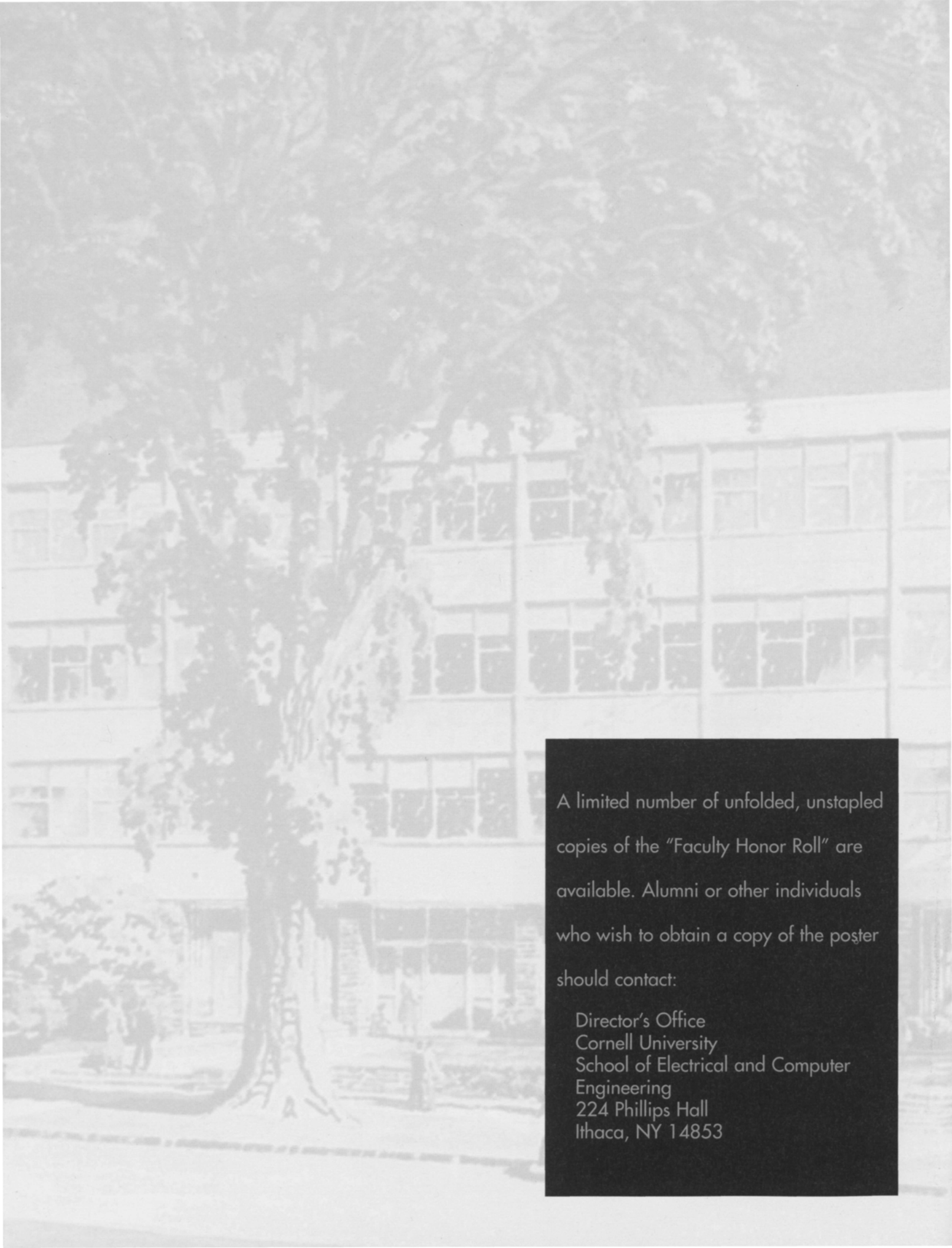
Charles B. Wharton 1967-1992



Edward D. Wolf 1978-1991



Noel MacDonald 1984-2000



A limited number of unfolded, unstapled
copies of the "Faculty Honor Roll" are
available. Alumni or other individuals
who wish to obtain a copy of the poster
should contact:

Director's Office
Cornell University
School of Electrical and Computer
Engineering
224 Phillips Hall
Ithaca, NY 14853

RECENT FACULTY ACCOMPLISHMENTS

Most of the listed awards were announced at the College of Engineering Fall 2001 Awards Ceremony and Faculty Luncheon on September 16, 2001 in Cornell's Willard Straight Hall.

• Professor **Joseph M. Ballantyne** (optoelectronic devices and materials) reports his most important contribution for the 2001-02 year was to launch the new Defense Advanced Research Projects Agency (DARPA) Optoelectronics Center involving Cornell, as the lead institution, Harvard, and the University of Rochester. This center has 24 faculty members from 8 different departments with 12 receiving funding in the first year. His responsibilities during the launch consisted of serving as principal investigator, organizing the executive committee and policy board, allocating funding, securing corporate matching funds, writing quarterly reports, launching a video-conference seminar series, and organizing two reviews. Funding at present totals about \$5.1 million over 4 years.

• Lecturer **John C. Belina** (bioelectronics), assistant director of the ECE School, has been working on the development of several team-oriented projects that provide interesting and challenging design assignments while giving M.Eng. and undergraduate students a chance to practice their organizational skills and learn something about project management. The goal of the RoboCAM project is to create a wireless, remote-controlled web camera that will survey developments on Cornell's Engineering Quad from a suitable vantage point remote to Phillips Hall. Students in John's course ECE 490, Practicum in Product Development and Systems Engineering, design a remotely accessible, home-automation or security system that includes technical design and components of a normal business plan to introduce real-world constraints into the effort. John's Electrocardiogram Measurement and Analysis Project (EMAP) concentrates on the search for a marker of susceptibility to sudden cardiac death, the nation's number-one killer. This summer, students will implement algorithms, previously developed at Cornell, which will allow use of data files from cardiologists anywhere in the world.

• Professor **Toby Berger** (information theory and communications), the Irwin and Joan Jacobs Professor of Engineering, received the Shannon Award for 2002. This award is the highest honor of the IEEE Information Theory Society and includes the Annual Shannon Lecture. With coauthors, Igor Devetak and Vladimir Levenshtein, he presented papers on

quantum rate-distortion, quantum remote-state preparation, and theory and application of two-stage group testing at major international conferences and also submitted to professional journals. Toby was an invited lecturer for Research Day, Ecole Polytechnique Fédérale de Lausanne, Switzerland. In the spring term, 2002, he introduced an experimental course, ECE 698, Biological Information Theory, which presents theoretical and practical connections between information theory and biology.

• Associate Professor **Adam Bojanczyk** (computer engineering, parallel architecture, and algorithms for signal and image processing) was on sabbatical leave for the 2001-02 academic year. From August to December 2001 he was with the Department of Mathematics, The University of Manchester, United Kingdom, working on indefinite least-squares problems. From January to March he returned to Cornell to work on greedy algorithms for least-squares approximations, followed by a period from April to June at the Department of Computer Science, Umea University, Sweden, to work on parallel algorithms for large periodic pencils.

• Assistant Professor **Martin Burtcher** (computer systems, microprocessor architecture, compiler optimizations) was able to reduce the size of a high-performing load value predictor by a factor of two without diminishing its performance.

• Professor **Hsiao-Dong Chiang** (analysis and control of nonlinear systems with applications to electric-power networks) and his group have developed a very comprehensive theory of the stability region and its boundary for a wide class of non-hyperbolic, nonlinear, dynamical systems. The theory has been applied to develop effective methods for solving constraint satisfaction problems. He has received \$112,000 in unrestricted gifts in 2001 from Taiwan Power Company, Taipei, Republic of China.

• Associate Professor **David F. Delchamps** (control and system theory) reports that his group's research program in intelligent and hybrid dynamical systems has led to some interesting new directions over the last five years. Such systems mix continu-

ous and discrete variables and often feature massively parallel architectures along with event-driven dynamics and collective phenomena. They have come to recognize the central importance of evolutionary computational approaches to the modeling, analysis, and control of such systems. Current research that applies dynamical systems techniques to problems in cognitive science and learning theory has continued to play a role in their investigations. Dave received the 2001-02 Professor of the Year Award in the College of Engineering, presented by the Interfraternity Council and the Panhellenic Council, and a 2001 Michael Tien '72 Excellence in Teaching Award.

