University at Buffalo
The State University of New York

CHEMICAL ENGINEERING NEWS

Spring 2003

Message From The Chair

Carl R. F. Lund

The Changing Face(s) of Chemical Engineering. It seems like every time I sit down to write this column there are arrivals and departures that need to be mentioned. This time I need to report that Dr. Sharon Fritts had to resign from her position as Teaching Professor in the Undergraduate Unit Operations Laboratories. Sharon's husband was transferred to Houston, and it seemed a little too far for her to commute to work. In only a little over a semester, Sharon had made a significant impact. She oversaw the relocation of our Unit Ops labs from Furnas Hall to Jarvis Hall, and was able to carry off the transition without any disruption to the students taking the labs. She was popular with the students, and we're sorry to see her go. Next fall Dr. Tammy Kofke will assume the role of Teaching Professor in the U/O labs. Tammy has a B.S. from Carnegie-Mellon and a Ph.D. from the University of Pennsylvania. She also has industrial experience with OxyChem, and I am sure our students will benefit from her strong chemical engineering background. So starting in the fall there will be two Dr. Kofke's in the Department (and yes, for those who don't know, they are married).

Continuing on the theme of changing faces, we'll be seeing less of Lakis Mountziaris' face for the next two years. Following a national search, the U. S. National Science Foundation selected Lakis to serve as the Program Manager for the Particulate and Multiphase Processes Program. This is a two-year appointment, during which Lakis will formally be on leave from the Department. We expect to see him regularly, however, as he will maintain his research program and continue to supervise his graduate students.

It seems that there is a changing face to the chemical engineering profession, as well. If you look at the national scene, a significant number of chemical engineering departments are expanding their outlook and horizons by embracing biological engineering as a part of their core activities. Indeed, we at U. B. are among this group with a strong effort in the biological engineering arena. It's important, in our view, that we are not changing the skills and tools we are teaching to our students. The chemical engineering approach, blending fundamental engineering science with empirical unit operations to create a systems approach to chemical processing remains at the heart of the curriculum here and in most, if not all, departments nationwide. Rather, what's happening here and elsewhere is that this approach is being applied very successfully in new and emerging areas, particularly in bio-related areas.

This leads, somewhat naturally, to the changing face of this newsletter. You may notice that this issue contains a little bit of "hard" information in addition to the typical items one expects to see in an alumni newsletter. In particular, Sriram Neelamegham has prepared a short description of one of the biological engineering projects being pursued within the Department. Johannes Nitsche has also written a nice piece based upon a service project he participated in with a local school. I'm hoping to be able to convince one of my colleagues to write a similar technical piece for each issue of our newsletter so you can gain a greater appreciation of the exciting research ongoing here.

Finally, I'd like to have the opportunity to see a few of your changing faces. As we have for several years, now, the Department will host a reception for its alumni and friends at the Annual AIChE Meeting in November. This year the meeting is in San Francisco. If you are going to be attending the meeting, or if you live in the Bay area, please plan to drop in and "show your face." It'll be early in the week, and we'll have signs posted on the general message board giving the room, date and time (once we know them). If you can't make San Francisco, but plan to be in Buffalo, stop in and see us then. If neither of these work for you, drop us a few lines or e-lines and let us know what you're up to these days. Hope to see or hear from you soon!

Have a great summer!

Stelios Andreadis Wins Exceptional Scholar —Young Investigator Award

Based on faculty nominations and the recommendation of a committee of Distinguished Professors from the School of Engineering and Applied Sciences, Assistant Professor Stelios Andreadis has been selected as the recipient of the Exceptional Scholar — Young Investigator Achievement Award. Stelios joined the Chemical Engineering Department in 1998, and has rapidly established a strong and productive research group focusing in the areas of gene therapy and tissue engineering. Dr. Andreadis is currently serving as Co-Director of UB's Center for Biomedical Engineering.

