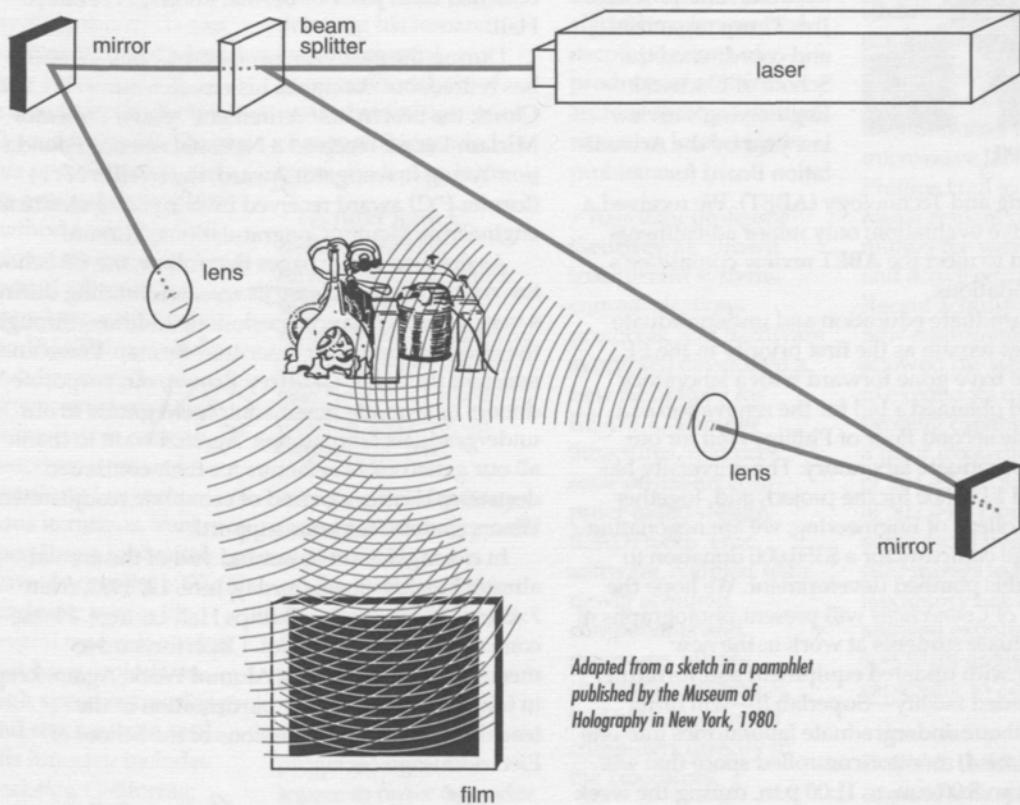


# CONNECTIONS

A Report from the SCHOOL OF ELECTRICAL ENGINEERING • Cornell University



*Adapted from a sketch in a pamphlet published by the Museum of Holography in New York, 1980.*

This sketch depicts how a hologram is made by means of a split laser beam that creates an interference pattern on a photographic film. A three-dimensional image is produced when the developed film is viewed under suitable light.

In the spring of 1985, during the centennial celebration of the EE School, many alumni saw the hologram of the historic Samuel F. B. Morse original telegraph receiver. That instrument received the first long-distance message on May 24, 1844. The subsequent Western Union Telegraph Company was the basis of Ezra Cornell's fortune and the founding of the university. The receiver is still in the possession of the College of Engineering. The statue of Ezra Cornell, on the Arts Quad, shows him with his left hand on a replica of the Morse receiver.

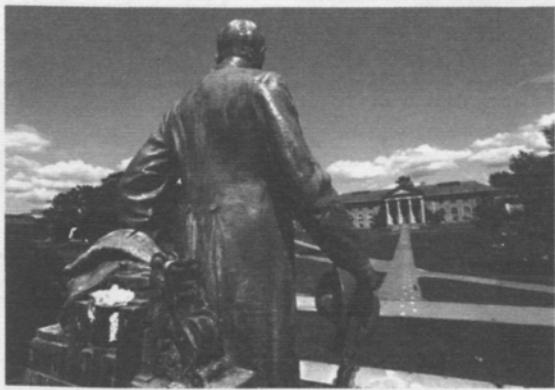
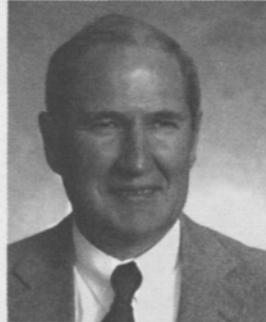


Photo by Jon Crispin

This second edition of *Connections* features the professional masters program, highlights two popular M.Eng.(Electrical) group projects, the Cornell Electric Vehicle Design Project and the Digital Audio Research Environment, and describes two new research programs in the EE School, Electronic Packaging and the Joint Services Electronics Program (JSEP) on Optoelectronics. This issue also reviews recent faculty accomplishments, announces one new faculty member and one recent faculty retirement, memorializes a late member of the faculty, introduces a new NSF Young Investigator (NYI) awardee, and presents the first of a series of profiles of outstanding young faculty members. Ellis L. Phillips, donor of Phillips Hall, is remembered in a brief biographical sketch, and EE School staff members who have been with the school for ten years or more are recognized in a special listing. The "Positive Feedback" feature is back with about two dozen responses. Several alumni sent some interesting stories that are included in "More Tales from the Past." Please fill out the information coupon on the last page of this newsletter, clip, and mail it to us. We want to hear what you are up to.

Simpson (Sam) Linke, editor  
SPRING 1993

# REPORT FROM THE DIRECTOR



NOEL C. MACDONALD

Engineering and Technology (ABET). We received a very positive evaluation; only minor adjustments are needed to meet the ABET review committee's recommendations.

Undergraduate education and undergraduate laboratories remain as the first priority in the EE School. We have gone forward with a laboratory design and obtained a bid for the renovation of a wing on the second floor of Phillips Hall for our new undergraduate laboratory. The university has committed \$150,000 for the project, and, together with the College of Engineering, we are negotiating with a large company for a \$350,000 donation to complete this planned development. We hope the next issue of *Connections* will present photographs of undergraduate students at work in the new laboratory with updated equipment and furniture. This expanded facility—Superlab II—will bring together all our undergraduate laboratories into one air-conditioned, monitor-controlled space that will be open from 8:00 a.m. to 11:00 p.m. during the week so students can have access to equipment during nonscheduled laboratory time.

The centerspread in this issue is devoted to our one-year professional Master of Engineering Program. The strong emphasis on design makes graduate study for the M.Eng. (Electrical) degree an effective vehicle for continuing education, particularly for engineering personnel in corporations that have established an agenda for industrial retraining. Financial support for regular professional masters students is a

A year has passed since my last writing, and I'm happy to report that professor emeritus **Sam Linke** continues as editor of this publication. Sam and professor **Jim Thorp** organized and coordinated the School of Electrical Engineering's review last year by the Accreditation Board for

continual problem, however, since the number of teaching assistantships is limited. We urge alumni who may wish to contribute to the Eminent Professors' Fund to consider designating their gift toward ongoing fellowships for M.Eng. (Electrical) students. More information about the program may be obtained from **John C. Belina**, Room 221, Phillips Hall.

During the past year, professor **Chuck Wharton** has retired, but continues his research effort. We wish Chuck the best in his "retirement" years! Professor **Miriam Leeser** received a National Science Foundation Young Investigator Award, the twelfth NYI (former PYI) award received by our young electrical engineering faculty. Congratulations, Miriam!

As detailed in the pages that follow, the EE School has continued to increase its research funding during a very difficult financial period. In addition, through the efforts of professor emeritus **Norman Vrana** and assistant professor **Geoffrey Brown**, our corporate donors have made major equipment grants to our undergraduate laboratories. Again, I want to thank all our generous benefactors for their continued donations during a period of economic readjustment. We are grateful for your support!

In closing, I want to remind you of the annual alumni breakfast on Saturday, June 12, 1993, from 7:45 to 9:30 a.m. in the Phillips Hall Lounge. Please come and visit your school. I look forward to meeting with you during Alumni Week. Again, keep in touch—we value your participation in the teaching and research missions of the School of Electrical Engineering.

## ENROLLMENT AND GRADUATION STATISTICS

### UNDERGRADUATE PROGRAM

Year	Juniors	Seniors	Degrees
90-91	132	139	149
91-92	132	140	142
92-93	114	117	*

### M.ENG.(ELECTRICAL) DEGREES

August	January	May	Total
26	6	37	69
42	7	67	116
40	5	*	*

### M.S./PH.D. PROGRAM

Year	Applicants	Admissions	Total Enrollment	Degrees
90-91	569	32	147	28 Ph.D.s, 9 M.S.s
91-92	648	21	148	30 Ph.D.s, 11 M.S.s
92-93	617	10	134	*

These figures indicate that both undergraduate and graduate programs have been relatively stable over the past three years.

\*Not available at press time. The number of degrees to be awarded in 1993 is expected to be somewhat lower than that of the two previous years.



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# RECENT FACULTY ACCOMPLISHMENTS

A

Associate professor **Venkatachalam Anantharam** (information theory) received the AT&T Foundation Research Grants for Presidential Young Investigators (PYI) and additional PYI funding from Bellcore. Both grants were for the 1991-92 academic year. During this period Venkat and his group developed a method to design the token buffer size in flow-control schemes for asynchronous transfer mode (ATM) networks, and discovered a structure theorem that characterizes convergence properties of distributed asynchronous iterations. Venkat is spending a sabbatical leave during the 1992-93 academic year with several research centers that have projects on high-speed networking and stochastic control. His itinerary includes Berkeley, California; Amsterdam, The Netherlands; Bangalore, India; and Sophia Antipolis, France.

Professor **Joseph M. Ballantyne** (optoelectronic devices and materials) has been appointed director of the Semiconductor Research Corporation (SRC) interdisciplinary Program on Microscience and Technology at Cornell. He succeeds professor **James W. Mayer**, of the Department of Materials Science, who retired from the university in fall

1992. During the 1991-92 academic year, Joe developed and taught two new upper-level graduate courses in his fields of interest and published three papers detailing his research on a substantial numerical analysis of nonreciprocal operation of monolithic guided-wave diode ring lasers.

• Lecturer **John C. Belina** (assistant director for instruction in the EE School) received the National Cash Register Corporation Award for Excellence in Teaching on October 28, 1992.

Professor **Toby Berger** (information theory and communications) is conducting research on successive refinement (progressive transmission) concerned with incremental specification of information produced by a data source in order to render it in more detail at each of several encoding stages. The class of sources known to be successively refinable has been broadened significantly by his group.

Assistant professor **Adam W. Bojanczyk** (computer engineering, parallel architecture, and algorithms for signal and image processing) has returned from a leave of absence in spring 1992 at the University of Minnesota, where he participated in a conference devoted to applications of linear algebra in signal processing. His recent research has been concerned with development of parallel algorithms for spectral decompositions of products of matrices, and for sliding-window, recursive least-squares problems.

• Assistant professor **Geoffrey M. Brown** (concurrent systems, communications protocols, and hardware synthesis) developed a new laboratory for EE 475, Computer Structures, that uses state-of-the-art computer-aided-design (CAD) tools. This software, coupled with newly acquired components and programs, allows students to design, build, and test small computers directly in the laboratory.

• Professor **Robert R. Capranica** (information processing in the nervous system) is the recipient of the U.S. Congressional Jacob Javits Award in Neurology and Communications Sciences for the period 1987-1994.

• **Hsiao-Dong Chiang** (analysis and control of nonlinear systems with applications to electric-power networks) was promoted to associate professor on July 1, 1992. During the past academic year, Hsiao-

Dong developed a high-speed linear-programming solver based on an artificial neural network.

