ChE department

Tulane University

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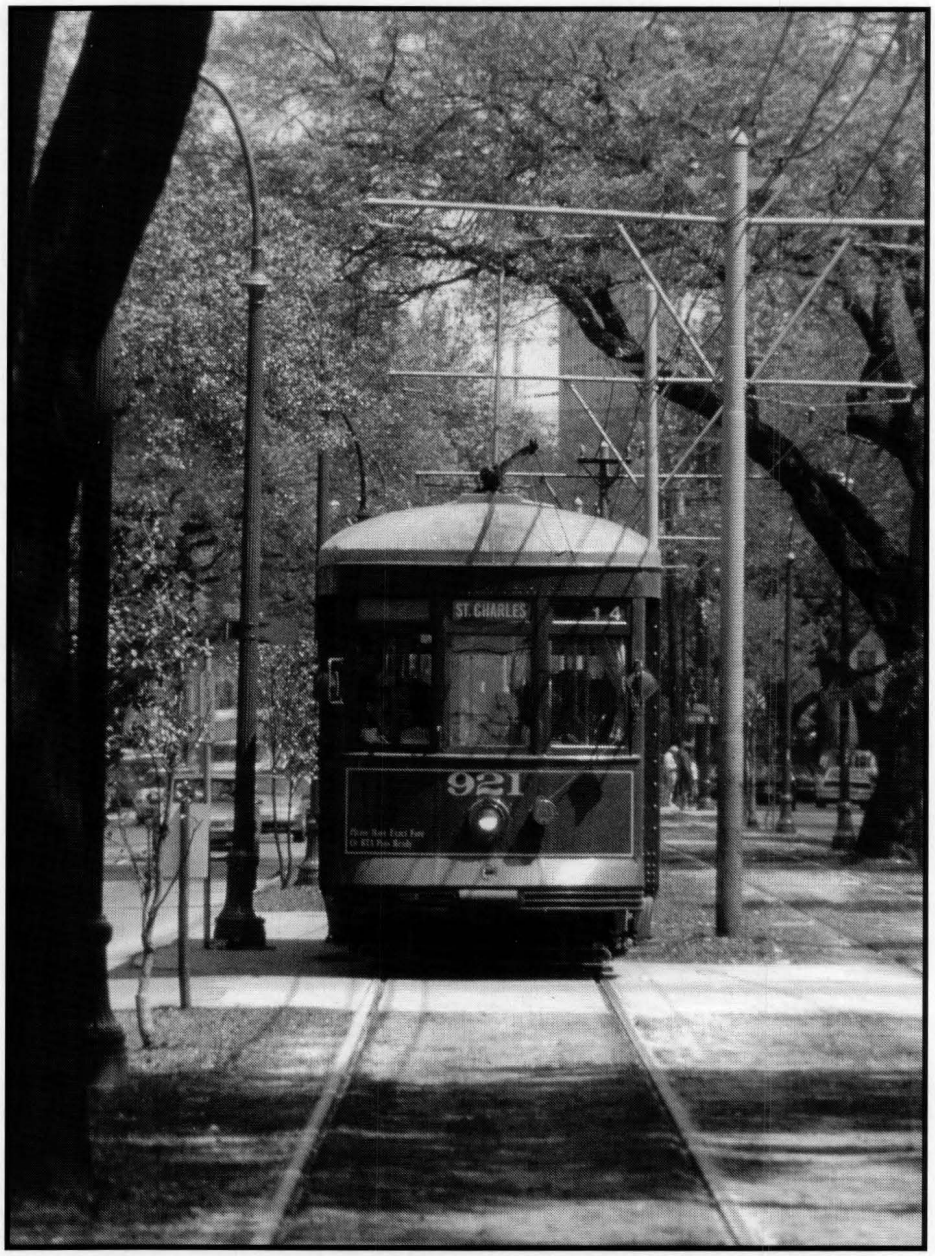
Tulane University's "Uptown Campus," the home of chemical engineering, is located in a scenic section of New Orleans, one of America's most charming cities. It is a selective private research university and has educated chemical engineers for well over a century. In 1979, at a joint congress of the American Chemical Society and the Chemical Society of Japan, a symposium was held on the history of chemical engineering, the proceedings of which were published in *Advances in Chemistry Series*. J.W. Westwater provided an article that traced the beginning of chemical engineering education in the U.S.,[1] and in it, after recognizing MIT as the first chemical engineering program in the nation and the University of Pennsylvania as the second, he said

