

HISTORY OF THE ChE SUMMER SCHOOLS

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Since 1931 the Chemical Engineering Summer Schools have remained a unique educational experience developed as a means of transferring the latest educational methods and technical information to new faculty; in essence, a mentoring process by experienced faculty to improve teaching and update curricula. Its impetus came from the Summer Schools for Engineering Teachers program developed by the precursor of American Society for Engineering Education (ASEE), the Society for the Promotion of Engineering Education (SPEE), founded at the World's Columbian Exposition held in Chicago, IL, in 1893. Before considering the development of these Summer Schools, it is helpful to briefly consider the history of chemical engineering and chemical engineering education.

HISTORY OF CHEMICAL ENGINEERING AND CHEMICAL ENGINEERING EDUCATION

Although chemical engineering can be traced back to 1572 — when Paracelsus first described the seven basic “Unit Operations” and “Unit Processes” as calcining, sublimation, dissolving, putrefaction, distillation, coagulation, and coloration in his book, *Von Naturlichen Dingen*^[1,2] — the major development of chemical engineering waited until the late 19th and early 20th centuries, which makes chemi-

cal engineering the newest of the four major engineering professions.^[3-5] In the 19th century chemical industries, operated by industrial chemists and mechanical engineers, rapidly developed. The concept of the Chemical Engineer was introduced: “. . . the word chemical engineer appeared in 1839 in a *Dictionary of Arts, Manufacturers, and Mines*, and . . . in 1879 the words were used also on a published drawing.”^[6] In 1881, George E. Davis, an industrial inspector from Manchester, England, made a serious attempt to form the society of chemical engineering.^[6] In 1887, Davis presented a series of 12 seminal lectures at the Manchester Technical Institute (now the University of Manchester) on chemical engineering. Davis introduced the concept of “Unit Operations,” although he did not use the term (coined by Arthur D. Little in 1915). Later, in 1901, Davis published the *First Edition of the Handbook of Chemical Engineering* with the 2nd Edition appearing in 1904.

Initially, engineering education was not accepted in university programs. “The then-traditional universities viewed engineering as too pragmatic and utilitarian for higher education.”^[7] In 1845 Union College in Schenectady, New York, opened its doors and offered a degree in civil engineering. Although engineering became more acceptable in universities after the