• Among other activities, assistant professor **Richard C. Compton** (millimeter and microwave integrated circuits) applies the facilities of the millimeter and microwave laboratory in Phillips Hall to the measurement of millimeter-wave passive and active circuits. Recent acquisition of new equipment has allowed the laboratory to expand its on-wafer probing capability from a prior frequency level of 26 GHz to a new level of 50 GHz. Donation of some radio frequency (RF) mixers to the laboratory has also allowed expansion of spectrum-analysis capability to 220 GHz.

• Associate professor **David F. Delchamps** (control and system theory) received the 1992 Tau Beta Pi/Cornell Society of Engineers Award and the 1992 IEEE Student Chapter Award, both for Excellence in Teaching. His research group is engaged in a further search for exact mathematical characterizations that have been found to be extremely useful problem-solving tools in the analysis and design of analog-to-digital converters.

• Professor **Lester F. Eastman** (compound semiconductor materi-

als, devices, and circuits), the John LaPorte Given Professor of Engineering, is spending a sabbatical leave in Ithaca during the 1992-93 academic year. He is consulting part-time with the Northeast Semiconductor Company on MBE-grown wafers for transistors and lasers, and on packaging lasers for efficient high-power arrays. Les is also exploring areas related to new EE School research contracts.

• Professor **Donald T. Farley** (radiowave and upper-atmospheric physics) and senior research associate **Wesley E. Swartz** are continuing their program of radar studies of plasma turbulence in the equatorial ionospheric E region over Peru. For the first time, high-resolution data have been obtained, over a continuous forty-eight-hour period, from power, Doppler-spectra, and interferometer measurements. A unique data base is thereby provided for advanced study of turbulence phenomena.

• Professor **Terrence L. Fine** (information theory, inference and decision making in the presence of uncertainty) is investigating the statistical capabilities of neural networks and their application to forecasting demand for

electric power. In addition to his regular duties, Terry is the computer coordinator for the EE School.

• Assistant professor **Lov K. Grover** (theory and application of computer algorithms) has used nonlinear potential functions to discover a new interior-point algorithm that, when applied to bipartite matching problems, provides the fastest known parallel algorithms for both approximate and exact solutions.

• Professor **Tor Hagfors** (radar astronomy and atmospheric sciences) director of the National Astronomy and Ionospheric Center, is spending a sabbatical leave during academic year 1992-93 in Lindau/Harz, Germany as a scientific member and member of the colleagues of the Max-Planck-Institute for Aeronomy, and director in the Institute.

• Associate professor **Chris Heegard** (communication, information, and coding theory) taught his new junior laboratory course, EE 320, The Audio Engineering Laboratory, for the first time in spring 1992 and received an enthusiastic response from the students. The course is being repeated in spring 1993. In research, Chris and his group have made significant developments in coding theory, high-fidelity audio compression, and fractionally spaced discrete-time wavelet decompositions. Chris's direction of the work of the Digital Audio

Research Environment (DARE) program is described on page 12.

• Professor **C. Richard Johnson, Jr.** (adaptive control and signal processing), has returned from his sabbatical leave activities in Sweden, Austria, and France. His research in the past year on adaptive-filter convergence rates, and a description of an equalization algorithm, has produced results that will have significant impact on the design of adaptive filters in communication systems applications.

• Professor **Michael C. Kelley** (upper-atmospheric and ionospheric physics) has been elected chairman of the National Science Foundation (NSF) CEDAR Steering Committee, the upper-atmosphere component of the NSF Global Change Program. Mike was also selected as the professor who most influenced Merrill Presidential Scholar **Francisco J. Garcia '92** B.S. (E.E.) during his career at Cornell.

• Professor **Paul M. Kintner** (ionospheric plasma physics) was the sole winner (out of twenty-four entries) of a NASA proposal competition for sounding rockets. Paul gave four invited talks that resulted from the publication of a paper, in *Physical Review Letters*, of which he was the lead author. In spring 1992, he introduced a new senior/M.Eng. course, EE 486, Space Science and Engineering. In the past year, Paul also served as chairman of the Cornell Faculty

Committee on Minority Student Affairs.

• Assistant professor **Ronald R. Kline** (history of technology and electrical engineering) completed his book, *Steinmetz: Engineer and Socialist*, published by Johns Hopkins University Press in April, 1992. In Washington, D.C., in June 1992, Ron placed first in the Society of National Association of Publications' "Editorial or Column" category of the 1992 Excel Awards competition. The award is in recognition of Ron's column "Engineer of Death" or "Winning with Technology?" published in the Summer 1991 issue of *IEEE Technology and Society Magazine*.

• Professor **J. Peter Krusius** (solid-state electronics, semiconductor devices and systems, and electronic packaging) received the Best Poster Paper Award at the 1992 Electronic Components and Technology Conference at San Diego, California in May 1992 for a paper on the electronic-packaging tool AUDIT. This computer-aided-design (CAD) software has been released to the Semiconductor Research Corporation and the Packaging Alliance member companies. (See story on "Electronic Packaging" on page 14.) Peter has also completed modernization of the educational laboratory for course EE 536, VLSI Technology.

• Assistant professor **Soo-Young Lee** (parallel architectures and algorithms) has completed development and analysis of parallel

algorithms for simulated annealing and particle simulation, and major progress has been made in parallel computerized tomography (CT) image reconstruction. Three journal papers and three refereed conference papers have been published. For several semesters, Soo-Young has organized and conducted a computer-engineering weekly seminar in the EE School.

• Assistant professor **Miriam E. Leeser** (VLSI design and computer engineering) has received the prestigious NSF Young Investigator Award (NYI). In the past year, Miriam completed improvements to BEDROC, a hardware-synthesis system that translates a high-level language to field-programmable logic. She also completed and verified a proof of PBS, a logic-synthesis program.

• Professor **Richard L. Liboff** (physics of microsemiconductor devices and solid-state plasmas) has derived an expression for the density of states in spherical geometry that should find application in "quantum dots." His paper on this work was published recently in *Physical Review*.

• Assistant professor **Yu-Hwa Lo** (optoelectronic materials and devices, and integrated optoelectronic circuits) has demonstrated an integrated semiconductor wavelength-tunable-laser array that functions at record high speeds for high-density wavelength division multiplexing (WDM) communications

systems. In June 1992, Yu-Hwa was a participant in the National Effective Teaching Institute in Toledo, Ohio.

• Professor **Noel C. MacDonald** (microelectromechanical and nanoelectromechanical systems), director of the School of Electrical Engineering, has been invited to present the recent work of his research group on the fabrication and operation of micro/nanoelectromechanical systems in silicon. Recent work focuses on the fabrication of moving tips to map the atomic structure of surfaces. Presentations will be made at the International Conference on Atomic and Nanoscale Modification of Materials; at the Annual Meeting of the American Association for the Advancement of Science; at the 51st Annual Device Research Conference; at the annual American Institute of Physics Corporate Associates meeting; and a plenary speech at the Seventh International Conference on Solid-State Sensors and Actuators. Four patents have been issued in the past year on micromechanisms and tips.

• Professor **Paul R. McIsaac** (microwave theory and techniques) has performed research on coupled-mode theory for waveguides, and developed a method to predict which modes are coupled and which are not, without having to evaluate the overlap integrals explicitly.

• Professor John A. Nation (electromagnetic fields and waves) has developed a new electron cathode based on the use of ferroelectric ceramics. In June 1992, John was chairman of an international workshop on advanced accelerator concepts that was held on Long Island, New York.

• Assistant professor Niels F. Otani (computer simulation of plasma-physics problems) has devised a new numerical method for the study of the electron acceleration properties of kinetic Alfvén waves.

• Professor Thomas W. Parks (signal theory and digital signal processing) developed a new laboratory for course EE 425, Digital Signal Processing, using MATLAB and Texas Instruments' digital-signal-processing boards. Tom received the 1991-92 Ruth and Joel Spira Excellence in Teaching Award for this effort.

• Associate professor Clifford R. Pollock (lasers and optoelectronics) has been active in the development of new curricula, starting with course EE 210, Introduction to Electrical Systems. Cliff also completed the establishment of the new optical electronics laboratory in the south wing of the third floor of Phillips Hall.

• Professor Christopher Pottle (computer engineering, parallel processors, VLSI technology) developed a completely new, design-oriented course, EE 576, Designing with

Microcontrollers. Newly acquired equipment allowed the sixty-three students in the course (mostly seniors) to perform seven laboratory projects during the 1992 spring semester.

• Associate professor Anthony P. Reeves (parallel computer systems, computer-vision algorithms) taught his course EE 547, Computer Vision, in conjunction with the new central computer facility in Phillips Hall and found a dramatic improvement in student performance on homework and projects. Tony plans to develop a laboratory section for this course that will include the acquisition of real imagery for the first time.

• Associate professor Charles E. Seyler, Jr. (theory and simulation of nonlinear plasma dynamics), has discovered a new plasma instability that may be related to loss of plasma confinement in tokamak fusion-reactor experiments.

• In June 1992, assistant professor Yosef Y. Shacham (VLSI technology, nanoelectronics, and process integration) and colleagues won the Best Paper Award for their paper, "Thermal stability in copper-based metallization," presented at the VLSI Multilevel Interconnection Conference (VMIC) in San Jose, California, in June 1991. The paper was published in *Proceedings of the VMIC* in June 1992.

• Associate professor J. Richard Shealy (development of compound semiconduc-

tor materials) established operation of the organometallic vapor-phase epitaxy (OMVPE) facility and demonstrated state-of-the-art GaAs and AlGaAs alloys with a new epitaxial-growth process.

• Assistant professor Allan O. Steinhardt (digital signal processing and adaptive detection) and colleagues have employed the group-theoretic notion of maximal invariance to establish the optimality (or nonoptimality) of existing adaptive detectors, and to devise new detectors.

• Professor Ravindra N. Sudan (plasma physics), the IBM Professor of Engineering, in collaboration with his student D. W. Longcope and professor D. Pfirsch of the Max-Planck-Institute of Plasma Physics, Munich, have made fundamental advances in plasma theory that explain solar flares, the heating of solar corona, and x-ray emission from the sun. Some of this work has been published in the *Astrophysical Journal, Physical Review Letters*, and *Physics of Fluids*.

• Professor Chung L. Tang (lasers, optoelectric devices, and nonlinear and coherent optical processes), the Spencer T. Olin Professor of Engineering, has developed the first femtosecond laser in the blue with an output power of hundreds of milliwatts. He has also obtained the basic patent on his recently developed Ti:sapphire laser-pumped

femtosecond optical parametric oscillator. This first-of-a-kind device has a broad tuning range in the infrared from 700 nm to 4 microns at a power level of up to one watt. Chung is spending a sabbatical leave in Ithaca during the spring 1993 semester. In addition to fulfilling some writing commitments, he plans to bring several technologies that have resulted from his recent research to the attention of appropriate industries for development into commercial applications.

• Professor Robert J. Thomas (control techniques for large-scale power networks, analysis of microelectromechanical systems), director of the Cornell component of the NSF Education Synthesis Coalition, reports that his program received high marks in a recent in-depth site review. He has started the development of a courseware laboratory and has created a new engineering course for freshmen with support from the President's Fund. Bob's technical research has been concerned with the understanding of neural networks and their use as dynamic controllers.

• Professor James S. Thorp (estimation and control of discrete linear systems as applied to control of electric power networks) has developed a technique for investigating cascading outages of power systems brought on by hidden failures in the protection system.

• Professor H.C. Toring (computer architecture applied to design of intelligent communication networks) has received a large grant from the National Science Foundation, with matching funds from the university provost, to initiate a doctoral program for students from under-represented groups in engineering. H.C. and his group have made significant breakthroughs in the design of superscalar processors.

• Professor George Wolga (quantum and solid-state electronics) is co-principal investigator of a recent five-year research grant from the U.S. Army's University Research Initiative (URI). His activities in the program will be concerned with the development of means for laser spectroscopic monitoring of combustion products in chemical-weapon disposal.