Tulane University was the first school in the South and apparently the third in the United States to have a four-year curriculum labeled "Chemical Engineering." This was in 1894 (ref). The degree label was a BE in Chemical Engineering and the first recipient was B.P. Caldwell in 1895 (ref). There were no courses labeled Chemical Engineering and no "Professor of Chemical Engineering." The most pertinent courses, three in industrial chemistry, were taught by John Ordway. In 1893 this man bore



Streetcars typify the flavor of New Orleans, home of Tulane University

three titles: (1) Professor of Applied Chemistry and Director of Manual Training School; (2) Professor of Industrial Chemistry; and (3) Professor of Industrial Chemistry and Acting Professor of Civil Engineering. The courses in industrial chemistry and those in chemistry were taught in the same building. Thus at Tulane, chemical engineering seems to have its roots in chemistry.

Others, however, disagree with some of Westwater's statements. According to Tulane Professor Emeritus Raymond V. Bailey, "...it is a matter of record in the history of AIChE that MIT had the oldest program by one year and that Tulane was second....It is also part of that record that Tulane has the oldest published curriculum."[2]

In the early days, Tulane's chemical engineering was a program in chemistry and did not have departmental or school status. On October 28, 1981, then-Professor Emeritus Francis M. Taylor, speaking to the Tulane Student Chapter of AIChE on the history of the department, stated that Charles Samuel Williamson, charter member of AIChE, was hired in 1913 to be Head of the "School of Chemical Engineering." That was also the year when chemical engineering was classified as a separate school from chemistry. In the mid-1950s, the department officially took the name of "Department of Chemical Engineering." Until the 1950s, Tulane's chemical engineering was primarily an undergraduate program, giving only a few Master's degrees at the graduate level. Then, in 1960, Ray Bailey started the doctoral program.[2]

By providing the infrastructure for a greater number of collaborative efforts and proposals between the departments of chemistry, biochemistry, and chemical engineering, the Tulane Institute for Chemical Sciences will increase our research abilities and opportunities.

Past chemical engineering faculty over the course of the 20th century are listed in Table 1.[3]

