UPDATE from the School of Civil and Environmental Engineering

CORNELL UNIVERSITY • HOLLISTER HALL • ITHACA, NY 14853

Fall 1990

A Bridge to Farmers' Market: Community Project for CEEs

A bridge that benefits local bicyclists and pedestrians also served to span the gap between work and school for a group of civil engineering students. Built last spring by Cornell's student chapter of the American Society of Civil Engineers (ASCE) as its annual community project, the bridge links Stewart Park with the Ithaca Farmers' Market and is a vital link in a citywide network of paths.

Initial discussion of the proposed project took place in the summer of 1989 when the group's community-service coordinators, Gregory Johnson '90 and Jonathan Pease '91, met with Larry Fabbroni of Ithaca's Department of Public Works. It was agreed that the student chapter would sponsor a contest to select a preliminary design for the bridge.

The contest was held in the fall, and twenty entries were received and reviewed by several ASCE officers and CEE faculty members, including the group's faculty adviser, Assistant Professor Mary Sansalone. The winning entry was submitted by Peter Clark, a Ph.D. student in structural engineering, and Catherine Olt '90, an architecture student. The ASCE students then performed site surveys and soil investigations, prepared a final design for the bridge and its foundations, drew up cost estimates, and built scale models of the site and the bridge. In February the detailed proposal was presented to the Ithaca City Planning Commission, which endorsed the project and allocated $17,000 for its execution.

The bridge as it is now (above), and under construction (below).

The design mimicked a nearby railroad bridge, using rust-colored steel I-beams, a wooden deck made of planking similar to railroad ties, and handrails made from old rails. Other design factors were the low cost and ease of construction.

Construction began in March under the direction of chief project engineer Paul Crovella, a graduate student in agricultural engineering. The handrails and the wooden deck were prefabricated in the George Winter Structural Engineering Laboratory. Over spring break, students built forms, placed reinforcing rods, and poured concrete for the bridge's foundations. After the 33-inch-deep, 78-foot-long steel beams were delivered in April, the students bolted the bracing members into place, fastened the wooden deck and handrails, and finished construction of the retaining walls. The bridge was completed in June.

From the Director

It has been several years since the School of Civil and Environmental Engineering last published a newsletter. In 1988 the administration of the CEE school was "streamlined" and I became its new director. The school is now a single unit, without separate departments.

We continue in our mission of education and research. Recent initiatives include a successful program in engineering management. Also, we are part of a new coalition of eight major engineering schools that aims to develop innovative engineering curricula for the 1990s and beyond.

There are many activities we would like to tell you about, but space constraints have limited us to just a few. Future issues of *Update* will cover much more.

We look forward to hearing from you so we can learn what interests you and expand our CEE alumni news accordingly.

—Arnim H. Meyburg

Update: Three CEE Laboratories

With the establishment of the Takeo Mogami Geotechnical Laboratory and improvements to the DeFrees Hydraulics Laboratory and the Craig J. Miller Structural Models Laboratory, the School of Civil and Environmental Engineering has significantly upgraded its teaching and research facilities.

Since its inception in 1984, the research capabilities of the DeFrees Hydraulics Laboratory have been continually improved. The lab is valuable also in the instructional programs; new or upgraded demonstrations and experiments are frequently introduced.

A major piece of equipment built in 1986 is the 110-foot-long wave tank with a random wave generator. It has been used in studies of breakwater installations and is now the focal point of a study of wave interaction with permeable and impermeable sea floors. Velocity measurements of particles in the boundary layer are being obtained with the use of a laser-Doppler velocimeter (LDV).

A tilting wind-water tunnel was installed in 1989 at the cost of $275,000. This is a unique resource for research in air-sea interaction; there is currently no facility with similar capabilities either in the U.S. or abroad. Recirculating flows of air and water move through the tunnel; gas transfer is studied at their interface. While still under construction, the tunnel was used in a research project on the discharge of oxygenated waste-water effluents. Currently it is being used to investigate gas transfer in streams with surface instabilities, and the wind effects on gas transfer in estuarine or coastal environments.

