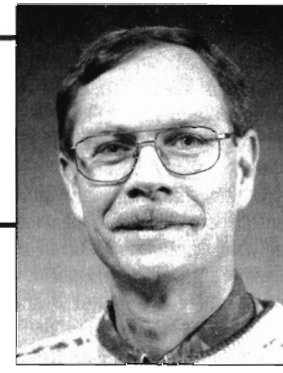
O. E. MEINZER AWARD
presented to
EDWARD A. SUDICKY



Citation by Carl A. Mendoza

It is both a pleasure and a privilege for me to introduce Dr. Edward Sudicky, from the University of Waterloo, as the recipient of this year's O. E. Meinzer Award. I graduated from Waterloo in 1993 and was Ed's third Ph.D. student. For me, Ed has been an outstanding friend and mentor. For the hydrogeological community at large, Ed has been an outstanding, and prolific, researcher in a number of areas.

First, some insight into Ed's personal life: He likes cars. When I was a grad student, Ed drove an old Mustang, but not just any Mustang. It was truly a muscle car, with high-performance tires, engine, and transmission. It got only about six miles to the gallon, which probably accounted for the fact that it had relatively low mileage when he finally sold it. Now that he has somewhat matured, reached the rank of full professor and volunteered to be chair of his department, Ed's taste in cars definitely has a European bent. Ed has four daughters, most of whom have been involved in figure skating. Ed spends a good deal of time driving his BMW from one rink to another for practices, coaching, and competitions. His wife, Nina, helps keep his personal life organized and on track. She has also graciously hosted a good number of grad students who "just dropped by for a beer," but stayed for many hours, usually talking about such mundane things as hydrogeology.

Ed's teaching abilities have influenced a large number of students. In Waterloo's porous media course, Ed's lectures on stochastic approaches to dispersion initially blew most of us away. However, once we sat down to think about it and work through some of the mathematics (that is, the math that we could), it actually made sense. He also teaches a course on solving hydrogeological problems with analytical techniques. His course notes were detailed and lucid. I still refer to them, along with his porous media notes, on a regular basis. To a large degree, the enthusiasm and ease with which Ed approached teaching led me to pursue an academic career. The same is true for others: five of the eight Ph.D. students that Ed has supervised have professorial positions, and another is pursuing a post-doc.

Ed is a terrific supervisor who cares deeply about his students. I recall several times that an M.Sc. student was having terrible troubles with a code, and the thesis deadline was approaching fast. In each case Ed stayed up until 5 or 6 in the morning to fix the problem. His students are first author on papers, and he strongly encourages them to present papers at conferences. There is always a large "Sudicky crowd," of current and former students, at GSA and AGU conferences. Ed also likes to have numerous research meetings and discussions; however, formality is not his strong suit in these cases. The preferred venue is the Grad House (the grad student pub). Ed always has a ton of ideas, and he freely shares them. A typical afternoon session when I was a grad student would result in three or four "things to try" the following day. Some failed, many worked, and my research has benefited greatly from Ed's suggestions.

Dr. Sudicky, the researcher, is a Fellow of AGU, editor of the *Journal of Contaminant Hydrology,* president of the IAHS Commission on Groundwater, and the 1994 Darcy Lecturer. He is also a likable, approachable guy who has a tremendous grasp of what is important and what is not.

A significant part of research requires knowing the history: what has been done before and by whom. Ed has an amazing system. His journals sit on a shelf and his collection of reprints are in a box on the floor. In 1992, the reprint stack was twice as high as the box. If asked about a specific topic or reference, Ed either directs you to an issue on the shelf, plus or minus a couple, or dives into the stack at a particular elevation. Invariably he is within a few papers of the intended reference.

Ed has published well over 70 journal papers in his short research career; however, the Meinzer Award is being presented for three particular papers coauthored with his students. His research interests include the development and application of models, both analytical and numerical, to describe groundwater flow, multiphase flow, and mass transport in heterogeneous porous and fractured media, subsurface remediation, groundwater–surface-water interactions, and quantification of model uncertainty. The papers he is cited for cover only a small part of this spectrum.

Burr, Sudicky, and Naff (*Water Resources Research,* v. 30, no. 3, 1994) provides a detailed look at the uncertainty associated with model predictions for reactive mass transport in heterogeneous media. The results call into question some of our conceptual ideas concerning the application of stochastic methods in such systems, compared to nonreactive cases. Ibaraki and Sudicky (*Water Resources Research,* v. 31, no. 12, 1995) examines the case of colloid-facilitated transport in fractured media. This paper provides important limits on the conditions under which colloid transport

may lead to enhanced migration of sorbed solutes. Finally, Therrien and Sudicky (*Journal of Contaminant Hydrology,* v. 23, no. 1-2, 1996) addresses the complicated problem of flow and transport in variably saturated, discretely fractured media. Hydrogeologists have been plagued with understanding the behavior of such systems for decades. The results of this paper provide significant insight into the physical processes responsible for many misleading observations.

Please join me in congratulating Edward Sudicky, recipient of the 1999 O. E. Meinzer Award.

Response by EDWARD A. SUDICKY

Thank you very much, Carl, for those kind words, and thanks to the Meinzer Award Committee in selecting me for this honor on the basis of the three papers cited. When I first learned that I was to be this year's recipient of the Meinzer Award, you can't image how completely surprised and overwhelmed I was. I am indeed humbled that those three papers will be included in the impressive list of Meinzer Award papers. I have always believed that credit should be given where credit is due, and hence it would not be proper for me to be standing here without recognizing the major contribution of my coauthors. Darin Burr, Motomu Ibaraki, and René Therrien are all former graduate students who molded a few of my modeling ideas discussed over a beer into theses upon which the cited papers are based. Darin is now a consulting hydrogeologist in Canada, Motomu is a professor at Ohio State, and René is a professor at Laval University in Québec, Canada. Rich Naff of the USGS in Denver has probably forgotten more about stochastic transport theory than I'll ever know, and his mathematical prowess was critical to the analysis contained in the Burr et al. paper.

