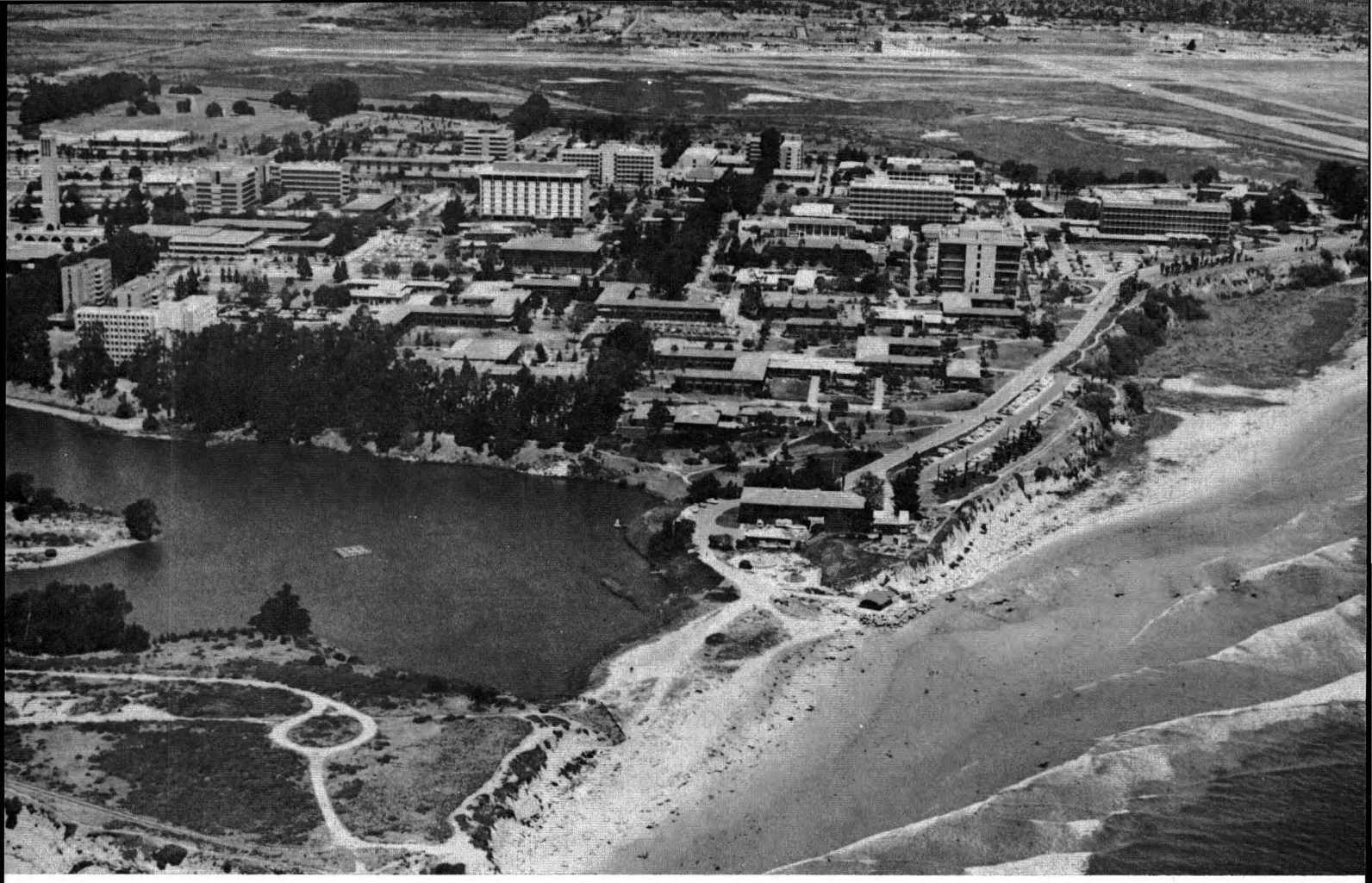


ChE department

CHE AT UC SANTA BARBARA

DALE E. SEBORG
University of California
Santa Barbara, CA 93106

CHEMICAL ENGINEERING BEGAN at the University of California, Santa Barbara (UCSB) in January, 1966 with two faculty members and six undergraduate students. During the next 15 years, the program grew to its present size of 9 faculty (including a vacant position), 195 undergraduates, and 33 graduate students. Campus visitors are surprised to learn that the Department of Chemical and Nuclear Engineering is located in the Arts Building which it shares with the Art Department. (A logical arrangement since chemical engineering is widely considered to be an art as well as a science). The UCSB campus is located on the Pacific shoreline, 100 miles northwest of Los Angeles and 330 miles south of San Francisco. The beautiful location and moderate Santa Barbara climate are two reasons why UCSB was chosen to host the next ASEE Summer Workshop for Chemical Engineering Faculty in August, 1982.

The UCSB campus is one of the nine campuses in the University of California system. The school's evolution into the UC system began in 1909 with the founding of the Santa Barbara State Normal School. In 1935 the school was designated as the Santa Barbara State College which, in turn, was incorporated into the UC system in 1944 and renamed, UCSB. After an engineering program was approved in 1961, Albert G. Conrad, then chairman of the Electrical Engineering Department at Yale, was appointed as the first Dean of Engineering. The College of Engineering now consists of four academic de-

partments which offer degrees in computer science and in four engineering disciplines: chemical, nuclear, electrical and mechanical. Over 1400 undergraduate students and 330 graduate students are currently enrolled in engineering at UCSB. Since the total campus enrollment is over 15,000, approximately 12% of the UCSB students are enrolled in engineering.