Another new installation is a water table for the study of shallow turbulent shear flows; this allows the use of advanced laser-induced fluorescence techniques and digital flow imaging.

The computing facilities have been upgraded with the acquisition of a Microvax II system, two IBM-System 2 computers, and other microcomputers. An electronics shop has also been established.

Professor Gerhard H. Jirka, director of the DeFrees Laboratory, is hopeful that the existing laser-Doppler anemometry (LDA) system can be upgraded to two velocity components with fiber optics. The system currently includes one component, which measures the horizontal velocity of particles—a second component is needed for vertical measurements. Also proposed is a small recirculating sediment-transport flume and a stratified flow flume.

The Mogami Geotechnical Laboratory honors the late Takeo Mogami, who was a professor and dean of engineering at the University of Tokyo and a pioneer in geotechnical engineering and soil-mechanics research. The lab was established with a gift from Ping Y. Hsu, a former student of Mogami who is now a New York City businessman. Ping's two daughters are Cornell alumnae and his son is currently a student in the College of Engineering.

Above: Sean Downing, a master's degree student, uses a laser-Doppler velocimeter to measure particulate movement in the boundary layer of the DeFrees Hydraulics Laboratory wave tank. This is only the second such study performed. Results are applicable to the movement of pollutants in water, such as heavy metals in oceans.

Below: In the DeFrees Hydraulics Laboratory, Dr. DaoYi Chen uses the new water table to study turbulent shear flow in shallow layers. An 8-watt laser causes the dye to fluoresce; the flow is then photographed and displayed on computer screens as a video image and as a digitized image.

New Hydrology Fellowship

The Joseph H. DeFrees Fellowship was established in 1988 to support a first-year doctoral student working in hydraulics and hydrology within the CEE school on research centered in the DeFrees Hydraulics Laboratory. The fellowship provides for full tuition, fees, and a stipend. It is funded by the family of Joseph H. DeFrees '29 (CE). For further information contact:

Faculty, Hydraulics and Hydrology
School of Civil and Environmental Engineering, Hollister Hall
Cornell University
Ithaca, NY 14853–3501.

The laboratory dedication, held September 29, 1989, was the concluding event of the four-day 2nd U.S.–Japan Workshop on Liquefaction, Large Ground Deformation, and Their Effects on Lifelines. The ceremony was attended by nearly fifty prominent geotechnical researchers and engineers, including Professor Kenji Ishihara, a former colleague of Mogami, who gave a warm, personal recollection of Mogami's accomplishments and contributions. Associate Professor Harry E. Stewart, director of the new facility, described the educational and research goals of the laboratory. Mrs. Mogami, who was accompanied by her granddaughter Ayako, was presented with a hand-blown Steuben glass sculpture.

The new laboratory, located on the second floor of Hollister Hall, greatly expands the CEE school's resources for research in earthquake engineering. Laboratory equipment includes two sophisticated devices for testing soil samples. The two are complementary systems—one is used to test torsional shear strength and the other simple shear strength. Both can operate at very low levels of stress or strain, which makes them valuable for work with soils, and both are capable of monotonic or cyclic loading. The systems can be used to test samples having a wide range of grain sizes and are fully equipped with sensors so that data can be monitored visually with microcomputers. Stewart is currently using the systems to characterize the behavior of silts with regard to their potential for liquefaction. The laboratory is used in undergraduate and graduate instruction.

Classmates of the late Craig J. Miller '61 have created a memorial to him by modernizing and renaming a laboratory in Hollister Hall. The Craig J. Miller Structural Models Laboratory is directed by Richard N. White, the James A. Friend Family Distinguished Professor of Engineering, and it is used in all undergraduate structural-engineering courses and in graduate research.