Department Leads NSF Sponsored Research Experience for Undergraduates on Nanostructured Semiconductors

Assistant Professor Mark Swihart, with co-PI Alexander Cartwright from Electrical Engineering, received a grant of over $300,000 from the National Science Foundation to run a Research Experience for Undergraduates site for the next three summers. The research theme for this site is nanostructured semiconductors – an area of increasing research emphasis in the department. For summer 2003, thirteen outstanding students from eight different universities and six different disciplines (including five chemical engineers) are spending 10 weeks at UB through this interdisciplinary research program. Nine faculty mentors from UB's departments of chemical engineering, electrical engineering, chemistry and physics are serving as research advisors for these students, including Professors Swihart, Mountziaris, and Kofke from chemical engineering. In addition to working in research labs, the students will participate in a series of seminars on research ethics, led by CE Professor and Associate Dean Mike Ryan. There will also be some social outings and field trips to high-tech companies for the students. Students from all science and engineering disciplines and from any university are encouraged to apply for this program. For more details, see *http://www.photonics.buffalo.edu/reu.*

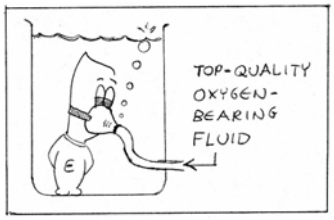
CE Safety Committee Receives Service Excellence Award

A *Service Excellence Award* was presented to the Chemical Engineering Safety Committee on June 10, 2003. Service Excellence Awards are presented to University at Buffalo individuals and teams whose initiatives have improved the quality of services to this University. In 2002, the Chemical Engineering Safety Committee thoroughly upgraded their safety inspection program for continual state and federal safety and environment regulatory compliance. This was achieved by a systematic approach to the re-development and implementation of the Department's safety program by the Safety Committee, with support from UB's Environment, Health & Safety Services. Members of the CE Safety Committee include: Dr. Mark Swihart, Chair; Dr. Carl Lund; Mr. Bharat Bajaj, Graduate Student; Mr. Zhifeng Li, Graduate Student; and Mr. Suddha Talukdar, Graduate Student. The Committee would also like to acknowledge Bob Najjar from UB's Environment, Health & Safety Services for his valuable time and effort that he has given to this endeavor.

Something Fishy

By Johannes M. Nitsche

There I sat in my office, sadly twiddling my thumbs because I had run out of exams to grade, when the phone rang, and I had the pleasure of becoming acquainted with Norma L. Gentner, enrichment teacher at Heritage Heights Elementary School (2545 Sweet Home Road, close to campus). She supervises groups of students preparing self-chosen independent research projects. One of her groups (comprising three fifth graders named Kelly, Jeanette, and Bradley) was interested in the possibility of designing some kind of wearable set of artificial gills to breath under water indefinitely. Would I be able to drop by and consult a little on this idea? As this problem is drenched with chemical engineering principles like membrane transport, and as Elroy was away whereas I was free, I thought, "sure, why not?"



There's a good book in the Health Sciences Library titled "The Physiology and Medicine of Diving and Compressed Air Work," 2nd ed. (P.B. Bennett and D.H. Elliott, eds.; MacMillan, New York, 1975) that's very pertinent to this question. Chapter 9 ("Liquid Breathing and Artificial Gills" by J.A. Kylstra) is eye opening. Would you believe: "Mice and rats have been kept alive up to 18 hours while totally submerged in salt solutions equilibrated with oxygen at high pressures. The animals appeared to inhale and exhale the salt solution… and were obviously capable of extracting adequate amounts of dissolved oxygen from their aqueous environment." Wow! It turns out that mammalian lung physiology is remarkably tolerant of fluids other than air — including LIQUIDS like saline (aqueous salt solution) and certain fluorocarbons — as long as they contain sufficient amounts of dissolved oxygen. Indeed, "...patients [that's HUMAN patients] tolerate the complete filling and subsequent 'ventilation' of one lung at a time, with a physiological salt solution at normal body temperature, remarkably well." Why the emphasis on breathing liquids? An oxygen-bearing liquid is essentially incompressible, and could eliminate many of the problems associated with high pressure diving at great depths.

