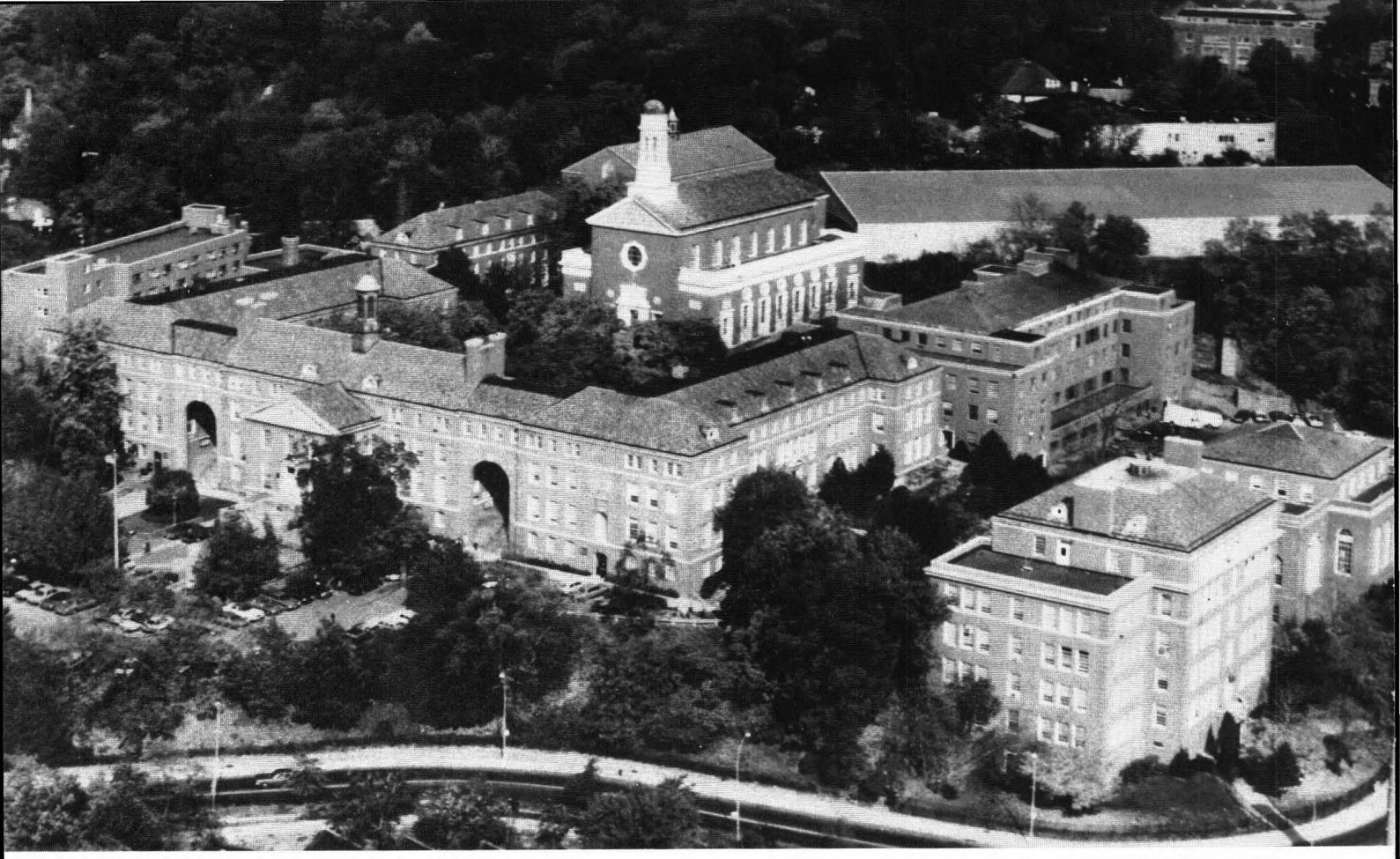

Overview of the Manhattan College campus.

ChE department

MANHATTAN COLLEGE

CONRAD T. BURRIS
Manhattan College
Bronx, NY 10471

THE YEAR 1987 marks the one hundred thirty-fourth anniversary of the founding of Manhattan College as a private independent college under the sponsorship of the Brothers of the Christian Schools (Christian Brothers). Although originally a commuter school for New York City students, the college's 4500 students now come from 17 states and 53 foreign countries. The largest division, the School of Engineering with 1500 students, was established in 1896 with programs in civil engineering and electrical engineering. Curricula in mechanical engineering and chemical engineering were introduced in 1957 and in 1958, respectively.

