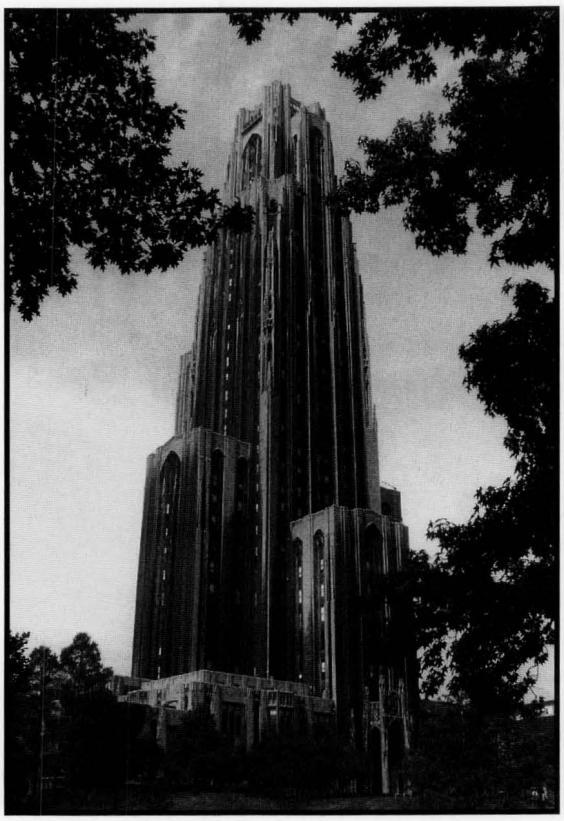

Pittsburgh's Cathedral of Learning

ChE *department*

University of Pittsburgh

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The University of Pittsburgh is located in Oakland, a bustling business district two miles from downtown (pronounced 'dahn-tahn' in Pittsburghese) Pittsburgh. Approaching the campus by car or bus, one is greeted by the university's tremendous Gothic structure, the Cathedral of Learning (shown in the photograph above). The top of the building provides an excellent view of the community: forty floors below, Pitt, Carnegie Mellon University, Carlow College, Carnegie Institute, the University of Pittsburgh Health Center, and Schenley Park merge to form one of the most exciting and hectic areas in Pennsylvania.

The University was chartered in 1787 as the Pittsburgh Academy and the degree of "Engineer" was first offered in 1845, although the Chemical Engineering and Petroleum Engineering departments were not initiated until 1910. Eventually, these two departments merged, with the petroleum program becoming a technical elective concentration for the undergraduate chemical engineers. The department currently offers MS and PhD degrees in chemical engineering and the MS degree in petroleum engineering.

The upper section of campus is home to the Michael L. Benedum Hall of Engineering (shown in a photograph on page 88). This completely air conditioned, twelve-story building contains classrooms, offices, and laboratories equipped for modern research. Six departments have resided within this facility since 1971, with the top two floors currently housing the Department of Chemical and Petroleum Engineering.

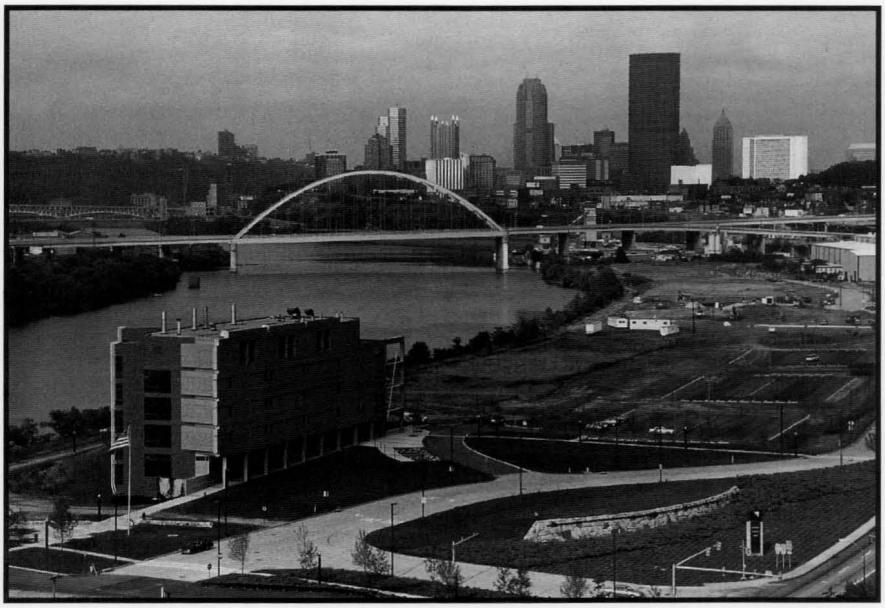
Nearly everything needed for an undergraduate's survival, with the exception of emergency cash, can be found in Benedum Hall. The engineering library, several computing and experimental labs, endless vending machines and a small deli, and a comfortable lounge area provide the students with a home away from home during the day. A two-minute walk outside the building takes the student to the bookstore, the registration area, dormitories, hospitals, Pitt Stadium, and many fine restaurants.