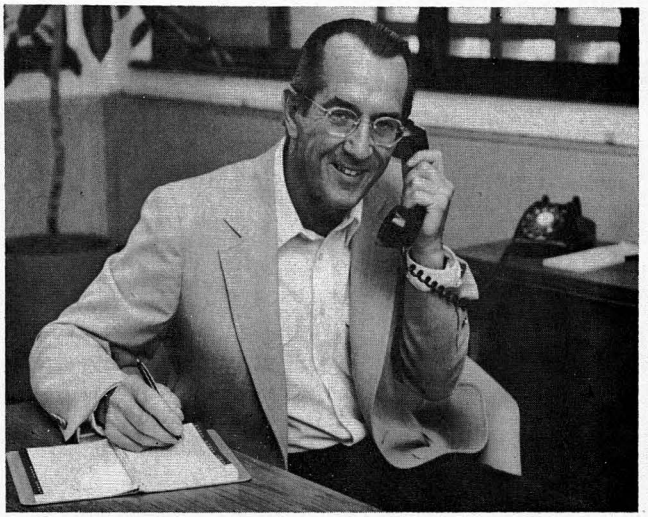
The department is fortunate that the UCSB campus has strong supporting programs in cognate areas such as chemistry, physics and biology. In addition to having excellent academic departments in these disciplines, UCSB houses a number of distinguished research institutes which include the Quantum Institute, the Marine Sciences Institute, and the new Theoretical Physics Institute which was started in 1979 with a 5 million dollar grant from the National Science Foundation.

DEPARTMENT HISTORY

THE FIRST CHEMICAL engineering faculty member to be hired at UCSB, Robert G. Rinker, arrived in July, 1965. Bob recalls that the department's first home was a 4000 square foot room in the basement of the Arts Building. Since this room had been used as a storage area for surplus equipment and furniture, Bob's first task was to create a working space for laboratories by disposing of the accumulated debris.

The department's "founding father" and first chairman, John E. Myers, came to UCSB in January, 1966 from Purdue where he had been a faculty member for 16 years. A native of Alberta, Jack received his B.S. degree from the University of Alberta and his Ph.D. degree from the University of Michigan where he was a doctoral student with Donald Katz. He has supervised 30 student theses on a variety of topics in heat and mass transfer, notably nucleate boiling heat transfer. Jack and a former colleague, C. O. Bennett, are co-authors of a very successful undergraduate textbook, *Momentum, Heat, and Mass Transfer*. This book is now in a third edition and has sold over 50,000 copies; it has also been translated into Spanish, Polish and Portuguese. Jack enjoys telling the story about the book salesman who visited him shortly after he arrived at UCSB and tried to persuade Jack to adopt his own textbook!

