ChE department

TEXAS

This paper was submitted by the Chemical Engineering faculty, University of Texas, Austin.

How did chemical engineering get started at Texas?

The parallelism that exists between the Department of Chemical Engineering at The University of Texas at Austin and the hydrocarbons processing industry of the state is not accidental. Each has complemented the other since before World War I, when the late Dr. E. P. Schoch foresaw the need to apply his profound knowledge of chemistry to develop uses for the crude oil which production was increasing daily. As a result of Dr. Schoch's direct effort, a degree program leading to the Bachelor's Degree in Chemical Engineering was authorized by the Regents early in 1916 and the first two degrees were awarded in June 1919. Official recognition was given to the new Department through the changing of Dr. Schoch's title from "Professor of Physical Chemistry" to "Professor of Chemical Engincering and Physical Chemistry."

For almost 20 years Dr. Schoch was the only permanent faculty member, but as the student load became heavier he was given assistance by the appointment of full time instructors on a year to year basis. In 1938 Chemical Engineering was established as a full Department in the College of Engineering with Dr. E. P. Schoch as Chairman. Among the early faculty members were Drs. J. S. Swearington, John Griswold, W. A. Cunningham, and K. A. Kobe. Physically, the Departmental activities were housed within the Chemistry Building until a new building for Chemical Engineering was authorized and constructed during the years immediately preceding the World War II. The building, containing 33,000 sq. ft. of floor space is devoted exclusively to office and laboratory usage.

The accrediting program of the AIChE was suspended nationally early in World War II, but this Department was given provisional accrediting in 1943, and after the war full accreditation was received and has been retained since that time.

How big is your department?

Prior to 1935 only 130 bachelors degrees had been granted with an average of 8 graduating seniors per year, but this number jumped to 24 in 1935 and reached a pre-war peak of 54 in 1939. With the onset of the war, the normal undergraduate activities slowed very substantially, but picked up again in 1947 when 80 degrees were awarded and reached a peak in 1948 with 105 Bachelor's Degrees. Since that time the average annual number of B.S. graduates has been approximately 60. Total undergraduate enrollment is currently about 350 full time students. Graduate enrollment increased steadily after 1948 until 1965, reaching a level of 50 to 60 full time students per year.

How does your undergraduate curriculum compare to that of other ChE departments?

Chemical Engineering curricula among the various schools have many similar features. We require the usual freshman courses in the areas of mathematics, physics, chemistry, drawing, etc., but in addition recently introduced a PSI course (see below) in computer programming for entering freshmen. One feature of this course, in addition to the development of programming skills, is the motivation of the students toward chemical engineering by means of a series of talks by Professor Schechter, the departmental chairman.

After the fresman year the typical student takes a series of core courses in chemical engineering consisting of material and energy balances, transport phenomena, thermodynamics, unit operations, kinetics, plant design, and laboratory. In addition, he takes courses in mathematics, chemistry, some engineering, physics, English, government, and history. He also takes eight elective courses generally grouped into blocks of similar content, such as

- **Computer applications, process analysis, control**
- **Materials engineering and chemistry**
- **Management and management decision making**
- **Environmental improvement**
- **Chemical processing**
- **Biomedical engineering**

It takes the average student four years plus a semester to complete the undergraduate program. Cooperative students spend three semesters working in industry in addition to their academic work.

What type of laboratory courses do you have?

A distinct upswing in the quality of our laboratory courses and facilities has taken place in the last three or four years. We believe that modern methods of data acquisition, real time analysis, and graphical display can be of value in making the undergraduate laboratory experience more meaningful for students. To implement this philosophy we have assembled an 8K mini-computer, A/D and D/A converters, magnetic tape drives, teletype, and CRT display, and interconnected them to the main university computer (see Table 1). The system is used in a variety of ways in the experiments from presenting tutorial material to the calculation of final results. The computer is incorporated into the procedure in a manner that improves student's understanding of the experiment while not isolating him from it.

