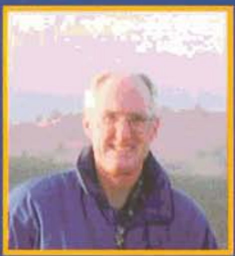
School of Chemical Engineering and Materials Science

OkChE

Oklahoma Chemical Engineer

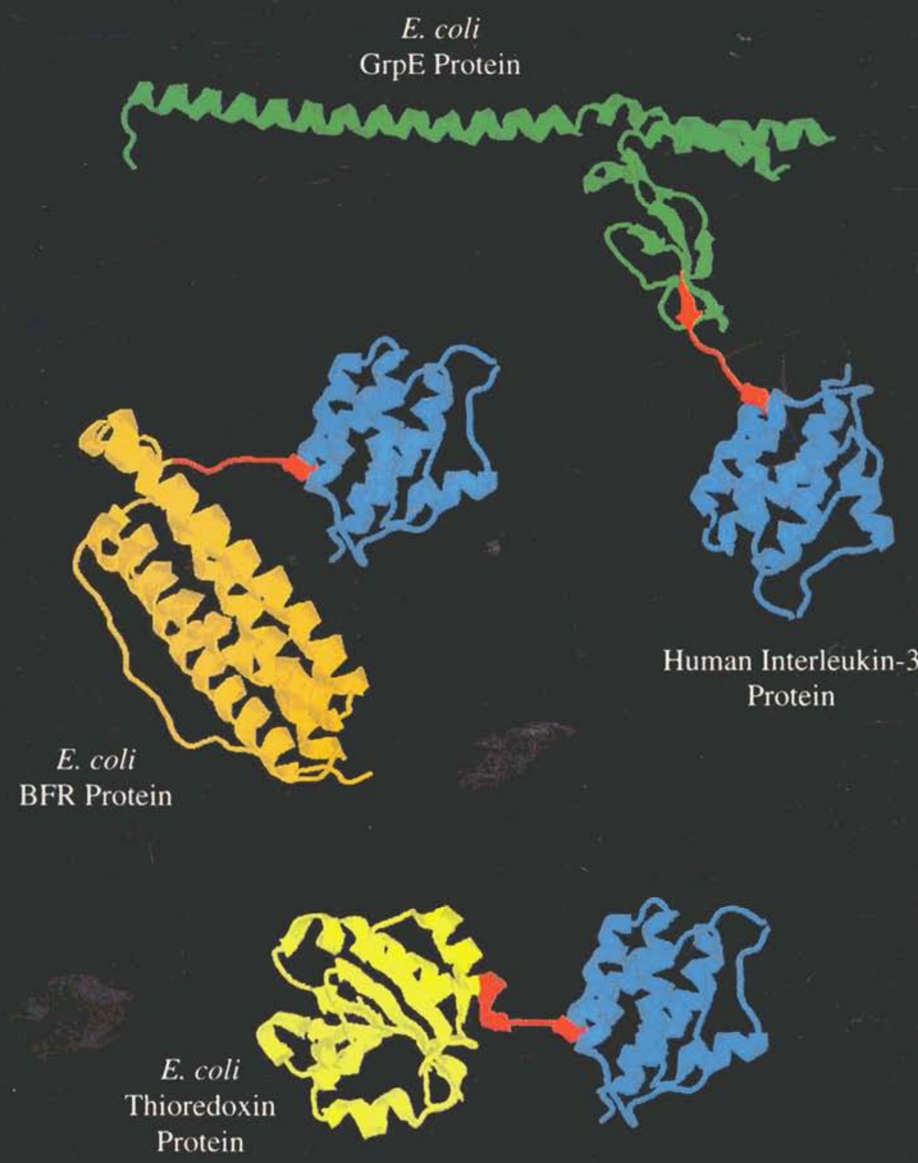
Spring 1998



Research has its privileges
pg 6

Spring grads listed
pg 12

How a ChemE student fills her time
14



Exploring the New Frontier: Biomed and Biotech

School of Chemical Engineering and Materials Science

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OklahomaChemicalEngineer

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Table of Contents

OkChE Magazine
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A Note from the Director

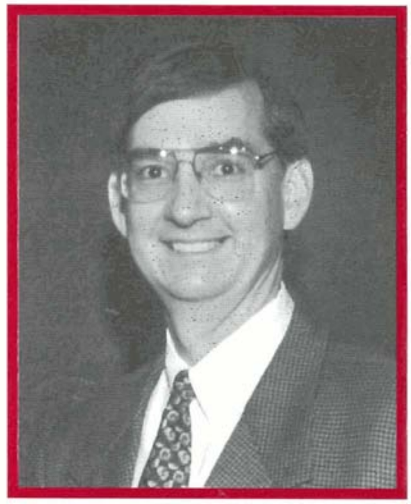
Greetings from Norman!

Change continues at the same unprecedented pace for our program. As an example, this is the first Director's Notes that have been dictated to a computer. That's right, I am dictating this article to my computer; new dictation software on the computer is converting what I say into text as I say it. While this is remarkable enough on its own, I am especially struck by the observation that the notebook computers which will be used by all our freshman engineering students beginning next fall, are more than powerful enough to run the same dictation software I'm using this moment. Currently, we're not requiring our students to purchase dictation software, but I expect that by the time most of them graduate in four or five years, many will be using it.

Another sign of this continuous change occurred recently when the College of Engineering faculty voted to submit our accreditation documents in 1999 under the new ABET 2000 requirements. As a department of chemical engineering we were already making plans to adapt our curriculum to the ABET 2000 standards; but I was still caught by surprise to find that the college faculty would choose to put themselves in the situation where they would have only a little over a year to adjust for accreditation under the new criteria. I was more than a little glad that we had already scheduled an all-day faculty retreat to review the chemical engineering curriculum!

Many other forces are moving to keep our lives exciting here at the college. We are currently interviewing the second of three candidates to replace Billy Crynes as the college of engineering dean. We have some exciting candidates, and I hope that I will be able to introduce one of them to you next fall as the new dean. Also, the State Legislature is in session, and the University has several important bills working their way through the Legislature. One bill is for a new bond issue for capital improvements; the other "bill" is really a group of changes in state law and possibly the state constitution designed to facilitate technology transfer from the University to the business community. Governor Keating is anxious to see Oklahoma's universities have an impact on economic growth and the standard of living for Oklahoma's citizens. A major impediment to this activity at the University in the past has been state laws designed to create barriers between industry and the University. We are hopeful that as these laws change you'll see greatly increased interaction between the college and the companies interested in the research we are doing.