During his 15 years at UCSB, Jack Myers has devoted his efforts to building the department and providing campus leadership during critical periods. Since 1976 he has served as the Dean of the College of Engineering during a period of rapid growth in both research programs and student enrollments. Despite his heavy administrative load, Jack continues to teach his popular fluid mechanics course and to supervise an occasional graduate student. He also serves as a hard-hitting first baseman on the faculty softball team at departmental picnics.



"The ChE program needs how much money?"— Dean Myers swings into action.

A third faculty member, Orville C. Sandall, joined the department in 1966 after receiving his Ph.D. at UC Berkeley. Orville is part of the "Alberta Connection" since, like Jack Myers, he is a native of Alberta who received his B.S. degree from the University of Alberta. Duncan A. Mellichamp arrived in January, 1977 after receiving his Ph.D. from Purdue and working with DuPont for two years. Owen T. Hanna joined UCSB in fall, 1967 from the Boeing Company. Owen received his Ph.D. from Purdue and is the current department chairman.

The third member of the "Alberta Connection," Dale E. Seborg, received his Ph.D. from Princeton and joined the department in 1977, after nine years as a faculty member at the University of Alberta. Dale has served as the department

During his 15 years at UCSB, Jack Myers has devoted his efforts to building the department and providing campus leadership during critical periods.

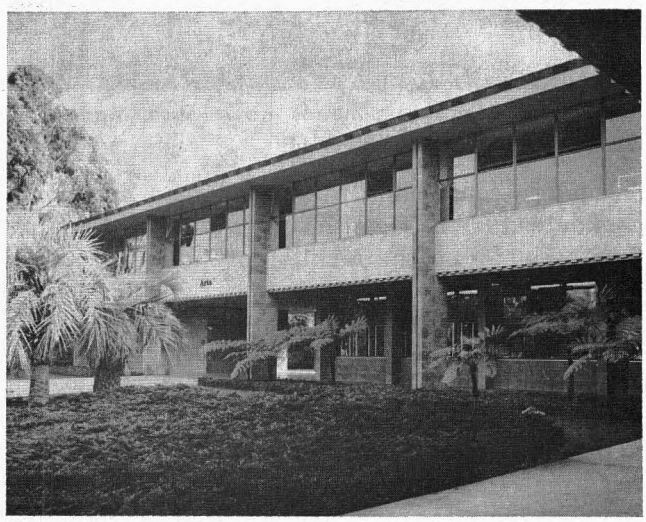
chairman during the past three years. H. Chia Chang arrived in 1980 after completing his Ph.D. at Princeton. A new faculty member, Peter Christman will join the department in 1982 after finishing his Ph.D. at the University of Texas.

In 1969 the department's first nuclear engineer, Henri Fenech, arrived from MIT where he had been on the faculty. The nuclear engineering program currently consists of 6 faculty, 50 undergraduates and 12 graduate students.

FACULTY PROFILES

A brief summary of the research interests and professional activities of the chemical engineering faculty are included below.

Chia Chang received his B.S. degree from Caltech in 1976 and his Ph.D. degree from Princeton in 1979. In his thesis research, Chia developed elegant new results based on Catastrophe Theory to predict the occurence of multiple steady states in reaction systems. He has research interests in



Since chemical engineering is an art as well as a science, the department is located in the Arts Building.

instabilities and oscillatory phenomena in chemical reactor dynamics; effective transport in heterogeneous media; and applied mathematics.

Owen Hanna is the current Department Chairman, a post he also held from 1971-73. Owen's main research interests include transport analysis, chemical reaction analysis and computational methods for the solution of chemical engineering problems. He has studied non-isothermal chemical reaction behavior for tubular reactors and catalyst pellets. In the way of computational methods,

Women currently comprise 23% of the chemical engineering enrollment and have played a leadership role in the technical societies.

Owen has developed a new method for efficiently integrating systems of differential equations which includes monitoring global accuracy. Owen is also working on the development of new asymptotic techniques which may be applicable to a variety of chemical engineering problems.

