
Chapter 5

Rebirth as a Modern Program. Greenkorn, Koppel and Andres

(1967 - 1987)

When Professor Brage Golding departed for Ohio State University in October 1966, it was somewhat late to find an immediate replacement for the academic year. Thus, Richard Joseph Grosh (1927-, B.S. '50, M.S. '52, Ph.D. '53, all from Purdue University), Associate Dean of Engineering, was named interim acting Head of the School. Grosh, a gifted administrator and an outstanding researcher (elected to the National Academy of Engineering for outstanding heat transfer research), who a year later would become the new Dean of Engineering (1967-71), and later President of Rensselaer Polytechnic Institute (1971-76) and CEO of Renco Inc. (1976-87), had some very big plans for Chemical Engineering. He made it clear that henceforth this School would devote its primary effort to building an outstanding graduate program. Dean Grosh predicted that in ten years Purdue would be a leading graduate school, able to attract the best undergraduates not only from the Midwestern region but from other regions as well; and that although undergraduate and graduate education would receive the continuous attention of the faculty, it was in graduate research that Purdue was lacking.

Most of the faculty members, especially those who had joined the faculty in the previous ten year span, welcomed this drastic change of policy with considerable enthusiasm and dedication, and found in Grosh an astute spokesman for their thoughts and expectations for change. The selection of the new Head, who was going to lead the School to a new era, took several months. From the beginning, a young Associate Professor, who had studied with Olaf A. Hougen at Wisconsin, had industrial experience, and had spent several years as an educator in other Universities, attracted Grosh's interest.

Robert A. Greenkorn had arrived at Purdue in the Summer of 1965. He had the advantage that he had brought new ideas to the School, and that he was not associated with any specific group among the older professors.

Moreover, during his years teaching at the University of Tulsa and Marquette University he had taught a wide range of engineering courses, including fluid mechanics, transport phenomena, statistics, applied mechanics and others. Finally, he had been educated at the University of Wisconsin, which had one of the nation's most outstanding chemical engineering programs, and his research mentor was Prof. Olaf Hougen, a premier chemical engineering researcher and educator. Therefore, Greenkorn had all the characteristics of the researcher and educator that the University was looking for, someone who could and would make significant changes in the School. But, would he be a good administrator? History would prove that he was. During an illustrious career as Head, then as Assistant Dean of Engineering, eventually as Vice President and Associate Provost, and as an advisor to the president, Bob proved many times over that he is a good administrator.

To appreciate the need for the changes that Dean Grosh and most of the faculty members were seeking, we will briefly examine the major changes in chemical engineering occurring in the late 1950's and early 1960's. We noted in Chapters 1 and 2 that in the early days of chemical engineering, teaching and research in industrial chemistry was the central theme. Around 1920 (Chapter 2), unit operations became the main focus of chemical engineering research and education and remained so until the war. In the 1930's (Chapter 3) applied thermodynamics also became an important component of academic chemical engineering^{1,2}. Two developments that occurred at the University of Minnesota and the University of Wisconsin in the 1950's (Chapter 4) changed the course of chemical engineering. Neal R. Amundson, Rutherford Aris, R. Byron Bird, Edwin N. Lightfoot, Jr. and Warren E. Stewart would become the leading forces of major changes in chemical engineering education and research. The "message" of these five academics was controversial and much questioned, but it was gradually accepted by both industry and academia.

Richard J. Grosh, Dean of Engineering (1967-71) and Acting Head of the School



Table 5-1. The Schools of Engineering at Purdue

This table presents the years of establishment of the various Schools, Departments and Divisions of Engineering of Purdue University.

Mechanical Engineering	1882
Civil Engineering	1887
Electrical Engineering	1888
Chemical Engineering	1911
Agricultural Engineering	1925
Aeronautical Engineering	1945
Dept. Freshman Engineering	1953
Industrial Engineering	1957
Materials Engineering	1959
Nuclear Engineering	1960
Interdisciplinary Engineering	1969
Construction and Engineering Management	1977
Biomedical Engineering	1998
Freshman and Interdisciplinary Engineering merge to form Engineering Education	2004
Environmental and Ecological Engineering	2006

When Charles A. Mann, the founder of Chemical Engineering at the University of Minnesota died in 1949, the search outside the department for a new head was unsuccessful³ and Neal R. Amundson, who became Acting Head in 1949, while still an Associate Professor, became the Head in 1951. Amundson was an educator and researcher with far-reaching insight. Educated both as a chemical engineer and a mathematician (his Ph.D. in 1945 was from the Department of Mathematics), he soon realized that further insight into chemical engineering problems lay in an analysis of chemical processes and phenomena based on fundamental analytical understanding of these problems. Applied mathematics and soon the computer became excellent tools for generalization and solution of various separation, transport and reaction engineering problems⁴. His first steps into this area were taken with some of his early graduate students such as Andreas Acrivos who became a professor at Stanford University and later at the City University of New York and the late Leon Lapidus of Princeton University. The efforts of these students with the collaboration of an adventurous young mathematician and fast learner in chemical engineering, Rutherford Aris, whom Amundson met at Cambridge in 1955, resulted in a bold attack on a wide range of chemical engineering problems, especially problems involving chemical reactor design. Amundson and Aris became a powerful duo in our profession, and were the heart of what is considered by many to have been the best chemical

engineering graduate program ever, the University of Minnesota of the 1960's and 70's (This is high praise indeed coming from Nicholas Peppas, a graduate of MIT). Professor Ramki Ramkrishna, now at Purdue, was part of the Minnesota group as a graduate student, assistant professor, visiting professor, and collaborator with Neal Amundson.

At about the same time, a second major educational revolution was occurring at the University of Wisconsin. Professors Bird, Stewart and Lightfoot, collectively known to future generations of students as BSL, prepared a set of notes (in 1957) and eventually a book (in 1960) entitled *Transport Phenomena*, which offered a new approach to the analysis of chemical engineering problems. The main lesson of BSL is that there is a strong unifying backbone to apparently different unit operations in the framework of the continuum equations of transport. The necessity for analysis of individual operations or processes does not disappear, but the differential volume and the balance equations become the central theme of this approach.

Thus, in the mid 1960's the major chemical engineering departments in the United States, with a handful of exceptions, were adjusting to the new ideas of our profession. Unit operations had definitely declined and unit processes were almost obsolete⁵ as unifying themes for education and research.

A third revolution, the implications of which would not be felt until the mid 1970's, was also occurring in chemical engineering in the early 1960's. This one did not start from one specific school but was rather initiated by a group of gifted educators and researchers in various universities and in industrial and government laboratories. These researchers recognized that chemical engineers could contribute significantly to areas outside of classical chemical engineering, in interdisciplinary areas such as biochemical and biomedical sciences, and polymers. Elmer L. Gaden of Columbia and Arthur E. Humphrey of the University of Pennsylvania in biochemical engineering, Arthur B. Metzner of the University of Delaware and R. Byron Bird in polymer engineering, Edward W. Merrill of M.I.T. in biomedical engineering and Michel Boudart of Stanford and Richard H. Wilhelm of Princeton in catalysis were only some of these researchers.

The changes in educational activities were immediately associated with major changes in research. The National Science Foundation, National Institutes of Health and other federal agencies became a "paradise" for funding of the work of the *nouvelle vogue* of chemical engineers, and major contributors to the success of the graduate programs of many Schools.

At Purdue the new ideas were accepted rather slowly, with reluctance by some, and with enthusiasm by others. Some of the problems of the previous period can be attributed to differences in philosophy of education and research among the faculty. But the future was evident. Already in 1966 Squires and Albright were working in kinetics and catalysis; Emery in polymer rheology; Koppel, Coughanowr and Williams in process design and control; and Greenkorn, Kessler, and Eckert in fluid mechanics.

Robert Albert Greenkorn (1928-)

Robert A. Greenkorn was a young Associate Professor when he was asked to head the School in June 1967. Born in Oshkosh, Wisconsin on October 12, 1928, he was educated at the University of Wisconsin (B.S. '54, M.S. '55, Ph.D. '57) after serving as a Navy pilot in the Korean war. At Wisconsin he worked under the supervision of the legendary Professor Olaf A. Hougen. His first employment was at the Jersey Production Research Company in Tulsa, Oklahoma (until 1963). At the same time he was also a lecturer in chemical engineering and mathematics at the University of Tulsa. In 1963 he joined the Department of Theoretical and Applied Mechanics at Marquette University and in 1965 he came to Purdue University as an associate professor. He was promoted to professor in 1967 and became the R. Games Slayter Distinguished Professor of Chemical Engineering in 1995 [This professorship is named in honor of R. Games Slayter (BSChE '21, Hon. Doc '49) the inventor of Fiberglass, vice president of Owens-Corning Fiberglas Corp., and the donor of Slayter Center.]. He retired in 2001, but as of 2011 still spends time in his office in Forney Hall when he is not living in Florida.

As a researcher Greenkorn developed strong programs in thermodynamics, fluid mechanics and flow in porous media. He advised 5 and co-advised 21 Ph.D. (plus one in ME) and advised 23 and co-advised 19 M.S. students. He wrote undergraduate and graduate textbooks and monographs such as *Transfer Operations* with D. P. Kessler (1972), *Thermodynamics of Fluids* with K.C. Chao (1975), *Modeling and Data Analysis for Engineers and Scientists* with D.P. Kessler (1980), and *Flow Phenomena in Porous Media* (1983); he also coauthored more than 90 journal publications.

His impressive list of administrative positions within the University includes Director of the Institute of Advanced Interdisciplinary Engineering Studies (1972-75), Assistant Dean of Engineering for Research (1972-76), Associate Director and then Director of the Engineering Experimental Station (1972-80), Acting Head of the School of Aeronautical and Astronautical Engineering (1973), Acting Director and then Director of the Environmental Engineering Center (1974-78), Associate Dean of Engineering (1976-80), Director of the Coal Research Laboratory (1978-80), Vice President and Associate Provost of the University (1980-1986), Vice President for Research (1986-1994), Dean of Graduate School (1993-1994), Director of the Technical Program TAP (1996-2000), and Vice President for Programs for the Purdue Research Foundation (1980-2000). Greenkorn is mainly responsible for the significant increase in research funds to Purdue University in the 1980's (see Appendix S). In 1990 he wrote the proposals that resulted in line items in the State budget for TAP and the Technical Information Service. His administrative skills were unsurpassed and can be best appreciated by those who saw him in his everyday work. There are few Vice Presidents of large Universities, who, in addition to their administrative duties,

regularly teach one course per semester, write successful books, conduct research with five or six graduate students, and even find the time to attend the Graduate Committee meetings of the School. He retired in 2001.

As Head, Greenkorn was responsible for the dramatic change of events in chemical engineering at Purdue after 1967. A firm believer in fundamental engineering research he made a series of successful decisions which led to the establishment of research programs of national reputation. In their fine profile of Greenkorn, Chao and Kessler [*Chem. Engr. Educ.*, 20 (2), 66-68 (Spring 1986)] tell many anecdotes about his life and his seemingly tranquil *modus operandi*. Concerned with the students' exclusive concentration on engineering courses, in the 1970's he used to bring a tape recorder to his class and spend the last five minutes listening with the students to classical and operatic music. The uninformed visitor would be truly puzzled to hear Lily Pons singing the *Bell Song* from Delibes' opera *Lakmé* in an engineering class!

Extremely proud of Purdue's achievements in and contributions to national education and research, he interrupted and corrected those who express momentary dissatisfactions with the decisions of the administration.

As a young assistant professor I (PCW) had a great deal of respect and some awe for my boss, Bob Greenkorn. One day when he was ahead of me in the hallway in CMET, I called out, "Professor Greenkorn." He turned and said, "My name is Bob." The respect remained, but the awe decreased.

A "terror" in theses defenses, he would attack any student who had not done the proper statistical analysis of his/her experimental results. One hour later he would approach the student to congratulate him/her on an otherwise excellent piece of work.

Now in retirement, Bob finally has time to study one of his favorite passions—the frequency and effects of the sun spot cycle. He has published one paper in *Solar Physics*, 255, 309 (2009), has submitted a second paper, and is working on a third.

Left: The two Heads of the School in the 1970's, Koppel (left) and Greenkorn, in 1966.
Right: Robert A. Greenkorn in 1974.



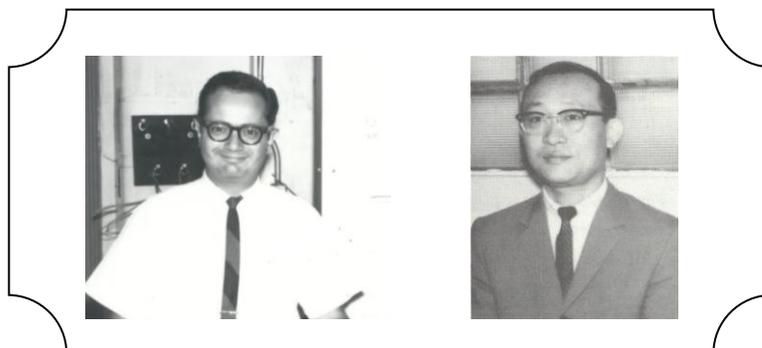
When Robert A. Greenkorn became Head of the School, fourteen of the twenty faculty members active in 1986 were not at Purdue and one (Lim) had just arrived. During the next fourteen years under the leadership of Greenkorn (1967-73) and Koppel (1973-81) changes of major significance occurred.

In the year of the transition, when Grosh was the Head of the School, two new faculty members were hired. Ronald Gene Barile (1938-, B.S. '61 University of Illinois, M.S. '63 Northwestern University, Ph.D. '66 Syracuse University) had studied with Howard Littman on fluidized beds and was added to strengthen the general area of transport phenomena. During the course of his work here, he developed research interests in the area of biomedical engineering and cultivated collaboration with the School of Industrial and Physical Pharmacy. As an educator he showed much concern for the students and developed great rapport with the undergraduates. In 1980 he moved to the Florida Institute of Technology in Melbourne to help develop a new ChE curriculum. Barile remains active as a research professor and consultant on hydrogen and renewable energy, and spacecraft systems.