# FACULTY PROFILES



• **David F. Delchamps, B.S.E.** '76, Princeton; S.M. '77, Ph.D. '76, Harvard, both in applied mathematics, joined the EE School faculty as an assistant professor in 1982 and was promoted to associate professor in 1990. His major research and teaching interests are in the areas of control and dynamical system theory, with special emphasis on theory of estimation and control of nonlinear systems. Since coming to Cornell, David has won five Excellence in Teaching awards as follows:

1983 IEEE Student Branch Award  
1984 Cornell Society of Engineers/  
Tau Beta Pi Award  
1987 IEEE Student Branch Award  
1988 Ruth and Joel Spira Award  
1992 Cornell Society of Engineers/  
Tau Beta Pi Award.

In 1984 he also received the National Science Foundation Presidential Young Investigator (PYI) Award. His text, *State Space and Input-Output Linear Systems*, was published by Springer-Verlag, Inc., New York, in 1988, and he has thirteen publications to his credit in the past five years.

Dave says that he was attracted to electrical engineering by the example and encouragement of his father and both grandfathers, all three of whom worked for Bell Laboratories. As for teaching, he admits to having had a liking for the stage and public speaking while in high school, and he enjoyed his years as a teaching assistant when

he was a graduate student. But he believes that his success as a teacher is due to careful preparation of lectures, projection of a natural enthusiasm for the material, and being readily available to his students.

In his spare time, Dave has a decided passion for ice hockey. He is a member of a local adult hockey league and plays five times a week, on average. In the warmer months he plays tennis and enjoys hiking, particularly in national parks. He plays recreational piano and listens to all kinds of music, with a preference for pre-1962 jazz.



• **Miriam E. Leeser** received the B.S.(E.E.) from Cornell in 1980 and the Diploma and Ph.D. from Cambridge University in 1984 and 1988, respectively, both in computer science. Following graduation from Cornell and three years with Codex Corporation in Mansfield, Massachusetts, she entered graduate study at Cambridge University in 1984 on an Overseas Research Student Award from the British government, and a fellowship from Acorn Computers, Ltd. Miriam joined the EE School faculty in 1988 as an

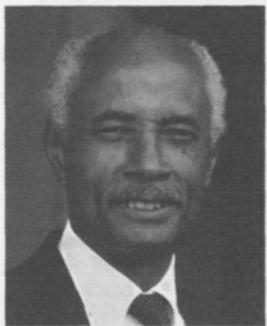
assistant professor. Her major teaching and research interests are in formal hardware verification and synthesis, VLSI design, and computer engineering.

In September 1992 Miriam was named a National Science Foundation National Young Investigator (NYI). She will receive grants of \$25,000/year, for five years, to perform research on the topic, "Toolkit Development for the Design of Floating-Point Arithmetic Hardware and Software." The research makes use of BEDROC, a synthesis system for the automatic generation of VLSI designs from a high-level description language. The objective is to verify tools that are used for synthesizing computer-chip designs, rather than to attempt the much more difficult task of testing the finished designs. Consequently, designers in industry will have more confidence in their ability to produce designs that are consistent through the many phases between inception and realization. Miriam is the editor (together with assistant professor Geoffrey Brown) of *Hardware Specification, Verification, and Synthesis: Mathematical Aspects*, Springer-Verlag Lecture Notes in Computer Science, No. 408, January 1990, and has published thirteen papers in the last five years.

# TEACHING AND RESEARCH GRANTS

structures for application to microwave, millimeter, and optical devices and systems. His most recent technical paper is "Mode Orthogonality in Reciprocal and Nonreciprocal Waveguides," published in *IEEE Transactions on Microwave Theory and Techniques*, vol. 39, pp. 1808-1816, November 1991.

Paul and his wife, Lou, are patrons of the arts. Paul likes classical music, but admits listening to jazz occasionally, providing it is of the pre-1950s variety. They are fond of theatre and visit the Stratford Festival in Ontario, Canada, every summer. Paul and Lou also enjoy art appreciation as a pastime, with interests that range from primitive to modern art.



• **Alfred Phillips, Jr.**, received the B.S. degree in physics from Loyola University in Chicago in 1961, and the M.S. and Ph.D. from Howard University in 1963 and 1968, respectively, both in physics. Following a two-year assignment with the Goddard Space Flight Center Laboratory for Theoretical Studies, he joined IBM Corporation in 1968. He came to Cornell in September 1991 as an IBM faculty loan fellow to work with the College of Engineering Office of Minority Programs, and joined the EE School faculty as an associate professor in fall 1992.

Al has research interests in quantum mechanical devices: optical switches, process modeling: ion migration theory, and epitaxial reactor modeling. In fall 1992 he taught his first course at Cornell in silicon semiconductor electronics, and is following up in the spring term with a course in compound semiconductor electronics. Al has twenty-nine technical papers to his credit in American Physical Society and IBM publications and has received seven U.S. and three IBM patent awards. He is active in IEEE affairs and is the recipient of the IEEE Centennial Medal. He states that his objectives at Cornell are to play a key role in the creation of a new quantum-mechanical device, and to help African American students perform at their true potential in the technical/scientific domain.

Al, a dedicated marathon runner, has completed some thirty runs (twenty-six miles, 385 yards), in the Boston and New York City competitions. He finds that running gives him a heightened awareness of his body and increases his ability to concentrate, not only on the runs but also on other aspects of life. He recalls his great satisfaction with his performance in the '78 NYC marathon when, as the second oldest of a group of twelve friends, he was the second fastest member of the group. Al has five sons, ranging from four to twenty-five years of age. With his two oldest sons he has motored through forty-six of the fifty states, missing only North Dakota, Alaska, and Hawaii. Among other activities, his sons are interested in space science and, except for the youngest, have built and launched model rockets.

## PAPA JOE FUND

We are glad to report that the Papa Joe Fund, established in honor of professor emeritus Joe

Rosson, has grown to about \$18,000. Income from this fund is used to support the work-study program for EE School undergraduates.

Alumni who would like to add to the Papa Joe Fund should contact professor Noel MacDonald in care of the EE School, Room 224, Phillips Hall.

Last October, Joe moved to his hometown of Memphis, Tennessee. He is still confined to his home because of his illness. Joe would appreciate receiving occasional cards or letters from his former students and friends. His new address is 6539 Knight-Arnold Blvd. # 36, Memphis, TN 38115.

## D

etails of corporate gifts to the EE School for computing facilities and laboratory equipment are described on page 13. Several special grants have been received by the EE School in the past academic year, as follows:

- AT&T Foundation donated \$40,000 to professor Noel C. MacDonald and assistant professors Yu-Hwa Lo and Yosef Y. Shacham for research in nanoelectromechanics; \$10,000 to professor J. Peter Krusius for research in electronic packaging; and \$10,000 to assistant professor Geoffrey M. Brown for research in communication protocols.
- The Theodore C. Ohart Teaching-Laboratory Improvement Fund in the College of Engineering was instrumental in arranging a grant to associate professor Chris Heegard for the purchase of six computers and associated equipment for the Digital Audio Research Environment (DARE) laboratory, and additional grants to professor Robert J. Thomas for the new electronic-courseware laboratory for engineering freshmen, Engr 181, Engineering in Context.
- IBM Corporation made Graduate Fellowship Awards of \$29,800 to Bruce Hahne, \$29,200 to Scott Pesarcik, and \$14,700 to A. J. Granesh.
- Intel Corporation donated 1,000 silicon wafers, valued at \$15,000, to assistant professor Yosef Y. Shacham for his research in VLSI technology.
- Intel Corporation, Altera Corporation, and Hewlett Packard Corporation donated computers, breadboards, and associated software, valued at a total of \$357,000 to assistant professor Geoffrey M. Brown for an upgrade of his laboratory. (See additional details in the article "Computing Facility Updated" on page 13 of this newsletter).
- Intel Corporation made a Visiting Faculty Award of \$10,000 to assistant professor Geoffrey M. Brown for a four-week visit in summer 1992.
- Hewlett-Packard Corporation donated equipment valued at \$2,368 to associate professor James R. Shealy for use in course EE 315, Electrical Laboratory I.

For the period January 1991 to March 1993, the EE School received total corporate gifts of capital equipment valued at \$3,600,000. For the same period, the school received total corporate and individual cash gifts amounting to \$1,196,000. These important grants aid the recipients in their teaching and research and help the EE School to establish and maintain a leading edge in the discipline.

# CHUCK WHARTON RETIRES

In the past year, one member of the EE School faculty has retired. Chuck Wharton was the guest of honor at a special retirement party in the Phillips Hall Lounge on May 7, 1992. His biography follows.



**C**harles B. Wharton, a member of the EE School faculty for twenty-five years, became professor emeritus on July 1, 1992.

Chuck received the B.S. and M.S. degrees from the University of California at Berkeley in 1950 and 1952, respectively, both in electrical engineering. From 1950 to 1962 he was a staff member at the University of California Lawrence Radiation Laboratory at Livermore and Berkeley, California. While in this position, he spent a year (1959–60) as engineer-scientist at the Max-Planck Institute for Physics in Munich, Germany, and also as a lecturer at the International Summer Course in Plasma Physics at Riso, Denmark. For the next five years he was a staff member of the Experimental Physics Group at General Atomics in San Diego, California. In September 1967, he joined the EE School faculty as a full professor.

Chuck's career at Cornell has been devoted to teaching, research, and service to the school and to the College of Engineering. In addition to directing the research of many graduate students, he has taught undergraduate courses in electromagnetic theory, plasma physics, and electrical sciences laboratory. His research has been principally in the area of plasma-physics diagnostics, in which he is a recognized world authority, and in plasma interaction and heating with waves and beams with applications to controlled thermonuclear fusion. He has served on many committees in the school and the college, and has been active in the Faculty Council of Representatives, and in IEEE affairs at both national and local levels. He is a past graduate field representative in the EE School, has served as a member and as chairman of the Steering Committee of the Laboratory of Plasma Studies, and as acting director of that organization. Along with all of these duties, Chuck was an active class advisor throughout his career in the school.

Chuck's reputation in the field of plasma physics has caused him to be in demand as a lecturer and director of studies in many distinguished laboratories and institutions around the world. In 1973 he traveled to Germany to receive the Humboldt Prize awarded by the Alexander von Humboldt Foundation "for achievements in scientific research and teaching," and spent the 1973–74 academic year at the Max-Planck Institute in Garching, Germany. He was elected a fellow of the American Physical Society in the same year. In 1976 he was elected a fellow of the IEEE "in recognition of contributions to the understanding of plasmas and to the development of plasma diagnostic techniques." In 1979 he was given the award, Socio Onorario, by the International School of Plasma Physics, Milan, Italy, "in considerazione di particolari meriti." From 1975 to 1991 he served as director of courses of the International School of Plasma Physics in Varenna, Italy, for six separate one-month sessions. He has been a visiting professor at the Ecole Polytechnique in Lausanne, Switzerland, at the Physical Research Laboratory in Ahmedabad, India, and at the Sandia National Laboratories in Albuquerque, New Mexico. In 1990 he was invited to the Academy of Sciences of the USSR to participate in discussions on perestroika and foreign collaboration. He stayed on in Novosibirsk to lecture at the Institute of Nuclear Physics. Over the years he has been a consultant to eighteen corporations and institutions. His text (with M. A. Heald) *Plasma Diagnostics with Microwaves*, John Wiley & Sons, New York, N.Y., 1965 (2nd. ed. 1978), is the standard authority on the subject.

