

*Aerial view of the VPI campus showing the College of Engineering in the upper left portion.*

## VIRGINIA POLYTECHNIC INSTITUTE & STATE UNIVERSITY

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VIRGINIA POLYTECHNIC Institute & State University, better known by the initials VPI and/or the nickname "Virginia Tech," is located in Blacksburg, Virginia, and is the state's largest university, resting on a plateau 2,100 feet above sea level between the Blue Ridge and the Allegheny mountains. Founded in 1872 as an agricultural and mechanical school and as the landgrant university of the Commonwealth, VPI has become a comprehensive institution with seven colleges and a professional school of veterinary medicine. Overall, 23,000 students are currently enrolled. This includes about 19,000 undergraduate students, of which 5,000 are students in the College of Engineering. A Board of Visitors (appointed by the Governor), to whom the President reports, governs the university.

The College of Engineering is directed by Dean Paul E. Torgersen, a member of the National

Academy of Engineering. He altered the course of the college in the early 1970s, allowing it to compete with the premier engineering schools in the country through a commitment to research, graduate education, and scholarship. The change was gradual at first, but has become much more dramatic in the past decade. As one result, the college was listed in the top twenty in a 1987 *U.S. News and World Report* survey of the best graduate engineering schools in America. It also now ranks in the top ten percent of the 220 engineering institutions reporting their research expenditures to ASEE. These citations have occurred because the external support of the college for faculty research has grown from about \$6.5 million awarded in 1978-79 to \$18.6 million in 1986-87. The college presently has about 270 faculty, two-thirds of which are engaged in research. While trying to hold the undergraduate population relatively constant (5,325 undergraduates in the fall of 1979, 6,280 undergraduates in the fall of 1987), a substantial increase in the graduate

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student population has occurred (518 graduate students in the fall of 1979, 1,167 graduate students in the fall of 1987). These changes are mirrored in the degrees presented by the college. In 1978-79 there were 661 bachelor, 157 master, and 35 doctoral degrees awarded by the college, and in 1986-87 these figures had increased to 954 bachelor, 296 master, and 77 doctoral degrees. The university grew significantly in the 1960s, from about 7,000 students to its present size. The students have a choice of studying one of twelve different engineering undergraduate curriculums in ten degree-granting departments. In addition, the freshman year is administered by the Division of Engineering Fundamentals.

The College of Engineering and the university maintain a rich history in both the state and the nation. In the fall of 1985, the college celebrated the 100th anniversary of the granting of its first four-year BS degree. That same fall, the Department of Chemical Engineering celebrated its 50th year as a modern department of chemical engineering at VPI.

#### **A HISTORY**

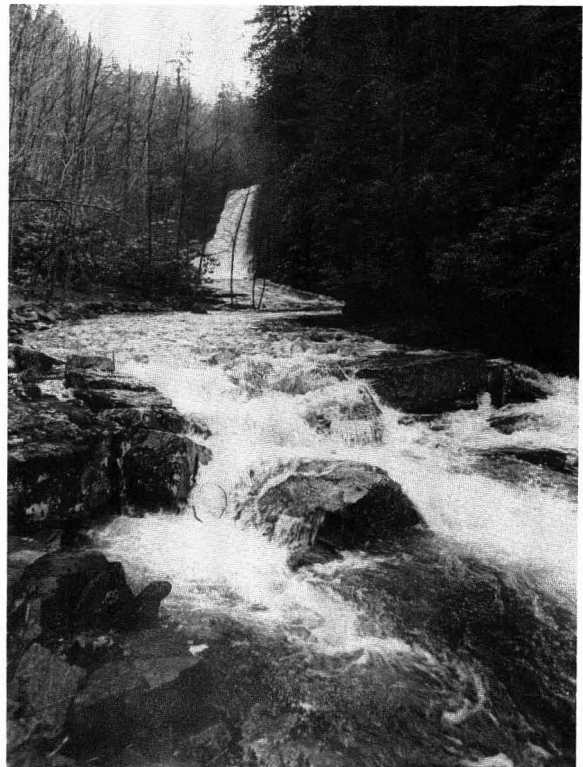
The Chemical Engineering Department was established in 1919, and two years later offered post-graduate degrees. In 1929, the name was changed to Chemistry and Chemical Engineering.

