Nanotechnology meets biology and DNA finds its groove

The object of fascination for most is the DNA molecule. But in solution, DNA, the genetic material that holds the detailed instructions for virtually all life, is a twisted knot, looking more like a battered ball of yarn than the famous double helix. To study it, scientists generally are forced to work with collections of molecules floating in solution, and there is no easy way to precisely single out individual molecules for study.

Juan de Pablo, Mike Graham, chemistry professor David Schwartz and others have now developed a quick, inexpensive and efficient method to extract single DNA molecules and position them in nanoscale troughs or “slits,” where they can be easily analyzed and sequenced.

The technique, which according to its developers is simple and scalable, could lead to faster and vastly more efficient sequencing technology in the lab, and may one day help underpin the ability of clinicians to obtain customized DNA profiles of patients.

Read more at www.news.wisc.edu/13436

CBE team develops higher-energy liquid-transportation fuel from sugar

Jim Dumesic and his research group keep churning out a steady stream of major advances in the effort to develop new renewable fuels for transportation. His latest advance, published in the June 21, 2007 issue of the journal Nature, is the development of a two-stage process for turning biomass-derived sugar into 2,5-dimethylfuran (DMF), a liquid transportation fuel with 40 percent greater energy density than ethanol. In addition to higher energy content, dimethylfuran also addresses other ethanol shortcomings: DMF is not soluble in water and therefore cannot become contaminated by absorbing water from the atmosphere. DMF is stable in storage and, in the evaporation stage of its production, consumes one-third of the energy required to evaporate a solution of ethanol produced by fermentation for biofuel applications. An interesting profile of Jim, titled, “Catalyzing the Emergence of a Practical Biorefinery,” appeared in the February 9, 2007 issue of Science, and is available through the department website.


Stem cells used to create critical brain barrier in lab

Writing in the Journal of Neurochemistry, a group led by Eric Shusta describes an experiment in which nascent rat neural stem cells were used to prod blood vessel cells to assume properties of the blood-brain barrier.

The blood-brain barrier is an anatomical feature in humans and other animals that protects the brain from chemicals and other harmful agents, but also limits the ability of clinicians to administer helpful drugs. It is a feature that can succumb to diseases such as Alzheimer’s or acute conditions such as stroke, which can leave the brain vulnerable.

The blood-brain barrier is a critically important structure, Eric says. Not only does it physically block the movement of substances between blood and brain, but it also possesses active properties that enable cells to pump unwanted molecules from cells back into the bloodstream. What’s more, it has a metabolic function that can alter the chemical properties of the molecules that do get through to the brain. “It dictates traffic in and out of the brain,” Eric explains.

Demonstrating that developing brain cells can release factors that may coax small blood vessels to exhibit the properties of the blood-brain barrier is important for a number of reasons. First, it forms a basis for understanding the mechanism that provides critical protection for the brain. Second, it may lead to insights regarding ways to overcome a barrier that frustrates neuroscientists, drug companies and clinicians who would like to sneak drugs past it to treat disease.

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W ell, it’s been a while. The last issue of On These Foundations appeared in the summer of 2005, shortly before the department’s hugely successful centennial celebration. If you missed it, check out the department website (www.engr.wisc.edu/che) to see Bob Bird’s and Harmon Ray’s talks about the department’s history, Jim Rawling’s talk on the department’s present and future, pictures, and more. On page 5 of this newsletter you’ll find information on how to purchase Bob Bird’s monumental book on the history of the department.

It’s been a busy two years for the department—challenging and exciting. On the challenging side, the department, college and university continue to face budget and staff reductions and constraints (which, in part, explains the delay in getting this newsletter out to you). We are continually thankful for the generous support of alumni and friends, which helps the department to continue to thrive in a financially difficult environment.

On the exciting side, in July we were joined by two new faculty members; Brian Pfleger and Jennifer Reed. Both Jennie and Brian are academic descendants of our own Ed Lightfoot (Jennie an academic “granddaughter,” Brian a “great-grandson”). We are pleased to have attracted both Brian and Jennie to Madison and we know we will see great things from them. Look for more information on their appointments in the next (not too distant!) issue of our newsletter.

Another big change for the department is the retirement, last September, of Charlie Hill. Charlie joined the faculty in 1967, becoming a leader both within the department and in the profession at large. (See page 5)

Tom Kuech’s term as department chair ended in June last year. We are grateful to Tom for his service and leadership. He brought us into our second century, adding new faculty (Christos Maravelias), new facilities (including a renovated polymer synthesis instructional lab and new research and graduate student space in the basement) and new elements to the curriculum, rounding out the department’s transition from Chemical Engineering to Chemical and Biological Engineering.

After reading this newsletter, I think you’ll agree that the department is off to a great start in its second century.