Chuck's various scientific activities have taken him to many exotic places, but he says that the oddest mission occurred some 1,200 feet underground in a coal mine in Grundy, Virginia, near Roanoke. While on a special leave of

absence in 1979–81 with Occidental Research Corporation in Irvine, California, he was given a most unusual task for a plasma physicist: to design, develop, and test a side-looking radar system that could track the position of a small drill that was used to bore one-kilometer-long holes in underground coal seams. The purpose of the bore was to detect the presence of methane gas and allow it to escape before the mining process was started. Since a coal seam follows the natural terrain of the earth, the radar system was required to continuously detect the floor and ceiling of the seam so that the drill could be kept within those bounds. When the device was perfected, Chuck, accompanied by his son, Mark, took it to Grundy for the test procedure. A recent unfortunate explosion at a nearby mine had caused a miner's strike at Grundy with demands for greater safety precautions. Chuck and Mark were given the red hardhats that designated "safety personnel" so they were allowed to cross the picket line. Accompanied by two miners and a driller, they took the elevator down some 1,200 feet below ground to the entrance of the mine shaft, and made the rest of the journey on their backs as they rode the electric "jeep" through the shallow channel to the test site. The frigid January temperature, the fifteen-mile-per-hour speed of the jeep, and frequent pauses for fresh air, all combined to make for a memorable data-gathering experience. Chuck says the experiment and the radar device were successful, but that adventure, plus another sojourn in an underground bunker during a nuclear bomb test, make him believe that he should be awarded an honorary title of "U.S. Mole."

Chuck's plans for retirement include a continuation of research with some former colleagues, consulting with the National Research Council, and a scheduled return to the Max-Planck Institute for Plasma Physics in Garching/Munich, Germany, in 1995. He is an avid sailor, skier, and mountaineer, and he plans to continue these activities while spending summers in Ithaca, and winters in Santa Fe, New Mexico.

In this issue we are restoring the "Positive Feedback" feature of previous years. The first issue of *Connections* triggered a gratifying number of responses. We hope that this issue will stimulate even more returns of the coupon at the end of this newsletter. The asterisks (\*) attached to some of the names in the following listing refer to respondents who contributed interesting stories that are contained in "More Tales From the Past." NOTE: Our alumni file is somewhat incomplete. If you know of fellow EE alumni who are not receiving *Connections*, please urge them to send their names and addresses to Jeanne Subialka, Engineering Public Affairs, 248 Carpenter Hall.

**Emmett W. MacCorkle\*** '29 (retired) lives in Portola Valley, California.

**Otto J. Glasser\*** '40 (Lt. General, U.S. Air Force, Retired) lives in Sarasota, Florida.

**Burt E. Nichols** '45, B.S.E.E. '44 (retired), lives in Fairhope, Alabama.

**Moti Lal Jain**, GR, M.E.E. '46, D.Sc. '49 (Harvard), is retired and lives in New Delhi, India. From 1958 to 1967 he was Professor and Head of the electrical engineering department of Thapar Institute of Engineering and Technology, Patiala (Punjab). From 1967 to 1971 he was a UNESCO consultant. From 1971 to 1982 he was director/principal of Thapar Institute. He retired in 1982 and is now a consultant to industry and institutions of technical education in India.

**Douglas W. Anderson** '50 (Sales Department of Carl Citron, Inc., Rochester, New York) writes that he visited professor Joe Rosson in his new home in Memphis, Tennessee recently.

**Allison C. Collard** '57, B.E.E. '58, graduate of Applied Science Program at Adelphi and the Fordham Law School (patent attorney with Collard & Roe, P.C., Roslyn, New York). He has been concerned with electrical patents for nearly thirty years, and is a member of the New York Patent, Trademark, and Copyright Law Association, the American Bar Association, and the International Law Association. He is a licensed engineer in New York State.

**Samuel O. Ulbing** '63, B.E.E. '64, M.B.A. '68 (retired), lives in Sarasota, Florida.

**William E. MacMillan** '64, B.E.E. '65, M.E.E. '66 (staff engineer, Consumers Power Company, Jackson, Michigan).

**Kenneth S. Schneider** '65, M.E.E. '66, Ph.D. '70 (V.P. sales, Telebyte Technology, Inc., Greenlawn, New York).

**David Haberman** '66, M.S. '69, Ph.D. (senior computer scientist for the Systems Engineering Division of Ball Corporation in San Diego, California) is working on avionic systems, simulation of aircraft and related systems, and data analysis and reduction.

**Paul Sanik** '69, M.E.E. '70, Ph.D. '78 (senior engineer with Owens-Corning Fiberglas Corporation in Granville, Ohio).

**Stephen A. Coulombe\*** '74, M.Eng. (Electrical) '75 (Lt. Col., U.S. Air Force, Albuquerque, New Mexico), writes that instead of kilowatts and cars, he now works with megawatts (lasers) and airplanes.

**Vilnis G. Kreismanis**, GR, M.S. '77, Ph.D. '84 (senior scientist at Raytheon Company Research Division in Lexington, Massachusetts), is working on epitaxial growth of HgCdTe for infrared detector applications.

**John C. Beck** '78, M.Eng. (Electrical) '79 (engineering manager, Digital Equipment Corporation in Hudson, Massachusetts), is working on integrated circuit design and graphics/multimedia design.

**William K. Conrad**, GR, M.Eng. (Electrical) '81 (self-employed engineering consultant in Paris, France), is working on English language documentation for high-tech French export products.

**Jeffrey D. Chinn**, GR, M.S. '82, Ph.D. '84 (engineering manager for Integrated Device Technology, San Jose, California), works on semiconductor process engineering.

**Thomas F. Lowum** '83 (supervisor, Manufacturing Systems Engineering for Corning Inc., Wilmington, North Carolina) supervises a group of engineers in the writing of process-control software.

**David M. Mertz** '83 (project design engineer, Ford Motor Company, Northville, Michigan) is responsible for car-audio system development on several models jointly engineered with Mazda.

**Ronald T. Logan, Jr.** '86, B.S. Engr. '87, M.Eng. (Electrical) '88 (member of technical staff, Jet Propulsion Lab/Cal. Tech., Pasadena, California), works on microwave/mm-wave photonics and is studying for the Ph.D. at U.S.C.

**Kevin R. Wrenner** '86, M.Eng. (Electrical) '88 (staff engineer, IBM T.J. Watson Research Center, Yorktown Heights, New York), works on communications circuit design switches (multi-processors).

**Tom Y. Tseng** '87 (assistant director of admissions, College of Engineering, Cornell University, Ithaca, New York.)

**Amy L. Pfannenstiel** '89 (development engineer, General Electric Laboratory, Syracuse, New York) works on microwave modules, antennas, and electromagnetic simulation.

**Keith D. Pitman** '89 (design engineer, New York Telephone Company, Liverpool, New York). He is studying, part time, for the Ph.D. at Syracuse University.

## ALUMNI BREAKFAST

Mark Saturday, June 12, 1993, on your calendar for the annual EE School alumni breakfast. The time is 7:45 to 9:30 a.m., and the place is the Phillips Hall Lounge. We hope you and your spouse will join other alumni and members of the faculty and staff for an event that is always a festive and memorable occasion.

# PROFESSIONAL MASTERS PROGRAM EMPHASIZES DESIGN

**A**lumni who occasionally compare their undergraduate-degree nomenclature will note that several different Cornell electrical engineering degrees have been bestowed over the years, dependent upon the period when they were awarded. The original degree, E.E., was in force through World War II. In 1945, the College of Engineering adopted the five-year undergraduate curriculum with the objective of conferring a "professional" degree, designated in the EE School as the B.E.E. The new program included advanced courses beyond those taken in a standard four-year curriculum, and also required a "Senior Project" with an associated formal report. By 1964, the college's five-year curriculum was abandoned in favor of four-year collegewide programs that award an engineering-science degree, without field designation, known simply as the Bachelor of Science (B.S.). The professional component of the former five-year curriculum in the EE School is offered in the form of a one-year Master of Engineering Program that grants the M.Eng.(Electrical) degree.

For the first twenty years or so after its inception, the electrical engineering professional

degree was optional, and, indeed, during the early years, the principal enrollment consisted of EE School students who considered the program to be equivalent to the five-year curriculum with the added advantage of offering a master's degree after

and design projects but the central focus of an advanced EE degree is retained through an emphasis on development of skills in engineering design and analysis.

Students in the program must achieve state-of-the-art profi-

The transition to the M.Eng. program brought a new financial-aid problem that is still present. In the late '70s and early '80s, the EE School was fortunate to have generous corporate support for the M.Eng. program. Many alumni who will read this account were recipients of that financial support. Of late, however, corporate funding has been greatly downsized. Provision for financial aid for the M.Eng. Program is a top priority for the college as it participates in the current capital campaign of the university.

five years of study. In more recent times the degree became popular with applicants from many engineering schools around the country. Several years ago the EE School faculty reviewed the M.Eng.(Electrical) curriculum and concluded that it should be considered as a true graduate program rather than as a fifth year of undergraduate study, and should be required for students interested in engineering-design careers. The program allows considerable flexibility in the choice of courses

ciency in at least one or two areas of electrical engineering specialization of their choice. Over sixty courses are available to them in the EE School in various fields such as computer engineering, communications systems, signal processing, quantum electronics, and neural networks. They may also enroll in elective courses selected from many offerings in other engineering disciplines, the sciences, information systems, and management studies such as productivity optimization, manufacturing effectiveness, and

decision-making processes for engineering systems.

**John C. Belina**, assistant director of the EE School and director of the M.Eng.(Electrical) program, in a recent article in the *Cornell Engineering Quarterly*, writes, "The centerpiece of the M.Eng. program is the design project, and the wide-ranging interests of both faculty and students combine to produce a variety of exciting and meaningful efforts. In a recent study, students indicated that the design requirement is one of the most rewarding and significant features of the M.Eng. program." Over the years, the traditional design project has been performed by one student (sometimes two) under the direction of a single professor or a staff member. Project topics are suggested by faculty members or, on occasion, by students who have a particular idea in mind. The decision to engage in a specific project is then made by each student after consultation with an appropriate professor. Current information sent to prospective M.Eng. candidates includes a partial listing of projects that

have been completed within the past two years, together with the names of the supervising professors. A few representative samples selected from the 100 or more projects in that list indicate the diversity of design-project interest: "Computerized On-Line Signature-Verification Model," with professor **Toby Berger**; "Solar-Cell-Based Power-Supply System," under professor **Michael C. Kelley**; "Hardware PASCAL: A High-Level Language Interface to BEDROC," with assistant professor **Miriam Leeser**; "Classification of Whale and Ice Sounds," under professor **Thomas W. Parks**; "A Transputer [interconnected computer processor] for Power-System Simulation," under professor **Christopher Pottle**; "Optoelectronic Communication Circuit," with professor **Charles B. Wharton**; "Tunable F-Center Lasers for Analytical Spectroscopy," under professor

CORN  
E-C  
TO ROLL

How many alumni remember reading *Tom Swift* and

way ahead of his time but the exact details of his ex-

problems associated with getting an actual electric car on the

last report on the E-car in the previous issue of *Connections*, sub-

**Joe Rosson's** original project. Professor **Robert Thomas** and

a team of EE undergraduates and M.Eng.(Electrical) candidates, he

expected to be "on the road" by the

The central feature of the current design is the use of a three-ph-

earlier models. While it is well known that control of a dc motor

introduces a major deterrent to successful road performance. The high ac-induction motor make it an excellent candidate for direct mounting. Modern electronic-control techniques has solved the formerly intractable problem of power is still the battery, as in the dc-powered models, but the resultant ac source can be readily adjusted from a few cycles per second to a maximum speed of about 10,000 rpm, the s

**George J. Wolga**; and "An AM Four-Channel Modulator for Recording Sub-Audio Elephant Calls," with **Bernard A. Hutchins**.