• Professor **Lester F. Eastman** (compound semiconductor materials, devices, and circuits), the John LaPorte Given Professor of Engineering, was elected a fellow of the American Physical Society in November 2001 for "pioneering contributions to the concepts of ballistic transport and piezoelectric doping in ultra-small III-V heterojunction transistors, for applications in high-speed and microwave power devices and circuits, and for leadership in transitioning electron device technology from university to industry." His group's most important research contribution is the achievement of new, high-power, state-of-the-art microwave amplification using AlGaIn/GaN high-electron-mobility transistors. The new normalized power level is an order of magnitude higher than for the usual AlGaAs/GaAs devices. Another honor for Lester: the biennial semiconductor conference that he founded in 1967 has been named the IEEE Lester Eastman Conference on High Performance Devices.

• Professor **Donald T. Farley** (radiowave and upper-atmospheric physics), the J. Preston Levis Professor of Engineering, has found his new position of assistant director of the National Astronomy and Ionosphere Center Observatory in Arecibo, Puerto Rico, to be quite rewarding. Don believes the morale and productivity of the SAS staff has improved significantly in the past year. Don received the Ruth and Joel Spira Excellence in Teaching Award for the 2001-02 academic year.

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- Professor **Terrence L. Fine** (information theory, inference, and decision making in the presence of uncertainty), Director of the Center for Applied Mathematics, has been refining his manuscript for a probability textbook with Prentice-Hall that he uses as the text for course ECE 310. Terry gave several invited colloquia (School of Operations Research and Industrial Engineering at Cornell, Illinois, Berkeley) on the progress his research group has made in providing a relative-frequency interpretation for a family of probability measures. Such a family of measures, taken as a whole, is to be understood as an imprecise probability description for chance phenomena. Terry also organized the Second International Symposium on Imprecise Probability Theory and Applications at Cornell on June 26-29, 2001.

- Associate Professor **Zygmunt J. Haas** (wireless communication and networks, mobile systems) proposed a multipath routing framework for a communication environment with highly reconfigurable topology that, in spite of the possibly frequent link failure, can statistically guarantee high quality of service. He also has proposed and analyzed a scalable multicasting algorithm for ad hoc networks that is based on selection of a set of minimally dependent routing trees.

- Professor **David A. Hammer** (plasma physics, controlled fusion, intense ion beams), the J. Carlton Ward Jr. Professor of Nuclear Energy Engineering, has been elected the vice-chair-elect of the Division of Plasma Physics of the American Physical Society (APS/DPP), with responsibility for selection of new fellows for the division. During last year's intensive research on the nature of X-pinch plasmas produced with 200,000-ampere, 100-nanosecond current pulses, Dave and his group showed these

plasmas to be truly unique. They used high-resolution X-ray radiography and plasma spectroscopy in the X-ray regime to determine that X-pinch plasmas made from two very fine molybdenum wires reach temperatures of nearly 10,000,000° Celsius at close to solid density. However, they are very small in size (about 0.001 mm or smaller) and they blow apart almost immediately (in less than 0.2 nanosecond) after being produced by the magnetic forces that arise from the high current in the wires. Because the X-pinch produces such a tiny X-ray source, with photon energies of only a few keV, they have used it to obtain very-high-resolution radiographs of small subjects, such as a house fly (see Figure 7).

- Assistant Professor **Mark Heinrich** (computer architecture) and his group provided the first thorough study of how well modern architectural simulation technology predicts the performance of the machines they were designed to model on both an absolute scale and when comparing the relative performance changes induced by varying an architectural parameter. They also showed how to extend compilation techniques to statically check higher-level constraints in complex coherence protocol code for multiprocessor systems. Papers on these findings were presented at the Ninth International Conference on Architectural Support for Programming Languages and Operating Systems, Cambridge, MA, November 2000. Mark received the 2001 Michael Tien '72 Excellence in Teaching Award.

- Associate Professor **Sheila S. Hemami** (application-specific compression techniques for packet networks, networking aspects of visual communication, and multirate coding and transmission) was selected as a finalist for the 2001 Eta Kappa Nu Outstanding Young Electrical Engineer Award program. The selection is based on outstanding technical contributions, service to community and

nation, cultural and aesthetic achievements, and professional activities. In May 2001 she was a Fulbright Distinguished Lecturer in Morocco. During the 2001-02 academic year she was on sabbatical leave at Princeton University and at Rice University; her primary goal at both institutions was to expand her recent work in modeling the visual system's responses to suprathreshold distortions. In previous research, Professor Hemami and her group have quantified how the human visual system perceives and understands distortion in highly compressed images and, based on this work, they have developed new strategies for compressing images at extremely low rates for wireless transmission. The resulting images provide higher visual quality than those compressed by means of current techniques.

- Professor **C. Richard Johnson, Jr.** (adaptive control and signal processing) was the IEEE Distinguished Lecturer of the Circuits and Systems Society (CAS) in December 2000 on the CAS Keynote Lectures Tour of China. A revised version of the text, *Theory and Design of Adaptive Filters*, by J.R. Treichler, C.R. Johnson, Jr., and M.G. Larimore, (Prentice-Hall) was released in April 2001. Patent applications were filed by corporate sponsors (Fox Digital and Philips Research Laboratories) on research by Professor Johnson's group on improvements in the adaptive processing of digital television receivers.

- Associate Professor **Edwin C. Kan** (modeling and fabrication of nanometer-scale devices) was promoted to associate professor with indefinite tenure on April 1, 2002. He has demonstrated the use of metal nanocrystals in complementary metal-oxide semiconductor/electrically erasable/programmable read-only (CMOS/EEPROM) device structures and of nonvolatile charges in micro-electromechanical (MEMS) applications.

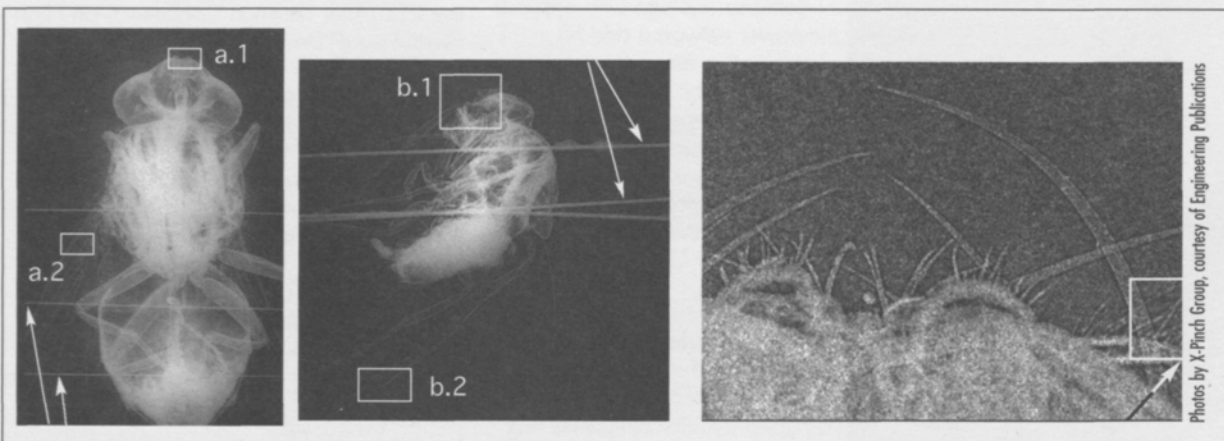


Figure 7. High-resolution photograph obtained with X-pinch plasma.

- Professor **Michael C. Kelley** (upper atmospheric and ionospheric physics), the James A. Friend Family Distinguished Professor of Engineering, has completed his term as associate dean of engineering. He continues as the Stephen H. Weiss '57 Presidential Fellow. Mike and his students have made major discoveries in the mesosphere using cameras and lidars. The Leonid Observing Campaign, headed by Cornell, was a huge success.

- Professor **Paul M. Kintner** (atmospheric plasma physics) was asked to serve as the coordinator of the Accreditation Board for Engineering and Technology (ABET). He attended training sessions for both the college and school and made presentations to both Sibley School of Mechanical and Aerospace Engineering (M&AE) as well as ECE faculties on the new ABET guidelines we must follow. Paul conducted a global positioning system (GPS) field campaign in January 2002 demonstrating that GPS receivers will lose their ability to operate under ionospheric storm conditions. He was selected to be a member of the NASA Headquarters "Living With a Star" Science-Architecture Committee, gave several papers at conferences in summer 2001, and lectured at Norwegian Physical Society meetings. During the spring semester, Paul developed an advanced GPS design course.