One thing that hasn't changed in the last year has been the University's success in recruiting National Merit Scholars. For 1997 Oklahoma moved into sixth place nationally in the number of freshmen Merit Scholars, right behind Rice, Stanford, and the University of California-Berkeley. We now rank third among public institutions in total number of Scholars, with only Berkeley and the University of Texas ahead of us. Given the size of OU and the size of Berkeley and Texas, we have now moved into first place in terms of percentage of incoming freshmen who are National Merit Scholars. I know that OU is already off to a good start in recruiting for next year, because my oldest son, Jeff Jr., is a National Merit Scholar, and he has chosen OU for an engineering degree. Watching his decision-making process was very instructive. He initially considered OU, Texas A&M, Rice, and the University of Kansas. While OU certainly had the best financial package of all three schools, he settled on it for non-financial reasons. One of these reasons was OU's Engineering Physics program: an engineering physics degree



will allow him to pursue an essentially inter-disciplinary degree incorporating aspects of mechanical, electrical, and computer engineering. But I think, however, that the overriding reason for his choice of OU was his meeting with the new dean of the honors college. Steve Gillon recently came to the University from Oxford University in England. Steve has been given a commission from President Boren to create an Ivy League educational experience at an Oklahoma price within the honors college. He was able to communicate his vision and excitement to my son during a banquet on the campus for National Merit Scholars. I am very enthusiastic about Steve's presence on the campus and the impact he is going to have on the quality of an OU education.

Thanks for taking time to keep up with your old school. Be sure to visit us on the Web; you can find us quickly off of OU's home page, which is at www.ou.edu. We'll be in touch again in the fall. ■

Yours truly,

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Exploring the New Frontiers: Biomed and Biotech

Pick up any magazine today from *Scientific American* to *Newsweek* and chances are you will find an article on biomedical technology. Advances in synthetic bloods, genetic engineering and gene therapy could have a remarkable impact on the treatment of conditions from cardiovascular disease to blindness in the near future.

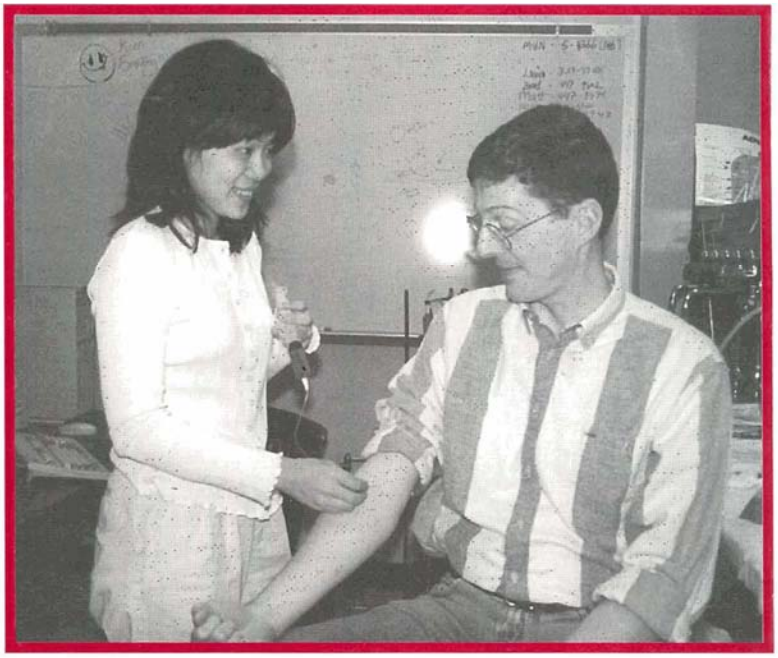
This issue of OkChE explores the research of three OU professors who are leading the way in biomedical and biotechnical research.

Roger Harrison (right), and his students look over some promising results in the lab.

When Matthais "Ulli" Nollert graduated from Luray High School in 1977, his classmates named him "most likely to become a mad scientist." Today as a biomedical engineer exploring mysteries hidden within blood vessels and cell walls, some of his classmates may feel justified in their prediction. But far from being mad, the practice is achieving remarkable breakthroughs in understanding the circulatory system and could have a dramatic impact on the treatment of heart disease and cancer.

Nollert had always wanted to be an engineer. His father, a mechanical engineer, had immigrated from Germany to the United States after World War II, when he was offered a job in a tannery. The younger Nollert always assumed he would go to college, but it was not a common dream among the young people growing up in Luray, a town of 3500, located between the Blue Ridge Mountains and the Shenandoah River in rural Virginia. Nollert graduated from a class of 100, one of six who went on to college and one of three who didn't drop out. He received his B.A. from the University of Virginia and was accepted at Cornell University in upstate New York to pursue an advanced degree in biochemical engineering.

"The research groups were huge in that area. I had always envisioned myself working more independently, so I changed my focus," he said. Although Nollert earned his Ph.D. in fluid mechanics, he never gave up his dream of working in biochemical engineering.



Dr. Nollert gives time, energy and even his own blood to his research students. Elizabeth Nguyen, a masters student, draws a sample for use in the lab.

His advisor at Cornell recognized this and encouraged him to contact Dr. Larry McIntire, a pre-eminent researcher in that field at Rice University.

The rest, as they say, is history. McIntire had enough chemists and biologists. What he needed was someone with a strong background in fluid mechanics and an aptitude for biomedical research, someone, as it turned out, exactly like Nollert. It was a productive match for both professor and post doc.

Today, Nollert is one of a highly specialized group of investigators worldwide who apply the properties of fluid mechanics to the intricate and complex systems within the human body. His fascination with vascular engineering led him to the University of Oklahoma. "I'm an engineer," Nollert said. "It's just that, in my case, the circulatory system is my 'factory.' So I wanted to teach at a university that had a very good medical school."

Not only did the University of Oklahoma fulfill that requirement, it had on its faculty at the Health Sciences Center Dr. Rod McEver, an internationally renowned researcher, and Dr. Chuck Esmon, a Howard Hughes investigator, whose findings on the components of endothelial cells were making medical history. Building on what McEver and Esmon have discovered, Nollert is investigating the chemical reactions which take place when white blood cells move to the site of an injury or infection.

Nollert's enthusiasm for his work is evident when he talks about his research. "White blood cells 'sense' when there is a need for them," he said. "Normally, the surface of the blood vessel walls is smooth, but when there is an injury, the vessel walls become sticky. Certain molecules get displayed on the surface, like a coat hanger sticking out on the blood vessel wall waiting for its counterpart coat hanger of a white blood cell to come along and attach.

Ulli Nollert

"The coat hangers are actually specific protein molecules discovered by Dr. McEver," said Nollert. "So, now that we know the molecules, we're trying to work out some of the biophysics. If you were a cell you'd be moving along at 60 miles an hour. So how do you suddenly put on the brakes and stick? Nobody knows. Somehow there has to be a purely physical interaction and it has to happen very quickly.

"We're trying to unravel the physics, the biophysics of this initial attachment of the white blood cell to the vessel wall. Not just any two cells will stick together. Clearly these adhesion molecules are very special. That's what we, together with the people from the health sciences center, are trying to figure out. They do the biological techniques, the genetic engineering. We do the fluid mechanics."

"I'm an engineer," Nollert said. "It's just that, in my case, the circulatory system is my 'factory.' So I wanted to teach at a university that had a very good medical school."