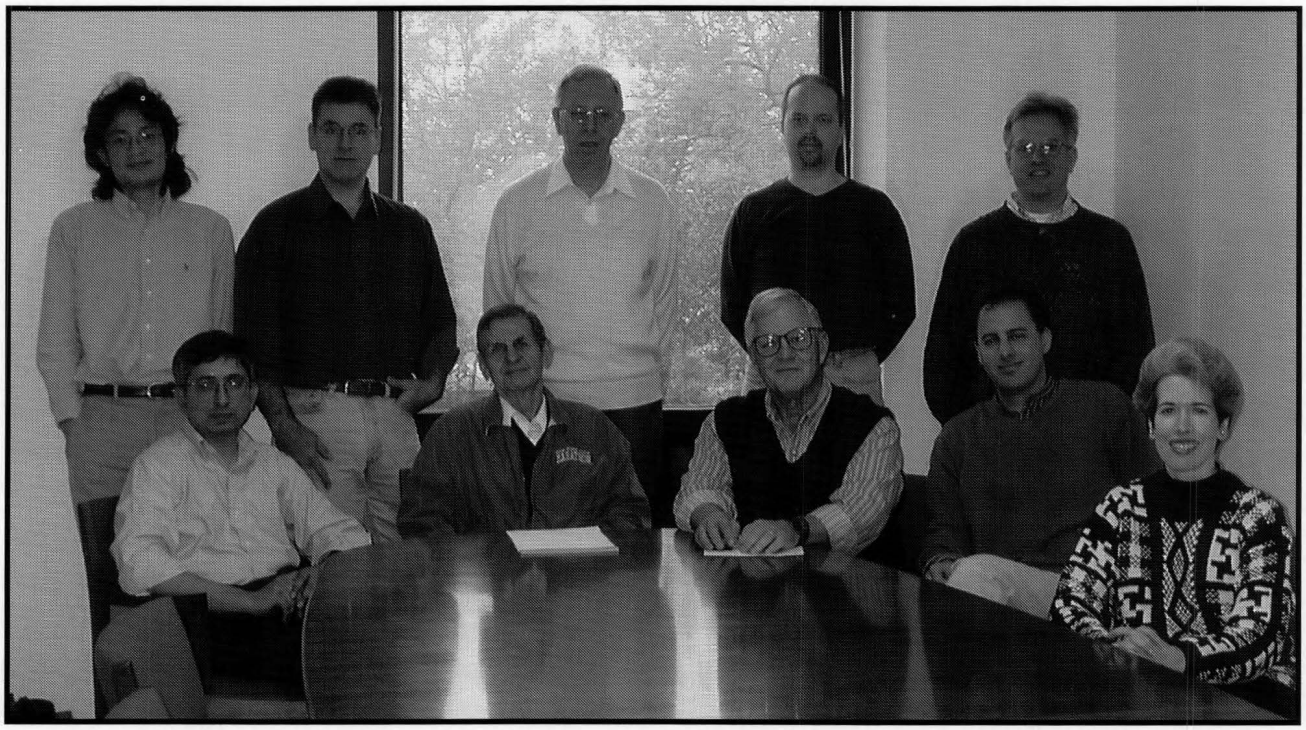
TABLE 1
Past Chemical Engineering Faculty at Tulane

1913-1917 • A.L. Metz
1913-1947 • Charles Samuel Williamson, Jr. *(Head of Department 1913-1947)*
1938-1970 • Francis M. Taylor *(Head of Department 1947-1951)*
1939-1943 • Jack A. Geister
1944-1951 • Charles G. Marshall
1950-1951 • Chuk C. Ma
1951-1994 • Raymond V. Bailey *(Head of Department 1951-1974 and 1981-1993) (Currently Emeritus Professor of Chemical Engineering and Emeritus Associate Dean of Engineering)*
1951-1961 • Mack M. Gilkeson
1957-1960 • James E. Kinard
1960-1981 • Robert E. Weaver *(Head of Department 1977-1981)*
1961-1995 • Samuel L. Sullivan, Jr. *(Currently Emeritus)*
1961-1977 • Daniel B. Killeen
1962-1967 • Charles H. Barron, Jr.
1963-1976 • Dale U. von Rosenberg
1965-1975 • Robert Chambers
1968-1974 • Gordon H. Harris
1973-1977 • Duane F. Bruley *(Head of Department 1973-1977)*
1976-1984 • Danny W. McCarthy
1976-1980 • James M. Henry
1977-1980 • Lynn J. Groome
1976-1978 • Neil Larry Book
1979-1986 • Richard W. Freedman
1975-1978 • Thomas R. Hanley
1980-1982 • Bert Wilkins
1981-1988 • Aysel Atimtay
1981-1985 • Henry Lutrell
1982-1986 • Young Gul Kim
1986-1993 • Anil Menawat
1992-1997 • John Y. Walz

THE PRESENT FACULTY

Tulane's Department of Chemical Engineering has always been a small, select department. Our current faculty is the largest in our history. Every faculty member is active in research and is funded by external grants. Nine have federal funding, and the National Science Foundation supports seven of them. The recent average yearly output of the department has been about four archival-journal publications per faculty member. In pursuing our educational and research mission, we are fortunate to have the invaluable help of Ms. Belinda Lacoste, Executive Secretary, and Mr. Paul Lane, Lab Coordinator.

