ChE department

Chemical Engineering at . . .

Northeastern University

Northeastern University, Huntington Avenue entrance.

RALPH A. BUONOPANE
Northeastern University • Boston, MA 02115-5096

The history of Northeastern University is the history of cooperative education in the United States. In 1896 the Boston Young Men's Christian Association (YMCA) proposed that an educational institution should be responsible to the needs and demands of the local community. Boston was a growing coastal city at that time; its land area was expanding inland through the filling of hundreds of acres of tidewater lands and its population was expanding through the arrival of new citizens immigrating mainly from Eastern Europe.

Although Boston was already a center for advanced education by the 1890s (Boston College, Boston University, MIT, Radcliffe & Wellesley had been added to the existing Harvard and Tufts Colleges prior to this time), a college education was available only to those fortunate enough by heritage to be able to afford the luxury of an advanced education. Thus, in 1896 the Directors of the Boston YMCA established, "with an eraser and two sticks of chalk," an "Evening Institute for Young Men" to merge, coordinate, organize, and improve the lectures and classes that had developed during the first forty years of the Association's existence.

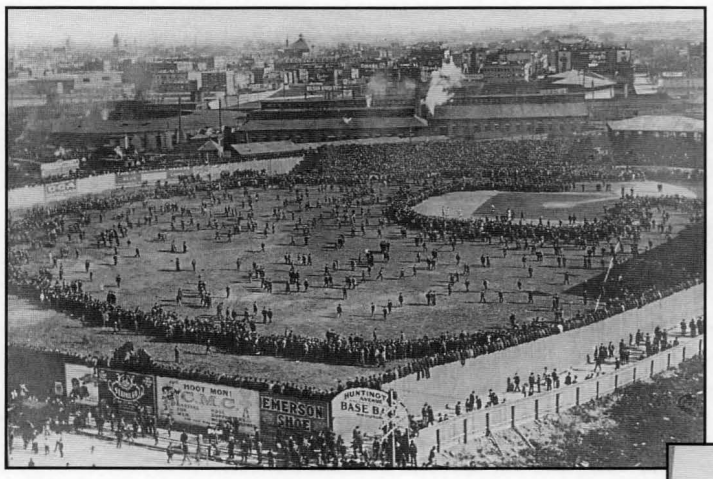
On October 3, 1898, the Boston YMCA established an "Evening School of Law," the first school of the educational units that were destined to become Northeastern University. The "Automobile School" in 1903 and the "Evening Polytechnic School" in 1904 were added to address the needs of the rapidly changing community.

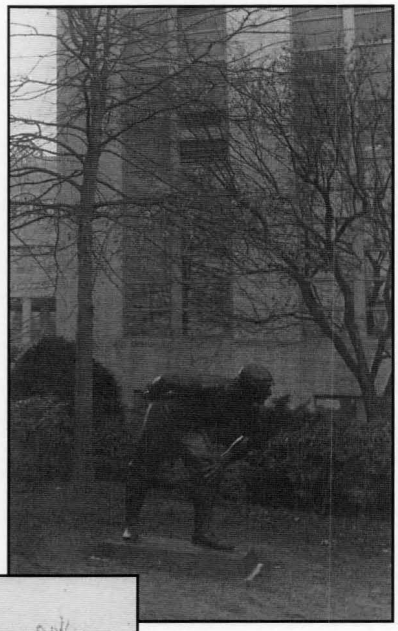
By 1909 the Boston YMCA began addressing the needs of younger boys in the growing Boston area by forming the "Association Day School," which provided a college preparatory program, and the "Co-Operative Engineering School," a day program providing young men of New England an opportunity to attend a technical school where both theory and practice are correlated while part of their educational expenses were earned through cooperative learning experiences. The Chemical Engineering Department was one of the original four day programs established as the "Co-Operative Engineering School" in 1909.

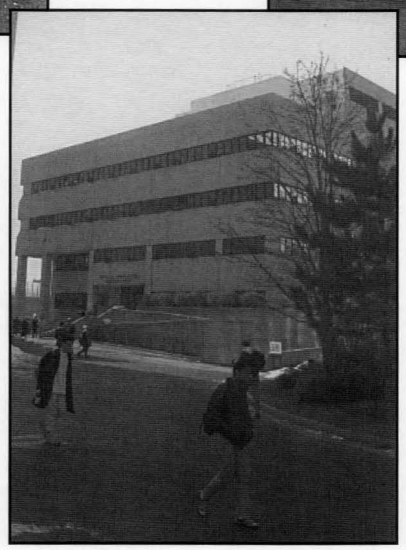
Today, Northeastern University is a private urban coeducational nonsectarian university offering cooperative educational programs in seven full-time basic undergraduate colleges. It is a modern, comprehensive urban university with nine graduate schools, part-time evening degree programs, and a Division of Continuing Education offering certificate and professional programs.