About Gills: These are any natural or engineered devices for gas exchange (oxygen in, carbon dioxide out) by diffusion through a semipermeable membrane. Semipermeable means the membrane has pores that are small enough to prevent transfer of water, and only let the gases through. The simplest incarnation of this idea was demonstrated by Robb (1965), who "managed to keep hamsters alive in a closed container with a silicon rubber membrane wall… completely submerged in bubble-oxygenated water." Ayres (1966) designed a "radiator-like device" comprising a stack of 96 membranes (total size 18x18x12 inches) separating alternating water and air compartments, and subjected it to a low-risk test sitting on a beach breathing into the box, with only the box submerged. In principle the idea works with enough membrane surface area (something like 500 sq. ft.). More extreme is the theoretical possibility of a blood-filled gill, "in which gas exchange occurs directly between seawater and the diver's blood." That would mean some kind of surgery to connect the gill to the main pulmonary artery. Yikes!

The Upshot: 1. Artificial gills are very possible in principle, although given the surface area requirement, they could easily be bulkier than SCUBA tanks. 2. Good things are happening in our local schools. Thanks to Norma Gentner, students like Kelly, Jeanette and Bradley are exercising their creativity, and learning how to back up the pursuit of dreams with research. It was nice talking with them, and later seeing their very professional final report!

Please feel free to send us your articles or ideas of things you would like to see in YOUR newsletter! Let us know how we can make it better.

A Novel Mechanism for Blood Clotting in Coronary Vessels?

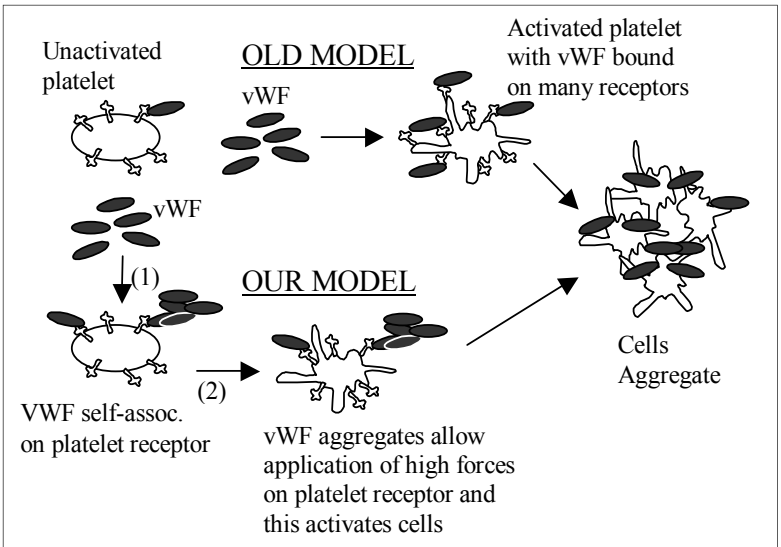
By Sriram Neelamegham

A paper[1] appeared from my laboratory in the April issue of *Blood*, the official journal of the American Society of Hematology. It received an Editorial commentary that presented the importance of the work in a broader context (see below). Dr. Lund saw the editorial commentary and suggested that I write a short note in the Newsletter since readers may be interested in hearing about new developments in the Bioengineering Laboratory.

"…In this issue Shankaran and coworkers extend this [vWF self-association] concept and show that self-association can occur with vWF multimers in solution. These new results are presented in the context of studies that, with a remarkable effort to numerical accuracy, contribute to clarify the mechanism of shear-induced platelet activation….. "

- Z. Ruggeri, The Scripps Research Institute

About five years ago, a student in my laboratory, Harish Shankaran, began developing a series of theoretical tools for the study of cell aggregation during blood circulation in the human body. This work aimed at extending work that many researchers in the colloids community have performed over the years to study particle flocculation. An important difference is that colloidal forces are not very important in biological systems at particle scales, since features on the cell surface like cell-surface protrusions (or microvilli) extend over larger length scales than colloidal forces. Also, cells have well-defined biological receptors and ligands on their surface, which allow very specific molecular bond formation. Thus, in this work, our interest was on developing new tools that could be used to study receptor-ligand bond formation under fluid flow. To verify the theoretical predictions, we developed new high-throughput quantitative experimental methods to monitor cell adhesion. The studies were aimed at examining: i) the process of thrombosis when blood cells called platelets occlude coronary vessels resulting in heart attacks, ii) the mechanics of inflammation which is associated with reddening of the skin and diseases like rheumatoid arthritis, and iii) the role of blood cells in augmenting cancer progression. In the last case, blood platelets stick to tumor cells and facilitate their motion to other sites in the body where dangerous secondary tumors form.



