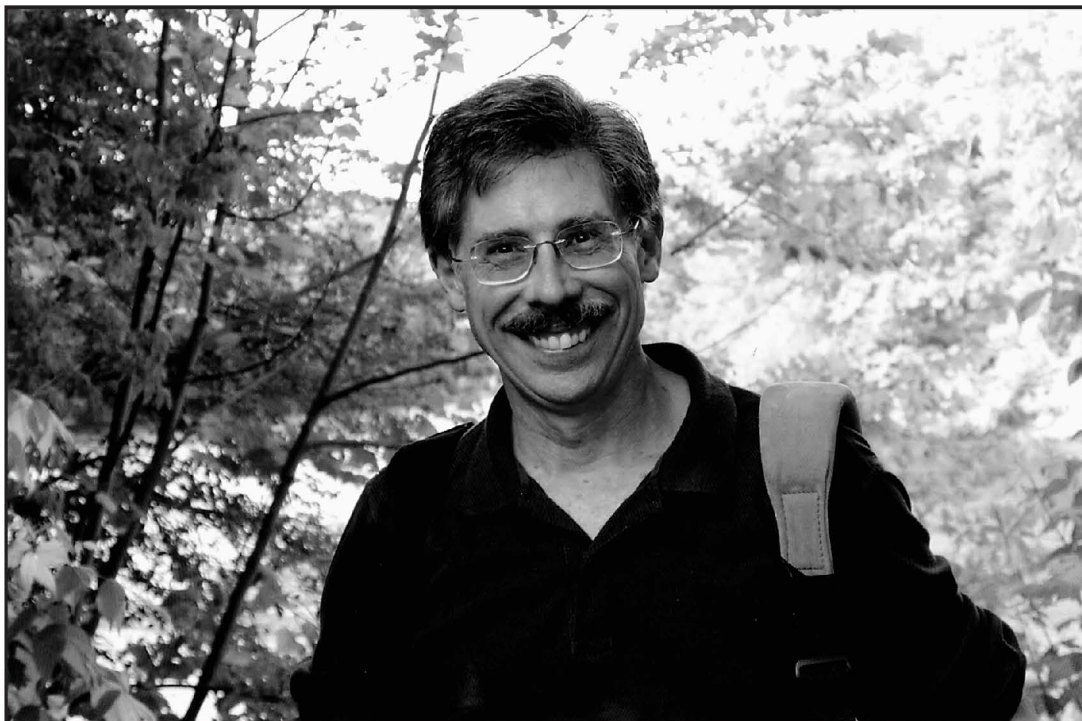


Bill Koros

of Georgia Institute of Technology



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The court of public opinion often holds that university professors fall solidly and completely into one of two extreme categories. One (the bad guys) is the group that lives to do research and has a visible disdain for teaching and for students. The other (the good guys) really loves teaching and students but must do research or fall victim to the old adage “publish or perish.” Personally I have never believed that this extreme view correctly characterizes most of us. Case in point: William J. (Bill) Koros, who loves both teaching and research, perhaps equally, and has excelled at both while never slighting one for the other. Indeed, it is fair to say that Bill would say research *is* teaching and vice versa.

I first met Bill in the fall semester of 1968 when he enrolled in an undergraduate elective course on polymer engineering

that I was teaching during my second year as a new faculty member at the University of Texas at Austin. Over the course of that semester it became apparent this fellow had more talent and enthusiasm than most undergraduates I had met to that point. Having Bill in my class was the beginning of going on 40 years of being close friends and colleagues. What a bonus for teaching a class!

CHRONOLOGY

Bill was born in Omaha, Neb., in 1947. He spent most of his youth in Houston, where his father was actively engaged during the booming growth of the oil and gas industry. After high school Bill entered the University of Texas at Austin and studied chemical engineering—intending a similar career in the oil and gas industry. Instead, upon receiving his bachelor’s in ChE in 1969, he found work with E.I. DuPont Co. in a polymer processing group. This move into the emerging

polymer area was significant. Bill has noted that the polymer course where we first met (in fall '68) was an important factor in broadening his vision of what "chemical engineering" could mean. His four years at DuPont were divided between assignments in Wilmington, Del., and Camden, S.C. It was while working for DuPont that Bill met his wife-to-be, Ann—then a newly arrived schoolteacher from Massachusetts who wanted to explore life outside New England.