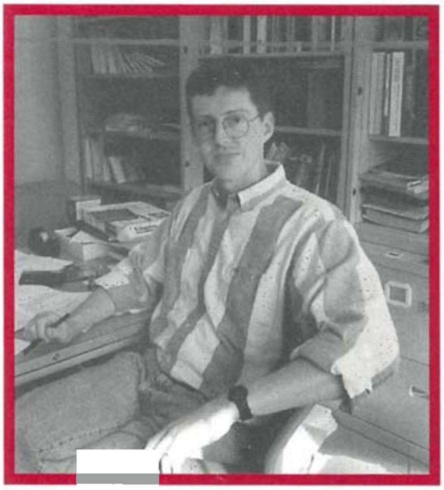
In his lab, Nollert uses a plastic model of a blood vessel to monitor cell reactions. "We let blood flow in and then we close the cell and watch how the white blood cells stick and quantify how they adhere. We're using basic chemical engineering fluid mechanics," he said. "The medical people can take this and apply it to patients who have lack of immune response. They suffer recurrent infections and ultimately have a short life span. On the other end of the spectrum are people who have excessive white blood cell response. Too many white blood cells go in, as is the case with rheumatoid arthritis, asthma or diabetes. There the white cells are too enthusiastic about sticking.

"If we understand what makes it work, we could design a drug that would interfere with this and suppress the symptoms of the disease without totally compromising the immune system," he said.

"Your body is like a lot of little factories. It produces a lot of chemicals and a lot of different types of proteins," he said. "Sometimes the factory gets the wrong blueprint and puts out the wrong stuff. If we put a piece of DNA into white blood cell, the cell would then have the right recipe and make the correct protein. What we need to do is find the factory where the blood cells are being made and change the formula or blueprint so your body can start making the correct coat hanger. This is gene therapy."

Gene therapy sounds great, Nollert said, but in the 20 years since its inception, only one patient has been helped out of hundreds that have been tried. He is not discouraged, however. "It's a very difficult problem, but one that holds a lot of promise. There are a lot of questions, like 'Are we not doing the gene therapy in the right location, are we getting the drug to the right place?' We have to find the answers. That's what chemical engineers do."

In addition to the white blood cell research, Nollert and his students are investigating the chemical reactions which take place during blood clotting. "Platelets are a bag of chemicals that initiate blood clotting," he said. "Within seconds of a cut, your platelets begin to stick and form a plug. As soon as they stick to the vessel wall some-



Dr. Nollert in his office.

thing inside the cell says, 'OK we're stuck, time to dump out the goods.'...But, once they start this, why doesn't all of your blood polymerize and you end up as one big blood clot?

"And how does the inside of the cell know what's going on out there in the first place? How does one platelet know when the external environment has changed and it's time to dump the bag of chemicals? How do you convey that information from the outside of the cell to the inside of the cell?" he asks.

That process is called signal transduction, in this case, how the signal of the injury get transduced into the cell. It's a multi-step cascade of chemical reactions and biophysical properties that the cells go through in order to get the signal to release the chemicals that will initiate clotting.

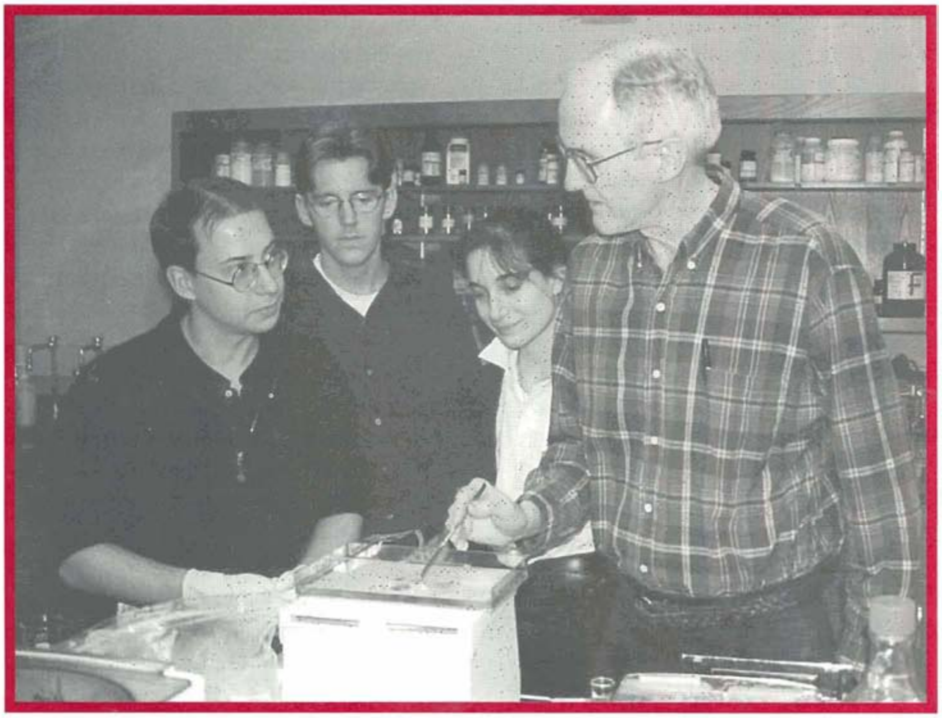
Another important mystery in the unraveling is what makes the platelets unstick once they are no longer needed and how long that reaction takes. These findings would have special implications for the prevention of heart attacks and strokes. "Often, when you have a blood clot forming, some platelets will stick together and float off in the blood stream and if they go to your heart and your vessels are constricted, you will have a heart attack," Nollert explains.

See Nollert page 11

With origins in Altus and a research career in Bartlesville and Norman, Oklahoma, it seems an anomaly that Roger Harrison moves with such ease through the language and culture of Clermont-Ferrand, France. A quintessential Renaissance man, the OU professor describes his 1997 stay as an invited professor at Blaise Pascal University, OU's exchange university, as "incredible—not just in scientific terms, but in the interaction with the students, the hospitality of the people, and the inspiration to read and reflect on my research. The experience exceeded my expectations, and has been one of the highlights of being on the faculty here." The soft-spoken Harrison, who speaks intermediate-level French, talks enthusiastically about the beauty of the area and the grace with which his fellow professors invited him into their homes and even loaned him their cars. He, his wife and two sons fell under the spell of French hospitality and cuisine in the summer of 1995 on a visit that included Clermont-Ferrand, Provence, Normandy, Brittany, and Paris. He currently oversees two French students in their studies here.

Harrison has a strong background in bioengineering. His Ph.D. research at the University of Wisconsin involved a biomedical engineering study of the transport of fluid across the artery wall. He began his career at Upjohn, working as a biomedical engineer to isolate antibiotics from cells through bioseparation. A stint in Bartlesville, Oklahoma, as a senior engineer in biotechnology sparked a major focus of his research: to apply genetic engineering, or gene-splicing, to improve the purification of proteins and peptides (small proteins) produced by microorganisms. A major project, supported by a three-year grant from the National Science Foundation, involves modifying *E. coli* bacteria cells, which are normally insoluble, to a soluble form which allows them to link to another solubilizing protein. This approach allows proteins to be mass-produced more easily for many uses.