Juan de Pablo, as director of the campus Materials Research Science and Engineering Center, led a successful bid to renew the center’s funding from the National Science Foundation at nearly $14.8 million over six years. The center promotes campus research, and educational outreach on interfacial phenomena at the nanoscale and facilitates collaboration among more than 30 faculty members in 13 UW-Madison departments, as well as nearly 40 graduate students and postdoctoral researchers, and about 20 undergraduate students. Juan has also been appointed as associate editor of the American Physical Society’s journal Physical Review Letters, but these service activities have not held back his own research. His group reported in Biophysical Journal on the development of new computational methods to better understand the forces affecting protein folding under severe confinement. Most research in this area has looked at proteins in free solution when in fact, most proteins in nature are confined in some way. The new methods enable calculation of atomic interactions that tend to fold the protein molecule, as well as entropy that tends to unfold it, providing a remarkably complete picture of protein folding in more relevant environments.

Mike Graham and his group reported in Physical Review Letters on a mathematical model they developed to simulate the motion of bacteria suspended in a fluid. At high concentrations, bacteria have been observed to move in coordinated whirling patterns that, among other things, facilitate the rapid distribution of food or oxygen through the local environment, but no one could explain what choreographs this complex dance. Bacteria in the model do not communicate with one another. Rather each just moves in and is moved by the fluid. The model reproduces coherent large-scale patterns of motion similar to those observed under the microscope, with tens to hundreds of bacteria organizing into large whirls that move together for a while before swimming off to join another whirl. In the future, bacteria or artificial swimming micromachines might be used to stir fluids in microfluidic devices.

Dave Lynn presented a summary of his work on ultrathin, nanoscale films composed of DNA and water-soluble polymers that allow controlled release of DNA from surfaces at the spring 2007 meeting of the American Chemical Society in Chicago. When used to coat implantable medical devices, the films offer a novel way to deliver useful genes. Dave has used his nanoscale films to coat intravascular stents. Similar in concept to currently available drug-coated stents, Dave hopes to deliver genes that could prevent the growth of smooth muscle tissue into the stents (which can re-clog arteries) or treat the underlying causes of cardiovascular disease. In preliminary experiments conducted in collaboration with researchers in the UW School of Medicine & Public Health, Dave has shown that DNA film-coated stents can successfully deliver a gene encoding a fluorescent protein into a rabbit’s artery, demonstrating that the films also can work in the complex environment of living tissue. He also received a highly competitive research fellowship from the Alfred P. Sloan Foundation, which provides flexible research support.

Christos Maravelias has received a Faculty Early Career Development (CAREER) Award from NSF. The CAREER awards, among the most prestigious given to faculty members who are just beginning their academic careers, are granted to creative projects that integrate research and education. Christos will apply his $408,285 award toward modeling and optimizing the pharmaceutical R&D and supply chain. His goal is to enable pharmaceutical companies to manage more effectively their R&D pipelines to reduce the cost of developing new drugs. Christos is integrating into the curriculum both the subject and the methods used in his research. At the undergraduate level, he is developing case studies to be used in the senior process design course. He also is developing a new graduate-level course on optimization methods for chemical engineers.

Manos Mavrikakis continues to gain prominence for his work using computational approaches to develop novel catalytic materials. Last November he published an invited editorial in Nature Materials titled, “A search engine for catalysts”. Several other papers from his group were published in Angewandte Chemie International Edition, and JACS. In October, an article by the National Center for Supercomputing Applications titled, “How the fuel cells will be won,” featured work by Manos’ group and experimental collaborators at Brookhaven National Laboratory to develop more efficient, lower cost catalysts for fuel cells. Manos and his student Anand Nilekar are the 2005-2008 S. C. Johnson Distinguished Fellows, pursuing research on designing improved fuel cell catalysts from first-principles. In addition, Manos was invited to participate in the NAE 2006 German-American Frontiers of Engineering Symposium (GAFOE) in May 2006.
For more information on many of these notes, see “In the News” on the department website at www.engr.wisc.edu/che.

Pattern of dead cells rather than isolated spots or plaques. John has applied for a patent on the particles to flow toward the edges of the dish, infecting many more cells and creating a starburst virus with a cover layer of agar, John’s group uses a liquid culture medium that allows the virus a viral sample into a Petri dish containing a layer of healthy cells. Rather than immobilizing the sensitivity of the standard plaque test for virus infectivity. The standard test involves introducing Methods, synthesis, repair themselves, or even evolve. In other work appearing in the Journal of Virological, Paul Nealey, Juan de Pablo, and an international team of scientists have reported in Physical Review Letters building novel, three-dimensional nanostructures by self-assembly of block copolymers on two-dimensional templates produced with standard lithographic techniques. Past work in the area was based on lithographic surface patterns that matched the bulk morphology of the block copolymer. By combining complex, nonobvious patterns with well known bulk morphologies, the team has created structures completely different from the same block copolymer materials in the bulk. The materials are stable, well defined, nearly defect-free over large areas, and align perfectly with the underlying lithographic pattern—all key requirements for any device or application based on them. With large surface to volume ratios, and the ability to control the dimensions of channels and pores, the materials could be ideally suited to applications in catalysis, separations, and filtration, and may demonstrate interesting mechanical or optical properties.