Schematic: Old model on top suggests that shear forces cause vWF to bind platelets and this causes platelet activation and aggregation. Our model at bottom suggests that fluid shear may cause vWF self-association on platelet receptors and this increases the force applied on platelet receptors. This increased force causes platelet aggregation via a two-step mechanism (labeled 1 and 2) as illustrated.

In the study published in *Blood*, we examined the role of fluid flow in augmenting platelet aggregation in a model of thrombosis, as it occurs in coronary vessels. Here, in collaboration with Prof. Paschalis Alexandridis, we observed using light scattering methods that application of fluid forces causes a blood protein called von Willebrand factor (vWF) to aggregate or self-associate. The observation is novel since, for the first time, we demonstrate that besides affecting cell function, fluid flow in the vasculature may also affect protein structure and function! vWF is also an interesting molecule since it is the largest protein in blood and it plays an important role in heart attacks that follow rupture of atherosclerotic lesions. These observations along with other experiments performed by Harish, enabled us to propose a new model for platelet aggregation (illustrated in Schematic).

What does this mean to us? While conventional logic suggests that pharmaceutical industries should/will develop antagonists to prevent binding of vWF to platelets, our study suggests that inhibition of vWF self-association may offer another target for therapy against thrombosis.

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[1] "Aspects of hydrodynamic shear regulating shear-induced platelet activation and self-association of von Willebrand factor in suspension" H. Shankaran, P. Alexandridis, S. Neelamegham, *Blood,* 101(7):2637-45, 2003.

Alumni News — What Are They Up to Now?

James T. Barnes (BS, 1982). Jim has recently become President of Veritay Technology, Inc., a small, local R&D company that he has worked at since 1985. Veritay is involved with defense R&D and some commercial electronic product sales. Jim still lives in the Buffalo area.

John DeJac (BS, 1986). John is currently working as Production Team Manager at The Mentholatum Company in Orchard Park, NY. Metholatum produces over-the-counter pharmaceutical and healthcare products for the US and foreign markets. He has been there since September 2000. Previous to that, John worked for over 11 years as a Project/Process Engineer at Occidental Chemical Corporation in Niagara Falls, NY.

James Eaton (BS, 1981; MS, 1993). Immediately upon graduation from UB in 1981, Jim went to work at Linde (currently known as Praxair), where he is still employed. He began working in process design and process control engineering roles before joining the Operations Group as a Team Leader, and has had a multitude of support roles, including Operations Planning and Capital Projects Liaison. Jim is currently the Manager of the Operations Engineering Services organization. Jim received an MBA in 2001. He is married with two teenage children.

Ellen J. Jaremka (BS, 1996). Ellen is working as a Process Engineer in the Technical Services Department for Bristol-Myers Squibb in Buffalo. She is responsible for ensuring a smooth transition for bulk manufacture of new products into her facility, which produces dermatological products. Ellen contributes to validations, leads investigation teams, and participates on the process safety team. Ellen enjoys the variety of assignments, and not doing the same thing everyday.

Martin Sanborn (BS, 1996). After graduating from UB in 1996, Martin enrolled in graduate school at Northwestern University. He received his MS in Chemical Engineering in 1998 under Prof. Michael Mavrovouniotis, and his PhD in 2002 with Prof. Randall Snurr. For the last year, Marty has been employed as a Senior Research Engineer at BP Amoco Chemicals in Chicago, IL, primarily doing modeling and optimization in olefins technology. He lives outside Chicago with his wife, Tracey, who is also a PhD chemical engineer.

Ashutosh Sharma (PhD, 1988). Ashutosh has been appointed Head of Chemical Engineering at the Indian Institute of Technology at Kanpur. He also recently received the Bhatnagar Award in Engineering Sciences, which is the highest scientific honor in India.