In fact, it was Rich's Ph.D. thesis work on macrodispersion, presented at the GSA meeting in Toronto in 1978, the first conference I ever attended, that gave me some of the stochastic mathematical tools used to interpret my natural-gradient tracer test conducted in the Borden aquifer. This tracer test, carried out in 1978 during the very early days of hydrogeological studies at Borden, formed the basis of my M.Sc. thesis on scale-dependent dispersion, under the tutelage of John Cherry. John, who continues to be one of my mentors and is a previous recipient of the Meinzer Award, has taught me the value of persistence and critical thought, and to always keep the "big picture" in mind. John also taught me the "amazing" filing system that Carl referred to, whereby reprints of papers are kept stacked high in unlabeled boxes scattered about the office. Since becoming chair of the Earth Sciences Department at Waterloo a couple of years ago, I've taken advantage of this system to file the many administrative memos and documents I receive on a daily basis. The one important change I've made to the system in this case is that most of these memos go into the so-called "circular file" instead of a box, and hence the pile never gets very high, owing to the nightly rounds by the janitorial staff.

I should perhaps give a little background as to how I ended up working in the field of hydrogeology. As an undergraduate, I studied civil engineering and originally focused on structural aspects. I soon became disenchanted with designing beams, because there was little challenge; material properties were known to the nth decimal point, and design recipes were well established from building codes. My course work then migrated toward water resources systems, mainly surface water, which I found to be much more fulfilling and challenging because of the uncertainty associated with natural systems. Then, in my senior undergraduate years, we were allowed to take a few optional courses from other faculties. I heard of this fourth-year course on groundwater, a topic of which I knew very little, being offered by Bob Farvolden in the Earth Sciences Department. I decided to take it. Bob was an amazing and inspirational lecturer, and I learned from him that there was even more uncertainty associated with this field of groundwater. In fact, Bob would deduct marks on an assignment if you calculated and reported a hydraulic conductivity value with more than two significant figures. This course was followed by summer jobs doing research for John Cherry, Emil Frind, and Bob Gillham. I'll never forget my first summer job with John. He asked me to set up and run a 2-D finite element model, in those days using punched cards, for a variety of cases to illustrate the effects of geologic layers and lenses on subsurface advective flow paths. Not knowing that particle tracking routines existed, I spent three solid months manually tracing particle paths from one finite element to the next on tracing paper overlaying the mesh, using a calculator and printouts of the velocity vector components for each element. The product of this tedious exercise led to Figure 9.8 in Freeze and Cherry's classic text, *Groundwater*, and an offer to do a master's degree with John when I graduated from engineering. This was in turn followed by a Ph.D. with Emil Frind because it was clear that I needed to upgrade my modeling skills.

Upon completing my Ph.D. in 1983, a time when sophisticated 3-D stochastic transport theories were emerging to explain scale-dependent dispersion, I thought it would be a useful exercise to go back into the field at Borden and test whether these theories made sense. At that time, the large-scale natural-gradient test was underway as a joint Waterloo-Stanford project. Following the Waterloo tradition of sampling overkill, many hundreds of permeability measurements were taken along numerous cores and analyzed geostatistically, and the results were inserted into theoretical expressions to predict dispersion parameters. The outcome of this exercise, which I published in *Water Resources Research* in 1986, proved to be fruitful from several perspectives. Stochastic macrodispersion theory seemed to make sense, it motivated other researchers to further test the theory at other sites, and the recognition it somehow brought me led to a faculty position at Waterloo in 1985. The latter point was particularly important to me because my wife Nina would keep reminding me that I had her and four young daughters to support and no real job.

Since joining the faculty, I have been particularly blessed to be associated with so many talented and hard-working graduate students. As Carl mentioned, many of my Ph.D. students have gone on to pursue productive academic careers supervising their own graduate students, and all of my former M.Sc. students are either making positive contributions in the consulting industry or have gone on to Ph.D. studies. During their studies, I try to provide a research environment that is stimulating, enjoyable, and rather informal. I encourage them to present their research on a frequent basis at major conferences such as GSA and AGU meetings, or I simply bring them along even if they are not presenting, just to meet the seasoned researchers they read about in the literature. They also become close friends of my dear and understanding wife, Nina, who likes to act as a surrogate mother whenever they drop by the house, which turns out to happen rather frequently. They also become extended family to my daughters, Nicole, Jennifer, Lindsay, and Meagan. Once in a while they even get to drive my prized car, to either drop off one of my daughters at the figure skating rink or to replenish the supply of beverages during a backyard barbecue.

Finally, I thank my father, Andrew, who, I am sad to say, passed away earlier this year, and my mother, Doris, for all their support and encouragement. Dad never received a formal education, but he was a very intelligent man who read books prolifically. He even read Freeze and Cherry in addition to the occasional journal paper on hydrogeology. I remember when I was still a graduate student and he paid one of his frequent visits to the university. While he was espousing his latest opinions about groundwater research directions in the presence of Bob Farvolden and me, Bob mentioned to him that he thought I was a pretty smart young student. Dad quickly turned to Bob and stated, "That's because I taught Ed everything he knows." Thank you very much, Dad, for that education, and thank you, GSA, for this honor.