Eric Shusta presented a summary of his recent work at the fall 2006 national meeting of the American Chemical Society in San Francisco. Eric and his group have identified a panel of unique antibodies that bind to the plasma membranes of brain endothelial cells that form the blood-brain barrier, and have demonstrated that some of these have the capacity to gain access to the cell via active transport mechanisms. By attaching therapeutic drugs to these antibodies, they could act as molecular Trojan horses to carry a wide range of pharmaceuticals to the brain. Furthermore, with different cell surface features in different regions of the brain, it might be possible to customize antibodies to carry drugs to only those parts of the brain that would benefit from treatment. Eric has received funding from the National Institutes of Health to continue this work.

Ross Swaney, together with Gary Scott (PhD ‘93) Cory Black (MS ‘01) and other collaborators at the USDA Forest Products Laboratory in Madison have been granted a patent on an improved process for producing paper pulp that involves pretreatment of wood chips or other feedstock with oxalic acid. The process reduces the electrical energy required to produce pulp mechanically, while improving the strength of the finished paper product. Process development is continuing in collaboration with a Wisconsin paper company. A second patent application has been submitted on a modification of the process that permits the extraction of hemicellulose in a form that is particularly amenable to fermentation for ethanol production. A third patent application has been filed on the production of medium density fiberboard providing enhanced water resistance.

John Yin, reporting in the journal Peptides, suggests that long before cells or other biological systems evolved, chemical reactions taking place under dry conditions may have played a role in forming the earliest simple proteins. By drying a stripped-down “primordial soup” containing just copper chloride and the amino acid alanine, his group observed that the alanine linked together in twos and threes, a critical step on the path to making proteins. The study defines the minimal conditions under which biological building blocks, in this case amino acids, can organize themselves into larger molecules—information engineers might one day use to design “smart” materials that can direct their own synthesis, repair themselves, or even evolve. In other work appearing in the Journal of Virological Methods, John’s group has developed a method to improve by a factor of 10 or more the sensitivity of the standard plaque test for virus infectivity. The standard test involves introducing a viral sample into a Petri dish containing a layer of healthy cells. Rather than immobilizing the virus with a cover layer of agar, John’s group uses a liquid culture medium that allows the virus particles to flow toward the edges of the dish, infecting many more cells and creating a starburst pattern of dead cells rather than isolated spots or plaques. John has applied for a patent on the improved test.

Regina Murphy has received the 2006 James G. Woodburn Award for Excellence in Teaching from the College of Engineering. She was recognized not only for her enthusiastic, engaging and effective teaching, but also as a mentor for her insightful input on everything from teaching philosophy to academic integrity. Regina transformed the department’s introductory course, replacing a lecture-based format with an active learning experience that incorporates in-class problem-solving and a group design project, and she developed a textbook to accompany the course (see p. 8). She also maintains an active mentorship program with select Madison public schools, and is both a formal and informal mentor to faculty in the department and to women throughout the university.

Emeritus News

Bob Bird received an honorary doctor of science degree from Iowa State University this past spring, and delivered the commencement address titled, “The Third Obligation: Development of Breadth.” With eight honorary doctorates and a knighthood to his name, in addition to his PhD, we now refer to him simply as Sir Doctor Doctor Doctor Doctor Doctor Doctor Doctor Doctor Doctor Doctor Doctor Doctor Bob.

Ed Lightfoot received the National Medal of Science, the nation’s highest honor for science and technology in early 2006 for his pioneering contributions to scientific research and education. Ed was recognized as one of the first biochemical engineering professors in the United States and for his distinguished record of service to the field, particularly for his work in the areas of blood oxygenation, oxygen diffusion into tissue, mathematical modeling of biological pathways, bioseparations and studies of diabetic responses.

In typically modest fashion, Ed said, “This award is really a testament to the excellent atmosphere in which I have worked for over half a century. Wisconsin was already a world leader in biochemistry when I arrived in 1953, and Olaf Hougen, our chair, was wise enough to bet scarce departmental funds on an area not yet recognized by the engineering profession.

In typically political fashion, he continued. “Behind all this was the willingness of American citizens to support activities that must often have seemed strange and even threatening, and to give us the freedom from political interference essential to long-term success.”