COMPUTING AND LIBRARY FACILITIES

The campus has several computing facilities available to the students, but the most popular for chemical engineers are the computer centers in Benedum Hall where they have ready access to PCs and workstations with a wide range of engineering, spreadsheet, and word-processing software. These machines and other terminals can also access Pitt's VAX and UNIX mainframe systems. A Cray Y-MP 832 supercomputer is also available to both the University of Pittsburgh and Carnegie Mellon University.

Three software packages of particular interest to chemical engineers include Aspen Plus, PRO II, and B-JAC, which are used throughout the undergraduate curriculum in the design of units. B-JAC, for example, is a menu-driven heat exchanger design program that is introduced in our transport phenomena course and used in the senior design and chemical engineering laboratory courses. Aspen Plus and PRO II are process simulators that can be used in core courses for the

Our student enrollment has increased dramatically in the last few years. For example, only 25 BS degrees were awarded in 1990, but this year over 50 chemical engineers will graduate.



The Center for Biotechnology and Bioengineering with downtown Pittsburgh in the background. Pittsburgh is known as the City of Bridges.

design of individual units, such as distillation columns in the staged separation course, or for the simulation of an entire plant in our design course.

Conveniently located on the first floor of Benedum Hall, the George M. Bevier Engineering Library has 52,000 of the university's three million volumes, and an additional 761 current journals. It has recently been expanded by 50% and now provides an adequate study area for our students—even during finals week.

ASSOCIATED FACILITIES

The new Biotechnology Center contains 45,000 net square feet and is the focal point of Pitt's Center for Biotechnology and Bioengineering. It is located on the former site of a steel mill and thereby provides a vivid image of the transformations that have occurred in this city. It contains offices for faculty from medicine, biological sciences and engineering in addition to well-equipped, modern laboratories and classrooms. Dr. Jerome Schultz is director and chief scientist of the Center in addition to being a professor in the chemical engineering department and the school of medicine.

Chemical engineering faculty involved in biotechnology research include Drs. Alan Russell, Mohammad Ataai, and Eric Beckman, who have offices and labs in both Benedum Hall and in the Center.

The University of Pittsburgh Health Center is a consortium of six local hospitals integrated with the University of Pittsburgh Medical School. Two members of the chemical engineering faculty, Drs. Edward Cape and William Wagner, have primary appointments in Pediatric Cardiology and the Department of Surgery, respectively., while Dr. Harvey Borovetz, an adjunct professor in chemical engineering, is also in the Department of Surgery. Another faculty member, Dr. John Patzer, has an active interest in biomedical research in the Health Center.

THE CHE DEPARTMENT

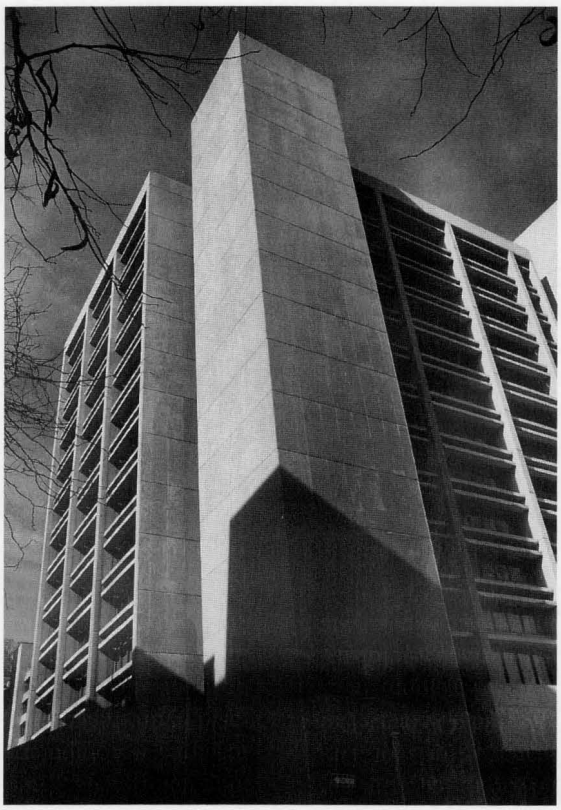
Gerald D. Holder has been the department chairman since 1987. He is responsible for coordinating teaching, research, undergraduate advising, and administrative activities of six professors, three research professors, seven associate professors, five assistant professors, two research assistant professors, three part-time instructors, and a visiting professor. The department also has an excellent staff that keeps all the administrative, educational, and research efforts flowing smoothly.

