Guest Editorial
Special Issue on Arc Plasmas

ERICH E. SOEHNGEN

WE ARE PLEASED to dedicate this Special Issue of IEEE TRANSACTIONS ON PLASMA SCIENCE to Erich E. Soehngen on the occasion of his 73rd birthday.

Erich served for nearly 27 years as a research scientist and manager in several different research and development laboratories at Wright-Patterson Air Force Base (WPAFB), Dayton, Ohio. During the 12 years prior to his retirement in 1972, he was Director of the Thermomechanics Research Laboratory of the Aerospace Research Laboratories (ARL). Thoughout his tenure he initiated and directed many studies of basic and applied research in the area of plasma arc technology. The results of this research have had a strong influence on many of the current activities in this multidisciplinary area.

A native of Kiel, West Germany, Erich received his degrees from the Technische Hoshschule in Munich, West Germany. His early aerospace experience in Germany at the German Aeronautical Research Institute (DVL) included research in heat transfer, fuel atomization, and thrust augmentation. In the early 1940's, he pioneered development of ceramic and cermet materials and combustion chambers for high-temperature gas turbines. He arrived at WPAFB in 1946, under the U.S. War Department Foreign Scientist Program, to conduct basic scientific studies in heat transfer and flow visualization at the Power Plant Laboratory. He later transferred to the ARL (1958—originally Office of Air Research) where his activities in heat transfer continued, together with initiation of plasma arc/gas flow programs.

Erich's foresight and advocacy initiated much of the plasma arc technology research relating to space flight and to other applications involving extremely high temperatures. Through his perseverance, he was instrumental in establishing the first cooperative thesis research program with the U.S. Air Force Institute of Technology (AFIT). He served as an adjunct professor, helping USAF graduate students train in experimental research laboratory techniques. His activities included directing basic in-house experimental research at ARL and the advocacy and management of extramural contract research at many industrial and university laboratories throughout the world. His outstanding communication techniques and unique ability to motivate his colleagues were manifested in many of the USAF/ARL programs.

Erich's real association with plasma arc technology originated in the mid-1950's, when his program emphasis was shifted from heat transfer and associated flow fields to extremely high temperature flows generated by plasma arcs. He was instrumental in establishing one of the first basic research programs on the physics and fluid mechanics of ionized gas flows relevant to aerospace problems and applications. In 1958, the initial USAF program in the field of ultrahigh temperature technology was established. Through his perception and commitment, many fundamental problems in the field of high-energy transfer, with emphasis on high-density fluid dynamic systems at extremely high temperatures, were investigated and solved. Within a few years, his research projects in plasma arc technology (spanning temperatures up to 25×10^3 K and pressures up to 10^3 atm) became the largest of their kind in the free world. Primarily through Erich's efforts, his laboratory grew to 32 military and civilian researchers, supplemented by about the same number of in-house contractors, AFIT graduate students, and visiting scientists from abroad. The results of many of these pioneering projects have served as the basis for the design of numerous high-energy density systems in the field of aerospace technology. During this period, Erich authored over 40 publications and presented over 100 invited scientific lectures throughout the world. More importantly, he created the necessary "caring climate" that stimulated researchers to do their best. He also eliminated the fear of failure

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from those researchers who worked with him (especially many of the novice AFIT students) by actively and enthusiastically participating, at times unrecognized, as a coworker/coauthor in many of the research programs.

Evidence of Erich's keen early awareness of some of the fundamental problems that first must be solved for advancement of plasma arc technology is still present today. International symposia, workshops, and seminars held throughout the world in 1985 included topics such as: a) fluid flow and temperature fields in the plasma region; b) nonequilibrium effects; c) plasma–surface interactions; d) interactions within the plasma (gas–gas, gas–solid); e) heating and quenching effects; f) thermodynamic and transport properties; g) electrode phenomena and erosion; and h) radiation from high-pressure plasmas. The majority of these aspects were initially identified by Erich as being critical for advancing the science base in high-temperature plasma technology.

Recent diagnostic improvements, often using lasers, permit accurate measurements of charged particle densities and electric fields, as well as neutral particle densities. Further, the modeling of both high- and low-pressure plasmas has been enhanced by efficient methods that handle stiff coupled differential equations, and by access to high-speed vector processing computers. Most of this work, however, has been on the simpler gases and on idealized discharge configurations. There is a need to establish a validated data base on the many gases or gas mixtures of technical interest, and to develop models on discharge configurations having flow and boundary conditions closer to those actually employed in plasma processing, pulsed power, and other applications.

As Erich himself stated, "This activity in plasma arc technology represented the challenge of my life when I was given the opportunity to start a new, unconventional research program at ARL." Being humble of nature, Erich's main rewards throughout his career came from the interest, dedication, and cooperation of his colleagues, students, and contractors. Because he was trained as a mechanical engineer, the field of high-temperature plasma physics was very new to him. His unique talents and dedication, however, allowed him to broaden his own basic background and advance the science base, simultaneously. His retirement did not stop his scientific career; it merely provided an opportunity to redirect his attention primarily to current energy problems, with emphasis on energy conservation and alternative fuel resources (e.g., as a consultant to USAF, Battelle Memorial Institute, Bechtel Corp., EPRI, DOE, and as an advisory committee member for MHD and combustion). The arc community does miss his advocacy, however, especially when fundamental plasma studies are needed to support the increased interest in high-power technology.

Erich is a good example of a research director who always responded unselfishly to the needs of his colleagues. It is impossible to list all of Erich's colleagues, students, coworkers, contractors, etc., individually. The large number of manuscripts that were submitted for this Special Issue by many of his colleagues, both here and abroad, attest to the respect and trust Erich has generated and received over many years. This, in a sense, is the greatest tribute to a distinguished gentleman of science.

We believe this Special Issue will complement the seven "outstanding performance awards," recognition plaques, and the Meritorious Civil Service Award that Erich received during his distinguished Air Force career. It is a wonderful feeling for one to know that his efforts have not gone by unnoticed and that colleagues from all over the world wish him well in future years.

Erich and his wife, Brigitte, now live in Belmont, California, where he still serves as a consultant in the fields of his interest. His entire "research family" wishes them both well.

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