Together with Robert Langer of MIT and Nicholas Peppas of the University of Texas-Austin, Ed was awarded the 2006 James E. Bailey Award for Outstanding Contributions in Biological Engineering from the Society for Biological Engineering of AICHE.
Robert Armstrong (PhD ’73), Chevron Professor at the Department of Chemical Engineering at MIT, has been awarded the 2006 Bingham Medal by the Society of Rheology. Bob’s research interests include rheology as well as polymer molecular theory, polymer fluid mechanics, multiscale process modeling, transport phenomena and applied mathematics. He delivered a lecture and received the prize at the society’s annual meeting in Portland, Maine, in October.

Richard K. Biener (MS ’89) has been promoted to professor in the Department of Natural Sciences at the University of Applied Sciences in Esslingen, Germany, where he works in the field of bioprocess engineering.

Reinaldo Caban (MS ’72, PhD ’76) retired as professor of chemical engineering and provost of the University of Puerto Rico-Mayagüez.

Edward L. Cussler, Jr. (MS ’63, PhD ’65) professor of chemical engineering and materials science at the University of Minnesota, together with Brian Gettefinger, now a graduate student in this department, won the 2005 Ig Nobel Prize in Chemistry for conducting an experiment to settle the longstanding scientific question: can people swim faster in syrup or in water? It took 700 pounds of guar gum in a pool and a lot of red tape, but Ed and Brian (then a member of the University of Minnesota swim team) demonstrated that swimming in guar gum solution does not change swimming speed. The Ig Nobel Prizes are given each year for achievements that make people laugh, and then make them think.

Steven B. Edgar (BS ’81) is taking part in the executive MBA program at Thunderbird—The Garvin School of International Management. Steve, as president of SBE Engineering, plans to expand the firm’s energy consulting services into the global market.

Dale R. Ericson (BS ’59) has founded American Energy for America, Inc. for the purposes of fostering concern for worldwide production and consumption of oil, and encouraging the development of renewable, domestic energy resources.

Roger Harrison (MS ’68, PhD ’75) has been selected to receive this year’s Meriam/Wiley Distinguished Author Award by the American Society for Engineering Education for the textbook Bioseparations Science and Engineering (Oxford University Press, 2003). As lead author, he shares the award with coauthors Paul Todd, Scott Rudge, and Demetri Petrides. The award, given every two years, recognizes work that contributes to the advancement of technical and professional competence at the undergraduate or graduate level. Roger is a professor in the School of Chemical, Biological and Materials Engineering at the University of Oklahoma.

Sanford A. Klein (MS ’73, PhD ’76), Ouweneel-Bascom Professor of mechanical engineering at UW-Madison, received an honorary doctorate from the University of Liege, Belgium, in March. The honor recognizes his research in solar energy systems and design methods. Sandy developed a software program and an equation solver for thermal system design and analysis that is used by both students and professionals worldwide.

Brian S. Mitchell (MS ’87, PhD 91) was recently appointed associate provost at Tulane University in New Orleans, and is the rising chair of the Materials Engineering and Science Division (MESD) of AIChE. On behalf of the Department of Chemical and Biomolecular Engineering at Tulane, Brian wishes to thank those of you who sent well wishes in the aftermath of Hurricane Katrina, and who hosted Tulane students for the Fall, 2005 semester.

Hari A. Nair (BS ’92) has joined Cadbury Schweppes as General Manager, Science & Technology, based in India. Prior to joining Cadbury, Hari was with Procter & Gamble for 13 years, most recently in Beijing, China.

Joseph Powell (PhD ’84) has been appointed as chief scientist, chemical engineering for the Royal Dutch Shell group. He is one of seven chief scientists with Shell, each representing a particular discipline, who are expected to provide advise on technology strategy, champion science, research and development and innovation, and work to enhance Shell’s technical reputation. Joe has received more than 36 patents and has received several awards, including the AIChE Arthur D. Little Award for Chemical Engineering Innovation, and the ACS Team Innovation Award.

Christopher V. Rao (PhD ’00), assistant professor at the University of Illinois Department of Chemical and Biomolecular Engineering, was awarded a 2007 CAREER Award by the National Science Foundation. Chris’ research interests involve use of both computational and experimental approaches to discover the system-level mechanisms regulating intracellular pathways, and also to engineer these pathways for novel medical and industrial applications.

Enefok Ubom (BS ’78) is serving as executive secretary of the Nigerian Society of Chemical Engineers. The vision of the society is to be the center of excellence for the chemical engineering profession in Africa, and the prime mover for the industrialization of Nigeria. Their activities include the organization of conferences on topical issues relevant to the industrialization of Nigeria.

John M. Wiest (PhD ’86), professor of chemical and biological engineering at the University of Alabama, has been named associate dean for research and graduate studies at the UA College of Engineering. As associate dean, John is responsible for working with research funding agencies, assisting faculty with research proposals and budgets, and coordinating the engineering graduate programs.

