R. L. Schuchter

ROBERT S. SCHECHTER

1929–2014

Elected in 1976

"Pioneering studies of surface chemistry directed to engineering applications over a broad spectrum including bioengineering, environmental protection, and energy."

BY LARRY W. LAKE, STEVE L. BRYANT, THOMAS F. EDGAR, GARY A. POPE, MAURICE BOURREL, AND WILLIAM R. ROSSEN

ROBERT SAMUEL SCHECHTER, a brilliant teacher, scholar, researcher, mentor, and leader, died October 8, 2014. He was a world-renowned chemical and petroleum engineer with great accomplishments in both disciplines. He made major contributions to the areas of fluid mechanics, transport phenomena, surface phenomena, optimization, variational principles, oil-well stimulation, and enhanced oil recovery. He inspired countless others to carry on research in these and other areas. He was a great person with a great sense of humor, had a generous and helpful nature, was a wonderful colleague and a role model for all, with the highest professional and ethical standards, and was admired and respected by all who knew him. He was an outstanding chairman of both the Chemical Engineering Department and the Petroleum Engineering Department at the University of Texas at Austin (UT).

With 202 refereed articles, 27 book chapters, and five books, two others edited, codeveloper of the spinning drop tensiometer, Bob Schechter was the equal of ten of his peers. His creativity and contributions earned him much recognition: election to the National Academy of Engineering in 1976, the Chevalier de l'Ordre des Palmes Académiques from the prime minister of France in 1980, the Billy and Claude R. Hocott Distinguished Engineering Research Award in 1984

(the first awarded), the Joe J. King Professional Engineering Achievement Award in 1991, the John Franklin Carll Award from the Society of Petroleum Engineers in 1994, and designation in 2009 as one of the *Journal of Petroleum Technology*'s Legends of Production and Operation. In 2014 he was posthumously recognized as a distinguished professor, the only non-UT alumnus to be so recognized.

At the University of Texas, where Bob had a 35-year career, he excelled in all three areas required of a faculty member. He was an excellent teacher; even his most difficult classes were in demand and he was always willing to take on and develop new classes. He was above all an excellent researcher. He and his colleague Bill Wade invented the Joint Industry Project (JIP) to fund university research. JIPs, in one form or another, have been emulated many times and form the backbone of chemical and petroleum engineering research support.

A man of such achievement cannot be memorialized by one pen. The following accounts are from a former student, friends, and colleagues.

Steve Bryant writes: Bob was greater than the sum of his parts. He was inquisitive, compassionate, always willing to help colleagues, especially the younger ones, witty without being offensive, friendly, always willing to share ideas, and never too busy to talk science. I never heard him say a bad thing about anyone.

On the occasion of being named an Improved Oil Recovery Pioneer, Bob wrote an elegant little speech in which he pointed out the common origin of many important scientific discoveries: a moment when someone said, "Hmmm. That's interesting." This, he claimed, was usually said when an experiment had not turned out as anticipated. An unimaginative scientist says nothing of the sort when this happens; usually she or he is simply annoyed. A great researcher testing a hypothesis will have expectations about the outcome of an experiment. He (in the old days scientists were usually "he") will therefore be alert to the unexpected. When nature does something more subtle or more complicated or even contrary to what was expected, a valuable opportunity is at hand: the opportunity to learn

something. Sometimes that opportunity turns into a discovery, once in a while into a paradigm shift. But the eventual "aha" moment on which the documentaries focus always starts with a bemused, sotto voce utterance of "that's interesting." I wish someone had preserved Bob's speech; it would rank with Medawar's meditations on the scientific method.

Bob's point was that serendipity plays no small role in the advance of science, and that while incremental progress might follow a reasonably linear path, major advances usually have an element of randomness or luck or coincidence that takes the work down a quite different path. But—and this is crucial—Bob was also saying that the random is not sufficient. The event must be observed by a brain prepared to notice, by an intellect prepared to wonder, by a mind prepared to think long enough to realize that something interesting might indeed have happened. Bob instilled an appreciation of the power of this approach to research. I am forever grateful for that gift, not least because it makes the whole enterprise of research fun. Poetically, it opens the possibility of research being a creative enterprise, more similar to the fine arts than many people realize—an activity in which relationships emerge between previously unconnected concepts, objects, or phenomena.