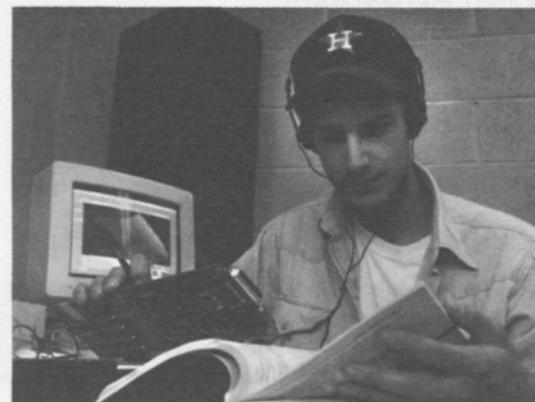
Several group projects have been attempted in recent years. The Cornell Electric Vehicle Design Project (a descendent of professor emeritus **Joe Rosson**'s program of earlier years; see inset below) is under the direction of professor **Robert J. Thomas** and **John C. Belina**. Twenty M.Eng.(Electrical) students are currently involved in that activity. Another popular group project, directed by associate professor **Chris Heegard**, is known as the Digital Audio Research Environment (DARE). In this work, students obtain design experience in the development of digital-audio systems. The project is described in more detail on page 12.

Still another group is engaged on an advanced signal-processing project conducted by **Bernard A. Hutchins**. Both individual and group projects will

be accommodated in the M.Eng.(Electrical) design-project laboratory proposed as part of the modification of the second floor of Phillips Hall. Plans for this laboratory are in abeyance, at present, pending acquisition of the necessary funding to complete renovation of the space. Extensive computing facilities for project design and evaluation will be incorporated in the proposed laboratory when it is established.

Financial assistance for graduate study has always been a major concern in the college and in the EE School. Support for the M.Eng. program has been particularly difficult to achieve. During the days of the five-year curriculum, standard tuition fees and scholarships accounted for student costs during the fifth year. The transition to the M.Eng. program brought a new financial-aid problem that is still present although considerable progress has been made in recent years. In the late '70s and early '80s, the EE School was fortunate to have

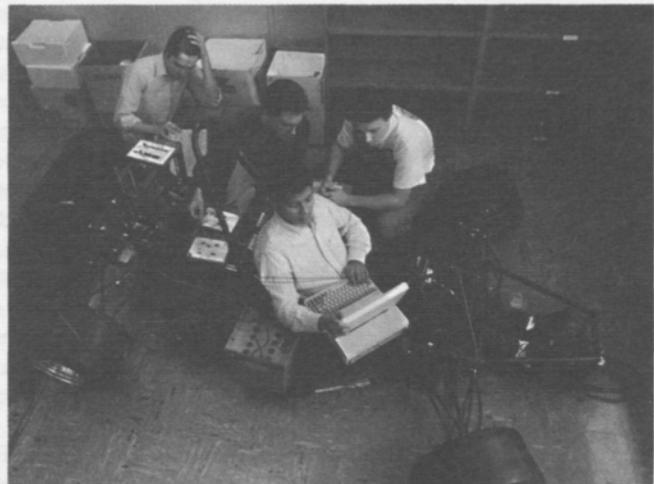
generous support for the M.Eng. program from Bell Laboratories.



M.Eng.(Electrical) students at work on design projects. Top: A digital-audio-signal processing card for installation in a Macintosh II computer. Bottom: Computerized "go-cart" for the E-Car program.

Many alumni who will read this account were recipients of that financial support. When the Bell Telephone groups were reorganized, the Bell Labs "One-Year-on Campus" (OYOC) program at Cornell, and the corre-

sponding financial support, were reduced dramatically. Subsequent attempts have been made to obtain firm corporate support, with particular attention given to the M.Eng. Intern Program. For several years a number of M.Eng.(Electrical) candidates were associated with the Schlumberger Corporation as interns, but that program has also been downsized. Provision for financial aid for the M.Eng. Program is a top priority for the college as it participates in the current capital campaign of the university. Until the results of that campaign are at hand, the main options for financing the M.Eng. degree are student loans, teaching assistantships, and corporate



support. The number of teaching assistantships is limited and competition for the available positions is stiff. In order to minimize the hardships posed by large student loans, applicants for the degree are being urged to conduct their own search for corporate funding either for internships or scholarships. Financial aid from the College of Engineering usually provides only partial support for M.Eng. students. Consequently, it is necessary for applicants to obtain funding from several sources.

In recent years, several M.Eng.(Electrical) students have chosen the Manufacturing Option as an adjunct to their regular EE studies. This program is offered by the College of Engineering in

cooperation with the Johnson Graduate School of Management and the Cornell Society of Engineers. It is sponsored by the Cornell Manufacturing Engineering and Productivity Program (COMEPP), a cross-disciplinary, industrially sponsored activity. The objective of the program is to meet a strong industrial demand for engineers in various specialty fields who can function in the area of integrated design and manufacturing.

Students who have a strong interest in this relatively new discipline may also apply for fellowships offered by the program. At present, four M.Eng.(Electrical) candidates are recipients of these awards.

## NELL CAR L AGAIN

and his Electric Runabout back in the '20s? Tom was is exploits were always conveniently vague; the real the road cannot be solved with the stroke of a pen. Since our substantial progress has been made on the updated version of and lecturer John C. Belina, in their direction of the activities of us, have brought the project to the point where a moving vehicle is by the end of the spring 1993 term.

phase ac-induction motor drive instead of the dc motor drive of the istor is relatively easy, the necessity for commutators and brushes e high efficiency and relatively simple and rugged construction of an nting on each wheel of an automobile. Fortunately, the availability of ctacle problem of convenient control of motor speed. The basic source tronic inverters are used to convert dc to ac, and the frequency of the er second (Hz) for starting, up to 180 Hz for high speeds. At present, ur-pole machine rated at 240 volts that can provide 10 horsepower the speed that is attained when 180 Hz is applied.

# DIGITAL AUDIO WORKSTATION DEVELOPMENT

In the early days of electronics, electrical engineering laboratory instruction relied heavily on audio engineering until that discipline gradually gave way to the



CHRIS HEEGARD

multiple developments of modern electrical technology. But the old standby has returned in a novel undergraduate and professional masters program in the EE School that uses digital audio for teaching practical aspects of signal and system principles. The goal of the program, known as the Digital Audio Research Environment (DARE), is the development of digital audio workstations that serve as testbeds for signal-processing algorithms. The current DARE system allows users to connect digital audio devices directly to Macintosh computers via a dedicated signal-

processing card that can perform real-time signal processing on audio signals for playback or analysis.

The initial concept for the system was based on a design that took serial digital audio from a compact disc player and fed it to a Macintosh II computer. From 1986 to 1992, under the direction of associate professor Chris Heegard and research and teaching assistant Talal Shamoon, eight M.Eng.(Electrical) and six EE School undergraduate students have designed and developed hardware and software that culminated in seven operational boards for the DARE 1.0 system. Subsequent development by five students has resulted in ten new boards of the current DARE 1.1 system.

Six DARE 1.1 boards are in use in the spring 1993 course EE 320, The Audio Engineering Laboratory. In this course, students explore the application of signal theory in the laboratory by building signal-processing hardware and software that highlight such concepts as amplification, filtering, sampling and quantization. The DARE system plays a pivotal role in the course. Development of a software interface to

MATLAB (a high-level, interpreted language designed for the manipulation of mathematical constructs such as vectors and matrices) allows students to run signal-processing algorithms on a stream of audio samples. Analog and digital-signal-processing concepts are tested and applied to audio signals in the laboratory. For example, students may design a filter system and then be able to hear the results of their work. Such capabilities have turned out to be a powerful pedagogical tool and have caused EE 320 to become a very popular course.

An interesting non-EE application for the DARE system is in its use by the Cornell Bioacoustics Program for advanced natural-sound analysis. That research program is developing spectrum-analysis software for service in the Alaskan North Slope Borough bowhead-whale census. DARE boards lie at the heart of the signal-processing system that will be used by the Cornell/Government of Alaska program to perform an acoustical census of the largest known population of bowhead whales on the

planet. Last year two DARE 1.0 boards accompanied the census team and received an icy baptism above the Arctic Circle, and this year two DARE 1.1 boards will listen to the mysterious drones and whistles of the arctic acoustical landscape.

—Talal Shamoon, Ph.D.  
candidate, electrical  
engineering

## Don Christiansen Retires as Editor of *Spectrum*

Donald D. Christiansen, B.E.E. '50, editor and publisher of *IEEE Spectrum* since 1971, retired in February 1993 after a long and distinguished career as editor and publisher in the technology press. In 1981, he was elected a fellow of the IEEE "for contributions to professional communication in electrical and electronics technology." In 1991, Don was named one of eleven "Living Legends of American Magazines" by *Folio* magazine. Over the years he has received seven other IEEE awards, including the Centennial Medal in 1984 and the Gruenwald Award in 1990. He is the recipient of a Citation and Medal for the Advancement of Culture, Flanders Academy of Arts, Science, and Literature. Don is an eminent member of Eta Kappa Nu, a fellow of the World Academy of Arts and Sciences, a fellow of the Radio Club of America, and a member of the Royal Institute, the Franklin Institute, and the Society of the History of Technology. His research interests include the history of technology, the innovative process, and the management of engineering and science.



We congratulate him on his outstanding achievements and wish him many happy and productive retirement years.

# Computing Facility Upgraded



The EE School Educational Computer Facility, described in the Spring 1992 issue of *Connections*, was used extensively in the 1991-92 academic year and continues to be open sixteen hours each day. In one of the four rooms in the facility, the HP400 workstations were used by 400 students enrolled in twelve electrical engineering courses as well as by students and faculty who were working on individual design and study projects. The HP400 facility, with its extensive software base, encouraged EE School faculty members to add computer laboratory sections to their courses, and several integrated-circuit-type courses expanded their use of the wide range of design, simulation, and testing software that can function on the workstations. Even the most basic undergraduate courses taught in the EE School began to include laboratory and homework assignments that required use of the facility workstations. After two years of this increased educational activity, it became necessary to attempt an upgrade of the facility capabilities.

Through the efforts of emeritus professor **Norman Vrana**, the EE School received six new HP700-series, precision-architecture, reduced-instruction-set computers (HP720 PA RISC) from the Hewlett-Packard Corporation. These units are now on-line with five more HP700-series units obtained from the College of Engineering Computer-Aided-Design Instructional Facility (CADIF). In response to a second proposal by Norman, Hewlett-Packard has made a further generous grant of new equipment, valued at over \$200,000, consisting of ten HP715 machines and one HP755 server fitted with two 2-gigabyte (GB) hard discs and 128 megabytes (MB) of random-access memory (RAM). When all twenty-two machines are in service in fall 1993, the computer facility will be able to meet the educational requirements of the next academic year.

The new equipment is based on leading-edge technology. The HP700-series PA-RISC machines use the HP-UX operating system, which is equipped with the updated version of the previously acquired Mentor Graphics software. The HP700 machines also operate much faster than the HP400 units and can be upgraded as new hardware becomes available. Acquisition of additional HP700 units is planned for future years to meet expanded educational needs. As the new machines become available for regular course instruction, the HP400 machines, which have been converted to use the HP-UX operating system instead of the Domain operating system, will be used by faculty and graduate students in other courses and in research projects.

Two VLSI design courses in the School offer typical examples of the potential of the HP700 machines. Assistant professor **Miriam Leeser** uses the new units in her course EE 596, Design Tools for VLSI, taught for the first time in spring 1993. Miriam says her objective in the course is to use "industrial-strength" tools to expose her students to actual design facilities that are available in industry. She employs a schematic-capture tool, Design Architect, and a simulation system, QUICKSIM, that is written for a hardware-description language called VHDL. Use of this Mentor Graphics software on the HP700 machines provides tools for the course that are truly state-of-the-art. At present, students in course EE 539, VLSI Digital System Design, use the computer-aided-design tool, MAGIC, in their chip-design projects. Miriam plans to use a Mentor Graphics software equivalent, GDT, and the HP700 machines to update the design tool.