R. S. Schechter, Department Chairman

The three main undergraduate laboratory courses in which the system is used are transport phenomena, process control, and the unit operations laboratory.

In general the work assigned in these laboratory courses has the principal objective of bringing students into actual contact with the physical world. Students are expected to see the correspondence between terms in an equation and the corresponding physical quantities; to make valid approximations while avoiding unwarranted assumptions; and establish that the theory they have learned does describe real world systems. To

Table 1. Characteristics of the Department of Chemical Engineering Computer System

I. Nova Mini-computer
   A. 16 bit word length
   B. 8 K words of memory
   C. Integer arithmetic
   D. 1.2 microsecond memory cycle time
   E. 4 accumulators
II. Data Acquisition
   A. 12 channel multiplexer
   B. Binary-gain range amplifier
   C. Analog-to-digital converter
III. Analog Output on 4 Channels
IV. Peripherals
   A. Computek graphics terminal
   B. Dual deck magnetic tape cassette unit
   C. ASR 33 teletype
V. Communications Interfaces (for communication with XDS-930, Sigma 5, and CDC-6600)
   A. 110 bits/sec. to teletype
   B. 110 bits/sec. to Bell type 103A data set
   C. 1200 bits/sec. to Bell type 202 data set
   D. Optional 2400 bit/sec. interface to the Computek terminal

realize these objectives, laboratory equipment has been designed and built for appropriate experiments some of which involve extensive computation. Efficient techniques have been implemented to acquire data, put it in the form having the greatest significance, and present the information to the student during the laboratory period.

Is it true that you have a tutoring service for undergraduates via the telephone?

Yes we do. Professor Rase realized several years ago that an undergraduate student who has difficulty in solving a homework problem often can resolve the difficulty with the help of a key suggestion. The telephone tutoring service enables the student to call a phone number at any hour of the day or night and receive hints that assist in the solution of homework assignments. Individual tutorial assistance in person or by phone can be routinely obtained from tutors on duty Monday through Friday from 3 P.M. to 5 P.M. Based on the questions asked each day, the tutors record or tape hints and suggestions for these homework problems that seem to cause students difficulty. The recorded material is activated when a student dials the proper number. If the student does not understand the information presented on the first reading, he can hang up and dial again. Another call re-initiates the tape.

What is the student evaluation of the program?

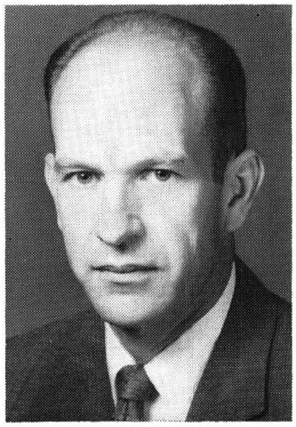
Almost every student who has used it believes it is very helpful, especially when credit on a homework problem is important.

What improvements are planned for the system in the future?

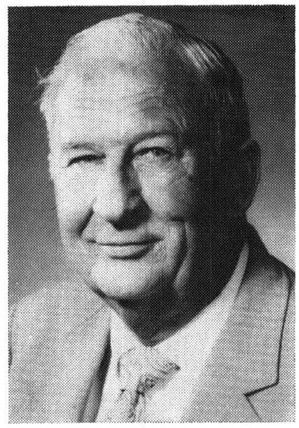
We are working on a way to computerize the system so that after the student dials the main number, he can dial an extension corresponding to the course number and receive a message for that course without having to listen to the whole tape.

Do you use the Personalized System of Instruction to any extent?

The College of Engineering at the University of Texas at Austin has been very active in developing applications of the Keller Plan, also known as the Personalized System of Instruction (PSI). PSI is distinguished by an initial careful analysis by the teacher of what the students are



Rase



Cunningham

to learn in his course. Once the terminal and intermediate objectives are fixed, he then divides the course into units, each containing a reading assignment, study questions, collateral references, study problems and any necessary introductory or explanatory material. The student studies the units sequentially at the rate, time and place he prefers. When he feels that he has completely mastered the material for a given unit, a proctor gives him a "readiness test" to determine if he is ready to pass on to the next unit. The proctor is a student who has been carefully chosen for his mastery of the course material. The student must make a grade of 100 on the "readiness test," and if he does not, he is told to restudy the unit more thoroughly. He receives a different test form each time he appears to be tested. All students who demonstrate mastery of all course units receive a grade of A.

