ChE educator

Michael B. Cutlip

of the University of Connecticut

*by Lucinda Weiss**

The teaching "bug" bit Mike Cutlip at an early age. He was taking sophomore calculus at Ohio State University in 1960 when his teacher, Margaret Jones, inspired by the way he explained problems at the board, asked him to teach an introductory math class. He did such a good job that he was subsequently hired as a "student assistant" to help teach algebra and trigonometry at OSU. On spring breaks, when others headed to Fort Lauderdale for fun and games, he went home to Milford, Ohio, a suburb of Cincinnati, and taught math or science at the high school as a substitute teacher when the opportunity arose.

Cutlip and his father, Sidney, representing (so far) over seventy-five years of teaching.

"I liked it. It kind of got me started in teaching," he recalls.

It began a career devoted to chemical engineering education in which Cutlip has combined a research interest in catalytic reactions with computer-based, self-paced educational programs for chemical engineering students. He has coauthored personal computer software that is presently used by more than one hundred chemical engineering departments, and he is president of CACHE Corp., a non-profit organization based at the University of Texas, Austin, which promotes the application of computing technology to chemical engineering education.

When Cutlip started taking chemical engineering courses at OSU, the slide rule still represented the prevailing technology. He majored in chemical engineering in a five-year program that combined the bachelor's and master's degrees. Joseph H. Koffolt was the department chairman at the time, and he was known for remembering all his student's names and calling them "his jewels." Cutlip still runs into his former classmates on occasion. "There are still a few gems around," he says.

But an even earlier influence on his decision to teach was his own father. Sidney Cutlip was the high school principal and was Mike's algebra teacher at Milford High. He, too, had started teaching at nineteen—in a one-room school that included all eight grades. He worked on his bachelor's degree during the summer months and eventually earned his master's degree. Now eighty-five and retired, his teaching career spanned forty-four years.

"I have a lot of respect for my father," Cutlip says.

Cutlip's high school chemistry teacher, Mary Moore, encouraged him to pick a profession such as chemical engineering. "Initially, I thought of high school teaching, but she encouraged me to consider other options as well," he says. One of those options was aeronautical engineering, but Cutlip particularly liked freshman chemistry and had the lucky foresight to reject aeronautical engineering as too dependent on government grants.

He also decided to study for a PhD so that he

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could eventually do research or teach, hoping to eventually expand his horizons beyond the Midwest. During one spring break at OSU he fortuitously visited the University of Colorado where Max S. Peters was the new Dean of Engineering. Peters was very supportive of young Cutlip's goals and later became Cutlip's PhD adviser.

But it was a ski-run down Aspen Mountain that clinched Cutlip's decision to attend graduate school at the University of Colorado. Cutlip and a fellow OSU chemical engineering student, Alkis Constantinides (now a chemical engineering professor at Rutgers University) had learned to ski on Ohio's Mt. Mansfield. He says, "For a guy who had skied before but who had only experienced a vertical drop of about 150 feet, skiing from the top of Aspen Mountain was an unforgettable experience!"

Cutlip did both his graduate and post-graduate work at Colorado, studying the catalytic properties of polymeric materials and looking for new catalytic materials. Cutlip points out that his adviser, Peters (who continued as Dean and who became vice president and then president of AIChE in 1967 and 1968), was good at delegating responsibility and often asked the graduate students to help write reports and develop proposals in addition to conducting their research. "What I learned from him was organization," Cutlip says.

Peters also helped Cutlip find his first teaching position. In 1968 Cutlip became assistant professor at the University of Connecticut, and was later appointed associate professor, then professor—and for "nine long years," he jokes, he was department head. He stepped down from that administrative post in 1989.

New England was quite a change of pace for Cutlip and his wife, Susan, who grew up in Denver and met Mike at the University of Colorado. On his first visit to UConn, Cutlip was surprised by its rural character. "I thought it would have been paved from New York all the way up through Connecticut," he says. When he got back to Colorado from that initial visit, he told Susan that he had driven around the area a little bit, "but I didn't see downtown Storrs." He didn't realize that "downtown" Storrs was a small grocery store, a movie theater, and a traffic light!

The chemical engineering department at UConn, then headed by Leroy Stutzman (now retired), was still relatively young, having seen its first students graduate in 1963. Cutlip pursued his interest in reaction engineering, applying catalysis to air pollution control. Among his projects at UConn has been a long-standing interest in the electrochemical processes in hydrogen/oxygen fuel cells and in looking for ways to improve their efficiency. As a result of this interest, he is heavily involved with the Pollution Prevention Research and Development Center, a new center in UConn's Environmental Research Institute that is supported by the EPA.