The current professor with the longest history in the department is **Vic Law**, who was also the very first PhD graduate in the department in 1963. Vic became Associate Professor in 1966 and Professor in 1970. In 1975, he left chemical engineering in order to start Tulane's Department of Computer Science but returned in 1988. He teaches courses related to design, computer methods, statistics, and applied mathematics. Since 1990, Vic has had an industrially funded research program targeted at the demetallation of Cat Cracker catalysts. He has also had DoE-funded projects on the use of Beach Cones to reverse coastal erosion and a project on modeling the emissions of methane from rice paddies in order to predict global methane emissions. An AIChE fellow and a fellow of the IChemE, Vic



Tulane's ChE faculty. Seated, left to right, Vijay John, Richard Gonzalez, Victor Law, Daniel Lacks, and Kim O'Connor; Standing, left to right, Yunfeng Lu, Kyriakos Papadopoulos, Daniel De Kee, Brian Mitchell, and Peter Pintauro

took a two-year leave (1998-2000) to found a program in chemical engineering at the University of Limerick in Ireland. He is a licensed chemical engineer in the State of Louisiana and a Charted Engineer in the United Kingdom and Ireland.

Kyriakos Papadopoulos joined Tulane's faculty in 1981, three months before defending his doctoral dissertation at Columbia University, where he earned his MS with Gerald Holder and his DEngSc with Huk Cheh. A member of the Editorial Board of *Colloids and Surfaces,* his research is in the stability of dispersions and their transport through porous media. He has recently focused on development of a "capillary microscopy" technique that has uniquely led to the visualization of several new phenomena. He has taught a wide variety of undergraduate courses in thermodynamics, engineering physical chemistry, fluid mechanics, separation processes, process control, and applied mathematics in chemical engineering, as well as several graduate courses in transport phenomena, thermodynamics, surface and colloid science, analytical mathematics, polymer physics, and advanced separation methods. He has received departmental, engineering-school, and campus-wide teaching awards and served as Chair of the department from 1998 until the end of 2001.

Vijay John came to Tulane in 1982, the year he obtained his doctorate from Columbia University. In his research, Vijay is interested in the use of self-assembly to template the synthesis of nanostructured materials. Applications of his work include field-responsive nanostructures, structural polymer-ceramic nanocomposites, and functionalized nanoparticles. He also does research in clathrate hydrate technology with applications to desalination and materials synthesis. For two years (1996-1998), he served as Program Director in the Chemical and Transport Systems Division of the National Science Foundation. His research is funded by NSF, the U.S. Army, and private industry. He teaches courses in applied thermodynamics, reactor design, and materials science and has received departmental awards for teaching. Vijay is very active in University efforts to build research collaborations across the chemical sciences, and he is the current Chair of the department.

In 1986, **Peter Pintauro** joined the department after receiving his PhD from UCLA and teaching at UCLA and Manhattan College. His research interests are in electrochemical engineering and membrane separations, with funding by the National Science Foundation, the Army Research Office, and private industry. Currently, his research efforts are directed in two areas: 1) development of new membrane materials for next-generation fuel cells, and 2) modeling multicomponent ion and solvent transport in ion-exchange membranes. Since 1997, Peter has been the North American Editor of the *Journal of Applied Electrochemistry.* In 2001 he was the first recipient of Tulane's School of Engineering Outstanding Researcher award. He has taught undergraduate courses in transport phenomena, numerical methods,

and design, as well as graduate courses in electrochemical engineering, corrosion, membrane separations, and advanced transport.

In 1990, we welcomed **Kim O'Connor** as a junior faculty member. After a BS at Rice and a PhD at Caltech (both in chemical engineering) where she worked under the direction of James Bailey, Kim did two post-doctoral fellowships, one at Caltech in molecular biology and one at Northwestern in cellular biology. Her research is in cell and tissue engineering. She has led and continues to lead multidisciplinary research groups in the health sciences. Kim's specialty is kinetic phenomena in animal-cell culture, such as apoptotic cell death, multicellular spheroid self-assembly, and cell differentiation. Her teaching has included courses in the Department of Chemical Engineering, the School of Engineering, and the Molecular and Cellular Biology Graduate Program. Kim has courtesy appointments at Tulane in the Department of Surgery, the Molecular and Cellular Biology Program, and the Cancer Center. She is the recipient of three research grants from NASA, as well as one engineering-school and two university-wide teaching awards.

