# Memorial to Stanley A. Schumm (1927–2011)

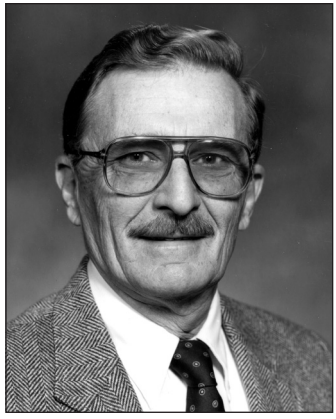
FRANK G. ETHRIDGE
ELLEN WOHL
*Department of Geosciences, Colorado State University, Fort Collins, Colorado 80523-1482, USA*

ALLEN GELLIS
*U.S. Geological Survey, Baltimore, Maryland 21228, USA*

DRU GERMANOSKI
*Geology and Environmental Geosciences, Lafayette College, Easton, Pennsylvania 18042, USA*

BEN R. HAYES
*Department of Geology, Bucknell University, Lewisburg, Pennsylvania 17837, USA*

SHUNJI OUCHI
*Faculty of Science and Engineering, Chuo University, Japan*



Stanley Alfred Schumm, distinguished professor emeritus of Colorado State University (CSU), passed away in Fort Collins, Colorado, on 10 April 2011. Stan was born in Kearney, New Jersey, on 22 February 1927. After service in the Navy during World War II, he received his B.A. in geology at Upsala College in New Jersey, and his Ph.D. in geomorphology at Columbia University, under the direction of Arthur N. Strahler. In his Ph.D. research on the evolution of drainage systems and slopes in badlands at Perth Amboy, New Jersey (Schumm, 1956), he introduced the constant of channel maintenance as an indicator of the minimum area required for channel maintenance and the dimensionless relief ratio as a valuable means of comparing geomorphic characteristics. This research was undertaken at a time when Strahler was a leading force in transforming geomorphology from a descriptive science to a dynamic quantitative science (Schumm, 2004; Doyle and Julian, 2005).

After completing his Ph.D., Stan worked for the Water Resources Division of the U.S. Geological Survey (USGS) as a research geologist from 1954 to 1967. During this period, Luna Leopold was the chief hydrologist for the USGS and provided a most advantageous research environment by granting a great degree of intellectual freedom for scientists. Many of the most-cited and classic works in modern geomorphology come from scientists who worked at the USGS during this period (Wohl et al., 1998; Doyle and Julian, 2005). This was an important and very productive time in Stan's career. Fieldwork in the western USA and in New South Wales, Australia, reviews of available data, and innovative thinking led to some of his more influential concepts in fluvial geomorphology, including intrinsic thresholds, complex response, river metamorphosis, and spatial zonation of drainage basins. Classic contributions to our understanding of fluvial systems that resulted from this period include: the semi-arid cycle of erosion (Schumm and Hadley, 1957); the relation between sediment yield and climate (Langbein and Schumm, 1958); the shape of alluvial channels in relation to sediment type (Schumm, 1960);

defining independent and dependent variables as a function of time and scale (Schumm and Lichty, 1965); the changing nature of the land phase of the hydrologic cycle before and during colonization of the landscape by vegetation (Schumm, 1968a, 1968b); river metamorphosis (Schumm, 1969); and thresholds and complex response (Schumm, 1973). These concepts now underlie much of geomorphic thinking and conceptualization of landscapes and landforms as nonlinear, complex systems.

In 1967, Stan joined the faculty of the Department of Geology at Colorado State University, where he was asked to build the department research program in surficial processes. Over the next thirty years he succeeded, building an internationally known program in fluvial geomorphology and attracting many high-caliber graduate students. During this period, his research and publication record was extended to a wide variety of subjects. He developed a strong research effort in experimental geomorphology with civil engineers at the well-known Engineering Research Center. This effort involved constructing a rainfall-erosion facility (REF) to investigate the evolution of drainage systems with different initial slopes and relief, with base-level lowering and the effect of sediment availability and intensity of geomorphic processes on runoff and sediment yield (Schumm and Parker, 1973). Other flumes were used to investigate factors affecting alluvial channel morphology. These research efforts over a decade by numerous graduate students are summarized in *Experimental Fluvial Geomorphology* (Schumm et al., 1987). Field research continued with studies of the metamorphosis of rivers of the Great Plains of the United States (Nadler and Schumm, 1981).

Stan's interests extended beyond fluvial geomorphology, as shown by his work on the history and philosophy of science (King and Schumm, 1980; Schumm, 1991). His slim 1991 volume *To Interpret the Earth: Ten Ways to Be Wrong* is one of the most readable and elegant volumes on the philosophy of science. Stan presented a scientific approach that enabled earth scientists to tackle problems associated with scale, time, and system response. In his teachings, Stan emphasized the fundamental principles of multiple working hypotheses by having his students learn how physicians formulate a diagnosis. Stan advised his students to incorporate these principles into their research.

