DATING OHIO'S HI

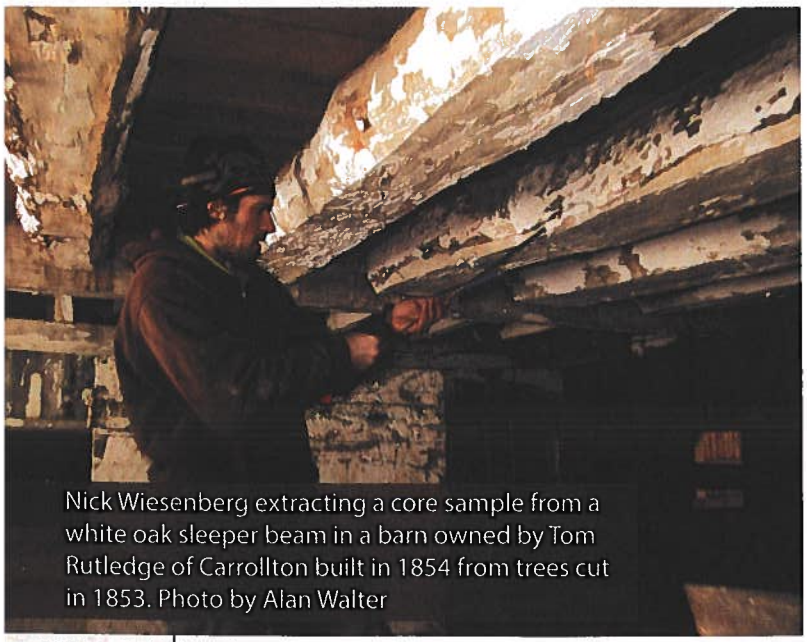
The College of Wooster Tree Ring Lab has been using tree rings to date historical buildings in Ohio for the past 20 years. We have discovered the calendar dates of timber harvests for more than sixty historical structures including barns, cabins, and houses. Our clients are homeowners, historical societies, archaeologists, and others who are interested in finding out or confirming a calendar date of their buildings using dendrochronology.

(Pages 20 and 21 show the various Figures mentioned in this article.)

Dendrochronology, or the use of tree rings to date wood, has been used in North America for more than 100 years. In fact, the science is largely a North American innovation that is now used worldwide to date timbers of historical significance as well as to date and reconstruct climate and ecological changes and where trees are affected by various earth surface processes. Tree-ring dating can document changes in glaciers, the timing of earthquakes, volcanic events, floods, and land use.

Early in the 20th century, Harvard astronomer A.E. Douglass was charged with establishing the Lowell Observatory in Flagstaff, Arizona. He had a long-term interest in sunspot cycles and hypothesized that tree rings in the American southwest might be sensitive to moisture change that, in turn, may be related to drought and ultimately could be linked to solar variability. He thus began the science of tree-ring analysis.

Douglass noted that patterns in the width of tree rings over time can be matched from tree to tree and that a tree-ring series could be developed from living trees and extended back in time (**Figure 3**) using overlapping dead wood. Furthermore, with the recognition that moisture in the North American southwest controlled the variability in the ring-widths, he also was one of the first *paleoclimatologists* (investigators of past climates) to use the tree-ring widths as an indicator of past moisture changes.



Nick Wiesenberg extracting a core sample from a white oak sleeper beam in a barn owned by Tom Rutledge of Carrollton built in 1854 from trees cut in 1853. Photo by Alan Walter

Remarkably, Douglass also began developing what are now the classic and ongoing studies in the American southwest on drought variability and providing a chronology for archaeological sites. This seminal work continues with dating timbers from Ancestral Puebloans' ruins in the Southwest, and the tree-ring records are now vitally important providing a long-term context for the present drying of the American southwest.

The early roots of tree-ring science in Ohio was begun by Ed Cook, cofounder of the Lamont-Doherty Tree Ring Lab at Columbia University in New York. Initially trained at the University of Arizona, Cook has developed old-growth tree ring records from around the world over the past five decades including his pioneering work in the state of Ohio during the late 1970s into the early 1980s. Among the sites that Cook and colleagues developed old-growth ring-width chronologies in Ohio include the white oaks of Johnson Woods, Orrville, chestnut oaks at Stebbins Gulch in Holden Arboretum (**Figure 1a**), and the white oaks of Glen Helen in southwest Ohio. These early investigations are part of a larger, ongoing effort to understand drought in North America and include the seminal compilation of the North American Drought Atlas (NADA) that has allowed scientists and water managers to visualize the development of droughts and pluvials (wet times) of the past two millennia.