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When he came to UConn, he was encouraged by Stutzman, who was a consultant and later a board member at Control Data Corporation, to research the potential of computers in education. Stutzman introduced him to CDC's PLATO (Programmed Logic of Automated Teaching Operations) system, and they looked into using it for self-paced, individualized instruction. "I feel fortunate that I've been able to do both lab research—hard-core research—and educational research projects simultaneously," Cutlip said. "There are not a lot of environments where that can be accomplished."

Cutlip developed a self-paced, mastery-oriented course in reaction engineering for seniors. The students could come into the computer lab at any time, go through the tutorials at their own pace, and then take assignments and quizzes as they were ready for them. They could send and receive messages from the teacher and work out intricate problems using a touch-sensitive screen. Cutlip points out, "We could keep track of each student and pose problems for them. We could tailor each problem for each student."

Between the computer time involved and the hiring of programmers, it turned out to be a very expensive developmental project, but it determined Cutlip's focus as a teacher. "I definitely like the concept of self-paced learning and mastery, giving the student a choice of educational activities. It's quite different from a one-way lecture where the student is passive," he states.

Computer-based instruction also helps chemical engineering students deal with the demands of their curriculum, he believes. The chemical engineering curriculum tends to be one of the most rigorous at a university, he notes, involving extensive math, engineering, and chemical engineering courses, with a continually growing load of course work being squeezed into the same amount of time. He feels that requiring students to have a personal computer

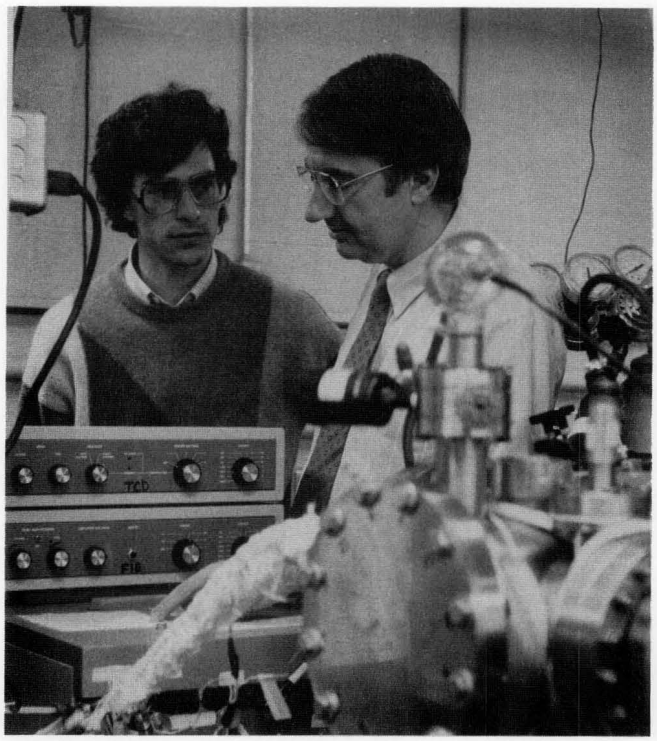
to use for tutorials would enrich their understanding of the course work.

Cutlip believes that the growing use of CD ROMs for personal computers will accelerate the development of computer-based learning methods. "We can get 650 megabytes of information on that little disk. It's a real educational challenge—what to put on it to enhance the educational process." He adds that CD ROMs could also be used for process design packages, for a physical properties data base, or for instructional modules that would serve as enrichment activities; health and safety training is another potential use. He points out that as students become more computer literate earlier in their education, computer-based course work will become a much more common approach to teaching.

One way to involve computer-based learning in chemical engineering education was developed by Cutlip and co-researcher Mordechai Shacham of Ben Gurion University in Israel. They developed a numerical analysis package, POLYMATH, that allows chemical engineers to use various numerical methods to solve chemical reaction problems on a variety of personal computers (Cutlip has both an IBM and an Apple in his office and uses both actively). Since it was developed ten years ago, POLYMATH has been refined and improved in several versions and is now widely used by chemical engineering departments. It is site licensed, so it is easily shared throughout a department by both faculty and students.

"In my view, if we provide students with the right general-purpose software, we can propose more realistic problems for them to use in their homework," Cutlip says. The homework could be more representative of actual industrial problems because the computer would allow the use of more complex numerical methods, and theory could then be taught in more detail. He adds, "It's a big opportunity for enhancing the educational process."

