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DAVID K. MATLOCK

AIST DISTINGUISHED MEMBER AND FELLOW

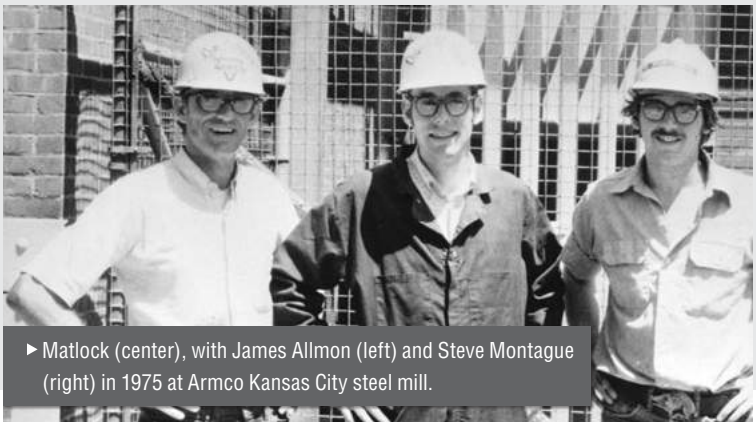
DAVID K. MATLOCK received his B.S. degree in engineering science from the University of Texas at Austin (1968), and his M.S. (1970) and Ph.D. (1972) degrees in materials science and engineering from Stanford University. He is University Emeritus Professor in the George S. Ansell Department of Metallurgical and Materials Engineering at Colorado School of Mines (CSM), Golden, Colo., USA. He joined the CSM faculty in 1972 and was involved in teaching and research, primarily related to the mechanical properties of materials. He served as director of the Advanced Steel Processing and Products Research Center, an industry-university cooperative research center at CSM, from 1993 through 2013. In retirement he continues to be an active participant in all Center operations. Matlock, a member of the National Academy of Engineering and a Fellow of ASM International, TMS, AWS and Alpha Sigma Mu, has received numerous awards for teaching and research, including the Robert Lansing Hardy Gold Medal (AIME, 1975), Howe Memorial Lecturer Award (AIST, 2011), American Iron and Steel Institute Finalist Medal (AISI, 2013) and J. Keith Brimacombe Memorial Lecture Award (AIST, 2014). Matlock received the AIST Distinguished Member and Fellow Award at AISTech 2016 in Pittsburgh, Pa., USA.

When did you first become interested in steel?

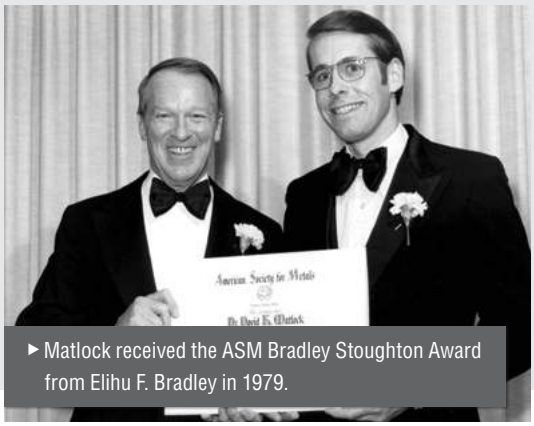
My initial involvement in steel and keen interest in the subject arose from a variety of events during the early days of my career at the Colorado School of Mines (CSM). I joined CSM in 1972 with a responsibility to expand the university's offerings related to mechanical properties of materials and to develop laboratory classes in mechanical testing, metal forming, fracture, fatigue, and failure analysis. In the laboratory classes I incorporated steels in many of the experiments which were designed to illustrate fundamental material deformation behavior.

As a young faculty member, I met many of the recruiters who visited the campus and it became clear that I did not know much about the specific companies that were hiring our graduates. One particular recruiter, Tom Scahill, from Armco's Kansas City, Mo., USA, plant, recognized this shortcoming and established a new program to bring young faculty members (I was the first) to Kansas City to spend an extended period at the steel plant. Thus, during the summer of 1975, I spent six weeks with Armco in a rotation program that provided me the opportunity to work alongside engineers in various parts of the plant. It was a great experience and I still reference specific information I learned from that summer. I had the opportunity to inspect gear cracks in the main drive gearbox of the primary breakdown mill (you had to crawl inside the gearbox and stand in the oil pan to see the gears) and was able to immediately contribute to a solution to the cracking problem.