The successful aging of the wood by the Wooster Tree Ring Lab depends on these initial collections of tree-ring data from Ohio and the subsequent follow-up work updating the chronologies and discovering new old-growth remnants. There are an amazing number of stands of trees around the state that have been spared from the early 19th century land clearing; these include several oak stands that are on The College of Wooster campus (**Figure 1b**), those managed by the Ohio Department of Natural Resources (Johnson Woods), The Nature Conservancy (Browns Lake Bog) and The Wilderness Center in Wilmot (Sigrist Woods). The wood of these collections is stored at the individual tree ring labs and the ring width data is archived at the International Tree Ring Database maintained by the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information.

How is the tree-ring dating done?

The hallmark of tree-ring dating is identifying the calendar date for each ring of a wood sample. This requires that the tree puts on one annual ring each year and that the rings are clearly discernible. Dating is done through careful sampling, polishing of the wood,

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Greg Wiles and Nick Wiesenberg
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measurement of ring-widths, and matching ring-width patterns (**crossdating; Figure 3**). Most species used in analyses in northeast Ohio are oak, although hickory, ash, and chestnut and, in some cases, beech can also be used in dating.

Special dry wood borers are used to extract a core (5-10 mm in diameter) from beams. Coring is done by hand or using power drills (**Figure 2b**). This sampling allows cores to be removed, which are then mounted on wooden sticks and sanded to a high polish so that individual cells in the wood and ring boundaries are clearly visible under the microscope (**Figure 4**). It is crucial in the sampling and ultimately determining the calendar year of timber cutting that the outer ring of the tree is intact. An intact ring can be recognized by timbers having the bark on them or having a smooth surface that indicates that the bark has peeled off.

Typically, ten to fifteen core samples per building are necessary for a successful date. The cores are extracted and glued into wooden slots and sanded with progressively finer sandpaper until the cells of the wood are clearly visible. Ring-widths are then measured in most cases to the nearest 0.001 mm. The next step is the process of crossdating the samples with one another (**Figure 3**) by matching the annually-resolved ring-width patterns from one sample to the next.

Crossdating is done visually and with the aid of various statistical computer programs. The variation in the ring patterns is crucial to the matching, and in Ohio the variability is primarily due to changes in summer precipitation that determines if the ring is wide (wet year) or narrow (dry year) (**Figure 3**). Once the cores are internally matched to one another, the ring patterns are compared with a master series that is calendar dated. Calendar-dated master

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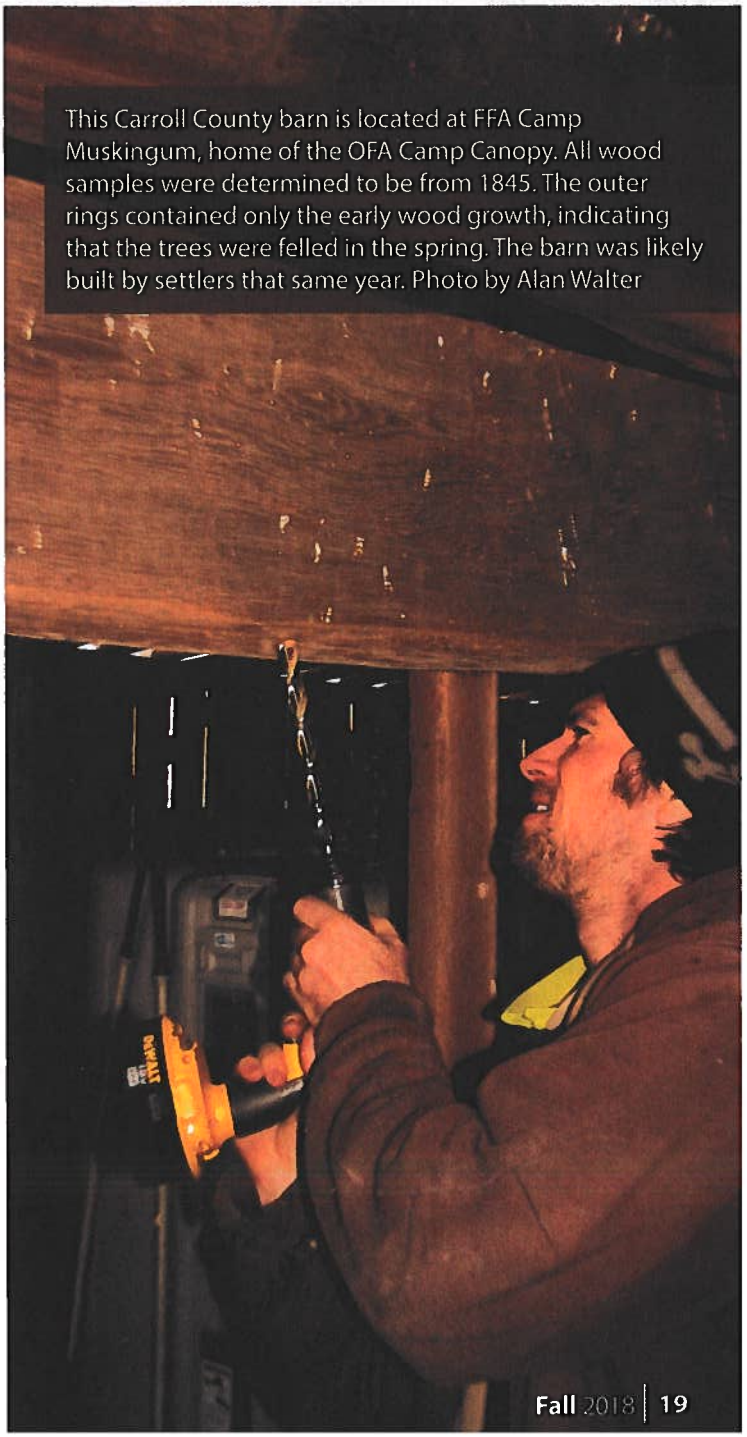