Donald R. Woods (PhD ’61), Professor Emeritus, McMaster University, Hamilton, Canada, has recently published two books with Wiley-VCH. Successful Trouble Shooting for Process Engineers details the principles of and skills used in troubleshooting, and provides 50 practice cases to improve confidence. Rules of Thumb in Engineering Practice focuses on skills for systems thinking, such as communication, problem solving, performance review and teamwork, for over 350 pieces of processing equipment. For each type of equipment, the book emphasizes when to use, how to rough size, how to trouble shoot, and how to estimate cost.
Retirement: Charlie Hill

Charles Graham Hill, Jr. has joined the ranks of emeritus professors following a 39-year career on the faculty of this department, where he made important contributions as a teacher, researcher, and administrator. Charlie received S.B., S.M., and Sc.D. degrees in chemical engineering from the Massachusetts Institute of Technology in 1959, 1960, and 1964, respectively. His studies at MIT were supported by a General Motors National Scholarship and a National Science Foundation Fellowship, both received in national competitions. From 1964-65, Charlie served as an assistant professor of chemical engineering and a Ford Foundation postdoctoral fellow at MIT. From 1965-67 he served as a first lieutenant and captain at the U.S. Army Nuclear Defense Laboratory in Edgewood Arsenal, Maryland. Charlie joined the department following completion of his military service in 1967.

Charlie is known as an outstanding teacher. He received more than 20 awards from student groups and divisions of the university for excellence in the classroom. He specialized in teaching courses in chemical engineering kinetics, catalysis, reactor design, and chemical engineering thermodynamics. In addition, he frequently taught the Operations and Process Laboratory course, with particular emphasis on the sections offered in London (5 times), Oviedo, Spain (3 times), and Vienna (once). Although he had a reputation as an instructor who worked his students hard by assigning challenging problems based on articles from the kinetics and reactor design literature, he employed the Socratic method to advantage in inculcating his students with an ability to go from first principles to a solution in a thoughtful, disciplined manner. Alumni frequently comment on the quality of their educational experiences with Charlie and his concern for their professional welfare. To facilitate his teaching of undergraduates, Charlie authored a widely used textbook, An Introduction to Chemical Engineering Kinetics and Reactor Design, that went through 29 printings since first published in 1977. His first professional goal in retirement is to complete a second edition of the book.

Professor Hill also was a very capable administrator, serving as chair of the department from 1989–92, and as associate chair for both graduate affairs (1981–84; 1988–89) and undergraduate matters (1990–2001). For more than a quarter of a century, he was heavily involved in recruiting graduate students to the chemical engineering program. Charlie also contributed to the welfare of his department, college, and university via service on innumerable committees.

Charlie is also a highly respected researcher, working on interdisciplinary problems long before it became popular to do so. In recognition of these efforts, Charlie held a courtesy appointment as Professor of Food Science and a seat on the executive committee of the Environmental Chemistry and Technology Program (formerly Water Chemistry). Charlie was the author of more than 300 publications in archival journals and presentations at professional society meetings. He supervised 38 PhD theses and nearly 30 MS candidates working on a wide range of research problems.

His first collaborations with faculty in the Department of Food Science involved recovery, purification, and characterization of proteins from cheese whey and was subsequently followed by studies of enzymatic modification of various milk constituents, particularly hydrolysis of lactose and conversion of undesirable saturated fatty acid residues in milk fat to mono- or polyunsaturated residues, with associated benefits for human health. Charlie also collaborated extensively with the USDA Forest Products Laboratory in Madison, working on problems related to hydrolysis of the cellulose constituent of wood and the generation of adhesives from furfural and its derivatives for use in the manufacture of composite wood products such as particleboard. The hydrolysis work has implications for production of bioethanol from biomass, a topic currently of major interest to the energy industry. With faculty in the Environmental Chemistry and Technology Program, Charlie co-supervised several graduate students working on the development of perselective ceramic membranes and membrane reactors as well as several problems involving the application of photocatalysis to the solution of environmental problems. Charlie continues to collaborate extensively with individuals working at academic and research institutions in Spain, Mexico, and Korea on problems involving adding value to agricultural and forestry products such as particleboard. The hydrolysis work has implications for production of bioethanol from biomass, a topic currently of major interest to the energy industry. With faculty in the Environmental Chemistry and Technology Program, Charlie co-supervised several graduate students working on the development of perselective ceramic membranes and membrane reactors as well as several problems involving the application of photocatalysis to the solution of environmental problems. Charlie continues to collaborate extensively with individuals working at academic and research institutions in Spain, Mexico, and Korea on problems involving adding value to agricultural and forestry products such as particleboard.

