The Graduate and Research Addition to the ChE Building. Notice the sugar kettle in front.

ChE department

CHEMICAL ENGINEERING AT LSU

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NEAR THE ENTRANCE TO the Chemical Engineering Building at Louisiana State University rests a large, overturned iron kettle. Along side is the inscription:

SUGAR KETTLE

Used by Jean Etienne de Boré in 1795 to granulate sugar from Louisiana cane for the first time, thus revolutionizing Louisiana's economy.

This kettle is a fitting symbol for the Department of Chemical Engineering at LSU, a department built on an agricultural economy which has developed to meet the changing economic needs of our space age society.

A TRADITION OF FLEXIBILITY

THE HISTORY OF THE Department of Chemical Engineering at LSU is firmly rooted in the technology of sugar processing. It was begun by Dr. Charles Edward Coates, founder and coach of LSU's first football team in 1893, Dean of the Audubon Sugar School, and Dean of the College of Pure and Applied Science until his retirement in 1937. As dean of the sugar school, he formulated one of the first courses in ChE offered in the United States. Coates' work in the Audubon Sugar School brought students to LSU from every sugar producing country in the world and at-

tracted worldwide attention from scholars in the field. Coates established a tradition of flexibility and service to industry, and his practical approach to teaching survives today.

The tradition established by Charles Coates was continued by his son, Jesse, a member of the faculty from 1936 to 1973 and department head from 1955 to 1967. Jesse Coates, who retired in 1973, still makes his home in Baton Rouge and maintains the title of Alumni Professor Emeritus of ChE.

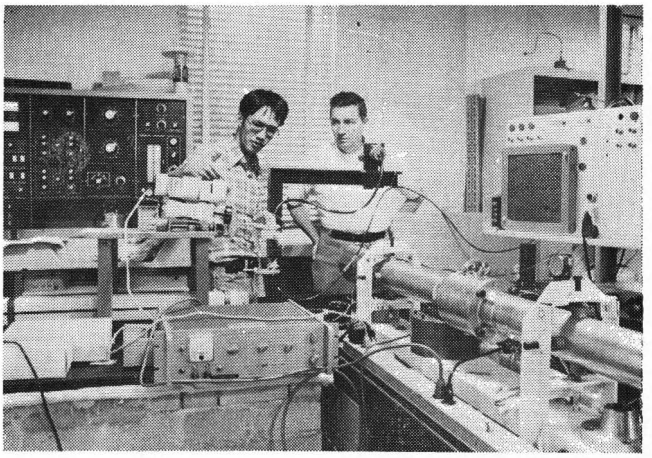
Flexibility continues to be the keystone of the department's development. Rather than adhering to any narrow field of technical specialization, department leaders have sought to shift the technical emphasis over the years without losing strength in fields of excellence developed in the past. As the cane fields along the banks of the Mississippi were replaced in the 1940's and 1950's by the towers of Louisiana's petrochemical industries, the department's expertise in process design blossomed. Then in the 1960's the race for space took LSU chemical engineering research into computer process control technology. The present department retains the best of such expertise yet continues to develop through active research in environmental control, energy sources, and bioengineering.

A TRADITION OF LEADERSHIP

THE FIRST LSU DEPARTMENT to have an all-Ph.D. faculty, ChE awarded its first degree in 1908 and the university's first Ph.D. in 1935. The department's philosophy has always incorporated its role as one of the university's leadership centers—with several faculty members rising to high administrative positions in the university. Paul Murrill, Head of the Department from 1967 to 1969 and now Chancellor of the Baton Rouge campus of LSU, was recently cited by *Change* magazine as one of the 100 "most respected young leaders" in higher education today. Ralph Pike is serving as Assistant Vice-Chancellor for Research Coordination, and Bert Wilkins is serving as Coordinator of Energy Research. Bernard Pressburg, recipient of the third Ph.D. awarded by the department, is Associate Dean of Engineering. For five years, from 1972 to 1977, Cecil Smith served as Chairman of the Department of Computer Science at LSU. To complete the cycle, Joe Polack, former Director of the Exxon Research and Development Laboratories in Baton Rouge, and Department Head from 1970 to 1976, is now Director of the Audubon Sugar Institute.

THE DEPARTMENT TODAY

THE CHE DEPARTMENT AT LSU is in a phase of rapid growth. Recent national figures on ChE enrollments show that LSU ranks seventh and seventeenth in undergraduate and graduate enrollment respectively. But growth is not occurring at the expense of quality. LSU chemical engineers at all degree levels continue to make important contributions in industrial, governmental and academic circles.