Currently, 200 of the 30,000 Pitt students are chemical engineering sophomores, juniors, and seniors pursuing BS degrees. At this time, 50% of our undergrads originate in freshman engineering. Most of the other half come from regional colleges and enter our department during the sophomore or junior year. Our student enrollment has increased dramatically in the last few years. For example, only 25 BS degrees were awarded in 1990, but this year over 50 chemical engineers will graduate.

THE CURRICULUM

The freshman and sophomore year curriculum is a busy mixture of chemistry, physics, calculus, philosophy, English literature, freshman engineering, and introductory chemical

engineering. The junior year provides a heavy dose of chemical engineering classics such as transport phenomena, thermodynamics, reactor design, and staged separations. An engineering statistics course and several chemistry courses and technical electives are also thrown in to keep everybody busy. The senior year is composed of courses in process control, professional practice, technical and nontechnical electives, and two-term sequences in undergraduate lab and design. Class sizes vary between 15 and 50 students, and most of our tenure stream faculty instruct at least one undergraduate course each year. Dr. Taryn Bayles, a visiting professor, is currently teaching two undergraduate courses each term, and Dr. Julie D'Itri will be joining our faculty this year after completing her post-doc at UC Davis. Her research interests are in chemical kinetics of atmospheric reactions, heterogeneous catalysis, and pollution abatement and waste minimization using heterogeneous catalysts.



Benedum Hall, with its top two floors the home of chemical engineering.

Bioengineering Minor • We are currently considering the establishment of a minor in bioengineering and are confident that the proposal will be approved and the program established within a year. The requirements for attaining this minor can be satisfied by appropriate selection of electives. Chemical engineers can receive the minor within the framework of their 137-credit curriculum, with no additional time or credits required. The sequence consists of an introductory bioengineering seminar together with courses in physiology, statistics, and three bioengineering electives which include courses in orthopedic biomechanics, bioengineering signals and systems, human factors engineering, and introductory courses in biochemistry and biochemical engineering.

ChE Sub-Specialties • A major feature of our department is the availability of areas of concentration which add considerable breadth to the undergraduate education. Our students are free to randomly pick their elective courses from a vast array of chemical engineering, engineering, math, chemistry, physics, computer science, biology, biochemistry, and geology electives. Most of them, however, select from one of the four technical elective concentrations of petroleum, polymer, bio-, and environmental engineering. Each of these areas has an ongoing undergraduate research program associated with the faculty involved in the curriculum development.

Since interest in **biotechnology** and **bioengineering** has been strong in recent years, we have instituted a three-course bio sequence for our students. The first course, an introduction to biochemistry, is designed for students with minimal biological background and can be used as a substitute for the dreaded Physical Chemistry 1. The students then enroll in a course in biochemical engineering and must select one course from the biosciences department, such as microbiology or principles of biochemistry. The professors involved in this program and their areas of research include: Jerome Schultz and his work on biosensors; Mohammad Ataai, who is studying bioprocess engineering, large-scale cell culture, and cellular metabolism; Alan Russell, who has an extensive research program concerning enzymes in extreme environments; Eric Beckman, who has several joint projects with Drs. Ataai and Russell; Edward Cape, studying cardiovascular flow; William Wagner, who is working on artificial organs and biocompatibility; and John Patzer, who is involved in the development of an electrochemical artificial kidney and glucose sensing for an artificial pancreas.

The **petroleum engineering** sequence for undergraduates focuses on reservoir engineering and includes courses in waterflooding, well-test analysis, enhanced oil recovery, and petroleum production. Our PetE program, the oldest one in this country, also offers an MS degree in Petroleum Engineering which encompasses courses in reservoir fluid and rock properties, numerical simulation, advanced enhanced oil recovery, and well logging. Dr. Badie Morsi coordinates the program and is assisted in instruction by three part-time faculty members, Drs. Willard Acheson, Neal Sams, and Pietro Raimondi.