The next addition to the faculty, Henry C. Lim (1935-, B.S. '57 Oklahoma State University, M.S. '59 Michigan, Ph.D. '67 Northwestern University), became an influential figure in biochemical engineering. He was educated under S. George Bankoff (a student of Shreve) and had considerable industrial experience with Pfizer, Inc. Lim brought a fresh research approach in the areas of reaction engineering and process control. After his arrival at Purdue he started collaborating with Lowell Koppel while developing a research program in the then obscure area of biochemical engineering. Lim's industrial experience at Pfizer and his conviction that biochemical phenomena are a natural for chemical engineers led to the establishment of a strong research and educational program which was internationally known. In this, he was helped by Alden Emery who, in 1971 after a sabbatical year in Israel, made a major change of career objectives from rheology to biochemical engineering, by Greenkorn and later Koppel who offered significant financial support for the establishment of biochemical research laboratories, and by the hiring of George Tsao in 1975. In addition to his research, Lim contributed significantly to the undergraduate and graduate programs with courses in applied mathematics, biochemical and environmental engineering, and control. He received the R.N. Shreve Prize three times in 1973, 1975 and 1977. With Leslie Grady of the School of Civil Engineering he coauthored the book *Biological Wastewater Treatment: Theory and Applications*, published by M. Dekker in 1980. He supervised the research of 29 Ph.D. and 35 M.S. students at Purdue. Among his former Purdue Ph.D. students we find a large number of ChE professors such as DiBiasio, Agrawal, Papoutsakis, Lee and Tarrer. With increasing national visibility came offers from other schools. Henry Lim moved to the University of California-Irvine as the founding chair of their Biochemical Engineering program in 1987. The program became Chemical Engineering in 1993 with Prof. Lim as chair. Henry is now Professor Emeritus at from the University of California-Irvine.

Left: Ronald G. Barile - shown here in 1966 - did research in biomedical engineering and transport phenomena.

Right: Henry C. Lim was one of the most active biochemical engineering researchers (1966 photograph).



The year Greenkorn became Head, William Adam Weigand (1938-, B.S. '62, M.S. '63, Ph.D '67 all from the Illinois Institute of Technology) also joined Purdue. Suddenly, the School had four ambitious researchers working in control and optimization (including Williams, Koppel and Lim). Soon Weigand became interested in biochemical reaction engineering and joined Emery and Lim in collaboration in this area. After a stay at the National Science Foundation, Weigand resigned from Purdue in 1981. He is now a professor at the Chemical and Biomolecular Engineering Department at the University of Maryland, College Park.

Meanwhile, the departure of several faculty members for new administrative positions [Myers to the University of California at Santa Barbara, Coughanowr to Drexel University, and Tucker to Tri-State University (now Trine University)], retirements, and some other changes in the faculty possibly related to the new research directions of the School, led to a number of openings which would be filled by Greenkorn over the next four years, albeit with much caution. Consequently, during the period 1967 to 1971 a number of visiting professors were invited to Purdue to teach and contribute in research. Most prominent among them were Heinrich O. Buhr from the University of Cape Town, Carl Hanson from the University of Bradford, Raul Garcia from the University of Trujillo in Peru, Antti Niemi from the Helsinki University of Technology and Francis A. Dullien from the University of Waterloo.

In the late 1960's the undergraduate enrollment was rather stable with 285 students enrolled in 1967 and 294 in 1971. The educational program was based on the 1964 plan of study (Appendix H) with small changes or additions in the ChE elective courses.

The next faculty member to join Purdue was Kwang-Chu Chao (1925-) who arrived in the summer of 1968. Greenkorn knew Chao well since they had been laboratory partners at the University of Wisconsin, and Greenkorn realized that Chao's combination of practical experience and theoretical competence would benefit Purdue. Not only did Chao create a strong program in theoretical and applied thermodynamics but also he brought

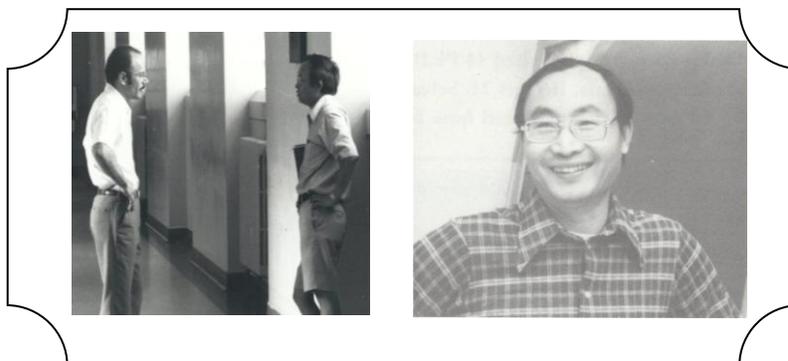
much attention to Purdue as a recognized researcher. Chao stayed at Purdue until he retired in 1993.

Kwang-Chu Chao (1925-)

K.C. Chao (BS '48 National Chekiang University, Taiwan; M.S. '52 and Ph.D. '56 both University of Wisconsin), was a contemporary and former laboratory partner of Greenkorn, where they both worked with Olaf A. Hougen. Known for the widely used and cited Chao-Seader correlation (this contribution was designated a Citation Classic in 1981), Chao brought to Purdue not only important industrial experience from his years with Taiwan Alkali Company (1948-1951, 1952-54) and Chevron Research (1957-63) but also academic understanding developed during his years at Illinois Institute of Technology (1963-64) and Oklahoma State University (1964-68). After several changes of scenery, K.C. found a home at Purdue and stayed here for the next 25 years. A meticulous and methodical investigator he developed an outstanding thermodynamics research group. Chao started with research in the area of measurement and estimation of thermodynamic properties of fluids. Notable among his accomplishments were a series of descriptions of molecular fluids, including the Chain-of-Rotators equation of state. On the experimental side, Professor Chao and his co-workers developed and exploited a unique experimental apparatus for measuring high temperature and high pressure phase equilibrium which found particularly fruitful applications in the study of the VLE properties of coal-derived liquids.

K.C. coauthored the book *Thermodynamics of Fluids* with Bob Greenkorn published in 1975 by M. Dekker, Inc. One of his graduate students, Herbert M. Sebastian (M.S. '77, Ph.D. '80), has the record of the most papers published from his M.S. and Ph.D. work, 32 in all. A fellow of the American Institute of Chemical Engineers, Chao is listed in numerous biographical references, was named Honorary Professor of both the Beijing Institute of Beijing Institute of Chemical Technology and Zhejiang University, and appointed Harry Creighton Peffer Distinguished Professor in 1989 [This professorship honors the founding head of the School.] He was granted emeritus status in December 1993 and he received the 1994 Donald L. Katz Award of the Gas Processors Association in recognition of outstanding accomplishments in gas processing research and excellence in engineering education. A thermodynamics symposium was held in his honor on September 15, 1995, with a banquet attended by friends, colleagues and former students. Chao advised 17 and co-advised 12 MS and advised nine and co-advised 18 PhD students. He worked closely with Bob Greenkorn in thermodynamics research and they co-advised many of these former students. Many of his former students and post-docs became academics (see Appendix B). KC is a great gentleman and has a dry wit that he effectively couples with his accent. He was usually very calm in faculty meetings and rarely spoke. However, when he had something to say, everyone listened because there was usually significant wisdom included in the message.

Left: Theofanis G. Theofanous (left) and Henry C. Lim in 1973.
Right: K.C. Chao made major contributions in the area of thermodynamics (1974 picture).



Having improved the areas of control, thermodynamics and biochemical engineering, Greenkorn turned his attention towards other research areas. In 1969 and 1970 six new faculty members were hired, five of them at the Assistant Professor level.

Table 5-2. Presidents of Purdue University

The following individuals have served as Presidents of Purdue. Parentheses indicate acting presidents.

Richard Owen	1872-1874
Abraham C. Shortridge	1874-1875
(John S. Hougham)	1875-1876
Emerson E. White	1876-1883
James H. Smart	1883-1900
Winthrop E. Stone	1900-1921
(Henry W. Marshall)	1921-1922
Edward C. Elliott	1922-1945
(Andrey A. Potter)	1945-1946
Frederick L. Hovde	1946-1971
Arthur G. Hansen	1971-1982
(John W. Hicks, III)	1982-1983
Steven C. Beering	1983-2000
Martin Jischke	2000-2007
France Córdoba	2007-

Of these, Owen was a geologist and former professor at Indiana University, Shortridge had studied education, White was a teacher, Smart had not finished high school, Stone and Elliott were chemists, and Hovde was a chemical engineer. Of the four more recent presidents Hansen was a mechanical engineer, Beering a physician and dean of the Indiana University medical school, Jischke was an aeronautical engineer and president at Iowa State University, and Córdoba an astrophysicist and president of the University of California-Irvine.

Robert Earl Hannemann (1930-, BSChE '52 Purdue, MD '59 IU Medical School), after graduating along with his twin brother Donald, pursued a successful medical career, which combined practice in the area of pediatrics with a very novel engineering approach to medical

problems. From 1962 until his retirement, he was associated with the Arnett Clinic (now part of IU Health) in Lafayette where he started the Department of Pediatrics. In 1969 he was offered a "permanent" Visiting Professorship in Chemical Engineering with the major goal of initiating courses in biomedical engineering (which at the time was very much in vogue) and to become the catalyst for important biomedical research work in the School. His engineering studies on the treatment of the respiratory distress syndrome and the non-invasive detection of newborn jaundice have been two of his most important research projects. Hannemann is nationally recognized as a leader in pediatric practice, research and education. He served as chairman of the Indiana Chapter of the American Academy of Pediatrics and is a fellow of the Academy as well as Past President of that organization (1996-1997). In 1998 he was appointed to the Secretary of Health and Human Services Advisory Committee on Infant Mortality and served in that position until 2008. In 2000 Hannemann was elected to the Board of Directors of the National Center for Missing and Exploited Children and continues to serve in that position. In 1997 he received the first President's Award from the Purdue Engineering Alumni Association and in 2000 received both the Outstanding Chemical Engineer Award from Purdue and was named a Sagamore of the Wabash by the Governor of Indiana, Frank O'Bannon. He has published over 30 papers plus numerous articles on pediatrics, nutrition, and child development in *Growing Child*. He was the Associate Medical Editor of four editions of the best selling child care book, *Caring for Your Baby and Young Child – Birth to Age 5*. Chemical engineering co-authors of his papers include Ron Barile, Elias Franses, Nicholas Peppas, and Ramki Ramkrishna. He retired from the Arnett Clinic in 2000 but continues as Visiting Professor in ChE, Child Psychology (since 1983), and Biomedical Engineering (since 1998) and was instrumental in the founding of the Regenstrief Center for Health Care Engineering in Discovery Park (2005). He continues to serve in its executive committee concentrating his efforts on the area of assistive technology.

Table 5-3. Deans of the Schools of Engineering

The following individuals have served as Deans of Engineering at Purdue:

William F.M. Goss	1900-1907
Charles H. Benjamin	1907-1920
Andrey A. Potter	1920-1953
George A. Hawkins	1953-1966
Richard J. Grosh	1967-1971
John C. Hancock	1972-1984
Henry T. Yang	1984-1994
(John McLaughlin)	1994-1995
Richard Schwartz	1995-2001
Linda Katehi	2002-2006
Leah Jamieson	2006-

Of these, Goss had studied practical mechanics, Benjamin, Potter, Hawkins and Grosh were mechanical engineers, Hancock, Schwartz, Katehi and Jamieson were electrical engineers, Yang was an aeronautical engineer, and McLaughlin (interim dean) was a civil engineer.

The next two faculty members to join Purdue were Theofanis George Theofanous (1942-, Dipl. Eng. '65 National Technical University of Athens, Ph.D. '69 University of Minnesota) and Richard Neal Houze (1938-, B.S. '60 Georgia Institute of Technology, M.S. '66 and Ph.D. '68 University of Houston). They were both hired to improve the transport area, more specifically heat transfer and fluid mechanics. Theofanous, who would become the first of four professors of ChE at Purdue to have graduated from the National Technical University of Athens, was educated in the mathematical and fundamental educational research system of the University of Minnesota where he had worked with Herbert S. Isbin. Houze, fresh from a postdoctoral year at the Technische Hogeschool, Delft, The Netherlands, had previously worked with Abraham E. Dukler at Houston. Houze and Theofanous developed common research in the area of two-phase flow which led to a fruitful collaboration until 1978. In 1982 Houze became Director of the Engineering Cooperative Education program. More will be said about his contributions to the School at the end of Chapter 6.

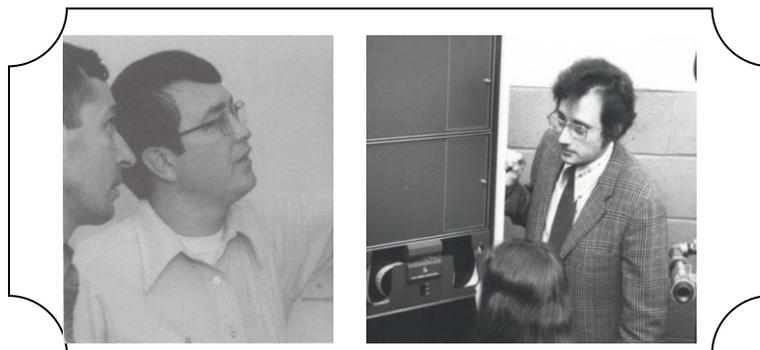
Table 5-4. Heads of the School of Chemical Engineering

The following individuals have served as Heads of the School of Chemical Engineering. Names in parentheses designate acting or interim Heads.