- Professor **Ronald M. Kline** (history of technology and electrical engineering) was on sabbatical leave during the 2000-01 academic year and conducted research in several archives in the United States and in England for his National Science Foundation-funded project on the history of information theory.

- Associate Professor **Kevin T. Kornegay** (computer-aided design for VLSI circuits) received the 2002 Black Engineer of the Year Award in the category of Higher Education. Kevin was recognized in February 2002 for his breakthroughs in developing the first complementary metal-oxide semiconductor (CMOS) circuits in silicon carbide, a semiconductor that remains functional at extreme temperatures, and for his success in creating a Cornell center for mixed analog/digital electronics based on high-speed germanium silicon technology. Kevin also was invited to participate in the 5th German-American Frontiers of Engineering Symposium held in May 2002, which is sponsored by the National Academy of Engineering (NAE) and the Alexander von Humboldt Foundation. Each year the NAE holds a Frontiers of Engineering symposium that brings together 100 outstanding engineers from U.S. companies, universities, and government labs to discuss leading-edge research and technical work.

- Professor **J. Peter Krusius** (solid-state electronics, semiconductor devices and systems, and electronic packaging) and his group have received the 2001 Display of the Year Award by the Society for Information Display. The award was made for developments that facilitate the design and manufacture of large-area, direct-view, active-matrix-liquid-crystal displays that can be tiled together without visible seams. The technology was developed by Krusius and his colleagues at Cornell under the auspices of a three-year \$4 million program jointly funded by the Advanced Technology Program of the National Institute of Standards and Technology (NIST) and Rainbow Displays Inc. of Endicott, New York. (See page 19 for more details of this project.)

- Professor **Richard L. Liboff** (physics of microsemiconductor devices and solid-state plasmas) reports that Addison-Wesley, the publisher of his text, *Introductory Quantum Mechanics*, has given approval for a fourth edition that will include a new chapter on quantum computing. A new work, *Primer for Point and Space Groups*, is on contract with Springer-Verlag and in the type-setting phase.

- Professor **Noel C. MacDonald** (micro-electromechanical and nanoelectromechanical systems) has joined the faculty of the University of California, Santa Barbara but remains as an adjunct professor in the ECE School. He makes frequent visits to the campus to consult with his graduate students.

- Assistant Professor **Rajit Manohar** (asynchronous VLSI design, computer architecture, parallel computing) conducts research that involves design of a new class of number representations for low-energy computation. The representations are adaptive and reduce the total energy consumption in a micro-processor by a factor of two, on average. In addition, he created new formal techniques to analyze handshaking expansion reshuffling, a performance-enhancing transformation that was previously applied in an ad hoc manner. Rajit received the IEEE Student Branch 2000-01 Teacher of the Year Award and the Sonny Yau '72 Excellence in Teaching Award in the College of Engineering.

- Assistant Professor **Bradley A. Minch** (analog and digital VLSI circuit design) and his group made significant refinements to his translinear-circuit synthesis methodology based on multiple-input translinear elements. This methodology should eventually result in general-purpose design automation tools for continuous-time analog circuits and systems.

- Professor **Thomas W. Parks** (signal theory and digital-signal processing) reports that he has developed a new laboratory for ECE 425, Digital Signal Processing, using gift funding from Texas Instruments for equipment and software. He became a member of the Center for Electronic Imaging Systems (CEIS) in Rochester and is also a co-principal investigator on a successful New York State Office of Science, Technology & Academic Research (NYSTAR) proposal.

- Associate Professor **Alfred Phillips, Jr.** (quantum mechanical devices, optical switches, and process modeling) reports he can show that the Davisson-Germer experiment can be explained entirely on a classical particle basis. This work suggests predictive empirical verification. The implication of this work is that the new interpretation has wide application in what is called quantum mechanics. He is now working on a theory that provides such a new interpretation. He is keenly aware of the deadline in completing this work if it is to have the imprimatur of Cornell University.

- Professor **Clifford R. Pollock** (lasers and optoelectronics), the Ilda and Charles Lee Professor of Engineering, focused much of his time this year on Duffield Hall. The project successfully passed through the environmental impact statement and the Ithaca building-approval processes. The design was reworked to get the project on budget, university trustee approval was obtained in May 2001, and a construction contract that meets the budget was signed. In academic activity, Cliff taught ECE 210 to 180 students in the fall and introduced a new course, ECE 486, Electromagnetics for Communications. The new course drew 62 students and was quite successful.

- Associate Professor **Anthony P. Reeves** (parallel computer systems, computer-vision algorithms) reports that his group, as part of the Early Lung Cancer Action Program (ELCAP) of the Weill Medical College of Cornell University, has started two major data-pooling research studies that collect data using a web-based data system. The first study, NY-ELCAP, is being conducted in New York State and involves ten New York medical institutions. The second study, IELCAP, receives contributions from a number of national and international medical centers. These projects are unique in their size, the web-based collection methods of computed tomography (CT) image data, and the incorporation of three-dimensional, computer-aided diagnostic methods that Reeves's group has developed for the analysis of CT images.

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• Professor **Charles E. Seyler, Jr.** (space plasma physics, theoretical and computational plasma physics), in his capacity as associate director for academic affairs in the ECE School, has actively participated in ECE curriculum revision. This effort includes substantial revision of courses ECE 210/215 and ECE 315. Together with the ECE Curriculum and Standards Committee, Charlie has overseen the establishment of the Culminating Design Courses (CDE), which will play an important role in meeting the new Accreditation Board for Engineering and Technology (ABET) requirements.

• Professor **J. Richard Shealy** (development of compound semiconductors) has developed a semiconductor materials technology in the last 5 years for high-power microwave transistors. Virtually all of the performance benchmarks for present-day power microwave transistors were established on Dick's gallium-nitride materials and devices. During this time, four patents were filed with the Cornell Nanofabrication Facility. In the last year the patents were licensed to RF Nitro Communications, a start-up company that Dick founded and which was subsequently bought by RF Micro Devices, the world's largest supplier of radio-frequency circuits for mobile phones. These recent activities are an example of initiation of new research at Cornell followed by commercialization.

• Assistant Professor **W. Evan Speight** (distributed computing, parallel processing, computer architecture, operating system research) published a paper describing a new technique for realizing transparent transmission control protocol/internet protocol (TCP/IP) networking on low-latency, user-level networks. The work was presented at the annual USENIX Advanced Computing Systems Association Symposium on the Windows NT operating system, in Seattle, Washington. Evan encouraged the Cornell Theory Center to donate an IBM-SP2 (valued, two years ago, at \$1 million) to the Computer System Laboratory; this cluster of 16 processors will be used in several parallel architecture courses, including ECE 572 and ECE 672.

• Professor **Chung-Liang Tang** (lasers, optoelectric devices, nonlinear and coherent optical processes), the Spencer T. Olin Professor of Engineering, reports that his research group carried out an analysis of the dynamics of intracavity-coupled semiconductor lasers for high-speed, all-optical switching and routing applications. An experiment also was started on the ultrafast relaxation dynamics of spin-polarized holes in semiconductors.

• Professor **Robert J. Thomas** (control techniques for large-scale networks, analysis of microelectromechanical systems) was recently appointed as a member of the Panel on Systems Analysis and Systems Engineering of the Committee on Science and Technology for Countering Terrorism, under the auspices of the National Academy of Sciences. The project is aimed at "helping the Executive Office of the President to use the nation's and the world's scientific and technical community in a timely response to the threat of catastrophic terrorism." While on sabbatical leave this year, Bob visited Sandia National Laboratories in Livermore, California, to work on their agent-based program for electric-market auctions. He spent this summer at Cornell, designing and carrying out new experiments on energy-plus-reserves markets and will return to Sandia in October. Bob is serving as the IEEE-USA vice president of 2001 Technology Policy Activities.

• Professor **James S. Thorp** (estimation and control of discrete linear systems applied to electric-power networks), the Charles N. Mellowes Professor of Engineering and former director of the School of Electrical and Computer Engineering, received the 2001 Career Service Award from the Power Engineering Society "for outstanding leadership and career service to the Power System Relaying Committee." During his sabbatical leave in the 2001 fall semester, Jim completed his contractual work with the Power System Engineering Research Center and on projects for the Electric Power Research Institute and Department of Defense, for which he collaborated with faculty at Cornell and the University of Wisconsin. He also began a revision of his textbook, *Computer Relaying for Power Systems*, and traveled to Virginia Polytechnic Institute, where his coauthor resides.