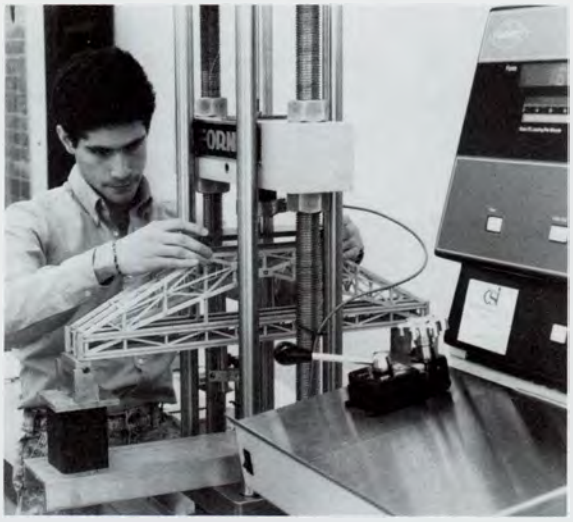
Miller, remembered by his Cornell associates as a good friend and an excellent student, was a professor of structural engineering at Case Western Reserve University.

The lab's experimental workstations have been equipped with sensors and a $6,000 computer-based data-acquisition system for performing both static and dynamic experiments. The Forney Universal Testing Machine, which is used to test materials and small-scale models of structures, was purchased in 1988 for $30,000, half of which came from the Miller fund. The fund was also used to renovate and recalibrate existing equipment.

Joseph D. Dreyfuss II '61 organized the memorial fund in conjunction with the 25th reunion of the class.

Left: In the Mogami Geotechnical Laboratory, Mary Ellen Caves, M.S.'90, uses the direct simple-shear system to test soil samples.

Left: Ph.D. candidate Ashraf K. Hussein works with the resonant column/torsional shear system in the Mogami Geotechnical Laboratory.



Left: In the Miller Structural Models Laboratory, Adam Hoffman '90 uses the Forney Universal Testing Machine to apply a compressive load to his model bridge. Students in CEE 116, Modern Structures, build models for an annual competition in which prizes are awarded for construction, design, strength, and aesthetics.

Learning from the San Francisco Quakes:
Computer Modeling for Damage Control

by Thomas D. O'Rourke

During the 1989 Loma Prieta (San Francisco) earthquake, several areas, such as the Marina and the Embarcadero, suffered severe damage, yet adjacent neighborhoods were virtually untouched. Why?

The answer lies in the phenomenon known as site response—the way in which geologic, groundwater, and soil conditions affect the response of a certain area to seismic waves. With funding from the National Science Foundation, Associate Professor Harry Stewart and I are studying site-response data from the 1906 and 1989 San Francisco earthquakes. Better understanding of site response should improve the classification of different areas and the determination of design criteria for critical structures, thus reducing damage from ground failures.

After the 1989 earthquake, a group of Cornell geotechnical researchers—including myself, Stewart, senior research associate Charles Trautmann, and graduate student Bruce Roth—flew to San Francisco to survey the damage and obtain soils data from the Marina and Embarcadero areas. Using the resources of the new Takeo Mogami Geotechnical Laboratory, which Stewart directs, we have performed dynamic and torsional shear tests. We are working with Masakatsu Miyajima of Kanazawa University, Japan, who is conducting computer analyses. He is at Cornell as a visiting assistant professor and is part of the joint U.S.–Japan research effort supported by the National Center for Earthquake Engineering Research. (Cornell is a prominent participant in the NCEER program.)

In San Francisco, two distinct processes are involved in site response. Soft alluvial and marine soils tend to amplify ground motion; and liquefaction can occur when loose, water-saturated sand is subjected to severe shaking. The soil of the Marina district, much of which was reclaimed from the bay, consists of a layer of sandy, water-saturated fill over a layer of soft clay and silt (known as Recent Bay Mud), which is over 70 feet thick in places.

We are especially interested in the coupled behavior of the mud and the overlying sandy fills. We are modeling the seismic behavior of the mud with special computer programs that account for the dynamic interaction between the incoming bedrock motions and the overlying soil deposits. The combination of ground-motion amplification through the mud and the liquefaction of the sandy

Right: O'Rourke (on left) and Stewart (on right) supervise soil exploration next to the heavily damaged Embarcadero Skyway in San Francisco. (Note the spalled concrete column.)

fill account for the severe damage the Marina sustained.

