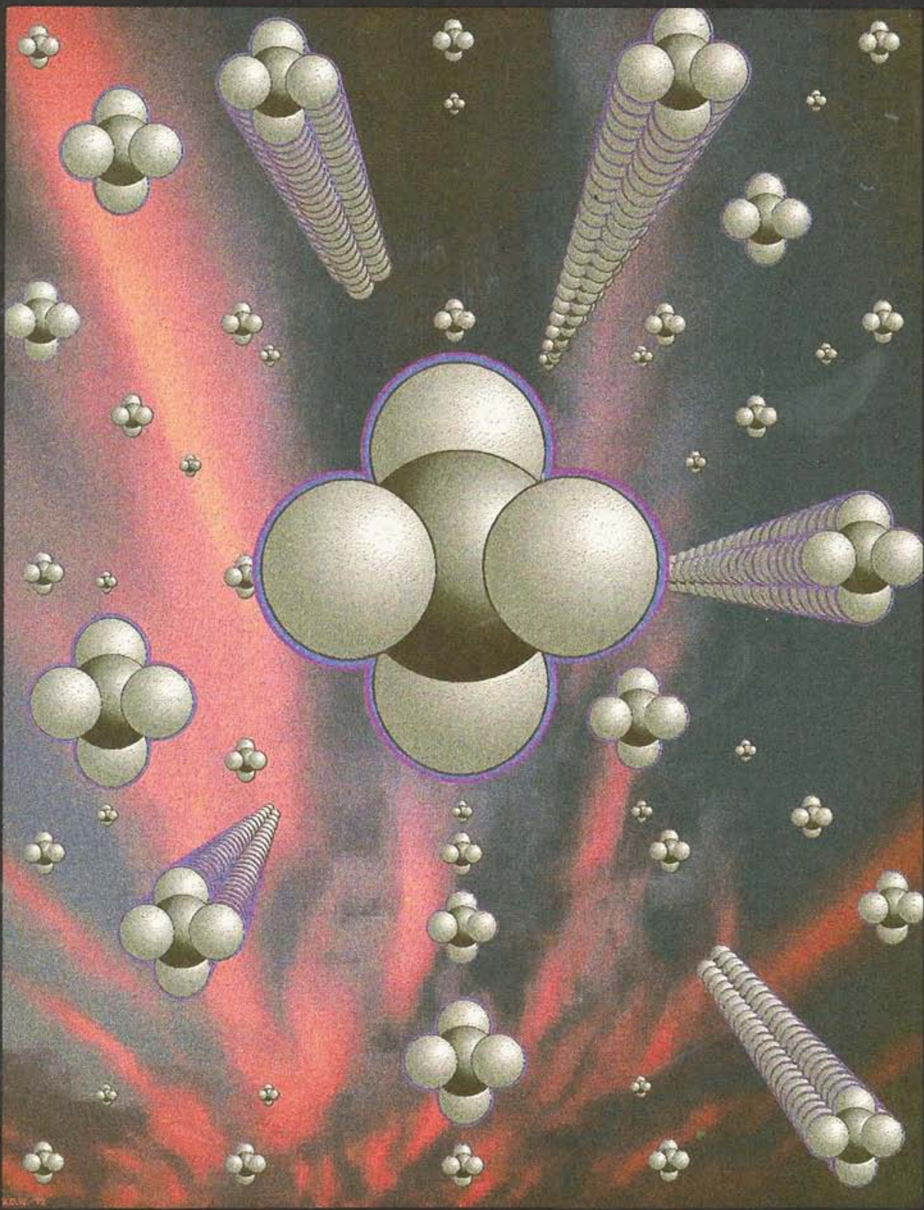
OKCHE

Summer 1992

Richard G. Askew Establishes Fund to Match Corporate and Alumni Gifts for CEMS Scholarship Endowment
Page 30



CEMS NATURAL GAS RESEARCH:

Engineering the Gas Industry for the 21st Century

The University of Oklahoma is a major, national research university serving the educational, cultural and economic needs of the state, region and nation. Created by the Oklahoma Territorial Legislature in 1890, the university has 18 colleges offering 121 areas for undergraduate study; 111 areas for master's degrees; doctoral programs in 71 fields; and professional degrees in law, laq/business administration, medicine, dentistry and pharmacy. OU enrolls more than 24,000 students on campuses in Norman, Oklahoma City and Tulsa and has approximately 1,500 full-time faculty members. The university's annual operating budget is in excess of $460 million.

OKCHE

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Contents

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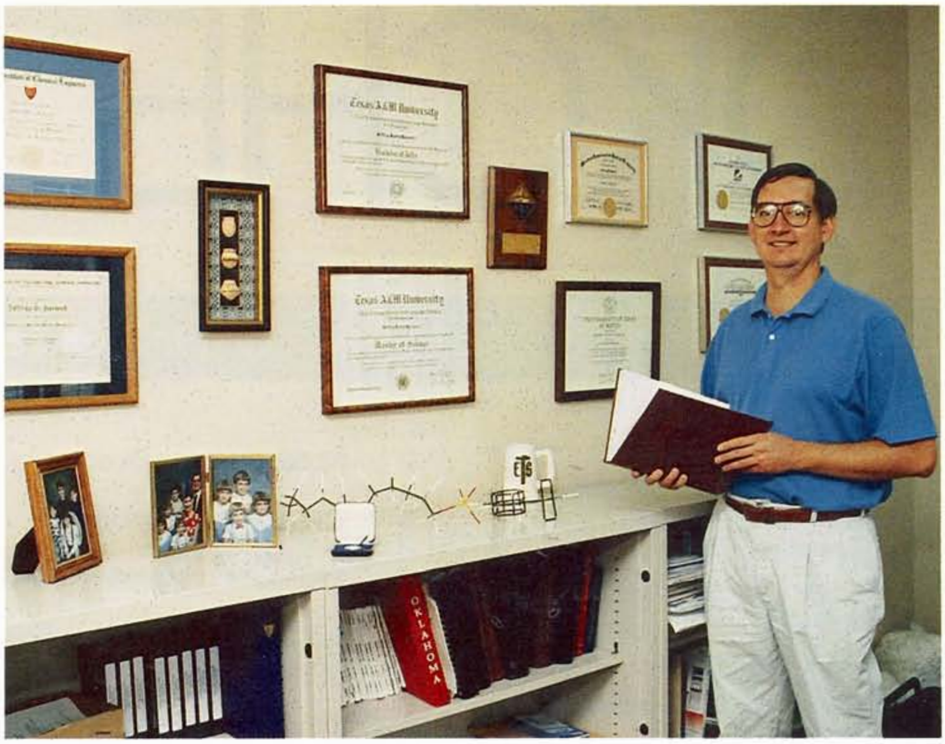
Notes from the Director



If you haven't received a copy of OKChE recently, don't be concerned! They have not been lost in the mail. There has just been a considerable gap since the last publication of OKChE. Rick Wheeler and I hope that, with this issue, we will be returning to a regular publication schedule.

The School of Chemical Engineering and Materials Science continues to change and grow despite the stagnant economy in Oklahoma and most of the rest of the nation. Long-term faculty member, Dr. Bob Block, has retired, but he has been replaced by a new faculty member, Dr. Ulli Nollert. Dr. Nollert is a significant addition to the fraction of the department which does research in biomedical and biotechnical engineering. He will be joining forces with Dr. Harrison and Dr. O'Rear in this area. Dr. Nollert has engaged in some exciting research on the underlying causes of heart attacks. I hope you will find the time to read his profile in this issue.

As this magazine is going to press, we are in the process of searching for two new faculty members, one to replace Dr. Ray Daniels, who will be retiring next year. We hope to be able to introduce them to you by this time next year.

Undergraduate enrollments in CEMS have stabilized and have begun to climb again after the precipitous fall in the early 80's. one dramatic change in the undergraduate student body in Chemical Engineering and Materials Science is the dramatic increase in the number of women in the program, which is now nearing 50%. One third of last year's B.S. degrees went to women. We also have had a dramatic increase in the number of Blacks, Spanish Americans, and Native Americans in the program. Unfortunately, despite vigorous efforts to hire a woman or minority as a faculty member, we have been unable to find such a person. Our efforts will continue in the coming year, however. Still another change in the undergraduate student body is the large number of National Merit and National Achievement scholars now represented. Thanks to the great success of the Program of Excellence, which provides scholarships from the department for outstanding students, combined with Dr. Hillel Kumin's tremendous success in recruiting National Merit scholars into the College of Engineering and Wayne Steen's success in recruiting minorities into the College of Engineering, we have the most outstanding student body in our history. One clear indication of this is that, while it has become more difficult nationwide for all job searchers, last year's graduating class in Chemical Engineering were all able to find the positions they wanted either in medical school, graduate school, or industry.

Another indication of the strength of the school, as we move into the 90's, is the level of research activity as measured by dollars spent on research. This past year, for the first time in recent years, the School of Chemical Engineering and Materials Science was listed as one of the top chemical engineering research institutions in the United States (C & E News, August 19, 1991, page 67) in terms of total dollars spent on research. What makes this achievement even

CEMS founding director Richard L. "Doc" Huntington has been honored with the dedication of the school's refurbished Unit Operations Laboratory. (Story page 28) This handsome bronzed bust was created and donated to CEMS by Huntington's daughter Helen Huntington Jennings.

moreremarkable is the relatively small size of the faculty. Whereas most leading institutions of chemical engineering research have a faculty of 16 and most of the top programs have faculties on the order of 20, Chemical Engineering at OU has been able to compete in terms of total dollars spent with a faculty of only 11. On a basis of research dollars per faculty member, the University of Oklahoma's Chemical Engineering Department would rank in the top 10 nationwide.

Another dramatic change that has occurred in the department in recent years is the number of chairs and professorships. Through the decade of the 80's there were no endowed chairs or professorships in the School of Chemical Engineering and Materials Science. Now in 1992 there are one fully funded chair and two fully funded professorships. With the launching of the College of Engineering's Plan 2000, we fully expect that we will see a significant increase in the number of endowed positions during the decade of the 90's.

Another encouraging trend is that alumni support for the school has never been stronger. Though we still can in no way compare to the support at schools like Texas, Texas A&M, and Purdue, the level of alumni support has been increasing dramatically. With the new emphasis on this aspect of the program by Dean Crynes and Dean Geis in the College of Engineering, we fully expect that our alumni support will rise to a level comparable to that at these other great schools.

As an example of what I expect will be a trend in alumni support for the program during the 90's, College of Engineering Distinguished Graduate, Dick Askew, has become the School of Chemical Engineering and Materials Science's first distinguished benefactor. Dick has pledged $100,000 to be used as matching money for the endowment of undergraduate scholarships at the University of Oklahoma. You can read more about Dick's donation and how you might be able to participate in completing the endowment of a scholarship for an outstanding undergraduate student on page 30. Thank you, Dick, for your generous contribution. It comes at a wonderful time.

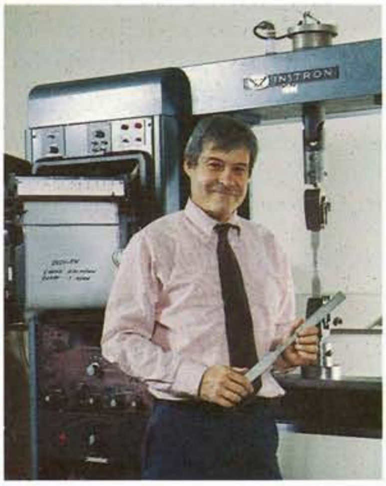
In summarizing the state of the school at the beginning of the 90's, I would be remiss not to mention the outstanding undergraduate labs that we have. While you may read much in the news media about the dilapidated state of university laboratory equipment, I am convinced that the undergraduate labs in the School of Chemical Engineering and Materials Science are the best that they have ever been. In fact, they are the best that I have ever seen anywhere in any visit to any university. There are many factors that explain the outstanding quality of our undergraduate labs. One of these is the generous help of industrial supporters like Koch Engineering, Exxon, and Texas Instruments in the donation of equipment and money. Another is the generous help of the Huntington family, which has endowed a student helper position for the labs in memory of "Doc" Huntington, the first director of CEMS who also built the first undergraduate Chemical Engineering Laboratory at OU. But, far and away the most important factor has been the truly sacrificial contribution of faculty like Dr. Jay Radovich in the early 80's and more recently Drs. Rick Mallinson and Lance Lobban in keeping the lab updated and in introducing modernized experiments with improved design instrumentation and documentation. Please take time to read the description of the Huntington Laboratory on page 28. We are also soliciting donations to increase the funding of the Huntington family student helper position. Details can be found in the story on the lab.

All of this is not to say that we are without problems. As with all of the rest of higher education, we are suffering from the general sluggishness of the economy. State funding to the University of Oklahoma last year increased at less than the increase in fixed costs such as increases in the health care costs and mandated increases in retirement costs, which were required to shore up a shaky teachers retirement system. Despite this, the university's administration was able to reallocate funds so that there were no cuts in academic areas and there were even small salary increases available for those faculty and staff who were promoted.

Despite all of these changes and the number of new technologies that chemical engineering faculty are now involved in, we still remember our roots in the oil and gas industry and the days of the oil and gas booms in Oklahoma. Also, despite the state of Oklahoma's attempts at economic diversification, the oil and gas industry continues to play a major role in the state economy. Forthis reason, this issue of OKChE magazine focuses on natural gas and gas liquids related research and other gas industry related activities within the department. I hope you will have time to look over this section. I think you will be impressed with the breadth of the research and its potential for having a major impact on the U.S. and world economy.

Finally, by the time you receive this issue of OKChE, you should have already received an invitation to a CEMS reunion this October. Please make an effort to attend. It is always a thrill for us to meet our alumni again and learn about their recent activities and accomplishments. I also think that you will really enjoy seeing the new Energy Center, the new chemical engineering research laboratories, and the outstanding undergraduate facilities. Of course, the best reason for coming back is to meet old classmates and to reminisce about what we are confident were the good times that you had as students at OU. We look forward to seeing you in October.

CEMS Faculty Updates

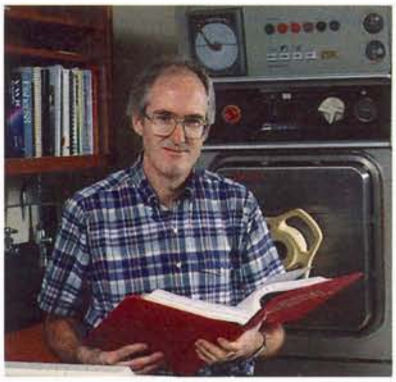


Professor Robert J. Block has taken early retirement from OU after 27 years in CEMS. Block, who was consistently rated by students as one of the top instructors in the College of Engineering, continues to enjoy a national reputation for his work in crystal plasticity and failure analysis, as a consultant in cases involving product liability, and through teaching annual short courses in corrosion control and metallurgy for engineers through the OU College of Continuing Education.

Professor Raymond D. Daniels concluded five years of service as director of CEMS and returned to teaching and research full-time in August 1991. He has since applied his considerable administrative experience to direction of the Oklahoma Mining and Mineral Resources Research Institute. In addition, Daniels has spearheaded the institutionalization at OU of an international faculty and graduate student exchange and linkage program of CEMS with a graduate program being developed at Chulalongkorn University in Bangkok, Thailand. In 1990, Daniels was honored by the National Association of Corrosion Engineers when he received their Distinguished Service Award. The award recognized his contributions during more than 30 years of service in every elected office of the south central regional body and service on several standing committees.

CEMS' new director Jeffrey Harwell presents outgoing director Ray Daniels and wife Libby with an original George M. Sutton seriograph given by faculty and staff in appreciation of his distinguished service as director of the School.

Professor Roger G. Harrison received a 3-year grant from the American Heart Association (Oklahoma Affiliate), a 2-year grant from National Science Foundation, and a one-year grant from Oklahoma Mining and Minerals Resources Research Institute. The Heart Association project involves "New Approaches to the Bacterial Synthesis of Human Atrial Natriuretic Peptide". The NSF project concerns "Utilization of Genetic Engineering and Affinity Separations to Improve Peptide Production". These two projects take different approaches to the production of purified atrial natriuretic peptide which has shown great promise in the treatment of congestive heart failure and essential hypertension. Harrison is coordinating efforts to recruit undergraduate chemistry students from other state colleges and from CEMS' own undergraduate program for CEMS' graduate program.



Professor Jeffrey H. Harwell was appointed director of CEMS in August '91 and promoted to full professor in July '92. Harwell and John Scamehorn co-organized the 65th Colloid and Surface Science Symposium of the Colloid and Surface Chemistry Division of the American Chemical Society held at OU in June '91. Harwell made the presentation "Migration of Immiscible Fluids in Subsurface Media and Effects of Surfactants on that Migration" at the Nato Advanced Studies Institute meeting on Migration and Fate of Pollutants in Soils and Subsoils held in May '92 in Maratea, Italy. He attended the 3rd International Conference on Ground Water Quality Research--Subsurface Restoration at where he and his colleagues presented 5 papers coauthored by him. He is chairing a session "Separation of Contaminants from Soil and Groundwater" at the '92 A.I.Ch.E. summer national meeting in Minneapolis, Minn.

Professor Lloyd L. Lee has received grants from Gas Research Institute totalling well over three quarters of a million dollars during the last three years for research in natural gas sweetening and in adsorptive refrigerative fluids. He also received funding from Oak Ridge National Laboratory for a project involving research in structure and properties of supercritical solutions. During sabbatical leave in '90, Lee conducted research in kinetics at the University of California at San Diego, and in phase equilibria in condensate reservoirs at the University of California at Berkeley. Lee's research on these projects resulted in more than a dozen publications of journal articles and book chapters. Lee presented papers at annual A.I.Ch.E. meetings in Chicago in '90 and Los Angeles in '91, and at A.I.Ch.E.'s national meeting in Orlando, Florida in '90. He also presented papers in '91 at the Second International Supercritical Fluid Conference in Boston, and at the Eleventh Symposium on Thermophysical Properties in Boulder, Colorado. Lee presented results of his tests of the statistical mechanical theory RISM on alkanolamine solvents in a paper given at the 6th Fluid Properties & Phase Equilibria for Chemical Process Design in Cortina d'Ampezzo, Italy in July '92.

