In MemoriamMinze Stuiver 1929-2020

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Source: Tree-Ring Research, 77(1) : 38-40

Published By: Tree-Ring Society

URL: https://doi.org/10.3959/TRR2020-15

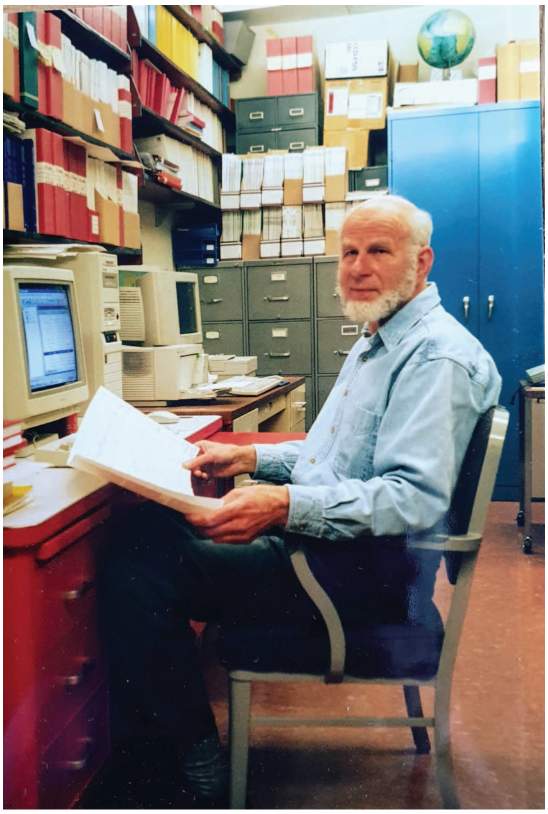
TREE-RING RESEARCH, *Vol. 77(1), 2021, pp. 38–40*
DOI: http://dx.doi.org/10.3959/TRR2020-15

In Memoriam

Minze Stuiver

1929-2020

"*Models come and go, but a good data set lasts forever.*" – Minze Stuiver (Quay 2002)



Minze Stuiver in the Quaternary Isotope Lab, U. of Washington [July 1998; Photo by Paula Reimer]

Minze Stuiver, Professor Emeritus of the Quaternary Research Center at the University of Washington where he founded the Quaternary Isotope Laboratory (QIL), passed away on December 26, 2020. Minze was born at the beginning of the Depression on October 25, 1929, in Vlagtwedde, the Netherlands, where he grew up in a rudimentary home with his five family members, a single cold water faucet and stove in the kitchen, a stove in the living room for heating, and a weekly bath with a bucket of water warmed up by the living room stove. His life and high school education (1942–1945) were greatly disrupted by German occupation during WWII, including nearly being conscripted into German forced labor near the end of the War.

Minze started his undergraduate life at the University of Groningen in 1947, studying physics, mathematics, and astronomy. After graduation in 1950, he embarked on graduate studies at the University of Groningen, receiving his M.S. degree in experimental nuclear physics and mathematics in 1953 and a Ph.D. in biophysics in 1958. There Minze worked under the direction of Hessel de Vries, who had been actively involved in developing radiocarbon methodologies and hardware, and who observed systematic discrepancies between radiocarbon and calendar dates (now known as the "de Vries effect"), forming the basis for calibration in radiocarbon dating. Minze worked with de Vries in 1958–1959 to model variations in atmospheric radiocarbon content, from which he identified a linkage of radiocarbon production to sunspot activity.

Minze and his wife Anneke moved to the Yale University Geochronometric Laboratory in 1960, where he helped develop the Yale Radiocarbon Laboratory, of which he subsequently became Director. Additionally, he became closely involved with the journal ***Radiocarbon***, which originated at Yale as the ***Radiocarbon Supplement*** to the ***American Journal of Science***. Minze became one of several early editors of Radiocarbon, but by 1977 he was the Editor-in-Chief and instituted a policy whereby the journal would no longer almost exclusively publish date lists from radiocarbon laboratories around the world, but would encourage submission of articles describing research to which radiocarbon measurements were applied. While at Yale, Minze worked with fellow radiocarbon researcher Hans Suess from La Jolla Radiocarbon Laboratory at the University of California–San Diego to develop a 1000-y calibration curve published in Radiocarbon (Stuiver and Suess 1966). Exactly-dated tree rings for the calibration were supplied from European oak trees dated at the dendrochronology laboratory of Bruno Huber in Munich, Germany, and from western U.S. Douglas-fir and sequoia provided through Bryant Bannister at the Tucson Laboratory of Tree-Ring Research.