Harry C. Peffer	1911-1934
(Andrey A. Potter)	1934-1935
John L. Bray	1935-1947
R. Norris Shreve	1947-1951
Edward W. Comings	1951-1959
(George A. Hawkins)	1959-1959
Brage Golding	1959-1966
(Richard J. Grosh)	1966-1967
Robert A. Greenkorn	1967-1973
Lowell B. Koppel	1973-1981
Ronald P. Andres	1981-1987
Gintaras V. Rex Reklaitis	1987-2003
Arvind Varma	2004-

In 1975 Professor Theofanous moved to the School of Nuclear Engineering becoming an expert in the area of nuclear reactor safety and reliability. In July 1985 he accepted a position as Professor of Chemical and Nuclear Engineering at the University of California at Santa Barbara, thereby becoming the fifth former student or associate (the others were Myers, Mellichamp, Hanna and Agrawal) to move to that School, which was affectionately called "Purdue West." In 2000 Theofanous was elected to the National Academy of Engineering.

Left: Robert E. Hannemann in 1972.
Right: William A. Weigand did research in process control of biochemical reactors (1974 picture).



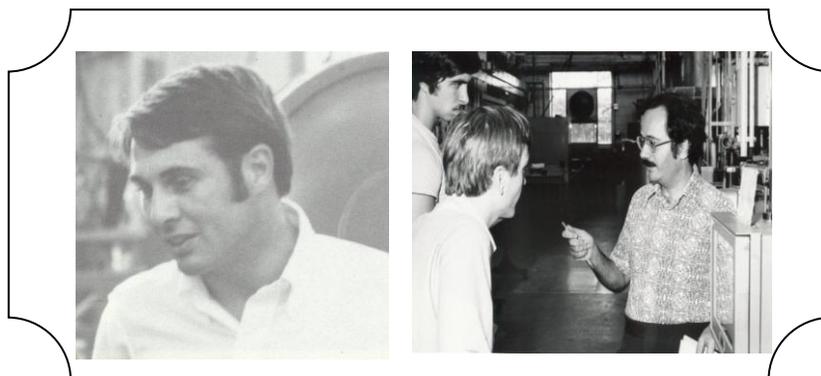
Phillip Charles Wankat (1944-, BSChE '66 Purdue, MS '67 and Ph.D. '70 Princeton University) joined in February 1970 at the start of the spring semester. At Princeton he worked with William R. Schowalter on convective stability of fluids exposed to temperature and concentration gradients. When Bob Greenkorn hired him it was made clear that Wankat could contribute to the area of fluid mechanics, or he could follow his new research interests in separation science (actually unit operations, but with a more up-to-date name), an area that he knew little about but found interesting. New Assistant Professors will probably have difficulty believing that there was a time when assistant professors were allowed, even encouraged, to go into new research areas without having a detailed research plan and several proposals prepared. However, with the biochemical explosion of the 1970's and 1980's Wankat found a natural collaboration with Emery, Tsao and later Wang which eased his start in obtaining both grants and students. Phil became an authority on separations, especially pressure swing adsorption and simulated moving bed processes. For his work he has been recognized by a number of national awards and has been elected a Fellow of AIChE and the American Society for Engineering Education. Wankat is also an extremely effective textbook writer. His textbook *Separation Process Engineering* (which appeared first in 1988 as *Equilibrium-Stage Separations*) by Prentice Hall is in its third edition (2012), has had two editions in Spanish and is widely adopted. He co-authored the section on Mass Transfer for the 7th and 8th editions of *Perry's Handbook*.

Phil also became interested in understanding how to be a better teacher and counselor and in 1982 earned a M.S.Ed. degree from Purdue. In 1983 on the suggestion of the new Head, Ron Andres, he joined with Dr. Frank Oreovicz, the School's Communication Specialist, to develop a course on how to teach engineering (now ChE 685). A book on Teaching Engineering was published soon thereafter, a book that has become the most cited in the field of engineering education. It is now available free in

<https://engineering.purdue.edu/ChE/AboutUs/Publications/TeachingEng/index.html>. This was followed by the book *The Effective, Efficient Professor: Teaching Scholarship and Service*. In 1987 he was appointed the Head of the Department of Freshman Engineering whilst maintaining his affiliation with ChE. Finally, Phil has served for many years as the Associate Editor of the journal *Chemical Engineering Education*.

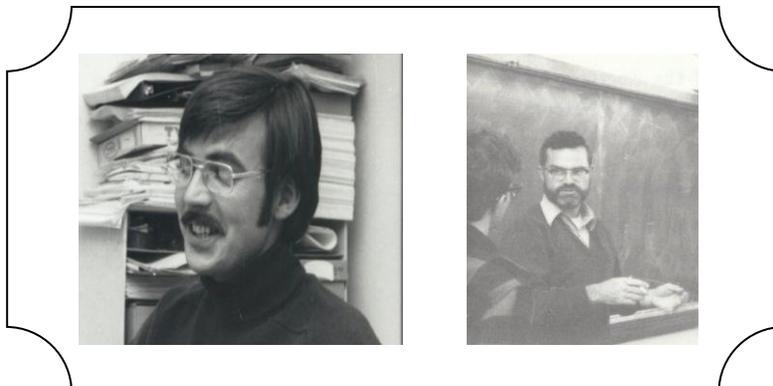
The next two faculty members arrived in the summer of 1970, both educated in Schools with strong programs emphasizing fundamental research. Daniel Robert Schneider (1943-, B.S. '65 University of Cincinnati, Ph.D. '74 University of Minnesota) concentrated on mathematical modelling of chemical reactors (being a former student of N. Amundson and R. Aris) and collaborated with John Woods and Rex Reklaitis on process design research and in teaching ChE 205, the beginning mass and energy balances course. In 1976 Schneider joined Monsanto Co.

Left: R. Neal Houze in 1973.
Right: Ronald G. Barile in the undergraduate laboratory in 1977.



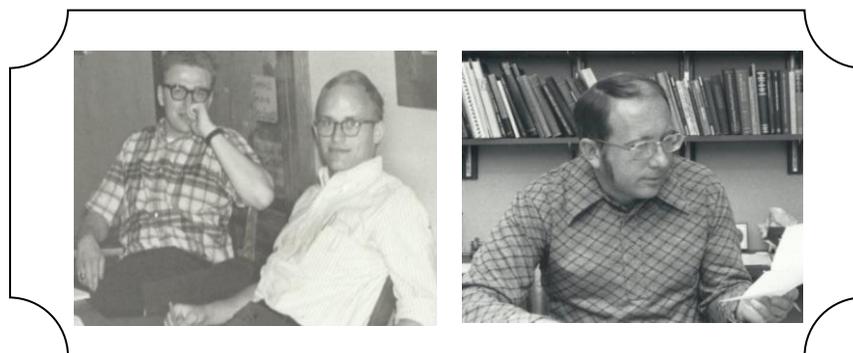
Gintaras Victor "Rex" Reklaitis (B.S. '65 IIT, M.S. '69, Ph.D. '69 both from Stanford University), a student of Douglas Wilde, joined the faculty with the goal of establishing a research program of international reputation in computer aided process design, optimization and simulation of chemical operations. An indefatigable worker and an excellent researcher, Reklaitis developed into a major contributor to the School in teaching, research, and administration. Since Rex became Head in 1987, the main part of his story will be told in Chapter 6.

One cannot but admire the progress of the School during the period of 1967-1973 when Robert A. Greenkorn was Head. In fewer than six years Greenkorn had achieved a significant renewal of the faculty by the natural attrition and retirement of some of the older faculty members, by the rejuvenation of some faculty, and by hiring a group of excellent young researchers and educators. During his tenure, he was able to quadruple the research budget of the School (Appendix S) and to stress the need for fundamental research.



Left: Gintaras V. Reklaitis works in the fields of systems analysis and synthesis, optimization and simulation (1974 Picture).

Right: Robert G. Squires in 1974.



Left: Michael P. Ramage (B.S. '66, M.S. '69, Ph.D. '71) and Phillip C. Wankat (right) as undergraduate students in 1966.

Right: David P. Kessler in 1974.

Greenkorn did not wish to imitate other research programs or to emulate other Schools, but rather to create a unique research environment based on a balanced effort in fundamental and applied research. A strong characteristic of his philosophy in research was his support of collaborative efforts. Some of the well-known research collaborations of the 1970's (Chao-Greenkorn, Houze-Theofanous, Lim-Emery-Weigand, Greenkorn-Kessler) were the result of this philosophy.

In his 1986 *History* Professor Peppas wrote "Historical essays cannot be written on recent events, especially when the author is part of the group or activity analyzed. However, this work will not be complete without a presentation of the achievements of the School in the last thirteen years under the administrations of Lowell B. Koppel (1973-1981) and Ronald P. Andres (1981-1987)." The first sentence is still true, but "recent" now applies to the administrations of Rex Reklaitis and Arvind Varma. We have enough distance from the administrations of Koppel and Andres to start to draw some historical conclusions, although the difficulty of being a part of their administrations remains.

After Dean Hancock asked Greenkorn to become Associate Dean for Research in the College of Engineering and Greenkorn agreed, Dean Hancock appointed a small search committee from the School consisting of one professor from each of the three ranks plus an undergraduate student. Alden Emery, the full professor, was the committee chair. This small committee was both efficient and effective. [Unfortunately, small committees have been replaced with mammoth committees including at least one representative from all possible constituencies. These mammoth committees tend to be much less efficient and seldom come up with better hiring decisions.] The committee put forward the names of two interested and well qualified candidates. After extensive interviews and a poll of the faculty, Dean Hancock chose the internal candidate, Lowell Koppel.

When Lowell B. Koppel, an influential faculty member, successful researcher and co-author of a bestselling textbook, was selected as the new Head of the School in March 1973, the School was full of enthusiasm with young faculty members (in 1973 the average age of the faculty was 36 years old), morale was very high, the educational program was very good (especially the undergraduate program), and research funds were readily available (a situation that is unlikely to repeat ever again).

Although not an experimentalist - at least not since 1960 - Koppel had developed an appreciation for experimental research. He recognized that to be a leading educational institution, Purdue should concentrate on improvement of graduate research and simultaneous modernization of its educational program. The latter could be done after a serious review of the program. The former, however, needed a thorough analysis of the future of chemical engineering, and the role of educational institutions (especially one such as Purdue which, with the excellent preparation of its large number of B.S. graduates, was an important source of chemical engineers for industry) in a technologically oriented society.

**Lowell B. Koppel
(1935-)**

Lowell B. Koppel, the seventh Head of the School, was born in Chicago on September 13, 1935. He received his B.S. from Northwestern University in 1957, his M.S. from the University of Michigan in 1958 and his Ph.D from Northwestern University in 1960, all in Chemical Engineering. At Northwestern he was a student of Professor J.M. Smith, working in the areas of thermodynamics and molecular physics. Upon graduation he spent one year at the California Institute of Technology as an Instructor and Research Associate to Prof. Neal Pings. It was there, and at the instigation of Prof. Bruce Sage, that he first taught process control. He arrived at Purdue in August 1961 as an Assistant Professor and rose to the rank of Professor in only six years.

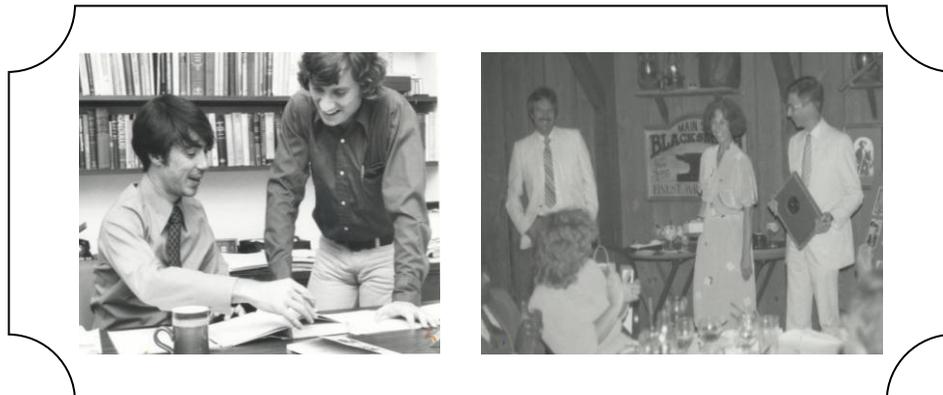
In collaboration with Donald R. Coughanowr he published the classic textbook *Process Systems Analysis and Control* (McGraw-Hill, 1965). This text became a *sine qua non* of the undergraduate process control education for fifteen years and sold more than 120,000 copies in its U.S. and English-International editions, and the various translations in other languages. This book was followed by a second textbook, a graduate one, entitled *Introduction to Automatic Control Theory* (Prentice-Hall, 1968). Most of his publications are also in the area of process control, where he also did extensive industrial consulting.

Koppel became Head of the School in March 1973 and stepped down in August 1981 to return to teaching and research. After 1981 he was much involved in the development of new educational methods in the area of process control. He established the Computer Graphics Laboratory (1982) through a substantial grant from the Shell Companies Foundation. He was also instrumental in establishing the Computer-Aided Process Engineering Facility (1983) provided by IBM Corporation and in developing IBM's process control software, the Advanced Control System (ACS), as an educational tool. In August 1985, after 24 years of loyal service to Purdue, Koppel accepted a position as a senior consultant for plant-wide computer operations with Setpoint, Inc. in Houston. When Setpoint merged with Aspen Technology, he became a Vice-President of Aspen. He is now retired in Winchester, MA, and is enjoying "intensive studies of Classics, Latin, History, Religion, Philosophy, Shakespeare, and opera".

The first five to six years of Koppel's headship (1973-1981) are considered by many to be one of the greatest periods in the School's history. A proponent of the strong relations of the University and industry, Koppel spent a significant part of his time increasing industrial awareness of the problems of a modern University and providing new avenues for major collaboration between the School and industrial companies. A major portion of his activities was also directed towards the continuous strengthening of graduate research in the School, a process that had started during Greenkorn's period as a Head. Indicative of his success in this field is that in 1973 research expenditures were \$317,000 and in 1981 \$1,604,000. During Koppel's administration the number of faculty publications doubled and the ratio of Ph.D./M.S. students almost tripled.