• Professor **Sandip Tiwari** (electronic and optical-semiconductor devices and compound semiconductors), the Lester B. Knight Director of the Cornell Nanofabrication Center (CNF) Knight Laboratory, reports that his group achieved key results at device, circuit, and architecture levels in the effort towards massive electronic integration. In particular, a new technique for three-dimensional integration of planar complementary metal-oxide semiconductor field-effect transistors was demonstrated, together with devices that can be software-programmed for functions. Professor Tiwari also was appointed the founding editor-in-chief of a new journal, *IEEE Transactions on Nanotechnology*.

• Associate Professor **Lang Tong** (digital-signal-processing algorithms, estimation theory, wireless communication systems) was on sabbatical leave during the 2001-02 academic year. In the fall semester he held the Cor Wit Professorship at Technical University in Delft, a visiting professorship sponsored by the Cor Wit Foundation in the Netherlands. In the spring semester Lang visited the Army Research Laboratory in Washington, D.C., where he participated as an outside researcher in the Army Consortium of Technology Alliance.

• Professor **Stephen B. Wicker** (wireless information networks, digital communication systems, error-control coding, and cryptography) reports that he collaborated with ECE and computer science faculty at Cornell, six other universities, and General Dynamics to submit proposals to the Army Research Laboratories, Defense Advanced Research Projects Agency, and National Science Foundation. The roughly \$10 million in funding requested for Cornell faculty would insure a leading position for the university in self-configuring, wireless networks. Steve also has managed several transitions in the ECE curriculum, focusing on the redefinition of the required undergraduate laboratories and the development of 600-level courses that will attract the nation's best Ph.D. students. Steve received the 2000-01 Ruth and Joel Spira Excellence in Teaching Award.

PROJECT NOTES

Arecibo Observatory Designated as an IEEE Milestone

The History Center of the Institute of Electrical and Electronic Engineers (IEEE) and the American Society of Mechanical Engineers (ASME) have designated the Cornell-operated National Astronomy and Ionosphere Center Observatory in Arecibo, Puerto Rico, as both an IEEE Electrical Engineering Milestone and an ASME Mechanical Engineering Landmark.

The dedication ceremony was held at the observatory on November 3, 2001. The 1,000-foot antenna and associated electronic radar gear were conceived in the late 1950s by then Cornell professor **William E. Gordon** Ph.D. '53, constructed under his direction, and began operation in 1963. The surface of the antenna was renovated in 1974 to increase the accuracy of operation, and an upgrade of the radar transmitter and receiver equipment in 1997 provided better bandwidth and frequency range. Since its inception, the observatory has been highly productive in areas of atmospheric and ionospheric studies, solar-system radar investigations, and radio-astronomy research.

Progress on Seamless Tiling for Large-Area Displays

Professor **J. Peter Krusius** and his research group have developed technology to facilitate the design and manufacture of large-area, direct-view, active-matrix-liquid-crystal displays (AMLCDs) that are tiled together without visible seams. A company that uses this technology, Rainbow Displays Inc., was founded by Professor Emeritus **C.Y. Li**, and Peter Krusius of Cornell, and D.P. Seraphim and K. Joshi from IBM. Their Rainbow Spectrum 3750 is the first seamlessly tiled, direct-view, color video display product. Seamlessness covers the full view-angle range and color space, the diagonal size is 37.5 inches with a pixel format of 852x480, and the display power is about 400 watts. The 3750 Spectrum is the largest visually continuous AMLCD that is being manufactured in volume at present. This display product has been designed for large-area color video and low-resolution color monitor applications, but the same tiling technology can support higher-resolution and smaller-size display products.

Correction

In Figure 10 of the 2001 issue of *Connections*, Professor Emeritus **Henry S. McGaughan**, a former graduate field representative in the EE School, also should have been mentioned as being absent in the photograph. The editor regrets the error.

ECE School Research Funding

Total research funds
expended in 1998-99 \$17,387,886

Total research funds
for 1999-2000 \$20,556,217

Percent increase 18.2%

Total research funds
expended in 2000-01 \$15,943,302

Percent increase 22.4%

The 2000-01 research expenditure has decreased since 1999-2000 because the school has changed the reporting structure for calculation of expended research funds. There also has been a slight decrease in departmental expenditures since two faculty members with large research programs have left Cornell for other universities. During the past academic year the school has received gifts and equipment valued at over \$2.8 million in support of faculty research, teaching, and special projects. Some of these sponsors include Agilent, BAE Systems, BF Goodrich, Emcore, Fuji Electric, General Electric, GTE/Verizon, Lutron Corporation, IBM, Intel, Microsoft Corporation, Northrup Grumman, Rockwell Scientific, RF Micro Devices, NxtWave, Zepton Networks, and many others. These generous grants from corporations and foundations, coupled with equally commendable gifts from many individuals, aid the recipients in their teaching and research and make it possible for the ECE School to establish and maintain a leading edge in the discipline.

Richard L. Liboff Retires

Richard L. Liboff, a member of the EE/ECE School faculty for 37 years, became professor emeritus on July 1, 2001.

Following receipt of an A.B. degree in mathematics and physics from Brooklyn College in 1953, Richard served in the Chemical Corps of the U.S. Army for two years. In 1955 he entered graduate study at New York University and held positions as a research assistant in applied mathematics with the NYU Courant Institute of Mathematical Sciences and as a consultant and research associate with Combustion Engineering Corporation until 1961 when he received a Ph.D. degree in physics. From 1961 to 1963 he was an assistant professor of physics at NYU and also served from 1962 to 1968 as a senior research adviser with Nuclear Research Associates in Hyde Park, New York. In 1964 he came to Cornell as an associate professor of electrical engineering and was promoted to full professor of applied physics, applied mathematics, and electrical engineering in 1969.

Richard's career at Cornell has been devoted to teaching, research, and service to the ECE School, the College of Engineering, and the university. Throughout the years he taught fundamentals of electromagnetic theory to undergraduates, senior and graduate-level courses in electromagnetic fields and waves, and graduate-level courses in kinetic theory and quantum mechanics, two of his major fields of research. Richard has a wide range of other research interests including short-wavelength lasing, fusion physics, dense recombining plasma, strongly coupled plasmas and fluids, condensed-matter theory, semiconductor transport and super-lattice theory, and applied mathematics with emphasis on classical and quantum chaos.

Mathematical analysis is at the heart of Richard's research. He is specifically focused on physical problems related to micro-semiconductor devices, solid-state plasmas in materials such as GaAs and InP that have application in field-effect transistor (FET) devices, structure of fluids and the theory of phase change, and kinetic theory of neutral fluids. His research on kinetic theory also is directed at a key problem in astrophysics—the tendency of galaxies to form clusters. He has conducted studies that indicate which kinetic theory is relevant to temperature-density intervals in the operational mode of particular microdevices. Another of his kinetic studies on charge carriers in solid-state microdevices describes behavior in the presence of large electric fields. His recent studies have been concerned with low-temperature resistivity in metals, high-field transport in a semiconductor, and quantum billiard-field chaos. Richard directed the research of many graduate students in these and related fields.

In the classroom Richard has been highly regarded for the infectious enthusiasm that he brought to the subject at hand and for his determined efforts to make the sometime-esoteric subject matter as clear as possible. Upon completion of a detailed explanation of a complex topic he has been known to look at his blackboard work and exclaim, "That's beautiful!" His students, at both undergraduate and graduate levels, could not help but share in that appreciation. Richard always has been generous of his time for office conferences—it was rare indeed to pass his door and not find him in concentrated discussion with one or more of his students.

In addition to his academic duties, Richard has served on several university committees—the Committee on Academic Freedom and Responsibility and the Committee on Minority Affairs. For the College of

Engineering he served on the Engineering Library Committee and the Committee for the Core Curriculum Governing Board (mathematics and science).

His other academic positions during his tenure at Cornell included a visiting professorship at Stanford



Richard L. Liboff

University in the summer of 1965, a Solway Fellowship in support of a one-year visiting professorship at the Université Libre de Bruxelles in Belgium in 1972, a visiting professorship at the Université de Paris-Sud Centre d'Orsay in France in 1979, a Fulbright Scholarship in support of a visiting professorship of physics at Tel Aviv University in Israel in 1984, and a visiting professorship of physics at the University of California at Davis in the spring of 1991. Over the years he has also been a guest lecturer at numerous academic institutions in this country and abroad.

