A Tribute to Richard Skalak

John B. Brunski, PhD, Section Editor

On August 17, 1997, at age 74, Professor Richard Skalak died in his home in San Diego, California. He lost a 2-year battle with cancer. I'd like to honor the passing of this remarkable man by telling you something about him and describing his place in the story of osseointegration.

To give you an idea of what Dick was like on a personal level, I'll first explain that he would probably object to my use of the word "battle" when referring to his cancer. He'd most likely say that the word "battle" is too dramatic. With his customary grace under fire, he'd probably say that his cancer was just another one of those problems that comes into one's life, and that problems are meant to be confronted and solved. Indeed, this is essentially the message he conveyed to me on several occasions when we talked this past summer, as he was nearing the end. In fact, I didn't know he was nearing the end, because he never mentioned it. We talked often because we were writing a book chapter together about the biomechanics of craniofacial implants. He would occasionally mention the treatments he was receiving and the effects of some of the medications, but he was never in poor spirits. Given his condition, one might have thought that Dick would cut back his activity, and of course to some extent, he did. Likewise, some low spirits would be expected. But Dick's approach to his illness was simply to accept his burden and go on with life as usual. For him, this meant going to work each day, if only for half of the day, and being fully involved in his work, family, and friends up to the end. It was a courageous approach that I will not forget. Some years back there was a book about astronauts entitled *The Right Stuff.* While we all might hope that we have "the right stuff" when faced with personal challenges in our lives, I can report that, in fact, Dick Skalak had the right stuff.

Besides the attitude noted above, another most impressive thing about Dick was that he was so well rounded in his knowledge. In this day of rather specialized niches of research activity—wherein people often labor to know more and more about smaller and smaller questions—Dick was pretty much the opposite. Of course he was an expert in his own fields of study—his awards and honors testify to this. Dick received practically all of the highest honors that can be given to an engineer, including the Lissner Award (Bioengineering Division, ASME), the Theodore von Karman Medal (Engineering Mechanics Division, ASCE), the Melville Medal (ASME), and membership in the National Academy of Engineering. But Dick never lost sight of the big picture and the need to communicate and cross-fertilize over many disciplines. Dick Skalak possessed a truly unique breadth and depth of scientific and engineering knowledge. And equally important, he had the ability to touch the lives of many colleagues, students, and friends, and in so doing, markedly

influence the development of whole new fields of study within engineering. A case in point is bioengineering and its newest subspecialty, tissue engineering, as well as osseointegration, which we'll explore in a moment. But to give you a sense of Dick's overall stature, let me describe his seventieth birthday.

On February 5, 1993, there was a big seventieth birthday party for Dick at the University of California at San Diego. Many people came to honor Dick's technical contributions and to celebrate this milestone in his life. The organizing committee asked each of Dick's friends, colleagues, and students, as well as his family, to write a short note about him for the "little" booklet (which actually had about 150 pages) that would be presented to him at the party. I have a copy of that booklet in front of me; it contains about 50 written tributes. Some of the articles are several thousand words in length. The list of contributors includes pioneers in the fields of bioengineering (eg, Y. C. Fung, Shu Chien, Robert Hochmuth, Sheldon Weinbaum, Robert Nerem, Savio Woo, Van Mow) and osseointegration (P.-I. Brånemark and Ragnar Adell). Dick’s impact is obvious in the titles of many of the tributes. For example:

- "Dick Skalak—A Great Scientist, But Also Totally Human" (by Ragnar Adell)
- "Richard Skalak: A Superb Scientist, a Great Teacher, a True Gentleman, and a Marvelous Friend" (by Shu Chien)
- "A Cross-Fertilizing Mathematician" (by P.-I. Brånemark)
- "Richard Skalak and the Deformability of Red Blood Vessels" (by Robert Hochmuth)
- "The Man With the Magician’s Briefcase" (by K.-L. Paul Sung)
- "Have Slide Rule, Will Travel" (by Herb Lipowsky)
- "To Dick Skalak, For Your Friendship and Role-Modeling" (by George Zarb)
- "Salute to Professor Skalak from the Czechoslovak Biomechanical Community" (by J. Valenta)
- "Dick Skalak: The ‘Iron Man’ of Dental Implants" (by J. B. Brunski)

The title of my tribute refers to the nickname that the Swedes have for Dick; they've seen him travel nonstop from California to Sweden and then jump off the plane ready to start consulting with them, showing no effects from jet lag! A time traveler indeed.