One target protein being studied in the NSF project is human interleukin 3, used in cancer research and currently extracted from blood. Harrison and graduate student Greg Davis discovered a solubilizing protein known as NusA,



From left, Sebastien Gauthier, Greg Davis, and Elisabeth Fayard work with Harrison on gene-splicing in the lab.

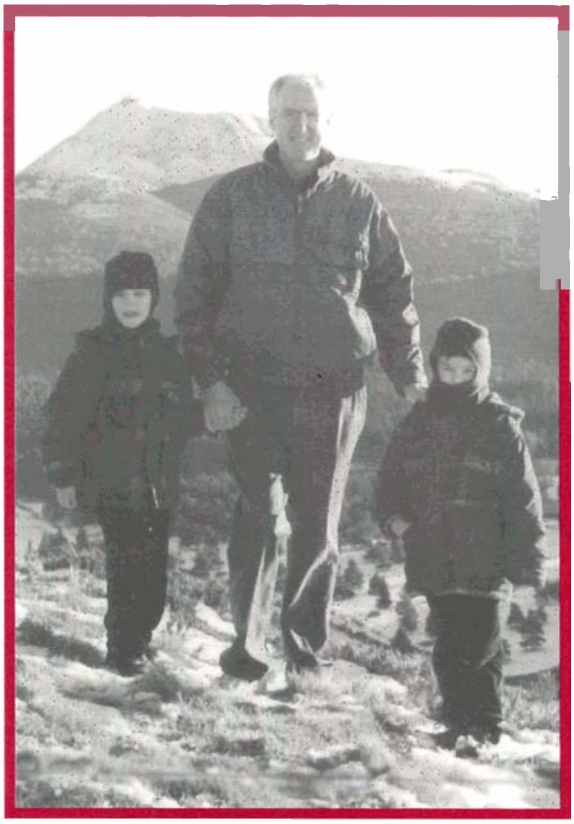
"This approach potentially can be used for the removal of metals from polluted streams, such as at the Tar Creek EPA Superfund site in northeastern Oklahoma."

Roger Harrison

which allowed interleukin 3 to be produced in soluble form in bacteria. This agent purifies interleukin 3 to homogeneity in two chromatography steps. "I have enjoyed this work because it proceeds rapidly and we have obtained a lot of interesting results," he says. The project is nearing completion and being evaluated for commercialization by two biotechnology companies.

Another fusion project also has far-ranging ramifications in cancer research. Currently, the accepted treatment for cancer, chemotherapy, has many harmful side effects; it kills healthy and cancer-causing cells alike. Harrison's research takes an exotoxin, which binds to and kills a cell, and removes the "binding" section, leaving only the "killing" section. This section alone is harmless, and can be connected to a protein which binds specifically to the receptors in cancer cells, creating a "magic bullet" which kills the cancer cells while doing minimal damage to healthy cells. Harrison is collaborating on this project with Dr. Tom Pento, OU Health Sciences Center. Once the protein has been made in sufficient quantity and purity, Pento will test its effectiveness on cultured cancer cells or laboratory mice with cancer.

Though he enjoys the cultural opportunities of France, the research opportunities are equally intriguing. Harrison and one of his students, Elisabeth Fayard, are currently collaborating with Blaise Pascal on a project to degrade toxic chemicals through biotechnology, with the cell engineering being done in Norman and the bioreactor studies in France. Fayard and Harrison are working to produce bacterial cells that are coated on the outer surface with a toxic-chemical-degrading enzyme. The undertaking has proved challenging, because the enzyme in the *E. coli* bacteria won't cross the two membranes that make up the cell wall. If successful, the project will greatly lower the cost of treatment of toxic chemicals with enzymes, because the purification step now required for the enzyme will be eliminated. "This approach potentially can be used for the removal of metals from polluted streams, such as at the Tar Creek EPA Superfund site in northeastern Oklahoma," he says.



Hiking the hills of Clermont-Ferrand, France, with Jule and Victor Dussop, sons of a Blaise Pascal University professor.

Harrison is also co-authoring a text on bioseparations with colleagues in Colorado and Australia published through Oxford University Press. "We've made sure to include ample examples and description, along with applied theory and a complete set of problems in each chapter. I took this on because there is currently no textbook on bioseparations for senior and graduate level students in chemical engineering. It should find a place in biochemical engineering courses throughout the world," he noted.

In addition to teaching biochemical engineering, Harrison also teaches design lab for seniors and unit operations lab for juniors. "I like teaching laboratory courses. Students learn a lot that tends to stay with them, since the courses are 'hands on'. I spent 13 years doing work in bench scale and pilot plant research and development, and feel that the perspective I've gained based on my experience has been helpful to my students," he says. In keeping with a new emphasis on communication skills for chemical engineers, Harrison has also developed an instruction module on oral presentations that he described in an article for the journal *Chemical Engineering Education.*

As graduate coordinator in Chemical Engineering for the past five years, Harrison, with the support of the department, has led an initiative to recruit U.S. students for graduate studies. This effort has increased the percentage of U.S. students to about 70%, from below 40% before starting the initiative. "Our U.S. students are from all over the country, from Michigan to Mississippi," he says. He has also made efforts to recruit more students from South America and Europe, which has created a broadly diversified group of international students. ■

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Much as Edgar O'Rear enjoys doing research, he believes that his role as a scientist is only a fraction of his job. "One of the most important parts of what we do is to teach students to do research. If we were interested solely in research for research's sake, we'd use only experienced workers," he says.

"Our student researchers have come from six continents; we've pulled from universities like Cambridge, MIT, and Purdue. My job is to help develop those researchers to make a difference in life all over the world."

In addition to teaching courses, including heat, mass and momentum transfer, he is professor of chemical engineering and associate dean for research in the College of Engineering.

"My role is to promote research within the college, to encourage high standards and high productivity in engineering. Research should be seen in the context of an overall part of education, and is integral to being a true university," he says.

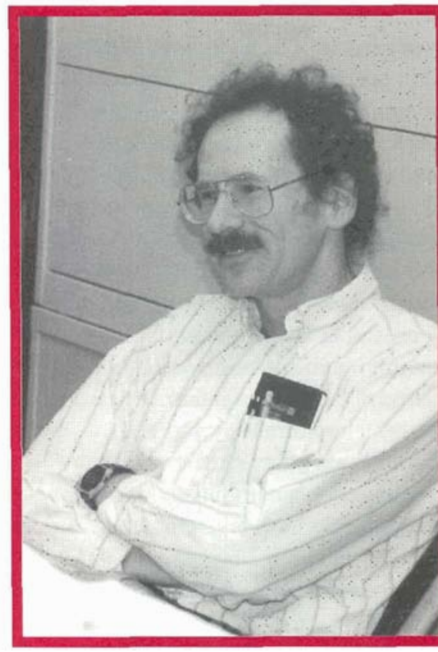
> "Our student researchers have come from six continents; we've pulled from universities like Cambridge, MIT, and Purdue. My job is to help develop those researchers to make a difference in life all over the world."