Although possessing the name "Manhattan," the college is located in Riverdale, an attractive residential section of New York City in the northwest corner of the Bronx on the heights overlooking Van Cortlandt Park. The campus was previously located on the island of Manhattan where the name originated, but moved to its present location in the Bronx in 1924. Since it already had an established reputation at the time of the move there was no effort to change the name along with the location.

Chemical engineering was introduced along with mechanical engineering at a time when a new engineering building was planned for the campus. As part of the planning process, advisory groups of industrial consultors were organized to meet with administrative officers to provide input so that the new departments would reflect the latest thinking of the engineering profession. With the assistance of the members of the Chemical Engineering Consultor Committee, a program was initiated at the sophomore level in 1958. The first enrollees were chemistry majors who decided to take advantage of the new opportunity presented to them. The first class graduated in 1961.

UNDERGRADUATE PROGRAM

The program began with very little in the way of equipment although a recently acquired building near the campus was available for its use. The industrial advisors who provided the incentive to get the program underway now came to the rescue. The chairman of the Consultor Committee, who was then a vice president of a major corporation but who had previously served as chairman of a chemical engineering department in an academic institution, realizing the needs of a new department with limited resources and knowing how industry could help, provided the necessary assistance. He assigned an engineer from his company to visit several chemical engineering schools to determine what experiments were needed for a modern unit operations laboratory and then authorized him to visit the company's storage locations to select appropriate surplus equipment which could be used in an academic environment. A laboratory manual was prepared based on the donated equipment so that a full set of experiments was ready for the first senior class.

Since that time the department has continued to expand, with modern laboratory equipment having replaced the donated surplus equipment. Today's unit operations laboratory is in excellent condition, thanks to grants from several companies and government agencies. Recent equipment grants from the National Science Foundation are providing opportunities for further updating of our undergraduate laboratories. Reverse osmosis and ultrafiltration, along with experiments in biotechnology, will now become an integral part of our undergraduate laboratory offerings.

The department has had three chairmen during its short history. Brother Conrad Burris served as chairman during the early years of the program. He was succeeded by Jack Famularo who served for four years and Joe Reynolds who served as chairman for seven years. Brother Burris, after serving ten years as Dean of Engineering, returned to the chemical engineering department and was again appointed chairman.

Close faculty-student interaction characterizes the Manhattan College program in chemical engineering. Small class size and excellent library and computer facilities in the Engineering Building and a newly constructed Research and Learning Center provide an excellent environment for the learning process. A special feature of our program is the involvement of undergraduate students in the research activities of the faculty. Among the research projects involving undergraduate student participation are the following: fluidized bed studies; analysis of air pollution control systems; hazardous waste incineration; paint and colloid surface phenomena; protein separation and purification processes; industrial wastewater treatment and membrane mass transfer studies. Many of these students are co-authors of published papers and papers presented at professional society meetings. In the last five years twelve papers involving student authors have been presented at meetings or conferences and nine journal articles have been published or accepted for publication.

Computer terminal room in the new Research and Learning Center.

Although primarily an undergraduate institution, Manhattan College has a chapter of Sigma Xi, which is somewhat unique since chapters of this prestigious research honor society are usually associated with doctoral granting institutions. Over the past five years, seventeen undergraduate students from the chemical engineering department have been inducted into the Manhattan College chapter.

Chemical engineering graduates from the Manhattan College program have done well in both graduate schools and in industry. In the past five years, 27 of the department's graduates have obtained or are in the process of obtaining their doctorate degrees from a variety of prestigious graduate schools. In addition, 82 graduates have obtained master's degrees. Several graduates each year also enter medical, dental and law schools. Chemical engineers from Manhattan College are highly regarded professionals in industry, with many achieving high-level positions in major chemical, petroleum, pharmaceutical and design companies.

DESIGN-ORIENTED MASTER'S PROGRAM

Once the undergraduate program was established and accredited, consideration was given to developing

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a graduate level program. At the time this was being considered in the mid-sixties, circumstances were such that there was no need for another doctoral granting institution in the New York City area. The college's industrial advisors were of the opinion that there were more than enough research-trained engineers with masters and doctorate degrees. Much of the graduate research done during that period was highly theoretical and geared to the programs being supported with federal funds. The needs of the more traditional chemical industries for engineers with some application-oriented work at the graduate level was becoming increasingly evident.