Professor Lance L. Lobban has consistently earned the highest teaching ratings for preparation and instructor effectiveness. In April '92, he received the $1000 Baldwin Study/Travel Award of the OU Alumni Association in recognition of excellence in classroom instruction. He received the award on the basis of student nominations and departmental recommendations. During Engineering Week in spring '92, he was named Outstanding Chemical Engineering Professor. In '89-'90, he was honored as a Mortar Board Top Ten Professor for '89-'90. Lobban served as a consultant during '90-'91 to Conoco, Inc. of Ponca City in the area of reaction engineering and catalysis and modeling a fluidized bed butane oxidation reactor. He is an engineer with C. M. Sliepcevich and Richard G. Mallinson in University Technologists, Inc. involved in reaction engineering and catalysis, and design, construction and operation of a system for production of nitrogen tetroxide from ammonia. He received funding from the National Science Foundation from this research on admicellar catalysis. His research on methane conversion is described as part of the feature article in this issue of *OkChE*.

Professor Richard G. Mallinson chaired the session "Interfacial Reactions" at the 65th ACS Colloid and Surface Science Symposium in Norman in June '91. Mallinson has been awarded a five-year Kerr-McGee Distinguished Lectureship to run through 1994. He received an Associated Western Universities Faculty Sabbatical Fellowship during 1990 which he used as a visiting research scientist at Lawrence Livermore National Laboratories. His gas- and gas liquids-related research is also described in this issue of *OkChE*.

Introducing Matthias "Ulli" Nollert

Professor Matthias U. Nollert joined the faculty in CEMS in August '91, increasing the School's strength in the areas of biomedical engineering and rheology. Nollert came to OU after four years in postdoctoral research at Rice University's Biomedical Engineering Department in Houston. While at Rice, Nollert investigated the influence of flow induced shear stress on the metabolism of vasoactive compounds and second messengers in human vascular cells in tissue cultures and studied the role of convective mass transfer in modulation of cell metabolism in parallel plate flow. He has developed a fluorescence video microscopy system to study cytosolic calcium and pH in single cells. In the course of his work in rheology, he used a molecular model for dilute polymer solutions to calculate the change in conformation expected for flow in porous media and determined how the stability of colloidal suspensions depends on the form of the bulk flow field.

Nollert completed a B.S. in chemical engineering at the University of Virginia in 1981 and his Ph.D. in chemical engineering at Cornell University in 1987. As an undergraduate student, Nollert gained considerable experience in industry working during summer 1980 for Union Carbide in West Virginia assisting in implementation of a preventative maintenance program, and during the summers of '78 and '79 at BASF in Ludwigshafen, West Germany, where he conducted tests and assisted in operations at a leather tannery pilot plant.

In his first year in CEMS, Nollert has taught courses in process design, numerical methods and fluid mechanics and performed research on vascular cells and blood/vessel wall interactions.

In his capacity as the new advisor to OU's student chapter of AIChE, Nollert, along with Ed O'Rear, accompanied a busload of students to a spring '92 regional meeting in Iowa. Out of the firey blast furnace of this experience, Nollert's (and O'Rear's) considerable dramatic/comedic talents emerged. This extra-engineering talent became evident at the annual OU AIChE banquet this spring when Nollert and O'Rear recreated, with great verve and finesse, the highlights of some 50 hours of undergraduate intellectual insights revealed during the course of the trip.

Nollert married Diana M. Kiehl just weeks before coming to OU. They are anticipating the first addition to their family in February.

Professor Edgar A. O'Rear, III is traveling to Japan to spend a month working in the laboratory of Dr. Makota Kaibara, who is a senior research scientist at the Institute of Physical and Chemical Research-RIKEN. While in Japan, O'Rear will co-chair a session at the Eighth International Congress of Biorheology with Prof. Nobuji Maeda of Ehime University on "Membrane Skeleton of Red Cells and Deformability". O'Rear's technology of liposomal encapsulated streptokinase, developed in conjunction with researchers from the Departments of Biochemistry, Pharmacology and Medicine, has been licensed to the Liposome Company of Princeton, New Jersey. With colleagues from Physics, Chemistry and Electrical Engineering, O'Rear helped establish the Laboratory for Electronic Properties of Materials (LEPM) with more than $2 million in funding from the Oklahoma Center for the Advancement of Science and Technology, the National Science Foundation and the University of Oklahoma.

Professor John F. Scamehorn was named George Lynn Cross Research Professor by the OU Board of Regents in April '92. He is among the youngest of OU faculty to be so named. He and Jeff Harwell co-organized the 65th Colloid and Surface Science Symposium of the Colloid and Surface Chemistry Division of the American Chemical Society which was held at OU in June '91. Scamehorn was presented the American Chemical Society Service Award 1988-1992 for service to the Division of Industrial and Engineering Chemistry as membership chair of the Separations Science and Technology Subdivision. He chaired a session on "Interfacial and Surfactant Phenomena in Separations" at the National American Chemical Society meeting during August '90 in Washington, D.C. Scamehorn was elected in '91 as a member-at-large of the executive committee of the Surfactants and Detergents Section of the American Oil Chemists' Society for a three-year term.

Professor Robert L. Shambaugh directed the fourth annual meeting of the Center for Polymer and Fiber Research (CPFR) at the University of Oklahoma in October, '91. The center is an industry/academic consortium that involves OU and six large chemical companies. In addition to the basic research done under the auspices of the consortium, a number of sponsors including Dow, Conoco/DuPont and Kuraray have contracted for specialized research work in Shambaugh's laboratories. For example, Kuraray sent one of their researchers, Chiyoo Watanabe, as a visiting scientist in Shambaugh's laboratory for a two and one-half year period. In November '91, Shambaugh gave an invited lecture on his melt blowing process at the PIRA International Nonwovens Conference in Bordeaux, France. During the past three years, Shambaugh has had published a number of journal articles on characterization of melt blown fibers and evaluation of variables influencing the melt blowing process. During this period, he has served as CEMS' liason to graduate college in the process of graduate student recruitment.

Professor Kenneth E. Starling has served since fall '91as chair of OU's Council of Energy Center Fellows. The Council is composed of 13 outstanding faculty members selected on the basis of their work in energy-related fields. The Fellows are responsible for planning the Sarkeys Energy Center seminar series on energy issues and for promotion of Energy Center activities. Starling's principal research involves the use of multiproperty analysis in the equation of state and transport property correlation and the characterization and correlation of the thermo-physical properties of liquids and gases in coal conversion processes. His current research includes a study to increase the density at which natural gas can be stored at ambient temperatures and low to moderate pressures through the development of a new class of natural gas adsorbents. This research effort has direct impact on natural gas production, as both the economics of production of remote sources of natural gas and the efficient use of natural gas as a transportation fuel are affected by problems associated with liquified natural gas and compressed natural gas. Dr. Starling si involved in development of an international standard for large-volume gas metering, which will provide quick and efficient measurement for the gas industry. During the past three years, Starling has had projects well in excess of $900,000 funded by Gas Research Institute, the Department of Energy, and the Oklahoma Center for the Advancement of Science and Technology. Some of his current work in natural gas research is described in the natural gas research feature in this *OkChE*.

65th Colloid & Surface Science Symposium Hosted at OU by Institute for Applied Surfactant Research

The 65th Colloid and Surface Science Symposium of the Surface Chemistry Division of the American Chemical Society was organized and held at OU in June 1991, by CEMS professors John F. Scamehorn and Jeffrey H. Harwell, both founding members of OU's Institute for Applied Surfactant Research, the host organization. The symposium drew well over 200 technical paper and poster session presentations and was attended by more than 300 colloid scientists from all over the world.

As co-organizers, Scamehorn and Harwell had begun planning for the event, which was held at the Oklahoma Center for Continuing Education, five full years in advance. Others at OU lending their expertise to the event as session organizers were CEMS faculty Lance L. Lobban, Richard G. Mallinson and Edgar A. O'Rear, a founding member of IASR; Chemistry Department professor Sherril D. Christian, director of IASR; Robert Knox and David A. Sabatini of the School of Civil Engineering and Environmental Science; and Faruk Civan of the School of Petreoleum and Geological Engineering.

Other session organizers included T. Alan Hatton, M.I.T.; Robert Rowell and Bruce J. Marlow of the University of Massachusetts at Amherst; Elias I. Franses of the National Science Foundation; Duane Smith of the U.S. Department of Energy; Clarence Miller of Rice University; Kirk Raney of Shell Development Company; Paul Holland of General Research Corporation, Donn Rubingh of the Procter and Gamble Company; and Randall Hill of Dow Corning.

Symposium presentations were concentrated in sessions in surfactant-based separations, adsorption at solid interfaces, biomedical applications of surface and colloid science, colloid and interfacial aspects of groundwater and soil cleanup, enhanced oil recovery, surface science and catalysis, interfacial reactions, mixed surfactant systems, novel surfactants, polymer/surfactant interactions, and general papers.

Special plenary lecturers included Scamehorn and Harwell's doctoral committee chairman, Robert S. Schecter, Getty Oil Company Centennial Chair in Petroleum Engineering in the Chemical Engineering Department of the University of Texas at Austin. Schechter was one of the first to recognize the importance and the broad applications of colloid and interface science in chemical engineering and one of the first in academia to promote the concept of joint industry consortium/university research programs (like OU's IASR). Schechter has pioneered several commercially distributed instruments and processes and developed many concepts which have received world-wide acceptance in industry and academia. He presented the lecture, "Foams Formed by Capillary Phenomena in Porous Media".

Another special plenary lecture entitled "Scanning, Tunneling and Atomic Force Microscopy Characterization of Macromolecules", was presented by D. Fennell Evans, Director of the Center for Interfacial Engineering in the Department of Chemical Engineering and Materials Science at the University of Michigan.

A special component of the 65th colloid symposium was the first annual Henkel Corporation Research Fellow Lecture as a new annual feature. Maria Del Carmen Laso, a May 1992 Ph.D. graduate of the University of California at Berkeley, the first fellowship recipient, presented the plenary lecture "Modeling of Structure and Stability in Thin Micellar Films". Henkel Corporation made a major contribution of $20,000 toward general expenses of the event. David I. Devore of Henkel's Research and Development Division served on the steering committee of the symposium.

Another special plenary lecture, "Fracture of and Adhesion between Biological and Synthetic Macromolecular Materials", was presented by Antonios G. Mikos, a research associate at M.I.T. and recipient of the ACS colloid division's 22nd Victor K. LaMer Award which was presented at the symposium banquet. The award is given annually by the division for best thesis produced during the proceeding three-year period. Mikos completed the winning thesis at Purdue in 1988 under Professor Nicholas A. Peppas.

In addition to a large number of technical paper presentations made at the symposium by faculty, many OU graduate students in chemical, civil, environmental, and petroleum engineering and in chemistry presented papers and posters.

In addition to Henkel Corporation, Amoco Corporation and The Procter and Gamble Company contributed funds to sponsor the event. Corporations participating through instrument and literature exhibitions included Brookhaven Instruments, Cahn Instruments, Malvern Instruments, Inc., Matec Applied Sciences, Inc., Marcel Dekker, Inc., and PenKem, Inc.

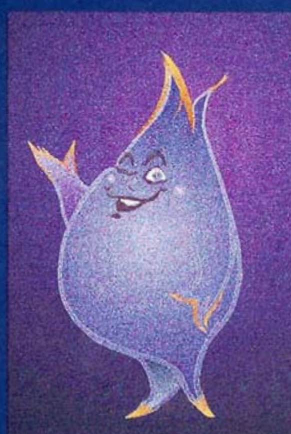
Kelvin Droegemeier, associate professor in the OU Meteorology Department and Deputy Director of the Center for the Analysis and Prediction of Storms, entertained and informed attendees at the symposium banquet with an after dinner presentation about the development of severe storms which included video animation of three-dimensional modeling of developing storms.

CEMS NATURAL GAS RESEARCH:

Engineering the Gas Industry for the 21st Century

Throughout its history, the School of Chemical Engineering and Materials Science (CEMS) at the University of Oklahoma has been associated with the Natural Gas Industry. In 1985 the OKChE Board (the CEMS board of alumni advisors) encouraged the School to make a new commitment to research in relation to natural gas. Members of the Board encouraged the School's commitment by raising nearly $200,000 to support the effort. Five companies, four industry-sponsored foundations, and two individuals joined in raising this amount.

Though not all of the plans made at that time have come to fruition, the alumni and industry support has helped catalyze a high level of activities and commitment to the Gas Industry in CEMS. Since 1985 CEMS faculty have received over $2M in funding for 21 projects related to the gas industry, have published 70 papers on gas-related research, have overseen the completion of 28 Masters Theses and Doctoral Dissertations on gas-related topics, and have presented components of this research in 33 presentations. This report provides an overview of these activities and others by faculty of the School.



The computer generated image on the facing page represents one concept for adsorptive storage of methane being explored in CEMS laboratories. This particular method of creating adsorbents from atomic clusters is being applied to forms of elemental carbon including Carbon C_{60} whose structure in outline form distinctly resembles a soccer ball. In this instance, adsorbents may be designed by utilizing C_{60}'s tendency to form solvates or clathrates. Such expanded C_{60} structures form single porous crystals exhibiting long range order lending analogy to zeolites and offering opportunity for tailored design of new adsorbents in a size range not presently achieved in industry. The drawing by Rick D. Wheeler is based on a schematic sketch by Jerry K. Newman, CEMS Graduate Research Assistant. Other methods of methane adsorption being explored such as use of surfactant bilayers are described on page 16.

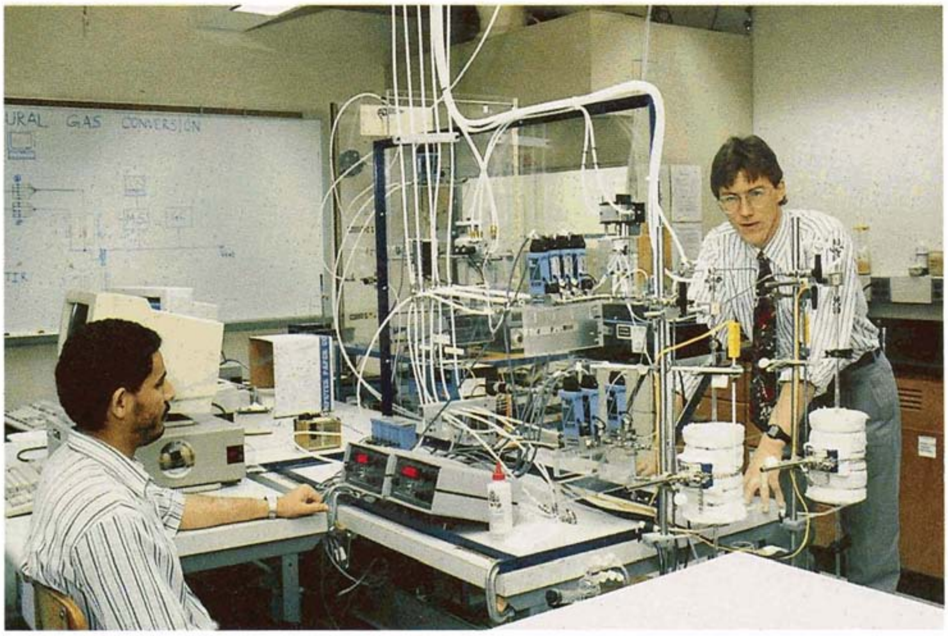
Catalytic Conversion of Methane to Ethylene

CEMS investigators are developing new catalysts and catalytic processes for the conversion of methane to the more valuable higher hydrocarbons ethylene and ethane. A number of catalysts have been identified which catalyze the oxidative coupling of methane to ethylene and ethane, but present yields from these catalysts do not justify commercialization. High selectivity has been achieved only at unacceptably low conversion levels, and increased conversion requires severe operating conditions which result in extensive nonselective oxidation of both reactant (methane) and products (ethylene and ethane) to carbon monoxide and carbon dioxide. Development of an economical process requires new catalysts with greater selectivity at high temperatures or with greater activity at low temperatures.

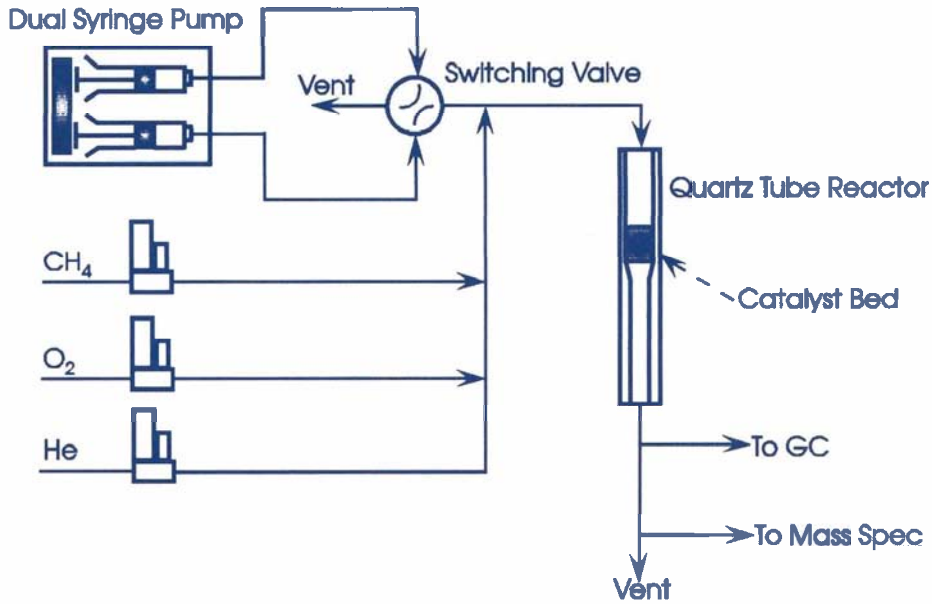
The potential economic impact resulting from commercial application of the results of this project are very significant. New conversion processes would produce a chemical feedstock of three to five times the value of the methane on today's market.