The main campus is located on fifty-five acres in the heart of the Back Bay (the bay that was filled) section of Boston. Near the center of the campus, which was the site of the "Huntington Avenue American League Base Ball Grounds" where the first World Series was played in 1903, there is now a life-sized bronze statute of Cy Young on the pitcher's mound poised to pitch to a batter. At the western edge of the campus are the world-renowned Boston Museum of Fine Arts, the Isabella Stewart Gardner Museum, and the Longwood Medical Area (New England Baptist Hospital-1903, Harvard Medical School-1906, New England Deaconess Hospital-1907, Peter Bent Brigham Hospital-1913, and Children's Hospital-1914). At the northern boundary lies Fenway Park, home of the Boston Red Sox, and the Fenway section of John Olmstead's "Emer-

"Huntington Avenue American League Base Ball" grounds in 1903, scene of the first World Series game (below). Lower photograph is of Snell Engineering Center, located today about where the grandstand behind home plate was, and the photograph on the right shows the statue of Cy Young that today stands on the site of the 1903 pitchers mound.







ald Necklace" of green space which threads through Boston. At the northeastern edge stands Symphony Hall, the New England Conservatory of Music, and the Christian Science Mother Church. To the east lies Copley Square, surrounded by the old and the new of Boston's major cultural/convention area; the original landmarks (Boston Public Library, Trinity Episcopal Church, and Copley Plaza and Ritz Carlton hotels) are intermingled with the new landmarks (John Hancock Tower, the Marriott and Westin hotels, and Copley Place).

In the southeastern corner of the University is the oldest multiple-use sports arena and artificial ice rink in the world—the Boston Arena, built in 1910. It was the first home of the Boston Bruins and was the site of the first Boston Celtics home game before the Boston Garden was built. Renamed Matthews Arena in 1977 after its purchase by Northeastern University, the late Boston Celtics Captain, Reggie Lewis, played all his collegiate basketball for the Northeastern Huskies there. The southern edge of the campus is bordered by the Northeast Corridor Amtrak line and the T Commuter Rail lines to the southwestern suburbs.

Thus, with the realistic goals of the founders of Northeastern University having been fulfilled, the location of the University continues to offer its students, faculty, and staff unique opportunities for interaction with the athletic, cultural, educational, medical, and religious institutions of the city. The campus now distinctly extends beyond the space and bounds of the single building shared by the YMCA and the College of Engineering in 1909. The College of Engineering now has office and laboratory facilities in four buildings, with primary locations near the center of campus in the Dana Research Center (1967) and the Snell Engineering Center (1984). The Egan Engineering/Science Research Center, presently under construction next to Dana and Snell, is expected to be completed in 1996. In addition to having offices and laboratories in the Snell Engineering Center, the Chemical Engineering Department also has offices and laboratories in Mugar Hall.

Chemical Engineering started with one student in 1909 when tuition was $100 a year (including YMCA membership), rooms were $1.50 a week, and board was from $3.50 to $5.00 a week. Cooperative work assignments paid from $5.00-6.00 a week for thirty weeks. By 1917, there were two faculty: Wm. F. Odom (also coach of the varsity baseball team) and Samuel A.S. Strahan, the first department head. It was operating under the considerations that *"a rapidly growing demand has arisen for men who possess, in addition to skilled chemical knowledge, the training and ability for the efficient control of plants and processes, economical utilization of power, the conversion of factory by-products into marketable commodities, and the adaption and design of mechanical appliances to carry out chemical reactions on a large scale."* The curriculum was defined such that chemical engineers *"must be able*

to consider propositions, processes, and plans from the combined viewpoints of the chemist and the engineer [and that their] *training should of necessity be very broad, combining that of both of the above named professions."* The cooperative plan of education then required that the men work in pairs, alternating one-week periods between the employing firm and the school.

The courses of study for chemical engineering included the traditional mathematics, physics, chemistry, and English courses, with descriptive geometry, mechanical engineering drawing, applied mechanics, practical electricity, thermodynamics, electrical engineering, heat engineering, and the metallurgy of iron required as engineering courses. The chemistry courses taken then were qualitative and quantitative analysis, organic chemistry, and industrial chemistry. There was also a senior professional course, **Chemical Engineering!**

. . . in 1896 the Directors of the Boston YMCA established, "with an eraser and two sticks of chalk," an "Evening Institute for Young Men" to merge, coordinate, organize, and improve the lectures and classes that had developed during the first forty years of the Association's existence. . . . [and] on October 3, 1898, [it] established an "Evening School of Law," the first school of the educational units that were destined to become Northeastern University.