Saying "that's interesting" is a powerful tool for a researcher. Bob's day-to-day definition of an interesting problem was easily stated: a problem for which the solution or explanation was not obvious. Given that problems he regarded as obvious are nothing of the sort for most of us, his criterion was certainly a sufficient condition. So among my proudest moments were visits long after I graduated during which he deemed interesting some scientific question that I had raised.

Bob's other great gift was my first peek behind the curtain where science actually gets done. The history of ideas usually celebrates inventors and discoveries with linear story arcs—a progression with a beginning, a middle, and an end. The scholarly literature devotes all its pages to accounts of explanations that are consistent with observations, steadily building on prior work to create the majestic edifice of science. This approach gives the impression that science itself is a linear and

rational series of steps. This is of course bogus, though this only becomes clear with experience.

Unlike the lesson about the importance of saying "hmmm, that's interesting," this gift was inadvertent, I think. A good deal of my PhD work was in pursuit of a physical and mathematical demonstration of something that we were sure was true, but couldn't prove. After months of this pursuit Bob suggested that I try to apply the second law of thermodynamics to the problem. It seemed to me this would just make a complicated problem even more complicated. But his insight was legendary, and if he thought this might work, I would have been a fool not to wrestle with this idea until the problem capitulated.

In the event it was I, not the problem, that capitulated. It took a while to work up the nerve to tell him I couldn't figure out how to make the second law tell us anything useful. Schechter's reverence for Gibbs, the father of thermodynamics, was well known, and an admission of defeat involving the second law seemed unlikely to be well received. To my surprise, he simply said "well, it was worth a try." It dawned on me that day that even legends like Bob Schechter didn't have everything figured out in advance.

In hindsight—and journal articles are always written in hindsight—it appears that the authors knew what they were doing each step of the way. The role of accident and serendipity is never discussed, since the blind alleys and wrong hunches don't contribute to the explanation and should not take up space in the journal. But quite often the actual path was tortuous and jumpy and involved wrong turns, backing up, and going around in circles.

Bob suggested applying the second law of thermodynamics not because he knew it would work, but because it was not an obvious thing to do, and sometimes the "out of left field" idea turns out to be useful. Sometimes . . . but not every time. It was an enormous relief to discover that in science, as in baseball, legends did not have to hit a home run every time they came up to bat. They instead needed to be willing to swing at a pitch, knowing that, if they missed, it was not the end of the world.

Certainly, with experience the batter/scientist develops better and better intuition about what the next pitch/hypothesis should be. And people like Schechter have a gift for making connections and simplifying assumptions and other tricks that speed up the research process enormously. But even so, sooner or later it comes down to being willing to say "let's try this and see what happens."

Bob had that willingness, which, combined with curiosity and intelligence and insight and perseverance, took him to the top of his profession. Part of his enduring influence is that he let so many students and colleagues in on the secret to success.

Throughout his career Bob was a witty, robust intellectual. Maurice Bourrel writes: When I met Bob for the first time in 1977, I immediately recognized I was going to learn a number of things from this man. A few months later, this proved to be true. Including in totally unexpected domains.

One day, he came to me and said, "I'm going to give you your first lesson in squash." I was in my 30s at that time, playing soccer regularly, running—in good shape! I looked at this big strong man, with his thick glasses, his unique way of walking (I refer to the clap-clap of his large shoes beating the ground), and said to myself: "Ha! I'd like to see that." And see I did. I went out of the court exhausted, very badly defeated.

A few weeks later, he came again and said, "I'm going to give you your second lesson in squash." I had practiced in the meantime, and said to myself, "Ha! Now we'll see!" I did a little bit better: I won 2 games, against 7.

I have to say, however, that I could see Bob was struggling to breathe and obliged to rest from time to time.

The day after, he had his heart surgery. This indeed devalued my performance in my own eyes.

This is how I learnt squash, and humility.

Gary Pope writes: Bob served as chair of petroleum engineering from 1975 to 1978 and hired me as an assistant professor in 1977. The dean appointed Bob, one of the top professors in the entire university, to rebuild the department. Bob did more than that. He transformed it. He led the department with

great vision and energy. It is because of his great leadership and vision that the department is what it is today.

The ideal departmental chair is a great teacher, world-class researcher, and strong leader. He was all of those things and more. He was always fair, treated everyone equally, and encouraged and promoted all of his colleagues. He also had the stature needed to do the job. Based on his outstanding research accomplishments, he had already been elected to the National Academy of Engineering, the highest engineering honor in the country. He also had the great respect of his faculty colleagues, the UT administration, and the petroleum industry. This enabled him to recruit and retain outstanding petroleum engineering faculty members, several of whom were also elected to the NAE later in their teaching careers at UT.