The worldwide demand for ethylene, a major petrochemicals and polymers feedstock, was over 100 billion pounds in 1986, and has increased by an average of 3.5% yearly since 1978. Processes which convert methane to ethylene for direct use or for further upgrading to higher hydrocarbons would stabilize and increase the demand for natural gas, directly increasing revenues to the industry. This would encourage further exploration for natural gas and would provide incentive for research into recovery techniques necessary to exploit 'deep gas', sour gas, and other presently uneconomical gas resources.

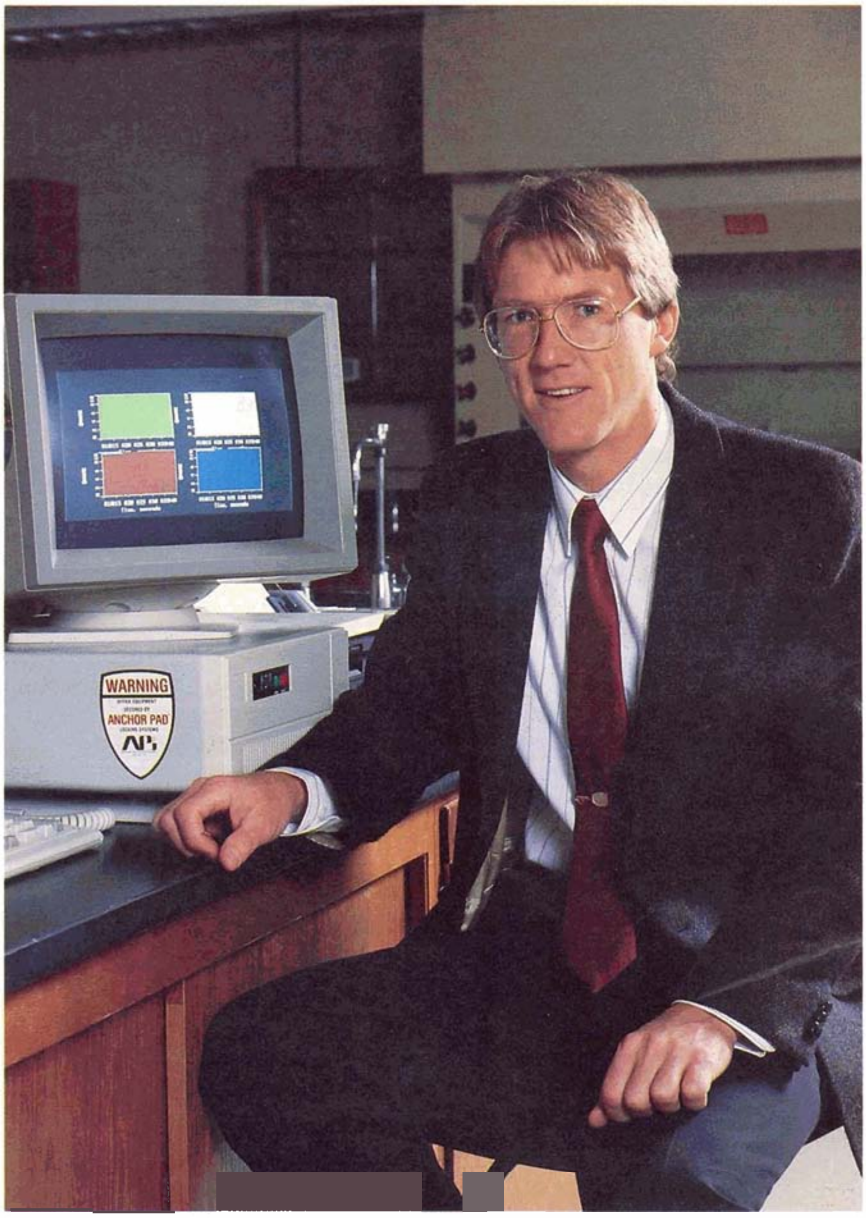
Development and implementation of small scale (e.g., skid-mounted) processes would have further economic impact. Presently a large number of natural gas discoveries are shut in or flared due to location. Development of small scale processes to produce easily-transportable liquid hydrocarbons would enable the exploitation of these significant resources and stimulate development of an industry for the manufacture of equipment for such processes.



Professor Lance L. Lobban and Ph.D. candidate Saaed Al-Zahrani with the experimental apparatus used to quantify reaction rates.

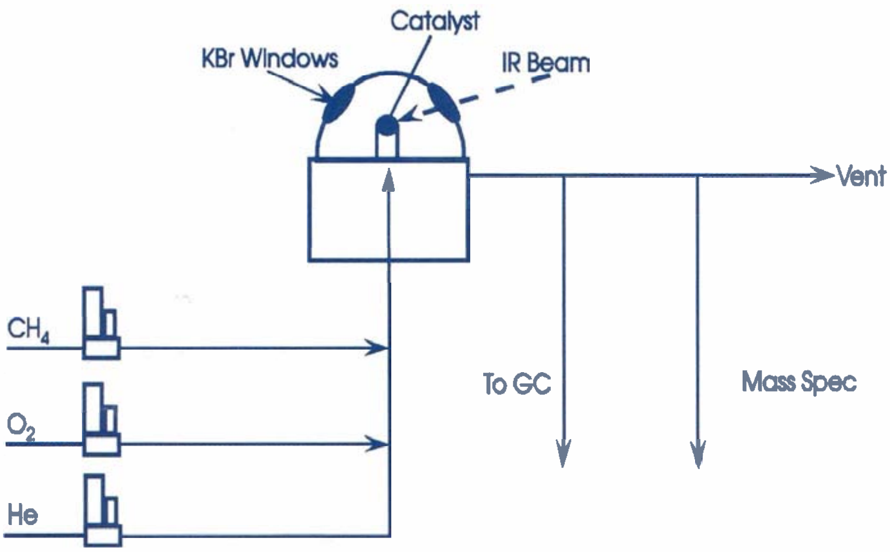


This figure shows the experimental apparatus used to quantify reaction rates. Most reactant gases are introduced as in the figure on page 11, but a dual syringe pump and switching valve allow very rapid interchange of two different gas streams, a technique that can yield valuable information. The reactor is a small quartz tube containing a small amount of catalyst. A temperature-controlled furnace is used to heat the catalyst to temperatures as high as 850° C. Product concentrations are determined using the GC and the mass spectrometer. From this information, the reaction rates can be calculated. In CEMS' experiments, investigators vary the reactant stream concentrations of methane, oxygen, carbon dioxide, and water in order to determine the dependence of the reaction rate on all these components. This information is necessary for reactor design and catalyst improvement.



L A N C E L. L O B B A N

To develop new catalytic processes, investigators Lance Lobban, Rick Mallinson and Billy Crynes, with sponsorship from the Oklahoma Center for Advancement of Science and Technology, are directing research addressing two specific objectives. The first objective is a better understanding of the reaction mechanisms governing the oxidative coupling of methane over heterogeneous catalysts. With understanding of the specific elementary steps leading to the coupling of methane, and of the steps leading to nonselective oxidation to CO and CO_2, the investigators will be better able to identify characteristics of the catalysts and the catalytic reactor operating conditions which promote the first path while inhibiting the second. Present knowledge of the mechanisms is insufficient for this purpose. The second objective is the development and testing of the new catalysts, and specification of (if necessary) innovative reactor design and operating conditions. A two-pronged investigation is being conducted consisting of formulation, characterization, and evaluation of new catalysts, combined with an ongoing study of the reaction mechanisms utilizing transient and isotopic techniques which have not been applied to this problem. A third, longer-term objective which will affect the research is the large and small scale implementation of the new catalytic processes. The final task of the research will be the development of the possible reactor configurations for these implementations.



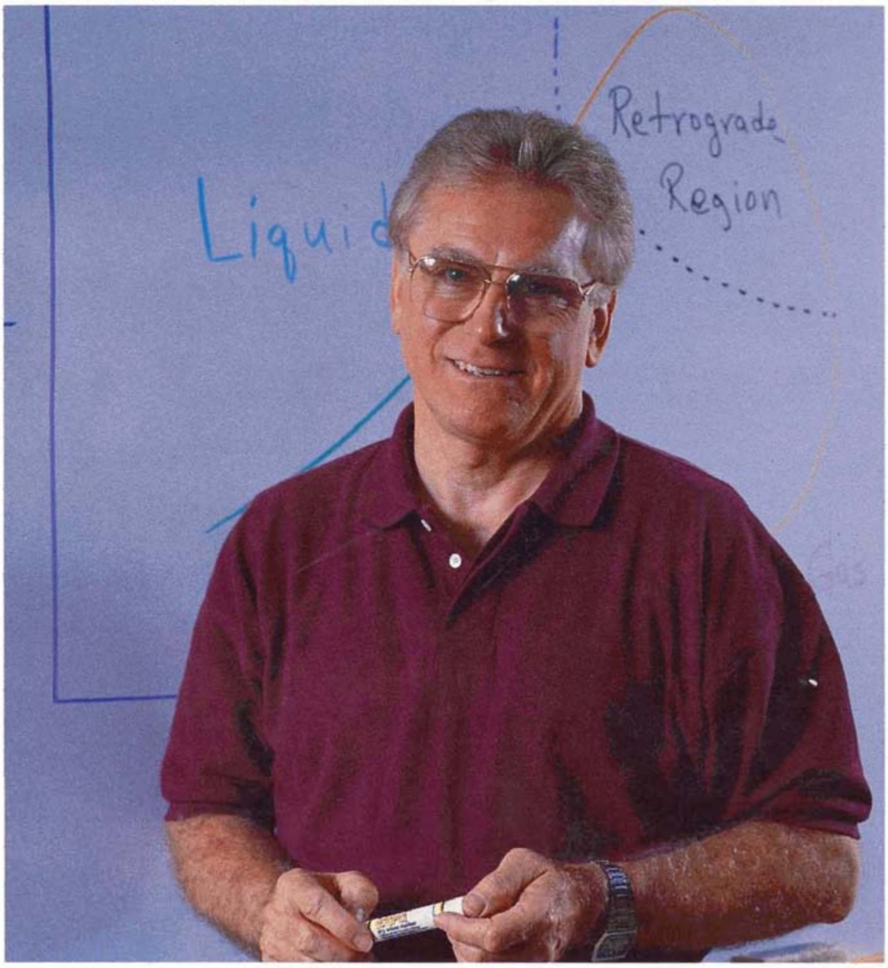
This figure shows the experimental apparatus used to observe reactions on the catalyst surface using Fourier transform infrared (FTIR) spectroscopy. The flow rates of the reactants methane and oxygen and the carrier gas helium are set using computer-controlled mass flow controllers. The catalyst is placed in the catalyst holder directly in the infrared beam path. The catalyst holder can be heated to 720 °C. IR radiation that reflects from the catalyst surface is collected by parabolic mirrors and focused on a detector. The amount of absorption of the IR radiation at varying wavelengths identifies the reactant and product species adsorbed to the catalyst surface, which helps identify steps in the complicated reaction mechanism. Product gases are also sampled using a gas chromatograph (GC) and a mass spectrometer to measure reaction rates.

Equation of State Development for Natural Gas Mixtures

This project, under the direction of George Lynn Cross Research Professor Ken Starling, is providing recommended methods to compute high accuracy, super-compressibility factors and natural gas densities for natural gas custody transfer and other gas measurement applications. Two compressibility factor methods are developed. The choice of method depends upon the application and the gas characterization information available to the user. The resulting methods are a further development of the previous standard, known as the AGA 8 equation. This research has been sponsored by the Gas Research Institute.

One method applies a detailed knowledge of natural gas composition as input to compute the compressibility factor (i.e. using standard composition information from a chromatographic analysis of natural gas). This method is referred to as the "*Detail Characterization Method.*" A second method applies an aggregate or gross knowledge of natural gas composition (given by heating value and/or gravity, and diluent content information on a natural gas) to compute the compressibility factor. This method is referred to as the "*Gross Characterization Method.*" Gross composition information can be applied within a limited range of natural gas composition (i.e. pipeline quality gas) by measuring natural gas gravity, heating value and diluent content.

Both the *Detail Characterization Method* and the *Gross Characterization Method* provide highly accurate calculations of natural gas compressibility factors, supercompressibility factors and densities; provided the calculations are made within the range of applicability of the equations and the user input information is accurate. On the average, values of volumetric properties calculated from the two methods differ by less than 0.01% in the usual custody transfer region. This region of agreement conservatively covers pressures up to 10 MPa (1450 psia) and temperatures between 0°C and 55°C (32°F and 130°F). It encompasses high methane content natural gases (i.e. greater than ninety percent methane with a typical gas industry pipeline compositions).



KENNETH E. STARLING

Electric Field Conversion of Methane To Higher Value Products

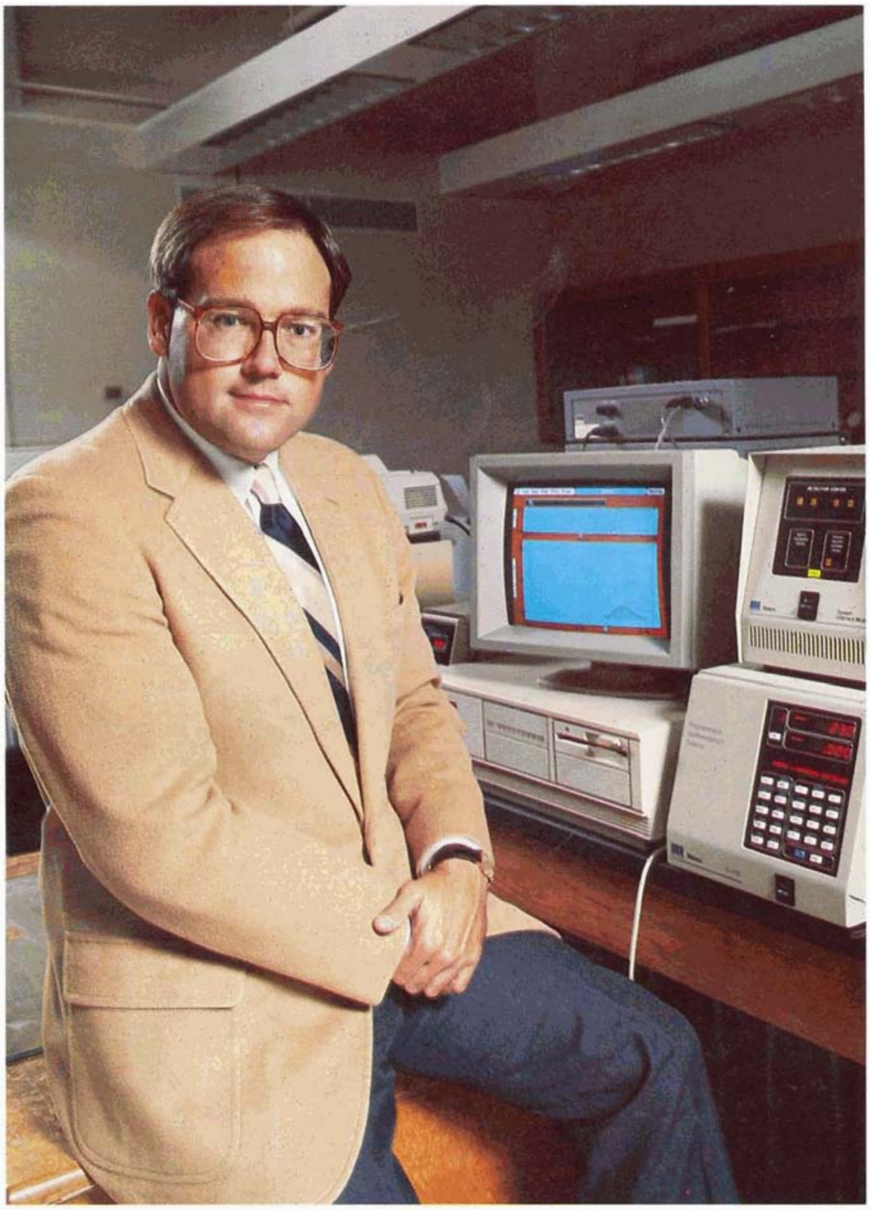
Economical conversion of natural gas to higher value products remains an elusive goal despite considerable research interest and effort for the past several years. For a number of reasons, the conversion techniques currently being considered have experienced only incremental improvement, in large part because the processes involve high temperature activation of methane. At high temperatures, unwanted gas phase reactions decrease the yield of the valuable products. The objectives of this are the study and development of two novel technologies for the conversion of methane to higher value products. These techniques are electric field conversion and electric field-enhanced catalytic conversion. The unique feature of these conversion techniques is that the methane molecule is activated at low temperature, avoiding the unfavorable gas phase combustion reactions.

This research, directed by Rick Mallinson, Lance Lobban and Cheddy Sliepcevich, has several major objectives. They are determining the relationship of conversion, selectivity, and electrical power consumption to the feed composition and system operating variables in order to determine optimal operating conditions. They will then construct and operate chemical reactors to determine the optimum reactor geometry for the above parameters, particularly the effect on power consumption at given levels of conversion as well as the effects on product selectivities. They are also developing and testing catalysts which show enhanced activity and/or selectivity in the presence of electric fields. They will then examine a number of other process operations and configuration variables to allow development of appropriate process flowsheets. After this, they will then be in a position to conduct preliminary and detailed economic analyses for various commercial operating scenarios.

The conversion processes have potential commercial application on both a large scale and asmall scale, and the potential economic impact resulting from commercial application of the results of this project are very significant.

For example, two potential products are methanol and ethylene, petrochemical feedstocks for which there is a tremendous worldwide demand. These chemicals are readily converted to gasoline range components for use as liquid fuels or fuel additives. The potential market for alternate fuels and fuel additives in the United States alone is many times greater than the existing worldwide capacity. Large-scale implementation of these processes would add significant value to natural gas resources as well as stabilize and increase the demand for natural gas.

Development and implementation of small scale (e.g., skid-mounted) processes would have further economic impact. Presently a large number of natural gas discoveries are shut in or flared due to location; small scale processes to produce easily-transportable liquid products would enable the exploitation of these significant resources as well.