Minze moved to the Quaternary Research Center at the University of Washington in Seattle in 1969, where he established the Quaternary Isotope Laboratory, primarily for radiocarbon dating and measurement of $^{18}O/^{16}O$ and $^{13}C/^{12}C$ stable isotope ratios in a variety of materials. One of the central and exciting areas of his research over the next several decades involved many additional radiocarbon measurements of tree rings to advance development of radiocarbon calibration curve(s), not only to improve accuracy of dates important to so many fields of study, but to unravel incredible astrophysical, geophysical, and carbon cycling stories related to radiocarbon production and distribution. In addition to Minze's own tree-ring samples, Bernd Becker (Hohenheim), Mike Baillie and Jonathan Pilcher (Belfast), and Wes Ferguson (Tucson) provided him many more samples, and Gordon Pearson (Belfast) and Bernd Kromer (Heidelberg) collaborated with Minze on radiocarbon analysis of those many tree rings. Minze with Paula Reimer helped integrate QIL tree-ring radiocarbon measurements with those of other radiocarbon researchers (some formerly competitors in the early calibration endeavors), to produce a longer and more robust calibration curve that was published in 1986 in an issue of ***Radiocarbon*** devoted to calibration. That issue of Radiocarbon also presented the first version of the CALIB radiocarbon calibration computer program (Stuiver and Reimer 1986). Minze continued to contribute to refinements of the calibration curve, to new calibration issues of ***Radiocarbon***, and to statistically and computationally-advanced versions of the CALIB program. The latest version of the calibration curve (IntCal20) was just published (Reimer *et al.* 2020) and extends back 55,000 years based on tree-ring measurements back about 14,000 years and then other materials including lake and marine sediments, speleothems, corals, and "floating" tree-ring series in the older portion of the curve. Another of Minze's enduring contributions to the radiocarbon enterprise (with Henry Polach of Australian National University, Canberra) is a seminal paper laying out conventions and standards for calculating and reporting radiocarbon concentration and radiocarbon dates, which has now been cited well over 4000 times (Stuiver and Polach 1977).

Over his career, Minze has used the measurements of age and stable isotope composition of ocean water, ice cores, atmosphere, and biological materials to improve understanding in many fields, including oceanography, the cryosphere, atmospheric sciences, sunspot activity and Earth's magnetic field, and the carbon cycle. Among the biological materials analyzed were the tree rings mentioned above for radiocarbon calibration. Additionally, Minze with his grad students, post-docs and colleagues performed thousands of stable-isotope analyses of tree rings. For example, Stuiver was one of the early researchers attempting to reconstruct a record of carbon isotope composition ($\delta^{13}C$) of atmospheric CO_2 to infer carbon sources and sinks in the global carbon cycle (Stuiver 1978; Stuiver *et al.* 1984), before such atmospheric records could more directly be derived from gas preserved in the layers of glacial ice. Stuiver *et al.* (1984) used tree rings of seven different species (including bristlecone pine and sequoia) growing at eleven sites near the western edges of South and North America from Chile up to Alaska, to develop $\delta^{13}C$ chronologies, several in excess of 1500 years. Notably, Stuiver *et al.* (1984) attempted to remove local environmental effects on tree-ring $\delta^{13}C$ using ring size in order to isolate the change in tree-ring $\delta^{13}C$ related to changes in atmospheric chemistry alone. Stuiver and Braziunas (1987) examined $\delta^{13}C$ of the N. Hemisphere trees in light of possible climate influence and found a strong correspondence with N. Hemisphere temperature index (albeit with a 70-yr lag). Using $\delta^{18}O$ of tree rings from trees growing along the west coast of N. America, (Burk and Stuiver 1981) identified a temperature signal, which seemed to have the highest fidelity in those sites with fairly constant high humidity.

Pieter Grootes formerly of QIL, who worked on dating and oxygen isotopes of Greenland ice with Minze, summed up the interactions between Minze and trees in the following observation (Unspecified 1998):

> "Over the years Minze has had a lively interest in trees, which was decidedly unhealthy for the trees. Along the West Coast he collected sections of old-growth trees to create a tree-ring calibration for the last few thousand years independent of the bristlecone pines. After a field trip the lab would look like a wood workshop. Later, those trips extended farther afield from Kodiak Island to Patagonia and focused on poor lonely trees from windy places. In the lab these told their story about their youth and their response to location and weather and to a slow change of CO_2 in the atmosphere."

Minze retired in 1998 and shortly thereafter, the QIL without his leadership was closed. Despite his recent passing, he has left the scientific community a bounty of his contributions through more than 200 published articles related to various aspects of the operation of the Earth system along with his encouragement that "… calibration research is crucial. Time should be measured and calibrated." (Stuiver 2009).

—Contributed by Steven W. Leavitt

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