In 1935, Frank C. Vilbrant founded the modern Department of Chemical Engineering at VPI, and he remained as department head until 1953 when Fred W. Bull became head. During Dr. Vilbrant's tenure, essentially all of the students were members of the Corps of Cadets. There was a strict code of conduct on campus associated with the military flavor of the institution. For example, students were not allowed to have automobiles in Blacksburg. A student found with an automobile was suspended. Dr. Vilbrant, while he seems not to have liked some of the military codes of conduct, made good use of the general atmosphere it created; he ran a tight ship.

After World War II and the Korean War the climate of the university changed; the military flavor of the institution began to subside and, toward the end of Fred Bull's headship, the civilian portion of the student body began to dominate. The mandatory membership in the Corps of Cadets for all undergraduates became a problem as veterans were returning to pursue their education. Also, at about this same time there was an influx of transfer students, due in particular to the new co-op program started in 1952 at the Norfolk, Virginia, division of William and Mary and VPI. During Fred Bull's last year as department head (1964), the president of the university, T. Mar-

shall Hahn, made membership in the Corps of Cadets voluntary. By then, the civilian student population surpassed the membership of the Corps.

One other happening in those years influenced the development of the university and thus of the department. Until 1964, VPI had an association with the all-female Radford College in Radford, Virginia. Radford became independent of Virginia Tech in 1964 and began to admit men in 1972. Simultaneously, the population of women on the VPI campus began to grow,



***The Cascades, situated a short distance from the Appalachian trail and just 25 minutes from campus.***

and as a result, the department began to see its first women students during the 1970's.

Fred Bull, who was known as a strong department head and as a forgiving and compassionate man, turned the department over to Gerry Beyer in 1964. Those were years of rapid growth and turmoil in the university. The department faculty realized that the curriculum needed modernization in order to allow the graduates to compete better in the major graduate programs in the country. The department had always had a strong practical orientation and had graduated many who became captains of industry, such as Clif Garvin and Al Giacco, the recently retired CEOs of Exxon and Hercules, respectively. The department was respected by industry for the quality of its under-

graduates, but it was felt that a greater portion of the graduates should attend graduate school.

In 1967, Nelson F. Murphy became department head and the department entered an era of high faculty turnover. This continued through the 1970s and into the 1980s. Henry McGee became head in 1971 and introduced stronger ties to chemistry during his tenure. Over this period, the size of the faculty increased significantly to the present number. Dr. McGee's headship coincided with the thrust in the college for stronger research, graduate education, and scholarship. He seized this opportunity to build strength in these areas in the department. In 1981, Dr. McGee resigned the headship to return to research and teaching. Chester Spencer, department head of materials

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engineering, served as the interim head until Bill Conger arrived in 1983 to assume the position.

A feeling of stability has marked the last five years in the department. The graduate program has grown significantly while the size of the undergraduate student population decreased and then stabilized. Since a number of faculty are now approaching retirement age, major changes in the faculty are expected to occur. Last year, Arthur Squires, (a member of the National Academy of Engineering) formally retired, although he remains very active on campus and retains an office. In 1987, Ken Konrad left to take a position with Exxon and Roland Mischke took a terminal year leave to help with the ChE program at Hampton University. These openings created an opportunity to add new input to the program at a time in the history of our profession when we are searching for new directions for chemical engineering.

## THE FACULTY

For the fall of 1987, there were thirteen fulltime faculty and one emeritus professor, Arthur Squires, very active in research. The department is seeking one, maybe two, additional faculty for the fall of 1988.

**Don Baird** came to VPI in 1978 from Monsanto. Initially, he held a joint appointment between the departments of engineering science and mechanics and chemical engineering, but in 1981 he became fulltime

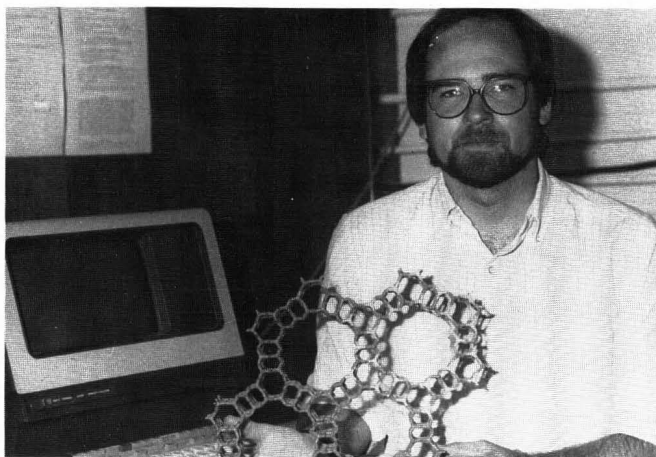
in chemical engineering. Although Don received his PhD at Wisconsin, we seem to hear more about his days at Michigan State where he earned All-Big Ten and Academic All-American honors as a linebacker and offensive guard on the MSU football team. Don is interested in the application of rheology to the processing of polymeric and food materials. His research runs from very fundamental to applied levels.