Over the ensuing years the curriculum and the cooperative work employment assignments followed the natural changes slowly taking place in chemical engineering education and industry. During those early years the University experimentally changed the four-year alternating program of one-week periods of cooperative work and school to programs with two-, and then five-week periods before developing a five-year, ten-week term calendar in 1918 after World War I to accommodate the demands of the industrial sector for longer periods. In each year after the freshman year the students alternated school and work periods in two ten-week terms and one five-week term; the summer was divided into two five-week terms with a two-week "shutdown" between terms. The fifth year of the plan was the middle, or "Middler," year which was sandwiched between the typical freshman-sophomore and junior-senior years. The emergence of distinct principles of chemical engineering that incorporated the concepts of unit operations became the chemical engineering educational standard.

As the United States prospered between world wars, Northeastern College was renamed Northeastern University of the Boston YMCA in 1922, and then in 1935 became independent of the YMCA as Northeastern University. Chester P. Baker, one of "Pop" Strahan's students, graduated in 1920, became an instructor in 1921, and was appointed as the second chairman in 1939. Together with John C. Morgan, who joined the faculty in 1930, Baker guided the department through many years of change in the profession. Industrial chemistry was replaced with physical chemistry, and reaction kinetics and unit operations were expanded to form the nucleus of the unique chemical engineering disciplinary courses.

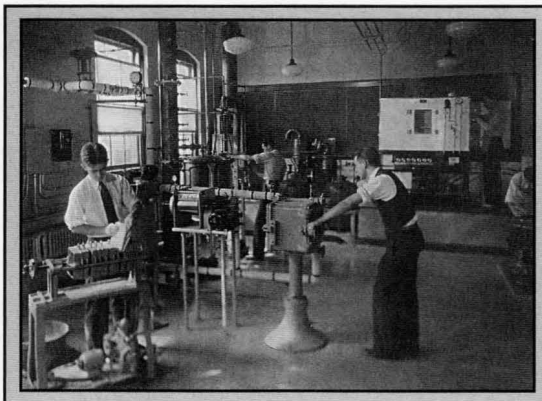
When Baker requested an accreditation visit from AIChE in 1939, the inspector turned down the request, indicating "among other things, a need for a larger unit operations laboratory that would have a two-story area of at least a thousand square feet." A new building, housing the Biology and Chemical Engineering Departments, was constructed in 1941 as a result. It not only included the thousand square feet of two-story area, but also a stock room, a machine shop, a travelling crane for installing equipment, floor drains, three underground water sumps, gas, water, electricity (DC), and steam. Ralph A. Troupe joined the faculty in 1940, and John C. Morgan was put in charge of the unit operations laboratory in 1941. In 1942 the department applied for and received its first accreditation, only the third in New England (after MIT and Yale).

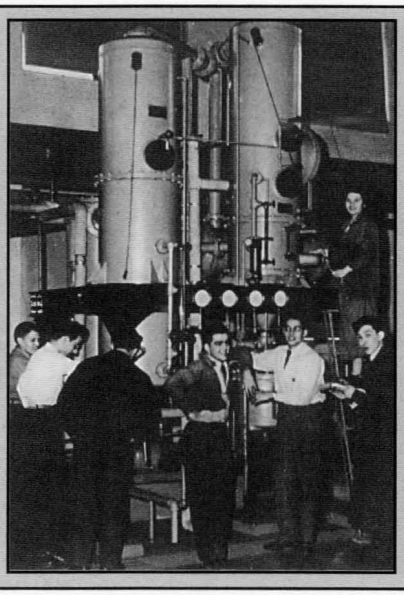
With the United States fully engaged in World War II, the first six women students matriculated in May, 1943, at the now coeducational Northeastern University. The only engineering student among those first six women was Lillian Kolodiz. In her first chemical engineering course with C.P. Baker, she was asked if she wanted to be a good engineer. Her "yes" response resulted in C.P. (Chemical Pure) Baker informing the class that she "would have to learn how to drink and swear because she couldn't be a good engineer unless she could do those things." Lillian Kolodiz Stone graduated with a BS in Chemical Engineering in 1946 after completing the demanding requirements of the accelerated continuous 36-month wartime program. In 1992, Lillian K. Stone, Chief of the Energy Facilities Division, Office of Environmental Affairs at the United States Department of the Interior received the Federal Environmental Engineering of 1992 Award from the Secretary of the Interior Department.

