PHILLIP BARKAN

1925–1996

BY THOMAS H. LEE

PILLIP BARKAN, professor of mechanical engineering at Stanford University since 1977 and former leader in research and development at the General Electric Company, died on June 21, 1996. He was survived by his wife, Susan; his daughter, Ruth Barkan; and his son, David, and daughter-in-law, Nancy Melrose.

Phil was born in Boston, Massachusetts, on March 25, 1925. He earned a bachelor's degree in mechanical engineering at Tufts University in 1946, a master's from the University of Michigan in 1948 and a Ph.D. from Pennsylvania State University in 1953. While at Penn State, he also worked first as a research assistant and then as assistant professor of engineering research. In 1953 he joined GE as a senior research engineer in the Switchgear and Control Laboratory in Philadelphia. He was promoted to the position of manager for mechanical engineering and circuit interruption in 1965 and to the position of manager for applied physics and mechanical engineering in 1972. He left GE in 1977 to become a professor in mechanical engineering at Stanford University, where he served until his death.

Most of the fifty-one patents issued in his name came during the period between 1953 and 1977. Therefore, it is important to review his inventive work during that period. Even though circuit breakers have been in existence for a long time, a great number of advances occurred in that period in three different areas:

1. The dynamics of the mechanical operation systems.
2. The dynamics of fluid mechanics and high-pressure arcs in circuit breakers during the important but brief period of circuit interruption.
3. The development of new types of circuit breakers

Phil made major contributions in all three areas. In the area of operating mechanical systems, he introduced scientific method into the design of mechanical linkages. For that effort, his operation was designated as the Center of Research for Transient Dynamics by the General Electric Research Laboratory. There were about ten such centers in the General Electric Company and their responsibility was to share their competence throughout the company with organizations that have comparable problems. While such a designation is an honor, the real purpose is to strengthen GE's capabilities in key technical areas.

Circuit interruption, although an important function in the operation of modern power systems, was and still is more an art than a science. A great deal of cut, try, and testing was needed, because the physics of high-pressure arcs is still far from adequate to allow designers of circuit breakers to handle their job analytically. Some of the phenomena involve high-pressure turbulent flow in a very complex way: even qualitative understanding can be invaluable to development engineers. In applying the science of fluid dynamics and the science of high-temperature plasma, Phil was able to bring understanding to the dynamics in oil circuit breakers, which helped designers tremendously.

Phil was also a major contributor to the development of vacuum circuit breakers, an idea conceived by Milikan and Sorenson in the early 1920s, but the commercial development of which did not occur until 1960. To bring that idea into practicality, one had to rely on the knowledge of rapid diffusion in a freezing liquid mixture. This made possible the invention of a special alloy, which was needed to bring vacuum circuit breakers to reality. I had the pleasure to be a close associate of Phil's because I was in charge of that project. Phil and I were co-inven

tors of that alloy. As the person in charge of research and development for that group in GE of which Phil's operation was a part, I have said to many senior GE executives that Phil Barkan was one of the most creative engineers we have seen in GE for many years. Of course, GE demonstrated its appreciation by giving him three managerial awards and made him the first recipient of the Charles P. Steinmetz Award, the highest honor for technical excellence in GE. In 1972 the Institute of Electrical and Electronics Engineers designated him a fellow for contributions to circuit breakers, particularly in the areas of dynamics of mechanical systems and protection. Recognition of his talents and contributions finally culminated in his election to the National Academy of Engineering in 1980.

The best way to describe Phil's work, I believe, is to quote some of his students who participated in his memorial service:

A group of four students said, “In Stanford, he basically started all over again. Phil continued to innovate and look for new challenges. While at Stanford, he moved into concurrent engineering and design for manufacturability and became a leading expert in the field and a highly sought after speaker in industry, where he maintained close ties. He developed Stanford's curriculum in design for manufacturability, a cornerstone in the mechanical engineering graduate design program, and passed on his successful design course sequence to one of his former doctoral students. His other former doctoral students are either successfully teaching in universities or are implementing his concepts in leading industry and government positions and are the best examples of the “rewards” he came in search of at Stanford University.”

Another student said, “Phil's course in design for manufacturability was the foremost course of its kind in the country. At the time he started his early work in manufacturing, there was desperate interest on the part of industry to have good courses that would help allow industry to reduce manufacturing costs through the design process.”

Another student said, “Phil was one of the greatest designers I have ever met. If his instinct didn't point the way to an answer, Phil would immediately start brainstorming ideas on a yellow

sketch pad (if he could find it), do back-of-the-envelope calculations, and think of quick experiments to get to the right answer."

Finally, I will quote what the dean of GM's Technical Education Program said, "General Motors' association with Phil Barkan spanned a decade. Ten years ago, he listened to leaders at GM discuss high-level concepts about designing for manufacture, and later built these concepts into a two-quarter graduate-level course. Phil Barkan was a pioneer in design for manufacturability. The course, which was first delivered eight years ago, is still unequaled today by any other university. This forward-thinking course has been critical to GM's success as a manufacturing company."

I will end this tribute by talking about Phil as a person. I would like to start by recalling a conversation I had with my wife after my initial interview with the Switchgear and Control Laboratory. Phil joined that organization in 1953, and I was interviewed for a parallel level job to develop vacuum circuit breakers. Phil was one of the interviewers. After spending an afternoon with him, I told my wife that I had met a person with whom I would really like to associate. He was not only technically smart but a real man of principle. The fact that we were supposed to work closely together greatly influenced my decision to accept the offer. Even though, later, I was given the responsibility of running the entire laboratory, we remained close friends even after I was transferred to the GE headquarters and Phil left for Stanford in 1977. Before 1974 we used to play tennis together every week.

Phil was active in school boards in Rose Valley and was president of the Middletown Township Democratic Club. Phil's first wife, Hinda, who died of cancer shortly after he joined Stanford, shared much of Phil's dedication to civic activities. Of course only those of us who knew Phil in the early days remember how Phil and Hinda shared their interest in nature and in their sense of personal responsibility to society and to the needy.

His students testified to his compassion for people in a different way. Let me quote just a couple:

"Phil was a wonderful human being. He offered me respect, affection, and support throughout our association."

"Phil was immensely generous with his time and willingness

to help and be involved in the finest detail. Phil's tremendous commitment to his students and the teaching process, even with his progressing illness, will never be forgotten."

This was the Phil I knew.