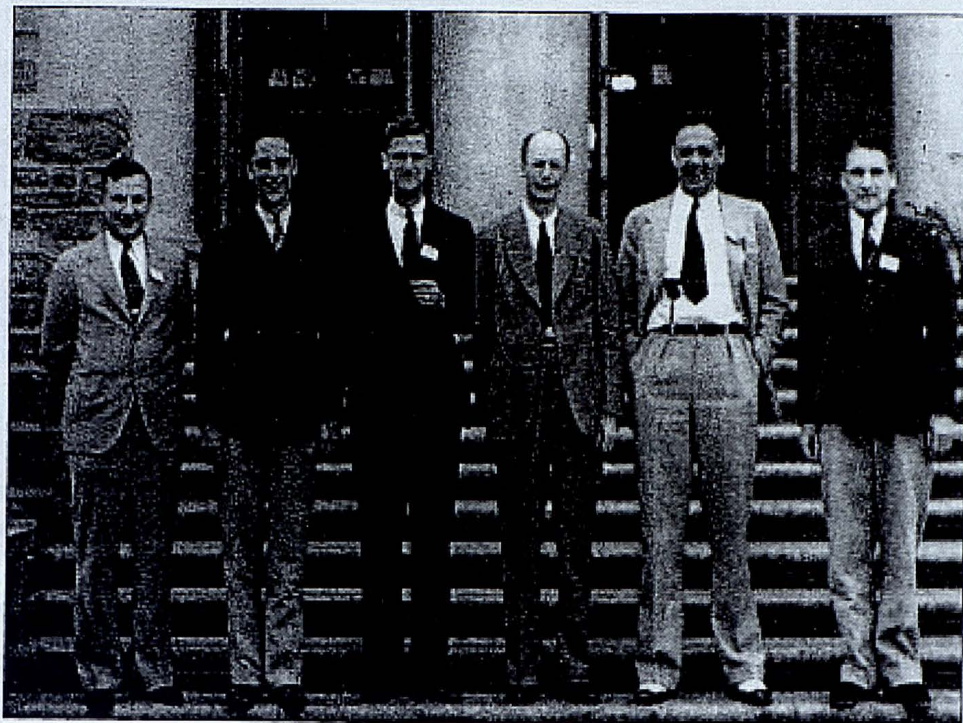


Fig. 8.2 SECOND SUMMER SCHOOL FOR CHEMICAL ENGINEERS

This photograph was taken at the Second Summer School for Chemical Engineers, sponsored by the Society for the Promotion of Engineering Education and held at the Pennsylvania State College in 1939. See the list of participants in section 8.6. From left to right, with year of PhD and major professor:

<i>Associate Professor Roland A. Ragatz</i>	<i>PhD 1931</i>	<i>Kowalke</i>
<i>Graduate Student W. Robert Marshall, Jr.</i>	<i>PhD 1941</i>	<i>Hougen</i>
<i>Graduate Student William A. Bain, Jr.</i>	<i>PhD 1943</i>	<i>Hougen</i>
<i>Associate Professor Allan P. Colburn</i>	<i>PhD 1929</i>	<i>Hougen</i>
<i>Professor Olaf A. Hougen</i>	<i>PhD 1925</i>	<i>Kowalke</i>
<i>Assistant Professor Roger J. Altpeter</i>	<i>PhD 1934</i>	<i>Kowalke</i>

In 1939, Colburn was on the faculty at the University of Delaware.

Question: Why is Olaf laughing about the pancake turner that is stuck in his belt?

(Photo by Roger Altpeter)

This image provided by Professor Bird at Wisconsin highlights some of the leaders in Chemical Engineering who attended the 1939 Summer School.

passage of the Morrill Land Grant Act of 1863,^[7] chemistry had a longer history and more acceptance in universities. In the United States most early chemical engineering programs were founded in chemistry departments.^[8,9] The first four-year curriculum in chemical engineering was offered at the Massachusetts Institute of Technology in 1888 when Lewis Mills Norton, professor of industrial chemistry in the Chemistry Department, introduced a course on industrial chemistry practice called "Course X." In 1920 it became a separate Department of Chemical Engineering. Other early chemical

engineering programs were the University of Pennsylvania in 1892, Tulane University in 1894, the University of Michigan and Tufts University in 1898, and the University of Illinois-Urbana Champaign in 1901.^[8] The first independent chemical engineering department in the United States was the University of Wisconsin in 1905.^[8] The Newark Technical School (now New Jersey Institute of Technology) in 1881, Case Western Reserve University in 1884, and other schools offered courses in industrial chemistry that were eventually converted into chemical engineering programs.^[8-10]

American engineers started to organize with the founding of the American Society of Civil Engineers in 1852, the American Institute of Mining Engineers in 1871, the American Society of Mechanical Engineers (ASME) in 1880, and the American Institute of Electrical Engineers in 1884.^[3] At the beginning of the 20th century the chemical industry was developing rapidly and the need for a professional society for chemical engineers in the United States became apparent. Richard K. Meade, a chemist by education, was the editor and founder of *The Chemical Engineer* in November 1904. Near the end of its first year of publication, in October 1905, in an editorial, he asked the question, "Why not the American Society of Chemical Engineers?" Finally, after much opposition from