Our research team has also participated in a geotechnical survey of the Marina district organized by the U.S. Geological Survey. With the assistance of Ted Gowdy, a participant in the undergraduate research program, we have analyzed scores of soil borings and have constructed a three-dimensional computer model of the bedrock and soils under the Marina. This has provided a comprehensive view of the site and allows us to determine better the influence of site characteristics.

In a related project, Professor Mircea Grigoriu, alumnus Mahmoud Khater, Ph.D. '88, and I have developed an interactive computer graphics model to simulate the effects of earthquakes on lifeline systems. Called GISALLE (Graphical Interactive Systems Analysis for LifeLine Engineering), we have used it to simulate the effects of earthquakes on San Francisco's Auxiliary Water Supply System. (The auxilliary system was established to prevent the kind of damage that occurred after the 1906 earthquake, when regular water-supply systems were disrupted and 490 city blocks were destroyed by fire.) We have modeled how different patterns of pipeline damage and multiple fires would affect the performance of water-supply systems for fire-fighting. The model contains a special algorithm to simulate the hydraulic performance of damaged systems with many pipeline breaks. Damage due to traveling ground waves is calculated by assessing earthquake intensity and is based on previous earthquake statistics; breaks due to permanent ground movements are established by means of subsurface surveys and studies of geotechnical site characteristics. Water flow and pressure at critical hydrants is assessed and compared to estimated demands in the event of fire. The results of these analyses are providing a reference base for system improvements and a fine-tuning of emergency-response procedures.

Above: Stewart and Trautmann inspect a collapsed building in the Marina district. An upper floor has been pitched out into the street. (Strangely enough, the lamp in the lower right of the photo had an unbroken bulb.)

Thomas D. O'Rourke has been a Cornell faculty member since 1978. His research interests include soil-structure interactions and underground construction, and he is involved in a joint U.S.–Japanese research project on earthquake effects that is sponsored by the National Center for Earthquake Engineering Research.

Honors O'Rourke has received include the C. A. Hogentogler Award from the American Society for Testing and Materials and the Collingwood and Huber Prizes from the ASCE. He is a member of the ASTM, the ASCE, the ASME, and the Earthquake Engineering Research Institute.

New Faces in the Main Office

Meyburg

Professor **Arnim H. Meyburg**, a specialist in transportation engineering and planning, became director of the CEE school in 1988 when the school was reorganized and the departments of structural and environmental engineering were merged.

Meyburg received M.S. and Ph.D. degrees from Northwestern University. He joined the Cornell faculty in 1969 and was chairman of the Department of Environmental Engineering from 1980 to 1985. He has authored or co-authored several books. His honors include two Fulbright awards, the U.S. Senior Scientist Award (the Humboldt Prize), and a Humboldt fellowship.

Stedinger

Professor **Jery R. Stedinger** is the associate director of the CEE school. Stedinger earned a doctorate from Harvard University in 1977 and then joined the Cornell faculty. Previously he worked at Sandia National Laboratories and the Lawrence Livermore Laboratory. At Cornell he has studied and written on problems of water-resource management, and statistical and risk issues in hydrology. One of the first recipients of a NSF Presidential Young Investigator Award, Stedinger also shared the 1989 ASCE Walter L. Huber Engineering Research Prize.

Carr

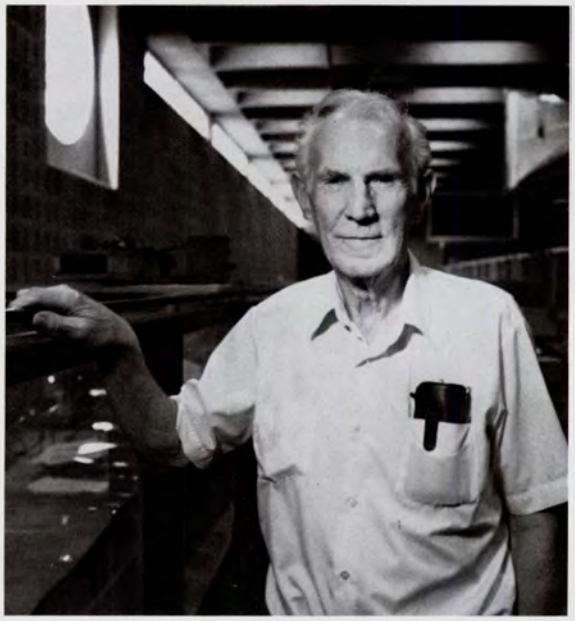
Linda Carr is the new administrative manager. She has a strong background in administration and personnel management. She has previously worked as a manager for University Relations and as a budgeting specialist for the university's Budget Management Office.