Lectures are given at stated intervals during the course to students who have completed a specified number of units and can therefore understand the material to be covered. The students who qualify for a lecture are not required to attend them, and the lecture material is not covered on any examination.

Is PSI an improvement over the lecture-recitation system of instruction?

The Keller Plan has worked well for us. Students like the flexibility that it gives them. Most (80 to 90 percent) prefer it to the more conventional methods of instruction; they report that it taught them how to study, and our results indicate that they learn more and learn it better.

Next year there are plans to develop eight new PSI courses in the College of Engineering, including Material and Energy Balances and Pro-

D. M. Himmelblau with Data Processing Equipment

cess Analysis and Simulation in the Chemical Engineering Department.

There are some problems, of course. Students who are poorly prepared are often forced to drop a course (they probably would have flunked in a conventional course), and those who haven't developed self-discipline are prone to procrastinate. And very little data are available on whether the PSI student's better grasp of course materials at the end of a course results in better long-term mastery. We hope that our continuing study of the method will throw some light on these matters.

Do you have a big graduate program?

We have a relatively large graduate study body, with 50 to 60 full time students being enrolled each year. About one-half are working toward the doctoral degree and the other half to ward the M.S. In the last ten years 72 students completed their Ph.D. degrees in our department.

What do you do in your M.S. program?

In the future we actually will have two types of M.S. programs, one with a thesis and the other without; the latter program was just introduced. A student can complete the requirements for the M.S. in one year but the average student takes about a year plus a semester. A wide variety of courses are available both within and outside of the Ch.E. department. We do not encourage students to specialize in any one area of course work but instead try to provide them with as broad a background as possible so that their future job potential will not be too constrained. The research completed for the M.S. degree is not nearly as extensive as that for the Ph.D.

How does your Ph.D. program operate?

One of the main goals of our doctoral program, as in other universities, it to provide a student with the opportunity to carry out an independent study under the general supervision of an expert, his professor. Our faculty take pride in their close personal contact with their graduate students and we feel that this interaction is a big contributor to high student morale. As with the M.S. students, doctoral students are not expected to limit their course work solely to the area of their research, and are encouraged to broaden their interests. We require no specific count of courses or hours completed for a Ph.D. so that the doctoral program is completely flexible and can nicely fit in with the student's needs and interests. We do require successful completion of preliminary written qualifying examinations and a foreign language test of some type before a student can become a doctoral candidate. However, the bulk of the student's time, beyond the M.S. requirements, is spent in his research.

What types of research programs are underway?

We have a full time faculty of 14 and consequently have a broad spectrum of on-going research projects. Because of proximity of the University to the vast chemical and petroleum developments on the Gulf Coast of Texas, an active interest is maintained in the fundamental problems of a wide variety of process plants. The Department has earned a reputation for excellence in research in materials, separation processes, polymers, fluid properties, surface and aerosol physics, catalysis and kinetics, automatic control, process simulation and optimization, and biomedical engineering. A summary of the individual faculty and their research interests is as follows:

James R. Brock

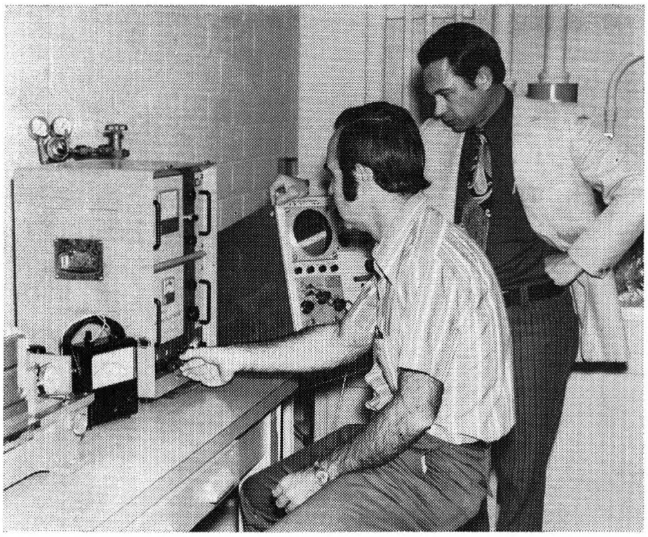
Aerosol physics and chemistry, nucleation processes, coagulation and condensation, deposition and filtration of particles, particle charging, the surface properties of particles, and quantitative human ecology as related to environmental problems of air and water pollution.

William F. Bradley

Crystal structure analysis and crystal chemistry, in particular studies of natural fine-grained mineral and the associations of organic matter with fine-grained minerals.

Tom F. Edgar

Process identification, optimization and control, energy systems engineering.



D. R. Paul (right) with Carl Locke in polymer lab

Robert P. Popovich

Physiological transport parameters in a patient's artificial kidney system; extracorporeal treatment of blood to alleviate major disease states; enzymatatic detoxification of endogeous and exhogeneous toxins (artificial liver); pathogenesis and treatment of atheroscelerosis.

David M. Himmelblau

Process analysis and simulation, and system analysis, optimization, stochastic modeling.

Joel O. Hougen

Process dynamics and control system design.

John J. McKetta, Jr.

Phase equilibria, thermodynamic properties and high pressure P-V-T.

Donald R. Paul

Polymer physics and chemistry. In particular the thermodynamics and transport properties of polymers in bulk and solution with applications to polymer processing.

Howard F. Rase

Reaction kinetics and catalysis with particular emphasis on catalyst geometry and specificity, new catalyst development and also enzyme model catalysts, process and chemical reactor design techniques.

Robert S. Schechter

Surface transport phenomena, surface viscosity, elasticity and diffusion, hydrodynamic stability, and the application of acids in oil reservoirs.

Hugo Steinfink

Crystal chemistry, magnetic, electrical, and optical properties of rare earth compounds, crystal chemistry of silicate-organic complexes.

James E. Stice

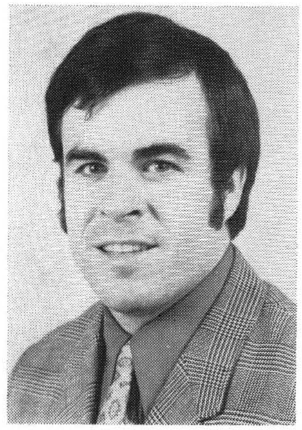
Computer assisted instruction, research in engineering teaching.

Matthew Van Winkle

Azeotropic and extractive distillation, solvent requirements and prediction of vapor liquid equilibria for multicomponent solvent-containing systems. Studies of efficiency in perforated tray columns including entrainment and frothing characteristics related to efficiency.

Eugene H. Wissler

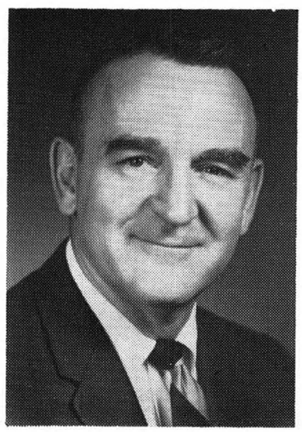
Properties of aerosol particles, aerosol beams, simulation of the human thermal system, and non-Newtonian fluids.



Edgar

Van Winkle

Members of the Chemical Engineering faculty are not only recognized leaders in their individual areas of expertise, but have been called on to take positions of leadership in University administrative functions, as well as in the AIChE and other professional organizations, in civic, and other activities of a broad nature. Dr. McKetta is a member of the National Academy of Engineering. □



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