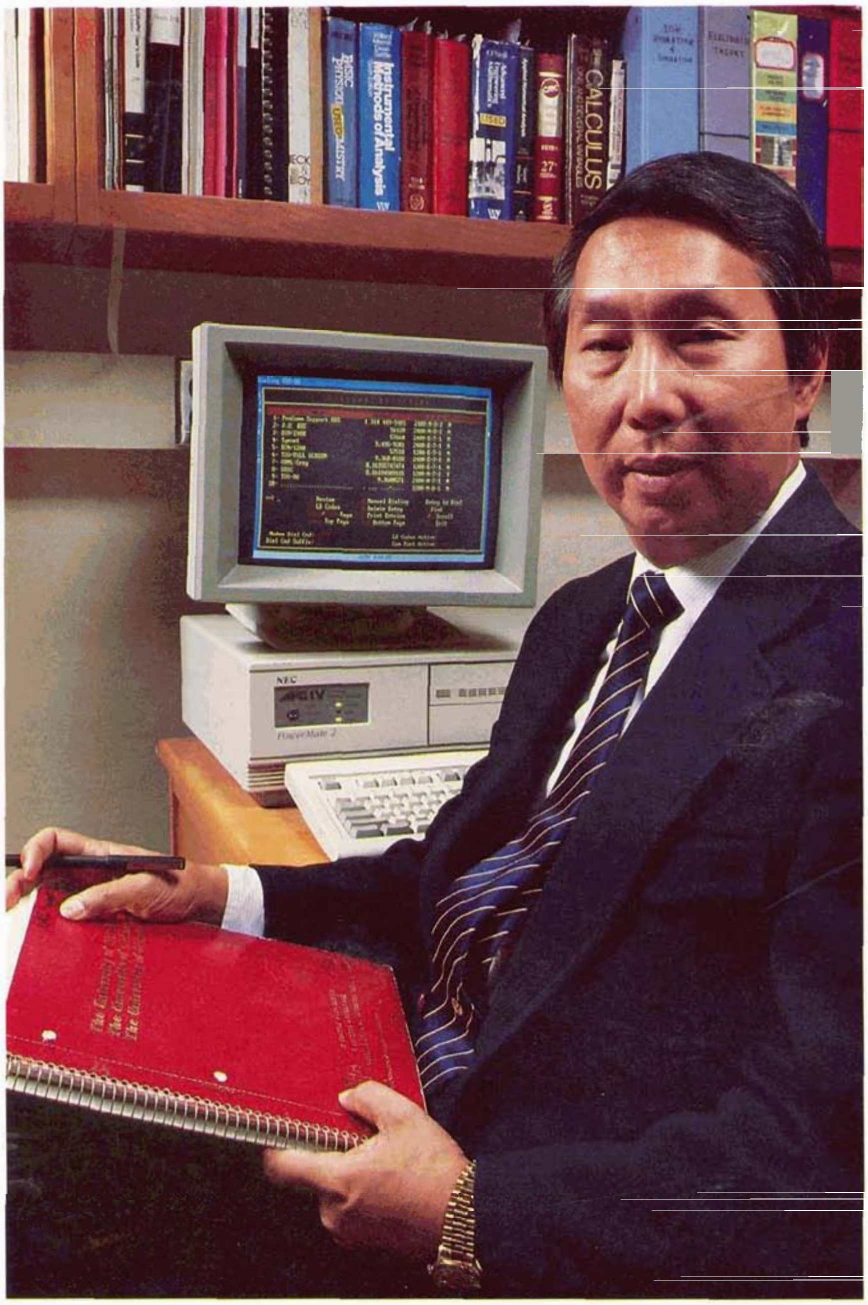
RICHARD G. MALLINSON

Working Fluids for Sorptive Refrigeration Systems

The objectives of this project are to provide correlation of the thermodynamic solution properties for advanced working fluids in adsorption cycles, and to generalize, based on the landmarks achieved, to aqueous amine mixtures for gas sweetening operations. Benchmark experimental data are to be taken for verification. The results will support the characterization and screening of working fluids and optimization of process operations in this project, directed by Lloyd Lee with sponsorship from the Gas Research Institute.

The advanced working fluids are electrolyte solutions. These fluids have taken on a sense of urgency for the air-conditioning and refrigeration industry as the chlorofluorocarbons are being phased out due to environmental damages. In absorption units, salt solutions are near their saturation limits. Thus a scheme valid for concentrated solutions is needed. We adopt the mean spherical approach (MSA) in molecular thermodynamics for finitely sized ions in this work. This approach accounts for the ion size effects on solution properties in addition to the valence and dielectric effects. Thus it is suitable for high concentration mixtures.

The project has successfully developed the properties packages for aqueous and ammoniac working fluids for single and double effect absorption cycles. Studies are commencing on mixed-solvent solutions: such as water-methanol-LiCl and other water-ammonia water-amine solutions. To accomplish this we utilized three pieces of theoretical software: the Gibbs-Duhem relation, the MSA for electrolytic effects, and Furter's relative volatility ratio on solvation. We could predict the ternary mixture properties to within 0.01 in mole fractions and 5 mmHg in pressure for salt concentrations from 10 to 15 molal. On the experimental side, ARMINES (in France, under the direction of Henri Renon) has carried out kinetics measurements on absorption of CO_2 in amine (MDEA) solutions. Our next goal is to apply group contributions method to these amine solutions.



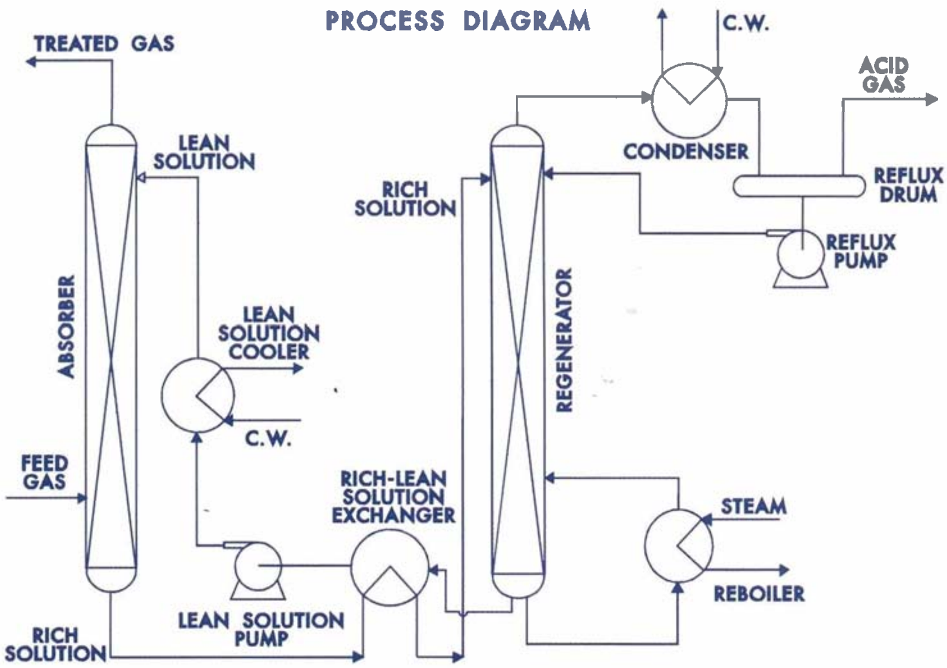
Professor Lloyd L. Lee has conducted a number of research projects totalling more than $1.5 million from agencies including the National Science Foundation, U. S. Department of Energy, Gas Research Institute, Oak Ridge National Laboratory and the American Gas Association in development of integral equations, perturbation theories and computer simulations. Lee has authored more than 60 major publications, including a recent book, Molecular Thermodynamics of Nonideal Fluids.

LLOYD L. LEE

Gas Sweetening

The objectives of this project are to provide accurate correlations of the thermal, phase, and solubility properties of the amine solutions in natural gas sweetening operations. This research will interact with the kinetics, mass transfer, and experimental studies and is also sponsored by the Gas Research Institute under the direction of Lloyd Lee.

An acid gas treating plant using aqueous amines as solvent consists, for the major part, of an absorber where acid gas is "cleansed" of its CO_2 and H_2S contents, and a regenerator where the richly laden amine is "stripped" clean of acid gases for recycle. Problems encountered during operations are that the regeneration requires energy inputs to strip off the acid gases and amines are lost due to carry-over and formation of heat-stable salts. Equipment is also subject to corrosion due to high ionic strength electrolytes. Sweet gas must meet environmental limits (< ~ 4 ppm H_2S). Also, aromatics should not be released from the regenerator. An increasing number of amines (alkanolamines, hindered amines) are available and are vying for the markets. What is the best choice for a given treatment is an open question.



The process diagram above shows the flow diagram of an acid gas treatment plant using aqueous amines as solvent. It consists for the major part of an absorber where acid gas is "cleansed" of its CO_2 and H_2S contents, and a regenerator where the richly laden amine is "stripped" clean of acid gases for recycle.

The solution of amines in water with acid gases forms a mixture rich in species. It requires the most powerful solution thermodynamics techniques to treat ionic solutions, polar fluids, hydrocarbons, and salts, all in one mixture. Lee divides the theoretical approach into two major parts: (i) group contributions method for polar multigroup species, and (ii) ionic mean spherical approach (MSA) for charged species with Coulomb forces. All are integrated in an interaction-site model for molecules, whereby a solution of large molecules of many chemical species is decomposed into a "solution of groups" consisting of segments of their functional moieties. A statistical mechanical theory of interaction-sites is used to determine the structure and energy from group interactions.

Lee and his colleagues have applied the RISM* (reference interaction site method) integral equations to the calculation of the structure and energy properties of TMA (trimethylamine), TEA (triethanolamine), and MDEA (methyldiethanolamine). By a judicious choice of the functional groups, they were able to reproduce the enthalpies of vaporization for these amines. It also pointed out the needs for more accurate and complete thermal data for these amines since they obtained the enthalpies from the Clapeyron equation, differentiating very small (0.001 psia) experimental vapor pressures. There might be numerical errors in the differentiation. It would be better to have direct calorimetric measurements of the enthalpies for pure amines. The RISM results will then be used to determine the group contributions for energy. They will then completely reformulate the conventional UNIFAC approach and base it on more rational grounds.**

The order of attack is to start the characterization of (i) pure amines, then go on to (ii) aqueous amines, then (iii) aqueous amines + H_2S and CO_2, and finally to (iv) aqueous amines + acid gases + other components that are encountered in acid gas treating.

The group contribution method in solution thermodynamics looks promising for correlating the internal energies of pure amine species. The advantages of the group contribution method are its generality for mixtures, not only for the amines studied, but also for other types of amines (primary, secondary, and hindered amines consisting of assemblages of many functional groups).

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* *A statistical mechanical theory for structured molecules.*

** *A molecular basis.*

Adsorptive Storage of Natural Gas

Natural gas is a very attractive transportation fuel. Because it burns cleanly, it is very low in polluting emissions. Because a large domestic supply exists, it could substantially reduce U.S. dependence on imported petroleum. Compressed natural gas (CNG) is already in widespread use as a transportation fuel. There are two major drawbacks to CNG, however. First, CNG has a low energy storage density relative to liquid fuels; this means that CNG fuel tanks must be replenished frequently, dramatically cutting the trip-radius for CNG-fueled vehicles. Secondly, CNG requires storage pressures on the order of 3000 psi, which therefore requires heavy storage vessels, so as a result, much of the energy from CNG fuel is spent transporting the fuel vessel itself. These considerations have hindered the general acceptance of natural gas as an alternate fuel.

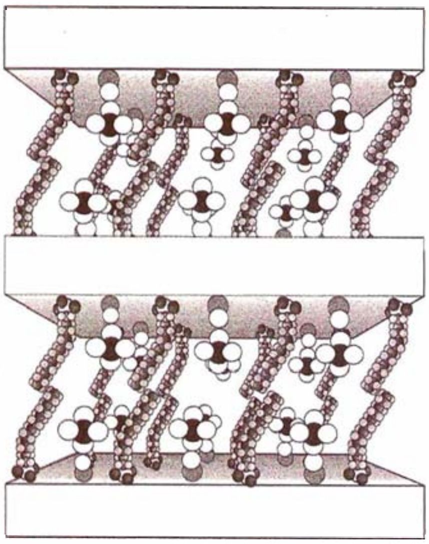
Because the critical temperature for methane is far below ambient temperature, methane can be stored at liquid densities only as a cryogenic fuel. While this is technically feasible, it raises other serious considerations. An alternative, non-cryogenic way of increasing the storage density of natural gas is to adsorb it on a high surface area adsorbent, such as micro-porous activated carbon. The use of microporous activated carbon does yield a slight increase in storage density over that of CNG, on the order of 10%. The major problems with carbon adsorbents are that only a monolayer of methane can be adsorbed onto the carbon, so that the volume of the macropores is essentially at the same gas density as CNG.

Researchers at OU (directed by Jeff Harwell and Ken Starling) have sought to overcome this problem by two routes: 1. Using adsorbed surfactant layers to increase dramatically the apparent microporous surface area of an adsorbent, and 2. Creating adsorbents from atomic clusters of polar materials to achieve adsorptions greater than a monomolecular layer while still having very high microporous surface areas.

This research project is less than two years old and is primarily experimental. Initial attempts to dope silicas and carbons with ionic surfactants showed promising interactions between the surfactants and the methane, but did not produce commercially interesting adsorbents. Based on revised hypotheses concerning the surfactant/methane interactions, new classes of surfactants and adsorbents are currently being pursued. Research on several new adsorbents based on new technology for making atomic clusters and for converting these clusters into adsorbents is also underway.

This project has been funded for three years by the Oklahoma Center for the Advancement of Science and Technology.

A variety of methods of adsorption of natural gas are being studied for improvements in packing densities in CEMS labs. Professor Jeffrey H. Harwell, left, and Ph.D. candidate Jerry K. Newman test amounts of adsorption on materials in the device in the foreground. The cylindrical device in the background is being tested as a unit for continuous process manufacture of C_{60}, a material with potential for making clathrates for methane adsorption.



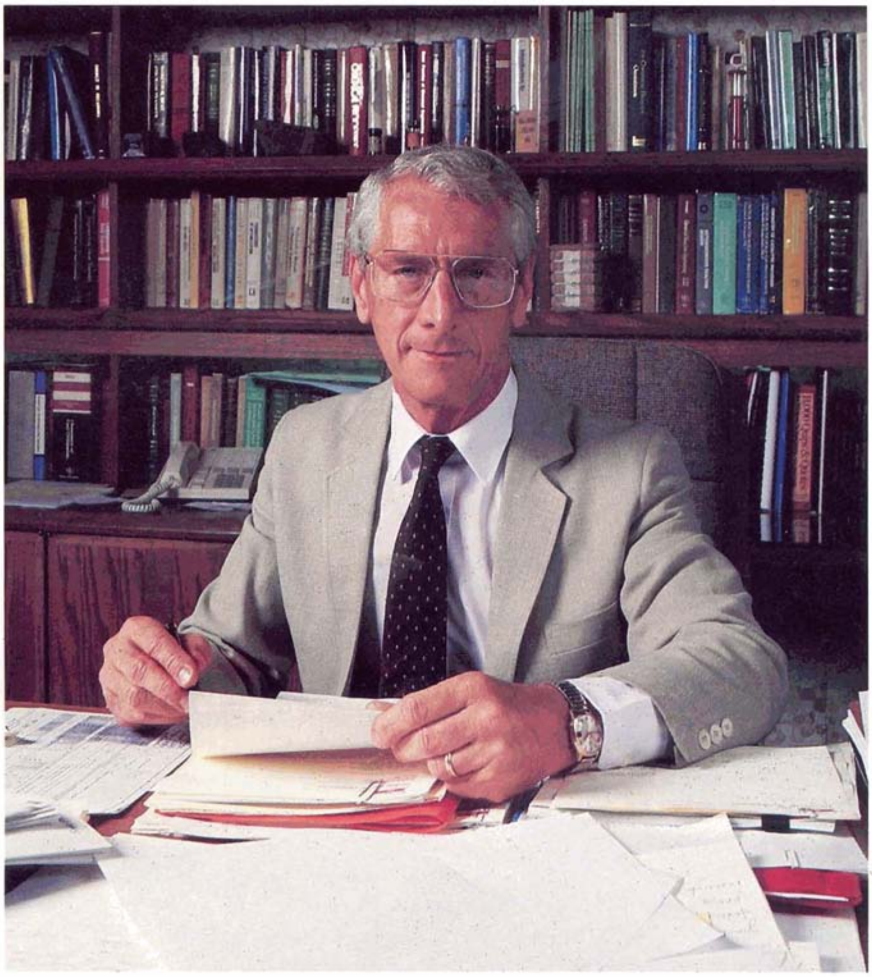
The figure at right represents a structural model of a microporous material modified by adsorption of a surfactant bilayer. In this case, a two-dimensional bilayered γ-zirconium phosphate has been pillared with surface active molecules creating an alternating structure of bilayers with ZrO_6 layers. Such structures lend analogy to zeolites, but with the added opportunity for tailoring porosity by varying pore size.

Hydrocarbon Pyrolysis

The development of a better understanding of thermal chemical conversion (maturation) of petroleum precursors, petroleum, and natural gas has significant potential for improving the characterization and development of such resources as well as for the conversion of the resources into higher value products, thus enhancing recoverability. To this end, this project continues the development of existing models and is developing new models for detailed chemical kinetics of hydrocarbon pyrolysis. The project has several objectives. Of particular interest in this study is the effect of pressure on the conversion products as well as the effects of non-hydrocarbon coreactants, such as water, CO_2, O_2 and H_2S. Specific tasks of this modeling project are the study of butane pyrolysis as a model for thermal transformations of kerogen and oil to gas under geochemical conditions. Progress towards completion of these tasks will provide a basis for development of experimental programs for verification of the modeling results and process development, where needed.

