1987 SUMMER SCHOOL

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The 1987 Summer School for Chemical Engineering Faculty, arranged through the Chemical Engineering Division of the American Society for Engineering Education, was held on August 9-14, 1987, at Southeastern Massachusetts University, North Dartmouth, Massachusetts. Over 350 attendees were present at the meeting, representing 113 universities in the United States and Canada and several European and Australian schools. Sixteen industrial sponsors (see Table 1) contributed nearly $100,000 to assist in the planning of the program, local expenses, and costs for instuctor and faculty member participation. It was the tenth Summer School in a series begun in 1931.

The theme of the 1987 Summer School was the revitalization of the chemical engineering curriculum in response to the changing technological needs of modern society. Five plenary sessions were held to discuss some of the broader implications of these changes. Four blocks of workshops were organized around specific themes: Emerging Technology (G. L. Schrader, Iowa State University), Computers and Computation in Chemical Engineering Education (H. S. Fogler, University of Michigan), Applied Chemistry in Chemical Engineering (J. W. Schwank, University of Michigan), and Curricula, Courses and Laboratories (J. C. Friedly, University of Rochester). Forty-four faculty members and industrial speakers served as instructors for the meeting, all donating their time and effort.

The first plenary talk addressing the general future curriculum directions in chemical engineering was given by Professor James Wei of the Massachusetts Institute of Technology. Professor Wei discussed the important need for a new paradigm in the curriculum, such as were provided by the unit operations and transport phenomena directions in the 1920s and 1960s. Because of the loss of important sectors of America's industrial economy, there has been a general concern regarding engineering education in the United States, and there are strong pressures for chemical engineers to become involved in new technological areas. Within traditional courses, there are opportunities to introduce new emphases or problems at the micro-, meso-, and macroscale at which chemical engineers are accustomed to work. For example, instead of dealing only with small molecules, gases and homogeneous liquids, large molecules, complex liquids and solids should be addressed; rather than being concerned exclusively with inorganic or organic chemistry applications, biochemistry, material science, and condensed state physical chemistry should have a role in chemical engineering courses. Professor Wei provided a number of specific curriculum suggestions, among which was the discussion of a product engineering course which would explore the relation between molecular configuration and aggregation and product quality. The design and synthesis of materials with specific performance in use could also be included in traditional design courses. Also proposed were courses in surface and colloid chemistry, electronic materials processing, biotechnology, and solid state chemistry. The new technological demands made on the chemical engineering profession may lead to need for new educational plans and degree requirements. Professor Wei pointed to the difficulty of cramming more courses or course content into the four-year BS degree and to the decline of the industrial "apprentice" format as traditional industry reduces senior staff, leaving fewer experienced engineers to teach incoming graduates. This is coupled with an information explosion which has made it increasingly difficult for all levels of engineers to be technically well-informed. Professor Wei called for a new consensus among academic and industrial engineers in which the first professional degree (four-year BS) is regarded as being suitable for light technical work such as marketing, administration, technical personnel, or production planning. To be effective in heavy technical work such as design, process development, consulting, and construction, the student should obtain a MS degree or secure a significant apprenticeship with an experienced senior engineer.

Dr. Stanley Proctor of Monsanto discussed "Biotechnology and Chemical Engineering Education" in the second plenary session. The value of products from biotechnology is projected to grow enormously by the year 2000, with major opportunities coming in human health care, crop science, and waste management. Dr. Proctor stated that chemical engineering is a good base from which the student can expand into the biotechnology area, specifically by the addition of life science courses such as microbiology, biochemistry, and biochemical engineering unit operations. Biotechnology can also be introduced into the core courses of chemical engineering with subjects such as bioreaction engineering and bioprocessing purification and separation. There is a need for laboratories suitably equipped for life science studies, with the appropriate unit operations and instrumentation. It is especially helpful to use laboratory assistants with life science backgrounds, as well as having faculty members with life science training. Dr. Proctor raised the difficulty of doing this in a four-year program, but suggested improving the curriculum flexibility, incorporating biotechnology into existing courses, reducing duplication, and eliminating credit for courses which are prerequisite for program admission. Dr. Proctor projected that the largest need for BS/MS