At that time it was noted that there were many talented sudents who desired advanced training in engineering, but who had little interest in research. These students were entering research-oriented programs because there were no alternatives available to them. The conclusion was that a need existed for a graduate program in engineering practice. This program was planned with the objective of training and motivating students toward productive careers in industry, and terminating at the master's degree level. New York City already had several engineering schools with excellent research-oriented graduate programs in chemical engineering, so Manhattan College, following the advice of its industrial advisors, decided to introduce a design-oriented master's degree program as an alternative for those students whose career objectives were directed toward design, production, and management rather than to teaching or research. The program was termed "design-oriented" because process and plant design project work is employed in place of a research thesis. The projects require exercise of judgment, creativity, and sound economic reasoning, and thus prepare a student for a wide spectrum of engineering assignments in industry. Although design had become an integral part of undergraduate chemical engineering education, its role at the graduate level had been minimal.

Several approaches to the program were considered by the faculty in consultation with their industrial advisors. It was generally agreed that some meaningful involvement by industry should be an integral part of the program. The MIT Practice School model was considered but discarded as being too expensive and impractical for an institution such as Manhattan College. In addition, industry appeared reluctant to support additional programs of that type. It was finally agreed that a three month "Summer Phase" should precede a nine month "Academic Phase." The summer phase would be under the direction of a "participating company" which supported the program. The company agreed to provide a work experience in the design office, laboratory, or plant which would be relevant to the overall objectives of the program. During this period a faculty representative from the chemical engineering department would monitor the progress of the student by visits to the industrial site. Selection of the student for specific summer jobs would be handled cooperatively by the college and the company involved, and salary, working conditions, and related matters would be handled by the company. Because of the proprietary nature of much of the work done during the summer months, it was agreed that the summer project should not be continued during the academic phase as part of the process and plant design project.

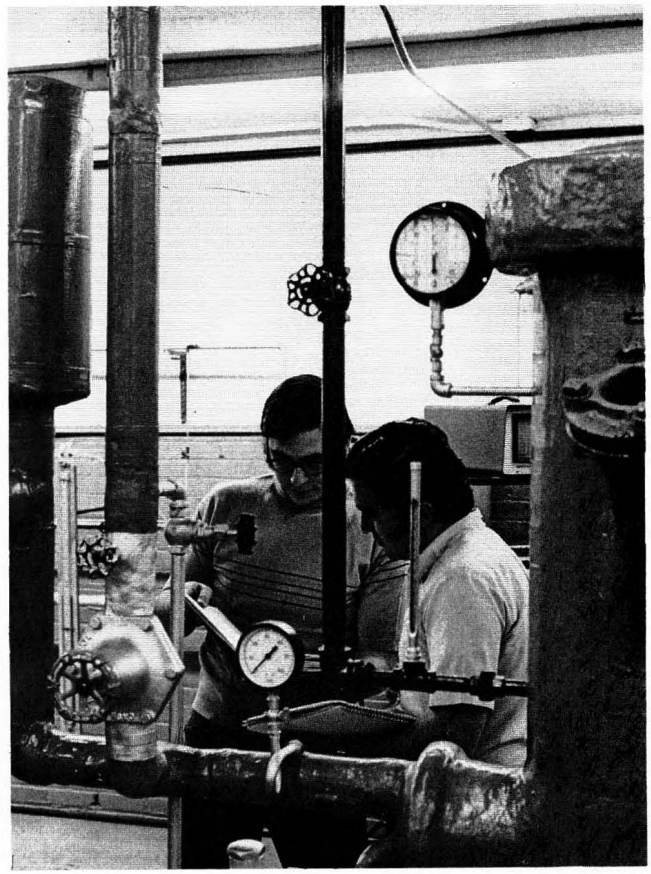
Required courses during the academic phase include applied process thermodynamics, distillation, design of thermal systems, and chemical reactor design. Included among the available elective courses are advanced chemical engineering economics, engineering statistics, numerical methods and computer methodology, optimization techniques, and computer methods in process simulation. In general, graduate courses are taught by faculty members whose background includes appropriate industrial experience. Adjunct faculty are also utilized to take advantage of their particular specialties. The many industries in the New York metropolitan area provide an excellent source of part-time teachers.

The specific objectives of the process and plant design project are to develop the capabilities of the student in the area of process synthesis, technical and economic evaluation of alternatives, process optimization and communication skills. Overall, student reaction to the project has been extremely favorable. Students have found it to be the unifying element within their graduate education. This is not as much due to the fact that the project represents the culmination of the program as it is to the fact that it serves to bring together much of the knowledge previously held to be unique and isolated.

