M. GORDON WOLMAN

1924–2010

Elected in 2002

"For outstanding contributions in fluvial processes, water resources management and policy, and environmental education."

BY RUTH S. DEFRIES AND THOMAS DUNNE
SUBMITTED BY THE NAE HOME SECRETARY

MARKLEY GORDON WOLMAN died February 24, 2010, at age 85. He was one of the founders of the modern quantitative approach to fluvial geomorphology, and he devoted his career to developing and teaching methods for applying earth science to questions of environmental management and public policy, creating a legacy of published work, influential reports to government, and students inculcated with his profound commitment to applying science as public service. His work guided public policy related to water management and environmental problems throughout the world as he pioneered interdisciplinary, systems-based approaches to solving complex societal problems ranging from land-use controls for limiting water pollution to river management for controlling disease vectors.

Known as "Reds" for his carrot-colored hair, Wolman was born August 16, 1924, in Baltimore, Maryland, to Abel and Anna (née Gordon) Wolman. He attended Haverford College in 1942 but was drafted into the Navy after one semester. After World War II he completed his undergraduate studies at

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Adapted with permission from *Biographical Memoirs of the National Academy of Sciences* (available at www.nasonline.org/memoirs), which includes a list of M.G. Wolman's most significant publications.

Johns Hopkins University with a BA in geology (1949) and all-American honors in lacrosse. He received his master's (1951) and PhD (1953) from Harvard University, also in geology. From 1951 to 1958 he worked as a hydrologist for the US Geological Survey (USGS), where he focused on quantitative analysis of river channels and floodplains.

He returned to Johns Hopkins University in 1958 as chair of the Isaiah Bowman Department of Geography. The department merged with the Sanitary and Water Resources Engineering Department in 1968 to become the Department of Geography and Environmental Engineering (DOGEE), which he chaired from 1970 to 1990. He then became director of the Center for Environmental Health Engineering at the Johns Hopkins Bloomberg School of Public Health while maintaining his DOGEE faculty position.

Wolman's intellect and career sprang from his lifelong companionship and conversations with his father, Abel Wolman, who was elected to the National Academy of Sciences in 1963 and the NAE in 1965. Abel Wolman championed the links between public health and engineering at a time when they were not obvious to many.

An only child, Reds grew up in a home of robust discussion and dedication to public service. Later, father and son were constant companions and were often together in seminars and meetings on the Hopkins campus. When Abel Wolman died in 1989, his son penned his biographical memoir for the National Academy of Sciences. About his inspiration from "Pop," he wrote, "My friendship with my father, that I can recall, began when I was about four.… The talk did not stop until he died on February 22, 1989. My father and I worked together, traveled together, and reviewed each other's manuscripts."[1]

Both Abel and M.G. Wolman's research and public service related to water, Abel with water for public supplies and M.G. with water in natural rivers. Both were also dedicated to Johns

[1] *Biographical Memoirs of the National Academy of Sciences*, vol. 83 (2003), pp. 344–61. Washington: National Academies Press. Also see the NAE memorial tribute for Abel Wolman published in vol. 5 (1992), pp. 284–89.

Hopkins University, spending nearly their entire careers there. The president of the university, Ronald J. Daniels, and the dean of engineering, Nicholas P. Jones, sent the following message to the Hopkins community when Reds died: "For the first time since 1937, the Johns Hopkins University is without a Professor Wolman on its faculty. Reds and his father were giants. We are a far better university for the years they spent here, and far better people for having known and learned from them."

In the late 1950s and early 1960s Reds authored or coauthored papers on river channel morphology that significantly broadened the earlier paradigm of the graded river, and opened up a more flexible approach to explain the variety of river forms and behavior by applying hydraulic theory, laboratory experiments, and field measurement. His papers from this period established many of the concepts and vocabulary that still dominate fluvial studies. Topics included channel adjustments to temporal and spatial changes in flow (1955), the formation of floodplains (1957), the morphological significance of floods of various sizes (1960), meanders and other river channel patterns (1957, 1960), and knick points in river profiles (1960). Most of this work was summarized in the coauthored textbook *Fluvial Processes in Geomorphology* (with Luna B. Leopold and John P. Miller; W.H. Freeman, 1964); it was the bible of the discipline for 20 years, and reprinted in 1995, still with many stimulating ideas, not all of which have been fully explored.

Reds worked with students and colleagues to increase knowledge of river channel behavior with his provocative, novel ideas. For example, a 1978 paper extended his study of the magnitude and frequency of morphogenetically significant weather events from river channels to the hillslopes of watersheds, in 1987 he demonstrated how flood discharge sequences control temporal fluctuations of channel geometry, and in 1990 he extended systematic study of channel geometry to forested mountain ranges and also expanded his earlier work on channel-forming discharges.

In the 1960s he turned his attention to an emerging public policy issue: sedimentation in stream channels of urban areas,

and once again he wrote definitive papers that crystallized understanding and still provide the basis for regulation and channel restoration. His paper on the effects of construction on fluvial sediment (1967) was among the first to link urban land use and water quality. His research quantified increased runoff and sediment load from construction associated with urbanization and illustrated how such impacts should be expected to spread through a landscape over time, consonant with predictable trajectories of urban development.

In 1971 he wrote an important paper demonstrating how the flood-prone areas of valley floors could be rapidly delineated through the use of simple field mapping without slow, expensive hydraulic data collection and computation, practices that continue to slow the delineation of flood-prone lands and allow development to spread into dangerous areas faster than regulation and sound advice can be implemented.

