



Photo courtesy UC Berkeley Dept. of Earth & Planetary Science

In Memory of Luna B. Leopold

1915–2006

Luna Leopold, professor emeritus at the University of California, Berkeley, and former chief hydrologist of the U.S. Geological Survey died at his home in Berkeley on February 23, 2006. The son of conservationist Aldo Leopold, Luna Leopold became widely recognized as one of our country's most distinguished earth scientists and will be remembered for his pioneering studies of rivers and fluvial geomorphology and for his tireless work toward protecting and restoring rivers, water resources, and the environment.

Luna Leopold was born in Albuquerque. His father, Aldo Leopold, was pursuing his career with the U.S. Forest Service as supervisor for the Carson National Forest. In 1922 his father helped to begin the transfer of the management of Gila National Forest to that of "wilderness area," the first such official designation (June 3, 1924). His mother was Estella Bergere, a member of the Luna family, one of the original Spanish families in New Mexico. At the age of nine he moved with his family to Madison, Wisconsin. Following high school Luna entered the University of Wisconsin, graduating in 1936 with a B.S. degree in civil engineering. He began his professional career in Albuquerque working for the Soil Conservation Service from 1936 to 1940 analyzing precipitation and runoff data. Between 1940 and 1946 he served with the U.S. Army Weather Service, Army Air Force Corps of Engineers. While in the Army Air Force he earned an M.S. degree in physics and meteorology from UCLA. During his military service he helped to develop new techniques of predicting probable weather patterns, the basis of present-day probability forecasting in weather prediction. From 1946 to 1949 he was chief meteorologist for the Pineapple Research Institute in Hawaii. He then went to Harvard University to continue his education as a student of Kirk Bryan, and in 1950 he received his Ph.D. degree in geology.

From 1950 to 1973 Luna worked with the U.S. Geological Survey as a hydraulic engineer (1950–1956), chief hydrologist (1957–1966), and senior research hydrologist (1966–1973). From

1972 to 1986 he held the position of professor of earth and planetary science and of landscape architecture at the University of California, Berkeley. "He made crucial discoveries about the nature of rivers, especially their remarkable regularity," William Dietrich, a UC Berkeley colleague of Leopold's and professor of earth and planetary science, said in a news release. "He showed that this regularity of form applies to all rivers, whether they are in sand boxes or draining entire continents, at scales of a laboratory flume or the Gulf Stream."

During his time with the U.S. Geological Survey Leopold was asked to assess plans for the South Florida Everglades Jetport and the Trans-Alaska Pipeline. After he flew the entire length of the route of the proposed pipeline and reported on the inadequacies of the plans and the potential for disaster, construction of the pipeline was delayed for several years while the problems were corrected. "In 1969, he practically invented the environmental impact statement through its design and early application to problems such as the proposed Trans-Alaska Pipeline and Everglades Jetport," wrote Thomas Dunne, a colleague of Leopold's who is a professor of environmental science and management and of earth science at UC Santa Barbara. "It can be fairly said that Luna Leopold has changed the way this society approaches environmental problems and conducts environmental science in the service of people and the natural environment."

Luna Leopold published his first paper in 1937, "Relation of watershed conditions to flood discharge: a theoretical analysis," and he continued to publish through 2005. During those 68 years Leopold wrote and coauthored six books and some 200 technical papers about the nature of rivers and streams, the problems of water and sediment supply, flood control, climate change, environmental planning, ecological restoration, scientific ethics, and the broader relationship between people and nature. Among his books are *Fluvial Processes in Geomorphology* (1964), *Water: A Primer* (1974), and *A View of the River* (1994). In 1949 following the death

of his father, Luna oversaw the final editing of the collection of his father's essays published as *A Sand County Almanac*.