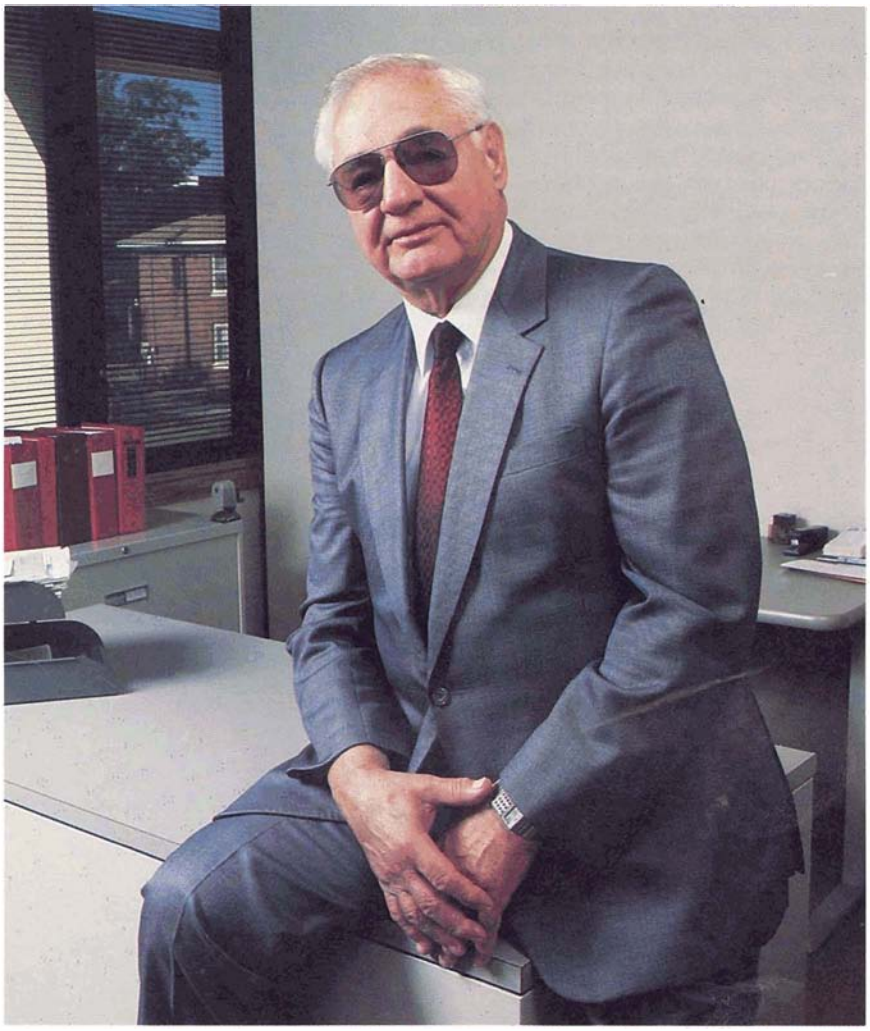
A detailed free-radical kinetic model has been developed to represent the pyrolysis of n-butane and has been used to study the role of pressure on the pyrolysis. The temperature range covered is from 200 to 600°C with pressures from 1 to 1000 atm. Simulations were conducted for isothermal, isobaric, homogeneous systems with pure n-butane as the initial reactant. At high temperature, increasing the pressure increases the decomposition rate of butane, as well as increasing the breadth of the carbon number distribution and decreasing the olefins content. Model results agree well with the literature. At low temperature, the rate of decomposition of butane is inhibited by increasing pressures until relatively high pressures, above 100 atm, when the rate increases with higher pressures. Increased pressures at lower temperatures also favor larger products and fewer olefins, but different mechanistic pathways control the decomposition.

Even though the present version of the kinetic model omits potentially important effects of minerals, heteroatoms, labile hydrogen donors, carbon residue, and organometallics that would be present in most real subsurface petroleum environments, results, so far, clearly indicate that the extrapolation of the pressure dependence of other pyrolysis models from high to low temperatures may be substantially in error. Current work under the direction of Rick Mallinson is to incorporate the complicating effects mentioned above as well as to develop simplified models which will be useable in reservoir modeling programs. The research is being conducted with the sponsorship of the U.S. Bureau of Mines. Modeling of hydrocarbon pyrolysis and surface effects during pyrolysis of hydrocarbons are the special areas of interest of Billy L. Crynes, Professor of Chemical Engineering and Dean of the College of Engineering, who has conducted research totalling more than $1.3 million in energy-related projects, primarily in this area.



B I L L Y   L.   C R Y N E S

Sliepcevich Professorship Endowed by OkChE Alumni and Friends



CEDOMIR M. SLIEPCEVICH

The Norman Transcript,

Friday, February 14, 1992

"Endowed OU Professorship Honors Sliepcevich"

Alumni and corporate friends of the University of Oklahoma School of Chemical Engineering and Materials Science have funded an endowed professorship to honor C. M. "Cheddy" Sliepcevich, Professor Emeritus of Chemical Engineering.

More than 80 colleagues, friends and former students joined with 11 corporations in raising a $250,000 endowment, which was matched by the State of Oklahoma to create the $500,000 C.M. Sliepcevich Professorship in Chemical Engineering.

Sliepcevich retired in May 1991 as George Lynn Cross Research Professor of Engineering after 36 years of research, teaching and administration.

Establishment of the C. M. Sliepcevich Professorship in Chemical Engineering was undertaken by OKChE, the college's alumni support group, as a three-year fund-raising project in conjunction with OU's Centennial campaign.

The funds raised to create the endowment to support the Sliepcevich professorship are invested and managed by the OU Foundation Inc. The principal sum will remain intact with only the income from the investment used to support the professorship.

Sliepcevich was born in 1920 in Anaconda, Mont., the son of immigrants from Hercegovina, now part of Yugoslavia. His parents taught their three children to love and value education and, as a result, Sliepcevich has devoted his life to teaching engineering and to improving the world through technology.

He attended Montana State College in Bozeman from 1937 to 1939, then transferred to the University of Michigan, where he received his bachelor's, master's and doctoral degrees in chemical engineering.

Shortly after completing his undergraduate degree, Sliepcevich began a long list of "firsts". Early in '42, he undertook the first electron microscopic study of crystals of hydration from Portland cement, contributing to improved concrete formulations for the construction industry.

During this period, he worked on a number of classified defense research projects that contributed to the success of the Allies in World War II, including work on generation and maintenance of screening smokes, development of proximity fuses, and heat transfer studies related to the development of processes for producing enriched uranium at the Oak Ridge nuclear facilities.

In his doctoral research, Sliepcevich pioneered the design of equipment for carrying out chemical reactions at high pressures and high temperatures. In subsequent work in the lab and in development of industrial processes, he made important contributions to the understanding of high-pressure technology, reaction kinetics and catalysis. The magnitude and quality of these contributions ultimately led to his selection as the recipient of the American Chemical Society's International Ipatieff Prize in 1959.

Sliepcevich began teaching as a graduate assistant at the University of Michigan and was appointed assistant professor of chemical and metallurgical engineering there in 1948. While there, he pioneered with G.G. Brown the development of a generalized system approach to thermodynamics that is widely used today in the teaching of thermodynamics to engineering students around the world.

With his graduate students, he developed laboratory facilities and programs that permitted them to conduct classical experiments in light and energy scattering, which in turn led to fundamental extensions in the theory of energy scattering.

These experiments constituted one of the first applications of high-speed computers for nonmilitary, scientific research and resulted in three widely acclaimed volumes on the mathematics related to light and energy scattering. This work was cited in his selection for the 1958 Curtis McGraw Research Award of the American Society for Engineering Education.

Another Sliepcevich "first" in the late '40s was the initiation of one of the first programs in bioengineering in this country.

The program resulted in development of the earliest clinical artificial kidneys and the techniques for using streaming potential to measure blood flow in remote portions of the body. This was part of the body of work that led to the development of modern hemo-dialysis technology.

Sliepcevich came to OU in February 1955 as professor and chair of the School of Chemical Engineering. From 1956 to 1962, he served as associate dean of the College of Engineering. His leadership in research, graduate study, accreditation, and faculty recruitment and development revitalized the college. Based on his conviction that the traditional engineering disciplines had much in common, he implemented the undergraduate core curriculum concept in the college, in which some 70 percent of all course requirements for all engineering programs were effectively identical.

The concept better prepared the student to cope with rapidly advancing technology and permitted optimum use of university resources. The initiation of the core curriculum concept led to development of a flexible curriculum in general engineering that met the full requirements of ECPD accreditation while allowing tailoring of individual programs to meet background and career goals of students.

Under his leadership, the college created a graduate program that cuts across disciplines within and outside of the College of Engineering. These contributions to engineering education earned him the American Society for Engineering Education's George Westinghouse Award in 1964.

During this period, Sliepcevich was instrumental in the rapid growth of the Research Institute – now the Office of Research Administration – and led OU to the forefront among universities in the use of digital computers. While fostering conditions for broader and deeper research universitywide through the institute, Sliepcevich served as principal investigator for contracts and grants in excess of $3.5M.

In 1963, he relinquished administrative responsibilities to devote full time to research and teaching as a George Lynn Cross Research Professor of Engineering – the youngest person to receive this distinction.

By the time of his retirement in 1991, he had directed 67 Ph.D. students, one doctor of engineering and 29 M.S. degrees. At OU alone, he had directed 52 Ph.D.'s, one doctor of engineering, and 27 master of science degrees.

While at OU, Sliepcevich developed the Process Control, Cryogenics and High Pressure laboratories and the Flame Dynamics Laboratory, which has become internationally recognized for its significant contributions to fire research. The lab played a major role in evaluating the escape worthiness and occupant survival factors in automobiles and buses.

He has published more than 165 technical papers in energy scattering, high-pressure reaction kinetics, flame dynamics, heat and mass transfer, extractive metallurgy, and desalination. He currently serves on the National Research Council Committee on Pipelines, Land Use, and Public Safety.

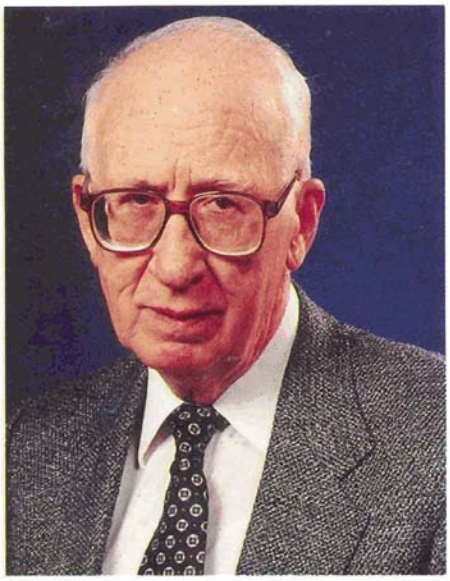
In addition to his academic activities in research and teaching, Sliepcevich has maintained an active consulting practice. Through his work with Chicago Stock Yards and Continental Oil Co., he managed and pioneered the research, development and implementation of the first commercial process for liquefaction and ocean transport of liquefied natural gas.

For his pioneering research in LNG technology, which became the basis for a multibillion-dollar industry, Sliepcevich received the 1986 Gas Industry Research Award given by the American Gas Association Operating Section. The "Father of LNG," as the association referred to him at the presentation, accepted the award at the 1986 annual AGA meeting in Seattle. The award, sponsored by Sprague Schlumberger, honors high scientific achievement in research representing a significant contribution of lasting benefit to the gas industry.

His numerous awards include the William H. Walker Award from the American Society of Chemical Engineers, Oklahoma Academy of Sciences Award of Merit, the University of Michigan's Sesquicentennial Award for Distinguished Alumni, and OU's Distinguished Service Citation. In 1972, he was elected to the National Academy of Engineering, and in 1974, he was inducted into the Oklahoma Hall of Fame.

When he retired from OU, members of Sliepcevich's research group and support staff gathered at his house for a dinner in his honor. His wife Cleo (standing, right), whose talent as a gourmet cook has been known by many CEMS graduate students welcomed into the Sliepcevich home during holiday breaks, created the special dinner. Tom Sciance, at left, presented Sliepcevich with a gift from the group.

A Brief History of Natural Gas Engineering at the University of Oklahoma



By F. Mark Townsend

Instruction in natural gas engineering began in 1924 at the University of Oklahoma when the first three-day session of the Southwestern Gas Measurement Short Course met on campus at Norman, Oklahoma. The course had been proposed earlier by Mr. W. H. Crutcher, then chairman of the Oklahoma Utilities Association. He suggested that the school be sponsored by the Association and the Oklahoma Corporation Commission in cooperation with the College of Engineering. The purpose of the school was to obtain a better understanding of the problems of gas measurement and to promote improved practices in the gas fields.

Sixty persons attended the first Short Course. The meeting was an outstanding success; since then it has met annually in April at the University of Oklahoma except for one year during the depression of the thirties and one year during World War II.

At the time of the first meeting, the natural gas industry had been passing through trying times, but was just beginning to reach the potential offered by construction of the first major pipe line during the period 1926-1929. The Monroe gas field in northern Louisiana had been discovered in 1916 but public confidence in the gas industry was so low that for nearly a decade the magnitude of this long-term gas reserve was not recognized and virtually all production was consumed by carbon-black plants. Then in 1926 the Interstate Gas Pipe Line Company built the first modern pipe line from Monroe to New Orleans. Other large diameter pipe lines were then built from Monroe to serve St. Louis, Memphis, Atlanta, Shreveport and smaller towns enroute. Gas pipe line promotion flourished during these boom years but this activity came to an abrupt halt with the market crash of 1929.

Lean years then came to the natural gas industry. Pipe line capacity vastly exceeded demand because purchasing power disappeared from the areas serviced by the gas lines. Many pipe line companies went into receivership, but the surviving companies continued their development work. Deep drilling techniques led to the discovery of important gas condensate reserves which had no market for the gas in the Southwest. Severe economic pressures led to development of gas cycling techniques and high-pressure gas processing to recover hydrocarbon liquids from gas which was recycled to the field for storage until needed later in the gas market.

This was the condition of the gas industry when the degree of Natural Gas Engineering was offered at OU in 1932. Professor William H. Carson, who assumed leadership of the Short Course in 1926, now took leadership of this program.

In the late thirties the United States

Laurance Reid Gas Conditioning Conference

The 42nd annual meeting of the Laurance Reid Gas Conditioning Conference was held on the OU campus March 2-4, 1992. With 250 participants, this conference remains the premier annual event for exchange of information on the latest developments in the field of gas conditioning. "Gas Conditioning", a term coined by Professor Reid refers to processes for removal of all types of contaminants in high pressure gas.

The Gas Conditioning Conference, organized by Professor Reid in 1951 and under his personal direction for many years, is now administered by an Advisory Board. Most of the board members are gas industry representatives who have participated in the conference over a period of many years.

After Professor Reid's death in 1986, the Advisory Board requested that a member of the CEMS faculty serve on the board to assure continued University support and involvement in the activity. Dr. Ray Daniels is our representative on the Advisory Board.

defense program began to develop a need for greater energy and so awakened the slumbering giant gas industry. The growth rate exploded and continued to grow during the years of World War II. Cross-country pipe lines were constructed to transport natural gas to virtually every part of the United States.

In 1950 representatives of several major gas companies asked that the Natural Gas Engineering curriculum at the University of Oklahoma be updated to conform to current practices and to fulfill the needs of the post-war industry.

This revision was effected and introduced in 1951. Professor Laurance S. Reid had been the driving force behind the program and was appointed chairman. He was ably assisted by Professor R.L. Huntington of the School of Chemical Engineering.

In 1956 the School was denied further accreditation by the Engineering Council for Professional Development, claiming that the curriculum was too specialized and should be an optional curriculum in chemical or petroleum engineering.

However, the School was allowed to continue until those in the program completed their studies. At this time Professor Reid took a leave of absence and Professor F. Mark Townsend was appointed chairman. He continued in this capacity for four years.

In 1960, Professor John M. Campbell, Chairman of Petroleum and Geological Engineering, received permission to offer the Natural Gas Engineering degree as an option in Petroleum Engineering. Professor Reid returned from his leave of absence in 1961 and taught those Natural Gas Engineering classes.

The Natural Gas Engineering Program at the University of Oklahoma has served the natural gas industry by staging two outstanding conferences each year, the Short Course has continued to emphasize gas measurement, flow rate and pressure control. When the energy crisis began in 1972, increasing amounts of petroleum liquids were imported and it became apparent that better measurement practices were of paramount importance. A decision was made to change the name to the International School of Hydrocarbon Measurement and to expand the format to include measurement and handling of all petroleum fluids ranging from liquefied natural gas (LNG) to tarsand slurries. The response to these expanded offerings has been tremendous and registrants from many other nations have attended. The School is comprised of a three-day series of lectures, approximately 156 in number, and an extensive exhibit by 60 manufacturers. Exhibitors teach the application and performance capabilities of their equipment on display.

The second outstanding conference program is the Gas conditioning Conference. This Conference grew out of a lecture sponsored by the American Chemical Society held at the University of Oklahoma in January 1951. The featured speaker was Dr. Donald L. Katz; his subject was "Gas Hydrates". There was such an enthusiastic response from gas industry members attending that an informal meeting that evening asked that the program be continued the next year. It was continued through the 1953 meeting. In that meeting, it was decided to change the name to the Gas Conditioning Conference and to include all phases of conditioning natural gas for market, except extraction and recovery of liquefiable hydrocarbons. Professor Laurence S. Reid served as chairman of the second and third conferences. In 1954, Professor John Campbell became co-chairman with Professor Reid. Camp-bell resigned in 1969 to begin a new highly successful venture teaching gas conditioning and processing to the natural gas industry.

The Gas Conditioning Conference is usually attended by about 200 industry representatives from the United States, Canada; and other gas producing nations. They meet in a single group over a three-day period and take part in extemporaneous discussions inspired by papers authored and presented by experts in this field. In these free, open discussions, many operating problems have been solved, designs improved, and controversies aired to the considerable benefit of the natural gas industry.