The American Chemical Society and ASME, officers were elected, committees formed, and the American Institute of Chemical Engineers (AIChE) was founded on June 22, 1908. The AIChE committee on Chemical Engineering Education, chaired by Arthur D. Little, studied chemical engineering programs and in 1922 came to the controversial conclusion that chemical engineering was based on the unit operations and involved industrial-scale chemical processes. In 1922 an AIChE committee chaired by H.C. Parmelee started to study the 78 programs that claimed to teach chemical engineering to

SPEE SUMMER SCHOOLS FOR ENGINEERING FACULTY

In 1925, William E. Wickenden, director of Investigations and Coordination for SPEE, was a guest of the English Board of Education as an unofficial observer of the Summer School for Engineering Teachers at Oriel College, Oxford University, England, UK. He was very impressed and felt that the concept could be transplanted to the United States. He suggested that SPEE “might organize and conduct one or more such schools as a cooperative undertaking of the colleges.”^[15] With funding received from the Carnegie Foundation, the Summer School for Engineering Teachers was held following the June 1927 Annual SPEE Meeting in two sessions, two and one-half to three weeks long, on Mechanics; first at Cornell and second at Wisconsin. The first 12 Summer Schools of SPEE are listed in Table 2.

Hammond^[16] stated, “. . . when the Summer School was established it was planned to follow this system of rotation of subjects so that in time all of the important divisions of engineering study would be considered.” The first cycle was completed in 1933.

SUMMER SCHOOLS FOR CHEMICAL ENGINEERING FACULTY

After the initial period of Summer Schools for Engineering Teachers, 1927-1933, SPEE gave them up to the individual professions.^[17] After 1931, the ChE Summer Schools were organized by the Chemical Engineering Division (ChED) of ASEE.

The 1st Summer School for Chemical Engineering Faculty held at the University of Michigan from June 22-July 15, 1931, was directed by Alfred H. White with W. L. McCabe as secretary. It was followed on July 10 and 11 by the fourth Conference on Chemical Engineering sponsored by AIChE

at Ann Arbor, Michigan. The program included: Principles of Teaching, Teaching ChE and Allied Subjects, Applications of Principles of ChE, and Miscellaneous (including History, Recreation, and Inspections).^[18] The presenters were a who’s who of chemical engineering^[17]: W.K. Lewis, The Place of Unit Operations in a ChE Curriculum; W.L. Badger, Historical Development of ChE; W.H. McAdams, Drying; H.C. Hottel, Radiation at High Temperature Heat Flow; and J.V.N. Dorr, Filtration.

TABLE 1
11 Decades of Chemical Engineering

1.	1905-1915	Industrial Chemistry
2.	1915-1925	Unit Operations
3.	1925-1935	Material and Energy Balances and Unit Processes
4.	1935-1945	Thermodynamics and Process Control
5.	1945-1955	Applied Kinetics and Process Design
6.	1955-1965	Transport Phenomena, Process Dynamics, Process Design, and Computer Technology
7.	1965-1975	Polymers, Reaction Engineering, Process Optimization, Model Building, and Applied Statistics
8.	1975-1985	Biotechnology, Catalysis, and Computer Aided Process Design and Control
9.	1985-1995	Processing of Microelectronic Materials
10.	1995-2005	Molecular Engineering and Nanotechnology
11.	2005-current	Biosciences surge including Biology, Biochemistry and Cell Biology.

determine which programs were satisfactory. The June 1925 Parmelee report, with the names of 14 acceptable programs, constitutes the beginning of engineering accreditation in the United States.^[11] After the Parmelee report, most industrial chemistry programs converted to chemical engineering.

Olaf Hougen,^[12,13] in the Bicentennial Lecture, “Seven Decades of Chemical Engineering,” identified the principal areas of chemical engineering in the first seven decades. The University of Wisconsin’s description of “110 Years of Chemical Engineering” expanded Hougen’s seven decades of chemical engineering to 10, and Armstrong^[14] added decade 11 (Table 1).