Industry involvement continues during the academic phase of the program. A steering committee made up of members of the faculty and a representative from each of the participating companies meets

once or twice during the year to review the program and to make recommendations for its improvement. In addition, the participating companies provide seminar speakers who give appropriate up-to-date information on industrial topics. Recent seminar topics have been: Three Dimensional Plant Design on a CAD System; Application of Unit Operations in Cryogenic Air Separation; Hazard and Risk Analysis of Process Systems; and Hazardous Waste Management in the Petroleum Refining Industry.

This program has been in operation since 1967 with the participation and support of such companies as Air Products & Chemicals, Inc., Celanese Plastics Company, Lummus Crest Inc., Exxon Corporation, FMC Corporation, Mobil Oil Corporation, Stauffer Chemical Company, Texaco Inc., Pfizer Inc., Consolidated Edison Company of New York, and Union Carbide Corporation. Reports from those companies employing graduates from the program indicate that it has been particularly effective in improving the competence of young engineers by affording them an intensive, guided experience in developing their capabilities in handling industrial problems. Over 450 master's degrees have been granted since the program began twenty years ago.



Students comparing notes in the unit operations lab.

EXTENSION TO LATIN AMERICA

Once the program became successfully established in the United States, it was expanded to include applicants from Latin America. It was believed that this type of educational opportunity would be of greater benefit to many Latin American students seeking an advanced degree in chemical engineering than the more traditional "research-oriented" program. This is particularly true if the student's career objectives are directed towards production and management. In general, programs of this type are not yet available in Latin America.

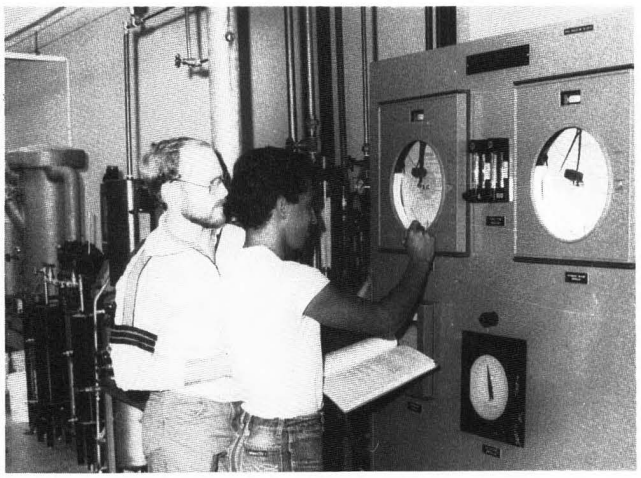
On the advice of Manhattan College's committee of chemical engineering advisors from industry, contact was made with representatives of government agencies, industry, and educational institutions in several Latin American countries. There was general agreement with the objectives of the program, and an effort was made to cooperate with industries and academic institutions in those countries by providing interested students from a cooperating engineering school with summer employment in the plant, design office, or laboratory of a participating company in the Latin American country in which the program was to become operative. After completion of the summer industrial phase, the student would spend the academic year at Manhattan College before returning to the country of origin. It was hoped that industry would provide financial assistance for those participating in the program.

Although there was general agreement with the value of the program, the format found to be successful in the United States was not viable in Latin America. Cooperation between industry and education in Latin America appears to be less than it is in the United States, and where it does exist there is little enthusiasm on the part of academic institutions involved to use industry support to provide scholarship assistance for local students to study abroad. They believe that local industry support should be for local academic institutions. So, while there was some willingness on the part of industry to provide suitable employment to satisfy the "summer phase" of the program, complications associated with the selection of a student acceptable to the company and monitoring his performance made this procedure impractical.

Since the "summer phase," or prior industrial experience, was felt to be important, a more suitable model for students from developing countries was sought. Fortunately, close cooperation with Bufete Industrial, a Mexican owned design and construction company, helped provide a suitable model for

maximizing the advantages which the program provides. The "summer phase" has been replaced for the Bufete candidates with six months to two years of industrial experience as employees of the company. They are then, in general, better prepared to appreciate the opportunities which the program provides than their United States counterparts. Students accepted for the program are employees of the Process Development Department of Bufete Industrial, so have been exposed to an appropriate industrial environment.