Carr took over from **Gen Smith**, who recently resigned after twenty-nine years at the CEE school. Meyburg commented that "the staff, faculty, and many generations of students owe Gen a great deal of gratitude for her dedicated and loyal service." He added that her long-term devotion to the school earned her the affectionate title "Mrs. Hollister Hall."

Paul Jones Celebrates Fifty-Year Anniversary with CEE

Fifty years ago S. C. Hollister was dean of the College of Engineering, the School of Civil Engineering was located in Lincoln Hall, and the current engineering quadrangle existed only as a plan. But there has been one constant: Paul Jones, who started his career in the civil engineering machine shop in 1940 and has continued there for fifty years.

Arnim Meyburg, director of the School of Civil and Environmental Engineering, characterized Jones as "an extremely kind man and a delightful human being," and emphasized not only Jones' "superb machining skills," but also "his sensitivity to the individual needs of the students, his willingness to do whatever he can to assist his colleagues, and his great dedication to the school."



Paul Jones, supervisor of the CEE school's machine shop, stands in front of the 110-foot-long wave tank that he helped build. The tank is used for experiments in the DeFrees Hydraulics Laboratory.

Jones doesn't think he's done anything extraordinary, but the scores of students he's helped would disagree. Jones' specialty is understanding the individual needs of students and helping them devise the apparatus that turns their research concepts into working experiments. A current graduate student commented, "Paul is practical. He'll find a better way to get the project done." Another student added, "He's a tremendous asset to the school."

Colleagues and students expressed their appreciation by honoring Jones with a reception held November 2, 1990. A sizeable check was presented by William B. Streett, dean of the College of Engineering. Jones also received a Cornell chair and several travel books.

No date has been set for Jones' retirement—an event he's not looking forward to. "Losing the people I work with will be a real heartache," he said. His ties with students often extend beyond their graduation. While reluctant to talk about himself, Jones is eager to tell of CEE alumni. These include Jamshid Amouzegar, B.C.E.'45, Ph.D.'51, who returned to his native Iran and served as prime minister during the last years of the Shah's reign; Jones followed his career on the evening news. As a student at Cornell, Aly Baligh, Ph.D. '53, built a hydrology flume with Jones' help. He became a professor at the University of Cairo and now some of his students are at the CEE school; Jones maintains a connection through them. Jones visited Juan A. Pastor, M.Eng.(Civil) '78, Ph.D. '86—a former student who is now a professor at the University of Costa Rica—when Jones and Professor Richard N. White flew there in 1989 to participate in the installation and dedication of model-testing tables built at Cornell.

Jones' energy extends beyond the CEE school. He and his wife Mary learned to fly glider planes in their fifties—Jones soloed at age fifty-eight. In the last decade Paul and Mary—their five children grown—have traveled to northern Europe, Morocco, Egypt, Israel, Turkey, Greece, Spain, Hawaii, and Alaska.

Jones' retirement plans include visits to New Zealand and Australia. The lure of faraway places is not the only enticement, however; there's a former student in New Zealand that he wants to look up.

—Lindy Costello

Alumni Briefs

CEE alumni in the news include **Gerard F. Fox**, B.C.E. '48, who was awarded honorary membership in the ASCE in recognition of his outstanding career in bridge design and for his twenty-five years of work with civil engineering students at Columbia University. At Cornell he has worked with M.Eng. students; he also serves on the CEE school's Advisory Council. A partner in the firm of Howard Needles Tammen & Bergendoff, Fox previously received the ASCE's Howard and Roebling awards for lifetime achievement.