Richard has been principal investigator for research grants that have spanned over fifteen years with both the Office of Naval Research and the Army Air Force Office of Scientific Research. More recently he has been principal investigator for a contract with the Army Research Office for work related to semiconductor physics. He has consulted with Battelle Columbus Laboratory for research on solid-state physics and on the theory of strongly coupled plasmas.

Richard is a fellow of the American Physical Society, a senior member of IEEE, and a member of Sigma Xi, the Scientific Research Society.

Throughout his career at Cornell Richard has been a prolific contributor to the literature in his fields of interest. He has written close to 130 refereed scientific articles and has authored five textbooks. The first of these, *Introduction to the Theory of Kinetic Equations* (John Wiley & Sons, 1968), was translated into Russian in 1974 and also received a second printing. The second book, *Introductory Quantum Mechanics*, was originally published by Holden-Day in 1980, translated into Korean in 1993, and received a third printing by Addison-Wesley in 1998. A work on waveguides was coauthored with



Figure 8. Professors Lee and Liboff performing with Susanne Lee in a chamber-music ensemble.

Professor **G. Conrad Dalman** in 1985. A fourth text, *Kinetic Theory: Classical, Quantum and Relativistic Descriptions*, was published by Prentice-Hall in 1990, and a second edition appeared in 1998 (Wiley-Interscience). His latest text is titled *Primer for Point and Space Groups* (Springer-Verlag, 2002). At Cornell in 1969, Richard, together with Professor **Norman Rostoker**, chaired the First International Meeting on Kinetic Theory. They co-edited the *Proceedings* of that meeting, which were published by Gordon and Breach in 1971.

Richard's non-technical colleagues know that he does theoretical analyses of abstract phenomena, but they often wonder about the nature of problems that attract his attention. A typical example of his intellectual interests may be found in the following anecdote. Several years ago researchers in the Cornell Laboratory of Plasma Physics were producing relativistic electron beams that contained perhaps billions of electrons moving in a vacuum at speeds approaching that of the speed of light. One investigation was designed to determine the interaction of these beams with strong magnetic fields. Richard's reaction to this physical experiment was, "That study can be performed in the laboratory, but the interaction of *one* relativistic electron with a strong magnetic field can only be done by a theoretical analysis that I would find to be very interesting." Richard's recent announcement that he has been fortunate to discover a break in the Second Law of Thermodynamics is another example of his imaginative approach to challenging problems.

Richard has had long-standing interests in music, chess, and travel. He plays the violin and often joined the late Professor **Charles Lee** and his daughter in informal musical sessions (see Figure 8). On several occasions Richard joined other faculty musicians in brief performances at festive gatherings in the Phillips Hall lounge. Richard played the trombone in the 9th Infantry Marching Band during his army service, continued to play afterwards, and in past years would practice occasionally in relative privacy in room 101 in Phillips Hall on afternoons when classes were not in session. Richard frequently enjoyed playing chess with Charles Lee and other faculty enthusiasts. He has traveled abroad extensively, and particularly enjoys his visits to the Weitzman Institute in Israel.

In retirement, Richard plans to continue research and writing in his fields of study. Richard and his wife, Myra, expect to continue residing in Ithaca, visit their children in New York City and Madison, Wisconsin, and travel abroad occasionally with particular interest in renewing acquaintances with sabbatical colleagues in Israel.

Alfred Phillips, Jr. Retires

Alfred Phillips, Jr., a member of the EE/ECE faculty for ten years, retired on July 1, 2002.

Al received a B.S. degree from Loyola University in Chicago in 1961 and M.S. and Ph.D. degrees from Howard University in 1963 and 1968, respectively, all in physics. Following a two-year assignment with the Goddard Space Flight Center Laboratory for Theoretical Studies, he joined the IBM Corporation in 1968. He came to Cornell in September 1991 as an IBM faculty-loan fellow to work with the Engineering Minorities Office, and joined the EE faculty as an associate professor in fall 1992. Al says that he was honored to have served as an associate professor in the school.

Professor Phillips thinks that his most significant work during his Cornell years is with quantum theory. He has shown that key experiments used to verify the De Broglie postulate on the wave nature of matter are more reasonably explained by an *all-particle* nature. He presented this work at the 2002 meeting of the National Society of Black Physicists and the March 2002 meeting of the American Physical Society. Using that realization, he is creating a new quantum theory. At the April 2002 meeting of the American Physical Society, he reported results on the hydrogen atom that are exactly the same as in conventional quantum mechanics. His *first-pass* modeling of the helium atom is as accurate as that of the Schrödinger equation. In modeling the hydrogen molecular ion, he has found all the features obtained with quantum mechanics. This work was presented to the ECE Colloquium in April 2002 under the title "A New Quantum Model."

Phillips's theoretical work also extended to field-effect transistors (FETs) and diffusion modeling. He created a two-postulate FET theory that he applied to the four most common FETs: metal-oxide semiconductor (MOSFETs), junction (JFETs), metal-semiconductor (MESFETs), and heterostructure FETs. He has shown that his predictions agree within a factor of two of the measurements. This work also was presented to the ECE Colloquium in February 2002 under the title: "Is This the Greatest FET Theory in the Whole-Wide-World?" He feels that his six-coupled partial differential equation modeling of impurity diffusion in semiconductors is sufficient to solve most diffusion problems in that media.

While at Cornell, Phillips has taught five courses: EE 457, Silicon Semiconductor Electronics; EE 558, Compound Semiconductor Electronics; EE 210, Introduction

to Electrical Systems; ECE 215, Introduction to Integrated Circuits; and one that he created, EE 595, Quantum Devices and Quantum Computing. This latter course on quantum computing was the first of its kind taught at Cornell. He says teaching that course convinced him to investigate some of the assumptions of quantum mechanics itself; accordingly, he modified his original goal of creating a quantum-mechanical device.

Phillips has been involved with the work of three M.S. students, guided many M.Eng. students in their design projects, and conducted the ENGRI 150, Engineering Seminar Program sessions during their first semester. During his tenure at Cornell he participated in advising two sets of students through to graduation. He served on the University Senate Affirmative Action Committee for three years, and has served on similar College of Engineering committees. He was the catalyst that enabled Associate Professor **Kevin Kornegay** to join the ECE faculty. He has expressed concern about the declining number of African-American undergraduate students in the College of Engineering. There has been a steady decline since he has been here—in academic year 2001-02, the number of these minority students is less than one-third of what it was in academic year 1984-85.

Al thinks of his departure from Cornell as graduation rather than as retirement. He maintains his health by running, meditating, and by careful selection of food. He ran the May 2002 Pittsburgh Marathon despite having had little time to train. He will soon publish a book of a general nature on which he has been working for many years, and intends to create a journal and an institute. He has five excellent male progeny and currently zero wives.

courtesy of Alfred Phillips, Jr.



Alfred Phillips, Jr.

Ravi Sudan Retires

Ravindra N. Sudan, the IBM Professor of Engineering, a member of the EE/ECE faculty for 42 years, became professor emeritus on July 1, 2001.

Ravi obtained a B.A. degree (with honors) in English from the University of Punjab in India in 1948 and transferred to graduate study at the Indian Institute of Science in Bangalore, where he earned a D.I.I.Sc. degree in 1952. Continuing his studies in England, he obtained a D.I.C. degree from Imperial College, London, in 1955 and a Ph.D. degree from the University of London in the same year, both in electrical engineering. From 1955 to 1957 he was an engineer with the British Thomson-Houston Company in Rugby, England; he spent the next year as an instrumentation engineer with Imperial Chemical Industries, Ltd., in Calcutta, India. In 1958 he came to the EE School at Cornell as a research associate. He joined the EE faculty as an assistant professor of electrical engineering in 1959, became an associate professor in 1963, and was appointed to full professor in 1968. In 1975 he was named the IBM Professor of Engineering.

Ravi's career at Cornell has been characterized by rigorous teaching and innovative research in the EE/ECE School and dedicated service to the College of Engineering and the world-wide plasma-physics community. Since his initial study and research had been in electric power and machinery, his first years in the school were spent with the electric-power group, where he introduced the mathematically oriented generalized theory of electrical machines into the curriculum with two elective courses, one on machines in both steady and transient states, the other on the unified theory of electromechanical systems. His research in this period was concerned with power circuit breakers in vacuum and the physics of electrical breakdown in vacuum, activities that stimulated a strong interest in the emerging field of plasma physics. In the early 1960s, Ravi developed and introduced two new senior and graduate-level plasma-physics courses in the EE School and in the School of Applied and Engineering Physics.