The Latin American extension of the program has been particularly successful in Mexico, with over 50



Collecting data for the distillation experiment.

students completing the program. An additional 25 students from several other Latin American countries have completed the program and returned to their countries. The recent decline in the price of oil, which has had an adverse effect on the economies of several Latin American countries, has resulted in a decrease in applicants from that part of the world.

OTHER GRADUATE PROGRAM OPTIONS

Although the original "Design-Oriented" Master's Degree Program was planned for full-time students, it became apparent that young engineers working in the chemical industry in the New York metropolitan area could also benefit from this type of program. Since they were already engaged in engineering work, the need for a design project as part of their degree requirement was considered unnecessary, so a part-time evening program consisting of the four required courses and six elective courses was established.

During the period when chemical engineers were in short supply, many chemists wished to work for the master's degree in chemical engineering. In order to accommodate these potential applicants, a "Chemist's Program" was established leading to the Master's Degree. Although they had a strong background in chemistry, these candidates lacked a background in chemical engineering. As a result, they were required to take and successfully complete twelve credits in undergraduate chemical engineering courses before being allowed to matriculate in the graduate program. Over 65 chemists have successfully completed this program in the nine years that it has been in operation.

PARTICULATE SOLID RESEARCH, INC. (PSRI)

Although not formally a part of the chemical engineering department, this organization (established in 1970) provides an opportunity for faculty and student involvement in applied research of benefit to the industrial community. The laboratories of PSRI are adjacent to the Manhattan College campus. The Technical Director, Fred Zenz, was originally attracted to Manhattan College because of its "Design-Oriented" graduate program. His recognized competence in the area of fluid-particle technology led to an institute devoted to the development of design data for use by industry. PSRI is modeled after the two older research institutes, Heat Transfer Research Institute (HTRI) and Fractionation Research Institute (FRI). A wide variety of useful information has been generated by this organization under Fred Zenz's leadership. Current investigations by this group include dilute phase conveying, dense phase conveying, cyclone efficiency and particle attrition. These studies have led to the development of basic formulations demonstrating that the properties of fluid-solids systems are analogous to liquid-vapor systems and obey the same quantitative relationships.

FACULTY ACTIVITIES

Continuing the tradition of excellence in teaching chemical engineering, the faculty is constantly upgrading course offerings to keep pace with advances in technology. Several of the faculty have been instrumental in developing new courses. Helen Hollein has introduced courses in biochemical engineering at both the undergraduate and graduate levels. Stewart Slater's contribution includes two new courses; one in separation techniques for resource recovery and a second in membrane process technology. Louis Theodore, who has been teaching graduate courses in air pollution control for many years, has recently developed a new course in hazardous waste incineration.

Although the department's Master's Degree Pro-

gram is still "design-oriented," some experimental work involving the newer technologies is underway. A recent NSF equipment grant has enabled Stewart Slater to develop a laboratory devoted to modern separation techniques such as reverse osmosis and ultrafiltration. Helen Hollein, also with the assistance of a NSF equipment grant, is establishing a laboratory in biotechnology. Both of these laboratories will be devoted to undergraduate instruction, undergraduate and graduate research participation, and faculty research.

Jack Famularo has been actively involved in updating our unit operations laboratory by incorporating computers into several experiments. These include a computer-controlled heat exchanger experiment and experiments in unsteady-state conduction and distillation. In addition he is currently doing research involving studies of adsorption processes in water treatment systems.

Helen Hollein is currently conducting research involving experimental studies and mathematical models for protein adsorption and desorption in ion-exchange chromatography. She is also working on the development of new resins for preparative separation of biological molecules by high-performance liquid chromatography. Stewart Slater's research in reverse osmosis is directed at process modeling and industrial wastewater treatment. He has developed models to simulate different processing modes based on mass transfer and operational parameters and is currently modeling the effects of concentration polarization. Helen Hollein and Stewart Slater have joint research projects on the purification and concentration of biological mixtures by ultrafiltration processes.

Louis Theodore and Joseph Reynolds are currently working in the area of air pollution and hazardous waste disposal by incineration. Their activities nicely complement the water pollution emphasis of Manhattan College's well-established environmental engineering program.

In addition to his work as Technical Director of Particulate Solid Research, Inc., Fred Zenz handles the design component of the undergraduate program as well as several of the graduate courses in the "design-oriented" master's degree program. Paul Marnell, who had many years of industrial experience, handles the graduate program design projects.

The recent opening of a Research and Learning Center on the Manhattan College campus is providing the much needed space for the expanding interests of the chemical engineering department. The future looks promising. □