Ed O'Rear

One of O'Rear's passions as a researcher, which he shares with three graduate students and several undergraduates, is investigation of the circulatory and cardiovascular systems and their behavior during acute myocardial infarction, or heart attacks.

A major breakthrough in treatment came in the 80s, when it was finally proven that blood clots were involved in heart attacks. This spawned a logical method of treatment using "clot busting" drugs, or plasminogen activators such as streptokinase (SK), as chemical triggers to activate the body's own system for dissolving clots. Dissolution of the clots allows blood flow to return to normal. The problem with the delivery of these drugs is that they don't work quickly enough: to minimize tissue damage during a heart attack, time is of the essence. Although clot-busting drugs are said to be effective up to six hours after a heart attack, major tissue damage actually occurs much more quickly. For example, other researchers have shown that, in dogs, 30-40% of the infarcted area tissue is lost in 40 minutes, and 80-90% in three hours. Even when flow is returned after one hour, damage is evident. Conventional treatments now take 30 minutes to an hour to reestablish blood flow once treatment begins, and may result in bleeding complications.

O'Rear found that the plasminogen activator streptokinase could dissolve clots more quickly, with fewer complications, when it was encapsulated with liposomes. This liposome-encapsulated streptokinase (LESK) dissolves clots in half the time or less and requires lower doses of medication to reestablish blood flow because it gravitates directly to blockages in the arteries. His research



Ed O'Rear counsels one of his students in his office.

has been duplicated in China and, according to one source, at Harvard, and he hopes to see it on the market within ten years. "This method is better, quicker, and less expensive than our current modes of therapy," he says. "Because it requires less medication to get results, dangerous complications such as bleeding problems may also be lessened."

O'Rear is currently doing research with a pharmacologist at the OU Health Sciences Center, Gene Patterson, and biochemist Art Johnson at Texas A&M on extending this work to strokes. In related research, O'Rear is working with a prototype of a damped oscillation rheometer built by a colleague in Japan. This device is used by researchers to conduct experiments with blood clotting. "Right now the popular techniques used to measure thrombolysis rates produce radioactive waste. This is a safer, more environmentally friendly way to do research, without the radioactive waste. It could potentially be used in clinical studies," he said.

He has also been working to measure the flow properties of red blood cells and the damage the cells experience from disease and medical technology. Associated with this was a study on an incompatibility of artificial blood with red blood cells. His research identified the underlying mechanisms of the problem, and could result in improvements in artificial blood and its interactions with living cells.

His interest in studying the properties and flow of matter has led O'Rear to become involved in the International Society for Biorheology. As secretary general, he has networked with people all over the world in the interest of research. "I can see the merit of President Boren's efforts to internationalize the University. It is our opportunity to help people around the world while learning from them, and enrich lives and cultures everywhere," he says.

His studies have taken him to Japan with Hitachi, to a visiting professorship in Thailand, and to Taiwan and Russia. "I grew up in the south, went to school in Houston and Boston, and have been at OU since 1981. From my travels all over the world, I appreciate that we're in select company here, thanks to support by many different groups and the blessing of many good students," he remarks.

What new mysteries intrigue O'Rear? "I'm interested in understanding the actual trigger for heart attacks," he says. "We know that the development of plaque, or hardening of the arteries, is the long-term condition which promotes the formation of blood clots. These clots are the short-term condition which leads to heart attacks. Most factors we've identified, such as cigarettes and high cholesterol, probably relate to the long-term. I want to understand the short-term trigger, to address the problem from that angle," he says.

That's good news for heart patients both in Oklahoma and around the world. ■

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Grady finds satisfaction in mentoring program

Dr. Brian Grady, assistant professor of Chemical Engineering, was recently honored by the National Science Foundation with a Career Award for faculty in their first four years of a teaching appointment.

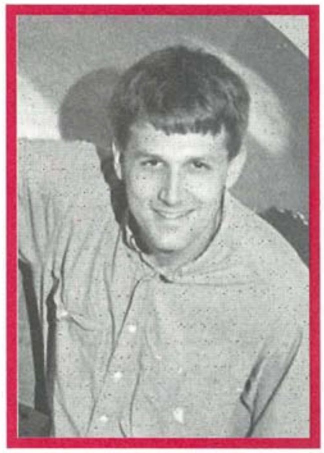
Grady's winning grant proposal, "X-ray Absorption Spectroscopy of Thermal Behavior in Polymers," included a career development plan for recruiting minority seniors and mentoring them throughout their undergraduate and graduate careers.

"My primary goal, both in research and in teaching," Grady wrote in his NSF proposal, "is to allow students to reach their full potential. I believe that students free to pursue their ideas are happier, tend to work harder and are more productive."

Grady said, rather than trying to force students to do things a certain way, his approach is based on allowing students to think for themselves, while ensuring that their thoughts are logical. "Undergraduates require more enabling and guiding," he wrote, "while mature graduate students should only require listening."

Although mentoring is important for all students, Grady is especially interested in meeting the needs of minority students. He is currently working with the OU Minority Engineering Program, which is one of the top-ranked collegiate minority mentoring programs in the nation. Together with the MEP office, Grady is working on a plan to travel to primarily minority high schools and give talks designed to interest students in science and provide them information about careers available to engineers.

Currently, almost 21 percent of enrollment in the College of Engineering comes from students in the Minority Engineering Program, and in Chemical Engineering, almost 28 percent. These



Dr. Brian Grady

figures are astounding, Grady says, when considering the representation of blacks, Hispanics and Native Americans in the engineering profession nationwide is only five percent.

In December 1994, the American Chemical Society's Board of Directors approved a scholarship program in the amount of one million dollars a year for five years to encourage and support African-American, Hispanic and Native American undergraduate college students in the chemical sciences nationwide. Grady serves as a mentor for the ACS program, along with OU ChemE professors Melissa Rieger and Edgar O'Rear.

"A colleague of my father talked to me about chemical engineering when I was in high school, and helped convince me to enroll," said Grady. "I feel that I am giving something back when talking to these students. I believe the engineering profession contributes positively to society and that our department provides an excellent education and a bright future." ■

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The ChemE faculty would like to congratulate Brian and his wife, Michelle, and big brother Ian, 2, on the birth of Nathaniel Richard, born April 17, 8 lbs., 6 oz.

Alumni Notes

The OU Chemical Engineering Advisory Board, OkChE, will match any donations for a memorial scholarship in honor of Kathleen Lorengo-Sultan, a 1996 ChemE honors graduate, who died Feb. 12 after a struggle with cancer. She was 33.

The daughter of John and Lois Lorengo, Sultan was born Aug. 15, 1964, in Butte, Mont. She married Akbar Sultan Dec. 6, 1995. She received her bachelor's degree in chemical engineering from the University of Oklahoma and an associates degree from Oklahoma City College.

OkChE will provide one dollar for every two donated to the Sultan Scholarship Fund. When the total reaches $10,000, a permanent endowment will be created to produce a memorial scholarship in perpetuity. Donations can be sent to the Sultan Scholarship Fund, Chemical Engineering, The University of Oklahoma, Norman, OK 73019.

