KIRK BRYAN AWARD FOR RESEARCH EXCELLENCE

Presented to Ellen E. Wohl

Ellen E. Wohl
Colorado State University

Citation by Martha Cary "Missy" Eppes

Members and friends of the Quaternary Geology and Geomorphology Division of GSA, it pleases me to no end to introduce Dr. Ellen Wohl as the 2009 recipient of our division's most distinguished honor, the Kirk Bryan award. Ellen receives this award for her paper 'Limits of Downstream Hydraulic Geometry' which was published in the journal *Geology*, Volume 32, in 2004. To quote one letter of support received for her nomination packet, "Ellen Wohl is clearly one of geomorphology's premier scientists. This work truly honors the field of geomorphology and the spirit of the Kirk Bryan Award."

Over 50 years ago Luna Leopold and Thomas Maddock described how an alluvial river's discharge, its channel morphology and its hydraulics are intricately linked in a delicate balance of form and process. The elegant numerical relationships that Leopold and Maddock developed are not only valid today, after decades of testing and refinement, but are widely employed by geomorphologists and engineers alike to address both academic and applied geomorphic problems in alluvial streams. It is notable in fact, that their 1953 classic paper 'The Hydraulic Geometry of Stream Channels and Some Physiographic Implications', went on to receive the very first Kirk Bryan Award in 1958 from this same Society.

A logical progression of the Leopold and Maddock body of work is to apply the same relationships and hypotheses to non-alluvial channels in mountainous settings, and numerous workers have attempted to do so. Be that as it may, however, when the same power functions have been tested for bedrock channels and mountainous rivers, the data have been equivocal. Nevertheless with rapidly increasing efforts to numerically model surficial processes, and with the ever expanding efforts of the consulting world to (quote) "restore streams to their natural state," it is becoming increasingly essential and relevant to understand the key variables which dictate a mountainous river's morphology and behavior.

In her creative and insightful paper, Dr. Wohl seeks to identify the conditions that must be met for a stream to *stop* behaving in the manner essentially predicted by Leopold and Maddock's seminal work. The results of Dr. Wohl's study thus move us beyond the question of *whether or not* bedrock and coarse-grained channels behave in a manner similar to alluvial ones, towards the more instructive questions of *when* do they stop behaving this way and *why*.

Using field data collected primarily by Wohl and her students from more than 350 individual stream reaches in ten different rivers around the globe, Dr. Wohl first determines which of these rivers exhibit 'well-developed downstream hydraulic geometry', i.e. a statistically significant relationship between channel morphology, hydraulics and discharge. Wohl then applies to these streams various versions of commonly employed, bedrock channel stream power and shear stress relationships in order to determine which of them might predict those streams that have well-developed or poorly developed downstream hydraulic geometry. Wohl's results suggest that well-developed downstream hydraulic geometry is closely linked not only to discharge but also to bedload grain size. Wohl then goes on to identify a specific threshold in the ratio of stream power to grain size below which the concept of downstream hydraulic geometry does not apply.

As one citationist noted in a letter of support for this award "One of the great strengths of this paper is that none of the results are over-interpreted or overextended. Ellen is both circumspect and forthright in discussing limitations of the analysis … The discussions of local complicating factors (such as bedrock outcrops or debris-flow processes), and the overall limitations of the study show admirable insight and integrity."

Needless to say, a long list of testable hypotheses stem from this well-designed and innovative analysis of a classic suite of field data collected by Dr. Wohl, her students and her colleagues. Despite the four page limit of *Geology* manuscripts, the paper moves us beyond recounting that mountainous fluvial systems are complicated, to identifying the specific conditions under which there are predictable relationships between discharge, bedload grain size and channel hydraulic geometry. Thus, now, as in 1953, we have the decades ahead of us in which to build upon Dr.Wohl's results and to test the hypotheses that develop from her study. I and many others certainly look forward to seeing where we stand in 2065.

Response by Ellen E. Wohl

It is a great honor to receive the Kirk Bryan Award from the QG&G Division, and I am particularly pleased by the symmetry of receiving this award today, 51 years after Leopold and Maddock's foundational paper on hydraulic geometry received the first Kirk Bryan Award. I would like to thank Missy Eppes and other colleagues who wrote letters of nomination for this award, as well as those on the division panel who served as evaluators. It is particularly gratifying when people who are always busy go out of their way to recognize the work of others.

I would also like to thank those who have made particular contributions to my development as a scientist. I must start with my parents, who encouraged my curiosity and an early passion for science, even encouraging a four-year-old's declared intention to be a "bacteriologist." I have been exceptionally fortunate in my mentors within academia. While an undergraduate at Arizona State University, I could watch Mike Malin and Troy Péwé move easily back and forth between teaching and research. During graduate school at the University of Arizona, Vic Baker and Bill Bull provided excellent role models of how to have fun while doing good science. Once I joined the faculty at Colorado State University, Stan Schumm made me welcome and helped me figure out how to succeed in a new environment. And, perhaps most importantly, my graduate students over the years have kept the job fun and intellectually challenging, providing a much-needed counter-balance to the university's logistical and budgetary challenges.

I am also pleased that the paper recognized by this award deals with mountain rivers. During the past decade, in particular, the geomorphic community has been revitalized by the need to expand the foundational fluvial work of the 1950s-60s to diverse fluvial environments, including bedrock and mountain rivers. One of the themes of any field-based science is exploring and quantifying consistency versus diversity in natural systems: Water always flows downhill, but what characteristics of that flow differ among rivers with readily erodible boundaries and rivers with greater erosional thresholds, for example? To paraphrase a contemporary social slogan, I like to think that my research celebrates fluvial diversity.