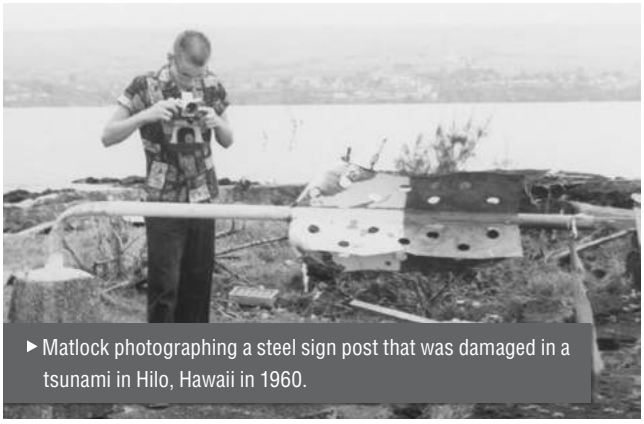
A second major event happened in 1975 that significantly impacted my career and interest in steel: Prof. George Krauss left Lehigh University to join CSM and assume a prestigious chaired position supported by the AMAX Foundation. George brought his ferrous metallurgy expertise that focused on detailed analyses of steel



▶ Matlock (center), with James Allmon (left) and Steve Montague (right) in 1975 at Armco Kansas City steel mill.



▶ Matlock received the ASM Bradley Stoughton Award from Elihu F. Bradley in 1979.



▶ Matlock photographing a steel sign post that was damaged in a tsunami in Hilo, Hawaii in 1960.

▶ Matlock (left) operating a wheel to control gap during a hot rolling experiment at CSM in 1986.

microstructures to CSM, and with my interests in mechanical properties, we developed a research partnership and professional association that continues today. Among other endeavors, in 1984 we started the Advanced Steel Processing and Products Research Center (ASPPRC), an industry/university cooperative research center that continues strong today.

A third event happened in the spring of 1976 that expanded my interests to mechanical testing and performance of steel products. I had the opportunity to participate in and lead a failure analysis project that involved steel wire and wire rope associated with a tragic accident on a ski lift in Colorado. Subsequent to my participation on this failure analysis project, I consulted with multiple ski areas and other industries in the U.S. and Canada to analyze failures and to provide input to improve equipment and manufacturing processes, design improved testing and inspection methods, and modify operating procedures. This work also led to the development of a very successful CSM graduate course on fractography and failure analysis that continues today, taught by Prof. Kip Findley.

Who has been most influential in your life or your career? How did this person influence you?

My father, Hudson Matlock, was clearly the person who most influenced my career path. In Austin, Texas, where I was born and lived until graduating from the University of Texas (UT) at Austin, Dad was a professor of civil engineering at UT.

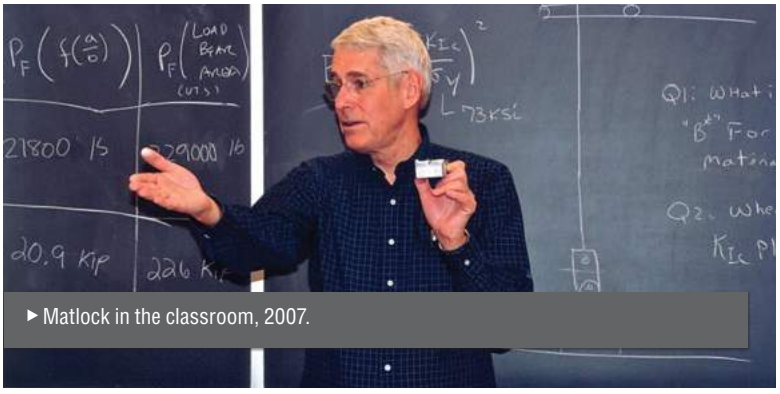
I learned some of the basics of engineering at a very young age. When I was 10, Dad helped me build a chicken coop for my "business venture" with my egg-laying chickens. I was frustrated because he insisted the coop had to be level and corners square and I asked him, "Why does the coop have to be level? The chickens won't notice."

In the summer of 1960, when I was 14, Dad had a contract from the U.S. Defense Atomic Support Agency to travel to Hilo, Hawaii, to assess structural damage caused by a tsunami (23 May 1960) and to provide recommendations for future structures to mitigate potential damage if a tsunami again entered Hilo Bay. My job was to photograph structures and make measurements to document the damage. This was my first formal failure analysis assignment.