David Darwin, B.S. '67, M.S. '68, has been named the Deane E. Ackers Distinguished Professor of Civil Engineering at the University of Kansas. Darwin is also director of the university's Structural Engineering and Materials Laboratory. He is a fellow of the American Concrete Institute and of the ASCE, which awarded him the 1985 Walter L. Huber Civil Engineering Research Prize.

Patricia Acker, B.S. '74, M.Eng.(Civil) '75, is an executive vice president of the Cornell Society of Engineers and is chair of the Eighth Annual Engineering Conference, to be held April 25–27, 1991. Previously she served on the CEE Advisory Council and the University Council. Acker works in the U.S. Department of Interior on programs for reclaiming abandoned mines.

Acker

Faculty Retirements

Within the past few years, four faculty members who have been at the School of Civil and Environmental Engineering for a total of over 143 years have retired as professors, emeriti.

Leonard B. Dworsky, a specialist in water-resource planning, management, and policy, retired in 1987 after twenty-three years on the faculty. Dworsky began his career as an environmental engineer for the Illinois Department of Public Health, and then served in the Army during World War II. Before coming to Cornell in 1964, he served for eighteen years as a senior administrator of the federal water-pollution control program in the U.S. Public Health Service. At Cornell, Dworsky directed the university's Water Resources and Marine Sciences Center from 1964 to 1974. He served on the national water and energy policy committees of the ASCE and was a member of the Science Advisory Board of the International Joint Commission (U.S. and Canada). He has been an environmental consultant to the Rockefeller Foundation and was an adviser on water resources to President Johnson. He is a diplomate of the American Academy of Environmental Engineers. Now living in Florida, he is a senior associate at the International Boundary Resources Center of the University of New Mexico School of Law.

William McGuire retired last year. McGuire first came to Cornell to earn a master's degree in civil engineering after serving in the Navy. He then spent two years in structural design practice and returned to Cornell as a faculty member in 1949. He has specialized in steel design and structure and, more recently, in the use of computer-aided design and analysis for structural engineering. He is the author or co-author of two textbooks in these areas. McGuire was one of the planners of the largest radio-radar telescope, built by Cornell near Arecibo, Puerto Rico. He has been a consultant to numerous organizations, including an architectural firm and the National Bureau of Standards, and has lectured internationally. He is a registered professional engineer in New York. His honors include the Norman Medal of the ASCE and a Special Award from the American Institute of Steel Construction. He is a fellow of the ASCE.

Floyd O. Slate retired in 1987. His early work included participation in the Manhattan Project, followed by three years of teaching at Purdue University. He joined the Cornell faculty in 1949. He has earned a worldwide reputation for his contributions in the areas of low-cost housing and concrete materials. His work in low-cost housing, particularly for developing nations, took him to seventy countries to conduct research and implement programs. For example, he spent 1955–56 as a housing adviser in Pakistan under the sponsorship of the United States Foreign Service. In 1976 he was awarded a senior fellowship by the East-West Center. Slate has received numerous awards, especially from the American Concrete Institute, for his research and publications. At Cornell he won the 1976 Excellence in Teaching Award at the College of Engineering. Active as an industrial consultant, he was also a founder of Geotechnics and Resources, Inc., and served as its director. Since his retirement, he has continued to work on low-cost housing in third-world countries.

Gordon P. Fisher, a specialist in the planning and design of transportation systems, retired earlier this year. Fisher joined the faculty in 1948 after serving as an officer in the Army Corps of Engineers and doing research on military aircraft during World War II. At Cornell he served as associate dean of the College of Engineering (1960–66); the first chairman of the former Department of Environmental Systems Engineering (1966–71); director of the Water Resources Center, which he founded; and director of the Program in Urban and Regional Studies. He has spent sabbatical leaves at the Pittsburgh–Des Moines Steel Company and at universities in Japan, Mexico, and Sweden. He also had a long and active involvement with the Engineering Research Foundation. Honors he has received include the 1962 Norman Medal of the ASCE. He has held fellowships with the National Science Foundation, NASA, and the Japanese Society for Promotion of Science; and he was a Distinguished Visiting Scholar at the University of Hawaii. Fisher will continue to teach; he recently returned from an appointment as a visiting professor at the University of Kyoto, Japan.