The computer-based facilities of several of the digital-systems courses with laboratory content have been improved. A proposal to Intel Corporation from assistant professor **Geoffrey Brown** and emeritus professor **Norman Vrana** resulted in a grant of fourteen Intel PCs that are being used in courses EE 475, Computer Structures, EE 576, Digital System Design, and EE 230, Introduction to Digital Systems. In addition, Geoffrey wrote proposal requests that brought donations of hardware and software for use with the Intel PCs in the teaching-laboratory assignments of these courses. Intel donated programming hardware consisting of 600 programmed logic devices (PLDs) for student assignments, and eighty special breadboards designed by Geoffrey for use in EE 230. Altera Corporation donated PLDs and the MAX+PLUS II Programmable Logic Development System software. Hewlett-Packard donated five HP1663A 32-Channel Logic Analyzers that allow students to use state-of-the-art test equipment to help debug their digital designs on the prototype cards connected to the PCs in the laboratory.

In the sophomore college-distribution course EE 230, Introduction to Digital Systems, class exercises since 1984 have been limited to simulation of logic designs, with results available only as diagrams on the monitors. The simulations have been conducted with the aid of the LogicWorks software on the Macintosh computer facility. In spring 1993, professor **H.C. Torng** and assistant professor **Geoffrey Brown** added a hardware component to the course. Students conduct their computer-aided design in the computing facility, as before, but also build and test physical models of their designs in the laboratory. These modifications have been made possible by the grant of personal computers and prototype circuit boards from Intel Corporation. Since many new students come to the College of Engineering with considerable computer background, enrollment in EE 230 is now open to qualified freshmen who thereby receive an early exposure to some electrical engineering theory and laboratory practice.

—*Norman Vrana, professor emeritus,  
electrical engineering*

# • ELECTRONIC PACKAGING??



J. PETER KRUSIUS

Visitors to Phillips Hall in recent years may have noticed an office on the second floor that is devoted to the work of the interdisciplinary Program on Micro-science and Technology under the sponsorship of the Semiconductor Research Corporation (SRC). Indeed, the current director of the EE School, professor **Noel MacDonald**, came to Cornell in 1984 as the first director of that program. Professor **Joseph M. Ballantyne** is the present director. A cooperative organization of leading U.S. semiconductor, computer, and telecommunications industries such as IBM, Intel, and National Semiconductor, SRC established the Cornell program as one of the first "centers of excellence" for research essential to the development of VLSI (very-large-scale integrated) circuits. In 1985, Cornell received SRC sponsorship of one of the first two comprehensive interdisciplinary research programs on "electronic packaging" to be conducted in parallel with the Micro-science and Technology Program. In 1990, in order to expand its research in this new field, Cornell entered into a special partnership with a number of companies, including the Carborundum Company, Digital Equipment Corporation, and other

SRC members, to form the Industry-Cornell University Alliance for Electronic Packaging. Professor **Che-Yu Li**, of the Department of Materials Science and Engineering, directs the SRC program and the alliance, and the associate director is professor **J. Peter Krusius**, of the School of Electrical Engineering. At present, grants for research in electronic packaging at Cornell total \$1.5 million.

What is this thing called "electronic packaging"? At first, one thinks of procedures for placing computers or other electronic gear into suitable cardboard boxes, or perhaps of electronic control of filling cereal cartons with measured quantities of corn flakes. Clearly, a technology that has inspired such academic and industrial attention must be concerned with matters more profound than these two necessary but rather prosaic examples. Peter Krusius thinks that "electronic-system integration" would be a much better name, but concedes that the term "electronic packaging" is probably here to stay.

The response to our query is found in statements paraphrased from a brochure that describes the Industry-Cornell Alliance. Electronic packaging provides a necessary and significant part of

the structure of electronic and computer products. In its most basic form, say for a typical computer workstation, it provides electrical interconnections for the chips within the computer and with the outside world, distributes electrical power to the chips, removes excess heat generated by the semiconductor chip, and protects the chip mechanically and environmentally. For more complicated or advanced systems, such as those requiring multiple processors, electronic packaging must provide the same amenities except that a higher level of performance, known as high-density electronic packaging, is necessary. In this mode, high-density interconnections, new architectural ideas, advanced structures, imaginative use of materials, and advanced cooling techniques must be applied. By the year 2000, microprocessor-based engineering workstation computers are predicted to reach a performance level of about 20 billion instructions per second (20 GIPS). In the same period, integrated high-speed digital networks will be employed for telecommunication and data-communication applications, including voice data, and full-motion video. Data rates in excess of one gigabit per second are expected

to be introduced in the second half of this decade. This integration of high-density and high-speed computer technology and broadband network technology will require the introduction of optoelectronic signal distribution within the structure of the computer. Completely new packaging concepts and technologies must be developed for these systems. The necessary research will be conducted in such areas as architecture, design, and performance simulation; materials, interfaces, and layered structures; optoelectronic interfaces and waveguides; and cooling and thermal management.

Electronic packaging is thus a critical component that governs the advances in computer and communications technologies. It represents roughly 60 percent of the cost of large computers, and generally is performance-limiting. Current trends suggest a faster growth of electronic packaging than of the electronic and computer industry as a whole.

As part of the alliance, an advanced electronic packaging facility for teaching and research is being established in Kimball Hall for fabricating and characterizing electronic chips, and electronic packages, materials, and assemblies involving electrical, optical, and

thermal applications. A clean room, vibration isolation, and other requirements necessary for high-density interconnect-fabrication technology will be built into the facility. It will house a variety of equipment, including an array of optical lithography tools, thin-film facilities, hole-making tools, plating and other wet-process benches, ceramic substrate facilities, micropositioning and alignment devices, micromechanical testing systems, and a range of tools for analysis, testing, and measurement. The facility is expected to be ready for operation in the summer of 1993.

Worldwide total annual business volume is projected to reach two trillion dollars by the end of the decade. Since the information and data-processing industry forms a substantial part of this total, electronic packaging, now the major component of that industry, is expected to reach the \$100 billion level within the same period. Despite this impressive technical and economic status, university education and research in electronic packaging is minimal, and an inadequate number of graduates, at all levels, enter the field. Under these circumstances, and in recognition of the importance of the Industry-Cornell Alliance in advancing

education in this critical discipline, representatives from eighteen universities and major corporations involved in electronic packaging attended the First Joint Conference on Electronic Packaging Education that was held on campus on October 5–6, 1992.

Since 1984, the Department of Materials Science and Engineering has offered a course in electronic packaging. The material for this course has been incorporated in a textbook, *Principles of Electronic Packaging*, by Donald P. Seraphim, Ronald Laskey, and Che-Yu Li, published by McGraw-Hill in 1987. In the EE School, professor Peter Krusius organized the course EE 537, Physical Design of High-Speed Computers, in 1989. The course is offered in the fall term and consists of weekly two-hour lecture-discussion periods. Peter coordinates the course and conducts several meetings. Other classes are conducted by professor H.C. Tornq, by IBM speakers from Endicott, Poughkeepsie, Kingston, Austin, Yorktown, and Boca Raton, and by a speaker from the Digital Equipment Corporation. Topics include computer packaging overview, functional architectures, optoelectronic signal distribution, electrical signal and power distribution, thermal management, and measurement and simulation. The majority of the students are in the professional Master of Engineering Program. The materials for this course are being expanded into a textbook.

## NEW JSEP Focus: SPEED LIMITS OF OPTOELECTRONICS

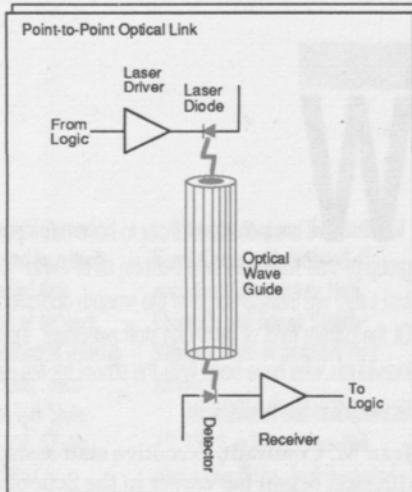
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The Joint Services Electronics Program (JSEP), the oldest currently running federally funded basic-research program, is supported by the U.S. Army, Navy, and Air Force. In order to provide the Department of Defense with a core-research capability in electronics and related sciences, eleven major research universities in the country participate in JSEP. The EE School at Cornell has been part of JSEP since 1977. During the early years, principal attention was given to band-gap-engineered materials and high-speed microwave devices, but during the past few years emphasis has shifted to optoelectronics. In May 1993, under the leadership of professor J. Peter Krusius, several EE faculty members started a new three-year research program on the fundamentals of speed limits of optoelectronic devices.

Optoelectronic devices have been used recently in optical communication to dramatically increase the bandwidth of long-distance telecommunication networks. Now the question is whether optoelectronics can replace electrical signal distribution for shorter distances in local-area networks, links, busses, and interconnects. In such applications, where waveguide bandwidth is not a bottleneck, adoption of optical techniques will depend on the ability to convert electrical signals into optical ones, the ability to amplify and switch optical signals, and, in a situation that is analogous to the effect on electronic circuits when integrated circuits were introduced, the ability to fabricate integrated optoelectronic devices into compact mass-manufacturable assemblies.

The new Cornell JSEP program involves six research groups working on speed-related issues from materials to devices. Associate professor Richard Shealy's group works on band-gap-engineered optoelectronics materials grown with organometallic vapor-phase epitaxy at the new Compound Semiconductor Materials Growth Laboratory

SCHEMATIC DIAGRAM OF HIGH-SPEED OPTOELECTRONIC LINK BETWEEN TWO ELECTRONIC MODULES. THE OPTICAL PORTION OF THE SIGNAL PATH IS SHOWN IN RED.



located at the Cornell Research Park near the Tompkins County Airport. Professor Chung L. Tang and associate professor Cliff Pollock, with their graduate students, explore new optical techniques to characterize optoelectronic processes in band-gap-engineered materials and devices. The research of professor J. Peter Krusius, and that of assistant professors Yu-Hwa Lo and Richard Compton, focuses on optoelectronic devices. Lo's and Compton's groups are building novel high-speed laser sources and detectors, respectively, while Krusius's group is developing a new generation of simulation methods and design tools for high-speed optoelectronic devices.

—J. Peter Krusius  
Professor, electrical engineering

## DARPA Optoelectronics Program Update

In 1990, the Defense Advanced Research Projects Agency (DARPA) established three national centers to advance optoelectronics technology. One of these awards helped establish the Optoelectronics Technology Center (OTC), a consortium of three major universities—Cornell, the University of California at Santa Barbara, and the University of California at San Diego. At present, OTC is under consideration for a three-year renewal.

OTC is charged with the design and development of optical interconnects for the next generation of computers and communications systems. The renewed program would provide support for work on optoelectronic materials, devices, integrated circuits, and electronic packaging, with efforts to be coordinated by the School of Electrical Engineering, the Department of Materials Science and Engineering, and the School of Applied and Engineering Physics.

The Cornell center is directed by associate professor James R. Shealy. Other EE School faculty members who are contributing to the work of the center include professor Joseph M. Ballantyne, assistant professor Richard C. Compton, professor Harold G. Craighead, professor Lester F. Eastman, professor J. Peter Krusius, professor Noel C. MacDonald, associate professor Clifford R. Pollock, professor Chung L. Tang, and professor emeritus Edward D. Wolf.