This Carroll County barn is located at FFA Camp Muskingum, home of the OFA Camp Canopy. All wood samples were determined to be from 1845. The outer rings contained only the early wood growth, indicating that the trees were felled in the spring. The barn was likely built by settlers that same year. Photo by Alan Walter

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Figure 1 – Examples of old growth trees in Northeast Ohio. a – Example of an old growth chestnut oak from the Holden Arboretum, Kirtland, Ohio. The spiral-corkscrew morphology of the tree is typical of the older trees in this stand. This site in Stebbins Gulch has the oldest living documented tree in Ohio with an inner ring date of 1608 CE (407 years old). b - Old growth white oak from the College of Wooster campus. This tree is over 350 years old and is a member of a remnant forest that once covered much of the Wooster region. Note the restricted canopy and few heavy upper limbs, which are often indicators of age. All figures furnished by the authors

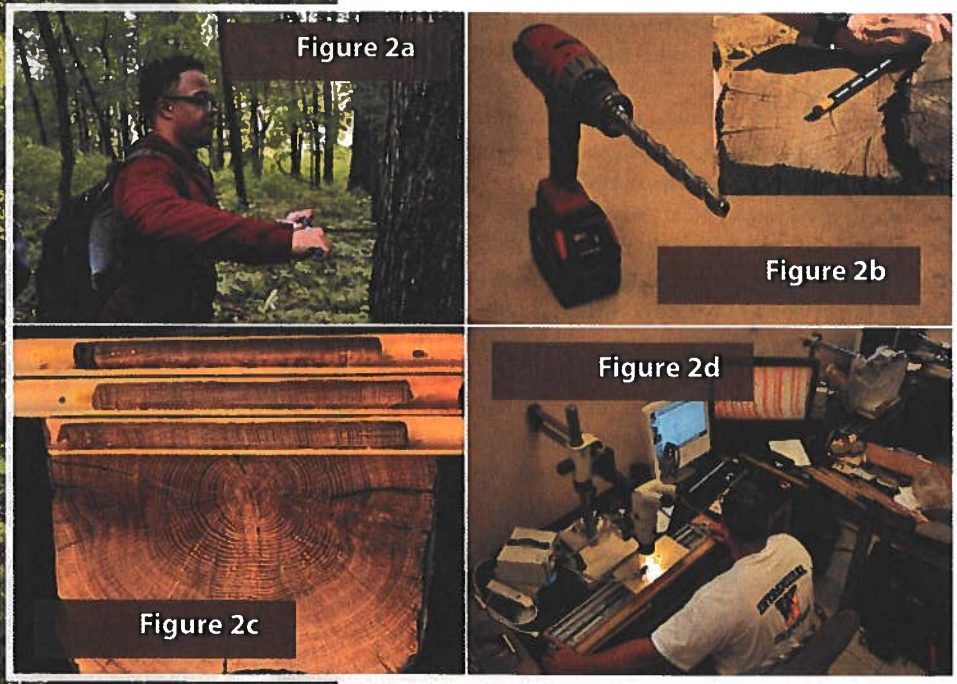

Figure 2 – Collage of photos showing sampling of living trees using an increment borer (2a). A dry wood borer on a power drill and extraction of a core from a beam (2b). Cores and a section mounted and ready for analysis (2c), and measuring ring-widths in the Wooster Tree Ring Lab (2d).

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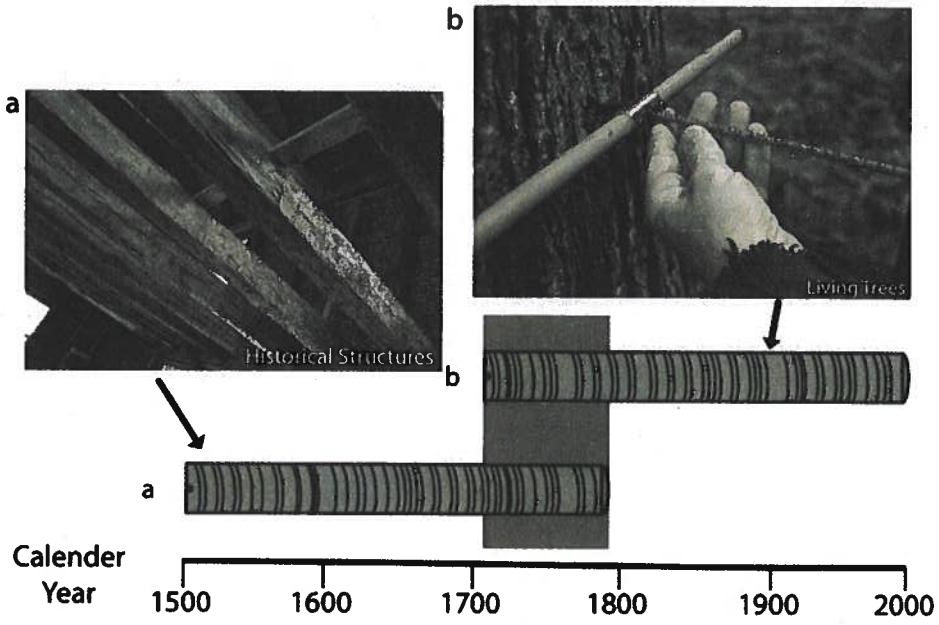


Figure 3 – Diagram of the essential principle of tree-ring research. Crossdating ring patterns extracted from the cores taken from historical buildings (a) are then matched to ring-width patterns from living tree-rings of known calendar date (b).