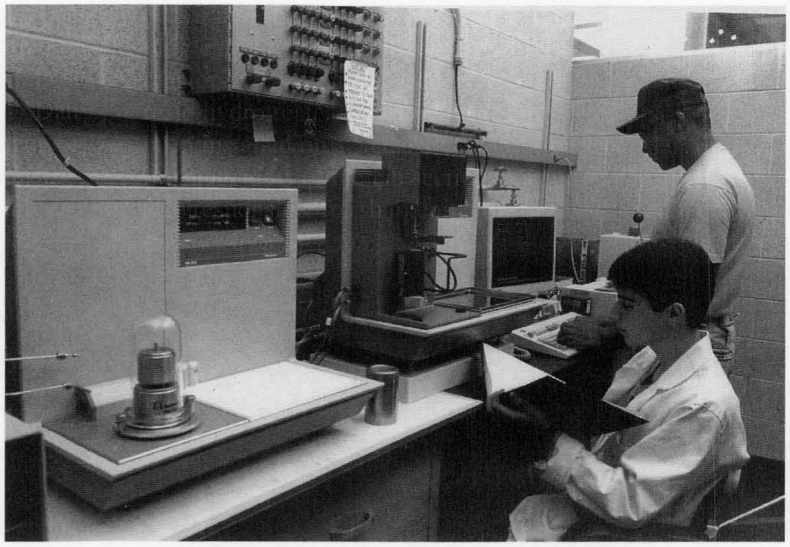
The **polymer engineering** concentration consists of at least three technical electives, including courses in polymer chemistry, structure-property relationships in polymers, and a material science course in polymer processing. Drs. Eric Beckman and Sindee Simon instruct the chemical engineering polymer courses. Beckman has an extremely active re-

search program which includes novel polymeric microstructure via supercritical fluid processing, thermodynamics of polymer solutions, plastics recycling technology, and the development of recyclable polymers. Simon's research efforts involve curing kinetics, structure/property relationships, and physical aging of thermosetting polymeric materials.

The University is also a leader in **environmental** education. Its Graduate School of Public Health has major foci on air quality, radiation protection, and industrial hygiene. One-quarter of the Civil and Environmental Engineering Department faculty devote the majority of their professional efforts to control water pollution and manage solid wastes. Our department collaborates with the Civil and Environmental Engineering Department in offering a four-course sequence of environmental engineering courses. CEE offers two courses for ChE students: an introduction to environmental engineering and a study of environmental engineering processes. Our students typically complete this sequence by taking chemical engineering courses concerning atmospheric pollution control and pollution prevention. Drs. James Cobb, Shiao-Hung Chiang, and Eric Beckman are associated with the environmental program. Cobb's research activities include environmental aspects of coal conversion and waste incineration; Beckman is involved in the development of recyclable polymers, microsorbation of post-consumer thermoplastics, and the removal of heavy metals from soils with CO_2-soluble chelating agents; Chiang's environmental work is related to coal cleaning technologies.

A new concentration in **solids processing** should be online within a year. Several of our faculty are developing this concentration in conjunction with a strong research program in the transport, processing, and separation of solids. Drs. Shiao-Hung Chiang, John Tierney, and George Klinzing are developing the academic program for this technical concentration. Klinzing is heavily involved in pioneering research in the transport properties of solid particles, and Chiang developed the LICADO process (LIquid CArbon DiOxide), a non-aqueous coal cleaning technology employing CO_2 as the separation medium. All of these professors have combined efforts to address coal dewatering in three manners: an overall macroview of the process, a microview of the filter cake, and computer modeling of the process.

The department's **Catalysis Research** group provides one of the strongest concentrations of catalytic research in any U.S. university department. The research efforts of Drs. James Goodwin, George Marcelin, Rachid Oukaci, Dan Farcasiu, and Irving Wender include the development of new catalytic materials, adsorption and surface chemistry, organometallic chemistry, chemical promotion of catalysts, reaction mechanisms, and catalyst deactivation.



Two award-winning undergraduate researchers, Jose Garcia and Andrew Riley, doing thermal analysis of polymers.

The department is also a leader in **multi-phase chemical reaction engineering.** This effort, headed by Drs. James Cobb, Badie Morsi, and John Tierney, has resulted in significant interaction with industry, providing students with opportunities for research experience in industrial settings.

We also have one of the largest concentrations of faculty in **thermodynamics** in the U.S. Drs. Gerald Holder, Robert Enick, Eric Beckman, and Alan Brainard are involved in phase behavior studies of gas hydrates, various supercritical fluid systems, carbon dioxide-soluble surfactants and chelates, and emulsion polymerization in supercritical fluids.

