

*In Memoriam*  
**Harold Clark Fritts**  
1928–2019



Harold C. Fritts [known to many as “Hal”] passed away at his home in Tucson, Arizona, on January 10, 2019, at the age of 90. Hal was born December 17, 1928, in Rochester, New York, and was raised in the town of Pittsford where he developed a growing interest in nature. He attended Pittsford High School where he graduated as class salutatorian in 1947. Hal then enrolled at Oberlin College in Ohio where he earned his B.A. degree in 1951. Hal went on to graduate school at Ohio State University in Columbus, where he was awarded his M.Sc. in 1953 (Thesis: *Radial Growth of Beech Trees in a Central Ohio Forest during 1952*) and Ph.D. in 1956 (Dissertation: *Relations of Radial Growth of Beech (Fagus grandifolia Ehrh.) to Some Environmental Factors in a Central Ohio Forest during 1954-55*), both in botany. The primary instrument of his dissertation research was the “dendrograph” [named the Fritts-Dendrograph], developed with the help of his father, an engineer. One year before completing his Ph.D. Hal married his first wife Barbara June Smith.

Hal took his first academic post as Assistant Professor at Eastern Illinois University in 1956. In 1960, he was appointed Assistant Professor of Dendrochronology at the University of Arizona, Laboratory of Tree-Ring Research (LTRR). His hire followed not long after the untimely death of LTRR Prof. Edmund Schulman in 1958. His early work examined intra- and inter-annual tree-ring growth of western conifers, aided by his dendrographs and cambial sampling. Moreover, he developed conceptual models of how various environmental factors could influence cell formation, maturation, and ring size, and eventually he began developing computer models of growth. This culminated in an advanced process model, **TREERING**, developed with Russian colleagues. These collective activities are tied to one of Hal’s enduring contributions to dendrochronology, namely that he injected scientific and computational rigor into the field and provided convincing quantitative validation to the underpinnings of dendrochronological principles. To this end, Hal also introduced

the use of digital computers to dendrochronology in the 1960s. This culminated in the development of the program **INDXA**, which massively streamlined the processing of tree-ring data for chronology development and use in climatic reconstruction. Then in 1968–69, Hal received a John Simon Guggenheim Fellowship to the University of Wisconsin–Madison to work on developing new spatial climate reconstruction methods. While there he conceived the ‘response function’, a still widely-used method for statistically modeling the interacting effects of temperature and precipitation on tree growth.

Based on Hal’s enormous body of work and contributions to the field of dendrochronology, one might broadly praise him with the idiom “he wrote the book”, but the reality is that Hal literally did write THE book, namely *Tree Rings and Climate* published in 1976 by Academic Press. Built on his own experimental field work in the 1960s and 1970s, together with his substantial understanding of tree physiology, climate and multivariate statistics, and with the input of graduate students in several of his classes serving as a sounding board for the ideas and presentation in the emerging manuscript, this seemingly timeless book continues to be heavily used today by scientists and students for research and teaching. According to Google Scholar his book has been cited more than 7800 times. This goes along with his 120+ publications including journal articles, book and volume chapters, reports, and manuals, and his 1991 book *Reconstructing Large-Scale Climatic Patterns from Tree-ring Data: A Diagnostic Analysis* (University of Arizona Press).

In a very real sense, Hal not only “wrote the book” for dendroclimatology but also for high-resolution paleoclimatology more broadly. This is the use of natural and documentary archives to reveal the variations and workings of climate over years, decades and centuries. His legacy underpins current attempts to place recent climate changes in the context of natural variability and to understand the role of humans in this.

Among Hal’s service contributions have been Associate Editor of the journal *Ecology* in the 1960s and Editorial Advisory Board of the journal *Quaternary Research* in the 1970s. In the 1970s he was also on the Paleoclimatology Committee of