What Bill learned in those pivotal years at DuPont shaped much of his subsequent professional life; one of the most important things he learned was that professional life would be a lot more fun and rewarding with a Ph.D. Thus, in fall 1973 he returned to UT for graduate school. It so happened that at that time I had a new grant from the National Science Foundation to study the peculiar aspects of gas sorption and diffusion in glassy polymers, and Bill decided to work on the project with me; this intersection of events shaped both our lives for decades to come.

To put Bill's Ph.D. dissertation on "Sorption and Transport in Glassy Polymers" into perspective, it is important to know that the 2-liter poly(ethylene terephthalate) soft drink bottle was being commercialized in this time frame and that modern hollow fiber gas separation membranes were actively being researched (although not commercialized until a few years after Bill completed his Ph.D. in 1977). Thus the experimental techniques and theoretical frameworks for data analysis that were developed during Bill's Ph.D. research were very pertinent to these new technologies, and as a result his work garnered a great deal of industrial attention and has continued to do so.

At about the time Bill was finishing his Ph.D., I learned of and alerted Bill to an opening for an assistant professor at North Carolina State University. The selected applicant would collaborate with the expanding research program of Professors V.T. Stannett and H.B. Hopfenberg, who were interested in topics similar to Bill's Ph.D. dissertation. Bill

was awarded this position and began a very prolific period of research and teaching. He was also very influential in the lives of many undergraduate students. As a result of his mentoring and encouragement, many of these students went on to enter Ph.D. programs throughout the country, beginning a trend that continues to this day—N.C. State students make up a notable portion of those choosing UT for ChE grad school. Many of these students went on to become leaders in industry and universities.



In 1984, Bill decided to return to his roots in Texas. He came to UT Austin as a professor of chemical engineering and was a key figure in establishing a program of research on membranes as part of the Separations Research Program that was just beginning under the leadership of Professor J.R. Fair. His 17 years on the faculty at UT were an incredible period of growth for Bill in research, teaching, and professional leadership.

In 2001, Bill joined the chemical engineering faculty at the Georgia Institute of Technology as a result of a very attractive offer from that growing department. Interestingly, Bill and Professor R.W. Rousseau, chair at Georgia Tech, were colleagues at N.C. State years before. Bill has established a strong research program at Georgia Tech and continues to be highly committed to research, teaching, and leadership.

One can gain a quick sense of Bill's impact in research and on people by examining the list of graduate students, post-docs, and visiting researchers he has worked with over his career at N.C. State, UT, and Georgia Tech, as shown in Table 1 (at end). Reflecting Bill's collaborative nature, a number of the M.S. and Ph.D. students were co-advised with various colleagues including Vivian Stannett, Harold Hopfenberg, and Rich Felder at N.C. State, and Grant Willson, Gary Rochelle, Keith Johnston, and myself at UT Austin.

Above, left: Never one to take himself too seriously, "Wild" Bill briefly held court as a cowboy in promoting the General Dynamics Teaching Award in 1992.

TEACHING

Bill brings to classroom teaching a genuine interest and concern for every student, an infectious enthusiasm about chemical engineering, and a wealth of experiences from research, his years in industry, and consulting. He spends countless office hours with students discussing homework, exams, life, and whatever else needs to be confided to someone. I have seen students lined up in the hall patiently waiting their turn; Bill gives each one his full and undivided attention. Sometimes when you call him and no one answers the phone, it may well be because there is a student “in chambers” who Bill feels cannot be interrupted. Bill is truly concerned about every individual in his classes, and he works very hard to ensure that each one becomes more than they were before he touched their lives. It is not uncommon for Bill to identify a seemingly undistinguished undergraduate student that he brings into his fold and nurtures; many of these have become Ph.D. graduates with very successful careers. Bill sees human potential where others often do not.