With a strong personality and definite ideas about high standards in undergraduate education at Purdue, Koppel left a lasting impression on his undergraduate students. For years the courses taught by Koppel as he cycled through the entire curriculum were considered the most difficult courses of the undergraduate curriculum because Koppel demanded and sometimes received perfection. His high standards, however, eventually won him the respect of most of his students. It is not then surprising that in replying to a 1984 questionnaire Koppel was nominated as the most influential teacher in their life by more than 150 graduates of the School.

In 1979 Koppel asked Dean Hancock to return to the faculty, but the Dean used his powers of persuasion to convince Koppel to stay as Head. After two years the Dean agreed to Koppel's desire to step down. The historical lesson here is when a strong leader can see that it is time to step down, he/she should do so.



Left: Lowell B. Koppel in 1976.

Right: Presentation of a plaque at the August 23, 1985 farewell dinner for Lowell and Barbara Koppel. From left to right: W.N. Delgass, Mrs. B. Koppel, and L.B. Koppel.

In the 1970's a trend developed in chemical engineering, and it is to the credit of Koppel and the faculty that they identified it early. Chemical engineering was fast becoming the most universal of all engineering disciplines. [Note that our friends in mechanical engineering dispute this statement.] Students educated in chemical engineering could contribute to emerging areas such as polymer science, biochemical and genetic engineering, catalysis, colloid science, environmental science, meteorology, microelectronics and other research fields, which in the 1960's would have been considered unconventional for chemical engineers. Chemical engineering was entering its period of interdisciplinary application and engineering science, a period which is still continuing and where a balance of chemistry, physics, mathematics and classical engineering is used to solve important problems in industry and academe.

Koppel recognized these factors very early in his administration, but there was one important obstacle. Research of this nature is done with specialized, sophisticated equipment which becomes obsolete quickly, and this means high financial burdens. Koppel was fortunate in that the Dean, John Coulter Hancock (1929-, trained as an electrical engineer, Dean from 1972 until 1983), was most appreciative of these changes. In the next few years Hancock provided the required funds with which to attract a large number of researchers who worked in more engineering science type areas and to upgrade the research facilities within the School. Hancock was convinced that the computer would soon be a necessary tool in all engineering programs, including chemical engineering. He and Koppel suggested, even insisted, that computers be used as much as possible in research and teaching.

These changes in the philosophy of research changed some of the "acceptable" ways of education. Industrial advisors, although impressed with Purdue's ChE education, had already suggested that more elective courses with in-depth analysis of specific interdisciplinary areas were required, even for undergraduate students, and that a reevaluation of the methods of teaching transport phenomena and reaction engineering was desirable. Even before Koppel became Head in 1973, discussions had started on the need to change the undergraduate curriculum by the addition of more statistics and computer applications. With the arrival of many new faculty members with specialized research interests, the number of undergraduate and graduate elective courses increased significantly so that by 1980 the School had a very impressive and extensive schedule of elective ChE courses.

Indicative of Koppel's recognition of the importance of interdisciplinary research is an excerpt from his memorandum⁷ to Dean Hancock on June 20, 1974. "The School has plans to significantly expand its activities in a rapidly emerging area, biochemical engineering. This area has applications towards solving the problems of food, energy, environment, and health...." The goals having been set, the faculty members and Koppel (and later Andres) spent a long time discussing their implementation. The enthusiasm and unity of the faculty during these changes were admirable.

Koppel, who was ambitious in both research and administration, ran a rather tight ship. Improvement of both undergraduate and graduate education was paramount, and faculty members were expected to improve their teaching skills. In that, the School has been blessed with many excellent educators. [One personal incident illustrates that Koppel was much more supportive of teaching than many observers believe. When I (PCW) wanted to earn a Master's degree in Education in the mid-70's, Dean Andrews of the Graduate School tried to prevent this because Purdue policy did not allow current professors to earn additional degrees at Purdue. Lowell wrote a letter supporting my goal and stood firm during a blistering telephone call from Andrews. Purdue now supports faculty who want to study in a second discipline.] Submission of research proposals, participation in research meetings, interaction with industry (especially when that was not "fashionable" elsewhere), scientific interactions with other leading chemical engineers through a most impressive, and of course rather expensive, invitation program for seminars, and service in scientific societies were highly recommended, almost required. A hard worker and an astute administrator, Koppel sacrificed to a major extent his own research (he kept one or two graduate students at most) to concentrate on industrial and academic relations that would improve the quality, but at the same time also the image of the School.

Since the last five professors hired were younger, the faculty thought that it would be beneficial for the School to add a number of more established researchers, preferably in biochemical engineering and catalysis. The next three faculty members (Tsao, Delgass, Ramkrishna) came at the level of Associate or Full Professor. The first of these, George Tsao, was hired to strengthen the already strong biochemical engineering research program. Tsao succeeded in this endeavor building a separately funded research center – LORRE – that out lasted the usual ten to eleven year life of successful research centers and continues to thrive today (see Chapter 8). Tsao stayed at Purdue for 31 years (see box).

**George Tsu Ning Tsao
(1931-)**

George Tsao (B.S. '53 National Taiwan University, M.S. '56 University of Florida, Ph.D. '60 University of Michigan) was a Director of the National Science Foundation on a leave of absence from Iowa State University (where he had been for eight years) when Emery and Lim, and then Koppel, approached him and invited him to join the faculty. Educated under two of the very early biochemical engineers, Seymour Block at the University of Florida and Lloyd L. Kempe of the University of Michigan, and with minors in biochemistry and microbiology from two different schools, Tsao also had major industrial experience with TVA, Merck, Union Starch and Miles Laboratories. He joined Purdue in 1974 as a visiting professor and in 1975 became a regular member of the faculty. Within a very short time he developed an outstanding, internationally known research program. In the mid-1970's the emphasis on biochemical engineering at Purdue was so strong that improvement of the research facilities was occurring continuously, until finally in 1978 the first center-within-the School, the Laboratory of Renewable Resources Engineering (LORRE), was formed with George Tsao as its first Director. Sponsored by funds from NSF, USDA, DOE, various companies, other agencies and, for a period of time, directly by the State of Indiana, LORRE offered during George's tenure until May 1999, and currently under the leadership of Professor Michael Ladisch, a research environment unsurpassed in biochemical engineering (see box in Chapter 8 for more information on LORRE). During the 1995-96 academic year, Prof. Tsao was on sabbatical leave as Visiting Professor of Chemical Engineering at the Hong Kong University of Science and Technology and at National Chung Cheng University, Chiayi, Taiwan. In January 2001 he became half time in Purdue's phased-in-retirement program. During this period he was a Visiting Professor at Tsinghua University, Beijing, China, from January 1, 2001 to December 31, 2002.

Tsao's research was characterized by a balanced fundamental and applied approach to problems of bioengineering. He made contributions to the development of new methods of ethanol production from various raw materials containing cellulose, production of other important chemicals, bioseparation methods, and production of biosynthetic polymers. Within LORRE he collaborated with a number of scientists and engineers, who serve as independent investigators and include, among others, Martin Chang (1937-, B.S. '59 NTU Taipei, Ph.D. '66 McGill University), Ramani Narayan (1945-, B.S.C. '67 Ramnarain Ruia University, M.S.C. '69 and Ph.D. '75 University of Bombay), and Norman B. Jansen (1954-, B.S. '76 Colorado State University, Ph.D. '82 Purdue University). Tsao also collaborated with eight ChE faculty (Appendix U). Martin R. Okos (1945-, B.S. '67, M.S. '72, Ph.D. '75, all from Ohio State University) and Michael R. Ladisch (1951-, B.S. '73 Drexel University, M.S. '74 and Ph.D. '77, both from Purdue University) faculty members of the School of Agricultural and Biological Engineering (ABE) with courtesy appointments in Chemical Engineering, also collaborated with Professor Tsao. After earning his Ph.D. with Tsao, Prof. Ladisch joined ABE and developed an internationally known research program in renewable energy and bioengineering that led to his election to the National Academy of Engineering in 2000. Tsao won the David Perlman Lectureship of ACS in 1986, the Marvin Johnson Research Award from ACS in 1987, the John Ericsson Award for "Outstanding Achievement" in Renewable Energy, presented by the US Department of Energy in 1988, and he was elected a Founding Fellow of the American Institute of Medical and Biological Engineering in 1992.

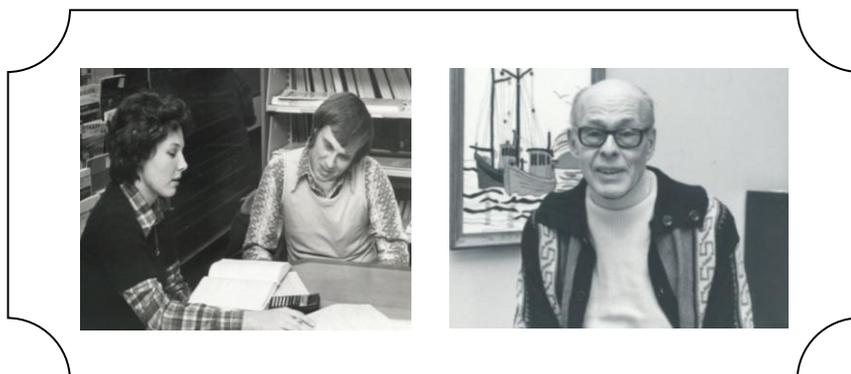
Tsao was a most prolific author who published more than 250 papers and received 14 US patents while he was at Purdue. He also edited several volumes including the *Advances in Enzyme Engineering*. He advised 29 and co-advised 11 MS and advised 44 and co-advised eight Ph.D. students at Purdue. Many of his students and post-docs became academics (see Appendix B). As an educator he concentrated his efforts on mass transfer, reaction engineering, and biochemical engineering. Tsao's later interests also included a major effort in genetic engineering in which he was assisted by Nancy W.Y. Ho (1935-, B.S. '57 National Taiwan University, M.A. '60 Temple University, Ph.D. '68 Purdue University). An excellent teacher, Tsao was the recipient of the 1984 R.N. Shreve prize. George became a professor emeritus on December 31, 2005 after 31 years of service at Purdue.



Left: George T. Tsao in 1974.

Right: W. Nicholas Delgass in 1974.

Purdue University and the School of Chemical Engineering are quite proud of the large number of extracurricular activities that are available and supported. We are very much aware that officers and committee chairs in all student organizations have a wonderful opportunity to develop their leadership skills in these extracurricular activities⁸. Some educational studies show that "the only factor predictive of adult success – however defined, and including post-college income – is participation in out-of-class activities."⁹ Receiving one of the awards sponsored by a student organization is also one of the highlights of many students' academic careers. In the following boxes we highlight several of the student organizations sponsored by the School, their award winners and officers. We apologize that some of the information is missing, but we have included all the data available. An interesting observation from the list of officers is that ~½ of the presidents earlier served in one of the other offices of that organization.



Left: Janelle Faunce-Raupp (B.S. '76, M.S. '78), now an attorney in Phoenix, Arizona, and R. Neal Houze in 1975.
Right: Lyle F. Albright in 1980.

The AIChE Student Chapter

A Chemical Engineering Society was formed in 1911, when Harry Peffer arrived at Purdue. The functions of this Society were at a minimum but after 1924 it became quite active. At that time their weekly newspaper was called *Chemical Kinetics*. To be sure, readers of the *Debris* of the early years of the School will find, to their surprise, that ChE students belonged to a "Chemical Society," namely the aforementioned Club. By the way, ChE's were collectively called by the solecism "the Chemicals." Although Peffer never became a member of AIChE he promoted the transformation of the Club into a regular Chapter of AIChE in September 1929, with 65 charter members including Professors Peffer, Bray and Leckie, and with Peffer as its advisor. After the death of Peffer, Shreve, who had some difficulties becoming a regular member of AIChE because of some animosity he had created with W. R. Lamar, one of his consulting associates in 1920 and brother-in-law of Martin H. Ittner (then president of the membership committee of AIChE and 1936-37 AIChE President), "informally" became the advisor of the Chapter

until his membership was approved in 1935. He was in charge of the Chapter for many years and promoted the participation of students in the Student Problem Contest of AIChE. Table 5-5 lists students who received prizes for their success in this competition. In 1960 the School stopped actively supporting this contest.

Table 5-5. AIChE Student Problem Contest

1936	Walter J. Ewbank, honorable mention
1939	Herbert F. Wiegandt, honorable mention
1953	Robert W. Scher, honorable mention
1954	John W. Klar, second prize
1957	Robert V. Mrazek, honorable mention

After 1935 the AIChE Chapter became the professional society of the School, the Catalyst Club taking charge of the more social functions. The older records of the Chapter have been lost and we do not know of its activities over a long period of time, although there were chapter members who were in charge of the ceremonies for the new CMET building in 1939 and helped in the activities of the 50th Anniversary of the School in 1961.

In the 1960's the advisors were John M. Woods and David P. Kessler, and in the 1970's Lyle Albright, Ron Barile, Phil Wankat, and Nicholas Peppas (1976-85) who won the AIChE National Best Counselor award in 1982. During this period a great tradition was established by the participation of a large number of students in the *Regional North Central AIChE Conference and Student Paper Contest*. Undergraduate student members have presented original research papers, competing for the coveted H.G. Donnelly Award (a miniature kettle) which has been awarded to them six times since 1965. Below is a list of the students who have won prizes for their papers. This is only partial list since second and third prize records have not been kept for the years before 1976 and records are spotty after 1999.