My favorite tributes in the booklet are "Dick—How Did You Get So Smart?" (by Herbert Meiselman), "A Sense of Clarity" (by Thomas Skalak, one of Dick's two sons), and "Work, Work, and a Little More Work—That's My Father" (by Barbara Skalak, one of his two daughters). These titles summarize the man. The first title highlights the fact that Dick was so smart, even other smart people tended to feel

less smart in his presence. The tributes by his son and daughter are full of love and contain some wonderful stories about what it was like to be a member of Dick's family. It turns out that Dick was a devoted father and husband, an accomplished dancer, an avid gardener, fisherman, carpenter, and cook, a good pianist and harmonica player, handy with model trains and kites, a great stone-skipper, an excellent badminton player, and, according to Tom, a reasonably astute "armchair" analyst of football and basketball. Moreover, Dick was evidently pretty good at taking foul shots with his sons in the driveway basketball court (which he built to last, of course). Tom explains that his dad seemed to take forever preparing to shoot (doing mental calculations to gauge the flight of the ball?), but ended up shooting "well over 90% over a period of several years." In a nutshell, this is probably an excellent epitaph of Dick's life: he shot well over 90% in everything he did!

Finally, when it comes to osseointegration, Dick's role was critical. He first came to know P.-I. Brånemark from their mutual interest in blood flow and microcirculation in bone. After working with Professor Brånemark on the use of indwelling titanium chambers for viewing red blood cells in bone, they came to the realization that the titanium chamber itself was rather well accepted by the bone. This fact, together with the biologic principles that were emerging about bone healing and the proper conditions to foster it, formed the basis of osseointegration and led to the current state-of-the-art techniques for using load-bearing implants in oral, craniofacial, and orthopedic applications. Dick's role in all this was pivotal: he helped design the actual implants. That is, Dick applied his basic knowledge of engineering materials and mechanics to help Professor Brånemark and coworkers design the right shapes and sizes of implants to meet the specifications dictated by the clinical applications. It is one thing to have good ideas, but it is another to apply them to successful clinical practice. Dick helped Professor Brånemark do both. I could cite many examples of Dick's contributions, but perhaps the most obvious is the Skalak model for predicting how implants are loaded while supporting a loaded prosthesis. Dick understood the need for information about implant loading to design successful implants. Understanding this need but finding no real solution in the literature at the time, he solved the problem himself in the early 1980s, based on a similar approach for analyzing loads in bolted connections in structural engineering. This solution was obvious to Dick because of the breadth and depth of his knowledge, again illustrating the importance of cross-fertilization and integration of knowledge over many disciplines.

It was about this time that I first met Dick. I had been doing research on dental implants since graduate school in the late 1970s. While I was aware of P.-I. Brånemark during my thesis work (I wrote to him), in general the U.S. research community and funding agencies were not. For instance, in 1978 the report of the Consensus Development Conference on Dental Implants (sponsored by NIH and Harvard) did not cite Brånemark's work, which was already more than 10 years old. For various reasons, it turned out to be a difficult time for anyone in the U.S. to build

a research career on the subject of dental implants. However, when Dick took the time to discuss my research and to offer encouragement and the possibility of collaborating with someone of his stature, it was a major turning point in my life and career. I didn't know it at the time, but I was simply joining the already long list of people whom Dick had helped in this way.

Dick Skalak will be sorely missed by all of us involved in bioengineering and osseointegration. He was an extremely rare individual. His great achievement was the ability to develop a true state of integration with his family, research colleagues, students, and friends at so many different levels. I am thankful to have known him.