In recognition of his many accomplishments, Charlie was appointed John T. and Magdalene L. Sobota Professor of Chemical Engineering in 1995.

Diane Peterson is enjoying a well-deserved retirement. Probably a substantial majority of the department’s living alumni will remember Diane, who joined the department as a technical typist in 1967. She worked with 12 department chairs, and earned the 2005 College of Engineering Classified Staff Distinguished Achievement Award, as well as this limerick from Bob Bird:

There once was a gal named Diane, whose talents would fill up a van.
You know, as a rule, she cycles to school—Like Thatcher, Regina, and Ann*.
She arrives in the morn with a list, of things to be done in her fist.
Now here she has many a fan, like Charlie, and Michael, and Stan,
And Harmon and Juan, And Manos and Sean—And Tom, John, David, and Dan.

*Ann Nonimus (a common ploy Bob Bird uses when he can’t find a word that rhymes)
In Memoriam

Warren Earl Stewart, McFarland-Bascom Professor Emeritus of Chemical and Biological Engineering, died on March 27, 2006 after a long and distinguished career. Warren was born in Whitewater, Wisconsin, on July 3, 1924 to Earl and Avis Stewart. He received both BS and MS degrees at Wisconsin, in 1945 and 1947, and the ScD in 1951 at Massachusetts Institute of Technology. All his degrees were in chemical engineering. While an undergraduate at Wisconsin, he became famous as the first student in the history of the College of Engineering to graduate with a straight-A academic record. His MIT experience introduced him to numerical analysis and computational techniques, essential subjects at the dawn of the electronic computer age.

In World War II, Warren enlisted in the U.S. Naval Reserve (1944-1946). He returned to Wisconsin as a Navy engineering trainee under the V-12 program, and after graduation served as a communications officer on the aircraft carrier USS Midway. In 1947 he was married to Jean Durham Potter, who served as Alderman for the City of Madison for 16 years (1977-1993). They had six children and eighteen grandchildren.

After five years at the Sinclair Research Laboratories, Warren Stewart joined this department in 1956 and taught here until 1997. While serving as chairman of the department, he recruited and nurtured several young faculty members who went on to become international leaders. He supervised many PhD students and postdoctoral fellows, who today hold responsible positions in universities and industry.

His more than 100 research publications are indicative of his breadth of interests and knowledge. How many chemical engineers could write significant contributions on such widely varying topics as prediction of vapor pressures, reciprocal variational principles, kinetics of benzene hydrogenation, chemical kinetics and reaction engineering, multicomponent diffusion, orthogonal collocation, measurement of diffusivities, droplet vaporization, kinetic theory of rigid dumbbell suspensions, tokamak reactors, thermal diffusion, catalysis, corrosion, parameter estimation, Bayesian statistics, strategies for process modeling and parameter estimation, viscoelastic fluid dynamics, insulation qualities of animal fur, sensitivity analysis, and distillation processes. His work in this area led to better design and safer operation of chemical processes. His research results, which have been adopted around the world, increased the fundamental understanding of chemical phenomena and significantly influenced industrial practice.

Beyond influencing his own research students, he was an inspiring teacher and valuable consultant for many students and professors in the Chemical Engineering Department. Furthermore, Warren was a coauthor of the 1958 green paperback Notes on Transport Phenomena, which served as a preliminary edition for the 1960 textbook, Transport Phenomena (John Wiley & Sons), the classic textbook that changed the direction of chemical engineering teaching everywhere in the world. It was translated into Spanish, Russian, Italian, Czech, and Chinese. After 64 printings of the first English edition, a second edition was prepared by the same trio of authors. This new edition appeared in 2002 and has been translated into Chinese and Portuguese. In the preparation of this textbook, Warren displayed important characteristics that were invaluable: very high standards for writing technical material, a photographic memory of the technical literature, and an insistence that there be no spelling or grammatical errors (this last quality earned him the nickname “gimlet eye”).

At the time of his death, he had almost completed, with Michael Caracotsios (PhD ’86), another book, Computer-Aided Modeling of Chemically Reactive Systems, along with accompanying software. This book provides an overview of chemical kinetics and reactor modeling, and then presents an extensive description of strategies for parameter estimation based on noisy and incomplete data sets. An interactive software package is included that can perform all the necessary modeling and parameter estimation calculations after the problem details are entered by the user.

He was given honorary membership in Phi Beta Kappa because of his exceptional level of scholarship and his extensive contributions to Chemical Engineering in Mexico and South America. He was a visiting professor at the Universidad Nacional de La Plata in Argentina in 1962, at the Universidad Nacional Tecnológico de Celaya in Mexico in 1983, and at the Universidad Autónoma de México in 1985. At these institutions he lectured in Spanish. For 18 years he served as editorial advisor for the Latin-American Journal of Chemical Engineering and Applied Chemistry. Following that he held a similar position for the journal Latin-American Applied Research.

