

Review of *Hans Albert Einstein: His Life as a Pioneering Engineer* by Robert Ettema and Cornelia F. Mutel

ASCE Press, Reston, VA 20191; 2014; ISBN 9780784413302; 330 pp.; \$65.00

Pierre Y. Julien, M.ASCE

Engineering Research Center, Colorado State Univ., Fort Collins, CO 80523-1320.

The ASCE Press should be commended for publishing such a wonderful biography of the greatest sedimentation engineer of all times. I had read an earlier book on the life of Hans Albert Einstein (HAE) by his second wife Elizabeth Roboz Einstein (ERE) (Einstein 1991), and had found the content absolutely fascinating. This new book by Robert Ettema and Cornelia Mutel came as a treasure and something to enjoy line by line. I was certainly not disappointed and will state upfront that this book must be read by all scientists and engineers truly interested in river sedimentation. It covers the professional development and life components of one of the most influential engineers. It is available for purchase at the ASCE website.

The book covers 330 pages of text and photographs, with no equations and very few tables. It contains 14 chapters and four appendices. The chapter titles are the following: "Early Life," "Divided Family," "Beginning as an Engineer," "In Meyer-Peter's Laboratory," "On the Enoree River," "Mountain Creek, a Very Small River," "Pasadena's Promise," "Move toward Prominence," "Berkeley Professor," "Mr. Sediment Movement," "Parents, students," "Broadened Interests," "At Home in Berkeley," and "Last Years." The four appendices cover the timeline, a glossary, publications by Hans Albert Einstein, and the graduate students and dissertations guided by Hans Albert Einstein.

The most fascinating aspect of this book is the thorough description of his professional beginning when he joined the Hydraulics Laboratory of Professor Eugen Meyer-Peter at the Eidgenössische Technische Hochschule (ETH) in Zürich. This book places the experiments of Meyer-Peter in the proper perspective of solving an important river engineering problem on the Alpine Rhine River. The experiments clearly exemplified some of the great difficulties of laboratory experimentation on sediment transport: (1) sidewall effects, (2) nonuniformity of the flow in a cross section, (3) the presence of bed forms and elongated bars, (4) secondary currents, and (5) some difficulties in the exact measurement of sediment transport rates. Despite significant progress, some of these difficulties still persist today.

Another very important technical aspect of the book relates to what I may call a triangular approach (physics, mathematics, and observations) to the sediment transport problem. A physically based approach, e.g., the Meyer-Peter and Müller formula, seems perhaps desirable to answer the question of how much bed sediment a river flow can transport. HAE preferred to use stochastic concepts to mathematically describe the probabilistic motion of bed-load particles. With this mechanistic approach, HAE has been the instigator of a very deep transformation in the understanding of river engineering in the United States. He was confronted by many proponents of the empirical approach known as the regime theory.

At Colorado State University, we have been privileged for decades to learn and teach both approaches from the empirical viewpoint of D.B. Simons and the mechanical understanding of H.W. Shen, one of HAE's doctoral students. Shen and Hung (1983) contains a quote from H.A. Einstein's closing session at the symposium: "... it is impossible to find complete solutions in the laboratory as it is impossible to find complete solutions in theory or in the field alone... and if you want to design anything, we must apply the knowledge from all of these sources, or we will make mistakes or at least not find the best solutions..."

The book nicely depicts how dedicated HAE was to the analysis of sediment transport. His efforts on the Enoree River and Mountain Creek are well presented by the authors. The direct practical knowledge gained through field measurements contributed to his unique expertise. HAE was extremely effective in working with federal agencies. His knowledge and practical experience enabled him to be influential and successful at solving practical river engineering problems. He worked on the Mississippi, the Rio Grande, the Missouri, and many other rivers in the United States and abroad. He faced a lot of criticism from the empirical school, and things seemed to turn around when the U.S. Bureau of Reclamation in Denver adopted his method for the analysis of sediment transport on the Rio Grande. Colby and Hembree (1955) adopted and modified Einstein's method. Later on, Lara (1966) and Pemberton (1972) at the U.S. Bureau of Reclamation Shen and Hung (1983) at Colorado State University contributed to additional modifications. The Modified Einstein Procedure is still in use today including: (1) the Bureau of Reclamation Automated Modified Einstein Procedure BORAMEP of Holmquist-Johnson and Raff (2006), (2) the Series Expansion Modified Einstein Procedure SEMEP of Shah-Fairbank et al. (2011), and (3) the Series Expansion Modified Einstein Procedure by Point SEMEPP of Shah-Fairbank and Julien (2015). The authors included memorable photos of meetings and field trips with the leaders of the time, e.g., Emory Lane, Don Bondurant, Hunter Rouse, Gerald Lacey, Tom Blench, Vito Vanoni, and Whitney Borland.

A unique aspect of this book is the direct relationship that HAE developed with practicing engineers and particularly with his graduate students at University of California at Berkeley. He selected several research topics in direct connection with the problems he encountered earlier at the ETH laboratory. For instance, he initiated studies on lift forces with E.A. El-Samni, composite roughness with R.B. Banks, secondary currents with H. Li, and meandering in straight channels with H.W. Shen. With N. Barbarossa, an engineer with the U.S. Army Corps of Engineers, he developed a leading method for estimating flow resistance with the influence of bed forms. His most influential advisee may have been Chien Ning, with brilliant contributions on (1) similitude and scale modeling of river engineering models, (2) the transport of sediment mixtures, and (3) the difference between bed material load and wash load. The authors deserve a lot of credit for extensive interviews with HAE's former students, colleagues, and acquaintances.

On a much broader scale, the book contains several situations on how someone can seek daylight in the shadow of an illustrious father. The book nicely describes the cultural, ethnic, and religious differences within a family living at the center of Europe at such a precarious time. It is fascinating that despite familial hardship, music reached their common soul and so deeply united them. The role of his mother Mileva is somewhat understated in this book.

Alongside Lise Meitner and Clara Immerwahr, Mileva Maric Einstein belongs to a very select group of most influential women of her generation. Among the brightest, she nurtured HAE's development while sacrificing much for his brother Eduard. There is more information about Mileva in ERE's book. The same could be said about HAE's wife Frieda and children Bernhard, Klaus, David, and Evelyn. The authors cautiously retained the essential family information in order to highlight the professional accomplishments of HAE.

It is difficult to suggest areas of improvement for this book. It reads so well and is purposely structured to highlight professional milestones. Perhaps three observations are worth mention. It is sometimes difficult to keep track of events in a timely manner. Some events seem to jump forward and backward in time and some photographs are not necessarily placed in chronological order. The best photo of HAE in 1973 is missing, but can be found in ERE's book. The index could also have been expanded to easily access information about topics and people.

The copy editor provided a clear presentation of the material and the publisher printed the manuscript in a very nice handy format. The outcome is a book that is most pleasant to read at a price affordable to everyone.

In summary, the authors of this book need to be commended for their splendid professional and accurate depiction of the professional life of Hans Albert Einstein. They spent countless months (or years) assembling and synthesizing this information in the most effective manner. This is likely to become a most interesting sedimentation book to read. It is a wonderful rendering of the life of someone who transformed the river engineering profession by adding mechanical understanding to empirical observations. The book is affordable and will be prized by those who want to tackle

sedimentation without laboring through equations and technical details.

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