He takes the same approach with graduate students working with him as he does with undergraduates in the classroom. He believes every one is a special individual and devotes enormous attention to the development of each. As a result, he attracts some of the most promising graduate students. His former students are major contributors in industry and academia, reflecting the excellent guidance Bill gave them.

Their subsequent feedback, sometimes years later, has rendered the verdict convincingly: Bill’s dedication to students and their development is greatly appreciated by those he’s taught. It has also been widely recognized by his peers: Bill has received numerous awards for teaching including two during his time at N.C. State and three during his time at UT—notably the prestigious General Dynamics Award in 1990, which is given once a year to a single engineering faculty member.

Above, right: It seems to be a recurring theme . . . Bill at age 5 in Houston.

RESEARCH

Bill’s research program has encompassed nearly every aspect of membrane science and technology. Beginning with his Ph.D. dissertation he has had an interest in the fundamental issues of how small molecules are sorbed into polymers and transported through them. His early work focused on barrier materials but quickly evolved into the use of membranes for molecular separations. Bill has contributed greatly to the understanding of sorption and permeation properties of polymers with theoretical models for pure- and mixed-gas sorption and permeation in glassy polymers. Complementary experimental work by his group has helped clarify which types of mixed-gas sorption and permeation behavior are readily predictable by straightforward extensions of pure-gas measurements. This work is important for gas separation using membranes and provides guidance on treatment of complex cases that require accounting for significant nonlinear interaction factors.

To assist in the analysis of these more complex cases, he has developed precise methods to experimentally measure polymer volume dilation during gas sorption. This approach allows simultaneous measurements of length, width, and thickness of a film after equilibration with a penetrant gas. His approaches have been used by researchers in Japan and Europe to better understand the complex interactions of pure and mixed gases in contact with glassy polymers. These glassy materials are preferred for the separation of CO₂ from natural gas; however, they show odd, history-dependent behaviors under some conditions. Better understanding of changes in separation efficiency in the presence of elevated CO₂ partial pressures has

been pioneered by Bill and his research group.

Bill’s research group has called attention to the need for advanced membranes that allow a step change in membrane performance while maintaining the well-accepted solution processing method for membrane formation. Bill has identified concepts to design polymer molecules and composite structures that circumvent the well-known trade-off between permselectivity and productivity of conventional membranes. His group has developed a class of polymers with hyper-rigid backbones that have extensive flat, packable segments, punc-





Bill models three decades worth of hairstyles in: (above) his third year as an undergraduate, accepting the “Engineering Fellows” mug award for good grades from UT Austin then-Dean John McKetta, April 1968; (above right) with his wife Ann one year before completing his Ph.D., spring 1976; and (right) with his research group at N.C. State, having just enjoyed their regular Friday lunch at Raleigh’s “Two Guys” restaurant, July 1980.



tuated by regions of highly packed disruptive units. This complex but highly desirable morphology provides a periodic “bottleneck” environment. Ideally, molecular-sieving size and shape discrimination occurs at the interconnected bottlenecks to permit excellent performance relative to conventional polymers.

In addition to the concepts of molecular design of new polymers mentioned above, Bill has been a pioneer in developing composite structures that defeat the selectivity-productivity trade-off. These consist of inorganic molecular sieves imbedded in a polymer matrix, or so-called “mixed-matrix” systems. He has substantially advanced this concept by demonstrating the importance of properly matching the transport characteristics of the two materials and by addressing the need to bond the two phases together to avoid bypass channels that can severely compromise this approach. He is the recognized leader of this new concept of membrane design, which has attracted much interest around the world.

Bill’s research has gone well beyond materials concepts to include understanding of the

processes by which advanced materials can be converted into membranes of practical value. He has developed a state-of-the-art hollow fiber spinning facility and has contributed significantly to the understanding of the issues governing membrane formation. He has worked closely with industry to advance the state of membrane art in practice. It is the complete integration of concepts from the molecular level to practical processing issues and finally into practice that truly distinguishes the contributions of Bill Koros in the area of membrane science and technology.