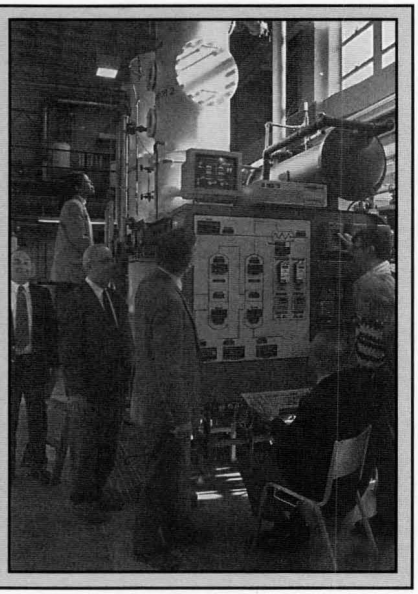
Although little appeared to change in the chemical engineering curriculum during the years betweem 1943 and 1950, the nature of a cooperative education program requires that current chemical engineering practices be continually integrated into academic courses. Additional courses in American and world literature, modern democracy, economics, and psychology became required, and courses such as philosophy, art, music, or history had to be elected.

While the United States engaged in the Korean conflict, the Cold War, and the space race in the late 50s and early

Evolution of a U. O. lab







The first laboratory (above, 935) was in a two-story YMCA building. The double-effect evaporator is shown in the center photograph with Lilian Kolodiz, first female ChE student. At far right is the double-effect evaporator today with the department faculty examining the modern computer control instrumentation.

60s, Northeastern University was expanding and the chemical engineering department was developing a graduate cooperative program to add to its successful and growing undergraduate program. Joining Professors Baker, Morgan, and Troupe in 1960 was Charles S. Keevil, who was the Chemical Engineering Chair at Bucknell before World War II. Three recent graduates of the department, John G. Miserlis ('53), Bernard M. Goodwin ('56), and Richard R. Stewart ('60), also were serving as instructors at that time. "Sam" Keevil was instrumental in forming the graduate masters program, which started in 1960 with one student. In 1961, Bernard M. Goodwin was appointed as an assistant professor to introduce the new "transport phenomena" approach to chemical engineering into the Northeastern University programs. Also that year, two cooperative graduate teaching assistants, Ralph A. Buonopane and Frederick C. Heron alternated their unit operations laboratory teaching assignments with graduate classes while six other graduate students alternated classes with assignments in industry. Thus, the first graduate cooperative program in chemical engineering was established.

In 1962, "Doctor" Troupe became the third chemical engineering department chairman when "Bone Dry" Baker retired. As both the undergraduate and graduate programs continued to grow, the department hired another young assistant professor in 1964, John A. Williams.

A full-time doctoral program leading to the PhD degree was established in 1964 with four doctoral students who had received masters degrees from the department. In 1965, the University adopted a new five-year academic calendar which operated with four 13-week quarters alternating between school and cooperative work assignments. Once again, the University responded to industry's call for students to spend a longer continuous period of time on cooperative work assignments. Although the quarter plan had proven successful for the undergraduate programs, the graduate programs shifted to full- and part-time operation without coop by 1920.

In 1967 the first PhD was awarded to Ralph A. Buonopane, who had been appointed an assistant professor in the department in 1966 to address the need for additional faculty to handle the growing number of undergraduate students (which had reached more than two hundred upperclass students by 1965). By the end of the 60s, as the University withstood the years of civil and student unrest, including a two-week closing in May 1970, the number of undergraduate chemical engineering students reached more than three hundred. In 1971 and '72, the department granted the largest number of BS degrees in the U.S.: 103 in '71 and 73 in '72.

Faculty changes in the 70s were made slowly and cautiously, while the number of graduate teaching assistants grew. In 1982, Ralph Troupe retired and Elisabeth Drake, became the fourth chairperson of the department, and in 1986, the fifth and current chairperson, Ralph A. Buonopane, was appointed. During these years, three new faculty were added to the department: Ronald J. Willey in 1983, Scott T. McMillan in 1987, and Donald L. Wise in 1987. When McMillan left in 1989 to start his own business, Gilda A. Barabino was hired to become the seventh faculty member in the present department. The current faculty members and their research areas of interest follow.