Professor Sudan began his distinguished research career in plasma physics by studying aspects of this discipline applied to space and solar physics, including dynamics of the solar magnetic field, plasma turbulence in the ionosphere, the structure and dynamics of the solar magnetic field, and plasma turbulence in the equatorial electrojet. His first work in this area was the independent discovery in 1963 of the "whistler instability," subsequently shown to be the physical mechanism causing very-low-frequency radio emissions from the magnetosphere. The major portion of his research career was concerned with activities related to controlled thermonuclear fusion that spanned the following areas: physics and technology of pulsed

Photo by Jon Reis Photography



Ravi Sudan

high-power electron and ion beams and their application to inertial fusion, ion rings and their application to magnetic fusion, intense laser-plasma interactions, plasma stability, nonlinear interactions in plasmas, solitons, and the physics of intense relativistic electron beams and intense ion beams. He is a widely recognized leader in research in all aspects of plasma physics.

In the classroom Ravi was known as a vigorous lecturer and an instructor who set very high standards of performance. His homework assignments were notable for the challenges they provided for his students and for the insights into the subject matter afforded by their solution. Members of the faculty who assisted Ravi in the plasma-physics courses also have testified to the difficulty of the exercises and their educational effectiveness. Outside the classroom, Ravi was easily available for student conferences and gave freely of his time in advising his many graduate students on their research projects throughout his active years. He was equally generous of his time with the many visiting scientists and graduate students from foreign lands who came to study with him during his tenure on the faculty.

From 1975 to 1985 he was director of the Cornell Laboratory of Plasma Studies. In 1984 he joined the 1982 Nobel Laureate in Physics, Professor **Kenneth G. Wilson**, to found the Cornell Theory Center and was the deputy director of that facility from 1985 to 1987. He has held visiting appointments in plasma and fusion physics in England, Italy, and the United States; been an invited lecturer in the former Soviet Union, France, former West Germany, and Japan; and chaired several international conferences. He has served as head of the theoretical plasma-physics section at the U.S. Naval Research Laboratory and was a consultant to a number of other government, industrial, and university laboratories. He has been on the editorial boards of several technical journals and is co-editor of Volumes I and II of the *Handbook of Plasma Physics*. His many awards include the James Clerk Maxwell Prize in Plasma Physics by the

American Physical Society in 1989 and the Gold Medal in Physical Sciences of the Academy of Sciences of the Czech Republic in 1994. At the June 2002 International Conference on Intense Charged-Particle Beams, held in Albuquerque, New Mexico, Ravi received the 2002 Beam Award "for original contributions as well as for helping to create the field of beams and sustaining it over the years." He is a past chairman of the Plasma Science Committee of the National Research Council and is a fellow of the American Physical Society, the Institute of Electrical and Electronic Engineers, and the American Association for the Advancement of Science. He has published more than 225 papers with his students and colleagues.

During his long career at Cornell, Ravi prepared many successful proposals that brought major research programs to the EE School and the College of Engineering. Over the years, he received grants from the National Science Foundation, the U.S. Department of Energy, the Office of Naval Research, the Naval Research Laboratory, and Sandia National Laboratory. For the extensive numerical studies required by many of these programs, Ravi had access to Cornell's National Supercomputing Facility, the National Magnetic Fusion Computing Center in Livermore, California, and the National Center for Atmospheric Research Computing Center at Boulder, Colorado. These programs collectively established Cornell as a major center of plasma-physics research and supercomputing capability and also provided support for the many graduate students who have gone on to distinguished careers in these disciplines.

In 1996 Ravi suffered a major medical setback that essentially ended his active research career. He has, however, made a remarkable recovery that allows him, on frequent occasions, to act in an advisory capacity to visiting scientists and graduate students who have been inspired to study plasma physics at Cornell because of his major contributions to the discipline. A gala celebration of Ravi's achievements, held in Ithaca on the evening of May 11, 2002, was attended by more than 100 distinguished members of the plasma-physics community from this country and abroad.

In his early years at Cornell, Ravi was fond of playing squash with several of his colleagues. On one occasion he was returning from the squash courts and stopped to watch a cricket match that was in progress on a green adjacent to Hoy Field. Ravi, obviously quite impressed with some outstanding play that he had just observed, called out, "Well played, Sir!" Without question, that very accolade summarizes Ravi's career at Cornell.

In retirement, Ravi and his wife, Dipu, will continue residing in Ithaca, visiting their children in Dallas, Texas, and San Jose, California, and travelling abroad to renew acquaintances with former colleagues.

MORE TALES FROM THE PAST

Your tales from the past are always welcome. Send us your favorite stories about professors, labs, classes, projects, stunts, or whatever you think made the EE/ECE School a special place. We'll print 'em as space allows.

This summer the Ithaca Section of IEEE is having a centennial celebration of its founding in 1902 as the first college section of the then American Institute of Electrical Engineers. This event, coupled with some of the photographs of prior faculty members shown in the "Faculty Honor Roll" in the center of this issue of *Connections*, suggests a selected look at some items related to early days in the EE School.

Many members of EE classes of the 1960s and beyond may have heard references to Franklin Hall but may be unaware that the building (now known as Tjaden Hall) was the home of electrical engineering at Cornell for 70 years. The red stone edifice, shown in an early photo in Figure 9, was erected in 1881, and the first courses in the new department of electrical engineering were offered in the building in 1885. A bas-relief of Benjamin Franklin is still inscribed on a stone panel above the entrance with the inscription, "In Honor of the First American Electrician." Morris Hall, the building to the left of Franklin, was partially destroyed in a fire, but it housed the EE machine shop in the basement for many years until the advent of the Johnson Museum on the site.

The lecture room, Franklin 115, located on the first floor, was a semicircular amphitheater that offered unobstructed views of the lecture stage and double-hung blackboards. An unusual structure to the right of the stage contained various motors and generators, a switchboard and control panel, two huge meters (a voltmeter, and an ammeter) with display scales about four feet long. Enterprising instructors with a liking for lecture demonstrations often used these devices to create some spectacular effects for the edification of their students. This advantage was somewhat offset by the

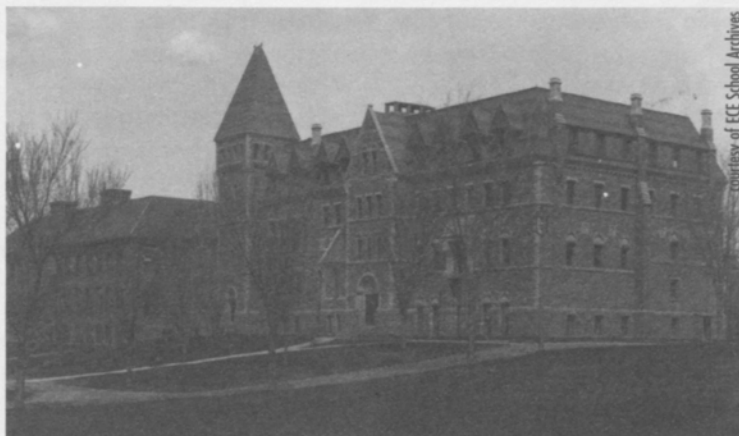


Figure 9. Franklin Hall, circa 1890.

ancient hot-water heating system in the room. Students attending an eight o'clock lecture on a cold winter morning would experience fifteen minutes of clanking and groaning pipes as the room heated up. Oldtimers will recall, however, that life classes conducted in the well-lighted, fourth-floor studio provided some compensation for this discomfort.

A number of nostalgic items are shown in Figure 10, a photograph of a display case in Rhodes Hall. In front of the painting of the venerable Professor **Vladimir Karapetoff**, (1905-1940), a working model of a three-phase induction motor may be seen on the left side of the exhibit. The motor consisted of three open windings and a solid aluminum ball mounted on suitable bearings. When a three-phase source was

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Figure 10. Early-times exhibit in Rhodes Hall.

applied, the ball spun mysteriously, to the amazement of all. An electromagnetic oscillograph, dimly seen to the right of the induction motor, was an interesting device composed of a galvanometer, a rotating mirror, a light source, and a portal for a camera. It was particularly useful in the measurement of high-voltage transients, and photographs of low-frequency waveforms could be obtained handily. Some models were equipped with several galvanometers so that oscillograms of simultaneous waveforms could be recorded, a feat that early cathode-ray oscilloscopes could not accomplish.