TABLE 2
The First 12 Summer Schools of SPEE

1	1927	Cornell University	Mechanics
2	1927	University of Wisconsin	Mechanics
3	1928	Massachusetts Institute of Technology	Physics
4	1928	University of Pittsburgh	Electrical Engineering
5	1929	Purdue University,	Mechanical Engineering
6	1930	Carnegie Institute of Technology	Drawing and Descriptive Geometry
7	1930	Yale University	Civil Engineering
8	1931	University of Michigan	Chemical Engineering
9	1931	University of Minnesota	Mathematics
10	1932	Stevens Institute of Technology	Economics
11	1932	Ohio State University	English
12	1933	University of Wisconsin	Mining and Metallurgical Engineering

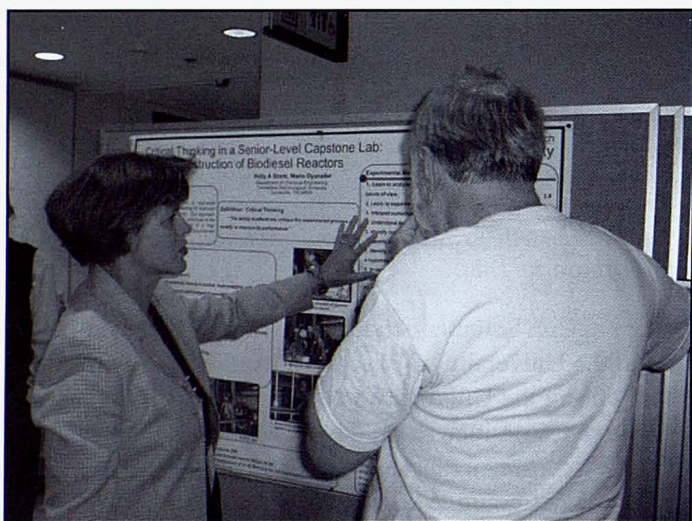
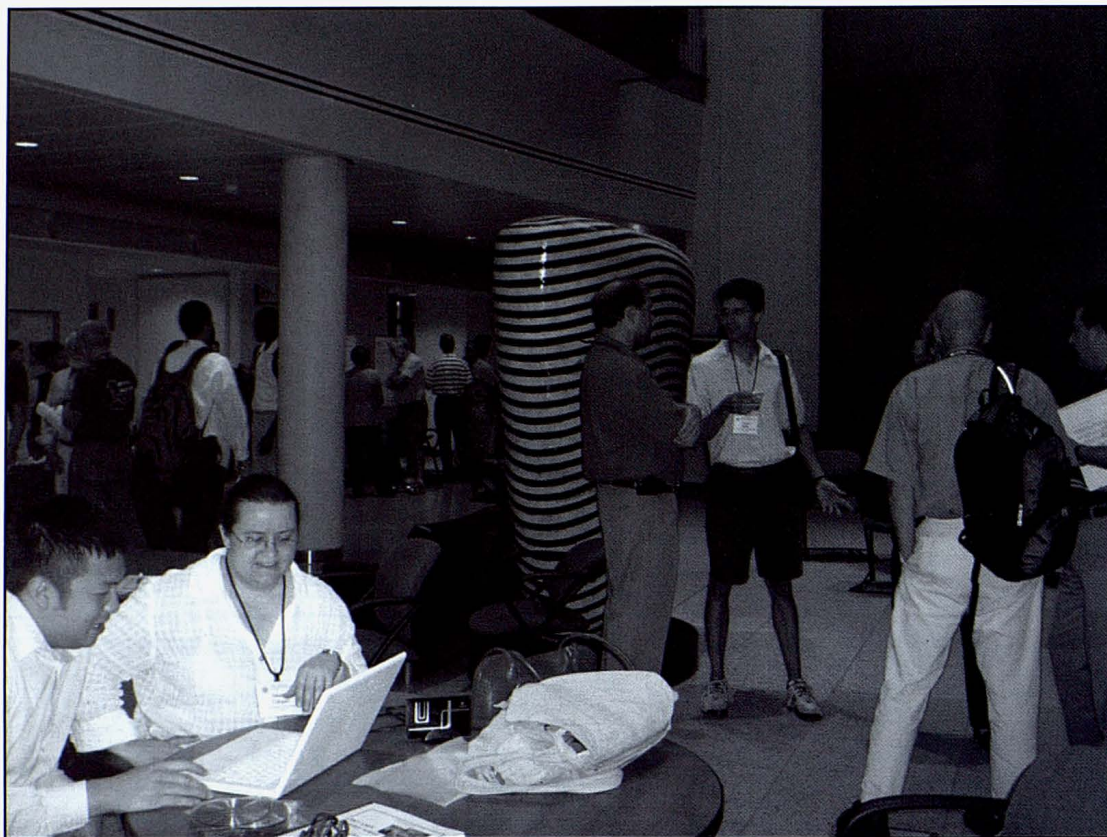