[Tulane] is a selective private research university and has educated chemical engineers for well over a century.

Also in 1990, we hired **Richard Gonzales** as the Herman and George R. Brown Professor of Chemical Engineering. Richard earned his PhD from The Johns Hopkins University in 1965. A past president of The North American Catalysis Society, he has been making research contributions to catalysis, reactor design, and surface science for the last forty years. His recent areas of interest include the design of ceramic membrane reactors, catalysis by solid acids, and clay chemistry. The National Science Foundation, the Department of Energy, and private industry currently fund his research. He has mentored twenty-five PhD students, ten postdoctoral students, and several masters' students. He has lectured extensively around the world and has taught graduate and undergraduate courses in reactor design, catalysis, and thermodynamics.

In 1994, **Dan Lacks** joined our ranks as a junior faculty member. After earning his BS in chemical engineering from Cornell and his PhD in physical chemistry from Harvard, Dan did a post-doctoral fellowship at MIT. His research involves the application of molecular simulations to problems of chemical engineering interest. Dan has taught process design, process control, separations, thermodynamics, statistical mechanics, and transport phenomena. He has received a CAREER grant fron the National Science Foundations, as well as departmental and campus-wide awards for his teaching.

In 1990, **Brian Mitchell** also came to our department as a junior faculty member. Brian earned his BS from the University of Illinois at Urbana-Champaign and his MS and PhD from the University of Wisconsin. Prior to joining Tulane, he was an instructor at Wisconsin and had done an NSF/NATO post-doctoral fellowship at the University of Karlsruhe, Germany. At Tulane he has taught a variety of undergraduate courses, including material and energy balances, heat transfer, probability and statistics, unit operations laboratory, and materials science. At the graduate level, he teaches a course in materials design. Brian's research encompasses a variety of materials processing topics, including the production of metal/ceramic nanocomposites and ceramic fibers, and the characterization of ceramics using spectroscopy and thermal analysis. He is active in the department as advisor to the student chapters of AIChE and Omega Chi Epsilon. He also serves the School of Engineering as a University Faculty Senator. He has been editor of the AIChE Materials Engineering and Science Division newsletter since 1997, and he is currently Vice-Chair of the AIChE New Orleans Local Section.

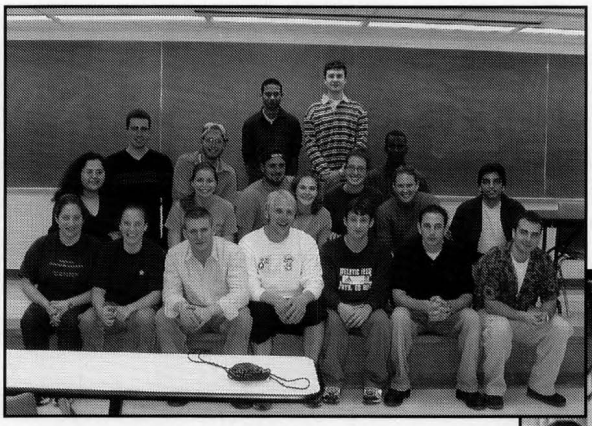
Following a distinguished academic career in Canada that led to several research awards, **Daniel De Kee** (PhD University of Montreal, 1977) joined the department in 1997. A past president of both the Canadian Rheology Group and the International Committee on Rheology, as well as a Fellow of the Chemical Institute of Canada, Dan has coauthored four textbooks in the areas of applied mathematics and rheology. He has also edited numerous volumes in these fields. Dan chaired the XIIth International Congress on Rheology and is a member of the International Advisory Board of the *Canadian Journal of Chemical Engineering*. At Tulane, he became the driving force behind the recent creation of a multidisciplinary research team in the area of polymer engineering and science. A prolific author, Dan has been invited to present numerous lectures worldwide on topics in non-Newtonian fluid mechanics, diffusion in polymers, and polymer rheology.