**Gerry Beyer** is another Wisconsin graduate and proud of it. In 1964 he came from the University of Missouri where he was department head, joining the VPI faculty as department head and remaining as head until 1967. Gerry is interested in energy production and use, separation and purification of materials, and the application of computers to the modeling of chemical and magnetic systems. His course on the use of the personal computer has been presented nationally as part of the AIChE Today series. A confirmed fisherman, he has caught several trophy-size fish, including a striped bass which he carried fresh and dripping into Bill Conger's office one afternoon.

**Bill Conger** was recruited to Tech as department head from the University of Kentucky in 1983. Bill received his degree from the University of Pennsylvania. His interests have included hydrogen as an alternate energy source and the thermodynamic analysis of energy intensive processes. Presently, he spends most of his professional time administering the department. He continues his outdoor activities (one of the lures of the Blacksburg, Virginia, area) including his work with Boy Scouts, his interest in canoeing, and even an occasional fishing trip with Gerry Beyer.

**David Cox** is one of the newest additions to the faculty. After graduating with a PhD from Florida, he spent two years at the National Bureau of Standards as a National Research Council Postdoctoral Associate before joining the faculty in 1986. David uses the spectroscopic tools of ultrahigh vacuum surface science to study the chemistry of solid surfaces. His work is aimed at understanding the adsorption, desorption, and surface reaction processes important in heterogeneous catalysis, chemical gas sensing, and the growth of interfaces on electronic materials. When he cannot be found in his laboratory, there is a good chance he can be located on a golf course.

**Mark Davis** chose to join the department after completing his PhD work at the University of Kentucky. Named a Presidential Young Investigator several years ago, his work under the PYI program has been extremely successful. Mark's major area of interest is the study of new molecular sieves. Dow Chemical Company and Mark recently announced the development of a zeolite with a 13 Angstrom opening



**Mark Davis holds a model of VPI-5 the new molecular sieve with a 13 Angstrom pore that he and DOW have developed.**

which could have a major impact on such areas as petroleum catalytic cracking and chromatography. Mark has also won the ASEE Dow Young Faculty Award. He is an accomplished scuba diver and underwater photographer. Examples of his work can be seen on display in some of the Bahamaian resort hotels.

**Y.A. Liu**, a graduate of Princeton, came to the department in 1982 from Auburn University. Y.A. is the Frank C. Vilbrant Professor of Chemical Engineering and has received several prestigious awards, including the 1984 Western Electric Award of ASEE and the 1986 Catalyst Award of the Chemical Manufacturers Association. He is currently interested in computer-aided design and process synthesis, fluidization processes, and magnetochemical engineering. He is active as an advisor to the Student Christian Fellowship at VPI and has led Bible studies for international students for years.

**Don Michelsen**, a Cornell graduate, arrived in Blacksburg in 1966 after securing industrial experience with Dow Chemical Company. He spent a period away from the department as Director of Career Advising and Director of the Graduate Engineering Program in Northern Virginia. Don is interested in industrial waste treatment, passive solar energy design, and treatment of hazardous wastes. He enjoys sailing and this past summer started sprouting a beard as "every old salt has to have a beard."

**Henry McGee**, a Georgia Tech graduate, left his alma mater to direct the department. Henry promotes his interest in closer ties between chemistry and chemical engineering through writing papers on the subject and is also available as a speaker on the topic.

He has always had several irons in the fire at the same time and is presently developing a large property on nearby Claytor Lake, where he keeps his cabin cruiser and enjoys water-related activities most of the year. Henry is interested in chemically pumped lasers as well as the application of laser irradiation in chemical reactions and in separations.

**Peter Rony**, a graduate of Berkeley, came to the department from Exxon in 1971. He is noted for his textbooks and his work with laboratories. He has earned several awards, including the Dreyfus Teacher Scholar Prize in 1973 and the DELOS Award in 1984. He is interested in the creation of novel measurement devices and instrumentation. Peter likes to travel and he delights in water sports. It is no surprise that his favorite places to visit include Florida, Cancun, and Southern California.