As an expert on soil mechanics, my father had many field projects where the family went along and I had the opportunity to assist in a variety of ways. Much of his field work involved the design and construction of instrumented steel test pilings and field testing of the pilings by systematically applying lateral loads with mechanical and hydraulic systems. Data on pile deflections and soil interactions provided critical input to computer models

▶ Matlock and George Krauss near Gore Pass, Colo., USA, in 1985.

▶ Matlock and colleagues receiving the SAE/AISI Sydney H. Melbourne Award for Excellence in the Advancement of Automotive Steel Sheet in 1998 (left to right): Robert Foley, Brandon Hance, James Fekete, Mrs. Sydney Melbourne and Matlock.



▶ Matlock in the classroom, 2007.

related to structural reliability. While assisting on these projects, I learned, among other things, the basics of designing and building displacement and force sensors, and was responsible for installing and wiring large numbers of strain gauges, some of which required connections to be soldered while viewed in a microscope. The basics of sensor design and circuitry benefited me significantly in my graduate work at Stanford and as I developed an extensive mechanical testing laboratory at the Colorado School of Mines.

While in high school and throughout my UT undergraduate career I continued to work with his research team. Through my involvement with his research programs I expanded my understanding of basic principles of experimental design and research program operation.

In addition to providing a good solid basis for my engineering career, Dad's work on laterally loaded piles provided the basis for API specifications for off-shore structure designs and led to him being selected to the National Academy of Engineering in 1982. I was very fortunate to grow up in a family of engineers, and my father clearly provided me a good, solid understanding of engineering fundamental principles which I could expand on in my career.

In addition to my father, who passed away in October 2015, several other individuals have had and continue to have significant impacts on my career. At the top of this list are Prof. William (Bill) Nix, my Ph.D. thesis advisor at Stanford; and Prof. George Krauss, my long-time colleague at CSM.

How did you get involved with AIST?

At the time AIST was formed, I was already a member of multiple professional societies, including ASM International; The Minerals, Metals & Materials Society (TMS); American Welding Society (AWS); Society of Automotive Engineers (SAE); Sigma Xi; and the American Society for Testing and Materials (ASTM International). Through my membership in TMS, I participated in all of the activities of the Iron & Steel Society. With the formation of AIST, Prof. John Speer convinced me to add one additional society to my list and join AIST, which I did.

How has membership benefited you in your career?

AIST participation has benefited me in multiple ways. Conference participation, particularly in the focused summer symposia that have been organized jointly by AIST and the ASPPRC on advanced sheet steels, plate steels, and

▶ Matlock pictured in the mechanical testing laboratory in Hill Hall at CSM in 1990.

▶ Matlock in 2007, teaching a laboratory section of Mechanical Properties of Materials at CSM.

▶ Matlock and his wife, Diane, at the National Academy of Engineering, Washington, D.C., in 2003.

▶ Matlock and John Speer at the first CSM Technology Showcase in 2003.

long and forged products. At these and other AIST conferences (e.g., AISTech) I have met many outstanding individuals; clearly the networking opportunities afforded by participation in AIST activities has helped us maintain our steel research center and maintain continued interest in the ferrous metallurgy educational focus at CSM. I am also very gratified that I have had the opportunities to share some of my thoughts via special lectures at AISTech, including the Howe Memorial Lecture in 2011 and the J. Keith Brimacombe Memorial Lecture in 2014.

What have you accomplished that makes you most proud?

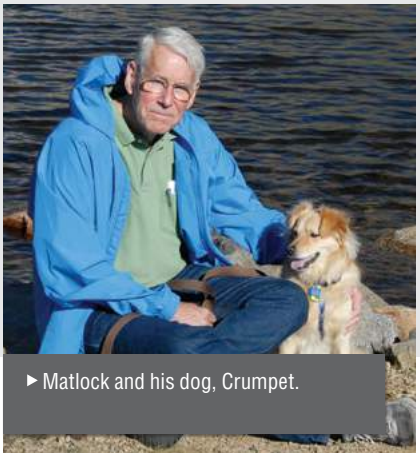
Beyond my family, there are accomplishments that I would like to particularly note. Over the years I have had the opportunity to work with numerous outstanding undergraduate and graduate students at CSM. I am very proud to have had the opportunity to contribute in some small way to their careers.