Table 5-6. AIChE Student Regional Contest Award Winners

1967	David T. Clay	first prize
1968	Ronald C. Schwabel	first prize
1971	R.L. Schilling	first prize
1978	Paula J. Hansen	third prize
1979	Rohit Khanna	second prize
1980	M. Jack Horvath	first prize
1981	John M. Larson	third prize
1982	Nancy M. Franson	third prize
1983	Jennifer L. Sinclair	second prize
1984	Julia G. Mounts	second prize
1984	Michelle J. Smith	third prize
1985	Scott Gustafson	first prize
1985	Rajesh Ramaswamy	first prize
1985	Gregg J. Howsmon	third prize
1986	Ed E. Parsonage	second prize
1988	Curt M. Walker	second prize
1991	Adrian K. Brown	first prize
1994	Natalie Wisniewski	first prize

1996	Jennifer Harting	second prize
1997	Upma Sharma	second prize
1998	Julie Wright	first prize
1998	Upma Sharma	third prize
1999	David Henthorn	third prize
2010	S. Atanasov	first prize

In addition to the regional contests, Rachel Hagy won third prize in 2006 in the AIChE student poster competition at the Annual Meeting.

Thus, from 1978 to 1986 Purdue students continuously received one prize in this competition, which has been held at Purdue five times (in 1967, 1981, 1985, 2000 and 2006) with more than 300 participants from 25 Midwestern Universities.

In the 1970's and 1980's the AIChE Chapter became a most active student organization. In the spring 1978 there was a phenomenal contest for the presidency and other positions of officers of the Chapter with two tickets running neck-and-neck until the final votes, an unusual event for the somewhat apathetic student life of those times. The officers of 1978-79 achieved a serious concession from the faculty, and one voting undergraduate student member (usually the president or another officer) still represents the views of the students in the Undergraduate Curriculum Committee; the first student representative was AIChE President Paula J. Hansen (BS '79).

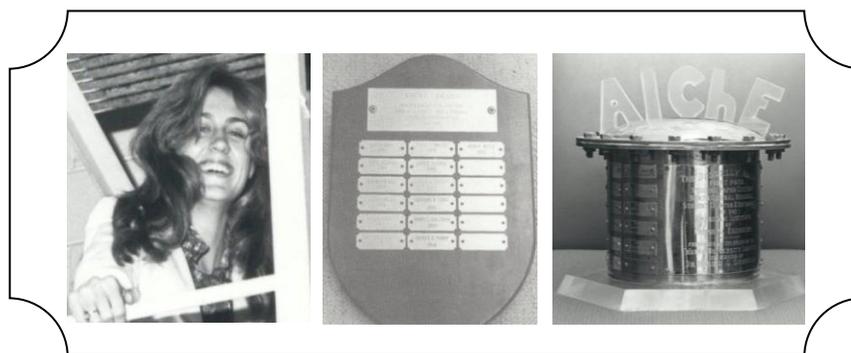
Student Chapter advisors after 1985 were David P. Kessler (1985-86), Elias Franses (1986-87), J. H. Seo (1987-88), Nicholas Peppas and John Wiest (1988-93), Hilary Lackritz and John Wiest (1993-1995), Hilary Lackritz and Christos Takoudis (1995-96), Osman Basaran (1996-99), David Corti (1999-2003), Steve Beaudoin (2003-2005), John Morgan (2005-08), Sangtae Kim (2006-08) and Ken Thomson (2008-present). In 1992-93 and again in 1997-98 the AIChE Student Chapter received the Vicki Michelson award as the most outstanding engineering society at Purdue. The chapter hosted the student program at the 2002 AIChE meeting in Indianapolis, and it won best chapter awards from AIChE in 1999, 2000, 2002, and 2006.

Presently, the Chapter has approximately 120 members, a *presidium* of five officers and fifteen committee heads and subheads. Ten students attended the 2010 Annual AIChE meeting in Salt Lake City. Notable projects include the Industrial Roundtable and Seasons for Sharing that raised over \$400 for Lafayette families unable to afford Christmas presents. In addition, AIChE sponsors periodic pizza lunches and Pubbing with the Professors to increase informal interaction between students and faculty. The AIChE Award is one of the three most important scholastic awards given to senior students, usually at the *Razz-Banquet*. The recipients of this award since its inception are listed in Table 5-7.

Table 5-7. AIChE Award for Graduating Seniors

1973	Dana B. Mirkin	1993	Kristin Hickey
1974	Jay V. Ihlenfeld	1994	Natalie Wisniewski
1975	Elizabeth R. Krug (Ryker)	1995	Lisa Ingamells
1976	Allan H. Bailey	1996	Krista M. Fitzsimmons
1977	Linda K. Russell (Brown)	1997	Stephen Schwallie
1978	Christopher R. Rhodes	1998	Thomas Manske
1979	Paula J. Hansen	1999	Jennifer A. Hyder
1980	John R. Haskins	2000	Emily S. Shockey
1981	Jerry D. Stacy	2001	Brandon Patterson
1982	Gregory R. Lewis	2002	Todd M. Reese
1983	Mary C. Cullinan (Scholl)	2003	Brittany Barrett
1984	Steven D. Perry	2004	Kevin Roche
1985	Jean F. Meyer	2005	Elizabeth J. Tocce
1986	Laura E. Zobus	2006	Jason A. Corah
1987	Robert A. Kranz	2007	Jason Conger
1988	Michele M. Williams	2008	Rochelle Chism
1989	Lisa Shieh	2009	Jeff Livarchik
1990	Curt W. Calhoun	2010	Drew Liebrecht
1991	Ryan Vannice	2011	Emily Ellsworth
1992	Andrew Ault		

This is the only one of the three senior awards that is given for leadership and service to the School as well as scholastic achievements. The AIChE award for juniors is discussed in Chapter 6.



Left: Linda (Russell) Brown (B.S. '77), the 1976-77 AIChE Chapter President, in the undergraduate laboratory.

Center: The AIChE Award in 1985.

Right: The AIChE H.G. Donnelly Award

Table 5-8. AIChE Student Chapter Officers					
Year	President	Vice President	Vice President	Treasurer	Secretary
1982	Sue McLaughlin	Theresa Gallo	Anne Holland	Blasine Penkowski	Helen Hall
1983	Steve Perry	Dave Muenz	Jean Meyer	Gail Dehli	Debbie Patrick
1984	Jean Meyer	Sonja Dalton	Laura Ross	Kevin Klatte	Nick Mittica
1985	Laura Zobus	Richard LeBlanc	Richard Dubroff	Daena Nelson	Ann Cullinan
1997	Tom Manske	Julie Right	Tom Calloway	Elizabeth Davis	Carrie Bauer
1999	Diane Whirledge	Emily Williamson	Elizabeth Davis	Brandon Patterson	Ethan Frye
2000	Brandon Patterson	Deny Bobula	Erin Race	Todd Reese	Keith Strohler
2001	Todd Reese	Kacey Fetcho	D. Sujan	Kanishka Mapa	Brandon Golden
2002	Kanishka Mapa	Leah Boone	Kendra Schmitz	Susan Gleissner	Amy Conn
2003	Kristin Nugent	Laura Main	Becky Book	Patrick Oglesby	Karim Khayat
2004	Nate Keen	Scott Stohler	Liz Tocce	Adam Slaboski	Brandyn Feller
2005	Adam Slaboski	Kevin Kickham	Jessica Moore	Jim Anderson	Jason Corah
2006	Jessica Moore	Jim Anderson	Sandra Azzano	Rachel Hagy	John Douglas
2007	Rochelle Chism	John Douglas	David Hanna	Dan Logsdon	Jeff Livarchik
2008	Jeff Livarchik	Vasilious Theodosopoulos	Amanda Jackel	Kyla Hebard	Pulak Sharma
2009	Vasilious Theodosopoulos	Luke McAfee	Kyle Roche	German Rendon	Lauren Cervellere
2010	Emily Ellsworth	Todd MacMillan	Jackie Logan	Yiwen Chen	Diana Rubiano

The student body is often lead by its academically best. In this November 1978 picture Rohit Khanna (1977-78 President of the AIChE Chapter and 1978-79 Vice-President of the SPE Chapter) and Paula J. Hansen (1978-79 President of the AIChE Chapter) work in the undergraduate laboratory. These two students received five Purdue ChE and three national awards in 1978-79.

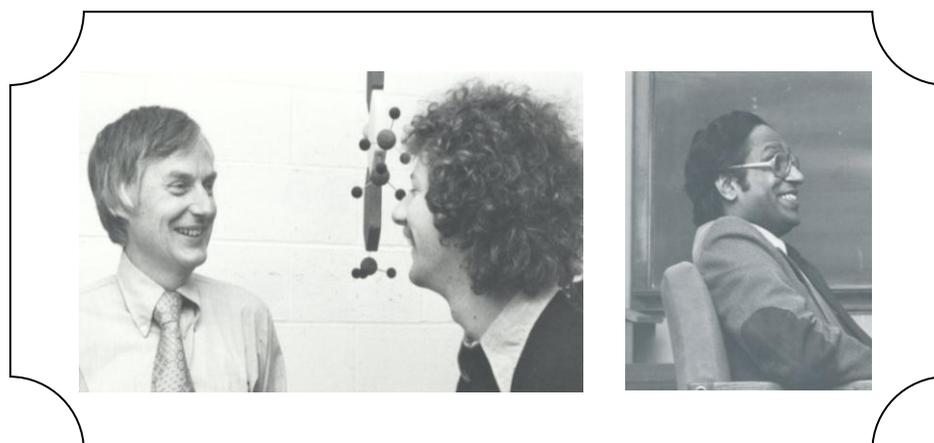


William Nicholas Delgass (1942-, B.S. ChE '64, B.S. Math. '64, University of Michigan, M.S. '66 and Ph.D. '69 both in ChE from Stanford University) also joined the faculty in 1974. Before coming to Purdue, Delgass was on the faculty at Yale University for five years. Nick has been one of the School's major contributors in research, teaching, and administration during the last 37 years, and his story will be told in Chapter 6.



Left: John M. Woods in 1976.
Center: Alden E. Emery in 1981.
Right: Henry C. Lim in 1976.

Doraiswami "Ramki" Ramkrishna (1938-, B.Ch.E. '60 University of Bombay, Ph.D. ChE '65 University of Minnesota) arrived here in August 1976. He was educated at the University of Minnesota under Arnold Fredrickson and Henry Tsuchiya, and became very well versed in the Minnesota idea of chemical engineering as being based on a firm mathematical basis. After several years on the faculty of IIT Kanpur he returned to the USA where he was Visiting Professor at Wisconsin and Minnesota for two years. Ramkrishna was the first of four Minnesota graduates who were to be hired in the next five years. Ramkrishna brought to Purdue a fresh approach to the study of chemical engineering problems. He was a major force in research and behind a revitalization of the graduate curriculum. Since Ramki is still going strong at Purdue after 35 years, his story will be told in Chapter 6.



Left: Roger E. Eckert and then graduate student David E. Guinnup (B.S. '75, M.S. '76), now professor at North Carolina State University, in 1976.
Right: Doraiswami Ramkrishna has developed an outstanding research program in applied mathematics.

Table 5-9. Student Chapter Society of Plastics Engineers Award

The Student Chapter of the Society of Plastics Engineers was founded in November 1978 by a group of 41 undergraduate and graduate students with the initiative of Mark A. Proegler (B.S. '79). It functioned as an organization for the promotion of polymer research and education on campus, and, in addition to ChE's, it had members from other Schools, notably Materials Engineering. Its advisor was N.A. Peppas (1978-84). Student members of the Chapter participated in the national student paper competition held at the Annual Technical Meeting of the Society of Plastics Engineers. Rohit Khanna (B.S. '79), in 1979 and Gurkirat S. Sekhon (B.S. '80), in 1980 received first prizes. The Chapter sponsored two awards annually. The *SPE Polymer Research Award* was given to one or more undergraduate students who had performed outstanding research. Its recipients were:

1979	Paula J. Hansen	1980	Gurkirat S. Sekhon
1981	Steven R. Burdette	1982	Nancy M. Franson and Kerry P. Staller
1983	David A. Gobran	1984	Douglas F. Kline

The *SPE Excellence in Polymers Award* was given to one or more undergraduate students who excelled in polymer education. Its recipients were:

1979	Rohit Khanna	1980	Paul W. Sibal and Thomas A. Speckhard
1981	William J. Zafian	1982	Nancy M. Franson
1983	John Ratulowski, Tammy K. Goodman and Scott W. Warren		
1984	Cecilia C. Latchford, Julia G. Mounts-Alexander and Michelle J. Smith		

This Student Chapter of the Society of Plastics Engineers was dissolved in November 1984 due to lack of student interest.

With Koppel's plans now materializing, he soon turned his attention to other research areas and more specifically polymers, colloid science and biomedical engineering. The next six faculty members would be hired at the level of assistant professor. As mentioned earlier, Lowell had a very good sense of quality and talent. His inspired first assistant professor hire, Nicholas A. Peppas (1948-, Dipl. Eng. '71 National Technical University of Athens, ScD '73 MIT), was a former student of the bioengineering pioneer Edward Merrill. Peppas had also done a post-doc with Clark Colton and Ken Smith at MIT. Peppas joined Purdue in 1976. Although he left Purdue in 2002 for the University of Texas at Austin where he is the Fletcher Stuckey Pratt Chair in Engineering and Chair of the Biomedical Engineering Department, Peppas' contributions to Purdue during the administrations of Koppel, Andres and Reklaitis were extremely significant (see textbox).

James Michael Caruthers (1953-, S.B. '75, S.M. '75, Ph.D. '77, all from MIT), a student of Robert E. Cohen, came to Purdue one year after Peppas, in 1977. He is the youngest researcher to have become a faculty member in ChE (at the age of 23) in recent history. Educated both as a chemist and chemical engineer, he developed an outstanding theoretical and

experimental program in polymers which expanded to include polymer rheology and fluid mechanics, and more recently battery technology. In addition, he was a major contributor to the teaching and (although Jim will wince at the word) the administration of the School. These contributions are discussed in more detail in Chapter 6.