Professor Farmer and graduate student Viroj Vilimpac contemplate modifications to the detector on the shock tube.

The undergraduate program, which has held continuous accreditation since 1939, attracts the best and brightest from Louisiana, the nation and the world. Each year the LSU Alumni Federation designates the "Top 100 Scholars" from among the state's high school graduates. Fully 15% of this year's "Top 100" have chosen a ChE major at LSU. The latest university statistics shows the average ChE student has an ACT score 21% above the university average. In contrast to both

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TABLE I
Chemical Engineering Faculty

PHILIP A. BRYANT, Professor, Ph.D., 1966, Louisiana State University. Heterogeneous Catalysis, Reacting Systems in the Hydrocarbon Chemical Industry.

CLAYTON D. CALLIHAN, Professor, Ph.D., 1957, Michigan State University. Microbial Conversion of Cellulose to Useful Products.

RAMSAY L. S. CHANG, Assistant Professor, Ph.D., 1975, Stanford University. Bioengineering, Membrane Transport.

JAMES B. CORDINER, Professor, Ph.D., 1941, University of Washington. Properties of Materials, Nuclear Waste Disposal.

ARMANDO B. CORRIPIO, Associate Professor, Ph.D., 1970, Louisiana State University. Automatic Control, Optimization, Simulation. (Currently on Sabbatical Leave).

RICHARD C. FARMER, Professor, Ph.D., 1962, Georgia Institute of Technology. Combustion, Numerical Analysis of Transport Phenomena.

FRANK R. GROVES, JR., Professor, Ph.D., 1955, University of Wisconsin. Automatic Control.

DOUGLAS P. HARRISON, Professor and Chairman, Ph.D., 1966, University of Texas. Kinetics and Catalysis, Pollution Control.

ADRAIN E. JOHNSON, JR., Professor, Ph.D., 1957, University of Florida. Dynamic and Steady State Modeling of Chemical Process Systems for Improvement and/or Optimization of Process Performance Indices.

EDWARD MC LAUGHLIN, Professor, Ph.D., 1956, D.Sc., 1974, London University (England). Transport Properties of Gases and Liquids, Thermodynamic Properties of Solutions, Solar Energy.

PAUL W. MURRILL, Professor and Chancellor, Ph.D., 1963, Louisiana State University.

RALPH W. PIKE, Professor and Assistant Vice-Chancellor for Research Coordination, Ph.D., 1963, Georgia Institute of Technology. Transport Phenomena, Optimization, Chemical Reactor Design.

JOSEPH A. POLACK, Professor and Director of Audubon Sugar Institute, Sc.D., 1948, Massachusetts Institute of Technology. Sugar Cane Processing.

BERNARD S. PRESSBURG, Professor and Associate Dean of Engineering, Ph.D., 1941, Louisiana State University.

CECIL L. SMITH, Professor, Ph.D., 1966, Louisiana State University. Process Control, Mathematical Modeling, System Engineering, Minicomputers and Microprocessors.

ARTHUR M. STERLING, Associate Professor, Ph.D., 1969, University of Washington. Fluid Mechanics, Heat Transfer, Biomedical Engineering.

BERT WILKINS, JR., Professor and Coordinator of Energy Research, Ph.D., 1965, Georgia Institute of Technology. Transport Phenomena, Bioengineering, Ecological Systems Analysis, Energy Planning.

Visiting Faculty

KUNIO KATAOKA, D. Engr., 1965, Kyoto University. Convective Heat and Mass Transfer.

ALEXIS VOORHIES, JR., M.S., 1926, Honorary D.Sc., 1964, Loyola University. Heterogeneous Catalysis with Crystalline Zeolites.

Adjunct Faculty (Part-Time)

GEORGE A. DANIELS, M.S., 1966, Louisiana State University. Senior Chemical Engineering Associate, Engineering and Mathematical Sciences Section of the Research and Development Department, Ethyl Corporation, Baton Rouge.

KENNETH L. RILEY, Ph.D., 1967, Louisiana State University. Staff Engineer, Exxon Research and Development Laboratories, Baton Rouge.

national and university trends, the average ACT score of LSU ChE's has increased steadily over the last ten years.