The present Natural Gas Engineering option is administered by the School of Petroleum and Geological Engineering. It is designed to provide a broad engineering and science training in all phases of the natural gas industry. Students learn to apply the principles of mathematics, chemistry, physics and mechanics to the problems encountered in producing, conditioning, transporting, distributing and measuring natural gas.

International School of Hydrocarbon Measurement

The International School of Hydrocarbon Measurement (ISHM) is the oldest, largest and most famous school of its type in the world. The first meeting of this school was at the University of Oklahoma in 1924. The name of the school from 1924 until sometime in the 1970's was the Southwestern Gas Measurement Short Course. The objective of the early schools was to provide technical information on methods for natural gas flow measurement and control. The school was expanded to include hydrocarbon liquid flow measurement and control in the 1970's. To include liquids measurement and in recognition of the international representation of registrants, the name was changed to the International School of Hydrocarbon Measurement. The School is held in May in Sarkeys Energy Center. Over 1300 industry people attended the 1992 School.

"Natural Gas: From Ancient Mystery to Industrial Giant"

This article first appeared in Sooner Shamrock . a publication of the OU College of Engineering. in December 1955. We are using it here to emphasize the long history of OU s involvement in the natural gas industry.

By Laurance S. Reid

This is a brief chronicle of the Natural Gas Industry, the newest and one of the finest examples of the American free enterprise system. Like other basic industries, the natural gas industry has an intriguing past for strange occurrences of natural gas have left their mark on history down through the ages.

The Pharisees of Biblical mention built fire temples along the shores of the Caspian Sea near Baku and worshiped the eternal fires burning among the rocks. These temples were destroyed by a series of explosions in 624 A.D. Ancient Greet fortune tellers are said to have inhaled "mephitic vapors," probably natural gas, causing them to conjure up the visions which brought lasting fame to the Oracle of Delhi. In 615 A.D., natural gas seeps were reported in Japan and the Chinese drilled shallow wells and piped gas through bamboo lines to fuel salt evaporators. Parts of Peking, China, were lighted by natural gas as early as 900 A.D.

Centuries ago, religious leaders considered natural gas "an emanation from Hell." Superstition suppressed invention so that any attempt to harness and use gas marked the experimenter as a witch or an impersonator of the devil. In 1609, German scientists claimed that natural gas was a wild spirit and Van Helment, the discoverer of carbon dioxide, originated the term "gas" in 1648 as a contraction of "chaos," defined as "untamable nature." Gas seeps were reported in England in 1667 by Thomas Shirley who wrote, "Water burned like oil, heaved like water in a pot and arose from a strong breath as it were. A wind which ignited on approach of a candle and did burn bright and vigorous."

In England, William Murdock made coal gas and lighted a house in 1792. In Italy, Genoa was lighted by gas produced from wells drilled at nearby Anniamo in 1802. Albert Windsor applied for an English patent on coal gas in 1804 and lighted London's Pall Mall in 1807. The London and Westminister Gas, Light and Coke Company was chartered in 1812 and is generally regarded as the world's first gas utility company.

Early American colonists reported gas and oil seeps but made no effort to develop them. General Washington dedicated a burning spring park in West Virginia in 1775 and Jesuit missionaries described "pillars of fire" in the Ohio River valley that same year. Natural gas was first used commercially in Philadelphia in 1796 and the main street of Richmond, West Virginia was lighted by a natural gas flambeau on a 40-foot tower in 1803. America's first gas utility was the Gas Light Company of Baltimore, organized in 1816.

The first commercial gas well in the United States was dug at Fredonia, New York, in 1824. Gas from this well was piped to a nearby house and used for light. This was so successful that the system was extended to provide gas light for the town square and this feat, in turn, occasioned a visit from General Lafayette in 1825. The following year, a new gasometer was installed at the well providing 88 cubic feet of gas every 12 hours which fueled 100 street lights. Fredonia citizens voiced strong objections to the annual flat rate of $150 per light and became the first customers in American history to complain about gas rates.

Natural gas was frequently encountered by brine well diggers, much to their disgust, for with the gas came an inevitable oil slick which ruined the brine. The drilling of Col. Drake's first commercial oil well near Titusville, Pa. in 1859, added fresh impetus to natural gas discoveries. Virtually all of this gas was wasted but there were a few attemps to employ it for light and as boiler fuel for drilling operations. In 1861, the Bloomfield and Rochester Gas Company was formed to lay 25 miles of 8-inch wooden pipe to supply gas to tile city of Rochester, N. Y. The line was split when tested and leakage was so great that deliveries were not sufficient to support the operation. The failure resulted in loss of 1 1/2 million dollars to the stockholders in 1872. However, that same year 5 1/2 miles of 3 1/2-inch diameter pipe was laid to transport gas to Titusville and this project was successful, inspiring development of gas compressor design and pipe line construction techniques. In 1876, 17 miles of 6 1/4-inch diameter line was laid in Butler County, Pa., to supply gas to Etna. In 1883, the Chartiers Valley Gas Company laid twenty miles of pipe of unreported diameter into Pittsburgh. One distributing company was operating 33.5 miles of distribution lines within the Pittsburgh city limits by 1885 and, in 1890, the Equitable Gas Company laid 21 1/2miles of 36-inch gas line into the city supplying gas from wells drilled to the south. This pipe was rolled from 1/4-inch plate and riveted. In 1891, the first high-pressure gas pipe line was built from Indiana to Chicago, a distance of 120 miles, by the Indiana Natural Gas and Oil Company. This system comprised parallel 8-inch lines operating at 525 psig maximum.

An era of shameful waste, exhausted gas reserves and loss of Public confidence plagued the young gas industry from 1890 to 1910. Reserves under 7000 square miles of productive acreage in Indiana were discovered in 1886 and exhausted by 1908. Believing the supply was inexhaustible, new industries were lured to the state by promise of free gas, proposed legislative controls were defeated, and ridiculously low gas service rates invited flagrant waste. Prestige of the natural gas industry suffered a near-mortal blow in Indidiana.

The story was repeated in Kansas, where gas was first discovered near Iola in 1873. Demand outstripped supply until 1896 when big wells were completed near Coffeyville, Cherryvale and Independence. The Kansas Natural Gas Company laid a 16-inch line from Neosho to Kansas City in 1904 supplemented by a second 16-inch laid from Iola in 1908. Steadily declining reserves at these sources were bolstered by a line laid from the Hogshooter Field in Oklahoma shortly thereafter.

By 1910, canditions in the gas industry were chaotic and it was obvious that its fundamental concepts had to be revised on a long-term basis. Great progress was made in the science of gas measurement at this time and measurement legislation was adopted by many states.

Though unrecognized at the time, the turning point in the program of sound development came to the industry in 1916 with the discovery of the Monroe gas field in northern Louisiana. Public disbelief in the gas industry was so widespread that for nearly a decade, the magnitude of this long-term gas reserve was not recognized and virtually all production was consumed by carbon black plants. In 1926, Interstate Gas Pipe Line Company built the first modern pipe line from Monroe to Baton Rouge and later extended construction to New Orleans. Other large diameter pipe lines were built from Monroe to serve St. Louis, Memphis, Atlanta, Shreveport and smaller towns en route. Gas pipeline promotion flourished during these boom vears but this activity came to an abrupt halt with the market crash in 1929.

Lean years came to the natural ,gas industry during the thirties. Pipeline capacity vastly exceeded demand, for purchasing power disappeared from areas boasting gas service. Most pipeline companies went into receivership, many of them more than once, to adjust capital structure to earned income. Deep drilling techniques led to discovery of important gas-condensate reserves which had no market in the Southwest. Severe economic pressure led to development of gas cycling techniques and highpressure gas processing to recover hydrocarbon liquids from gas now going to market twenty years later. The defense program of the late thirties awakened a slumbering giant and the gas industry started to grow once more.

After Pearl Harbor, the Tennessee Gas Transmission Company set the pattern for the future by building a 24-inch high-pressure line from the Texas Gulf Coast to the metropolitan area of New York and eastern Pennsylvania. During the war years, there was tremendous demand for natural gas which has grown progressively since that time. Today, cross-country gas pipe lines transport natural gas to virtually every part of the United States from the prolific producing areas of the Southwest. Other important reserves discovered in the Rocky Mountain area and in western Canada now supplement this supply.

The natural gas industry remembers well the lessons learned in 1890-1910, for today, known gas reserves are sufficient to supply the demand for decades to come. Even more encouraging is the fact that the annual rate of discovery substantially exceeds the current demand for natural gas. A new major industry has come into its own.

Current CEMS Grants in Natural Gas Research

1. "Experimental and Analytical Services in Support of the API Natural Gas Flow Test Program," K.E. Starling, American Petroleum Institute (2/85-12/85) $24,806.

2. "Structural Characterization/Correlation of Calorimetric Properties of Coal Fluids," R.G. Mallinson, K.E. Starling, US DOE (9/85-8/87) $134,799.

3. "Development of a Critical Compilation of Binary VLE Data for Light Hydrocarbons with Methane," K.E. Starling, National Bureau of Standards (12/85-11/86) $49,923.

4. "Structural Characterization/Correlation of Calorimetric Properties (of Coal Fluids)," K.E. Starling, Department of Energy (9/85-8/87) $86,748.

5. "A Kinetics for the Depolymerization of Coal Upon Hydrogen Donor Solvent Liquefaction," US DOE (11/86-10/88) $146,526.

6. "Thermodynamic Properties and Phase Behavior Correlations for Important Coal Gasification Industry Applications," K.E. Starling, Department of Energy (11/86-10/87) $113,505.

7. "Advanced Working Fluid Properties in Heat Pump and Adsorption Cooling Operations," L.L. Lee, GRI (12/87-11/89) $158,000.

8. "Evaluation and Correlation of Flange Tapped Orifice Discharge Coefficient Data," K.E. Starling, Gas Research Institute (4/87-12/87) $69,003.

9. "Coupling of Methane Over Metal Oxide Catalysts," L.L. Lobban, Energy Center (7/88-6/89) $16,198.

10. "Study of the Reaction Mechanism of the Oxidative Coupling of Methane Over Metal Oxide Catalysts," L.L. Lobban, OU Research Council (1988) $4,000.

11. "Highly Accurate Compressibility Factor Equation for Natural Gas Using Specific Gravity, Heating Value and Nonhydrocarbon Component Concentrations for Natural Gas Characterizations," K.E. Starling, Gas Research Institute (11/89-10/90) $30,000.

12. "Methane Partial Oxidation in Elective Fields," R.G. Mallinson and C.M. Sliepcevich, Energy Center Director ( ) $19,245.

13. "Mixed Solvent Ionic Systems as Absorption Fluids: Thermal and Phase Properties for Heat Pumps and Gas Sweetening Operations," L.L. Lee, GRI (12/89-11/92) $422,000.

14. "Catalytic Processes to Convert Methane to Ethylene," B.L. Crynes, M. Seapan, and L.L. Lobban, Oklahoma Center for the Advancement of Science and Technology (1/90-12/92) $265,641.

15. "New Sorptive-Storage Technology for Natural Gas," K.E. Starling and J.H. Harwell, Oklahoma Center for the Advancement of Science and Technology (8/90-7/93) $168,000.

16. "Vapor-Liquid Equilibria and Computer Programming in Absorption Refrigeration Cycles," L.L. Lee, GRI (6/90-9/90) $30,000.

17. "Conversion of Natural Gas to Higher Value Products," L.L. Lobban, Department of the Interior/Bureau of Mines (7/91-6/92) $13,000.

18. "Hydrocarbon Pyrolysis Modeling for Improved Oil and Gas Resource Characterization," R.G. Mallinson, OMMRRI (7/91-6/92) $13,000.

19. "Planning Proposal for DOE/EPSCoR Program," K.E. Starling, Department of Energy (9/91-9/92) $100,000.

20. "DOE/EPSCoR Traineeship Proposal," K.E. Starling, Department of Energy (9/91-9/92) $250,000.

21. "New Technologies for Conversion of Natural Gas to Higher Value Products," R.G. Mallinson and L.L. Lobban, Plains Resources, Inc. (4 Years-Submitted 1991) $1,443,241 (TBA).

Recent Papers Resulting from CEMS Natural Gas Research

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4. Z.U. Rehman and L.L. Lee, "Self-Consistent Equations for Calculating Ideal Gas Heat Capacity, Enthalpy and Entropy III. Coal Chemicals," *Fluid Phase Equilibria*, **22**, 21 (1985).

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7. K.E. Starling and K.H. Kumar, "Computer Program for Natural Gas Supercompressibility Factor, Custody Transfer Calculations and Process Calculations Using the OU/GRI Correlation," *64th Proceedings of the Gas Processors Association*, 147-151 (1985).

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12. S. Kanchanakpan, L.L. Lee and C.H. Twu, "Equations of State for Nonspherical Molecules Based on the Distribution Function Theories," in American Chemical Society Symposium Series 300, *Equations of State: Theories and Applications*, K.C. Chao and R.L. Robinson, Jr., Eds. (American Chemical Society, Washington, DC 1986) pp. 227-249.

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1. "Evaluation of Equations of State for the Calculation of Enthalpies of Petroleum and Coal Fluids," Arif Khalil, M.S. (1985).

2. "Prediction of Natural Gas Compositions from the Properties Heating Value and Gravity and CO_2, N_2 and CH_4 Content for the Purpose of Supercompressibility Factor Calculations," Bradley Dale Eckhardt, M.S. (1985).

3. "A Corresponding-States Correlation for Low-Pressure Gas Viscosity of Pure Fluids," Mark Langenberg, M.S. (1985).

4. "Application of Local Composition Model Equation of State to Describe Vapor-Liquid Equilibria of Ideal and Non-Ideal Mixtures," Chiu-Kwan So, M.S. (1985).

5. "Methodology for Development of a Highly Accurate Natural Gas Equation of State," Jeffrey L. Savidge, PH.D. (1985).

6. "Accurate Second Virial Coefficient Prediction for Natural Gas Components and Related Compounds," J.A. Howard, M.S. (1985).

"Correlation of Equation of State Binary Interaction Parameters Using Multicomponent Vapor-Liquid Equilibrium Data and Development of Procedures for Computer Simulation of Naturally Occurring Hydrocarbon Reservoir Fluids," Mahboobul Mannan, PH.D. (1986).

8. "Natural Gas Flow Calculations for Sonic Nozzles with Analysis of the Critical Region of Methane for Use in Generalized Equation of State Development," Thomas B. Reid, M.S. (1986).

9. "A Generalized Second Virial Coefficient Equation for Non-Polar, Polar and Associating Fluids," Sadasivan Shankar, M.S. (1986).

10. "Adsorption of Model Hydrocarbons on Graphite Surface Using the Molecular Dynamics Method," Su Lin, PH.D. (1986).

11. "An Analysis of the Thermal Degradation of a Crosslinked Polymer Network as a Model for Coal Depolymerization," I-der Lee, M.S. (1986).

12. "Analysis and Structural Characterization of Coal Fluids for Calorimetric Property Correlation," Michael Peters, M.S. (1987).

13. "A Group Contribution and Equation of State Approach for Coal Fluid Calorimetric Properties," Randall D. Hulvey, M.S. (1987).

14. "A Critical Compilation of Binary Vapor-Liquid Equilibrium Data for Methane with Other Paraffinic Hydrocarbons," Sanjeev Mohindra, M.S. (1987).

15. "A Group Contribution and Equation of State Approach for Coal Fluid Calorimetric Properties," Randall Dean Hulvey, M.S. (1987).

16. "A Corresponding-States Correlation for Predicting Liquid Viscosities of Model Coal Compounds, Their Mixtures and Application to Undefined Fluids," Kiran Sheth, PH.D. (1987).

17. "Behavior of Supercritical Mixtures of Aromatic Compounds: Application of Kirkwood-Buff Solution Thermodynamics," D.M. Pfund, M.S. (1987).

18. "Prediction of Compressibility Factors of Gas Phase Coal Gasification Components," Krishnan Gangadhar, M.S. (1988).

19. "Computer-Aided Engineering Design of an Expander Plant for Production of LPG and Natural Gasoline from Natural Gas," Clara Ortiz, M.S. (1989).

20. "Equation of State Composition Dependence: I. Implications from Experimental Binary PVT Data II. Application of Hybrid Composition Dependence for Representing the Vapor Liquid Equilibrium of Nonideal Mixtures," Alauddin Khan, PH.D. (1989).

21. "Chemical Potentials from Integral Equations Using Scaled Particle Theory," D.M. Pfund, PH.D. (1989).

22. "A Molecular Approach to Electrolyte Solutions: Predicting Phase Behavior and Thermodynamic Properties of Single and Binary-Solvent Systems," K.L. Gering, PH.D. (1989).

23. "An Experimental System for Transient and Isotopic Studies of Heterogeneous Catalysis," Fernando Otero, M.S. (1989).

24. "Molecular Simulation and Modeling for the Thermodynamic Properties of Polyatomic Molecules and for Surfactant Adsorption," Rong-Song Wu, PH.D. (1990).

25. "Kinetic Study of Methane Coupling Over Li/MgO Catalyst," Wen-Yuan Tung, M.S. (1991).

26. "A New Highly Accurate Vapor Phase Equation of State for Computing the Compressibility Factors of Natural Gas Mixtures Containing Water and Hydrogen Sulfide," Enrique F. Rondon, M.S. (1991).

27. "Development of a Highly Accurate Vapor-Phase Equation of State with Application to Methane, Ethane, Carbon Dioxide, Nitrogen and Hydrogen," Carl W. Fitz, PH.D. (1991).

28. "Equation of State for Natural Gas Using Relative Density, Heating Value and Nonhydrocarbon Content for Characterization," Ying-Chih Chen, M.S. (1991).

Presentations of Natural Gas Research

1. L.L. Lee, "Equations of State: Theories and Applications." (Speaker – "Development of Equations of State for Nonspherical Molecules Based on Distribution Function Theories".) 189th American Chemical Society Meeting, Miami Beach, FL, April 1985.

2. L.L. Lee (Speaker – "Equations of State for Polar Fluids.") Ninth ASME Symposium on Thermo-physical Properties, Boulder, CO, June 1985.