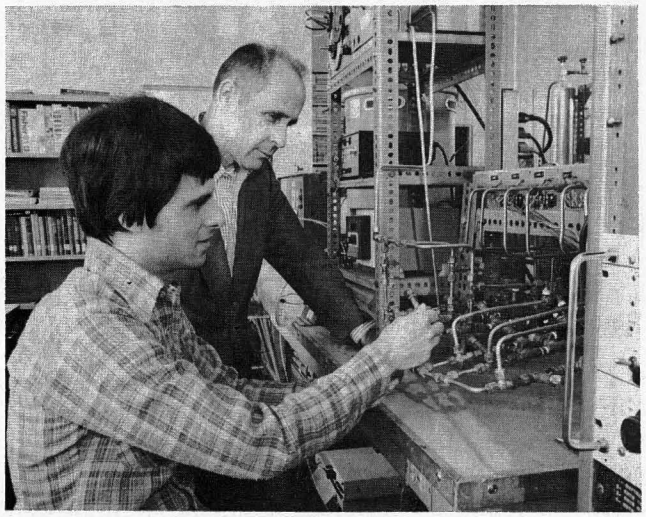
Owen and Orville Sandall have collaborated on a number of problems involving heat transfer and mass transfer. They have developed a successful asymptotic formalism (for large Prandtl or Schmidt numbers) which has been applied to a number of problems in turbulent transport.

Duncan Mellichamp's research interests in the areas of process dynamics and control, and digital computer control overlap those of several other faculty. He presently is collaborating with Bob Rinker on the control of an autothermal packed-bed reactor, particularly at an unstable steady state. Duncan has recently developed several new methods to help design multivariable control systems for large-scale, i.e. high-order processes, such as distributed reactors. He has worked with several Ph.D. students and faculty from the Electrical and Computer Engineering Department on problems of interest in the design and optimal operation of real-time computing systems. Finally, Duncan and Dale Seborg are collaborating on several advanced control studies which will be evaluated using a computer-controlled multicomponent distillation column.

Duncan has been very active with the CACHE organization having served as Editor of the Real-Time Monograph Series and in a number of administrative positions including President (1977-78). He presently is working as Editor of a textbook on real-time computing which will be published soon.

Bob Rinker, who obtained his Ph.D. from Caltech, has relatively broad research interests in the general areas of kinetics, catalysis and reactor behavior. Notably, Bob and his graduate students have conducted experimental studies of transport and chemical reaction in supported liquid-phase catalysts, dynamic and multiple steady-state behavior of distributed-parameter chemical reactors, and concentration forcing of nonlinear chemical processes in fixed-bed reactors. He is also col-

laborating with Professor Peter Ford of the Chemistry Department to study the kinetics and mechanistic behavior of homogeneous catalysis by transition metal carbonyl complexes. Bob and a physicist, Dr. Robert Hill, are investigating the atmospheric fixation of nitrogen by electrical discharges at low and high temperatures. Collaborative studies with Duncan Mellichamp are mentioned under the latter's name.



Bob Rinker and graduate student Bill Savage are studying transport and reaction in supported liquid phase catalysis.

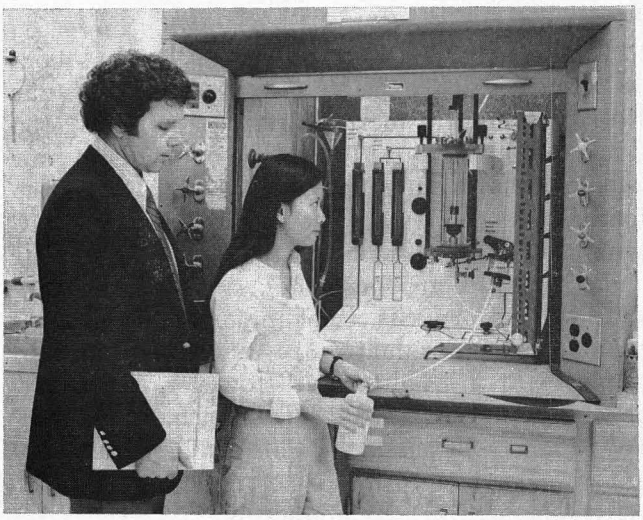
Bob took his turn as Department Chairman (1973-78) and has had the main responsibility over the years of teaching both the undergraduate and graduate lecture courses and laboratory experiments in chemical reaction engineering as well as the dual level course in polymer engineering.