**Felix Sebba**, a very active senior citizen of our department (age 75), came in 1979 from the University of Withwatersrand in Johannesburg, South Africa. He has degrees from the University of Capetown and the University of London. Felix became a U.S. citizen in the fall of 1987. He is interested in the physical and chemical behavior at interfaces. He has developed separation processes using colloidal gas aphrons and liquid core aphrons, both of which he invented.

**Bill Velandar** is the newest member of our faculty, having arrived from Penn State in January of 1987. Prior to his work at State, he was employed for several years at Merck. He is interested in cell-to-cell adhesion and synthetic vesicle membrane structure as well as the separation of proteins from biological fluids. Bill enjoys softball, basketball, golf, and (since coming to VPI) volleyball.

**George Wills**, another Wisconsin graduate, came to VPI in 1964. He is known for his excellence in teaching and has won the Wine Award, a VPI award for such excellence. He was instrumental in developing the summer unit operations laboratory program in England in which seven to ten of our students participate each year. George likes to travel, especially in England and Europe. He takes trips abroad as often as he is able.

**Garth Wilkes**, the Fred Bull Professor of Chemical Engineering, earned his degree at the University of Massachusetts and came to VPI from Princeton in 1978. Garth is co-director of the Polymer Materials and Interfaces Laboratory with James McGrath of chemistry. PMIL is an extremely successful interdisciplinary program with fourteen faculty members from six different participating departments. A total of more than 150 people work with the faculty. His

Four years ago, the College of Engineering made owning an IBM PC (or compatible) a requirement for all entering students. Now there are over 6,000 PCs in the college. The chemical engineering students use them extensively in their classes and many software packages are provided. The most difficult part of introducing these machines . . . was requiring the faculty to become proficient.

own primary interest is in the structure/property relationships of polymeric solids, with an emphasis on the molecular approach. Garth is an avid outdoorsman, an accomplished hunter and fisherman. Also, he has played guitar professionally with several rock groups.

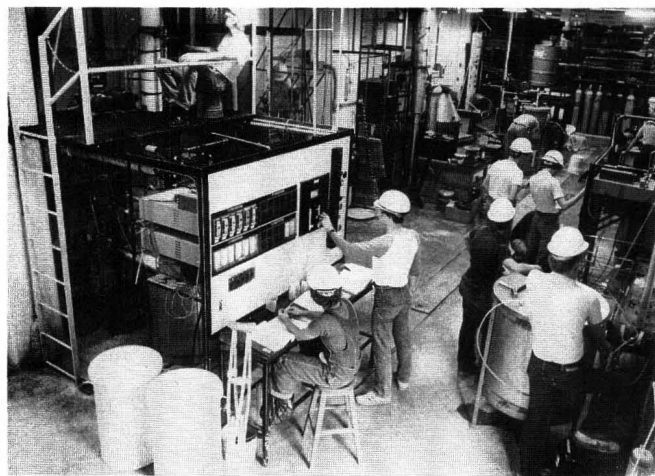
### THE UNDERGRADUATE PROGRAM

The undergraduate students come mainly from Virginia and a strip of states along the Eastern Seaboard. In the most recent sophomore class, one out of every ten students was valedictorian of his/her high school class, and well over 60% were in the top 10% of their high school class. Average SAT score was about 1240.

In fall 1988 the university will convert from the quarter system to the semester system. This conversion provided the opportunity for an in-depth analysis of the curriculum. The faculty decided to seize upon the flexibility offered in the new ABET and AIChE statement on the chemistry requirement. In the new curriculum, only the first semesters of organic and physical chemistry are required. In place of the second semesters of these courses, the student selects from a list of chemical science electives which includes the second semester of organic and of physical chemistry, and also includes advanced courses in inorganic chemistry, solid state chemistry, biology and biochemistry, polymer chemistry, *etc.* This allows the student to acquire a wider background than was previously possible at VPI. However, the advising function of the faculty is now much more important since the faculty member must take more time to discuss with the student the various options that are available and what they mean.

The undergraduate program is known for its strong control and design components. This will not change under the semester system. Two required courses and one elective course will remain in the undergraduate control sequence. In the last five years the students have won two third places and one second place in the AIChE Process Design Contest. Students have access to Aspen Plus and other software packages useful in the design course.

Probably the summer Unit Operations Laboratory, supported by many industrial friends, is the one aspect of the undergraduate program most remem-



**The summer Unit Operations Laboratory—one aspect of the undergraduate program most remembered by VPI graduates.**

bered by the graduates. Roland Mischke called it a "slice of life." Students work in teams on experiments all day, every day, for five weeks. It is an intense experience. Each group is assigned a classroom in Randolph Hall and they essentially move into the building. Refrigerators, easy chairs, computers, *etc.* appear in the classrooms as these will be the students' "homes" for the period of the lab. The routine is broken about halfway through the session with a cookout and picnic for all. Students complain about the pressure while taking the course, but years after graduation, they recall the coursework as one of the most rewarding experiences of their undergraduate program.