Class of '82: These double group shots attest to the strong turnout at the 9th Annual Summer School, held at the University of California-Santa Barbara in 1982.

The 2nd ChE Summer School was held at Pennsylvania State College in State College, PA, from June 21-30, 1939, in conjunction with the 47th Annual Meeting of SPEE from June 19-23. During the Summer School period there were three periods of one hour each in the morning and one period of one and a half hours in the afternoon (sessions ended at 3:00 p.m.). This schedule left time for informal discussions. R. C. Kintner, Armour Institute of Technology, director of the Summer School, announced the general theme, "What Should We Teach and How Can We Teach It?"^[17] Unit Processes appears to have been an informal theme. The presentations were again done by well-known chemical engineers^[17]: B.F. Dodge, The Teaching of Thermodynamics; R.N. Shreve, The Teaching of Unit Processes; R.C. Kintner, Inorganic Unit Processes; R.N. Shreve and R.K. Toner, Unit Processes Laboratory; A.P. Colburn, The Teaching of Absorption; W.M. Cobleigh, Engineering Economy; C.P. Baker, Plant Design Instruction; O.A. Hougen, Comprehensive Problems; K.M. Watson and C.S. Keevil, Kinetics; and R.A. Ragatz, Instruments for the Measurement and Control of Process Variables.

The 3rd ChE Summer School, delayed by World War II, was held at the University of Wisconsin from Aug. 30 to Sept. 4, 1948, during the University's centennial year.^[17] The ChED Executive Committee chaired by Ronald A. Ragatz, University of Wisconsin, organized the event. The general theme was again "What Should We Teach and How Can We Teach It." The program included sessions on: Unit Processes; Report Writing; Thermodynamics; Electrochemistry; Mathematics; Chemical Reaction Kinetics; Graduate Programs; The Newer Unit Operations; Plastics Technology; and Teacher Qualifications and Development. Consensus was that chemical reaction kinetics had completed its apprenticeship in research laboratories and was ready to rank with thermodynamics and applied mechanics as a working engineering tool. The best way to teach kinetics was as part of reactor design.^[20] In 1977, Ragatz wrote, "One unique thing about the third Summer School was that it was completely self-supporting, there were no subsidies from ASEE or from industry."

The 4th ChE Summer School was held at Pennsylvania State University at University Park, PA, from June 27 to July 2, 1955,



*Scenes from the 2007 Summer School:
Evening socializing, top; the Poster Session, bottom.*

during the university's centennial year. The continuing large influx of students into chemical engineering following World War II had caused a large influx of young, new teachers, who would benefit from a summer school.^[17] The theme of the fourth Summer School was "What's Ahead in Chemical Engineering Education." Kenneth A. Kobe from the University of Texas was General Chairman and F.L. Carnahan of Penn State served as Local Arrangements Chairman. The sessions were on: Process Rates, Design and Economics, Nuclear Curricula, Engineering Science Approach in ChE Teaching, Instrumentation and

Process Control, Applied Mathematics, ChE Laboratory, The First Course in ChE, Teaching of Thermodynamics, Teaching of Unit Operations, Teaching of Plant Design and Economics, and Studies of Instruction by Television.