UNDERGRADUATE LABS

Our students gain laboratory experience in organic chemistry, physical chemistry, and instrumental analysis. The seniors must also complete a two-course sequence in the undergraduate chemical engineering laboratories. These labs, located in Benedum Hall, enable the students to gain hands-on experience with experiments designed to illustrate concepts discussed in their classes. These experimental modules are associated with transport phenomena, staged separations, reactor design, process control, and the chemical engineering design curriculum. Specifically, the topics include heat exchangers, distillation and extraction columns, diffusion cells, climbing film evaporators and wetted-wall columns, free radical polymerization and crystallization kinetics and melting of polymers, CSTRs, differential scanning calorimetry, fluidization, humidification, and catalytic reactors. A computer module which simulates an AMOCO resid hydrotreater, developed at Purdue University, has also been installed on a SUN III workstation. Dr. Alan Brainard instructs most of the lab sections for our department, and is also responsible for sharpening the oral and written commu-

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DEPARTMENT: Pittsburgh

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nication skills of our seniors during the lab recitations.

INDUSTRIAL POSITIONS AND RESEARCH OPPORTUNITIES

Cooperative Education Experience • Four years ago the School of Engineering reinstituted the cooperative education program. The benefits of alternating terms of academic study with practical engineering experience in industry have been obvious. Enhanced communication skills, an appreciation of the value of education, a strong dose of problem solving that does not include finding copies of last year's exams, and a greater chance of full-time employment upon graduation are a few of the benefits. The financial rewards are also appealing—salaries currently range between $1200 and $2600 a month.

Our program has been designed to permit students to enter as early as halfway through their sophomore year and as late as the end of the junior year. Each student must complete at least three four-month rotations in order to satisfy the program requirements. Currently, 40 of our 200 students are in the co-op program.

The program has also caused a dramatic change in the level of undergraduate activity on campus during the summer. We offer a full slate of courses in the summer to permit the completion of the coop program in four years and eight months. The additional eight months have been a small price to pay in return for the 100% job-placement rate of those who complete the program.

Internships • Summer internships are also encouraged. These opportunities are usually handled by Pitts' placement center. It does an excellent job of arranging interviews, publicizing openings, assisting in resume preparation, and arranging mock interviews.

Undergraduate Research Positions • Another opportunity for experience is undergraduate research. The level of funded research in our department is typically between $1.8 and $2.5 million per year. Although these projects are usually associated with graduate students, our faculty has also aggressively recruited undergraduates to become involved in the laboratory (shown in the photograph). About twenty students are involved with the faculty each term, either working for credit or for a salary. We also organize a formal program each summer for undergraduate research opportunities. This year a generous NSF grant will greatly enhance our ten-week program. About twenty undergraduates will be involved.

International Opportunities • Several exciting avenues of undergraduate research opened last year for the more adventurous students. Two chemical engineering coop positions involved extended assignments (four to six months) in Germany, and one of them will subsequently involve a term-long visit to Spain. The University Center for International Studies also helped us place a student in Japan for an eight-month internship. Several departments, including chemical engineering, are currently planning to initiate coop positions in Mexico this year that will involve both educational and employment for participating students.

OTHER EDUCATIONAL ACTIVITIES

We have integrated several activities into our program that provide students with a perspective that cannot be achieved in the classroom or laboratory. A plant trip is arranged each term to familiarize students with the appearance and operation of a chemical plant. During the visits, engineers familiar with the facility's design and operation share their experiences and answer questions. Industrial participants that have participated in this program include Calgon Carbon's activated carbon regeneration facility, ARCO Chemical's styrene and polystyrene plant, USX Steel's continuous caster, and Waste Technologies, Inc.'s hazardous waste incinerator.

JOB PLACEMENT

The University of Pittsburgh has an excellent placement service. Students are provided with resume preparation, interview practice sessions, campus interviews, resume referrals, and an extensive compilation of small and large engineering firms and high-tech companies. The placement rate of our graduates in engineering jobs or graduate school during the past six years has ranged from 71% to 100%, and the average starting annual salary over this period has increased steadily from $30,100 to $38,500, with some undergraduate salaries in excess of $41,000.

SUMMARY

We feel that the University of Pittsburgh provides a unique, exciting, and challenging environment for undergraduate chemical engineers. The faculty and students are enthusiastic about the undergraduate research, cooperative education, summer internship, and international co-ops and internship programs. Each of these programs receives strong support from the School of Engineering. Our department has vital links to other institutions on campus, such as the Biotechnology Center and the University of Pittsburgh Health Center. Our curriculum provides a thorough foundation in chemical engineering while providing flexibility in the selection of technical electives. Our active research efforts have resulted in a popular set of technical elective sequences and research opportunities. Our computing facilities and software packages are state-of-the-art, and our undergraduate laboratories are spacious and well-maintained. Our faculty is accessible to the undergrads and is committed to excellence in both teaching and research. Finally, our department and the University make a diligent effort to assist recent graduates with job placement and resume referrals. ❐