Luna Leopold received six honorary doctoral degrees, and his awards include the Warren Prize from the National Academy of Science (1973), Horton Medal of the American Geophysical Union (1992), Penrose Medal of the Geological Society of America (1994), and Ian Campbell Medal of the American Geological Institute (2000). In early March of this year he and M. Gordon Wolman of The Johns Hopkins University received the Benjamin Franklin Medal in Earth and Environmental Science from the Philadelphia-based Franklin Institute. The posthumous award was "for advancing our understanding of how natural and human activities influence landscapes, especially for the first comprehensive explana-

tion of why rivers have different forms and how floodplains develop. Their contributions form the basis of modern water resource management and environmental assessment."

"Put simply, Luna inspired," William Dietrich said in a news release. "His passion about science and his joy about the natural world were felt by students. He strongly believed that simple, systematic observations of natural processes—and the keeping of good field notes—would reveal how nature worked and was a powerful tool in the fight for the environment."

Thanks to William W. Emmett, retired USGS, and Robert Sanders, Media Relations, University of California (Berkeley), for their memorials to Luna Leopold and from which this tribute was compiled.

Leopold selected bibliography with emphasis on New Mexico

- Leopold, L. B., 1937, Relation of watershed conditions to flood discharge—a theoretical analysis: U.S. Department of Agriculture, Bulletin 57, 21 pp.
- Smith, C., and Leopold, L. B., 1942, Infiltration studies in Pecos watershed: *Soil Science*, v. 53, no. 3, pp. 195–204.
- Leopold, L. B., 1942, Areal extent of intense rainfall, New Mexico and Arizona: *American Geophysical Union, Transactions*, pt. II, pp. 556–563.
- Leopold, L. B., 1943, Climatic character of the interval between the Jurassic and Cretaceous in New Mexico and Arizona: *Journal of Geology*, v. 51, no. 1, pp. 56–62; *abs. in American Association of Petroleum Geologists*, 1942, v. 26, no. 5, p. 901.
- Leopold, L. B., 1944, Characteristics of heavy rainfall in New Mexico and Arizona: *ASCE Transactions*, v. 109, pp. 837–866.
- Leopold, L. B., 1946, Discussion of "Future of Lake Mead and Elephant Butte Reservoir," by J. C. Stevens: *ASCE Transactions*, pp. 1258–1262.
- Leopold, L. B., 1946, Two intense floods in New Mexico: *American Geophysical Union, Transactions*, v. 27, no. 4, pp. 535–540.
- Leopold, L. B., 1950, The erosion problem of the Southwest: Unpublished Ph.D. dissertation, Harvard University, 179 pp.
- Leopold, L. B., 1951, Pleistocene climate in New Mexico: *American Journal of Science*, v. 249, pp. 152–168.
- Leopold, L. B., 1951, Rainfall frequency—an aspect of climatic variation: *American Geophysical Union, Transactions*, v. 32, no. 3, pp. 347–357.
- Leopold, L. B., 1951, Vegetation of southwestern watersheds in the nineteenth century: *Geographical Review*, v. 41, no. 2, pp. 295–316.
- Leopold, L. B., and Snyder, C. T., 1951, Alluvial fills near Gallup, New Mexico: U.S. Geological Survey, Water-Supply Paper 1110-A, 19 pp.
- Leopold, L. B., 1953, Downstream change of velocity in rivers: *American Journal of Science*, v. 251, pp. 606–624.
- Leopold, L. B., and Maddock, T., Jr., 1953, The hydraulic geometry of stream channels and some physiographic implications: U.S. Geological Survey, Professional Paper 252, 57 pp.
- Leopold, L. B., 1956, Data and understanding arroyos in New Mexico; in White, G. F. (ed.), *The future of arid lands: American Association for the Advancement of Science Publication*, no. 43, pp. 114–120.