Kudos to ChemE alum John Waller, who volunteers his time to counsel OU Chemical Engineering students about job placement, and teaches communication and job skills in several classes.

We'd like to hear from you! Please send your alumni notes via the OkChE Web page at: www.ou.edu/engineering/CEMS/OKChE/okche97.html or email to: rwheeler@mailhost.ecn.uoknor.edu.

Nollert, *continued from page 5*

"So how long do the platelets stay sticky? That's part of what we're trying to work out. What are the mechanisms that regulate the blood clotting? The biochemist, the medical people have worked out which molecules are involved in telling the platelets to turn back off. There are literally dozens of chemicals involved. How do you know which one is the most important? Again, that's where chemical engineers come in.

"In a test tube you can adjust the concentration of chemicals. What concentration of chemical X do I need to get the platelets to become unstuck and how do you measure what the concentration of this chemical is in the blood? Well, since the platelets here are producing a lot of this chemical you'd expect it to be high here and lower here. How much lower?

"The health science center guys identify what the molecules are, but in order to know which molecule is important, you need to know what its concentration is. That is a classic engineering problem. The techniques of how to solve this problem have been around for 50 years. I think there are just not enough chemical engineers doing medical research," he said.

Nollert's experiments utilize plastic replicas of blood vessels, which can be used repeatedly to verify results, without the cost or the ethical dilemmas associated with animal subjects.

"We don't do animal or human experiments here," Nollert said. "That kind of experiment is expensive and traumatic to the animal. With a model blood vessel, we just draw some blood and put it in our model. Then we'll make our model have an 'injury' and count how many platelets stick at the site. We can do this again and again fairly economically. Instead of subjecting a dog to surgery, we just draw a little blood."

Nollert also is taking a close look at the blood vessels in the heart for susceptibility to coronary artery disease. "Heart attacks or vascular disease take 50 percent of our population," Nollert said. "If we had a way to cure vascular disease, we are talking about a huge impact."

An exchange student comes in, interrupting the interview. Nollert seems eager to show her around. He has taken an active role in student affairs since he came to the University seven years ago. He is currently the AIChE student chapter advisor and senior class advisor. An associate professor, since being granted tenure in 1997, Nollert is happy with the working atmosphere in the department, the collaboration and interest among faculty members and the support of the director.

"I had met most of the faculty members at the AIChE meeting in Chicago in late 1990," he said. "Over lunch, everyone was saying what a great place this was. That this (the University of Oklahoma) was a place where everyone works well together, teaching load is not excessive, so there's time for research, money for equipment, and grad students to help. But I had been around and I thought, there is no place like that...and then I got here and found it was all true."

If Nollert has his way the Chemical Engineering Department at the University of Oklahoma will become world famous, not just for being a great place to work, but as a place where diseases of the vascular system meet their match. ■

Email: nollert@ou.edu

Awards and Special Achievements for Students

Undergraduates

Johnaca Biggins Kevin McAllister and Jeremy Ortega	Awarded scholarships from the American Chemical Society for 1997-98.
Jennifer Cocharo	Selected as the 1997 Miss Hispanic OU.
Nilanjana "Lynn" Ghose	Selected to receive the Conoco Leadership Program Scholarship for 1997-98.
David Larson	Awarded the F. Mark Townsend Scholarship for 1997-98.
Jeffrey Wayne Thornton	Awarded the Jack and Medora Blanton Enrichment Scholarship for 1997-98.
Connie Grimes	Awarded F. Mark Townsend Scholarship, established in 1983 by his students to honor Professor Emeritus F. Mark Townsend, a favorite instructor who continues to give generously of his time as a member of the OkChE Board of Directors.
Quincy Amen and Christine Tratz	CEMS Outstanding Sophomores
Jennifer Cocharo	AIChE Award for Outstanding Junior in Chemical Engineering
David Larson	Outstanding Senior
Richard Lamirand and Denton Newham	Robert Vaughan Award for Excellence in Undergraduate Research

Graduate Students

Terence Caldwell	Graduate Student member of the Graduate Council September 1, 1997 to August 31, 1998
Martina Dreyer	Awarded the President's Trophy in recognition of outstanding participation in academics, campus activities, community service and cultural interaction.
J. Kent Leach and Elizabeth Nguyen	Phillips Petroleum Company Graduate Research Assistantships, 1997-1998.

Spring Graduates

PhD Graduate
Hatice Gecol
Ahmadali Tabatabai

Master's Graduate
Brian Douglas Tate

Bachelor's Degrees
Willis Ballew
Brian Bogard, Glenpool
Jason Bryant, Oklahoma City
Scott Haas
Danny Hensley, Yukon
Jennifer Jarvis, Kimberly, ID
Rob Jeffries, Oklahoma City
Yeol Tae Kim, South Korea
Genesta King, Harrah
Tety Kwee, Indonesia
Richard Lamirand, Shawnee
David Larson, Aberdeen, SD
Chris Lichtenwalter, Edmond
Chong Sin Lim, Malaysia
Tzeh Wen Lim, Malaysia
Guan Kheng Low, Singapore
Richard Merriott, Lubbock, TX
Sooi Sooi Ooi, Malaysia
Jon Poglitsch, Dallas, TX
Patricia Prasatya, Indonesia
Grant Rodolph, Parker, TX
Sandy Snyder, Menomee Fall, WI
Hubert Song, Malaysia
Andrew Sprouse, Okmulgee
Jennifer Strojny
Pick Har Tan, Malaysia
Jeff Thornton, Norman
Subha Varahan, Norman
Josh Wickersham, Tulsa
Sook Yang, Seoul, Korea
James Yeager, Great Falls, MT

1997 Faculty Publications

M.J. Bagajewicz
"Design and Retrofit of Sensor Networks in Process Plants," *AIChE Journal*, 20, N 9, pp. 2300 (1997).
(with Q. Jiang) "An Integral Approach to Dynamic Data Reconciliation," *AIChE Journal*, 43, N 10, pp. 2546 (1997).
(with R. Pham and V. Manousiouthakis) "On the State Space Approach to Process Design," *Chemical Engineering Science*. To appear.
"On the Design Flexibility of Crude Atmospheric Plants," *Chemical Engineering Communications*. To appear.

B.P. Grady
(with W.B. Genetti and E.A. O'Rear) "The Effect of Orientation on Electrically Conducting Polymer Composite Properties," *Electronic Packaging Materials Science IX, Materials Research Society Symposia Series*, Volume 445. S.K. Groothuis, P.S. Ho, K. Ishida and T. Wu Eds. (Pittsburgh: Materials Research Society) (1997).
(with K.C. Lim, J.D. Margerum, A.M. Lackner, E. Sherman, M.S. Ho, B.M. Fung, W.B. Genetti) "A Liquid Crystal Based Polymer for Applications in MMW Modulation Devices," *Molecular Crystals and Liquid Crystals*, 302, 187 (1997).