Four years ago, the College of Engineering made owning an IBM PC (or compatible) a requirement for all entering students. Now there are over 6,000 PCs in the college. The chemical engineering students use them extensively in their classes and many software packages are provided. The most difficult part of introducing these machines into the program was requiring the faculty to become proficient. Almost every course now has significant use of the machines.

### THE GRADUATE PROGRAM

The department maintains a population of about fifty graduate students. These are currently about equally distributed between the MS and PhD degree

programs. Many of the MS students intend to continue for the PhD. There is a core curriculum of four courses: advanced thermodynamics, advanced kinetics, and two transport phenomena courses. Beyond these requirements, the students are free to design their course of study. Under the semester system, 30 semester credits (10 of which can be research) are required beyond the baccalaureate for the MS degree, and a total of 90 semester credits (60 of which can be research) are required beyond the baccalaureate for the PhD. Doctoral students must pass a Preliminary Examination generally within the first two years of study. An oral examination on the proposal for their PhD research (Qualifying Exam) is also required.

A wide variety of research areas exist within the department, as mentioned in the section on faculty, but the majority of the graduate students and funding is in five areas: polymers, catalysts and solid state surface science, environmental engineering and surface chemistry, fluidization engineering, and bioengineering. In particular, the polymers (Polymer Materials and Interfaces Laboratory, PMIL) and the catalyst programs have international reputations and, as a result, are very much in demand by prospective graduate students.

#### THE FUTURE

As mentioned previously, the department is in the process of adding more faculty. We intend to continue strengthening the research effort in the department while maintaining the traditionally strong teaching commitment. Ground will be broken soon for an addition to Randolph Hall. It will include modern facilities for the undergraduate Measurements and Control Laboratory and Unit Operations Laboratory. Initial planning is beginning for a new engineering building which would house the department and its research laboratories. Present space in Randolph Hall would then be turned over to Aerospace and Ocean Engineering and to Mechanical Engineering for a much needed expansion of their facilities.

As the change to the semester system occurs, there will be opportunities for the curriculum to evolve to meet the needs of the changing profession. Changes to the new approved semester curriculum are under consideration which, if implemented, will give the student even greater freedom of choice.

The department looks forward to new facilities, an even stronger faculty interested in research and teaching, a more flexible curriculum, and increased emphasis on the quality of the graduate program. The department is in a position of strength, facing a future that is bright for the faculty, the students, and the profession. □

## ChE book reviews

### ELEMENTS OF CHEMICAL REACTION ENGINEERING

by H. S. Fogler

Prentice-Hall, Inc., Englewood Cliffs, NJ 07632

(1987) \$49.95

Reviewed by

John L. Falconer

University of Colorado

This is an excellent text for an undergraduate reactor design course. Mole balances and reactor staging are introduced first. Then rate laws, stoichiometry, and isothermal reactor design are discussed. The order of presentation, though somewhat different from other texts, is good. The next chapter, on analysis of rate data, also discusses laboratory reactors. Catalysis and homogeneous kinetics are then presented before nonisothermal reactor design and multiple reactions. The text concludes with two chapters on external diffusion and diffusion in porous catalysts, one on multiphase reactors, and two on residence time distribution and nonideal reactors. The Appendices present common integrals used in reactor design, numerical techniques for integration and differentiation, and a series of guided design problems. Both SI and English units are used in the text. A complete Solutions Manual is available.

The text is well written, the order of presentation and the approach are very good, the notation is clear, the figures and print type are excellent, and the number of errors is small. A number of desirable features separate it from other reactor design texts. The text emphasizes problem solving and reasoning rather than memorization. Thus, at the end of most of the chapters, a few pages are devoted to techniques used in problem solving. This is valuable, though it could be improved upon by showing the application of these techniques to reactor design problems. Important equations are boxed in, and the margins are used to emphasize and summarize important points. Volume changes due to gas-phase mole changes or phase changes are covered more completely than in most texts. A summary of important points is presented at the end of each chapter. Numerical techniques for solving differential equations are presented.

A strong point of the text is the inclusion of numerous example problems and homework problems for real reactions in each chapter. A variety of challenging problems are given, such as those taken from the

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