TABLE 1
Industrial Sponsors

American Cyanamid Company
Amoco Oil Company
BASF Corporation
Chevron Corporation
Dow Chemical U.S.A.
Dow Corning Corporation
E. I. du Pont de Nemours & Company
EXXON
Merck, Sharp & Dohme Research Labs
Phillips Petroleum
PPG Industries Foundation
Shell Development Company
Tektronix
The Standard Oil Company (SOHIO)
3M
Union Carbide Corporation

biotechnology graduates focused on design and operation will come after 1990.

The opportunities for chemical engineers in high technology materials processing was addressed in two plenary sessions presented by practicing chemical engineers. Dr. Michael Bohrer of AT&T Bell Laboratories discussed "Chemical Engineering in Electronic Materials Processing." Chemical engineers have made substantial contributions to modern silicon and optical fiber manufacturing technology. The core curriculum has served chemical engineers well for working in the electronics industry, as reflected by the rapid increase in the hiring of BS chemical engineers. Students should be exposed to a broad range of problems; courses in material science and solid state physics should also be included.

Dr. Kenneth McKelvey of Dupont addressed some of the important technological problems associated with the design and manufacture of advanced materials and composites. The microstructure of these materials must be very carefully engineered since the interfacial region frequently involves two incompatible materials. There are important technological opportunities in developing more engineered microstructure materials, liquid crystalline polymers, and electrically conductive polymers. Dr. McKelvey stated that chemical engineering education frequently does not take the interdisciplinary approach used by industry and this can be a serious drawback. Chemical engineers do have a unique approach to problem solving which frequently begins with a phenomenological description in areas such as transport phenomena, kinetics, and thermodynamics. This is followed by a quantifying and modeling approach. Dr. McKelvey pointed to a reduced hiring pattern for chemical engineers by companies that are forming special expertise in the advanced materials area.

The final plenary speaker was Professor Warren Seider of the University of Pennsylvania. Professor Seider spoke on "Chemical Engineering and Instructional Computing—Are They in Step?" Transitions in chemical engineering courses and advances in instructional computing were examined. Developments in optimization, micro-computer software, and expert systems for teaching the design and control of conventional and unconventional processes were detailed. New developments to introduce "open-ended," design-oriented computing lessons in courses other than process design and process control were described. In addition, examples of more advanced concepts in undergraduate courses were presented, including reactor stability analysis, thermodynamics in the critical region, and mass transfer in separators. Questions concerning the minimal requirements for computation in the accreditation of chemical engineering curricula were discussed. Professor Seider concluded that the instructional material for design and control courses are in step with the technology represented by conventional processing, but that there needs to be an improvement with respect to the more recent technological interests of chemical engineering.

Workshop sessions were held in the mornings and evenings and provided an informal atmosphere for faculty members to exchange specific information about coursework development. Poster sessions were held in the afternoon, permitting up-to-date presentations of materials by the participants. Over seventy posters were submitted.

On Wednesday, the 3M Award Lectureship was awarded to Professor James J. Christensen, of Brigham Young University, who spoke on "Reflections on Teaching Creativity" and who addressed the essential need of including creativity in the chemical engineering curriculum.

The lecture was followed by the Division business meeting. The Summer School participants also had opportunities to tour the Newport area.

A financial report of the Summer School will appear after the final distribution of subsidies to participating departments (planned for late 1987). Any questions concerning the final preparation of this report should be addressed to the Co-Chairmen.

Local arrangements for the Summer School were assisted by Professor L. Bryce Andersen of Southeastern Massachusetts University, and by Professor Stanely M. Barnett of the University of Rhode Island.