The quality of the graduate program has also long been recognized. In the 1970 evaluations published by the American Council on Education, LSU's ChE graduate program was placed in the second highest category. Recently the Board of Regents of the State of Louisiana, as part of a statewide review of all doctoral programs, officially commended the chemical engineering doctoral program for the "distinguished level of academic excellence." Only eight doctoral programs received such commendation.

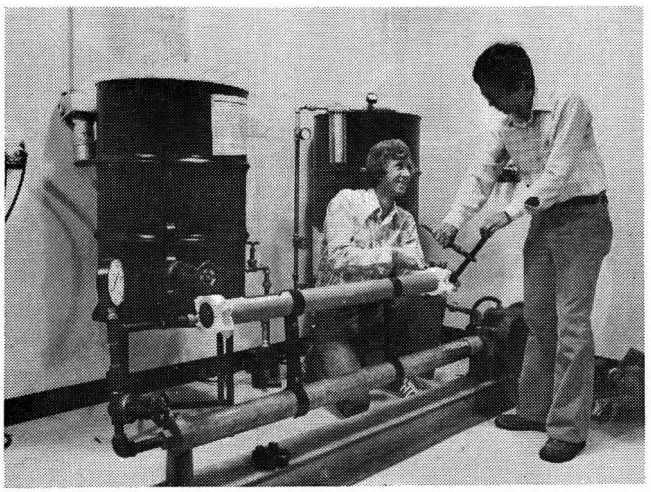
Today, LSU chemical engineers are subject to vigorous recruitment, not only by South Louisiana's petrochemical industries but by industries throughout the sun belt and the nation. According to William F. Vaughn, Director of Professional Employment for the Chemical Division of PPG (and a recruiter of LSU graduates for more than 20 years), "you can count on the LSU chemical engineer to have a good, basic understanding of the field and to move easily into positions of responsibility." This year's B.S. candidates are receiving starting salaries at or above the national average. Considering the relatively low cost of living throughout the sun belt, a B.S. in ChE at LSU is a rather wise investment.

FACULTY AND STAFF

TWENTY-THREE CHEMICAL engineers currently hold faculty titles. University administrative assignments, coupled with the part-time nature of some appointments, reduce the current full-time

equivalent faculty to fourteen. The faculty is supported by three technicians and an administrative and secretarial staff of three. A new member of the faculty (to begin next fall) has been added and another is being sought. A complete listing of the faculty and their research interests is given in Table 1.

The department has two faculty positions designated for visiting professors. One of these positions is held, on a renewing basis, by Alexis Voorhies, Jr., who teaches graduate courses on petroleum refining and petrochemical technology and is pursuing research on heterogeneous catalysis. Alexis was recently honored with the E. V. Murphree Award by the American Chemical Society. The other position has been ably filled the previous three years by Professor Jaime Wisniak from Ben Gurion University, Beer-Sheva, Israel, Mr. Edgar Bristol of the Foxboro Company, Foxboro, Massachusetts, and Professor Alexander Burcat from The Technion, Haifa, Israel. This



Professor Chang and graduate student J. P. Merle make final adjustments on the membrane separations unit.

year we are fortunate to have with us Professor Kunio Kataoka from Kobe University, Japan. The success of the visiting professorships in the past has encouraged us to continue with this program for it has brought to the department fresh ideas and new approaches to both teaching and research.

UNDERGRADUATE PROGRAM

CONSISTENT WITH THE department's policy of technical flexibility and adaptability, the undergraduate program places strong emphasis on the fundamentals of the physical and engineering

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sciences. Laboratory and design courses allow the student to apply the fundamentals to the solution of today's practical engineering problems. The faculty is firmly convinced of the need to strengthen the communication skills, both written and oral of today's ChE student. Many courses stress the quality of the student's presentation in addition to the quality of the technical work. Oral presentations have been video taped to permit later playback and self-critique.

A total of 133 semester hours is required in the undergraduate curriculum with a brief summary shown in Table II. Proper choice of elective courses permits the student to minor in a second field such as chemistry, pre-medicine or business, or to obtain additional courses in the primary field of ChE. One recently popular minor field is that of petroleum engineering. Elective courses in reservoir engineering, drilling and well completion, and secondary recovery methods permit the ChE graduate to compete and contribute as a petroleum production engineer. Senior ChE electives in such diverse topics as industrial pollution control, hybrid computation, polymers, bioengineering, food engineering, and process dynamics provide the opportunity to supplement required courses. Students with an interest in ChE graduate study are encouraged to choose ChE electives.