J.H. Harwell
(with H. Sakai, M. Abe) "Preparation and Properties of Multiphase Microemulsions with Some Phosphatidylcholines Having Different Alkyl Chains," *Colloids and Surfaces B: Biointerfaces*, 9, pp. 177-186 (1997).
(with R.C. Knox, D.A. Sabatini, R.E. Brown, C. West, F. Blaga, C. Griffin) "Surfactant Remediation Field Demonstration Using a Vertical Circulation Well," *Ground Water*, 35, N 6, pp. 948-953 (1997).
(with D.A. Sabatini, R.C. Knox, T. Soerens, L.Chen, R.E. Brown, C. West) "Design of a Surfactant Remediation Field Demonstration Based on Laboratory and Modeling Studies," *Ground Water*, 35, N 6, pp. 954-963 (1997).
(with H. Sakai, H. Imamura, Y. Kakizawa, M. Abe, Y. Kondo, N. Yoshino) "Active Control of Vesicle Formation Using a Redox-Active Surfactant," *Denki Kagaku*, 65, N 8, 669-672 (1997).
(with S.W. Horstkamp, K.E. Starling, R.G. Mallinson) "High-Energy Density Storage of Natural Gas in Light Hydrocarbon Solutions," *AIChE Journal*, 43, N 4, pp. 1108-1113 (1997).
(with M.A. Ioneva, R.G. Mallinson) "Sorptive Storage of Light Hydrocarbon Vapors by Capillary Condensation in MCM-41 Type Mesoporous Materials," *MRS Symposium Proceedings*, 454 (1997).
(with M.A. Hasegawa, D.A. Sabatini) "Liquid-liquid Extraction for Surfactant-Contaminant Separation and Surfactant Reuse," *Journal Environmental Engineering*, 123, N 7, pp. 691-697 (1997).
(with C.L. Lai, E.A. O'Rear) "Adsolubilization of Flourocarbon Alcohols into Perfluoroheptanoate Admicelles Formed on Alumina," *Langmuir*, 13, N 16, pp. 4267-4272 (1997).
(with N.P. Hankins) "Case Studies for the Feasibility of Sweep Improvement in Surfactant-Assisted Waterflooding," *Journal Petroleum Science Engineer*, 17, N 1, pp. 41-62 (1997).

L.L. Lobban
(with A. Marafee, C. Liu, G. Xu, R. Mallinson) "An Experimental Study on the Oxidative Coupling of Methane in a DC Corona Discharge Reactor over Sr/La2O3 Catalyst," *Ind. and Eng. Chem. Res.*, 36, 632-637 (1997).
(with A. Marafee, C. Liu, G. Xu, R. Mallinson) "Methane Conversion to Higher Hydrocarbons over Charged Metal Oxide Catalysts with OH Group," *Applied Catalysis A: General*, 164, 21-33 (1997).
(with C. Chakulsukanant, S. Osuwan, A. Waritswat) "Adsolubilization and Stability Characteristics of Hydrocarbon Aggregates Chemically Bonded to Porous Silica," *Langmuir*, 13, 4595-4599 (1997).

R.G. Mallinson
(with A. Marafee, C. Liu, G. Xu, L.L. Lobban) "An Experimental Study on the Oxidative Coupling of Methane in a DC Corona Discharge Reactor over Sr/La2O3 Catalyst," *Ind. and Eng. Chem. Res.*, 36, pp. 632-637 (1997).
(with S.W. Horstkamp, J.H. Harwell, K.E. Starling) "Calculation of Properties for Methan-Light Hydrocarbon Mixtures for use as High Energy Density, Liquid State, Transportation Fuels," *AIChE*, 43, pp. 1108 (1997).
(with C.A. Liu, A. Marafee, L.L. Lobban) "Methane Conversion to Higher Hydrocarbons in a Corona Discharge over Metal Oxide Catalysts with OH Groups," *Applied Catalysis*, A., N 164, 21, (1997).
(with M.A. Ioneva, J.H. Harwell) "Sorptive Storage of Light Hydrocarbon Vapors by Capillary Condenstration in MCM-41 Type Mesoporous Materials," *MRS Symposium Proceedings*, 454 (1997).
(with M.A. Ioneva, J.H. Harwell) "Adsorption of Light Hydrocarbons in Sorbents with Controlled Porosity," revision pending *Langmuir*, August (1997).
(with L.L. Lobban) "Methane Conversion to Higher Hydrocarbons, Olefins and Oxygenates in Low Temperature Plasmas," US Patent Application, University of Oklahoma, March (1997).
(with K.E. Starling and J.H. Harwell) "High Density Storage of Methane in Light Hydrocarbons," U.S. Patent Application, July (1997).
(with L.L. Lobban) "Methane Conversion to Higher Hydrocarbons, Loefins and Oxygenates in Low Temperature Plasmas," US Patent Application, University of Oklahoma, January (1997).

E.A. O'Rear
(with S. Kawakami, M. Kaibara, M. Nakayama, Y. Isogai, S. Ikemoto, J.S. Lee) "Rheological Study of the Dynamic Process of Fibrinolysis," *Blood Coagulation and Fibrinolysis 8*, pp. 351-359 (1997).
(with C.L. Lai, J.H. Harwell) "Adsolubilization of Flourocarbon Alcohols into Perfluoroheptanoate Admicelles Formed on Alumina," *Langmuir* 13, pp. 4267-4272 (1997).
(with W.B. Genetti, B.P. Grady) "The Effect of Orientation on Electrically Conducting Polymer Composite Properties," in Electronic Packaging Materials Science IX, *MRS Symposia Series*, 445, 153 (1997) Materials Research Society, Pittsburgh.
(with V.V. Tuliani) "Circulatory Concentrations of Fibrinolytic Species During Thrombolytic Therapy Estimated by Stirred-Tank Reactor Analysis," *Pharmaceutical Research 14*, pp. 1053-1059 (1997).

D.M. Resasco
(with S.M. Stagg, C.A. Querini, W.E. Alvarez) "Isobutane Dehydrogenation on Pt-Sn/Sio2: Effect of Preparation Variables and Regeneration Treatments," *Journal of Catalysis*, 168, 75 (1997).
(with W.E. Alvarez, H. Liu) "Comparison of the Different Promoting Effects of Fe-Mn, Ni, and Pt on the n-Butuane Isomerization Activity of Sulfated Zirconia Catalysts," *Applied Catalysis*, 162, 103 (1997).
(with J.M. Smith, H. Liu) "Deactivation and Shape Selectivity Effects in Toluene Nitration over Zeolite Catalysts," *Stud. Surf. Sci. Catal*, *111*, 543 (1997).
(with S.M. Stagg) "Effects of Promoters and Supports on Coke Formation on Pt Catalysts During CH4 Reforming with CO2," *Stud. Surf. Sci. Catal*, 199 (1997).
(with A. Ali, W.E. Alvarez, C.J. Loughran) "State of Pd on H-ZSM-5 and other acidic supports during the selective reduction of NO by CH4 studied by EXAFAS/XANES," *Applied Catalysis B*, Environmental 14, 13, (1997).