Another influential paper in 1971 was his review of water quality, the first to illustrate temporal trends in the quality of the nation's rivers and the extremely nonlinear response of water quality to cleanup efforts. This work became the impetus for the USGS National Water-Quality Assessment Program (NAWQA), aimed at tracking trends in the nation's water quality. Later he summarized downstream impacts of dams on channel bed sediment and morphology (1985), leading to policy discussions about the environmental consequences of large dams.

He was well recognized for his outstanding research contributions. In addition to the NAE, he was elected to the National Academy of Sciences, American Academy of Arts and Sciences, and American Philosophical Society. He was an elected fellow of all the major societies in earth and environmental science, and received the Cullum Geography Medal (1989) of the American Geographical Society, Ian Campbell Medal (1997) from the American Geosciences Institute, Penrose Medal (1999) from the Geological Society of America, and the American Geophysical Union's Robert E. Horton Medal (2000).

Reds Wolman set an extraordinary standard for public service, as a member and officer of numerous committees,

boards, and commissions—national, international, regional, and local—that provided advice to government and addressed emerging or enduring environmental problems.

He was very active in the work of the National Academies, serving on the Committee on the St. Lawrence Seaway: Options to Eliminate Introduction of Nonindigenous Species into the Great Lakes, Phases I and II (2004–08); Committee to Assess the US Army Corps of Engineers Methods of Analysis and Peer Review for Water Resources Project Planning (2001–04); Committee on the Interaction Between Population Growth and Land Use Change in China, India, and the United States (chair, 1996–2001); Board on Sustainable Development (1995–99); Water Science and Technology Board (1989–92); and Committee on Conservation Needs and Opportunities (chair, 1984–86), among many others.

He also devoted considerable service to his home state of Maryland. His work in the 1960s to link runoff from construction projects with sedimentation of Maryland's streams led to the first state regulations in the nation to address the problem. In the 1990s he chaired the Oyster Roundtable to develop a plan to restore the Chesapeake Bay's shellfish, which were suffering from disease and overharvesting. Beginning in 2003 he chaired Maryland's Advisory Committee on the Management and Protection of the State's Water Resources, which led to a state law requiring a water management plan before building.

He also used his expertise in fluvial geomorphology to address global issues through service on international committees. He addressed issues ranging from the impacts of soil erosion on crop productivity to links between population, land use, and environment. His colleagues in these endeavors frequently elected him to leadership positions in societies, where he gently prodded them to reflect on the future conditions and possibilities of their disciplines.

He was both internationalist in perspective and nationalist in the most constructive sense of the word. He was committed to social justice and equity in his choice of environmental science problems to work on, and he exemplified the model of a truly ethical scientist-statesman. Observing him inspired

his colleagues in the environmental sciences to do better for humanity.

He published influential papers, reports, and book chapters on important resource problems facing the United States and the world. These reports still deserve attention mainly because the problems are so important: energy, human response to flood hazard in developed and developing nations, water supply and human health, pollution of waterways, the management of large rivers, the transmission of water-borne diseases in tropical rivers, land degradation and soil productivity, water resources, and toxic waste disposal policies. His work also guided the application of systems analysis and interdisciplinary approaches to derive solutions for environmental problems.

Wolman thrived beyond the halls of academe and scholarly publication. Every Thursday afternoon during spring semester he donned his green rubber boots and piled into a van with his students for field trips to streams, farms, and suburban developments around Baltimore. Here he was in his element, in the messy world of real-life environmental problems.

Visiting urban streams, he explained to his students the principles of fluvial geomorphology, urbanization, ecological succession, and transport of pollutants to weave an interdisciplinary vision of the stream's behavior and evolution. In the rolling hills north of Baltimore, he explained the geology, soils, history of farming, and potential for soil erosion and sedimentation with impending suburban expansion. The message to students was to understand the environment in all its complexity, and to avoid focusing exclusively on any single disciplinary perspective.

He extended his interdisciplinary vision to the design of educational programs at DOGEE during his reign as chair. The department reflected his breadth of vision, with scholarship ranging from microbiology to Marxist theory and operations research. The graduate program exposed students to the humbling realization that a single discipline alone cannot solve environmental problems. He encouraged students to gain firm grounding in quantitative methods, systems analysis, and a

core area of expertise, while maintaining knowledge of the breadth of disciplines required to solve real-world problems.

He presided over one of the first and most ambitious experiments in interdisciplinary research and education, firmly rooted in his notion that "the rationality for interdisciplinary studies is based on the common observation that problems in the real world are not separable into disciplines."[2] He acknowledged the difficulties of establishing an interdisciplinary faculty and graduate program in a discipline-based academy (a continuing problem with no resolution in sight), but concluded that

> a number of recurring environmental themes, such as the inseparability of natural and social processes, the existence of spillover effects or externalities, the problem of the commons, the existence of incommensurate and nonmonetary values, and the importance of large-scale natural processes undergoing dynamic and evolutionary change, appear to warrant continuing emphasis.

Wolman's legacy resides largely in the principles for interdisciplinary research that he strove to transmit to his many students: rigor, appreciation for multiple perspectives, service to humanity, and problem solving in a real-world context.

Reds and his wife, Elaine (née Mielka), raised four children: Elsa Wolman Katana (Tom), Abel Gordon Wolman (Deborah Locke), Abby Lucille W. McElroy (Peter "Mac"), and Fredericka J. Wolman. At the time of his death he had two grandsons. Elaine died March 25, 2019.

[2] Wolman MG. 1977. Interdisciplinary education: A continuing experiment. *Science* 198(419):800–04.