The third polymer scientist was Michael Francis Malone (1952-, B.S. '74 Pennsylvania State University, Ph.D. '79 University of Massachusetts-Amherst) who joined Purdue in 1979 with research interests in polymer processing and process design. A year later he decided to return to his alma mater, the University of Massachusetts-Amherst. Much to the surprise of his former colleagues who he would entertain with stories of bathing *au naturale*, when he grew up he became Department Head, Dean of Engineering, and now the Vice Chancellor at University of Massachusetts-Amherst.

Nicholas A. Peppas (1948-)

Nicholas A. Peppas (Dipl. Eng. National Technical University of Athens '71, ScD '73 MIT) did his doctorate at MIT working with bioengineering pioneer Edward W. Merrill. After graduation, he spent two years in the Greek army as a second lieutenant and then was a post-doc in biomedical engineering at MIT with Clark Colton and Ken Smith. In 1976 Peppas came to Purdue as an assistant professor, was promoted to associate professor in 1978 and then to full professor in 1982. Peppas chose to accept Purdue's job offer because of his tremendous respect for the School's Head, Lowell Koppel.

In his career at Purdue Peppas supervised 51 Ph.D. students out of the 93 he has graduated up to now. Whilst working with these students, Peppas was also doing pharmaceutical research at the University of Paris and the University of Geneva and he graduated 9 Ph.D. students from these universities. Many of Peppas' former students have gone on to academic careers (see Appendix B). From 1976 to 2002 Peppas authored numerous books (Table 8-11), original technical articles, educational papers (Appendix X) and patents. This research work done *at Purdue with Purdue students* has had significant impact and Peppas is now the second most cited US chemical engineer (after Bob Langer of MIT) with 27,000 citations as of 2011.

From 1982 until his departure in 2002, Peppas served as the editor of the journal *Biomaterials*, which has become the most cited journal in the field. In addition, he served on the editorial boards of a number of journals, and in a large number of positions in professional societies. During his stay at Purdue, he served on the Board of AIChE, was Chairman of the Materials Division of AIChE and was elected President of the Society for Biomaterials and the Controlled Release Society. At Purdue he did many behind the scenes tasks such as writing the first edition of the School's history and writing award nominations for his colleagues that were greatly appreciated by the person who subsequently won the award. [I (PCW) was one of these fortunate nominees more than once, and am pleased to publically thank Nicholas for his efforts.]

In November 1993 Peppas was named the Showalter Distinguished Professor of Biomedical Engineering at Purdue [This professorship honors Ralph W. and Grace M. Showalter and was assigned to the BME Department where Nicholas had a 0% appointment]. While at Purdue he received a number of other Purdue and national research (Tables 8-4 and 8-7) and teaching awards (Tables 7-2 to 7-4). He was awarded honorary doctorates from the University of Ghent in Belgium (1999), the University of Parma in Italy (2000) and the University of Athens in Greece (2000). In 2002 Peppas left Purdue to become the Fletcher Stuckey Pratt Chair in Engineering at the University of Texas-Austin, Professor of Chemical Engineering, Biomedical Engineering and Pharmacy, and (since 2009) the Chairman of the Biomedical Engineering Department. A farewell dinner for Prof. Nicholas Peppas was held at the Lafayette Country Club on December 5, 2002. The entire faculty attended to pay tribute to his remarkable contributions to Purdue.

His innovative work and scholarly endeavor at Purdue and then Texas led to his election to several academies. In 2005 he was elected to the National Academy of Pharmacy of France, in 2006 he was elected to the US National Academy of Engineering (Table 8-8) and in 2008 to the Institute of Medicine (which is the US academy of medicine). During its centennial, AIChE named him as one of the 100 "outstanding chemical engineers of the modern era".

Jennifer Sinclair Curtis (BS '83, ChE faculty 1997-2004), who did undergraduate research with Nicholas, and Christopher N. Bowman (BS '88, PhD '91), who did his Ph.D. with Nicholas, wrote a touching tribute in *Chemical Engineering Education*, 43(3), 170-178 (Summer 2009).



Left: Elias I. Franses established, shortly after his arrival in 1979, a strong research program in colloid science.

Center: Linda N.H. Wang in 1983.

Right: James M. Caruthers (1979 picture).

The great achievements of the Greenkorn/Koppel era were soon recognized nationally. School rankings are by no means an adequate way to evaluate the successes or failures of a School and especially the effectiveness of its educational or research program. They are, however, a sure indicator that one's peers recognize quality changes in a particular institution. Thus, the various academic surveys of the late 1970's and early

1980's are indicative of recognition of progress in the School. Also important are the results of a 1978 evaluation of ChE educational programs by industrial managers¹⁰ in which Purdue Chemical Engineering ranked first with significant difference from the other Schools. Finally, in 1979 the research expenditures of the School were more than \$1,500,000 or about 9% of the total engineering research budget. Rankings are discussed in more detail at the end of Chapters 7 (undergraduate programs) and 8 (graduate programs).

Naturally, Koppel's administration was not without problems. In the late 1970's research space became a grave problem, especially considering that only one of the recently acquired faculty members did not do experiments. This problem reached a critical stage in 1978, at which time space was offered to the School by Dean Hancock in the newly constructed A.A. Potter Building with the provision that the research conducted there would be of "interdisciplinary nature." In the mid-1980's the Potter building housed the research facilities of Professors Tsao in biochemical engineering (including the Laboratory of Renewable Resources Engineering), Caruthers in polymer rheology, Squires in coal gasification, and Andres in materials science. For a period of time (1978-81) the facilities of the Hemodialysis Laboratory, loosely associated with the School under the direction of Steven R. Ash (1945-, B.A. '67, Northwestern University, M.D. '71, University of Kansas), were also used by Professors Barile, Kessler and Wang. Major upgrading of laboratory space was also done in the CMET building with the construction of a modern biochemical engineering lab in 1974, a new catalysis laboratory in 1978, and major facilities for computer terminals between 1980 and 1983. However, the space problem again reached a critical level in the middle 1980s. This difficulty was temporarily resolved in 1989 when the Materials Engineering faculty moved to the new MSEE building.

The second major problem faced by Koppel, indeed by the whole faculty, was the doubling of the undergraduate enrollment in the late 1970's. For those who were students at Purdue in the late 1930's or 1940's, a comparison of undergraduate enrollments will show that the numbers are not that different. However, in 1980 the faculty was much more research-oriented than in 1948, and the large number of graduate students (and therefore the time required for graduate supervision) made these high enrollments almost unbearable. The undergraduate enrollment reached a maximum in 1982, when 565 sophomores, juniors and seniors were enrolled. The senior class swelled to a high of 176 graduates in 1980, the fourth largest class in the history of the School. These enrollments were observed at a time when the School also had 120 resident graduate students and about 15 to 20 postdoctoral fellows. Significant discussions among the faculty and with the higher administration led to a few solutions, including stricter requirements for admission to the sophomore class in chemical engineering.

These requirements did not produce any serious alleviation of the situation. Instead, they led to an increase of the number of "better" undergraduate students coming to chemical engineering. As in the 1920's (see Chapter 2), the chemical engineering curriculum again developed the reputation of being the most difficult curriculum on campus. After 1983, a dramatic reduction in enrollments occurred, mostly in response to the changing appetite of industry for B.S. chemical engineers.

In the late 1970's it was also recognized that the new generations of graduates, probably because of the demanding curriculum, were somewhat lacking in their writing skills. Koppel and Delgass, who were very sensitive to the need for a truly balanced undergraduate education, led the faculty to again hire an English specialist (Prof. Miller from English had been on the faculty in the 1960's). Frank Stephan Oreovicz (1944-, B.S. '67, M.S. '70 both from Illinois Institute of Technology in Physics, Ph.D. '78 Pennsylvania State University in English) was hired in 1979 as an Education Specialist in Communication. From 1979 until he retired in 2007 Oreovicz made significant contributions to the undergraduate and graduate programs of the School, not only by working directly with students to improve their written and oral communication skills, but also by collaborating with Wankat and to a lesser extent Squires. These collaborations will be discussed in more detail in Chapter 7.

Table 5-10. University-wide Teaching Awards for Faculty

A number of faculty received University-wide awards while at Purdue.

The **Amoco Outstanding Teaching Award** (now the **Murphy Award**) is the highest university-wide recognition for outstanding teaching by a faculty member and is given annually to three faculty members of the University. The recipients from our School are Robert C. Squires in 1981, R. Neal Houze in 2002 and Nicholas Delgass in 2003.

The **Teaching Academy** recognizes professors who have made outstanding contributions to teaching as **Fellows**. ChE fellows are Nicholas Delgass, R. Neal Houze, Robert C. Squires, Venkat Venkatasubramanian, and Phil Wankat.

The **"Helping Students Learn" Award** was established in 1980. Lowell B. Koppel was the 1984 recipient of this award.

The **Teaching for Tomorrow Award** is to encourage outstanding teaching by young faculty. David Corti was a recipient in 2002, and Neal Houze 2003 and Venkat Venkatasubramanian 2004 were Senior Faculty mentors.

The **Sigma Delta Chi Medallion** was given annually to a professor of Purdue who excelled in teaching. The only ChE recipient was John L. Bray, who received it in 1952.

Robert George Squires (1935-)

Robert Squires (B.Ch.E. '57 Rensselaer Polytechnic Institute, M.S.E. '58, M.S. Math. '60, PhD. '63, all from the University of Michigan) had studied catalysis under a pioneer scientist of those days, Giuseppe Parravano, who had previously worked in Italy as an assistant to Giulio Natta (Nobel laureate, 1963). Shortly after his arrival in 1962, Squires established an ambitious program in catalysis, working initially with IR spectroscopy and then with other spectroscopic techniques. In the 1970's along with W.N. Delgass he established the catalysis research program of the School which is still a major component of the School's research portfolio.

Although his research interest was in kinetics and catalysis, Squires' teaching interests extended to thermodynamics. Generations of alumni know him as the gifted teacher of ChE 311 (now ChE 211) and ChE 439 (now ChE 348). For years Squires and his wife Carol invited students over to their house, conveniently located within walking distance on Salisbury Street, for informal evening chats with snacks. Other than the Catalyst Club, this was the only informal opportunity many students had to get to know a professor as a person. Squires received almost every important local and national teaching award, including the prestigious 1981 Amoco Foundation Award, now the Murphy award. Squires was the first ChE faculty member to win this award, which recognizes the best University teachers. He won the Shreve prize as the best teacher in ChE six times (1976, 1981, 1987, 1990, 1992, and 1996) and the Potter award as the best teacher in Engineering twice (1977 and 1991). Nationally, Bob won the ASEE Western Electric Award in 1977 and the Chemical Manufacturers Association Catalyst Award in 1985.

In the 1980's and 1990's Squires became interested in developing videos that allowed students to do experiments virtually that were impossible to do in the unit operations laboratory. Working in collaboration with Rex Reklaitis and others, he developed collaborations with a number of companies to produce these videos. The resulting videos were beta tested at Purdue and distributed nationally. For this work Squires and Rex won the Corcoran Award from ASEE ChE Division for best paper in *Chemical Engineering Education* in 1991, and Bob won the ASEE Carlson Award for educational innovation in 1995.

Squires' interest in students led him to accept the position as the coordinator of the ChE Cooperative Engineering Education Program in 1982 when Houze stepped down upon becoming Director of the co-op for all engineering. Bob continued as coordinator of the ChE program until he retired.

Squires was heavily involved in many national societies, including the Industrial and Engineering Chemistry Division of the American Chemical Society, which he served as Chairman* in 1980, and he was elected a Councilor of ACS.

At the time Bob retired in December 2004, he held the record (42 years) for longevity on the faculty (in 2011 tied with Bob Hannemann and Neal Houze).

*Squires was the fourth Purdue ChE faculty member who became Chairman of the I&EC Division of ACS. Previously, R.N. Shreve (1943), J.H. Rushton (1953) and E.W. Comings (1956) had served in the same position.

In 1979 David Gordon Taylor (1950-, B.Sc. '73 Virginia Commonwealth University, M.Sc. '76 and Ph.D. '79 both from the University of Virginia in Analytical Chemistry) was hired to contribute to the needs of the School for design of sophisticated research equipment. He became Director of Instrumentation and Computer Resources of the School and retired in 2010.

The last two faculty members hired by Koppel, E.I. Franses, and N.H.L. Wang, joined the School in 1979 and 1980, respectively. Their contributions will be briefly introduced here and delineated in more detail in Chapter 6. Elias Iosafat Franses (Dipl. Eng. '74 National Technical University of Athens, Ph.D. '79 University of Minnesota) immediately established an outstanding program in colloid science, contributed greatly to teaching, and for many years ran the ChE Honors program.

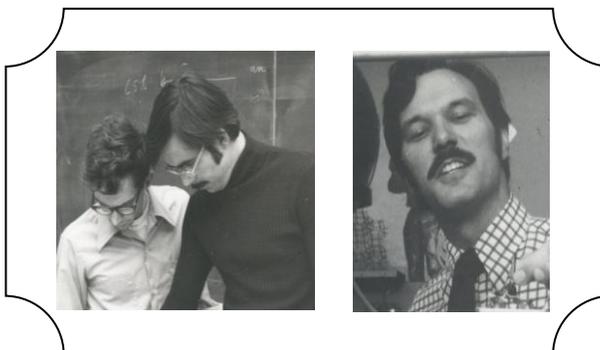
Nien-Hwa Linda Wang (B.S. '71 National Taiwan University, M.S. '73 University of Wyoming, Ph.D. '78 University of Minnesota), was hired in 1980 to strengthen the biomedical engineering area. The School was quite fortunate in that, in addition to her expertise in biomedical engineering, it gained a specialist in separations as well. In addition to developing an outstanding research program in separations, Wang served as a role model for three decades of female students.