J.F. Scamehorn
(with B.R. Fillipi, R.W. Taylor and S.D. Christian) "Selective Removal of Copper from an Aqueous Solution Using Ligand-Modified Micellar-Enhanced Ultrafiltraiton

See Publications page 16

Grants, *continued from page 15*

Robert Shambaugh, Chemical Engineering and Materials Science
Various
Center for Polymer and Fiber Research
$15,000.00

John Scamehorn, Chemical Engineering and Materials Science
Surfactant Associates
Extend to December 31, 1998
Measurement of Surfactant Properties
$4,000.00

Edgar O'Rear, III, Chemical Engineering and Materials Science
Research Corporation Technologies
December 18, 1997 - December 31, 1998
Application of Liposomal Encapsulated Plasminogen Activators in a Stroke Model
$2,500.00

Daniel Resasco, Chemical Engineering and Materials Science
National Science Foundation
January 1, 1998 - December 31, 2000
Role of Acid Sites in the Selective Reduction of NO by Methane Over Pd-Based Catalysts in the Presence of Excess Oxygen
$265,022.00

Daniel Resasco, Chemical Engineering and Materials Science
Phillips Petroleum Company
Extend to December 31, 1998
Sulfur Resistant Catalysts for Aromatization of C6 and C7
$20,000.00

Richard G. Mallinson, Chemical Engineering and Materials Science
Lance L. Lobban, Chemical Engineering and Materials Science
U.S. Department of Energy
Extend to December 31, 1998
Enhancement of Methane Conversion Using Electric Fields
$100,000.00

CEMS Faculty Scholarship Endowment

Chemical Engineering faculty members at the University of Oklahoma have contributed $10,000 in personal gifts to the department to be used for undergraduate scholarship funding. CEMS alumnus, Richard Askew, has matched this amount, bringing the total to $20,000. Currently Askew has pledged to match up to $100,000 in contributions to the department.

CEMS faculty wanted to show alumni how much they appreciate their gifts to the department, in terms of both leadership and personal contributions. "We felt like a good way to communicate our appreciation to them was to fund a scholarship ourselves," said Dr. Jeffrey Harwell, Conoco/Dupont Professor of Chemical Engineering and director of the department.

The program is part of the Plan 2000 initiated by Dean Billy Crynes and Dean Don Geis in the early '90s. At that time, CEMS set a goal of funding ten $20,000 endowed scholarships to enhance the Program of Excellence.

"We looked for a champion to pledge $100,000 to be used as matching money for any additional money we could raise," said Harwell. "Dick Askew came to us as soon as he heard about the program. He became that champion."

Since then, more than $70,000 has been raised to create individual scholarships. The OkChE Board funded two, named in honor of Ruth and R. L. "Doc" Huntington, the first chairman of chemical engineering at OU , and Laurance "Bud" Reid, a gas industry pioneer who was largely responsible for OU's leading role in the development of natural gas industry.

Other scholarships have been funded by OkChE Board members J. D. Holbird and Omer Pipkin and his wife, Marjorie. Former CEMS department chair Ray Daniels and his wife, Libby, also are funding a scholarship. ■

In other endowment news...

Dr. Harwell is pleased to announce that The Sam Wilson Endowed Professorship is now fully funded and eligible for state matching funds. ■

Publications, *continued from page 13*

Using an Alkyl-B-Diketone Ligant," *Sep. Sci. Technology*, 32, 2401, (1997).

(with Guo, H. Uchiyama, E.E. Tucker, S.D. Christian) "Use of Polyelectrolyte/Surfactant Complexes in Colloid-Enhanced Ultrafiltration," *Colloid Surf.*, 123, 695 (1997).

(with D.A. Rockstraw) "Volumetric Mixing in Anionic/Nonionic, Cationic/Nonionic, and Anionic/Cationic Mixed Micelles," *Journal Collloid Interface Science*, 186, 215 (1997).

R.L. Shambaugh

(with A.S. Harpham) "Velocity and Temperature Fields of Dual Rectangular Jets," Ind. *Eng. Chem. Res.*, 36,N 9, pp. 3937-3943 (1997).

"Modeling of the Next Generation of Melt Blowing," *Tappi Journal*, 80, N 9, pp. 163-166 (1997).

Program of Excellence Scholars and Sponsors, 1997-1998

Kirk Allen
Tulsa, Oklahoma
Diamond Shamrock Co. Scholar

Jamie Craig
Norman, Oklahoma
CEMS Associates Scholar

Rodney N. Alles, Jr.
McAlester, Oklahoma
Diamond Shamrock Co. Scholar

Jeremy J. Daniel
Pawhuska, Oklahoma
CEMS Associates Scholar

Quincy V. Amen
Bartlesville, Oklahoma
National Merit Scholar
Omer A. & Marjorie M. Pipkin/
Richard G. Askew Scholar

Brian H. Daugherty
Claremore, Oklahoma
CEMS Associates Scholar

Maria Fassio
Krebs, Oklahoma
CEMS Associates Scholar

Gary A. Barber
El Paso, Texas
CEMS Associates Scholar

Zachary J. Frazier
Cushing, Oklahoma
CEMS Associates Scholar

Jeffrey A. Blomgren
Wylie, Texas
Texaco Inc. Scholar

Nilanjana "Lynn" Ghose
Tulsa, Oklahoma
Sam A. Wilson Memorial Scholar

Lorna M. Bradley
Tulsa, Oklahoma
Shell Development Co. Scholar

Gregory R. Gonser
Great Falls, Montana
National Merit Scholar
Phillips Petroleum Scholar

Jill M. Brown
Brookfield, Wisconsin
National Merit Scholar
Richard L. Huntington/
Richard G. Askew Scholar

Brandon H. Grissom
Sulphur, Oklahoma
W. D. Owsley Scholar

Jason E. Bryant
Oklahoma City, Oklahoma
W. D. Owsley Scholar

Ginny M. Harris
Sioux Falls, South Dakota
National Merit Scholar
Laurance S. Reid/
Richard G. Askew Scholar

Julio C. Cabrera
Coral Springs, Florida
National Hispanic Scholar
Laurance S. Reid/
Richard G. Askew Scholar

Bret D. E. Hunter
Altus, Oklahoma
Sam A.Wilson Memorial Scholar

Crystal N. Casey
Sherwood, Arkansas
National Achievement Scholar
Omer A. & Marjorie M. Pipkin
Richard G. Askew Scholar

Kurt E. Johnson
Corvallis, Oregon
National Merit Scholar
CEMS Associates Scholar

Patricia Chung
Tulsa, Oklahoma
Sam A. Wilson Memorial Scholar

Kathryn C. Keister
Dallas, Texas
Sam A. Wilson Memorial Scholar

Russell Cook
Milburn, Oklahoma
CEMS Associates Scholar

The University of Oklahoma is a doctoral degree-granting 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 20 colleges offering 160 undergraduate degree programs, 125 master's degree programs, 79 doctoral programs, professional degrees in four areas and 20 dual professional/master's programs. OU enrolls more than 25,000 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 $507 million.