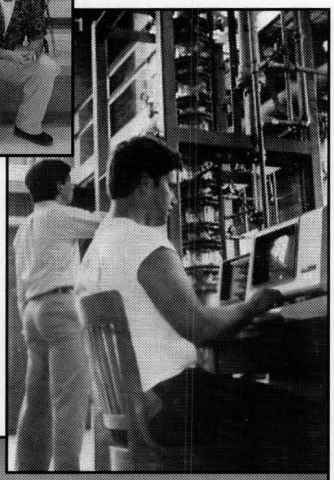
Prior to joining us in January 2001, our youngest and most recent hire, **Yunfeng Lu**, worked at Applied Materials for almost two years and at Sandia National Laboratories for one year. His PhD thesis research at the University of New Mexico under C. Jeffrey Brinker earned him the Victor LaMer Award of the American Chemical Society in 2000. His current research focuses on nanostructured materials, microelectronic materials, and sol-gel materials.

THE UNDERGRADUATE PROGRAM

Our undergraduate student body is currently composed of

about 40% women and 30% minority students. We take pride in the small classes that we offer within the major. The resulting low student-to-faculty ratio allows for close student-professor relationships, giving students superior advising and mentoring. Our proximity to the petrochemical and chemical industry offers our undergraduates opportunities for summer internships as well as long-term employment.





The class of 2002 (above), and the class of 2003 (below) typify the hard-working students at Tulane.

Curriculum • Tulane's chemical engineering program has been accredited by ECPD or ABET since 1954. In October of 2001, we had our most recent accreditation visit, which led to a six-year accreditation. In recent years, our graduating classes had an average number of about twenty students, although in the past there were instances when this number was in the mid-forties. Our graduates have always been successfully employed by industry, and contrary to the current national trend, the majority of them are still employed by the petrochemical industry. About 15% go to graduate school, and another 5% to medical school. A number have also pursued successful careers in law, finance, and other non-traditional avenues. We offer a traditional chemical engineering curriculum, with emphasis on design and in-plant experience. In view of the changing perspectives of the industries we serve, we are now studying the possibility of implementing several non-traditional options, such as biotechnology, environmental engineering, and business.

Practice School • A unique feature of our undergraduate program is the Tulane Practice School, which was started by Ray Bailey in 1951 and offered its first session in the spring of 1952.[2,4,5] The idea was proposed by local industry (Pan-Am Southern, subsequently Amoco), and the faculty member in charge was Mack Gilkeson. Since the time of its inception, the method of running the Practice School has evolved according to the nature of the participating industries and the changing chemical engineering curriculum in the country.

Presently, the Practice School is taught in the second semester of the senior year, and groups of three or four students work on a project at a local industrial facility, hospital, or governmental agency. Projects must be of real and current concern to the organizations and can range from study of an operating process to development of a new process. Projects are open-ended and students are expected to apply the principles of good design practice with realistic constraints, such as economics, safety, reliability, aesthetics, ethics, and social impact. Students are normally assigned to a project that fulfills certain career goals and an effort is made to assign every student to their top choice of available projects. One Tulane professor is assigned to supervise each group, although the students interface with practicing engineers and other industrial personnel. Students are expected to develop the ability to learn from and earn the cooperation of such personnel. Practice School carries six credit hours, and the students are expected to devote approximately twenty hours a week to it. They use and develop leadership skills and the ability to communicate effectively through reports to practicing engineers as well as to the faculty and fellow students. They have to deal with a real-world problem without the guarantee of a successful solution, thus needing to demonstrate and develop creativity in choosing those tools that are important for the project and that have been acquired in course work.

One professor has overall responsibility for the Practice School, selects appropriate projects from the local companies, and assigns the students to a project in November. Typically, before the end of the Fall semester, the students have had their first visit to their assigned plant, agency, or hospital. Initiative in setting up appointments and demonstrating leadership is encouraged from the beginning. The students are required to devise a work schedule based on constraints imposed by classes that they may be taking in the Spring semester. Different companies may require different schedules for working on location.