- Leopold, L. B., and Miller J. P., 1956, Ephemeral streams—hydraulic factors and their relation to the drainage net: U.S. Geological Survey, Professional Paper 282-A, pp. 1–37.
- Leopold, L. B., and Wolman, M. G., 1957, River channel patterns—braided, meandering and straight: U.S. Geological Survey, Professional Paper 282-B, pp. 39–85.
- Wolman, M. G., and Leopold, L. B., 1957, River flood plains—some observations on their formation: U.S. Geological Survey, Professional Paper 282-C, pp. 87–109.
- Leopold, L. B., and Langbein, W. B., 1960, A primer on water: U.S. Geological Survey, Miscellaneous Reports, Special Publication, 50 pp.
- Leopold, L. B., Bagnold, R. A., Wolman, M. G., and Brush, L. M., Jr., 1960, Flow resistance in sinuous or irregular channels: U.S. Geological Survey, Professional Paper 282-D, pp. 111–134.
- Leopold, L. B., 1962, The Vigil Network: *International Association for Hydrological Sciences, Bulletin*, v. 7, no. 2, pp. 5–9.
- Leopold, L. B., and Baldwin, H. L., 1962, *Water: Saalfeld Science Series*, 5807, New York, 48 pp.
- Leopold, L. B., and Langbein, W. B., 1962, The concept of entropy in landscape evolution: U.S. Geological Survey, Professional Paper 500-A, 20 pp.
- Leopold, L. B., and Langbein, W. B., 1963, Association and determinacy in geomorphology; in *The fabric of geology: Geological Society of America*, pp. 184–192.
- Leopold, L. B., Leopold, E. B., and Wendorf, F., 1963, Some climatic indicators in the period A.D. 1200–1400 in New Mexico; in *Changes of climate—arid zone research: United Nations Economic, Scientific, and Cultural Organization (UNESCO)*, pp. 265–270; *abs. in American Geological Institute, Geoscience Abstracts*, v. 5, no. 5–3789, p. 8.
- Leopold, L. B., Wolman, M. G., and Miller, J. P., 1964, *Fluvial processes in geomorphology: W. H. Freeman and Company, San Francisco*, 522 pp.
- Leopold, L. B., and Davis, K. S., 1966, *Water: Time-Life Science Library*, 200 pp.
- Leopold, L. B., Emmett, W. W., and Myrick, R. M., 1966, Channel and hillslope processes in a semiarid area, New Mexico: U.S. Geological Survey, Professional Paper 352-G, pp. 193–253.
- Langbein, W. B., and Leopold, L. B., 1966, River meanders—theory of minimum variance: U.S. Geological Survey, Professional Paper 422-H, 18 pp.
- Leopold, L. B., 1974, *Water—a primer: W. H. Freeman Company, San Francisco*, 172 pp.
- Leopold, L. B., 1976, Reversal of erosion cycle and climate change: *Quaternary Research*, v. 6, no. 4, pp. 557–562.
- Leopold, L. B., and Bull, W. B., 1979, Base level, aggradation, and grade: *American Philosophical Society, Proceedings*, v. 123, pp. 168–202.
- Osterkamp, W. R., Emmett, W. W., and Leopold, L. B., 1991, The Vigil Network—a means of observing landscape change in drainage basins: *Hydrological Sciences Journal*, v. 36, no. 4, pp. 331–344.
- Leopold, L. B., 1994, Response on receipt of the Penrose Medal: *Geological Society of America*.
- Leopold, L. B., 1994, River morphology as an analog to Darwin's Theory of Natural Selection: *American Philosophical Society, Proceedings*, v. 138, no. 1, pp. 31–47.
- Leopold, L. B., 1994, *A view of the river: Harvard University Press*, 290 pp.
- Leopold, L. B., 2000, *Water, rivers, and creeks: University Science Books, a Library of Science Selection*.
- Gellis, A. C., Emmett, W. W., and Leopold, L. B., 2005, Channel and hillslope processes revisited in the Arroyo de los Frijoles watershed near Santa Fe, New Mexico: U.S. Geological Survey, Professional Paper 1704, 53 pp.

For a more complete bibliography, go to the Web site <http://eps.berkeley.edu/people/lunaleopold/>