Dworsky

McGuire

Slate

Fisher

Schuler Heads Waste Management Institute

Richard E. Schuler, professor of civil and environmental engineering and of economics, is the director of the recently established Cornell Waste Management Institute and the associated New York Solid Waste Combustion Institute.

A recent issue of *Engineering: Cornell Quarterly,* entitled "Dealing with Waste", highlights his work and that of others at Cornell in waste management and disposal. Copies of the magazine may be obtained from the Office of Engineering Publications, Cornell University, 254 Carpenter Hall, Ithaca, NY 14853–2201.

Faculty Honors

Since the last *Update,* a number of CEE faculty members have received honors and awards.

Wilfried H. Brutsaert received the 1989 Robert E. Horton Award from American Geophysical Union. He was honored for his findings on evaporation from planetary surfaces—research that was cited as among the most original of the past two decades. Brutsaert is a fellow of the AGU.

Jery R. Stedinger was one of five recipients who shared the ASCE's 1989 Walter L. Huber Civil Engineering Research Prize. Stedinger received the award for his research in the use of stochastic hydrology and reliability analysis in water-resources engineering, planning, and management. He is currently serving as associate director of the CEE school (see related article, this issue).

James A. Liggett recently gave the tenth Hunter Rouse Hydrologic Engineering Lecture, entitled "Computation: Investigation, Education, and Application," at the 1989 ASCE National Conference on Hydraulic Engineering, held in New Orleans.

Gerhard H. Jirka won the 1989 Arthur T. Ippen Award of the International Association for Hydraulics Research for basic research on stratified flow and air-water-sediment transfer processes, for innovation in experimental techniques, and for applied research contributions in waste-heat disposal and the environmental impact of energy facilities. Jirka has also received two ASCE awards: the 1981 Freeman Hydraulics Prize and the 1983 Walter L. Huber Civil Engineering Resarch Prize. At Cornell he is director of the DeFrees Hydraulics Laboratory.

Richard I. Dick, the Joseph P. Ripley Professor of Engineering, received an Outstanding Publication Award from the Association of Environmental Engineering Professors for a paper entitled "Evaluation of Activated Sludge Thickening Theories," coauthored with Benjaman B. Ewing of the University of Illinois. This is the second time Dick has won this prize, which has been awarded only four times.

Fred H. Kulhawy was the 1988 Cross-Canada Lecturer of the Canadian Geotechnical Society. He lectured in eleven cities in 1988. Kulhawy is a fellow of the ASCE and the Geological Society of America.

Anthony R. Ingraffea and **Catherine Mink** shared a 1989 Dean's Prize for Innovation in Teaching for their work in developing the college's Computer-Aided Design Instructional Facility (CADIF) and for extending the CADIF concept to other institutions through the educational and software-sharing project SOCRATES. Ingraffea is a faculty member and the associate director of the university's Program of Computer Graphics. Mink is the director of the college's educational computing facilities.

Ingraffea is also the director of a new National Engineering Education Coalition. This five-year, $30.6-million program involves eight universities, including Cornell, in an effort to develop high-technology methods of teaching engineering and to increase the number women and minority engineers.

Mary J. Sansalone, M.S. '84, Ph.D. '86, who joined the faculty in 1987, has received several awards, including a 1989 Presidential Young Investigator Award from the National Science Foundation, the 1989 Excellence in Teaching Award at the College of Engineering (which is sponsored by the Cornell Society of Engineers and Tau Beta Pi), a 1988 Dean's Prize for Innovation in Teaching, and the 1989 Chi Epsilon Professor of the Year Award at the CEE school. She also won a Sears-Roebuck Foundation grant in support of research on effective teaching methods.

UPDATE

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