In October 1980, after seven years in a demanding position, Lowell Koppel announced his intention to step down as Head of the School. A national search was conducted for a new Head and Ronald P. Andres was selected in March 1981. He arrived here in August 1981. Koppel stayed on the faculty as a "senior statesman" and contributed much to the development of the various computer facilities of the School, especially the IBM system. He used this system to establish a new course, ChE 597K, Intermediate Process Control. This course became the most popular elective course of the School in the early 1980's. For his many contributions to education in 1984 Koppel received the University-wide "Helping Students Learn" Award. In July 1985 to the great surprise of most of the faculty, Lowell B. Koppel, the seventh Head of the School, an excellent educator and researcher, and a brilliant administrator, announced his intention to resign. In retrospect, the decision made sense since Lowell had accomplished his goals and when the opportunity arose, he decided this time to leave at the top of his game. He left in August 1985 for Setpoint, Inc. in Houston, Texas. In 1994 he was awarded the *Chemical Engineering* magazine Personal Achievement award. When Setpoint merged with Aspen Technology, he became a Vice President of Aspen Technology.

The history of the School, under the Headship of Ronald P. Andres, is one of continuing educational and research achievements by the faculty and students. A gifted experimentalist and theoretician from Princeton University,

Andres transferred here his conviction that chemical engineers should concentrate on a balanced program of fundamental and applied research with special emphasis on frontier-technological problems such as semiconductors and VLSI systems, genetic engineering, bioengineering, advanced separations and computer aided design. Along with his heavy administrative load he kept an active research program with five to six graduate students. After stepping down as Head in 1987, he increased his research productivity.

W. Nicholas Delgass (right) and Gintaras V. Reklaitis (left), the two Stanford educated faculty members, in 1982.



Christos George Takoudis (1954-, Dipl. Eng. '77 National Technical University of Athens, Ph.D. '82 University of Minnesota), the first addition under Andres, arrived at Purdue as an assistant professor in November 1981. A former student of Lanny D. Schmidt and Rutherford Aris, he developed a significant research program in catalytic and non-catalytic reaction engineering, which includes both elegant mathematical analysis and sophisticated experimental techniques. He also worked in polymerization reaction engineering and particularly in semiconductor and VLSI technology. Takoudis contributed significantly to the graduate educational program especially in the reaction engineering area and developed the first course in the School on semiconductors and VLSI technology. He was promoted to associate professor in 1987 and to professor in 1995. He also served as Chair of the Undergraduate Curriculum Committee. In 1996 he joined the relatively new department of Chemical Engineering at the University of Illinois-Chicago (UIC) to help build and grow that department, and in 2005 he accepted a joint appointment with the Department of Bioengineering at UIC.

Christos G. Takoudis came to Purdue in 1981 and did important work in the area of reaction engineering.



Ronald Paul Andres (1938-)

The eighth Head of the School, Ronald P. Andres, was born in Chicago on January 9, 1938. He was educated at Northwestern University (B.S. '59) and at Princeton University (Ph.D. '62), being the last Ph.D. student of Prof. Michel Boudart before Boudart moved to the University of California at Berkeley. Andres became Assistant Professor of Chemical Engineering at Princeton University in 1962 and rose through the ranks until July 1981 when he moved to Purdue University. He was a Visiting Professor at IIT, Kanpur, India (1970) and at the University of Eindhoven, the Netherlands (1974).

Professor Andres' research includes molecular analysis of reaction kinetics and catalysis. He has contributed to a number of research areas including molecular cluster chemistry, aerosol physics, nucleation and atmospheric chemistry. A more than casual interest in control theory developed into a research area when, after the untimely death of Leon Lapidus at Princeton, he undertook the supervision of several of the latter's graduate students.

After his arrival at Purdue, Andres directed his efforts and enthusiasm towards the further development and strengthening of certain technological frontier research areas such as computer-aided design and control, biochemical and genetic engineering, advanced reaction engineering, microlithography and VLSI processes, and colloid and surface science. In collaboration with L.B. Koppel and G.V. Reklaitis he was instrumental in bringing to the School new major computer facilities for education and research.

Administratively, Andres was faced with the same problems faced by any major ChE School in this country, that is, lack of space, renewal of research equipment becoming rapidly obsolete, and decreases in federal research funding for fundamental research. He inherited the space problems of the Koppel administration and the helpful but inadequate solution of spreading chemical engineering research among several buildings. Planning for the partial solution to the space crunch – moving MSE to the under-construction MSEE building – was started, but did not come to pass until 1989. In addition, Andres always enjoyed his research and working with his graduate students more than doing routine administrative tasks. In the summer of 1987 Andres announced that he would step down as Head of ChE. In August 1987 Dean Yang appointed Prof. Rex Reklaitis as the Interim Head of ChE, and Andres returned to a happy life as an Engineering Research Professor.

As a creative researcher generating new ideas Andres is almost without peer in the School. Although he retired in 2004, he remains very active in his research. In 2006 he received the AIChE Nanoscale Science and Engineering Forum Award, and in 2007 he received the Purdue Research Foundation Invention Recognition Award. He has been awarded four patents and is the author of approximately 110 publications, including the 1996 classic on "Self-assembly of a two-dimensional superlattice of molecularly linked metal clusters", *Science*, 273, 1690-1693 (1996), which, according to the Web of Knowledge, is the most highly cited article in the history of the Purdue ChE Department with 878 citations.

The second and last hire during Andres' administration was Jin Ho Seo (1953-, BS '76 Seoul National University, MS '78 KAIST, Ph.D. '85 Cal Tech) who came to Purdue in 1986. His research with Prof. Jay Bailey on using flow cytometry to understand recombinant organisms fit in very well with the

biochemical engineering research group. He started research that later blossomed into world-renowned research at Seoul National University after he left Purdue in 1989. He is now Director of the Bio-Molecular Engineering Laboratory in Food Science & Technology in the Dept. of Food & Animal Biotechnology in the College of Agricultural and Life Science at Seoul National University, South Korea.

The last few years of Andres' administration were years of reserved confidence. One of the major changes during Andres' administration was a revision of the undergraduate program which has led to the plan of study included as Appendix I. Also during Andres' administration the ChE Honors program was established as an alternative educational program for highly motivated seniors, particularly those interested in graduate school. Thus, in 1985 the first six students participating in this program graduated with B.S. theses performed under the direction of D. Ramkrishna, G. Tsao, L. Wang, and S. Ash. The ChE Honors program continues with the changes that since both Purdue University and the College of Engineering instituted honors programs in the 2000s, the ChE honors program now meshes with these programs (see Chapter 7 for more details on the ChE Honors program).



Ronald P. Andres, the eighth Head of the School.

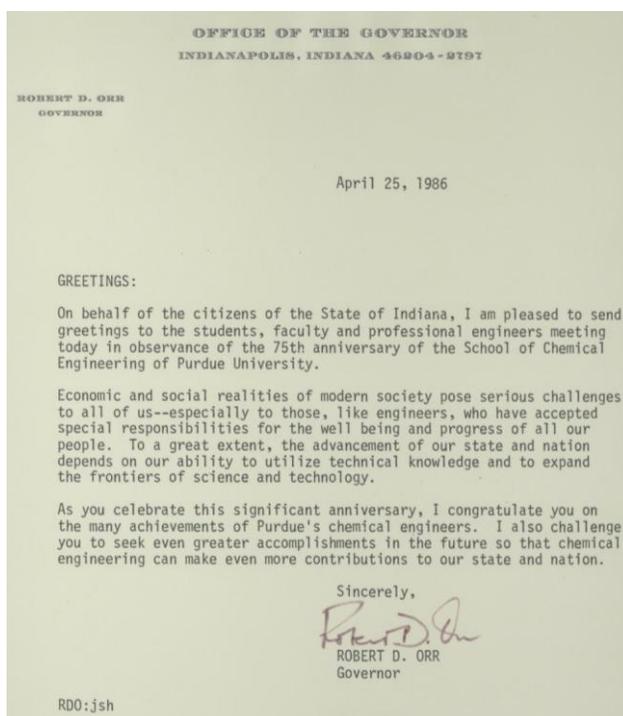
Nationally, in 1985, a committee was formed by the National Research Council to prepare a report on Chemical Engineering Frontiers: Research Needs and Opportunities. Headed by Professor Neal R. Amundson of the University of Houston, the committee consisted of subcommittees in each of the seven frontier research areas identified: Biochemical and Biomedical Engineering (Arthur E. Humphrey, chair, Lehigh University); ChE Aspects of Advanced Structural Materials (Arthur B. Metzner, chair, University of Delaware); ChE Aspects of Electronic, Photonic and Recording Materials and Devices (Larry F. Thompson, chair, AT & T Bell Laboratories); Computer-Assisted Process and Control Engineering (Arthur W. Westerberg, chair, Carnegie-Mellon University); Energy and Natural Resources Processing (Keith W. McHenry, Jr., chair, Amoco Oil); Environmental Protection, Safety and Hazardous Materials (Adel F. Sarofim, chair, MIT); Surface and Interfacial

Engineering (Alexis T. Bell, chair, University of California at Berkeley). In November 1985 the first monumental suggestions of the Amundson Committee were presented at the Chicago AIChE meeting.

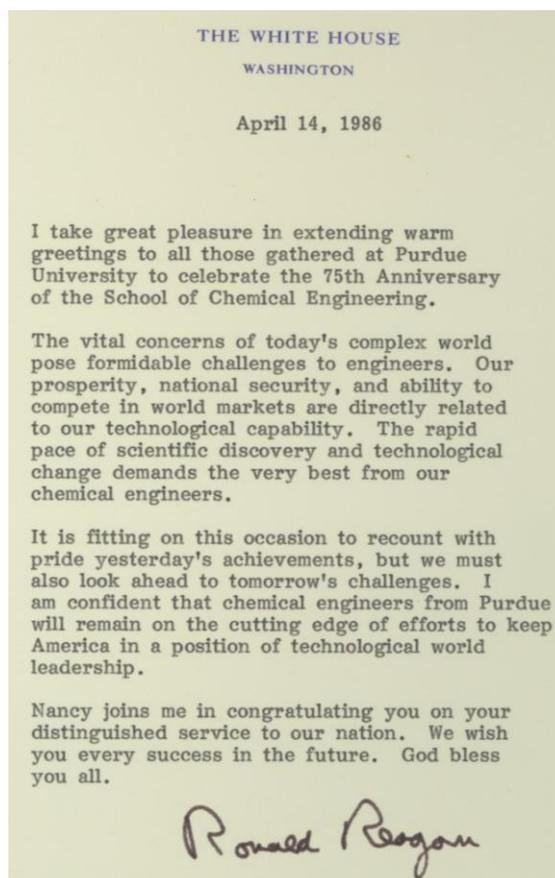
The titles of the seven subcommittees offer a good identification of the main research areas that attracted the interests of chemical engineering researchers in the mid-1980s. The Amundson study was aimed at a variety of audiences including perspective students of chemical engineering, the chemical engineering community itself, and lawmakers at all levels of government. Its final report was published in 1988¹² although there were significant discussions before this¹³. This report had a profound impact on ChE research for a period of years¹⁴. The accuracy of some of the predictions of the report is remarkable since many of the areas highlighted remain key research areas in 2011 and are significant parts of the 14 Grand Challenges for Engineering developed by the National Academy of Engineering¹⁵ although the structure of the Amundson report and of the Grand Challenges is different. The report recommended retaining the core of chemical engineering in the undergraduate curriculum and that new faculty should have strength in the frontier areas. To a large extent the School followed these recommendations.

During Andres' administration the 75th Anniversary Celebration of the School was planned and held. Throughout 1986 a 75th Anniversary Seminar Series was planned by a committee consisting of Kessler, Peppas and Reklaitis. A number of well-known academic and industrial speakers with Purdue connections were invited to speak. The academic speakers, many of whom have been discussed frequently in this history, were Profs. George Bankoff, Carroll Bennett, Donald Coughanowr, Martin Feinberg, Samuel Hite, Ganesh Laddha, Duncan Mellichamp, Gary Poehlein, Henry Ramey, Robert Reid, V. P. Shih, Joe M. Smith, Peter G. Smith, Hendrick Van Ness, and Jaime Wisniak. The equally august list of industrial speakers included Robert Forney, Donald Hannemann, James Henderson, Maurice Lorenz, Paul Orefice, A. K. S. Raman, James Schorr, and Vern W. Weekman, Jr. Letters of congratulation signed by President Ronald Reagan and Governor Robert Orr were received and displayed.

The first edition of this History was prepared by Prof. Peppas with the able assistance of then PhD student Ronald S. Harland (BS '83, PhD '88). The preparation of the History took many hours of patient digging for information in the archives (see text box) and other sources. Fortunately, this work has made the preparation of the second edition immensely simpler.



Above Letter from Indiana Governor Robert Orr celebrating the School's 75th anniversary.
Below: Letter from President Ronald Reagan celebrating the School's 75th anniversary



The Archives of the School of Chemical Engineering

The Archives of the School of Chemical Engineering comprise a wide range of items from the early and more recent days of the history of the School. The original registration files of all the B.S. graduates from 1909 until the present have been kept. For the early years (1909-1950) Professor Shreve personally added in the files all types of informational material about the career of the alumni, from newspaper clips to letters and biographies. The alumni files are again rich with career material for the years 1965-present. Similar files exist for all the M.S. and Ph.D. graduates.

Most of the early correspondence of the faculty members is lost, excluding some scattered letters of Professor Bray (especially for the period 1935-1951) which can be found both in the Archives of the School and in a special file of the School of Materials Engineering. The correspondence of Professor Shreve including a description of many of his activities before he joined Purdue is detailed and well kept for the years 1919-1939. Selected correspondence from later years is kept at the Engineering Administration Building in a special collection. No correspondence of Professors Lovell, Maxwell, Leckie, Serviss and others in the pre-1945 years has been kept. This is probably due to an unfortunate 1967 administrative decision which led to Professor Shreve's reading all the old files and disposing of "about ninety percent (of the material) as being no longer of interest."¹¹ Of the letters of Professor Peffer only a small portion (1930-33) is available in the Archives.