The 5th ChE Summer School, held at the University of Colorado at Boulder, Colorado, from Aug. 20-25, 1962, followed the 69th Annual ASEE Meeting at the U.S. Air Force Academy. This summer school started the current five-year cycle. General Chairman Lloyd Berg of Montana State College and Chairman of Local Arrangements B.E. Lauer of the University of Colorado obtained partial

support from NSF. The theme was "Advances in Chemical Engineering Education." The program included sessions on Unit Operations and Physical Separations, Materials Engineering, Materials Instruction for Chemical Engineers, Computers in Engineering Education, Optimization of Chemical Processes, Undergraduate Kinetics, Chemical Content of the ChE Curricula, Modern Industrial Design, The Purpose of the Undergraduate Laboratory, Industry's Opinion of the ChE Graduate, Advances in Heat and Mass Transfer, Material and Chemical Process Design Calculations, Use of Computers in Teaching ChE, and Use of Analog Computers to Teach Process Control.^[17] This Summer School appears to be the first to devote an entire morning of sessions to the use of computers in ChE Education. It is very clear that significant changes had taken place in ChE education and practice since the 1948 Summer School.

The 6th ChE Summer School was held from June 20-24, 1967, concurrently with the 74th Annual Meeting of ASEE at Michigan State University. For the second time Lloyd Berg of Montana State University was the general chairman. Donald K. Anderson of Michigan State University was chairman for Facilities and Housing. The theme was "Dynamic Objectives of Chemical Engineering Education." The program included sessions on Chemical and Statistical Thermodynamics, Process Dynamics and Optimization, Teaching of Transport Phenomenon and Applications, Kinetics, Catalysis and Reactor Engineering, Future Trends in ChE Education, Are Engineers

Selling Their Birthrights for a Place in the Ivory Tower?, Industry Needs Scientific Engineers NOT Engineering Scientists, Current Problems in Computer Control, Equations of State from Statistical Thermodynamics, Mass Transport Phenomena in the Human Circulatory System, Reactor Design Engineering, and Undergraduate Laboratory Experiments in Reaction Kinetics and Reactor Design.^[17]

The University of Colorado at Boulder was the site for the 7th ChE Summer School from Aug. 13-18, 1972. L. Bryce Andersen of Newark College of Engineering was the chairman of the Planning Committee. The three objectives were: (1) to upgrade ChE subject matter in important developing areas; (2) to share new teaching approaches and; (3) to explore new educational objectives. The five-day program included parallel morning workshops on Chemical Process Design and Engineering, Integration of Biomedical and Environmental Applications of ChE into Undergraduate Courses, Applications of Molecular Concepts of Predicting Properties Needed for Design, Numerical Methods for ChE Problems, and New Developments in Undergraduate Laboratories. Attendees selected which extended workshop to attend. The evening program included panels on: Effectiveness of Graduate Engineering Education—Industry vs. Academic Viewpoint; Training of Foreign Graduate Students—Problems and Solutions; and Trends in Engineering Education—Will the M.S. Program become the First Professional Degree in ChE?^[17] Two afternoon sessions were presented by CACHE (Computer Aids for ChE Education).

The 8th ChE Summer School, held at Snowmass Village in Snowmass, Colorado, from July 31-Aug. 5, 1977, was the first summer school not held on a university campus. The co-chairmen, C. Judson King and Michael C. Williams of the University of California-Berkeley, organized the school in a Gordon Conference format, with programs in the morning and evening and afternoons free. The co-chairs obtained significant financial support from 31 companies, NSF, and the Camille and Henry Dreyfus Foundation, Inc. J. Peter Clark of Virginia Tech was in charge of Local Arrangements.^[17] The theme was “New Applications of Chemical Engineering,” organized in a series of one- or two-day workshops arranged in seven simultaneous morning and evening sessions. Workshop topics included Biochemical Engineering; Chemical Reactions; Economics and Industry; Applied Chemistry; and Surfaces, Teaching, Administrative, and special ‘potpourri’ workshops.