Orville Sandall joined the department in 1966 after receiving a Ph.D. from Berkeley. He teaches and does research in the areas of mass transfer and separation processes. Current research projects include experimental and theoretical studies of gas absorption with chemical reaction in turbulent liquids and multicomponent distillation in continuous contact equipment. This research is generally motivated by the desirability of placing mass transfer design procedures on a more fundamental basis. Orville also collaborates with Owen Hanna on theoretical studies of turbulent heat and mass transfer. During the past five years, Orville has served as the Graduate Advisor for the chemical engineering program. He is currently on a leave of absence at the National Science Foundation to serve as the program director for the new Separation Processes Program.

Dale Seborg joined UCSB in 1977 and has served as the department chairman from 1978 to 1981. Previously, he was a faculty member at the University of Alberta for nine years where he and Grant Fisher co-authored a book, *Multivariable Computer Control—A Case Study*. His process control research ranges from theoretical developments of new control techniques to experimental evaluations using computer-controlled pilot plants. Dale and Duncan Mellichamp direct an active process control program which includes about a dozen graduate students and financial support from five industrial sponsors. Dale received the 1980 Technical Achievement Award from the AIChE's Southern California Section and was a co-recipient of the Best Paper Award for the 1973 Joint Automatic Control Conference. Within AIChE, Dale has chaired the Systems and Process Control Group and currently serves as the society delegate on the American Automatic Control Council. As an antidote for his process control activities, he teaches the introductory chemical engineering course to sophomores.

NUCLEAR ENGINEERING RESEARCH

THE NUCLEAR ENGINEERING faculty have developed strong research programs with special emphasis on three areas: nuclear materials, thermal hydraulic processes, and biomedical engineering. Bob Odette and Gene Lucas have developed a comprehensive materials laboratory which includes a Scanning Transmission Electron



Orville Sandall and graduate student Alice Tang are conducting research on gas absorption in liquid jets.

Microscope (300,000 x magnification) and is supported by over $1,000,000 in research grants. Together with Sam Gurol, they are involved in developing a better understanding of the fundamental physical processes which govern the microstructure and mechanical properties of nuclear structural materials.

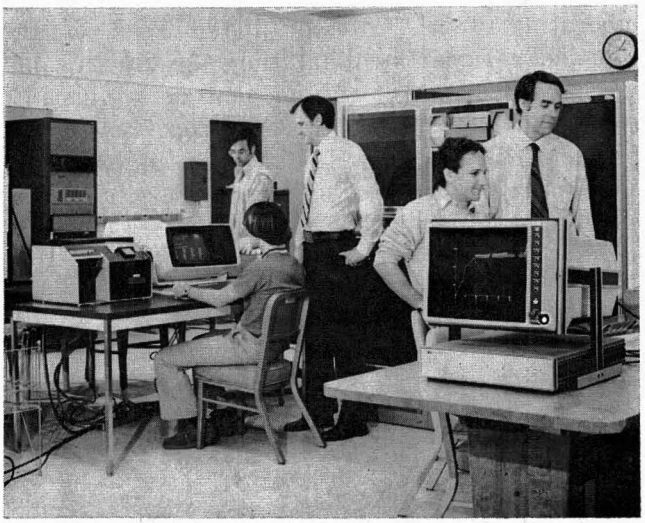
Two nuclear engineering faculty, Sanjoy Banerjee and Henri Fenech, are directing research on the complex thermal hydraulic processes that occur in nuclear systems. In particular, mechanisms which play a key role in reactor safety are being investigated including rewetting of hot surfaces, reflux condensation, and pressure and wave concentrations in multiphase systems. Sanjoy provides a very beneficial link between the chemical and nuclear wings of our department since he has an extensive background in nuclear engineering as well as B.S. and Ph.D. degrees in chemical engineering. He joined the department in 1980, arriving from McMaster University where he held the Westinghouse Chair in Engineering Physics.