3. L.L. Lee (Speaker – "A Molecular Group Contribution Theory.") Annual AIChE Meeting, Chicago, IL, November 1985.

4. R.G. Mallinson and K.E. Starling, "Structural Characterization/Correlation of Calorimetric Properties of Coal Fluids." U.S. Department of Energy University Coal Program Contractors' Conference, Pittsburgh, PA, July 1986.

5. L.L. Lee (Speaker – "A Molecular Theory of Solubility Parameters: Generalization to Polar Fluids.") Annual AIChE Meeting, Miami, FL, November 1986.

6. R.G. Mallinson and K.E. Starling, "Structural Characterization/Correlation of Calorimetric Properties of Coal Fluids." Abstract. U.S. Department of Energy University Coal Program Contractors' Conference, Pittsburgh PA, July 1987.

7. R.G. Mallinson, R.D. Hulvey, M.W. Peters, M. Li and K.E. Starling, "The Characterization Requirements for an Equation of State Based Correlation Framework for Predicting the Calorimetric Properties of Coal Fluids." Abstract. Boulder, CO, July 1987.

8. R.G. Mallinson, R.D. Hulvey, M.W. Peters, M. Li and K.E. Starling, "A Combined Group Contribution and Equation of State Methodology for Calculating Calorimetric Properties of Coal Fluids." AIChE Annual Meeting, New York, NY, November 1987.

9. L.L. Lee (Coauthor – "Equation of State Composition Dependence.") AIChE National Meeting, Houston, TX, April 1987.

10. L.L. Lee (Speaker – "The Interaction Site Model of Group Contributions in Molecular Mixtures.") West Coast Statistical Mechanics Conference, Berkeley, CA, June 1987.

11. L.L. Lee (Speaker – "Application of the Molecular Theory of Electrolyte Solutions to Calculation of the Activity and Osmotic Coefficients of Concentrated Solutions.") Midwest Thermodynamics Symposium, Wisconsin, May 1988.

12. L.L. Lee (Speaker – "Application of the Test Particle Approach to the Zero Separation Theorems.") West Coats Statistical Mechanics Conference, UCLA, CA, May 1988.

13. L.L. Lee (Speaker – "Chemical Potential Prediction in Realistic Fluid Models with Scaled Particle Theory.") 10th Symposium on Thermophysical Properties, National Institute of Standards and Technology, Gaithersburg, MD, June 1988.

14. L.L. Lee (Speaker – "Application of the Zero-Separation Theorems of Molecular Correlation Functions to the Chemical Potentials in Supercritical Mixtures.") International Symposium in Supercritical Fluids, Societe Francaise de Chimie, Nice, France, October 1988.

15. L.L. Lee (Speaker – "A Molecular Approach to Electrolyte Solutions: Phase Behavior and Activity Coefficients for Mixed-Salt and Multisolvent Systems.") Annual AIChE Meeting, Washington, DC, November 1988.

16. L.L. Lobban, G. Philippou and D. Luss, "Temperature Nonuniformity of Electrically Heated Catalytic Ribbons." AIChE 1988 Annual Meeting, Washington, DC, December 1988.

17. L.L. Lobban and D. Luss, "Spatial Temperature Oscillations During Hydrogen Oxidation on a Nickel Foil." AIChE 1989 Annual Meeting, San Francisco, CA, November 1989.

18. L.L. Lee (Presentation – "Calculating the Vapor-Liquid Equilibria of Mixed Solvent Salt Solutions.") Midwest Thermodynamics Symposium, Wisconsin, May 1989.

19. L.L. Lee (Speaker – "New Zero-Separation Results for Cavity Distribution Functions in Isotropic and Anisotropic Mixtures.") West Coast Statistical Mechanics Conference, Lawrence-Livermore Laboratory, CA, June 1989.

20. L.L. Lee (Presentation – "Prediction of V-L Equilibria and Thermodynamic Properties of Multisolvent Electrolytes.") 5th International Conference on Fluid Properties and Phase Equilibria, Banff, Canada, April 1989.

21. L.L. Lee (Speaker – "Thermal Properties Modeling of Advanced Working Fluids in Gas-Fired Absorption Engine Cycles.") 5th International Gas Research Conference, Tokyo, Japan, November 1989.

22. L.L. Lobban, "Methane Coupling Over LiMgO Catalyst." Oklahoma State University, April 1990.

23. L.L. Lobban, "Methane Coupling: Modeling and Results." Kerr-McGee, Inc., November 1990.

24. L.L. Lee (Speaker – "Structure and Properties of Ternary Supercritical Mixtures.") National AIChE Meeting, Orlando, FL, March 1990.

25. L.L. Lee (Speaker – "Enthalpy and Vapor-Liquid Equilibria of Mixed Solvent Electrolyte Solutions.") Annual AIChE Meeting, Chicago, IL, November 1990.

26. R.G. Mallinson, R.L. Braun, C.K. Westbrook and A.K. Burnham, "A Detailed Kinetics Study of the Effect of Pressure on Hydrocarbon Cracking at Mild Temperatures." AIChE National Meeting, San Diego, CA, August 1990.

27. J. Newman, J.H. Harwell and K.E. Starling, "Methane Sorption in Admicelles." AIChE Annual Meeting, Los Angeles, CA, November 1991.

28. L.L. Lobban and S. Bhumkar, "DRIFTS Study of Methane Coupling Over Li/MgO Catalyst." 65th ACS Colloid and Surface Science Symposium, June 1991.

29. L.L. Lobban and W.-Y. Tung, "Kinetic Study of Methane Coupling Over Li/MgO Catalyst." 65th ACS Colloid and Surface Science Symposium, June 1991.

30. L.L. Lee (Speaker – "An Interaction Site Analysis of the 'Solution of Groups' for Short Chain Molecules.") Eleventh Symposium on Thermo-physical Properties, Boulder, CO, June 1991.

31. L.L. Lee (Speaker – "Molecular Group-Group Interaction Site Model for Electrolyte Solutions.") Annual AIChE Meeting, Los Angeles, CA, November 1991.

32. R.G. Mallinson, A.K. Burnham, R.L. Braun and C.K. Westbrook, "Effect of Pressure on Hydrocarbon Cracking." 15th International Meeting, Proceedings, 309-312, Manchester England, September 1991.

33. R.G. Mallinson, R.L. Braun, C.K. Westbrook and A.K. Burnham, "Effect of Pressure on Oil Cracking." American Chemical Society National Meeting, Atlanta, GA, April 1991.

CEMS Unit Operations Laboratory Dedicated to Richard L. Huntington

The School of Chemical Engineering and Materials Science dedicated its undergraduate teaching "unit operations" laboratory to the school's founder, Richard Lee Huntington, in a ceremony held October 19, 1990.

Throughout his academic career Dr. Huntington took a personal interest in undergraduate laboratory instruction for chemical engineers. He served as instructor in the laboratory for more than a generation of undergraduates. Much of the process equipment in the original laboratory was designed and built by Dr. Huntington and his students. This tradition has been followed in subsequent development of the laboratory.

Shortly after joining the faculty of the University of Oklahoma, Dr. Huntington set out to establish a state-of-the-art instructional laboratory in the unit operations of chemical engineering. The concept of "unit operations" holds that any chemical manufacturing process can be resolved into a coordinated series of generic operations, such as drying, filtering, evaporation, distillation, etc. Thus the academic study of specific aspects of manufacture can be replaced by the generic study of the unit operations involved in the overall process.

The original laboratory was located in the Chemical Engineering Building located just north of the University Field House. The laboratory remained there until 1965 when chemical engineering moved into new facilities on the two lower floors of Carson Engineering Center. Dr. Huntington designed the new undergraduate laboratory in the Engineering Center and supervised all details of installation of equipment in the laboratory. These were among his major activities in the last years before retirement.

Among the experiments in the recently refurbished CEMS Unit Operations Laboratory is the Distillation Tray Hydraulics Unit.

In 1986 the chemical engineering undergraduate laboratory was moved from Carson Engineering Center to the University's new Energy Center which was still under construction. With that move, equipment from the old laboratory was refurbished and upgraded with new instrumentation and a number of new process experiments were added to the laboratory. With completion of the Energy Center in late 1990, the Board of Regents of the University of Oklahoma approved the naming of the chemical engineering undergraduate laboratory, the Richard Lee and Ruth Huntington Chemical Engineering Laboratory.

Over the years since Dr. Huntington's retirement, O.U. has been fortunate in having dedicated faculty who have continued the tradition of excellence in undergraduate laboratory instruction started by Lee Huntington. Though many individuals have contributed to CEMS' undergraduate laboratory instruction, two other individuals, in their service as Director of Undergraduate Laboratories, have done the most to assure the quality of the laboratory facilities and laboratory instruction.

Dr. John F. Radovich, as laboratory director from 1977 to 1984, undertook a major refurbishing of the laboratory, involving planning, proposal writing, and acquisition of new equipment. In addition to physical improvements in the laboratory, he prepared a new laboratory manual and reorganized the undergraduate laboratory courses to emphasize written and oral technical communications.

Dr. Richard G. Mallinson, as laboratory director from 1985 to 1989, supervised the move of the laboratory into the Energy Center. This involved tearing down and rebuilding of most of the existing units. In the process he upgraded the instrumentation on all units and instrumented some experiments for digital data acquisition and control. He also added new experiments to laboratory.

Companies and foundations have also made major contributions to the development of the new laboratory in the Energy Center. They include: the Kerr Foundation whose major gift of funds made possible the purchase of new equipment and renovation of several existing experiments; the Exxon Foundation whose grant to the College of Engineering made possible the implementation of digital data acquisition and control for several experiments; the Texas Instrument Company for their contribution of computer equipment for process control experiments; and Koch Engineering Company for fabrication of a new bubble tray experiment unit.

Richard Lee Huntington

Lee Huntington was born March 24, 1896 in Nardin, Oklahoma. He graduated from El Reno High School in 1913, and attended the University of Oklahoma from 1913 to 1917, earning the B.S. degree in chemistry. In World War I he served in the U. S. Army Chemical Warfare Service and spent 14 months in France.

He was employed by Skelly Oil Company in 1920 and for 10 years operated gasoline plants and refineries throughout Texas and Oklahoma. In 1930 he returned to school for graduate study in chemical engineering, first at M.I.T. and then at the University of Michigan. He earned the M.S. degree in 1932 and the Ph.D. in 1933 from the University of Michigan.

He was invited to join the faculty of the University of Oklahoma in the fall of 1933 as Associate Professor of Petroleum Refining in the School of Petroleum Engineering. Four years later he was named Director of the newly created School of Chemical Engineering.

Huntington established a doctoral program in chemical engineering, the first doctoral program in the College of Engineering.

In 1954 Huntington was granted the title of Research Professor in recognition of his energetic and successful efforts in research. He published more than fifty papers on petrochemical topics and authored the textbook, Natural Gas and Natural Gasoline, published by McGraw-Hill in 1950.

Dr. Huntington served on the University of Oklahoma faculty for 33 years. He retired in 1966 at the age of 70. He died in Norman in 1972.

The Huntington Family has established the R. L. and Ruth Huntington Memorial Fund which now provides partial support for a graduate assistant to work in the summer to help maintain the laboratory and continue the upgrade of experiments. State funds provide support for a graduate assistant in the laboratory during the academic year. The School of Chemical Engineering and Materials Science hopes that the Huntington Memorial Fund can be increased to provide full support for the summer position. To complete the endowment for a fully funded summer assistantship, $25,000 more will be needed. The endowment will provide a $3,600 summer stipend.

Friends and alumni who wish to contribute to the fund can do so by making a contribution to the O.U. Foundation and designating the Huntington Memorial Fund.

The Richard Lee Huntington Chemical Engineering Laboratory

The Richard Lee Huntington Chemical Engineering Laboratory is an undergraduate instructional laboratory. The Laboratory occupies 3,250 square feet on the ground floor in the Sarkeys Energy Center at the University of Oklahoma. Of this space, about 450 square feet are high-bay (two-story ceiling) area to accommodate tall experimental units. The Laboratory has a full complement of utilities including steam, cooling water, compressed air, natural gas, vac-uum, and both 110 and 220 volt electricity. Utility drops with valve cutoffs are conveniently located along the length of the laboratory to provide easy access and flexibility in locating experimental units.

The facility is used for two undergraduate laboratory courses in the chemical engineering curriculum, Unit Operations Laboratory in the junior year and Chemical Engineering Design Laboratory in the senior year. Recent modifications and additions have introduced digital data acquisition and automatic control facilities to a number of experiments. With these new capabilities, the laboratory will also be used by two other senior level courses, Process Design and Control and Chemical Engineering Kinetics.

The experiments in the Laboratory are designed to introduce chemical engineering undergraduates to generic operations widely found in industrial applications. These experiments give the students an opportunity to apply the principles of chemical engineering--material and energy balances; momentum, heat, and mass transfer; thermodynamics; kinetics; and chemical enginering design--to real problems.

Experiments in the R. L. Huntington Chemical Engineering Laboratory

- Climbing Film Evaporator
- Fluid Flow Characteristics
- Gas Absorption in a Packed Tower
- Liquid Level Control
- Liquid-liquid Extraction Column
- Membrane Gas Separation
- Shell and Tube Heat Exchanger
- Steam Condensation on a Single Tube
- Shurig Distillation Column
- Technovate Distillation Column
- Tray Hydraulics
- Chemical Reaction in a CSTR
- Chemical Reaction in a Catalytic Packed Bed

Richard G. Askew Establishes Fund To Match Corporate and Alumni Gifts For CEMS Scholarship Endowment

Richard G. Askew

CEMS alumnus Richard G. Askew has established a fund of $100,000 to be used to encourage contributions to support a program of endowed undergraduate scholarships in the School of Chemical Engineering and Materials Science through a benefactor matching program.

Under the program, scholarship gifts of $10,000 or more by individuals, including corporate matching funds, will be matched on a 1:1 basis, and the resultant endowment fund will bear the name of both the donor and the benefactor.

Endowed gifts of $10,000 or more by a corporation or foundation will be matched on a 1/2:1 basis and the resultant endowment fund and awards will bear the name of both the donor and the benefactor.

Endowed gifts of less than $10,000 will become part of a "pooled fund" until the total principal reaches $20,000, at which time the endowment will be matched on a 1:1 and/or 1/2:1 basis, based on whether the respective donors were individual or corporate. The resultant endowment fund and awards will bear the name of the Richard G. Askew Chemical Engineering Alumni Scholarship.

In order to attract and encourage well rounded students, selection of recipients will be based on the dual criteria of academic performance and evidence of significant participation in extra-curricular student activities. Incoming freshman candidates whose ACT scores fall within the upper 25 percent range of the freshman class of the previous year, and all chemical engineering students with a 3.0 or better grade point average will be eligible for consideration. Students selected for an award may be considered for subsequent awards as long as they maintain the required g.p.a. and make satisfactory progress toward graduation, and continue to show evidence of significant student activities.

Awards may range between $1000 and $2000 per student per year.

The selection committee for this new program will be composed of members of the scholarship committee of the School of Chemical Engineering and Materials Science.

The names, addresses and pertinent information regarding academic status and student activities of all scholarship recipients will be furnished to donors annually by the selection committee.

Richard G. Askew received a B.S. and M.S. in Chemical Engineering in 1947 and 1948 respectively. After a thrity-seven year career in a variety of domestic and international assignments, he retired as Senior Vice President of Phillips Petroleum Company and President of Phillips Chemical Company, with responsibility for the company's worldwide chemical operations.

His contributions to the University, College of Engineering, and the School of Chemical Engineering and Materials Science have been many and significant following a pattern of leadership and participation established while a student at the University. He has been very supportive of all of the work of the College of Engineering Board of Visitors, including serving a term as the Chairman of the Board. He is a former Chairman and current Honorary Director of the OkChE Chemical Engineering Advisory Board. In addition to his many contributions to Engineering, he is an Energy Center Sponsor and is an active supporter of numerous OU academic and athletic programs, serving as Tournament Director for the 1991 NCAA Regional Golf Tournament.

Askew has always given generously of his time and abilities to numerous industrial, civic and governmental associations. He has served on the Board of Directors of the Chemical Manufacturers Association, the Chemical Industry Institute of Technology and the American Institute of Chemical Engineers, and is past Director of the Bartlesville Chamber of Commerce, President of the Bartlesville Jaycees and Secretary of the Oklahoma Jaycees. He is currently a Director, a member of the Executive Committee and Chairman of the Budget Review Committee of the Regional United Way.

He received th eOU Regents' Alumni Award in 1990.

Brigham Recipient of National Award in Energy Research

[redacted] alumnus Dr. William [redacted] Brigham has received the federal government's most prestigious award for research in fossil fuels. Brigham, whose work has produced fundamental knowledge in the enhanced recovery of "heavy oil", received the 1990 Homer H. Lowry Award for Excellence in Fossil Energy Research in a May 10, 1990 ceremony at the Energy Department's Washington, D.C. headquarters. Deputy Secretary of Energy W. Henson Moore presented Dr. Brigham with a gold medal, a citation, and a $10,000 cash award.

The Lowry award is one of three Energy Science and Technology awards issued by the Energy Department. It is awarded to a U.S. citizen who has made notable contributions in the field of fossil energy science or who has demonstrated managerial excellence of innovative talents in coal, oil, or natural gas-related research.

Brigham, a professor in Stanford University's Department of Petroleum Engineering, led a research team of faculty and students in investigations of the physical mechanisms that control oil recovery in thermal processes. It is for his systematic development of the engineering of thermal recove[redacted]methods that Dr. Brigham was presented the Lowry Awad.

Much of the oil in California and substantial amounts elsewhere in this country, is too viscous to be recovered by conventional methods of oil production, but with careful engineering, a substantial fraction of that oil can be produced by thermal recovery methods. Those methods use heat, which is injected into the reservoir as steam or generated in place by combustion, to recover oil that would otherwise flow too slowly to allow its production.

