

Paul C. Paris, Eulogy

Not only was Paul Paris one of the fracture and fatigue greats but he was also a fine gentleman. I first met him in the 1990s and it was always a pleasure to meet again. At the European Conference on Fracture (ECF 21) last June which was sponsored by the European Structural Integrity Society, he was awarded the Wöhler Medal for his seminal contributions to the field of fatigue crack propagation. The Paris Law continues to be quoted in an ever increasing list of publications. From crack propagation in metals, it has been extended to many materials including that of delaminations in composite laminates. At ECF 21, young (and old) researchers gathered round him to hear his stories and take selfies with him. He was the hit of the conference. He so appreciated the recognition from the award. All of us who knew him, will miss him dearly.



Paul was born in 1930 in Buffalo, New York. Following in a family tradition established by his father and uncles, he studied at the University of Michigan, where he received a B.Sc. in engineering mechanics in 1953. He enrolled in the applied mechanics program at Lehigh University where he received an M.Sc. in 1955. He was then hired by Boeing Company to work on fracture related problems. During the period from 1955 to 1960, Paul was particularly influenced by the work of George Irwin on fracture mechanics. His pioneering work on fatigue crack growth was also firmly supported by Bill Anderson and others at Boeing.

Following the publication of George Irwin's classical paper in 1957, Paul recognized that Irwin's stress intensity factors could be applied to fatigue crack growth problems. He proposed that the stress intensity factor range may be used to represent the driving force for crack growth under cyclic loading. Paul's ideas were promptly rejected by three of the leading journals in the field (AIAA Journal, Journal of Applied Mechanics and the Philosophical Magazine). One reviewer went so far as

to say that an elastic parameter such as K could not be used to characterize fatigue crack growth. However, the paper was finally published in 1961 in an internal journal of the University of Washington entitled *The Trend in Engineering*. Soon, these ideas were widely embraced by the scientific and engineering community at large, and it was not long before the relationship between the fatigue crack growth rate and the stress intensity factor range became known as the Paris Law.

In 1962, Paul received his Ph.D. in applied mechanics from Lehigh University, and the same year, accepted a position as an Assistant Professor in the same department. During the next few years, Paul rose rapidly through the ranks to become a Full Professor in 1965. Meanwhile he formed a fracture mechanics group at Lehigh University including Fazil Erdogan, George Sih and, later, George Irwin and Bob Wei. Over the next ten years, Paul did extensive work on fatigue crack growth in the near-threshold, linear and high ΔK regimens. Following Elber's discovery of crack closure in 1967, Paul and his research group performed systematic experiments to study the effects of stress ratio and crack closure on fatigue crack growth. He also worked with John Hutchinson and Jim Rice to develop practical applications of the J -integral.

In addition to his outstanding research accomplishments, Paul contributed significantly to the education of many people in the areas of fracture mechanics and fatigue. As a professor at Lehigh University, he trained students such as Richard Hertzberg (Paul's first graduate student), John Landes, Jim Begley, Matt Creager and Jim Rice, and many others. Paul organized and taught short courses designed to educate non-university students on the principles of fracture mechanics and fatigue. Following the advice of Rudy Hartmann, Paul founded Del Research Corporation in 1967. With Rudy supplying the test machines, the company soon became well known for its consulting work in areas of failure analysis and mechanical testing. Del Research also hired promising young engineers such as Keith Donald and Hiroshi Tada, and its directors included Richard Hertzberg and George Irwin. In the late 1960s, Paul together with George Irwin initiated the Annual National Symposium on Fracture Mechanics and the *Journal of Engineering Mechanics*, both of which continue today. Paul joined the Department of Mechanical Engineering at Washington University in 1976 as a professor in mechanics. He continued being active for many years.

He has received many awards including:

- 1972: Honorary Fellow of ASTM • The Award of Merit of ASTM
- 1976: Stanley P. Rockwell Memorial Lecturer and Medal of ASM and AIME
- 1987: The Fracture Mechanics Medal of ASTM (First Recipient with George Irwin)
- 1987: Banquet Lecturer at the National Symposium on Fracture Mechanics of ASTM
- 1988: Honorary Fellow of the International Congress on Fracture
- 1990: Honorary Fellow of the International Fatigue Series
- 1992: Swedlow Memorial Lecturer of ASTM
- 1996: Honorary Editor of the *Journal of Engineering Fracture Mechanics*
- 1997: The Symposium in Honor of Professor Paul Paris of TMS/ ASM (with proceedings: *High Cycle Fatigue of Structural Materials*)
- 1998: The Dudley Medal of ASTM (Presidents Medal)
- 2000: Banquet Lecturer at the International Conference on Fatigue Damage of Structural Materials III (Hyannis, MA)
- 2001: Invited Opening Plenary Lecture at the International Conference of Fatigue in the Very High Cycle Regime (Vienna, Austria)
- 2003: The Third Crichlow Trust Prize of the American Institute of Aeronautics and Astronautics. A medal-\$100,000 Honorarium, a citation for lifetime contributions to aircraft structural analysis
- 2003: The Medal of Conservatoire National des Arts and Métiers (Paris, France)

2004: Invited Opening Plenary Lecture at the International Symposium on Gigcycle Fatigue (Kyoto, Japan)

2006: Invited Opening Plenary Lecture at the Crack Paths conference (Parma, Italy)

2009: Honorary Doctorate from the University of Paris West (Paris, France)

2016: Wöhler Medal, European Structural Integrity Society, ECF 21 (Catania, Italy)

Paul passed away at his home on January 15, 2017 in St. Louis, Missouri.

L. Banks-Sills