Gilda Barabino, the newest faculty member, teaches kinetics, biochemical engineering fundamentals, and polymer science. Her research specialties are in the areas of bio-fluid mechanics, bio-reactors, and sickle cell disease. She was the

recipient of the 1994 ASEE Dow Outstanding New Faculty Award for the New England Section and is the DiPietro Assistant Professor of Chemical Engineering.

Ralph Buonopane, the Department Chairman, teaches chemical engineering calculations and directs development of the chemical engineering laboratory. His research interests are in the area of developing novel process heat transfer equipment. He is a Fellow of AIChE, is active in ASEE and AIChE at the local and national levels, is involved in town government, and plays softball in his local community.

Bernie Goodwin, with the longest service in our department, teaches calculations computation lab, thermodynamics, separations processes, and engineering problem solving with applications software. His research interests are in the areas of computational thermodynamics and kinetics. He has edited the AIChEMI Modular Instruction Series in Thermodynamics.

Dick Stewart, a former Northeastern University varsity basketball player, teaches momentum transport, heat transport, chemical process control, and engineering problem solving and computation. His research interests are in the area of process control, and he is about to complete a textbook in that area.

Ron Willey, an avid "lunchtime basketball" player, teaches experimental methods, chemical process safety, and engineering design and graphics. His research work in the area of catalysis is specialized in the development of high surface area aerogels.

John Williams, a registered professional engineer, teaches the senior process design courses and economics. His students have received national awards in three of the last four years of the AIChE Student Design Contests.

Don Wise, a Vice President at Dynatech R&D before coming to Northeastern, teaches chemical process pollution control. He is the Director of the Center for Biotechnology Engineering and conducts research in the areas of controlled release materials and biological reactions for pollution control and waste minimization. He has edited five handbooks in these areas and is the Cabot Corporation Professor of Chemical Engineering.

Today, the department currently has about 130 upperclass chemical engineering students, with approximately 31% women, 7% international, and 8% minority students. In the past decade, the department has granted 326 bachelor's degrees, 95 master's, and 10 doctorates.

The curriculum today includes traditional calculus, physics, chemistry, and English courses, with engineering design and computer applications, taken in the freshman year; chemical engineering calculations, organic chemistry, and differential equations are required in the sophomore year; chemical engineering thermodynamics, momentum transfer, and physical chemistry are the middler year courses; experimental methods (unit operations laboratory), heat transport, separations processes, and economics are the junior-year courses; and the senior year includes process design, process control, three chemical engineering electives, an engineering elective in another department, and an advanced chemistry elective. To complete the non-engineering requirements, six social science/humanities courses (including macroeconomics) and a technical writing course to satisfy the University upperclass writing requirement are taken. The three current chemical engineering electives are chemical process pollution control, chemical process safety, and mass transfer operations.

All of the chemical engineering courses incorporate the most current practices used in academia and industry by emphasizing relevant problems and using current problem-solving techniques. The chemical engineering laboratory, named the Baker Laboratory in 1972, has been upgraded to include modern data acquisition and control equipment on most of the experiments. A large double-effect evaporator system, a 450-gallon agitated mixer unit, and a 10-foot, 7-tray distillation column are equipped for remote computer control. All experiments now include the use of modern electronic process sensors and remote computer data acquisition hardware and software.

By combining their classroom and laboratory experiences with cooperative work assignments, our chemical engineering students possess, as in the words of our founders, *". . . in addition to skilled chemical knowledge, the training and ability for the efficient control of plants and processes, economical utilization of power* [energy], *the conversion of factory by-products into marketable commodities* [pollution prevention], *and the adaption and design of mechanical appliances* [chemical process equipment] *to carry out chemical* [and biochemical] *reactions on a large scale."* Today, 130 undergraduate students are *"co-operating with* [fifty-six] *firms in connection with the Chemical Engineering course and* [the program] *could have more* [102 firms], *had we sufficient students to supply the demand."* A demand greater than the supply exists today, as it did in 1917 when "42 men" were assigned at "seven" companies.

As Northeastern University prepares to celebrate its Centennial Anniversary in 1998, cooperative education in chemical engineering is firmly established and progressing to meet the challenges of the next century. A 1973 alumnus of our department, Albert Sacco, Jr., is scheduled to be a Payload Specialist aboard the Space Shuttle Columbia (STS-73) on the second Microgravity Laboratory (USML-2) in late September, 1995. With the information and communications ages already in place, we are incorporating new methods of delivering chemical engineering education while our students are experiencing cooperative work assignments in the newly re-engineered workplaces of our industry. The future belongs to the chemical engineer! ❐