He also investigated the variability and complexity of large alluvial rivers of the world (Schumm and Winkley, 1994). Studies of the influence of base-level change on fluvial coastal plain and shelf systems followed using the REF and other flumes (Schumm, 1993; Koss et al., 1994). Stan and his students' research on the influence of active tectonics on alluvial rivers is summarized in another volume (Schumm et al., 2000). Stan incorporated intrinsic geomorphic processes and thresholds as a new paradigm to the late–nineteenth-century arroyo cutting argument (Schumm and Hadley, 1957; Gellis et al., 1991) and its application to the Quaternary record (Patton and Schumm, 1981). Most of Stan's ideas and concepts, which developed over a lifetime of research, are brought together in *River Variability and Complexity* (Schumm, 2005), in which he examined the relative roles of upstream, downstream, and reach controls on river morphology.

His book *The Fluvial System* (Schumm, 1977) is among the top ten cited complete volumes in geomorphology (Doyle and Julian, 2005). At the end of this volume, Stan noted that the concepts elucidated provide a basis for prediction (and in some cases post-diction) and that they have practical application in the general fields of soil conservation, civil engineering, sedimentology, and stratigraphy, as well as geomorphology. In this regard, we see the practical side of Stan Schumm. From the beginning of his career at the USGS and continuing at CSU, his research with civil engineers and his ideas and concepts provided the basis for improved river management. As a senior associate with Ayres Associates and a principal geomorphologist with Mussetter Engineering, his consulting activities for government agencies, public corporations and as an

expert witness brought recognition to geomorphology as a necessary science in environmental impact assessment. For clastic sedimentologists, Stan's concepts and ideas on river complexity and variability and paleohydrology provided new insights into interpretation of ancient fluvial systems. In the mid-1960s, Stan suggested that the advent and development of land vegetation changed the hydrology, sediment load, dynamics, and morphology of river systems (Schumm, 1968a). Stan hypothesized that a predominance of bedload-dominated, braided rivers in the early Paleozoic record would give way to an increase in mixed-load and suspended-load rivers (meandering and anastomosing) with the development and evolution of land plants. This notion was substantiated in broad terms by Cotter (1978) and further developed more recently by Davies and Gibling (2011).

The series of experiments on base-level change provided insights that were important in the development of the sequence stratigraphy paradigm. These experiments revealed how complex the morphological and sedimentological responses are on continental shelf and slope systems, depending on initial conditions, and rates and magnitudes of change.

Stan was an internationally acclaimed geomorphologist whose research into earth surface processes over a 55-year-long career was recognized by his peers worldwide. His recognition and rewards included the Horton Award by the American Geophysical Union in 1957 for his research with W.B. Langbein on the effects of lithology and climate on sediment yield in the arid and semi-arid western United States; the Kirk Bryan Award of the Geological Society of America in 1979 for his book *The Fluvial System*; the David Linton Award from the British Society for Geomorphology in 1982 for his contribution to the discipline over a sustained period; and the G.K. Warren Prize in 1986 from the National Academy of Sciences for contributions to the role of fluvial processes in the evolution of slopes, stream channels, and sediment production, and their practical application. Stan was appointed a distinguished university professor by Colorado State University in 1987; was selected as a fellow of the American Association for the Advancement of Science in 1989; received the best paper award from the *Journal of Sedimentary Research* in 1994 for his contribution with J.E. Koss and F.G. Ethridge of an experimental study of the effects of base-level change on fluvial, coastal plain, and shelf systems; and received the Distinguished Career Award from the Quaternary Geology and Geomorphology Division of the Geological Society of America in 1997. In 2001, he was named a senior fellow of the International Association of Geomorphologists in Tokyo. For his teaching excellence and dedication, he was awarded an outstanding Educator of America Award in 1974 and the J.W. Durrell Award in 1980 by Colorado State University. His research program at CSU attracted some 63 graduate students from the Unites States and many other countries. These students went on to successful careers in industry, government, and academia and remained lifelong friends and colleagues. In 1996, Stan was honored by his former students and colleagues with a two-day "Schummposium" at CSU. Many of the papers presented at this event were published in Anthony et al. (2001).

Stan was devoted to his family and is survived by his wife Ethel, children Brian, Mary, and Chris, and grandchildren Kate, William, Emily, and Jack. Graduate students will long remember the warm hospitality that he and Ethel extended at informal seminars in their home. They will also remember the excellent food that Ethel served them.

Stan had a lifelong fascination with the processes that shaped the Earth and particularly its surface. His career was characterized by a deep intellect, unswerving honesty and integrity, unselfish assistance with ideas and support for others, and the utmost modesty for his substantial contributions to fluvial geomorphology, hydraulic engineering, sedimentology, and stratigraphy, among others. He was a scholar, teacher, mentor, and a gentleman. We who knew him well, and all scientists and engineers who came in contact with him or his research, have been enriched and rewarded in ways too numerous to document in this short memorial.

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