TABLE II
Curriculum in Chemical Engineering

Required Courses		Semester Hours
Chemical Engineering		33
Chemistry		26
Mathematics		13
Other Engineering		9
Physics		6
English		6
Economics		3
Computer Science		1
	TOTAL	97
Elective Courses		
Chemical Engineering		6
Humanities Electives		15
Free Electives		6
Approved Technical Electives		9
	TOTAL	36

Computers have long been an integral part of ChE at LSU. Students follow an introductory computer science course in FORTRAN programming with a course in numerical solution to ChE problems. Most of the other undergraduate courses utilize the computer on either a required or optional basis. Students have access to the department's as well as the university's computer systems.

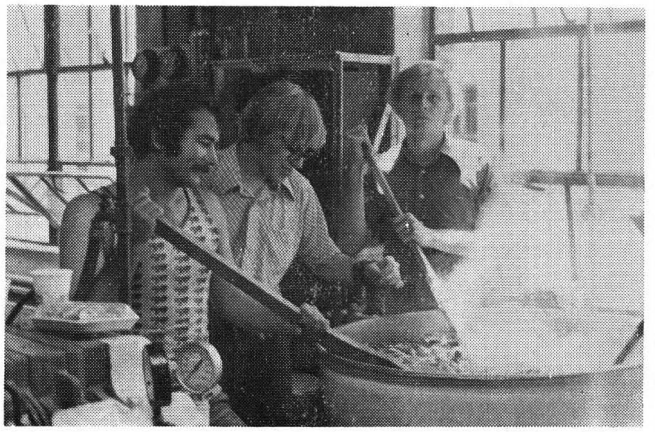
GRADUATE PROGRAM

Both the Ph.D. and M.S.Ch.E. degrees are awarded with either the thesis or non-thesis option available at the master's level. The graduate student is provided with a broad selection of courses in all areas fundamental to ChE. In a typical semester, the student may choose from among a dozen graduate credit courses.

No specific courses are required for either the M.S. or Ph.D. degrees. Course selection is made by the student in consultation with the major professor and the advisory committee. Students in the non-thesis M.S. option and the Ph.D. program must pass comprehensive written examinations, thus ensuring that the individual's program includes a broad coverage of the most fundamental topics.

Graduate enrollment is divided almost equally between full- and part-time students. The concentration of refining and petrochemical industry in the Baton Rouge area provides a large pool of chemical engineers hoping to further their education through part-time study. The department caters to the needs of this group by offering many of the graduate courses in the late afternoon and early evening hours. It is possible to complete all requirements for the M.S. degree solely through part-time study. While such a program combining full-time work and normal family responsibilities with part-time graduate study is both arduous and time consuming, two or three students per year complete all requirements and receive the master's degree.

To supplement the normal classroom and research components of the graduate program, the department offers an extensive seminar program. Ph.D. students often present a departmental seminar as part of their final dissertation defense. Numerous speakers from local industry are invited to present seminars. However, the key to the seminar program is the presentations made by faculty from other institutions. In recent years, such distinguished ChEs as Neal Pings of Cal Tech, Bob Bird of Wisconsin, Art Humphrey of Penn, Bob Reid of MIT, and Skip Scriven of Minnesota have presented seminars to LSU's faculty and students.



A practical experiment in heat transfer.

RESEARCH

DEPARTMENTAL RESEARCH interests are broad, and range from A (automatic control) to Z (zeolite catalysis). As examples of current research, four of the most active research programs are described below.

AUTOMATIC CONTROL

Heading research in automatic control is Cecil Smith, author and co-author of ten books and many articles on the application of computer and mathematical modeling techniques to process control. Smith's program is directed primarily toward the application of new techniques to achieve improved control in process plants. Digital systems, either mini-computer or microprocessors, are emphasized to implement the control scheme. Future directions for the work include analysis of dynamic interaction, integration of plant design and process control, new techniques for control of distillation columns, and use of optimization techniques for implementing supervisory computer control.

Housed in the ChE building is a Xerox Data Systems Sigma 5—Electronics Associates Incorporated 680 hybrid computer, which provides much of the computational support for this program. But the university has recently installed the powerful and efficient IBM 370/3033, the first of its kind at any university in the country. This system will provide unequalled computer capability for process control research as well as for other research areas.