POLYMATH is distributed by CACHE, which develops educational products and supports projects that promote computer-aided chemical engineering education. One of CACHE's biggest successes in its twenty-three years, says Cutlip (who is in the first year of a two-year presidency of the non-profit organization), has been the introduction of computer-aided process design (via FLOWTRAN) with the help of the Monsanto Chemical Corporation. Recent CACHE activities include participation in three curriculum development projects (with National Science Foundation support) at the University of Michigan, Purdue University, and the University of Washington. Cutlip also is leading CACHE's effort to produce the first CD ROM for an educational discipline and has encouraged a new effort in advanced computing.



Cutlip and one of his former graduate students, Angelos Efstathiou, who is now doing teaching and research at the University of Patras in Greece.

Cutlip views the computer as a tool—much as the slide rule and the electronic calculator which preceded it—that aids students in mastering the material but which does not diminish the role of the teacher. He is actively involved with his students; they pop in and out of his office constantly. He greatly admired his own teachers, such as Peters, who were accessible to students even when they had heavy administrative responsibilities, and he has vowed to continue that tradition.

During the past semester Cutlip taught a graduate chemical reaction engineering course and the undergraduate laboratory. He is also the AIChE student chapter advisor for the second time in his UConn career (he served for six years the last time) and recently helped the students organize and host the New England Regional AIChE student chapter meeting.

He has been active in the local AIChE chapter himself, serving as chairman and vice chairman of the Western Massachusetts Local Section (which in-

cludes eastern Connecticut) and winning its Diamond Jubilee Award in 1983. He won the Ralph R. Teetor Award for Outstanding Teaching Record from the Society of Automotive Engineers in 1974 for his work in helping engineering students at UConn develop and engineer a prototype catalytic converter device for an urban car (before these were required on automobiles).

Cutlip has also been awarded fellowships to study and teach in the United Kingdom and in Japan. In 1990 he went to Japan to work on fuel cells and also gave seminars at six universities on interactive numerical methods in chemical engineering education. At his host institution, Yamanashi University, he held afternoon teas for Japanese students, giving them an opportunity to practice their conversational English. He observes that students in Japan have more day-to-day direction from their faculty advisers but less interaction in lectures than do their American counterparts.

He has taken two sabbaticals at Cambridge University in England (1974 and 1983) and regards Cambridge as his "second academic home." He first worked there with Dr. Nigel Kenney, and they have since shared post-doctoral researchers, graduate students, and research projects using computers in catalysis-related work. One result of their work, using gradientless reactors to study the oxidation of CO and hydrocarbon mixtures, was that they were among the first to determine that these reaction systems would oscillate or change with time in a repetitive way. They published and described mathematically and physically why this happened.

Another project that Cutlip developed at UConn as a result of this collaboration involved periodic reaction operation and the finding that the reaction rate can be enhanced by feeding in one reactant and then another, alternately instead of all at once.

While at Cambridge, Cutlip was a member of Fitzwilliam College, participating in college activities and learning how the English university system works. He found that the colleges allow faculties of different departments and interest to interact and get to know one another's fields.

The Cutlips also enjoyed living in a small village near Cambridge, where their son attended school and where Cutlip was elected to the PTA/school committee. Susan, who is an accomplished musician and plays the violin in chamber groups and orchestras in eastern Connecticut, was invited to play in both the Cambridge University Orchestra and the Cambridge Symphony while they were there.

Sabbaticals are one of the really great benefits of a university position, offering an opportunity to see how educational systems work and how societies function in other countries, Cutlip observes, adding "Chemical Engineering is a pretty small group of professionals at the academic level, and sabbaticals let you get to know people around the world." His most recent sabbatical was at the University of Adelaide in Australia in 1989, working with John Agnew, who is the chemical engineering department chairman there and who also worked in Cambridge with Kenney.

Cutlip and some of his Japanese students.

Before leaving for Australia, Cutlip stepped down from a nine-year tenure as department head at UConn. Although he jokes about the demands of that job, he confesses he "really enjoyed it—it's one of the most, if not *the* most important job at the university." It requires interfacing with so many varied groups, he notes—parents, prospective students, faculty, students, graduates, deans, administrators, business and industry, government, and accreditation bodies. "You are at the center of the network that really makes the university go," he says.

The chairmanship also offers an opportunity to have an impact on the curriculum and to recruit and nurture new faculty. One of the interesting contrasts of the job, he says, is trying to get the faculty to pull together as a cohesive group, yet encouraging faculty members to work on their own projects independently. "You have to be very persuasive in order to get all this to work," he declares.

Ultimately, Cutlip's primary career interest in chemical engineering has been teaching. As one who began teaching at nineteen and who is now fifty-one, he is likely to surpass his father's record in front of the blackboard. Or, perhaps more aptly, in front of the computer screen. ❐