The 9th ChE Summer School, held at the University of California-Santa Barbara from Aug. 1-6, 1982, again used the Gordon Conference format. The school was organized by T.W. Fraser Russell and Stanley T. Sandler, University of Delaware. Dale E. Seaborg of the University of California at Santa Barbara was in charge of local arrangements. Financial support was provided by 36 industrial companies. The general theme was “Chemical Engineers Need to Have an

Impact on Society in a Broader Sense.” The program was organized in a series of one- or two-session workshops arranged in six simultaneous morning and evening “threads of interest.”^[17] The threads were New Technical Directions in ChE, The Expanding Role of Computers in ChE Education, ChE in the Classroom and Laboratory, Industrial-University Interactions, The Social Responsibilities of the Engineer, and Chemical Sciences and Chemical Engineering. “Hands-on” computer sessions were held on Tuesday, Wednesday, and Thursday afternoons and there was a Special Poster Session on ChE Teaching.

Glenn L. Schrader and Maurice A. Larson from Iowa State University organized the 10th ChE Summer School held at Southeastern Massachusetts University at North Dartmouth, Mass., from Aug. 9 to 14, 1987. L. Bryce Anderson, dean of Engineering at Southeastern Massachusetts University, and Stanley M. Barnett of the University of Rhode Island, were in charge of local arrangements. Financial support was provided by 16 industrial companies. The theme was “The Revitalization of the Chemical Engineering Curriculum” in response to the changing technological needs of modern society.^[17] The program was organized with five plenary sessions followed by a series of four parallel workshops (blocks) arranged in eight simultaneous morning and evening sessions. The five plenary sessions were: Future Curriculum Directions in ChE, Industrial Needs in Biotechnology, Industrial Needs in Electronic Materials Processing, Industrial Needs in Advanced materials and Composites, and Computers in ChE Education. The four blocks were: Emerging Technology; Computers and Computation in ChE Education; Applied Chemistry in ChE; and Curricula, Courses, and Laboratories. Phil Wankat, Rich Felder, and Dendy Sloan presented an afternoon teaching workshop for new faculty.

The 11th ChE Summer School was held at Montana State University in Bozeman, Montana, from Aug. 9-15, 1992, at the start of the ASEE Centennial Year. Ralph A. Buonopane of Northeastern University was the chairman and John T. Sears and Ron Larson of Montana State University were in charge of local arrangements. Financial support was provided by NSF and 10 industrial companies. The theme was “Frontiers in Chemical Engineering Education—Curriculum and Needs for the Next Century.” The program was organized in four parallel workshops arranged in simultaneous morning and evening sessions. A thematic plenary session—“The Future Belongs to Those Who Prepare,” “Interactive Dynamics of Convection and Crystal Growth,” “How Modern Chemical Engineering Came About,” and “ChE Education Needs Industry’s Viewpoint”—opened each of the morning workshop sessions. The workshops were on Biotechnology, Computers-CACHE, Mixing, Effective Electronic Materials, Environmental, Process Safety, Separations, and Undergraduate Laboratory and Computer Data Acquisition. Reaching out to younger faculty, women, and minorities was a goal of

this summer school. On Sunday NSF sponsored an effective teaching workshop for new faculty by Phil Wankat and Helen Hanesian. Of the 147 participants, 50 were new faculty, 21 were female chemical engineering participants (of whom 16 were faculty), three were graduate students and two were industrial participants. The program was developed to allow all to make new and lasting friendships and to have the older faculty share their experiences with the new generation of chemical engineering teachers.^[17]