The primitive harmonic generator in the center of the photo was also a useful teaching device. Three-slotted iron "tone wheels" of three different diameters were spun at constant speed by a small synchronous motor. The pick-up coils adjacent to each wheel were electromagnets from early telephone handsets. The tone wheels produced good sinusoidal waveforms at 60 Hz, 180 Hz, and 300 Hz when driven by the 60 Hz motor. The movable pick-up coils on the third and fifth harmonics allowed those voltages to be changed in phase relative to the fundamental. When all three voltages were placed in series and viewed by an oscillograph, or later by a cathode-ray oscilloscope, it was possible to produce quite complex waves.

The "Buck Rogers" mercury-arc, full-wave rectifier may trigger memories for some alumni. The device required the output terminals of a center-tapped ac transformer to be connected to the anodes of the rectifier and a resistive load to be connected between the center tap and the mercury cathode. A separate arc circuit created a "cathode spot" on the pool of mercury to supply the necessary electrons. When operated in a dark room the rectifier produced a rather spooky "mad scientist-type" demonstration.

The improved version of the famous black Dumont 208 oscilloscope, at the extreme right in the figure, is a faithful old laboratory friend that served students well in the immediate post-World War II years until the more powerful instruments became available in the late 1950s. Stability of the trace was a common problem that could be managed with patience, and the general performance of the improved model was clearly better than the original one. The exotic Lissajous patterns could be demonstrated easily, and the hysteresis loop for magnetic material could be produced with the aid of some auxiliary circuitry.

Another item of the past is shown in Figure 11. In a recent cleanout of an old desk in Rhodes Hall, a yellowed, mimeographed copy of laboratory notes on the theory of some feedback oscillators was found in a tattered folder. The notation "E8" in the upper left-hand corner of the reproduced first page of the notes indicates that the material may have been a holdover from notes distributed to students in the Navy V-12 program during World War II. For example, course numbers of that period were designated as "NEE7" or "NEE8." Perhaps some members of the Class of '49 will recognize these notes and may be able to identify the professor who passed them out in a senior lab course.

Sam Linke

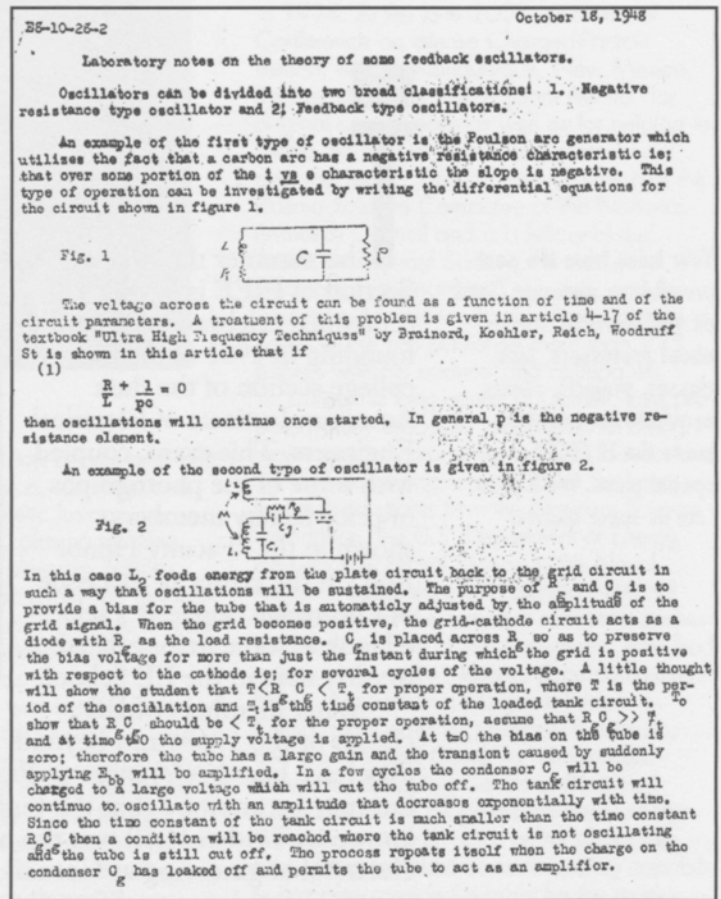


Figure 11. Mimeographed laboratory notes, circa 1948.



The annual ECE School Alumni Breakfast was held on Saturday, June 8, 2002 in the Phillips Hall lounge. More than 130 alumni, companions, and friends joined members of the ECE School faculty and staff for an event that is always a festive and memorable occasion.

Irwin M. Jacobs, B.E.E. '56, M.S. and Sc.D. (MIT), chairman and chief executive officer of QUALCOMM, was inducted into the American Academy of Arts and Sciences in 2001. Irwin was among the 180 new fellows who attended the American Academy induction ceremony, held on October 13, 2001 in Pound Hall at Harvard Law School and at the House of Academy in Cambridge, Massachusetts.

Joseph E. Bell, M.Eng. '62, IT architect/consultant with IBM in Atlanta, Georgia, writes that he is enjoying his work with the company. For the past five years he has served as a Cornell Admissions Ambassador Network volunteer and has derived satisfaction from seeing several of his students accepted by and attending Cornell.

James O. Moore, B.S. Engr. '64, M.S.E.E. '69 (Rensselaer Polytechnic Institute), now retired, was vice president of research at Moore Products until its sale last year to Siemens Energy & Automation. Jim is executive vice president for membership of the board of directors of the Cornell Society of Engineers (CSE) and was chairman of the April 2002 CSE Engineering Conference on the Convergence of Engineering and the Life Sciences.

Karl F. Miller, B.E.E. '65, M.E.E. (Rensselaer Polytechnic Institute), management adviser and engineering consult-

ant in Ridley Park, Pennsylvania, has twice been chairman of Cornell Society of Engineers (CSE) conferences and is currently secretary of the board of directors of CSE.

Kai Fong Lee, Ph.D. '66, B.S.C. and M.S.C. (Queen's University, Kingston, Ontario, Canada), became dean of the School of Engineering at the University of Mississippi on January 1, 2001. Professor Lee, formerly chairman of the Department of Electrical Engineering at the University of Missouri at Columbia, writes that his research interests are concerned with small-size wideband microstrip antennas for wireless communication.

Robert E. Maroney, B.S. ENGR. '72, M.B.A. (Harvard), president and owner of RM Capital Holdings, in New Canaan, Connecticut, is the current president of the board of directors of Cornell Society of Engineers (CSE). Robert has served as a CSE conference chairman and is a past member of the Cornell University Council.

Jaclyn A. Spear, B.S. ENGR. '75, M.B.A. (University of Pittsburgh), principal engineer, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina, is executive vice president of programs for the board of directors of Cornell Society of Engineers. Jaclyn is a member of the President's Council of Cornell Women.

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In this issue we are continuing the Positive Feedback feature of previous years. The first ten issues of *Connections* triggered a gratifying number of responses. We hope that this issue will stimulate even more return of the coupon at the end of this newsletter, or reports on your recent activities.

Note for Internet surfers:

The ECE School home page is on the World Wide Web at www.ece.cornell.edu. The College of Engineering URL is www.engineering.cornell.edu. The e-mail address for *Connections* is <SL78@cornell.edu>.

Note: Our alumni file is somewhat incomplete. If you know of school alumni who are not receiving *Connections*, please urge them to send their names and addresses to **Jeanne Subialka**, B.S. '99 (ILR), Engineering Public Affairs, 248 Carpenter Hall, Ithaca, NY 14853-5401.

ece ONLINE NEWS

New ECE Web Page

The ECE School web page has been extensively modified. The current version contains a guide for enrolled and prospective students, an updated alumni section, and general information about the school and faculty. Check it out at www.ece.cornell.edu.

ECE Alumni Online

Alumni may access alumni information that has been organized specifically for them by clicking on the "Alumni" link on the home page of the ECE School web page site.

William J. Schaff, B.S. ENGR. '78, Ph.D. '84, is a senior research associate in the ECE School. He is responsible for the Cornell Molecular Beam Epitaxy (MBE) Facility and performs research in MBE growth and characterization of III-V compound semiconductors for microwave electronic and photonic devices. Bill has over 290 publications and conference presentations in his field of interest.

Jeffrey C. Hawkins, B.S. ENGR. '79, founder of Palm Computing and co-founder and chairman of Handspring, Inc., Palo Alto, California, delivered the Faculty of Computing and Information Distinguished Lecture on April 17, 2002 in Cornell's Statler Auditorium. Jeff spoke on the topic, "Synapses to Silicon: How Neuroscience Will Impact the Next Fifty Years of Computing."