He was adored by the students he taught. They in turn have taught other students and led other departments and companies, among other achievements. His impact was huge and lasting. It set the course of the department for decades. We are what we are because of Robert S. Schechter. We and the world owe him tremendously for this great achievement.

Bill Rossen writes: In the summer of 1989 I came to the University of Texas at Austin as an assistant professor. That summer I attended the Gordon Conference on Flow in Permeable Media and told several people about my move. Twice during that conference people came up to me saying essentially the same thing: "I hear you are going to the University of Texas? Bob Schechter teaches there. Bob Schechter *is the nicest man I ever met*."

At one ceremony Bob was receiving a major award from the UT College of Engineering; I think it was the Joe King Award for research. When he started his remarks upon receiving the award, he started by saying that he was thought of as a big shot around UT, but in Austin he was known as Mary Ethel's husband. I have always admired that gracious opening, and have tried to follow its excellent example (though never under circumstances quite that august).

The welcome mat at Bob and Mary Ethel's front door said, enigmatically, "At this house live one very nice person and

one old grouch." I never found out which was alleged to be the old grouch. . . .

For many years Bob hosted an annual evening at the UT Faculty Center in celebration of the birthday of J. Willard Gibbs ("father of thermodynamics") on Gibbs' birthday in February. To enter the party one had to be able to define entropy—but one didn't have to be able to give a lecture on it. (My wife Janice, with her PhD in English literature, duly learned the definition and joined the party one year.)

In addition to socializing, there was a special activity each year. One year we saw a demonstration of the principle illustrated in the National Commitee for Fluid Mechanics Films feature "Low-Reynolds-Number Flows," showing the reversibility of the flow if diffusion is limited. There were two coaxial vertical cylinders, perhaps 12 and 18 inches in diameter, with glycerin filling the gap in between. The inner cylinder could rotate, and the outer cylinder was fixed. (The apparatus had been brought to UT years earlier by Bob Hermann, a professor in mechanical engineering who had come from General Motors' labs. He had had it built there after seeing, and being much impressed by, the fluid mechanics film.)

At the party, Bob placed a large dot of blue-dyed glycerine on the surface between the cylinders. (In the movie, they write "Re << 1" there.) The inner cylinder was rotated about two revolutions: the dot first stretched and then disappeared in about the first half-revolution. Then the inner cylinder was rotated back. In the last half-revolution the dot reappeared, first stretched, and then back in its original shape. It was like a magic trick, or a miracle.

One year I was invited to provide the activity. I had heard that if someone spills red wine on a carpet, one should shake salt on it: the red wine is drawn in among the salt grains by capillary action and one can vacuum up the salt, leaving the carpet unstained. I brought a scrap of carpet, poured a bit of red wine on it, and poured on salt. The salt turned pink, but enough red wine stayed below to stain the carpet. Sadly, another great theory bit the dust.

At his office, Bob was interested in discussing anything

about research. At his home he was always a gracious host when I would visit in his later years. He was interested in everything—his visitors' activities, their research, anything. When he had trouble with his eyes in his later years (a detached retina?), he reported to friends that the problem had to do with the van der Waals interactions between the two surfaces. Nothing was beyond the reach of his interest.

Academics features individuals with, uh, healthy egos. Bob, however, was always gracious in academic controversies. In one case, fresh out of grad school and working at Chevron, I found that in one of his papers his student had incorrectly tried to find the simultaneous optimum of two functions (solubilization ratio and adsorption in surfactant flooding, I think). It turns out this is a standard problem in economics (maximizing utility while minimizing spending), and I wrote to Bob, showing him the solution from an economics textbook. I didn't know Bob personally then, but I was much impressed with his gracious reply when I wrote.

I didn't attend Bob's classes, of course, but I believe he imbued his students with a vivid sense of humor. One day his lecture was not going smoothly. Then the star pupil in his class (I forget his name—let's call him Smith) seemed to be joining the class in the critical questioning. Bob called out, "Smith, have you turned against me too?"

I am proud to have known a man as intellectually sharp, hard-working, inquisitive, and personally gracious as Bob Schechter. He was one in a million!

A line from *Hamlet* says it best; Shakespeare, writing of the prince's father, says

"He was a man, take him for all in all,
I shall not look upon his like again."