the American Meteorological Society and the Climate Variation committee for the Global Atmospheric Research Program. Hal was the organizer of the first International Workshop on Dendroclimatology in Tucson (1974) from which he became the leader in establishing and maintaining the International Tree-Ring Data Bank (ITRDB). The ITRDB flourished under Hal’s tenure. To this day, dendrochronologists around the world continue to contribute data from their tree-ring studies to this publicly accessible clearinghouse and likewise use data from it. Its global importance is indicated by the ITRDB having been maintained since the late 1980s by the NOAA National Centers for Environmental Information (NCEI) in Boulder, CO, as an early paleoclimate building block of the World Data Center system of the International Council of Scientific Unions (ICSU). The ITRDB continues to be a vital tool for researchers dating tree-ring samples, developing new chronologies, and ever-increasingly seeking to analyze tree-ring data to address emerging scientific questions. Without Hal’s visionary thinking, the ITRDB would very likely not exist today. Moreover, his tireless encouragement of colleagues around the world and his intellectual leadership and willingness to share tools and insights laid the foundations of multiple scientific careers and collaborations. Hal’s cumulative achievements were recognized by the *Tree-Ring Society Lifetime Achievement Award* that he received at 7th International Conference on Dendrochronology held in June 2006 in Beijing, China. The award was subsequently named in his honor as *The Harold C. Fritts Award for Lifetime Achievement in Dendrochronology*.

Hal retired in 1993 as Professor Emeritus, yet he continued working on his research, scientific papers and projects, attended conferences, visited colleagues (particularly those in Switzerland), honed his photographic skills (particularly with flowers), and dispensed his wisdom to all who interacted with him. His wife Barbara passed away in 1981, yet Hal married Miriam Colton in 1982 and was able to spend many happy retirement days with her and their common enjoyment of botany, photography, and traveling, until her passing in 2014. Hal is survived by daughter Marcia (Charles) Miller, son Paul (Pamela) Fritts, several grandchildren, and a great-grandson.

Notice of Hal's passing prompted an outpouring of condolences from around the world, a few of which are summarized below.

*"It is with great regret we learned that Hal Fritts, a scientist of world-wide reputation and our colleague for many years, passed away. His memory will live not only in his books and articles but in our hearts too."* Eugene Vaganov, Alexander Shashkin (Siberian Federal University and Sukachev Institute of Forest, Krasnoyarsk, Russia)

*"Hal was one of my best friends and my favored discussion partner. We had long discussions about response functions and pointer years. Fritts came to Birmensdorf in 1972 and met the young inexperienced Fritz. I learned a lot from him, e.g. that networks are important, and that dendrochronology without a physiological and/or ecological background can never be fully understood. He was very generous and provided a grant for a 3-month visit to Tucson. He showed me the desert, he supported me intensively in writing my first scientific paper."* Fritz Schweingruber (WSL, Birmensdorf, Switzerland)

*"Our whole ecological research team would like to express to his family, colleagues and friends the sadness and regret we all felt this morning as we received the news of Harold C. Fritts's death. Few of us have had the chance to meet him personally, but we all know that we owe him a lot. This day concludes a chapter in history of sciences. It marks the end of an Era. But the adventures of dendrochronology continue recognizing his massive contributions."* Vincent Badeau, Nathalie Breda, Sandrine Chauchard, Jean-Luc Dupouey, Laura Fernandez-de-Una, Francois Lebourgeois, Abib Ouayjan, Gonzalo Perez-de-Lis-Castro,

Stephane Ponton, Cyrille Rathgeber, Clara Tallieu (Silva Joint Research Unit, INRA, Champenoux, France)

*"I read the news about Hal's passing with sadness, and wanted to share the following for the upcoming remembrance of him. I keep multiple copies of Hal's 1976 and 1991 books in my lending library, where they are go-to references. His career and work, by its example, continues to encourage me to pursue observational, statistical and mechanistic modeling for process understanding – in trees and elsewhere. But what I will remember best about Hal was that he was so very kind to me when I arrived at the LTRR in 2001. I hope I can pay that debt forward in my interactions with others and in my mentoring activities."* Mike Evans (University of Maryland)

Hal's life was celebrated at the LTRR on January 21, 2019, in coordination with his family. Part of this celebration of life included both in-person remembrances as well as pre-recorded tributes to Hal. A video of part of this event can be viewed at: [https://www.youtube.com/playlist?list=PL7n2J6xi6G7m4DzyFAC3\\_td8QTSjBrIbg](https://www.youtube.com/playlist?list=PL7n2J6xi6G7m4DzyFAC3_td8QTSjBrIbg)

The multi-disciplinary work of dendrochronologists over the last five decades has been built on the broad and solid foundation of Hal's remarkable insights and contributions, which will remain valuable to dendrochronologists around the world at all career stages, who further explore and solidify new research frontiers. Conversely, Hal would also be pleased hear and read about all those dendrochronology projects to come!

—Contributed by *Steven W. Leavitt, Edward R. Cook, Malcolm K. Hughes*