Bill’s research has resulted in more than 270 peer-reviewed papers, several major reports, and 16 patents for novel membrane concepts. He has been invited to talk about his research at venues around the world. He was among the very first group of young faculty to receive an NSF Presidential Young Investigator Award (1984). While at N.C. State he received the Sigma χ i Outstanding Young Scientist Research Award (1980) and the Alcoa Foundation Research Award (1983). While at UT he received similar recognition for his research and leadership. At Georgia Tech he received the W.T. Ziegler Award as the Outstanding Chemical Engineering Professor of the Year in 2003. He received the AIChE Institute Award for Excellence in Industrial Gases Technology in 1995 and the AIChE Separations Division Clarence Gerhold Award in 1999.



Above left, On behalf of ARK (Animal Rights Kinship), Ann (then ARK president) and Bill (then ARK vice president) receiving a special proclamation from the Austin City Council. Above right, Bill surrounded by some members of his Georgia Tech research group, August 2006.



LEADERSHIP AND SERVICE

Bill has given freely of his time to professional leadership and service. He served as secretary of the North American Membrane Society (NAMS) from 1987 to 2004. He was chair of the 1989 Gordon Research Conference on Membranes. He has organized and chaired numerous conferences and working groups. Since 1990, he has served as editor-in-chief of the *Journal of Membrane Science*, clearly the premier journal in this field. The journal has grown tremendously under his leadership and now has editors in France (P. Aimar), Korea (Y.M. Lee), the Netherlands (M. Wessling), and the United States (A.L. Zydney). Bill has also served on the editorial boards of *Chemical Engineering Education*, *Journal of Macromolecular Science: Reviews in Macromolecular Chemistry and Physics*, *Polymer Contents*, and *Industrial and Engineering Chemistry Research*.

While at UT, Bill served as associate department chair (1991-1993) and then chair during 1993-1997. During his term as chair Bill coordinated significant alumni fund-raising activities in addition to the usual issues of budgets, teaching schedules, catalog revisions, and recruiting faculty and graduate students, etc. He spent a great deal of time building consensus among the faculty for decisions that needed to be made. Since arriving at Georgia Tech he has gracefully transitioned to the role of senior statesman—making things happen behind the scenes and through committees.

A BIGGER PICTURE

Bill considers himself very fortunate to have identified and pursued his field of research during some of its most pivotal times, which covered several decades—a fact much in evi-

dence in his photos from that span. Certainly, Bill's dedication to the trilogy of academic life—*i.e.*, teaching, research, and service—has been equally evolved: He has been judged worthy of an enviable amount of recognition of a broader nature than that for any single pursuit. In 2000 he was named a Distinguished Graduate of the University of Texas at Austin (B.S. 1969, M.S. 1975, and Ph.D. 1977) and was elected to the National Academy of Engineering. In 2002 he was elected fellow of the American Institute of Chemical Engineers, and in 2003 he was elected fellow of the American Association for the Advancement of Science. He holds the prestigious Roberto C. Goizueta Chair in Chemical Engineering at Georgia Tech and has been designated a Georgia Research Alliance Eminent Scholar. He receives numerous invitations every year to give plenary lectures or to give advice on some weighty issue or another.

No matter how busy Bill is, however, I know there is one person who gets his full attention and devotion, and this is his wife, Ann. They are a deeply committed couple, to each other and to doing their part to make the world a better place. Ann's schedule is as full as Bill's, so it is an uncommon but always welcome treat to see her accompanying him at conferences. Ann, in addition to being involved in leadership roles in a number of animal rights/welfare organizations for nearly 30 years, has used her considerable video production skills to promote the work of many animal and environmental groups—causes very close to her heart. In addition, since moving to Atlanta, she has been teaching videography and editing in a special program for inner city students. And it isn't beyond her to ask Bill to take the stand in the name of a cause, as well: One semester she recruited "Professor

Koros” and a team of his graduate students to lecture and give science demonstrations at her school. The audience may have been worlds away from Bill’s usual student body, but Bill noted that the experience was as stimulating and eye-opening for him and his students as the lessons seemed to be for the youngsters. So while the jury may still be out on whether one person can do it all, I confidently rest my case: All-around educator Bill Koros comes as close to that ideal as anyone I know. □