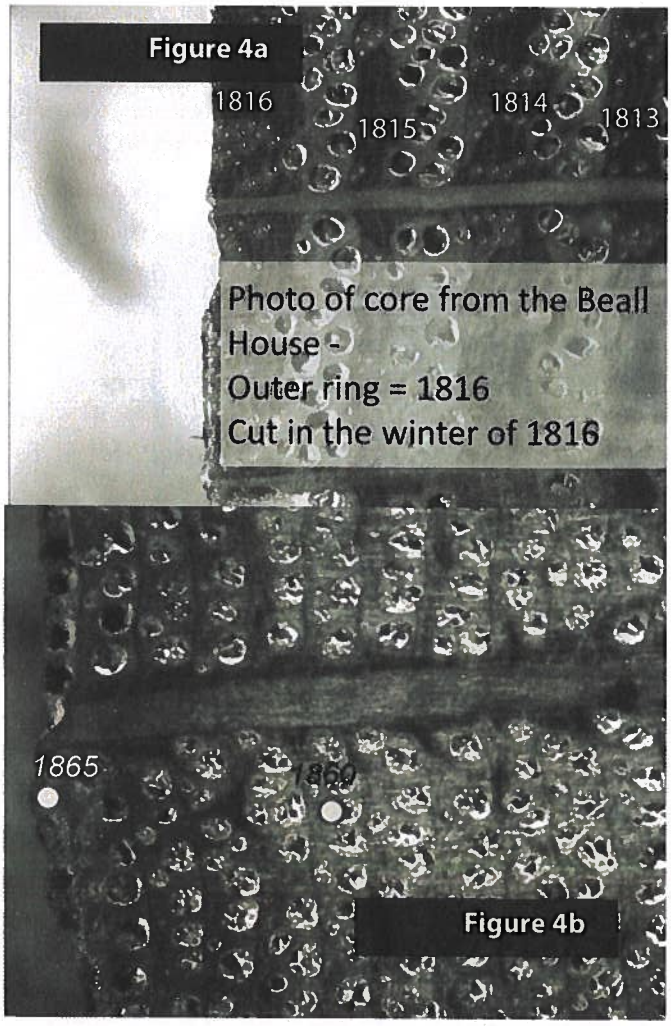
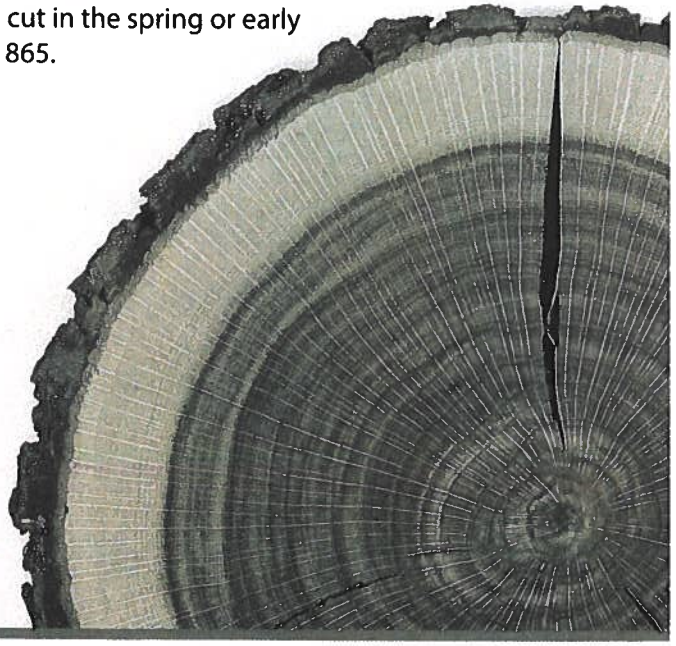


Figure 4 – Photos of tree cores (both white oak) showing the outer rings of two crossdated historical structures. a – the fully-formed outer ring of a sample from the Beall House (now the home of the Wayne County Historical Society, Ohio). The date of 1816 on the outer rings indicates the tree was cut after the 1816 growing season, likely in the winter of that year. b – The partially-formed outer ring of this sample indicates the tree was cut in the spring or early summer of 1865.



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series are the chronologies derived from the old growth stands of Ohio.

For those familiar with analytical error in science, once the sample is dated, the dendrochronologist can claim to know the year of cutting plus or minus an error of zero. Once dates are assigned to each ring, the completeness of the outermost rings can be assessed to determine the season the timber was cut. Tree rings consist of earlywood and latewood in diffuse-porous species like oak, and in the case where the outer ring is complete (both earlywood and latewood are present), the timber was cut after the growing season of the calendar date of that ring. Thus, the timber was likely cut in the late fall or winter of the growth year. If the ring is partially formed, then cutting occurred in the spring or early summer of the growing season **(Figure 4b)**.

Once tree-ring width series from buildings are dated to the calendar year, the ring-width data from the historical building can be incorporated into the master tree-ring chronology for further dating. Additionally, as the ring-width variations are an indicator of past moisture changes, these data are used to reconstruct past changes in drought and are incorporated into drought modeling efforts such as the North American Drought Atlas.

The Wooster lab continues to amass tree-ring series from living trees and wood from historical structures while we collaborate with other scientists interested in the drought and ecological history of the region. Individuals and organizations who wish to have their buildings tree-ring dated can contact us at The College of Wooster Tree Ring Lab (https://treering.voices.wooster.edu) or gwiles@wooster.edu.