Susan Spira Hakkarainen, B.S. ENGR '82, M.E.E. '83, Ph.D. (MIT), founder and president of Ivalo Lighting Inc., has been appointed as a member of the Advisory Council of the School of Electrical and Computer Engineering at Cornell. Susan was formerly vice president of International Marketing and general manager of Commercial Systems of Lutron Electronics Company, Inc. of Coopersburg, Pennsylvania.

Shaygan Kheradpir, B.S. ENGR. '82, M.S.E. '83, Ph.D. '87, chief information officer for Information Technology, Verizon Communications, is a member of the Advisory Council of the School of Electrical and Computer Engineering at Cornell. Before assuming his present position in January 2002, Shaygan was president of the eBusiness Group for Verizon Communications, and prior to the Bell Atlantic/GTE merger had been vice president for information technology for GTE in Massachusetts.

Allyson D. Yarbrough, M.S.E.E. '85, Ph.D. '88, has been promoted to the position of principal director, Electronics Engineering Subdivision, Electronics Systems Division of the Aerospace Corporation in Los Angeles, California. Allyson also received an achievement award for significant contributions to the corporation during 2000.

John D. Ralston, Ph.D. '88, has assumed a position as vice president of marketing and is a member of the management team for Stratelight Communications in Campbell, California, a new company devoted to the development of fiber transmission technology. John was formerly vice president of marketing and licensing for Morphics Technology, Inc. in Cupertino, California.

Andrew D. Williams, B.S. ENGR. '91, writes that after separating from the U.S. Air Force in September he is now designing computer networks and integrated audio-visual solutions for a Department of Defense site in the United Kingdom. He enjoys *Connections* and reading the latest research of his department and his professors.

Ray D. Zimmerman, M.S. '92, Ph.D. '95 is a senior research associate affiliated with the Cornell Power System Engineering Research Center, where he is currently concerned with the development of an interactive, distributed, internet-based simulation environment for experimentally testing various power-exchange auction markets using human decision makers.

Kathleen N. Kostival, M.Eng. '94, Ph.D. '99, is a development analyst with Nestlé PTC in New Milford, Connecticut, concerned with development of patent-pending technology. She is currently on a nine-month international assignment in Switzerland.

Alan J. Nawoj, B.S. ENGR. '01, reports that he ran the Los Angeles Marathon on March 3, 2002, and finished 348 out of the 18,815 total runners who finished. He was second overall among New Yorkers. His time was 3 hours, 17 minutes, 33 seconds. Congratulations, Alan!

A Message from Jamie L. Edgar, New Manager of Corporate and Alumni Relations

Hello, Alumni and Friends.

I am the new corporate and alumni relations manager for the School of Electrical and Computer Engineering and the Sibley School of Mechanical and Aerospace Engineering. I hold an engineering degree from Clarkson University, and, before joining the Cornell community, I worked in both the power and telecommunications industries. I look forward to my new position in alumni relations—my responsibilities are to facilitate effective communications between the schools and their respective alumni and friends.

The ECE School is experiencing an energetic and exciting period of development and expansion. With hope for a renewed economy and the promise of support from our corporate sponsors, we continue to provide highly regarded educational opportunities for both academia and industry. At the same time, we look toward the support of our alumni to continue our growth and energize our initiatives as we develop resources for the future.

Staying connected to you and communicating our progress is of primary importance! I invite you to contact me with comments, questions, or suggestions. Also remember to visit our website—at www.ece.cornell.edu—for the latest information about the school and its programs.

Jamie L. Edgar
corporate and alumni relations manager
e-mail: jle29@cornell.edu



Frank Dilleo, Cornell University Photography

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OPTIONAL

I would like to explore possibilities in the following areas:

- Contributions to the Eminent Professors' fund
- Contributions to the Joseph L. Rossen (Papa Joe) Memorial Fund
- Establishment of one-year fellowships for professional master's students
- Engineering Cooperative Program
- Job placement of Cornell EE School seniors or graduate students
- Other _____

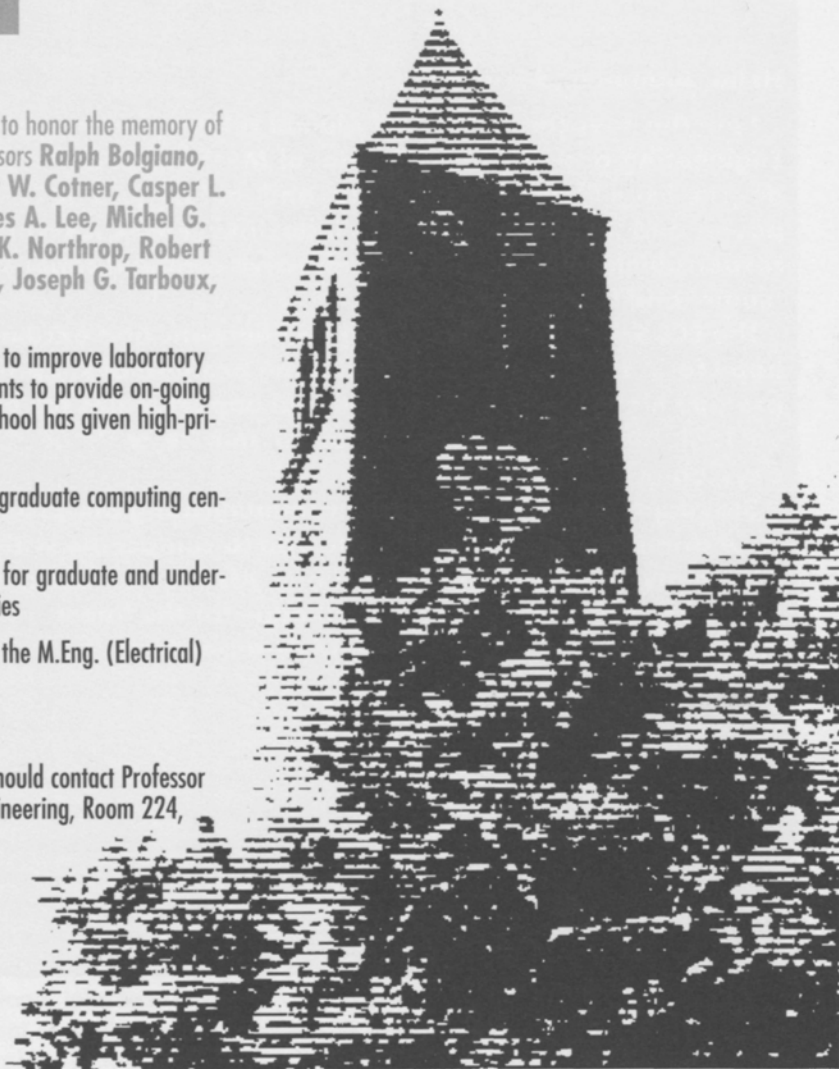
Eminent Professors' Fund

Ten years ago the EE School established the Eminent Professors' Fund to honor the memory of notable members of the school's faculty of past years, including professors **Ralph Bolgiano, Jr., Henry Booker, Nelson H. Bryant, L.A. Burckmyer, Walter W. Cotner, Casper L. Cottrell, William H. Erickson, Clyde E. Ingalls, M. Kim, Charles A. Lee, Michel G. Malti, Malcolm S. McIlroy, True McLean, Wilbur Meserve, B.K. Northrop, Robert Osborn, Joseph L. Rosson, Howard G. Smith, Everett Strong, Joseph G. Tarboux, Stanley W. Zimmerman**, and others whom alumni may recall.

The objectives of the fund are twofold: (1) to acquire specific grants to improve laboratory and research facilities in the ECE School, and (2) to establish endowments to provide on-going financial support for undergraduate and graduate students. The ECE School has given high-priority status to the establishment of:

- an endowment fund to supplement the operating costs of the undergraduate computing center and the undergraduate teaching laboratory
- an endowment fund to provide financial support, on a yearly basis, for graduate and undergraduate students who serve as teaching assistants in our laboratories
- one-year fellowships to support professional masters candidates for the M.Eng. (Electrical) degree
- a fund to support M.Eng. (Electrical) research projects

Alumni who would like to contribute to the Eminent Professors' Fund should contact Professor Clifford R. Pollock in care of the School of Electrical and Computer Engineering, Room 224, Phillips Hall.



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