TABLE 1 Ph.D., M.S., Post Doctoral and Faculty Visitors Who Studied with Bill Koros (1977-2006). Ph.D. and M.S. Degrees Granted.*		
Ph.D. Student	Institution	Year
Gautam Ranade *	NCSU	1980
Rey T. Chern	NCSU	1983
James L. Osborne*	NCSU	1983
Edgar Sanders	NCSU	1983
Dyi-Kang Yang *	NCSU	1984
Mark E. Stewart *	NCSU	1987
Tae-Han Kim	UT Austin	1988
Greg K. Fleming	UT Austin	1988
Brooks J. Story	UT Austin	1989
Susan M. Jordan	UT Austin	1989
Mark Hellums	UT Austin	1990
Ingo Pinnau	UT Austin	1991
Dave Pope	UT Austin	1991
Maria R. Coleman	UT Austin	1992
James R. Miller	UT Austin	1992
Mary Rezac	UT Austin	1993
Luiz A. Pessan	UT Austin	1993
David R. B. Walker	UT Austin	1993
Steven C. Peseck	UT Austin	1994
Lora C. Bonser	UT Austin	1994
Peter Pfromm	UT Austin	1994
Maryam Moaddeb	UT Austin	1995
Edward J. Simpson*	UT Austin	1995
Egbert Jakobs	UT Austin	1996
Vincent Geiszler	UT Austin	1997
Scott A. McKelvey	UT Austin	1997
Henky D. Kamaruddin	UT Austin	1997
David Woods	UT Austin	1997
Anshu Singh	UT Austin	1997
Mathews Thundiyil	UT Austin	1998
Dominic Clausi	UT Austin	1998
Catherine Zimmerman	UT Austin	1998

* Indicates a Ph.D. or M.S. student co-supervised with a colleague at NCSU or UT Austin as acknowledged in article text.

Rajiv Mahajan	UT Austin	2000
Keisha Steel	UT Austin	2000
Seth Carruthers	UT Austin	2001
De Vu	UT Austin	2001
David Punsalan	UT Austin	2001
John Wind *	UT Austin	2002
Ryan Burns *	UT Austin	2002
Ted Moore *	UT Austin	2004
Mohammed Al-Juaied *	UT Austin	2004
David Wallace *	UT Austin	2004
Wen Xu *	UT Austin	2004
Shilpa Damle *	UT Austin	2004
Fangbin Zhou	Georgia Tech	2004
Bill Madden	Georgia Tech	2005
Alexis Hillock	Georgia Tech	2005
Jason Williams	Georgia Tech	2006
Shabbir Husain	Georgia Tech	2006
Preeti Chandra	Georgia Tech	2006
Raymond Chafin	Georgia Tech	2006
MS Student	Institution	Year
Gary N. Smith	NCSU	1980
Clyde J. Patton*	NCSU	1980
Ned R. McCoy, Jr.*	NCSU	1981
Danny Henderson	NCSU	1981
Sam-Heng Chen*	NCSU	1982
Charles T. Page	NCSU	1982
Haitham Al-Hussaini*	NCSU	1983
Robert E. Yui	NCSU	1984
Lewis R. Iler	NCSU	1984
Richard Kollaja	NCSU	1985
Michael Moe	UT Austin	1987
Chad J. Segura	UT Austin	1987
Ronald J. Kuse	UT Austin	1987
Michael A. Henson	UT Austin	1989
Maria Gou	UT Austin	1989
Jay Carnes	UT Austin	1993
Brian Price	UT Austin	1994
Jennifer Qin	UT Austin	1999
Gunaidi Djoekita	UT Austin	2000
Maria Towidjaja	UT Austin	2001
Post-Doctoral Fellows and Visiting Faculty (1977-2007)		
Dr. Ron Husk	Dr. Thomas Steinhausler	
Dr. Kevin O'Brien	Dr. Jin Hui Lee	
Dr. May-Britt Hagg	Dr. Eberhard Staude	
Dr. Birgul Tantekin-Ersolmaz	Dr. Wulin Qui	
Dr. Claudia Staudt-Bickel	Dr. Shabbir Husain	
Dr. Alan Greenberg	Dr. Shan Wickramanayake	