BIOENGINEERING

Clayton Callihan, who heads the research in bioengineering has distinguished himself in cellulose research

and has gained international recognition for his work on the conversion of cellulose waste products into high-protein food. His current research is directed primarily towards conversion of cellulosic wastes to liquid and gaseous fuels. The normal pathway for nature to decompose fallen trees, dead grasses, and other natural waste materials, is to first hydrolyse the cellulose to glucose. This is followed by conversion of glucose to volatile fatty acids and finally conversion of the acids to gaseous methane. The current work has two basic aims. The first is to speed up the conversion of cellulose to glucose and the second is to maximize production of the intermediate volatile fatty acids. The result would be to create a pool of organic acids that have high combustion temperatures, and thus the potential to serve as liquid fuels. To date, the results have been most encouraging, but a great deal more research is waiting to be done.

COMBUSTION

Research in combustion is the primary interest of Dick Farmer. Recent studies include a shock tube investigation of aromatic pyrolysis and oxidation as well as bench scale furnace modeling of bagasse combustion.

Aromatic combustion is of great current interest because increasing percentages of aromatics are being blended into gasoline to maintain octane requirements in unleaded fuel. Since aromatics have a strong tendency to smoke, future engine and furnace designs must take into account the concomitant heating and combustion inefficiencies caused by the soot. In collaboration with Richard Matula, Dean of the College of Engineering, Farmer is measuring combustion rates in shock tube experiments. Pressure and spectrally resolved infrared radiation are the diagnostics of this study. Gas chromotography and computer processing of the large volume of thermodynamic and kinetic data are used to complete the analysis.

The investigation of these aspects of combustion, as well as an investigation of the effect of field dirt on furnaces which burn bagasse, are essential to the fulfillment of one of the department's primary goals—finding ways to save energy in tomorrow's as well as today's industries.

AUDUBON SUGAR INSTITUTE

The Audubon Sugar Institute, modern counterpart of the Audubon Sugar School, indicates the seriousness with which the department approaches an industrial need. For example, ASI is involved in research in cutting natural gas consumption in sugar mills through utilization of bagasse—the cane residue which remains after the juice is removed. Currently, bagasse combustion provides 70% of the energy used in Louisiana sugar mills. According to Institute Director, Joe Polack, this research is indicative of the high degree of success that is possible in the area of industrial energy conservation. The institute is currently expanding its research on sugar cane processing and by-product uses. New research areas include: crystallization rates of dextran-containing sugar solutions, combustion and drying studies of bagasse, mechanism of scale formation in syrup evaporators, and process control studies in evaporators and crystallizers. A substantial effort is beginning in the biochemical engineering area. The first such work involves the use of enzymes to control troublesome polysaccharides in sugar juices.

The institute, whose facilities include a complete sugar mill and extensive pilot scale laboratory equipment, directs graduate research in almost every ChE aspect of sugar processing.

AFTER HOURS

LEST THE READER GAIN the impression that only work is involved in ChE at LSU, let us consider a few of the extracurricular activities which also play an important role. At almost any time heated discussions concerning the current and future status of Tiger football and basketball fortunes can be overheard in the halls and the student lounge area. Somehow, most of the students find time to forego studying for a few hours on Saturday nights of home football games.

The student chapter of AIChE, while quite active in professional roles, excels in planning and executing social affairs. For many years the annual crayfish boil has provided a much needed break from academics near the end of the spring semester. Approximately 500 pounds of Louisiana crayfish, coupled with adequate supplies of beer, are enjoyed by faculty and staff as well as the graduate and undergraduate students. This event also provides lower level students with perhaps their first exposure to a practical heat transfer problem. A steam jacketed stainless steel kettle in the unit operations laboratory is used to condense the steam, and incidentally, to cook the crayfish. Needless to say, this piece of laboratory equipment is maintained in top-notch operating condition. In addition to the social aspects, the annual crayfish boil provides a fitting forum for the presentation of awards recognizing outstanding accomplishments of ChE students.

The faculty-student tennis tournament is a recent addition to activities occurring on the day of the crayfish boil. In the first match, the faculty defeated a combined team of graduate and undergraduate students by a 5-4 score. The deciding point was supplied by Professor Voorhies and Dean Emeritus Roger Richardson who utilized 150 years of combined experience to defeat their undergraduate opponents. Subsequent matches have been three team affairs with separate scoring for faculty, undergraduates, and graduate students. In the most recent match, the graduate students emerged victorious and the faculty immediately resolved that in the future the graduate students would be expected to devote longer hours to their research projects. □