At CSM in 1984, George Krauss and I established the ASPPRC, an industry/university cooperative research center to support the steel using and producing industries in North America. I am very proud that 32 years later the center is still going strong, has evolved to embrace industrial globalization, and has an operating structure that facilitates continued success with the retirements of both George Krauss and me. Personally, as a result of the need to interact with the global industries that support ASPPRC, I have had the opportunity to interact with companies and industries around the world and now have three trees planted in my name (at the CBMM mine complex in Brazil; at Karabuk University, Turkey; and O.P. Jindal University, India).

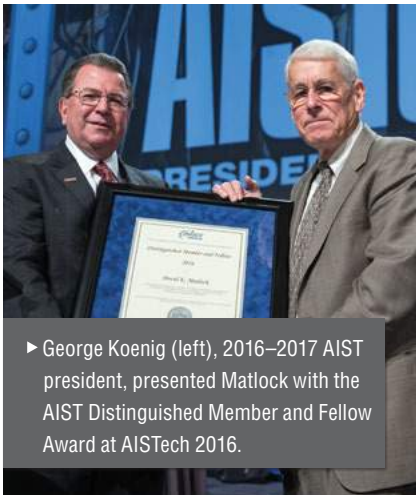
With the retirement of George Krauss in 1997, John Speer left Bethlehem Steel to join CSM and become a principal participant in ASPPRC. Today he is the center director. Furthermore, as a consequence of the presence of ASPPRC at CSM, the George S. Ansell Department of Metallurgical and Materials Engineering (MME) has successfully attracted outstanding young faculty members, Profs. Kip O. Findley and Emmanuel De Moor, who have strong interests in ferrous metallurgy and are committed to the continued success of the center and the MME Department.

I am also very proud that in 2003 I was elected as a member of the National Academy of Engineers of the United States. I was very gratified because selection was based on accomplishments entirely at CSM, and also because this made me and my father one of the very few father/son pairs to simultaneously

▶ Matlock and Dr. Yoshitaka Okitsu (left of Matlock) and colleagues at the Honda Automobile R&D Center, Utsunomiya, Japan, in 2014.



▶ Matlock and his dog, Crumpet.



▶ George Koenig (left), 2016–2017 AIST president, presented Matlock with the AIST Distinguished Member and Fellow Award at AISTech 2016.

be NAE members, a fact that was very significant for my father.

How have you seen steel-related research evolve over the years?

During my career the character of steel-related research has changed significantly. Traditional, large corporate laboratories that in the past focused on both fundamental and product-oriented research have been replaced by smaller, focused facilities dedicated to technology and product development. With more limited time to focus on fundamental research, opportunities for partnerships with universities (i.e., ASPPRC) have evolved to help fill the gaps in needed research to advance the steel industry.

Traditional metallurgical engineering educational programs at universities have been downsized and replaced with materials science programs that focus on alternate materials, often driven by the availability of federal funds. While the National Science Foundation and other U.S. government agencies have continued to fund ferrous metallurgy-based research, the trend over recent decades has been to de-emphasize the amount of funding for steel research programs in lieu of funding new programs including nanomaterials, biomaterials, renewable energy and bioengineering, all of which have merit in their own right. As a consequence, higher education institutions that focus on metallurgical and materials engineering have modified their programs to move away from traditional metallurgical engineering and instead focus on materials science. Correspondingly, many universities have de-emphasized offerings related to ferrous metallurgy or manufacturing. The loss of metallurgical engineering programs that focus on ferrous metallurgy creates challenges for the steel industry and manufacturing industries that utilize steel. The development of partnerships provides the opportunity to overcome these challenges.

Industrial globalization and corporate consolidation in the steel industry has led to the development of international research teams that combine research groups, each with their own "culture," into truly international organizations. In some cases, the combinations of cultures have led to modified perspectives and changes in the ways companies approach research.

Clearly in the last 20 years, the rapid growth of steelmaking capacity and consumption in China has had a major influence on steel research programs.

Competition with alternate materials driven by various pressures, including lightweighting of transportation vehicles leading to more efficient use of energy, development of alternate energy sources, governmental regulations to decrease emissions, etc., have had significant effect on the focus of steel research and, in some cases, have helped to facilitate rapid developments of new technologies to meet these challenges. As a consequence, research developments today must lead to rapid implementation of new processes and products.

What does winning the AIST Distinguished Member and Fellow Award mean to you?

This award also recognizes the accomplishments of all of the people who have influenced my career and for that I greatly appreciate the recognition. Having spent my entire professional career at the Colorado School of Mines, this award also recognizes the importance of our university to engineering education and to the industries that produce and use steel. ✦