Warren’s hallmark throughout his career was understated excellence in his work and unflagging kindness to students and colleagues. He was also well known for his sly sense of humor and his ability to produce—instantly—jokes on just about any topic. He loved puns and had a warning sign on his desk given to him by colleagues: “Incorrigible punster—don’t incorrige.”

Warren’s family has established the Warren E. Stewart Memorial Scholarship Fund for undergraduates in the department. Gifts to the fund in Warren’s honor may be sent to the department address.

Despite the fact that he was a quiet and modest person, Warren received many awards for his research and teaching activities; among these are:

- 1973 Elected Fellow of American Institute of Chemical Engineers (AIChE)
- 1981 Alpha Chi Sigma Research Award of AIChE
- 1981 Benjamin Smith Reynolds Award for Excellence in Teaching
- 1983 Chemical Engineering Division Lectureship Award, ASEE
- 1983 Elected Honorary Member of Phi Beta Kappa
- 1983 Named McFarland-Bascom Professor
- 1984 Computing in Chemical Engineering Award, CAST Division of AIChE
- 1989 E. V. Murphree Award, American Chemical Society
- 1991 Byron Bird Award for Outstanding Research Publication (UW)
- 1992 Elected to the National Academy of Engineering

Professor Emeritus
Warren E. Stewart

Notes on Transport Phenomena, 2002

Professor Emeritus Warren E. Stewart
Dorothy Robbins Marshall

Dorothy Marshall, widow of Chemical Engineering Professor and former UW Dean of Engineering W. Robert Marshall, died in Madison on March 12, 2007. She and Bob Marshall, who died in 1988, were married for 45 years and raised three children: Peggy, Mary and Bill. Bob Marshall was one of Olaf Hougen's PhD students. He became a productive researcher and educator, and was active in national societies, university affairs, and in initiating international cooperative programs. Dorothy was a graceful partner on many professional occasions in Madison, and at national and international conferences. They were active in civic and cultural affairs, with a special interest in dance. Bob even served as a president of the Wisconsin Ballet Company.

Dorothy, a native Madisonian, was a superb swimmer and diver, and swam across Lake Mendota as a teenager. Having a keen mind, and becoming an avid bridge player, she often won the weekly prize at Black Hawk Country Club.

Dorothy’s loving family and friends remember this grandmother and great-grandmother for her generosity, kindness, and strong interest in their activities. Many chemical engineers and professional associates will also remember Dorothy for the same qualities and her congeniality on a variety of occasions. Both Bob and Dorothy were involved in advancing equal opportunities for minorities.

Remembering their positive imprint in diverse areas, one of the professors who came to Wisconsin in the 1960s during Bob Marshall’s tenure as associate dean has initiated a Robert and Dorothy R. Marshall Scholarship Fund. Others, who have similar memories, or who have benefited in different ways, can donate to the fund through the University of Wisconsin Foundation (attn: Deb Holt), 1848 University Ave., Madison Wisconsin, 53706. The names of contributors will be shared with the family unless anonymity is requested. Alternatively, memorials for Dorothy can be sent to Oakwood Foundation, 6225 Mineral Point Road, Madison 53705 or to Hospice Care Inc. (Cheryl Parkway).

IN MEMORIAM: STAFF

Jeanne Lippert died in late 2005 at the age of 80. Jeanne served as administrative assistant for the department for 35 years until her retirement in 1990, working with nine department chairs. She is remembered for her dedication and hard work, as well as her outgoing personality and helpful nature. In retirement, Jeanne was active with family, church, friends, and travel and often visited the department for special events.

IN MEMORIAM: ALUMNI AND FRIENDS

Rutherford Aris, Regents Professor Emeritus of chemical engineering and classics at the University of Minnesota and the first Hougen Visiting Professor at UW, died at the age of 76. His many honors during a long and distinguished career include election to the National Academy of Engineering and the American Academy of Arts and Sciences. His work on chemical kinetics and reactor design provided a deeper understanding of observed phenomena and allowed much improved design of chemical processes. In the latter part of his career, he pursued his deep interest in paleography by taking an appointment in the Classics Department, where he taught classes and published books and research articles.

Alfred B. Cooley (BS ’41, MS ’46) passed away at the age of 87 in Mequon, Wisconsin. He retired as vice president of Zimpro Systems of Wausau, which offers water and wastewater systems, products and services. He is survived by his wife of 60 years, Laura.