The early detection and localization of lung tumors which are too small to detect using conventional X-ray techniques is the goal of a research program directed by Ed Profio. Ed and his students have clinically tested a promising new technique based on fluorescence bronchoscopy. Another research project involves the development of fast neutron radiography for the detection of breast cancer.

UNDERGRADUATE PROGRAM

IN RECENT YEARS THE number of chemical engineering majors at UCSB has steadily increased to the current level of 195, a record high. About 45 students are expected to graduate in June 1981, a significant increase over the normal 25-35 graduates per year. Typically, one-half of our undergraduates have transferred to UCSB from junior colleges, state colleges or other UC campuses. The vast majority (~90%) of our undergraduates are California residents. Since the state of California is a net importer of chemical engineers, our graduates are readily able to find employment i nCalifornia. However, an enterprising minority (~15%) of each graduating class accept jobs outside of California, presumably to verify persistent rumors that life does exist east of the Sierra Nevada Mountains.

Women currently comprise 23% of the chemical



Duncan Mellichamp and Dale Seborg in the Real-Time Computing Laboratory.

engineering enrollment and have played a leadership role in the technical societies. For example, during the 1980-81 academic year, female chemical engineers have served as the president of the Society of Women Engineers student chapter and were elected to three of the top four offices in the AIChE student chapter. (Inevitably, the AIChE vice-president was referred to as the token male.)

The B.S. degree in chemical engineering is a four-year program which nominally requires only 180 quarter units, the standard graduation requirement for all UCSB degree programs. However, the typical chemical engineering student graduates with more units, particularly if he or she is a transfer student. The UCSB chemical engineering curriculum places considerable emphasis on laboratory experience, especially in the senior year when students take two quarters of Chemical Engineering Laboratory and a two-quarter course in process dynamics and control which includes a laboratory.

In the Chemical Engineering Laboratory courses, students have a four-hour lab period each week for 20 weeks. The courses include a balance of bench-scale experiments which provide accurate experimental data and unit operations experiments which provide familiarity with large-scale equipment. A unique feature of this laboratory is a wind tunnel which has a large test section (18″ x 18″) and can generate velocities up to 200 feet per second. This versatile apparatus is used for a wide variety of transport phenomena experiments.

A unique feature of the UCSB curriculum is the unusual emphasis on two areas, process dy-

namics and control, and real-time computing. Undergraduates are required to take two quarters of process dynamics and control as part of the core curriculum. Many students also choose the popular Real-Time Computing sequence for their technical electives. Duncan Mellichamp has gained widespread acclaim for his pioneering efforts in developing excellent instructional laboratories in both areas, real-time computing and process dynamics and control.

GRADUATE PROGRAM

GRADUATE ENROLLMENTS IN chemical engineering at UCSB have steadily grown to their present level of 24 M.S. students and 9 Ph.D. students. Virtually all of our M.S. students pursue the thesis option since the non-thesis option is rarely approved. It has also been department policy to strongly encourage our own undergraduates to broaden their background by pursuing graduate studies elsewhere rather than staying at UCSB. Consequently, all of our current 33 graduate students received their B.S. degrees from other universities. Furthermore, of the 18 Ph.D. students and approximately 60 M.S. students who have graduated from the department since 1966, none of the Ph.D. students and only a few M.S. students received their B.S. degrees from UCSB.

CAMPUS GOVERNANCE

THE UNIVERSITY OF CALIFORNIA has a strong tradition of shared governance between the Academic Senate and campus administrators. In particular, Academic Senate committees play a critical advisory role in academic planning and personnel decisions. Although the Department of Chemical and Nuclear Engineering is a relatively small department at UCSB, our faculty have played a disproportionately large role in the Academic Senate. In recent years, five of our faculty —Jack Myers, Duncan Mellichamp, Bob Odette, Owen Hanna and Bob Rinker—have chaired key Academic Senate committees. By providing this leadership, they have not only performed a valuable service to the campus, but they have also extended the department's influence with the campus administration. Our faculty's active participation in campus governance has undoubtedly played a major role in developing strong administrative support for our programs over the years. □

ACKNOWLEDGMENT

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