During the summer of 2018, the authors and students in the Department of Earth Sciences were supported by The Sherman Fairchild Foundation and AMRE (Applied Methods Research Experience) who provided funding for the tree-ring dating project in northeast Ohio. We are grateful to our clients during this project that included The Nature Conservancy, Holden Arboretum, Barnes Preserve (Wooster), The Wilderness Center, Sonnenberg Village, and various homeowners. ◆

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Further Reading and References Cited

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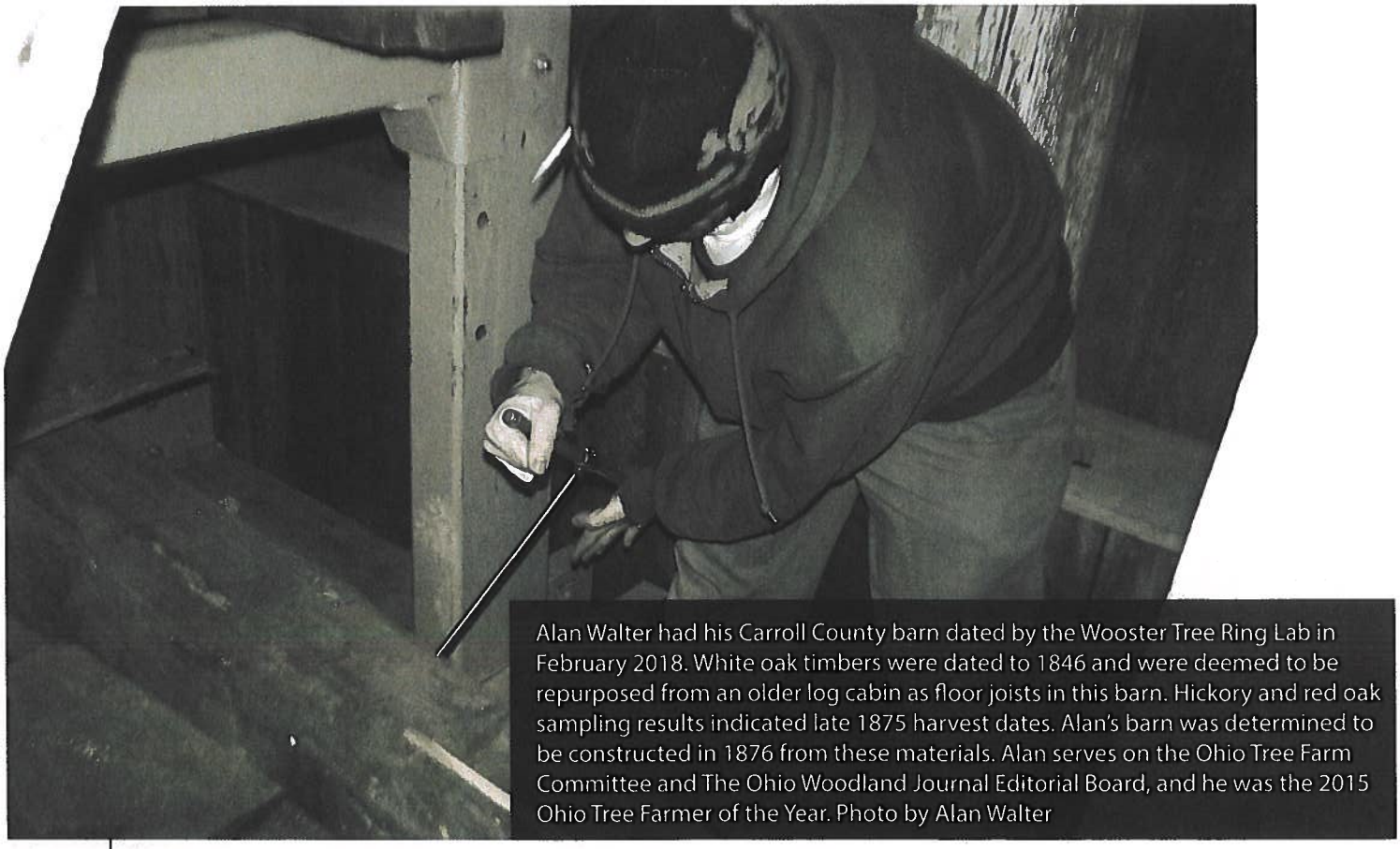

Alan Walter had his Carroll County barn dated by the Wooster Tree Ring Lab in February 2018. White oak timbers were dated to 1846 and were deemed to be repurposed from an older log cabin as floor joists in this barn. Hickory and red oak sampling results indicated late 1875 harvest dates. Alan's barn was determined to be constructed in 1876 from these materials. Alan serves on the Ohio Tree Farm Committee and The Ohio Woodland Journal Editorial Board, and he was the 2015 Ohio Tree Farmer of the Year. Photo by Alan Walter