Upon completion of the final report and presentation, the hosting companies evaluate the group using a standard questionnaire. In addition to giving a final presentation at the work site, a day is set at the end of the semester when all groups give a presentation at Tulane—juniors are encouraged to attend these presentations. After listening to all presentations, the professors evaluate each group, and the seniors are asked to do the same for their peers. Thus, two-to-three weeks before graduation, we are provided with multiple-source feedback on various aspects of the overall education Tulane chemical engineers have received.

Each Practice School group's faculty advisor makes decisions about final grades, and different advisors put more/less weight on different criteria. In addition to the technical merit of a project, such criteria may include initiative, amount of work, hours on the project, common sense displayed, collegiality, leadership, reliability, promptness, and meeting deadlines. The professor also considers very strongly the students' impression of the participating company, agency, or hospital, as well as the overall performance of the group during the final presentations. Not every member in a given group necessarily earns the same letter grade, and in fact, in some of the groups, grades may be widely different.

Undergraduate Research • Because of the low student-to-faculty ratio and the fact that all members of the faculty are active in research, we are able to provide every undergraduate student with the opportunity to be involved in research. About half of the students decide to spend varying portions of their undergraduate years doing research in the form of part-time work, independent-study courses, or senior honors theses. Those undergraduates who join research labs as freshmen or sophomores and continue through their upperclassmen years are able to accomplish research that leads to conference presentations and even journal publications and patents.

THE GRADUATE PROGRAM

The graduate program's emphasis is clearly on the PhD. In admitting graduate students, we seek those who have the ability and ambition to pursue a doctorate. With few exceptions, in recent years all our graduate students have been full-time and fully supported as Teaching Assistants, Research Assistants, or Fellows. Our present graduate enrollment is twenty-five, with an almost even distribution of U.S. and international students. Women make up one-third of all the students. A Louisiana Board of Regents fellowship restricted to superior American applicants carries a competitive stipend and has helped recruitment of highly qualified U.S. students. In the last decade, our doctoral graduation rate has averaged over five PhDs per year. Our highest productivity was in the 1997-98 academic year when we graduated nine PhDs with nine faculty members on board.

The average time to complete the PhD is about four-and-a-half years. The students must take sixteen courses beyond the BS, up to five of which may be independent studies, usually offered by the student's research advisor. A Master's thesis counts for two courses. Because of the increased emphasis on demonstration of research aptitude by PhD students, in the mid-nineties we adopted a doctoral-qualifying-exam format that moved from testing the candidates on "textbook fundamentals" to discerning their ability to do research. All graduate students are asked to take their qualifying exam in the summer of their first year, after they have had two semesters of coursework. For the exam, we give a research problem to the students. They then have one month to write a proposal and defend it in front of a committee of three or four professors.

THE FUTURE

Over the years, we have established close ties with the departments of chemistry and biochemistry. These ties recently led to the creation of the Tulane Institute for Chemical Sciences (TICS). By providing the infrastructure for a greater number of collaborative efforts and proposals between the departments of chemistry, biochemistry, and chemical engineering, TICS will increase our research abilities and opportunities. Under the aegis of TICS and other multidiciplinary programs currently in development, we will be applying for research-center grants that will take us to a quantum-step higher level of funding.

Our Department continues to forge ahead, in step with the University's stated mission to enhance its research reputation. There are new challenges to be met. The University is in transition to taking the "decentralized management center" as its financial model, in which the individual units of the University become responsible for their own finances. The Department, in conjunction with the engineering school, sees in this an opportunity to manage its finances and carry out strategic decisions to enhance our enrollments, curriculum, and research. A major aid in enhancing growth is administration's recognition of chemical engineering as one of its best science and engineering departments. We also expect our non-traditional options at the undergraduate level to attract students. A welcome challenge in the years to come will be increasing the Department's endowment.

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