For the post-1945 years a few selected letters and other items of the faculty members have been kept in the Archives. However, the files of Professor Rushton have been preserved. After Prof. Peppas left in 2002, no attempt was made to systematically collect information. Peppas continues to keep at Austin, TX numerous letters written to by pre-1940 alumni during the period of the preparation of the first edition of this history book. In addition he has kept a complete listing of all faculty meeting minutes (1976-2002), seminars, interview files as well as all publication titles and citations from 1976 to now.

A collection of all the books published by Purdue ChE faculty can be found in the Goss Room in the Engineering Library and a few rare manuscripts are available from the Special Library Collection of Purdue in the second floor of the Stewart Center, including thirteen boxes with the post-1945 correspondence of Professor Shreve.

ChE faculty minutes have been kept only after 1968, and other educational material, such as schedules and announcements, has been lost.

The theses of the students can be found in the Engineering Library, excluding the old B.S. theses which are available in the Special Library Collection and one or two M.S. theses of the 1920's which can be found in the Chemistry Library.

Finally, the best sources for old (pre-1950) photographs are the collections of Debris and other books of the Special Library collection, and the collection of former Professor E. Kohl kept in the Department of Agriculture. The excellent photographic collection of Alden Emery is the best post-1950 source of pictures about the life of the School, the students and the faculty. The old pictures decorating the corridors of the CMET buildings in the 1940's and 1950's have also been kept in the Archives.

We were unable to find any historical equipment from Peffer's days, including his famous roll-top desk, which according to Bray was still available in the building in 1951.

Alumni of Chemical Engineering

The products of research universities are knowledge and educated students. The greatest impact of the School has been through the contributions of our alumni. We are justly proud of their contributions both in chemical engineering and in a variety of other careers. Some of the contributions of alumni have been celebrated with Outstanding Chemical Engineer Awards, with Distinguished Engineering Alumni Awards, and with the highest recognition the University can bestow, Honorary Doctorates. The distinguished winners of these awards are listed here. Unfortunately, there are many alumni who have made equal contributions, but since the School is unaware of them we have been unable to celebrate their accomplishments.

Purdue University did not start to award honorary doctorates until the 1940's. Unlike some universities, Purdue has always given this award out quite sparingly. Most years, two or three and very occasionally four honorary doctorates are awarded in engineering. Thus, the record of Chemical Engineering alumni in receiving these awards is quite remarkable.

Distinguished Engineering Alumni (DEA) awards were first awarded in 1964. After some initial catch-up of very deserving alumni, the steady state rate has been approximately ten awards per year, which means less than one per cent of all alumni will win this award. Any year that ChE alumni win more than one award is a good year.

The most recent award is the Outstanding Chemical Engineer Award that was started in 1988. In 1993 the School decided to have a special ceremony and award this award to all previous winners of DEA and Honorary Doctorates. Approximately three awards are awarded per year, which represents less than three per cent of graduates.

Table 5-11. Outstanding Chemical Engineer Award Recipients

1988	Albert Bernard	1989	Robert Bringer
1989	Robert Henson	1989	William Schmitt
1990	William Madar	1990	Robert Postlethwait
1990	Norman Priutt	1991	Donald Hannemann
1991	Linda Huff	1991	Rohit Khanna
1992	Alan Fox	1992	Robert LaFortune
1993	S. George Bankoff	1993	William Bares
1993	Andrew Barnes	1993	Robert Becherer
1993	Donald Brophy	1993	Bernard Butcher
1993	John Ciborski	1993	Alexander Clarke
1993	Robert Covalt	1993	Robert Forney
1993	Robert Gadomski	1993	Bruce Gonser
1993	Frederick Haas	1993	William Harris, Jr.
1993	James Henderson	1993	John Hesselberth
1993	Thomas Hodgson	1993	John Horner

1993	Harold Hunsicker	1993	Roberto Lee
1993	A.W. Lutz	1993	John Lux
1993	Tom Maliszewski	1993	J. Timothy McGinley
1993	Roger Moser	1993	Gordon Mounts
1993	Randall Murill, Jr.	1993	Paul Oreffice
1993	Donald Orr	1993	Michael Ramage
1993	Henry J. Ramey, Jr.	1993	Robert Reid
1993	Harold Ritchey	1993	John Roorda
1993	Samuel Salem	1993	Dave Schornstein
1993	James Schorr	1993	Yen-Ping Shih
1993	John Siegesmund	1993	Edward Steinhoff
1993	Miller Swaney	1993	Joseph Temple, Jr.
1993	Francis Theis	1993	Vern Weekman
1993	Maynard Wheeler	1993	Robert Wheeler
1993	Robert Winslow	1993	William Wishlinski
1993	Jamie Wisniak	1994	Deborah Grubbe
1994	Richard Hazleton	1994	Lowell Koppel
1994	Phillip Krug	1994	John Lillich
1994	Joe Stewart	1994	William Young
1995	R. William Eykamp	1995	Che-I Kao
1995	Craig McLaughlin	1995	William Smith
1996	Robert Buckman	1996	Chin-Tien Liou
1996	David Rea	1996	Thomas Storer
1996	S. Margaret Willoughby	1997	Frank Becker
1997	Andrew Crowe	1997	Eleftherios Papaoutsakis
1998	Guy Camarata	1998	Charles Kline
1999	Todd Gehr	1999	Stanley Gembicki
1999	Richard Grabham	1999	Emily Liggett
1999	David Pershing	2000	Robert Davis
2000	Abbie Griffin	2000	Robert Hannemann
2000	Robert McNeeley	2001	Max Downham
2001	Donald Dunner	2001	Jeffrey Hemmer
2001	Jay Ihlenfeld	2001	Brian Stutts
2002	Michael Graff	2002	Donald Lamberson
2002	Michael Ott	2002	Nicholas Peppas
2002	Ellen Tobias	2003	Paul Dickensheets
2003	Ben Lipps, Jr.	2003	Tom Maliszewski
2004	Joseph S. Alford, Jr.	2004	Susan Hardman

2004	Rick Roberts	2004	Lloyd Robeson
2005	Charles Davidson	2005	Robert Weist
2005	Arindam Bose	2006	Michael Ladisch
2006	James Rust	2006	James Stake
2007	Pierre Latour	2007	Duncan Mellichamp
2008	Antonikos Mikos	2008	Gary Poehlein
2008	Roberta Gleiter	2009	Henry Sampson
2009	Mary Ellen Weber	2010	Norman Gilsdorf
2010	William Greer	2010	Harold Igdaloff
2010	Peter Kraemer	2011	James Hoover
2011	Gerald Skidmore		

Table 5-12. Distinguished Engineering Alumni (DEA) Awards won by ChEs

1964	John Elliott Haines	1964	Dr. Robert J. Raudebaugh
1964	Samuel Salem	1965	William James Harris Jr.
1965	John Herbert Lux	1966	Francis William Theis
1967	Alexander Boyt Clarke	1967	Harold Yundt Hunsicker
1969	Randall Tolman Murrill Jr.	1969	Robert Albert Winslow
1970	Dr. George S. Bankoff	1970	Wayne Burette Brewer
1971	Robert William Donahue	1971	Dr. Robert C. Reid
1972	Dr. Joseph Andrew Brink Jr.	1972	J. Timothy McGinley
1973	Dr. John F. Horner	1973	Dr. Fredric Reynolds Lloyd
1974	Dr. Robert Clyde Forney	1974	James Forrest Schorr
1975	Dr. James Brooke Henderson	1975	Dr. Henry Jackson Ramey Jr.
1976	Ashley Willard Lutz	1976	Dr. John Francis Roorda Jr.
1978	Joseph George Temple Jr.	1979	Donald Thomas Brophy
1980	Dr. Vern William Weekman Jr.	1981	William G. Bares
1981	Robert B. Covalt	1982	Dave W. Schornstein
1983	Roger A. Moser	1984	Gordon Dale Mounts
1985	Thomas Richard Hodgson	1986	Dr. Michael Parmley Ramage
1987	Bernard B. Butcher	1987	Dr. Yen-Ping Shih
1988	Albert Ralph Bernard Jr.	1989	Donald Orr
1989	Edward Stenhoff	1990	John F. Hesselberth
1990	William L. Wishlinski		
1991	William M. Schmitt	1991	Dr. Jaime Wisniak
1992	Robert E. Gadomski	1992	William Paul Madar Jr.
1993	Frederick Carl Haas	1994	Richard Alan Hazleton

1994	William Douglas Young	1995	Dr. Che-I Kao
1995	Robert Niel Postlethwait	1996	Dr. Ching-Tien Liou
1996	David Richard Rea	1997	Frank Carl Becker
1997	Dr. Craig Munson McLaughlin	1998	Charles R. Kline
1998	William Edward Smith III	1999	Stanley A. Gembicki
1999	David W. Pershing	2000	Linda Lou Huff
2001	Robert Henry Buckman	2001	Donald Robert Dunner
2001	Jay Vininv Ihlenfeld	2002	Deborah Lynn Grubbe P.E.
2002	Donald L. Lamberson	2003	Richard Hughes Grabham
2003	Ben Joseph Lipps Jr.	2004	Emily Louise Liggett
2004	Lloyd M. Robeson	2005	Charles Dean Davidson
2006	Robert Newton Davis	2006	Max Curtis Downham
2007	Michael Herman Ott	2007	Rick Lee Roberts
2008	Michael Joseph Graff	2009	Jeffrey Lynn Hemmer
2010	Norman Lee Gilsdorf	2011	Ellen E. Tobias

Table 5-13. Honorary Doctorates Awarded to ChEs

The Honorary Doctorate is the highest award presented by Purdue University.

1945	Clifford C. Furnas	1949	R. Games Slayter
1951	Gerald L. Reasar	1951	Maynard C. Wheeler
1955	Robert C. Becherer	1959	John C. Siegesmund
1960	Harold W. Ritchey	1961	Arthur Kelly
1961	R. Norris Shreve	1963	Donald H. Tilson
1964	Robert C. Wheeler	1967	Bruce W. Gonser
1968	John M. Ciborski	1976	Paul F. Oreffice
1978	William J. Harris, Jr.	1981	Robert C. Forney
1983	James B. Henderson	1987	James F. Schorr
1988	Joseph A. Temple, Jr.	1989	John H. Lux
1990	Ashley Willard Lutz	1991	William G. Bares
1992	Robert B. Covalt	1993	Thomas R. Hodgson
1994	Joe J. Stewart	1996	Michael P. Ramage
1998	Richard A. Hazleton	1999	William P. Madar, Jr.
2000	William D. Young	2001	Robert E. Gadomski
2006	Donald J. Orr	2007	Vern W. Weekman, Jr.
2010	Deborah Grubbe	2010	Timothy McGinley

Some Unusual Careers and Interests – Part 1.

Many students and alumni have achieved notoriety in unusual areas, thus having "violated" the stereotype of a chemical engineer. It would be impossible to mention all of them here but a few are well known during this time period of our history.

In search for the unusual we must recognize Deli S. Atkins-Schleiffarth (BSChE '78), the first and only ChE Homecoming Queen (1978) now with Monsanto Co., Andrew Forti (BSChE '01) was a member of the 2000 Homecoming King's court, and Terry G. Dischinger (BSChE '63) who won a gold medal in basketball at the 1960 Olympics, was first team all-American 1961 and 1962, played in NBA 1963-1972 (rookie of year in 1963), and is currently a practicing orthodontist in Lake Oswego, Oregon. http://www.lostlettermen.com/terry_dischinger-purdue-basketball-big_10-p4340.

Kudos also to the 1982 ChE team to the College Bowl (a game of encyclopedic knowledge) consisting of Richard W. Korsmeyer (M.S. '80, Ph.D. '83), Donald R. Miller (Ph.D. '83), Cathryn Davidson (B.A. '85), David Gobran (B.S. '83) and Jennifer D. Sinclair (Curtis) B.S. '83) which won the Purdue championship.

Present and former students with strong interests in the arts abound, including, for example, G.W. Raymond Davidson, III (M.S. '82, Ph.D. '85) who danced with the Houston Ballet, Everton E. Stidham (B.S. '18) who was a very successful baritone in the Seattle Opera Company, Michel P. Renaud (B.S. '53) who was a professional piano teacher in Geneva, Switzerland, Kevin H. Erwin (B.S. '82) who is a stand-up comedian, and John P. Snyder (B.S. '48) who was a cartographer.

Many of our alumni have excelled in areas significantly different from chemical engineering. We might mention J. Robert Fields (B.S. '50), George R. Caruso (B.S. '58) and Donald V. Badgley (B.S. '50), who were pastors in Huntington, Bremen and Muncie, Indiana, respectively, and Rev. Louis A. Fishcer (B.S. '44), who was a Roman Catholic priest in Salt Lake City, Alan M. Gundelfinger (B.S. '22) who was a motion picture and television engineer in Los Angeles, and William M. Steinfeldt (B.S. '38) who was a state senator from the 55th district of New York (Rochester).

One of the most unusual academic careers was that of Loren R. Graham (B.S. '55) who after several years at Dow Chemical Co. decided to study history. He was awarded his Ph.D. from Columbia University in 1964 and became Professor of Russian History and History of Science at MIT. Paul B. Hessert (B.S. '45) was for many years Professor of Systematic Theology at the Garnett-Evangelical Theological Seminary of Northwestern University, and Hunton D. Sellman (B.S. '22) was Professor Emeritus of Drama at San Diego State University.

Finally, the authors wish to tip their hats to two brave alumni who returned to school for graduate studies at a more mature age. Clark Holloway (B.S. '37) returned to the University of Pittsburgh to receive his Ph.D. in 1981 at age 66, and became Professor of Business Administration at the University of South Carolina. Frank M. Branner (B.S. '42) returned to the University of Kentucky to receive his Ph.D. in mathematics in 1985 at the age of 65.

Part two of this list is in Chapter 6.

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