Bruce Finlayson of the University of Washington directed the 12th ChE Summer School held at the Snowbird Conference Center in Snowbird, Utah, on Aug. 9-14, 1997. Lamont Tyler and Edward Trujillo, University of Utah, were in charge of local arrangements. Financial support was provided by NSF, the Universities of Utah and Washington, and eight industrial companies. The plenary sessions included: "Learning Styles and Problem Based Learning" and "Synergism between Research and Teaching in Separations." Phil Wankat presented a workshop on "Teaching Effectiveness for New Faculty." There were parallel workshops on: Use of Computers and Computer Technology, Written Communications, Chemical Process Safety Education, Electronic Materials, Environmental Protection and Pollution Prevention, Biotechnology and Biomaterials, Fluid Particle Processes, Undergraduate Laboratories: Their Importance to ChE Education, Outcomes Assessment & ABET Criteria 2000, Preparing Graduate Students to Teach, and Freshman Engineering Design and Capstone Design. With 33 sessions from 95 presenters and organizers, over 99 universities were represented by 180 participants.

The 2002 ChE Summer School, the 13th, was held at the University of Colorado in Boulder from July 27 through Aug. 1, 2002. The co-chairs were H. Scott Fogler, University of Michigan, and Michael Cutlip, University of Connecticut. Robert H. Davis, University of Colorado, was in charge of local arrangements. Financial support was provided by NSF, Minorities in CHE Faculty-Christine S. Grant-NCSU, University of Michigan, University of Colorado, EPA, CACHE Corporation, and eight industrial companies. This summer school strived to promote development of primarily new faculty with the assistance of established faculty and industrial organizations, and included representatives of NSF and EPA. The 2002 summer school was planned for an especially auspicious time, as interest in teaching was greater than it had been in the last 25 years. Many ChE departments were revising their curricula in response to new ABET criteria, and knowledge was rapidly changing in a number of important areas. The Effective Teaching workshop was presented by Richard Felder, Rebecca Brent, and Phil Wankat. Poster sessions included presentations of: learning styles, general approaches and outreach, strategies for lecture and laboratory courses, and computer-based strategies. Additionally, materials from the summer school were placed on the Internet for faculty who were not able to participate.

The 14th ChE Summer School was held at Washington State University in Pullman, Wash., from July 28- Aug. 2, 2007. The theme for the Summer School was Education for the 21st Century. Co-chairs were Steven LeBlanc, University of Toledo; Kirk Schulz, Mississippi State University; Douglas Ludlow, University of Missouri-Rolla and Richard Zollars, Washington State University. Richard Zollars was also in charge of local arrangements. Financial support was provided by NSF and two industrial companies. The Effective Teaching workshop was presented by Richard Felder and Rebecca Brent. The session workshops included: Molecular Simulation, Process Design, Outcomes Assessment, New Approaches, Sustainability, Spreadsheets, Safety, Career Development and Pre-College Activities, Quantum Chemistry, Product Design, ChE Problem Solving, Bio-Basics, CFD, New Teaching & Learning, How to Succeed as a Female Engineer in Academia: Lessons Learned, Remote Labs, CACHE Systems Biology, Novel Experiments, Nano, and Process Design. The Plenary Sessions were: "Workforce Planning and Development: University/Industry Collaboration," "Unboiling the Egg: Protein -Disaggregation and Refolding under Hydrostatic Pressure," and "The Innovation Imperative."

CONCLUSION

Today only Chemical Engineering has continued its Summer School program! The 15th ChE Summer School was held at the University of Maine in Orono, Maine, July 21-27, 2012. Although we could not present all the details here, the complete "History of the Summer Schools for Chemical Engineering Teachers (Faculty)" will be available at <<http://www.asee-ched.org>> and in libraries at AIChE, ASEE, ACS, Library of Congress, Linda Hall Library, Chemical Heritage Foundation, NJIT, and Northeastern University.

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