Obituaries

Paul Ehrlich, Professor Emeritus of the Chemical Engineering Department at UB, died February 18, 2003 while cross-country skiing near his home in New Hampshire. He was 80.

Dr. Ehrlich arrived in this country with his widowed mother as a refugee from Nazi Austria. He entered Queens College in New York City before joining the Army and serving in Europe during World War II.

After the war, he went to the University of Wisconsin, where he earned a doctorate in chemistry. He then worked for two years for the Bureau of Standards before accepting a postdoctoral fellowship at Harvard.

After Harvard, Ehrlich worked for Monsanto Co. before joining the Chemical Engineering faculty at UB in 1967. Paul's research was in the area of polymers. He made important contributions to the polymerization and electrical properties of conjugated polymers, particularly polyphenylacetylene. He also published seminal research related to the thermodynamic properties of polymer solutions and the computer modeling of tubular high pressure polyethylene reactors. His research was funded by the National Science Foundation and the Petroleum Research Fund of the American Chemical Society. Paul retired in 1991 and moved to Lebanon, NH. In retirement, he remained active in high-pressure polymers research.

Music was a lifelong hobby for Paul; in retirement, he continued to take violin lessons. He also was active in the Green Mountain Club and Upper Valley Trust.

Paul is survived by his wife of 52 years, the former Celia Lesley; three sons, Dan, Jim and Paul; two daughters, Katy and Margot; and nine grandchildren.

Student, Faculty & Staff Honors & Awards

Students:

Michael Dray (Undergraduate Student) received the *James and Nancy McLernon Student Scholarhip*.

Zhao Fang (Undergraduate Student) received a *Gregory B. Jarvis Student Scholarship*.

Geoffrey Genesky (Undergraduate Student) is this year's recipient of the *American Institute of Chemical Engineer's Outstanding Senior Award*.

Adebimpe Ogunade (Undergraduate Student) is the 2002-03 *Allied Signal Scholarship Award* winner.

Brian J. Peer (Undergraduate Student) received the *American Institute of Chemical Engineer's Othmer Sophomore Award*.

Nate Putnam (Undergraduate Student) received the *Student of the Year – 2002-2003 Award* presented by the local section of the American Institute of Chemical Engineers.

Victoria Tomei (Undergraduate Student) received the *American Institute of Chemical Engineer's Outstanding Junior Award* (formerly known as the *Edwin Sokol Award*).

Rainee Van Natter (Graduate Student) has been awarded a *Praxair Fellowship*.

Jesse Wagner (Undergraduate Student) received the *WNY College Outstanding Undergraduate Senior Science Majors Award* from the American Chemical Society.

Faculty & Staff:

Dr. Stelios Andreadis received the *UB Exceptional Scholar—Young Investigator Achievement Award*.

Dr. Carl Lund received the *Professor of the Year* from the Student Chapter of the American Institute of Chemical Engineers.

Dr. T.J. Mountziaris has been appointed to serve as a *National Science Foundation Program Manager* for a two-year term beginning in the Fall 2003.

Dr. Mark Swihart is the recipient of the *J. B. Wagner, Jr. Young Investigator Award* from the High Temperature Materials Division of the Electrochemical Society. This award will be officially presented to Dr. Swihart in the Fall.

Dr. Eli Ruckenstein was awarded the *Thomas P. Cooke Award* from SUNY at Buffalo, April 2003.

Special congratulations and best wishes go to Emeritus Professor **Dr. Sol Weller** and his lovely bride of 60 years, Miriam. The Weller's celebrated their 60th wedding anniversary on June 11, 2003.

Irene Brubaker and her husband, Ken, became 4th-time grandparents on June 13, 2003 with the birth of their grandson, Peter Charles. Congratulations to them!

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We would like to hear from you to know what you've been up to since graduation! Please take a few minutes to fill out the form below and mail it to us, or reply via the web at: ***www.cheme.buffalo.edu/alumni***. We'll put your news in future issues of our newsletter, unless you indicate otherwise. (Please check one of the boxes below to indicate your preference).

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