## • LONG-TERM STAFF MEMBERS RECOGNIZED

**W**

e are indeed fortunate to have a competent and dedicated group of staff members who perform all of those "behind-the-scenes" tasks that are indispensable to the smooth operation of the EE School. Of the current total of thirty-one staff personnel, there are twelve individuals who have been with the school for ten years or more and deserve special recognition:

**Jean M. Coonradt**, executive staff assistant to the director, began her career in the School in September, 1966 as administrative aide to professors Dalman, Eastman, and Mackenzie. In July 1971 she assumed her present position when professor Carlin was the director of the EE School. Jean has taken up oil painting as a hobby, but likes to spend much of her spare time with her five grandchildren, a pastime that requires occasional trips to Florida and Massachusetts. She also enjoys visits to various interesting regions in the U.S., but, at present, has no interest in travel abroad. **William Dougherty**, technician, came to the EE School in March 1962 as a mechanician with the Cornell High-Voltage Cable Project at the Mitchell Street High-Voltage Laboratory under professor **Joe Rosson**. When the project was completed in 1963, he transferred to Phillips Hall and continued as a mechanician in the school until 1980 when he became the building manager for Phillips Hall and the Knight Laboratory. Bill is a snowmobile enthusiast who often participates in long-distance runs. This winter, for example, he completed a 1200-mile trek in Quebec. He satisfies his liking for travel by taking occasional cruises during vacation times. **Bruce Fingerhood** obtained an Associate of Arts degree from Pasadena City College in 1975. He came to the EE School in December 1981 as a research equipment technician. He is responsible for the activities of the electronics tech shop that include maintenance and repair of computer terminals, instruments, and equipment in the school, and procurement of materials and accessories for laboratories and M.Eng. and faculty research projects. As a hobby, Bruce engages in an activity known as "rail fanning," the observation and study of railroads of the past and present. He also engages in amateur photography where again his principal subjects are trains. **Mukles Haddad** obtained a Science Teaching Associate degree from Teachers College of Amman, Jordan, in 1974. After teaching science in Jordan for two years he moved to Spain and studied architectural design at the Valencia Applied Arts Institute. He came to the EE School in July 1982 as an Electronics Technician with joint responsibilities in the activities of the electronics tech shop. In his spare time Mukles engages in carpentry and cabinet making, and enjoys oil painting of landscapes. **Bernard A. Hutchins**, B.E.P. '67, has been a lecturer in the EE School since

January 1979, following five years in the school as a teaching associate. Over the years he has been the principal instructor in courses concerned with signal-processing design, and has been a project advisor to many M.Eng. and EE senior students. Bernie likes to apply his signal-processing skills in the analysis of audio recordings of sounds uttered by animals, with particular attention in recent years to low-frequency vocalizations by elephants. **Raymond C. Ink**, supervisor of technical services, came to the EE School in January 1961 as a mechanician with the Cornell Cable Project at the Mitchell Street High-Voltage laboratory under professor **Joe Rosson**. When the project was completed in 1963, he transferred to Phillips Hall and continued as a mechanician in the school until 1980 when he became the building manager for Phillips Hall and the Knight Laboratory. Ray is active in Masonry and serves as Master of the Lodge and as Assistant Grand Lecturer for the Cayuga-Tompkins County District. Ray says that most of his spare time in the summer is spent in maintenance of his personal property and his pond. **Catherine J. Kuhl**, secretary, joined the staff of the EE School in June 1982. For most of her time in Phillips Hall she has been the secretary for members of the faculty who occupy the second-floor north wing of the building. When many members of the EE School faculty were moved to the new Engineering and Theory Center Building, she was transferred to that facility for a time, but has since returned to her former station. Catherine enjoys reading poetry and caring for her four Saluki pets (an ancient breed of dog, similar to a small greyhound, that originated in Arabia). **Joan Manning**, executive assistant to the EE School graduate field representative, came to the EE School in August 1959 as the fourth-floor secretary. In 1966 she assumed her present duties. In her time in that position she has managed the graduate office for ten separate grad reps who maintain that Joan knows the answers to all questions about graduate study in the school. For a number of years Joan was interested in oil painting, but much of her spare time is now given to gardening. **Francis D. McLeod, Jr.**, '63, B.S. (E.E.) '65, has been a lecturer in the EE School since January 1985, following two years in the school as a teaching associate. He has taught with professor Lester Eastman in courses in semiconductor electronics and with assistant professor Yosi Shacham in courses concerned with analysis and design of integrated circuits. Fran says that his former interest in bicycling has given way to sailing on Cayuga Lake. **Steven P. Powell**, B.S.(E.E.) '82, M.S. '83, has been a senior electrical engineer with professor **Paul Kintner's** group since June 1983. He is concerned with engineering, design, and development of

wideband (10 kHz to 4 MHz) instrumentation for research satellites, rockets, and balloons that are sent aloft to study plasma waves. Steve has been a ham-radio operator since high school and is the current advisor to the Cornell University Amateur Radio Club. Much of his free time for the past three or four years has been given to home-improvement projects. **Linda L. Struzinsky**, administrative aide, joined the staff of the EE School in June 1981 as the third-floor secretary in Phillips Hall. She moved to her current office in the Engineering and Theory Center Building in late October 1990 along with the EE School faculty members and graduate students who were also transferred at that time. During vacation periods, Linda enjoys camping in the family motor home, assists in preparation of vehicles for stock-car racing, and attends the races when family members participate. **Elma J. Weaver**, administrative aide, had her first association with the EE School in 1953 when we were still in Franklin Hall. She resigned in 1963, but would do occasional typing at home for members of the faculty. She rejoined the staff in October 1978 as administrative aide to professor **Lester Eastman**, her present position. In her spare time Elma enjoys reading.



• Professor emeritus **Clyde E. Ingalls** died at age 88 on December 6, 1992 in Potsdam, New York after a long illness. Clyde had a distinguished career in non-academic circles before coming to Cornell. From 1929 to 1941 he was with the Stromberg-Carlson Telephone Manufacturing Company in Rochester, New York, as radio engineer, head of the Research Laboratory, and head of the Instrument Development Laboratory. In those capacities Clyde made many innovative contributions to high-frequency electronic engineering, particularly in radio broadcasting and reception and in early television. During the war years, from 1941 to 1945, Clyde was with the eminent MIT Radiation Laboratory where he was in charge of all work on fire-control radar receivers. One of his most significant developments in that period was a fast automatic gain-control technique that reduced feedback instabilities and minimized most forms of radar jamming. He was also the author of several articles in the Radiation Laboratory series of books on radar. In 1946 he formed a private consulting firm, Canisteo Electronic Instrument Laboratories, with which he was associated for many years afterward. In 1947 Clyde was recruited by the director of the EE School, **Charles R. Burrows**, joined the EE School faculty as an

associate professor in September of that year, and was associated with the school for twenty-four years until his retirement in 1971.

Throughout his career as a member of the EE School faculty, Professor Ingalls taught both elementary and advanced courses, but principally theory and laboratory courses to upper-class and graduate students. He taught the first course in television at Cornell, which developed into two courses, one in transient operation of networks, and the other in network analysis and synthesis based on the use of the Laplace transform and convolution methods. He taught the first course in transistors in the EE School and developed several courses in acoustics. He built the first computer at Cornell and was chairman of a committee that established computing facilities on campus that eventually developed into the Cornell Computing Center. Clyde was active on many committees in the school and in the college, with particular emphasis on those involved with graduate study. For three years he was chairman of the Graduate Committee of the Engineering Division of the Graduate School, and in that period served as the first advisor in the school to all graduate students in the M. Eng. (Electrical) Program. He also served as special committee chairman and minor committee member for many doctoral and masters graduate students. He was a member of a school committee that revised the entire laboratory program beyond the second year to conform with a new College of Engineering program that placed all engineering students in a common curriculum in their first two years.

The windowless Phillips Hall tower was originally planned to house an acoustics laboratory in the

EE School. It is likely that Director Burrows had that object in mind when he convinced Clyde to come to Cornell. Since the funding for an elaborate anechoic chamber for the tower never materialized, Clyde had to conduct his acoustic research with electric organs and various loudspeaker configurations in an inexpensive chamber that he designed, built, and installed in the tower. In 1961 Clyde and a colleague from the General Electric Laboratory conducted some acoustic research of an unusual nature. In October 1964, at the University of Texas in Austin, Clyde presented the results of that study at a meeting of the Acoustical Society of America. The newspaper, the *Austin Statesman*, reported (erroneously) that Clyde had said that humans could hear electromagnetic waves, specifically radar waves. The resulting flurry of reports by other newspapers created a minor sensation that did not subside until Walter Sullivan reported the correct version of the phenomenon in the *New York Times* of December 6, 1964. It seems that Clyde and his colleague had found that certain individuals with good hearing at high frequencies could indeed detect pulsed radar waves that impinged directly on the cranium, and that the pulse-repetition rate of the radar signal could be "heard" without benefit of the ear. Clyde reported that he had experienced the phenomenon himself, although he advised others not to try the experiment. He also said that a somewhat parallel phenomenon had been reported on several occasions by people who had heard a hissing sound when they observed a falling meteorite, even though the object was travelling at a speed far exceeding that of sound. Clyde received many letters and inquiries

as a result of all this publicity and was particularly amused by a book about UFOs that justified their existence on the basis of his work. His paper, "The Sensation of Hearing in Electromagnetic Fields," was published in the *New York State Journal of Medicine*, Vol. 67, No. 22, November 15, 1967.

Clyde was a senior member of IEEE and of the Institute of Radio Engineers (IRE), and a member of the Acoustical Society of America. He held all of the offices in the Ithaca Section of IRE and served as program chairman of the Cornell Chapter of the Society of Sigma Xi. He was a Licensed Professional Engineer in New York State. When he retired from Cornell he moved to Potsdam, New York, and taught in the electrical engineering department at Clarkson University for one semester until an accident and subsequent ill health caused him to end his academic activities. He was able to continue as an amateur radio operator and to enjoy music for some time until increasing medical difficulties necessitated admission to a nursing home.

Well before his retirement, Professor Ingalls had the satisfaction of knowing that many of the innovative ideas and techniques that he introduced into the curriculum and laboratories of the EE School had become standard material in many courses. He came to the school at a time when electrical engineering education was undergoing major changes. In his quiet and modest way he preferred to work behind the scenes, but his extensive theoretical background, clear understanding of engineering principles, and broad industrial experience allowed him to make key contributions to the evolving new standards in the EE School.

• We regret to report the passing of **Teall Coonradt**, husband of executive staff assistant Jean Coonradt, and **Janet Smith-Kintner**, wife of professor Paul Kintner.

Mr. Coonradt died on December 15, 1992, in Ithaca, New York, after a long illness. Teall graduated from Clarkson University in Potsdam, New York, and served in the U.S. Army from 1941 to 1945. He was employed by IBM for a number of years and later developed and directed his own business in Owego, New York. He was a member of the New York State Society of Professional Engineers, the American Legion in Candor, New York, and the BPOE in Seneca Falls, New York.

Mrs. Smith-Kintner died on September 12, 1992, in Ithaca, New York, after a long illness. Janet came to Cornell in 1976 with a Ph.D. in physics to work at the synchrotron facility, and soon afterward became interested in the education of minority students in science and mathematics. Following two years as an instructor in the Learning Skills Center, she was associate director of that program until 1985, when she became an assistant dean in the Advising Office of the College of Arts and Sciences. In 1987 she was appointed director of state programs for the Office of Minority Affairs, a position she held until her illness. Janet will be long remembered by her colleagues at Cornell for her significant contributions to the university, her integrity, organizational ability, and her firm commitment to effective education.

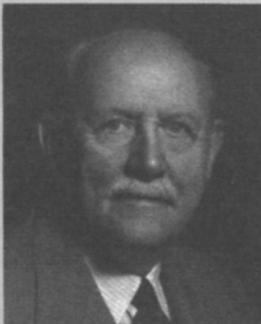
## Ellis L. Phillips Remembered

One Friday afternoon in the spring of 1956, Ellis Phillips was present in the Phillips Hall Lounge to attend the unveiling of his portrait that now hangs on the eastern wall of that room. After the ceremony, the celebrated (now unhappily moribund) EE Delta Club held a special meeting of students and faculty to "initiate" the donor of the new EE building into our social organization. Mr. Phillips, in a short acceptance speech, thanked us for the honor and then wished us all "as much success and satisfaction in your careers as I have had in mine." Some of the details of that career are outlined in a pamphlet, *The Desk at 50 Church*, by Mr. Phillips's son, Ellis L. Phillips, Jr., former president of Ithaca College.