Donald N. Hanson (PhD ’43), professor emeritus of chemical engineering at the University of California, Berkeley, died this past January at the age of 88. Don was a world-renowned expert on chemical distillation processes and an inspiring teacher and mentor. His early work on computational methods for distillation processes was both critical and timely, coinciding with the beginning of large-scale use of computers in the chemical industries. He was the last surviving member of the group of faculty that launched the chemical engineering program at UC Berkeley after World War II.

Gary J. Powers (PhD ’71), professor of chemical engineering at Carnegie Mellon University passed away this past July. Gary was a leading researcher in process systems engineering. He did pioneering research in process risk assessment and in process synthesis. He co-authored the text Process Synthesis with emeritus professor Dale Rudd and Jeff Sirola (PhD ’70), the first text in this area. Gary’s seminal contributions to safety analysis covered more than three decades. He developed new methods for efficiently generating detailed fault trees for quantitative risk assessment. He applied these methods in industry with great success, and in 1976 he founded the company Design Sciences, Inc. Gary developed theories and models for synthesis and evaluation of high integrity operating procedures, and novel approaches for the verification of real-time control systems combining chemical engineering models with software engineering techniques. For his contributions in the safety area Gary received the 2005 AIChE Norton H. Walton/Russell L. Miller Award in Safety/Loss Prevention. Gary was also an outstanding educator at Carnegie Mellon who loved teaching students at all levels. He was a frequent recipient of the department’s “Kun Li Award for Excellence in Education,” which is selected each year by the graduating class.

Frank G. Steffes (BS ’65, MS ’67, PhD ’70) died in August 2006 in Eugene, Oregon at the age of 63. Frank worked for 35 years in the paper industry in Washington, Louisiana, and Alabama. Early in his career, he spearheaded process studies that resulted in a patented machine that revolutionized the preparation of wood chips for pulping. With James River Corporation, Frank led a project team that was responsible for a $45 million modernization of the groundwood mill in St. Francisville, Louisiana. From 1997 until his death, Frank had his own consulting business. He was active in a number of cultural and social organizations, including the Unitarian Universalist churches in Baton Rouge, Atlanta, and Vancouver, and the Atlanta chapter of Parents, Friends and Families of Lesbians and Gays, where he received an honors award in 1997. He is survived by Janice Rutherford, his wife of 18 years.

Rollin G. Taeccker (MS ’42, PhD ’47) passed away in August 2005 in Naperville, Illinois at the age of 86. Rollin became a professor of chemical engineering at Kansas State University, and in 1953, helped initiate President Eisenhower’s Atoms for Peace program at Argonne National Laboratories. He retired in 1981 as director of Argonne’s International School of Nuclear Science and Engineering, a position that took him around the globe promoting atomic energy. In retirement, he was active in community service in Naperville, and he pursued his lifelong love of tinkering. He is survived by his wife of 58 years, Patricia, three sons, and five grandchildren.

Otto H. Wustrack (BS ’34) died in August 2004 in Portland, Oregon at the age of 95. Otto was born in Kiel, Germany and immigrated to the U.S. with his family, spending his early years in Milwaukee. He is survived by his wife of 66 years, Dorothy, and three granddaughters.
About a dozen years ago, the chemical engineering faculty decided to redesign our introductory course, with two primary goals in mind: (1) to provide students a better understanding of how chemical processes convert raw material to useful products, and (2) to equip students with an appreciation for the problem-solving strategies that chemical engineers use to make decisions and balance constraints in coming up with new processes and products.


Regina designed the textbook to link to freshman chemistry by illustrating how chemical principles influence processing; to develop student skills in both analysis and synthesis of chemical processes; to balance rigorous calculations with heuristics-based strategies; and to introduce students to the enormous variety of products and industries to which their chemical engineering skills can be applied. Each chapter concludes with a “ChemiStory”—a brief historical recounting of significant achievements in chemical products and processes. These stories show the humanity of the giants of the chemical enterprise, illustrate how achievements are products of their time and place, and provide cautionary notes about the unintended consequences of some technological advances.

Textbook writing has been a tradition of the Chemical and Biological Engineering department since its inception, and the tradition continues with the publication of *Introduction to Chemical Processes*. Within the last few years, department authors have released the 2nd edition of the classic *Transport Phenomena* by Professors Bird, Stewart and Lightfoot, and *Chemical Reactor Analysis and Design Fundamentals*, by Jim Rawlings, with co-author John Ekerdt (BS ’74). New books in the works include *Chemical, Biological and Materials Engineering Thermodynamics* by Juan de Pablo and Jay Schieber (PhD ’89), and a revised version of Charlie Hill’s text, *An Introduction to Chemical Engineering Kinetics & Reactor Design*. Book writing is a time-consuming process; publication of *Introduction to Chemical Processes* would not have occurred without the financial support provided by Harvey D. Spangler (BS ’56), who sponsored a chair named in his honor. The faculty greatly appreciate the strong continued support provided by department alumni.