The two areas of thermal processes that Dr. Brigham has concentrated on are *in situ* combustion and steam flooding with additives. Initial efforts were directed toward laboratory experimentation and analytical methodology. Correlations developed by Brigham and his students for oil recovery by *in situ* combustion as a function of the volume of air injected along with important reservoir and fluid parameters, were recently used by the National Petroleum Council to make recovery projections. His research on steam injection has led to the use of high temperature surfactants as a means of improving steam flood recovery. This process is being used in a number of worldwide field applications.

His results on tracer testing work were the first in the literature that showed that the effects of mixing in the reservoir, sweep efficiency of patterns and multiple reservoir layers could be combined to analyze field tracer production history. This work culminated in a generalized formulation which can be used to analyze tracer data from any producing well pattern.

Dr. Brigham was born in Murphysboro, Illinois, on April 1, 1929. He received his B.S. in Chemical Engineering in Iowa State University in 1950. His M.S. and Ph.D. Degrees were in Chemical Engineering from the University of Oklahoma in 1956 and 1962. From 1958 to 1971, he was employed by Continental Oil Co. In 1971, he joined the faculty of the Department of Petroleum Engineering at Stanford Univ.

Brigham's wife Carol, after raising five children, now concentrates on the more relaxing pursuits of playing duplicate bridge, gourmet cooking, playing with their four grandchildren, reading and travelling worldwide with husband Bill.

Four of their five children live in the Bay area. Nancy is with the Better Business Bureau; Bill is an architect; Sarah is with a wholesale nursery; and David is a student in music education at San Jose State. The fifth, Laura lives and works as a city planner at Rancho Palas Verdes.

Longtime OkChE Supporter M. F. "Wirge" Wirges Deceased

[redacted] Longtime OkChE supporter and CEMS alumni M. F. "Wirge" Wirges died July 7, 1992 at his home following an extended illness.

A native of Beatrice, Nebraska, he was reared in El Reno. He received bachelor's and master's degrees in chemical engineering from the University of Oklahoma in in 1944 and 1945, respectively.

Wirges joined the Cities Services Company's research division in 1946. He held technical and managerial position in natural gas liquids, chemicals, petroleum refining and corporate planning in Bartelsville, Oklahoma, Shereveport and Lake Charles, Louisiana, and New York City. He moved to Tulsa in 1974 as vice president of Cities Services.

After retirement from Cities Services, Wirges became an oil industry consultant, specializing in natural gas liquids serving companies in Tulsa and Houston, Texas. He was a volunteer consultant to the Executive Service Corps. of Tulsa.

Wirges was a member of the American Institute of Chemical Engineers, American Petroleum Institute, Institute of Management Sciences, Newcomen Society of North America and the Twenty-Five Year Club of the Petroleum Industry.

He was on the advisory board fo St. John Medical Center in Tulsa and the executive committee of Frontiers Foundation of Oklahoma.

He was an Honorary Director of OkChE at the time of his death.

Wirges is survived by his wife, Joan, and a daughter, Kelly Marie (Mrs. James) Sager of New Hartford, Iowa.

Crest Engineering Founder Joseph Maher Dies at Florida Home

Joseph Lewis Maher, BSChE 1936, whose career in the oil industry spanned 43 years and included the founding of Crest Engineering Co. in Tulsa in 1958, died June 13, 1990, at his home in Naples Florida. He was 77.

A native of Carterville, Mo., after graduation from OU, Maher went to work as an engineer in west Texas for Phillips Petroleum Co.

He left Phillips in 1940 to become production manager for Cooper Gas Co. in San Angelo, Texas. He served in the Navy in the South Pacific from 1942-46 and in 1946 he became assistant chief engineer for National Tank Co.

Maher was an initial founder and president of Crest, a consulting engineering firm serving the oil and natural gas exploration, drilling, production and processing industries. Under Maher's direction, the company added offices in New Orleans, Houston, London, Tehran, and Alberta, Canada.

After his retirement from Crest, Maher served as partial engineering consultant to Lowell Johnston and Associates in Tulsa.

Lowell Johnston, a colleague and longtime friend of Maher's said Maher was responsible for the development of much of the equipment and technology used in processing gas and oil.

Maher was a former member of the Tulsa Country Club and a longtime member of Southern Hills Country Club.

He is survived by his wife, Billie; and a son, William C. Maher of Texarkana, Texas.

Alumni Notes

Glen A. Blackburn, BSChE '75, is manager of technical services for Amoco Production Co. in Houston.

Robert Bourbeau, BSChE '87, is now working as a process computer engineer for Mobil Chemical Co. in Houston.

Lester Edward Brown, MSChE '67, PhD ChE '72, died recently.

Cheryl Breece, BSChE '86, recently stopped in to visit CEMS' new facilities in the Energy Center. She is working as a project controls engineer at J.A. Jones Construction Co. in Bridgewater, NJ. and lives in nearby Bell Mead.

Mike H. Chance, BSChE '85, is working as a quality manager for Martin Marietta Manned Space Systems in New Orleans. A recent project involved quality control on Nasa's space shuttle external fuel tanks.

Harold J. Corbett, BSChE '50, recently retired from Monsanto Co. as senior vice president of environment, safety, and health. He was a member of the Executive Management Committee and an advisory member on the Monsanto Board of Directors. He had served the company as vice president since 1980 when he was also appointed managing director of Monsanto Plastics and Resins Co. Corbett completed an advanced management course at Harvard in 1970.

Jess Edward Dew, BSChE '43, visited CEMS recently. He's chief engineer at Breakfast Productions, Inc. in Brooklyn, Ny.

Hamid Farzammehr, BSChE '83, MSChE '85, was recently promoted to manager of product development at Master Builders, Inc. He spends most of his spare time with his wife and his children, ages 9 and 12, in the new home he recently purchased.

Nancy Gullickson, BSChE '86, MSChE '88, has a new job as process engineer on in a polyol unit at Mobay in Houston. Nancy spent the previous three years with National Semiconductor Co., but said she "wanted to get back to real Chem. E. work–sizing equipment and all that stuff".

Thomas L. Fightmaster, BSChE '81, is now with Ashland Chemical, Inc.'s Drew Industrial Division as territory manager of their district in the Midwest based out of Oklahoma City and Wichita, Ks.

Tim Fitzgerald, PhD ChE '91, has moved from the Patent and Trademark Office to ICF, Inc., subsidiary of ICF, International, a comprehensive environmental consulting and engineering firm headquartered in Fairfax, Va. Tim married Karen Kedrowski in October '91.

Kenneth R. Hall, PhD ChE '67, has been appointed deputy chencellor for engineering of the Texas A&M University System. Hall continues as associate dean of enginereing at Texas A&M.

Velmer V. "Val" Hendrix, BSChE '40, made significant contributions to the modern U.S. Navy and nuclear technology during a long career. Graduating just prior to U.S. involvement in World War II, Hendrix joined the Navy as an ensign and because of his degree was assigned to ordinance in Schenectady, Ny., where he and Marjorie Stevenson Hendrix were married. Though Val was dissappointed to never get out to sea, Marjorie was delighted to have him stationed ashore in Watertown, Ny., near the mouth of the St. Lawrence. They were soon transferred to Oak Ridge Tenn., where he was involved in nuclear research for ten years. During that period, the Hendrix's had four children. Hendrix transferred to Idaho Falls, Idaho where he was in charge of all reactors in the Test Area North, doing core meltdown research. In his free time, Val enjoyed trout fishing and deer hunting there while the children pursued skiing and ice skating. Hendrix achieved the rank of commander before retiring from the U.S. Navy and completed his career with the Atomic Energy Commission on the Nuclear Regulatory Commission. Val and Marjorie now live in Conway, Arkansas, where Val is under care for Alzheimers.

Charles Merritt Hewett, BSChE '32, died November 9, '89, in Sykesville, Md. He was retired from American Oil Co. of Chicago.

Yoshihiro Hongo, BSChE '62, is general manager of Mitsubishi Corp.'s Plastics and High Performance Chemicals Division in Tokyo, Japan.

Kevin James Kennelley, BSMetE '80, MSMetE '85, PhD MetE '86, has been selected as one of only three recipients of the 1992 ARCO Outstanding Technical Achievement Award. Kennelley chose CEMS as recipient of the $5000 monetary grant associated with this distinction.

Mark Kennelley, BSChE '83, has joined the Global Corporate Finance Division of Bankers Trust New York Corp. as vice-president. Kennelley came to Bankers Trust from Citicorp Securities Markets Inc. where he had been vice-president.

Robert N. Maddox, PhD ChE '55, received an honorary Doctor of Science degree from the University of Arkansas where he completed his B.S. in 1948. He recently retired from teaching but continues work as a consultant.

Gretchen Matthern, BSChE '82, MSChE '84, is employed as an engineering specialist at EG&G in Idaho. She is engaged to an engineer also with EG&G. Gretchen spends a great deal of her free time skiing, particularly cross-country, and is a member of the Nordic Ski Patrol. She lives in Idaho Falls, 80 miles west of Jackson Hole, Wyoming.

Estil O. McBride, BSChE '38, of McBride Engineers in Houston, TX, has been named a fellow of AIChE. He was cited for his 50-year experience in process engineering and design, particularly in refining and petroleum chemical processes.

Rowena Buck McReynolds, BSChE '83, has been promoted to Computer Systems Engineering Manager at AT&T in Oklahoma City. She makes her home in Edmond, OK.

Chris Root, BSChE '80, MSChE '81, is s senior plant engineer working in gas plant operations and proces design at Amoco Production Co. in Houston.

Robert A. Royer, BSChE '49, is now employed as chemical services and environmental manager at Arcadian Corp. in Memphis, Tenn. He makes his home in Blytheville, Ark.

Bruce Stevens, BSChE '82, MSChE '83, joined PetroliteSpecialty Polymers Group in Kilgore, Tx., in '89. He and wife Nancy bought a house in Longview as a home for their young son Samuel Hodde Stevens (that's "Howdy" according to Bruce's coworkers).

Thomas D. Taylor, BSChE '58, has been working as acting director of the Naval Technology Office of Advanced Research Projects in Arlington, Va.

Greg Thomas, BSChE '84, stopped in to visit CEMS in the Energy Center recently. He is a process engineer for a butadene recovery unit with Lyondell Petrochemical Co. He recently married a TCU graduate from Stillwater, Ok., and they've just bought a house in Clear Lake City, Tx.

Harry M. Turner, BSChE '71, recently transferred with ARCO, where he's worked for 15 years, from California to Dallas, Tx., where he is a staff facility process engineer supporting major gas processing facilities ARCO operates and provides designs for new facilities as needed. In his free time, Turner enjoys snow and water skiing, tennis and travelling.

Jim L. Turpin, PhD ChE '66, a member of the University of Arkansas faculty, has been named a recipient of the Chemical Manufacturers Association's 1991 Catalyst Award for Outstanding Teachers.

Robb Vanskike, BSChE '88, is a process engineer for Davy McKee's Dresser Engineering Division in Tulsa. He recently bought a home in South Tulsa and a ski boat. He's been travelling in his free time to Disneyworld, San Franciso and Houston.

Hugh Alan Walls, BSChE '57, MSChE '58, PhD ChE '63, died in mid-1991. He is survived by his wife, Juanita, of Austin, Tx.

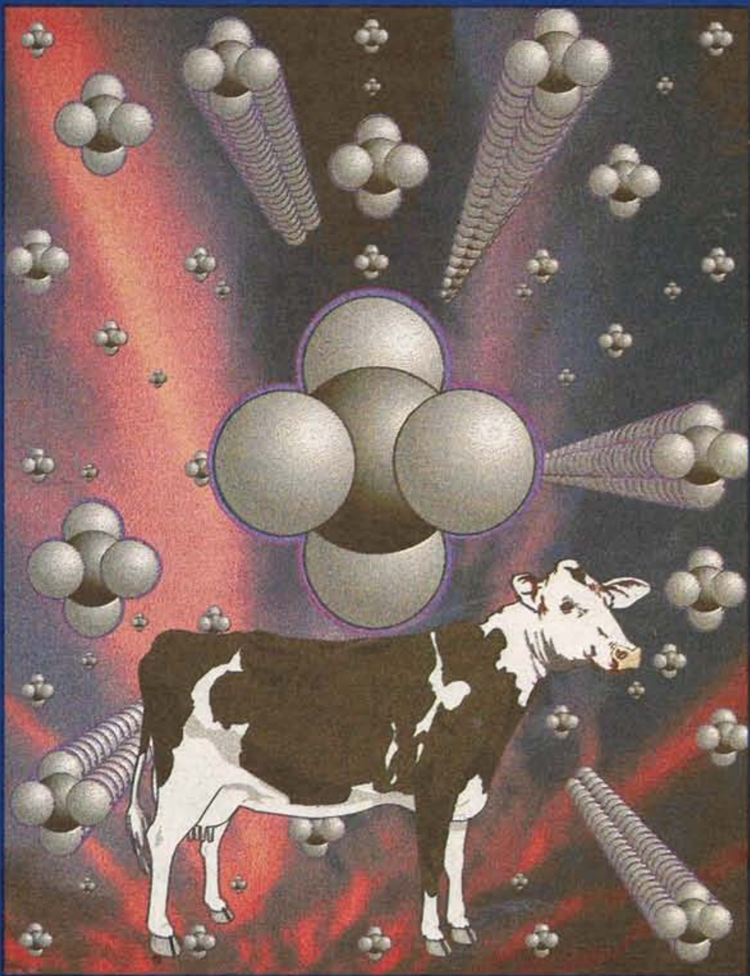
Edward Norman Washburn, BSChE '34, died March 21 of this year in Bartlesville, Ok.

Aubrey D. Wood, BSChE '60, was on campus in October '90 to make presentations to the College of Engineering about computer systems for engineering applications. He is manager of Engineering/Science National Support Center for International Business Machines, Corp. The center specializes in supporting structural analysis, computational fluid dynamics, computer-aided chemistry, seismic/reservoir, CADAM, CATIA, CBDS, CAEDS, quantitative analysis, physics, material science, and scientific visualization applications efforts.

Rosendo Zambrano, MSChE '81, was recently appointed President of PMI Services North America, Inc., a subsidiary of Petroleos Mexicanos' PEMEX operation in Houston. He joined PEMEX in Mexico City as a process engineer upon graduation. He later joined the International Commerce Dept. in the Crude Oil Area and with that position, transferred with his wife Sally to Paris and later to London where he was responsible for the Crude Oil Contracts in the Northwest European Region. He returned to Mexico City in '87 as Senior Trader for Middle Distillates and Residuals, a position he held until his current promotion. Zambrano, Sally and their two daughters Sarah and Sherry make their home in Houston.

NewAlumni

	'90	'91	'92
BSCHE	Mark S. Allen Christopher Bryan Canfield Hans Kristopher Christain Theadore Morris Cole II Marilyn Kay Grass Culp Mark A. Dawkins Lance Clavel Gibson Mercer Derek Gregory Rebecca Dianne Holland William Wayne Johnston Todd Michael Krier Brian Scott Milum Brian T. Oakwood Vanessa Lynn Ong Paul Eric Pfeffer Mark Porter Richard Andrew Sager Michael A. Scherlag Michelle Dee Schupbach Kristy Michelle Sells Julie Ann Sheffield Steven Ray Spaulding Michael D. Strasser Kimberly Renee Yates	Sharon Ann Richey Annesley Tracy Ann Byford Ernest Chan Juli Elaine Boone Coble Randall James Craddock Khoa M. Dao Jarrad Scot Garrison Cyntha Rose Kachelmyer Juan Felix Luong O Kevin Jay McKeown Susan Denise Patrick Michael Forrest Reid Raymond Edwin Rooks Bryan Kent Stewart Edward Dale Terry Joe Don Willingham	Jason Scott Anderson Bradford Dillman Barber Thomas Lee Burghart Dawn Renee Burns Cheveil Annette Bush Brian Franklin Clagg Heather Michelle Horstman Norma S. King Robert Edward Krish James Afton Lane Loretta J. Lierly Bijo Punnoose Mathew Nora T. Melton Peter Ajayi Ogbeide Sanjay D. Patel Robert Allen Pendergrass II Cynthia BaoKhue Pham Tuyet Ngoc Pham Sharon Kay Provine John Darrell Shelley Adeline Sides Kevin Damon Sitton Scott Reed Spence Jerry Marc Taylor Charles Eldridge Teacle II Choon Heng Teo Si Quang Thieu Abdiel Rene Urriola Sonia Katyoshka Vahedian Giang Trinh Vo Yuefeng Yin
MSCHE	Muhammad Arshad Lawrence Lee Crynes Maria Victoria Gonzalez Ming-Jiing Juang Che-Chian Ko Lori Ann Hole Lowrey Biswaroop Majumdar Bor-Jier Ben Shiau	Lori Lynn Brant David Kent Krehbiel Enrique Francisco Rondon Wei-Ming Shih Wen Yuan Tung	Soujanya Chidanand Bhumkar Hoern-yann Chen Ying-Chih Chen Cheng-Hsein Hsu Yuan-Der Alexander Ju Chung-Li Lai Anup Suresh Mangaokar Abdeally Mohammed Susan Bakhtiari Shadizadeh Chun-Tun Wang Shang-Jen Yu
PHD	Tze-Wen Chung Churl Hee Lee Philip Duke Nguyen	Sayed Alireza Arshad Tien Tsung Wu	Mukesh Kumar Bisaria Timothy Patrick Fitzgerald Jeffrey John Lopata



The Sarkeys Energy Center amid fireworks of the U. S. Olympic Festival fireworks in Norman in 1990.

Credits

Photos pages 2,3, 4 top, 4 bottom, 5, 6, 10, 11, 12, 13, 14, 16, 17, 18, 21: Gil Jain, OU Media Services.

Photos 4 middle, 36: Rick D. Wheeler, CEMS.

Photo 19: Billie Ann Brown, CEMS North Campus Research.

Photo 28: J. Pat Carter, OU Media Services.

Cover, 9, color adaptation page 10, 16 (drawing), Rick D. Wheeler.

Lineart 9, 12, 13, 20, 25, & 27: "Kipp", whom after much research we were unable to identify further. If any OkChE reader can help identify the artist who published his work in the December 1955 *Sooner Shamrock*, the editors would be grateful to hear from you so that proper credit can be given.