Ellis L. Phillips, a "country boy" from Yates County, New York, was awarded a New York State Scholarship to Cornell University on June 13, 1891. Following receipt of the EE degree in 1895, and after three years of industrial design experience, he joined the Westinghouse Company and engaged in engineering and electrical design with that firm until he formed his own consulting firm in 1904. In the ensuing years, E. L. Phillips & Company, with Mr. Phillips as president, was responsible for many important design and construction projects throughout the country, including development of the Long Island Lighting Company (LILCO) that Mr. Phillips and associates founded in 1910. Mr. Phillips served as president of LILCO until 1937. Favorable returns from his many successful business investments allowed formation of the Ellis L. Phillips Foundation. From 1950 until his death in 1959, the philanthropic work of the foundation received his close personal attention.

Mr. Phillips visited the Cornell campus in the fall of 1952 and interviewed members of the EE School faculty to learn how they would make use of a new EE building. In the spring of 1953, Cornell received a grant of one million dollars from the Phillips Foundation for a new electrical engineering building, plus another \$100,000 for new furniture and other facilities. In 1981, the EE School received \$30,000 and an antique Jacobean table from the foundation to improve the student-faculty lounge now known as the Ellis L. Phillips Lounge. More recently, in 1991, the foundation made a generous grant of \$50,000 to the EE School for renovation of the space on the third floor of Phillips Hall that now houses the comprehensive new central computing facility that is used at all levels in the school.

—Sam Linke, professor emeritus, electrical engineering



# T

he short article in the 1992 issue of *Connections* on the new Electric Car Project in the EE School prompted Steve Coulombe, B.S. (E.E.) '74, to write us an interesting letter about his trials and tribulations with the earlier versions of the EE electric car. He gives particular attention to the genesis of the "fire-engine-red" Alfa Romeo "Showcar" of those days, and incidentally points out that the Cornell E-Car was a 1931 replicar, not a 1920 model, as stated in the article. Steve, now a Lieutenant Colonel in the U.S. Air Force, stationed in Albuquerque, New Mexico, also provides some pertinent insight on what it was like to study with professor Joe Rosson. In Steve's words:

I had been working on E-Cars since my freshman year, having complained to Papa Joe (my advisor) that I needed some "hands on" work to keep my sanity amidst all that engineering-theory stuff. So he paired me up with Foster Hinshaw (B.S.E.E. '70) to work on electric cars. Joe said to me, "You may not understand everything the senior engineers are talking about, but don't worry, there's something called..." and he leaned forward for emphasis, "OSMOSIS." He was right, because I learned a lot from guys like Foster, and Geoff Hanshaw (B.S.E.E. '72).

Foster told me about one trip up to Ithaca College in the old electric VW van, when the SCR controller locked up. Fortunately, that van had a clutch, so he just stopped the van by the side of the road and decided to shut down the controller. I forgot if there was a main contactor or switch to do this; maybe it was already welded shut from high dc currents and associated arcing.

(All of our E-cars were dc-powered in those days.) Or was the contactor sustaining an arc? No matter. Foster decided to commute the main SCRs by throwing a crowbar across the 120-volt battery pack. It was a miracle he wasn't killed when the resulting short circuit launched the crowbar up into the air. It worked. However, it helps to have a healthy respect for dc traction batteries.

Then there was the time when we were testing a new SCR chopper controller by driving a motor and large inertia mass (a steel cylinder). The controller worked fine, but Foster wasn't happy with the motor resistance that limited the motor current to only a few hundred amps. So he said, "Let's see if this thing will control current into a dead short." The rest of us always thought that Foster was a little crazy—but what the hell—a quick change of one of the armature cables to the second motor-armature lug,

and we were ready. We stood back expecting to see arcs and sparks when Foster cranked up the power-control potentiometer to maximum. What we saw, besides the maniacal gleam in Foster's eye, was not expected: the two main armature cables, which were rather heavy, sprung up off the floor as they tried to repel each other.

"Gee, that was neat! Let's do it again."

With such an electrical engineering upbringing, it's no wonder that unconventional thought continued to give birth to strange new E-cars. In my senior year, we built a car for which Geoff Hanshaw designed a very simple control system, one making very effective use of field control of a dc shunt motor. This model was built on an old VW-bug chassis, had no body whatsoever, was painted all black, and incorporated a roll bar. Many of us learned the fine points of welding on that vehicle. The batteries and everything else were visible to the casual observer, and that car got lots of stares whenever we drove into College town for lunch. It was also nice to have a CU "Service Vehicle" sticker for on-campus parking and access to the Phillips Hall dc supply so we could recharge the batteries in the parking lot while attending classes. With this background we can now go on to the '31 Alfa.

Late in my senior year, when I was the student leader of the E-car project, a couple of us were summoned to Papa Joe's office. He

opened a golf magazine that was on his desk, gave us a curious look, and asked our opinion of an ad displayed therein for a 1931 Alfa Romeo replicar. We thought it would make a great electric if it had enough room for all the batteries. Joe was concerned that there would be enough room left over for his golf clubs.

But more seriously, he also thought it would make the perfect Cornell E-car demonstrator, especially with that fire-engine-red color. We told him we'd check it out and see if it was feasible to do it all in one year. I finally had an M. Eng. project!

By that time, we had a pretty good idea of what it took to build a fully functional E-car. A Mech. Eng. project to design a strong tubular spaceframe took care of the concern for weight. The biggest problem, however, was manpower: not enough with just a few EE M. Eng. grads. Prof. Rosson came to the rescue. He simply started a new EE course for underclassmen, "Special Topics in Electrical Engineering," or something like that. ("They'll learn by

OSMOSIS"). We got two semesters of eager help. (I still have a copy of the original Alfa brochure from Antiques and Classics, Inc., in Buffalo, New York, where we bought the fiberglass body kit. I also have one of the project work schedules that we put together to get the Alfa built within two semesters before graduation in 1975.)

The project steadily took shape for a year, culminating in the Cornell "Showcar." I think we impressed more than a few gals as we cruised around campus. Too bad they were only looking at the car! We also took our cars to local gymkhana (autocross) and did fairly well. Of course we were alone in our class: "electric." Trips to

Watkins Glen and displays around New York rounded out the show circuit.

My five years of Cornell E-car fun and "hands-on" learning have stuck with me ever since. Now, instead of kilowatts and cars, I work with megawatts (lasers) and airplanes. And it all started "by OSMOSIS."

It is always pleasant to hear from alumni who like to reminisce about their professors, particularly when the anecdotes are concerned with events that occurred in the '20s and '30s. We received just such an account from Emmett W. MacCorkle, Jr., EE '29, now retired and living in Portola Valley, California, who writes:

The article (in the recent issue of *Connections*) about Wilson Greatbatch's receipt of the HKN Karapetoff Award brought back some wonderful memories of "Kary." In his last lecture to the EE class of 1929, he gave us much sound advice, one part of which was an anecdote about a garden party he had attended with several other savants. While the host was mixing the drinks, the guests strolled around his garden. In the center was a pedestal surmounted by a mirror-finish sphere. One of the guests happened to place his hand on the side of the

sphere illuminated by the sun. He was surprised to feel it to be cold! He touched the opposite side and found it to be warm. He remarked to his friends about this strange phenomenon, and the learned men quickly developed a theory to explain why the side away from the sun was warm, and vice versa. When the host rejoined them, the new and revolutionary theory was explained to him. "Well, gentlemen," he responded, "Just before you arrived I dusted off the sphere and turned it around!" Kary's lesson to us was, "Don't jump to conclusions without

thorough investigation!"

The article about the "Color Organ" mentioned Bob Schutz, a 1929 classmate [obviously a predecessor of the Bob Schutz of 1950—Ed.] Bob was working on the idea at that time. I observed some of his experiments one evening after the lab had closed to classes. His principal tools were colored spotlights, a pan of water for reflection from waves on the surface, and a screen to catch the result. The only controls remotely related to present-day electronics were the pioneer three-element vacuum tubes. How the transistor, modern frequency

(Continued on next page)

Please return to Sam Linke, Cornell University, School of Electrical Engineering, 204 Phillips Hall, Ithaca, NY 14853-5401.

Name \_\_\_\_\_

Position title \_\_\_\_\_

I am employed by \_\_\_\_\_

street \_\_\_\_\_

city \_\_\_\_\_ state \_\_\_\_\_ zip \_\_\_\_\_

My current activities in EE (or related to EE) are:

\_\_\_\_\_

Optional:

I would like to explore possibilities in the following areas:

- Contributions to the Eminent Professors' Fund
- Contributions to the Papa Joe Fund
- Establishment of one-year fellowships for professional masters students
- Engineering Cooperative Program
- Job placement of EE School seniors or graduate students

changers, etc., have changed the electrical engineering field!

I was sorry to read of professor Everett Strong's death. He was the lab instructor for professor Johnny Pertsch's electricity and magnetism course. I completed an experiment to show the distribution of light from a lamp bulb. When Everett handed it back to

me with a rather generous grade, he referred to my curves with the comment, "MacCorkle, you have discovered a revolutionary concept. The way your curves are drawn indicates that the lamp bulb gives off illumination when no current whatever is flowing." Those were great days!

I read in the business section of the paper

Dave Pfeiffer's memoir on his "color organ" apparently has stirred up some memories of similar exploits. Otto J. Glasser, EE '40, now Lt. Gen. USAF, Retired, writes from Sarasota, Florida:

J. David Pfeiffer's piece on the color organ was interesting, but raised a question in my mind. Back in '39 we had an Engineers' Day (for which I fashioned a huge Tesla coil from used 8" x 10" photographic plates!) and someone constructed a "color organ" complete with multi-colored fountains. It was erected on the arts quadrangle, directly in front of Sibley Hall, and was the hit of the show. Could it have been the progenitor of Pfeiffer's award-winning organ?

Actually, I felt a bit archaic after reading the articles. The words "60 cycles" were nowhere to be seen. I wondered if any of today's grads could calculate the temperature of the hottest coil in a synchronous converter as we were required to do! Even the "elite" of us who took the communications option were primitive by today's standards! [Otto, the brief account of professor Jim Thorp's work on computer relaying of power systems, which appears on page 3 of the 1992

recently that out here in Silicon Valley there are over 35,000 electrical engineers, the greatest concentration in the United States. Perhaps one-third of them are Cornell graduates. That makes me more proud than ever of the products of former Franklin Hall, now succeeded by Phillips Hall, and the great laboratories.

issue of *Connections*, indicates that 60 cps (or 60 Hertz in present-day parlance) is still of interest in the EE School. The current E-car project, described elsewhere in these pages, is also concerned with low-frequency devices.—Ed.]

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 School a special place. We'll print 'em as space allows.

## EMINENT PROFESSORS' FUND

Last year the EE School established the Eminent Professors' Fund to honor the memory of notable members of the EE faculty of recent years such as professors Henry Booker, L. A. Burckmyer, Clyde E. Ingalls, M. Kim, Wilbur Meserve, Robert Osborn, Howard G. Smith, Everett Strong, 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 EE School, and (2) to establish endowments to provide ongoing financial support for undergraduate and graduate students. The EE School has given high-priority status to the following activities:

- Renovate 5,000 square feet of now-vacant space in the second floor of Phillips Hall to form a new state-of-the-art undergraduate laboratory (i.e., a new "Superlab").
- Establish an endowment fund to provide financial support, on a yearly basis, for graduate and undergraduate students who serve as teaching assistants in our laboratories.
- Establish one-year fellowships to support professional-masters candidates for the M.Eng.(Electrical) degree.

Alumni who would like to contribute to the Eminent Professors' Fund should contact professor Noel MacDonald in care of the School of Electrical Engineering, Room 224, Phillips Hall.



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