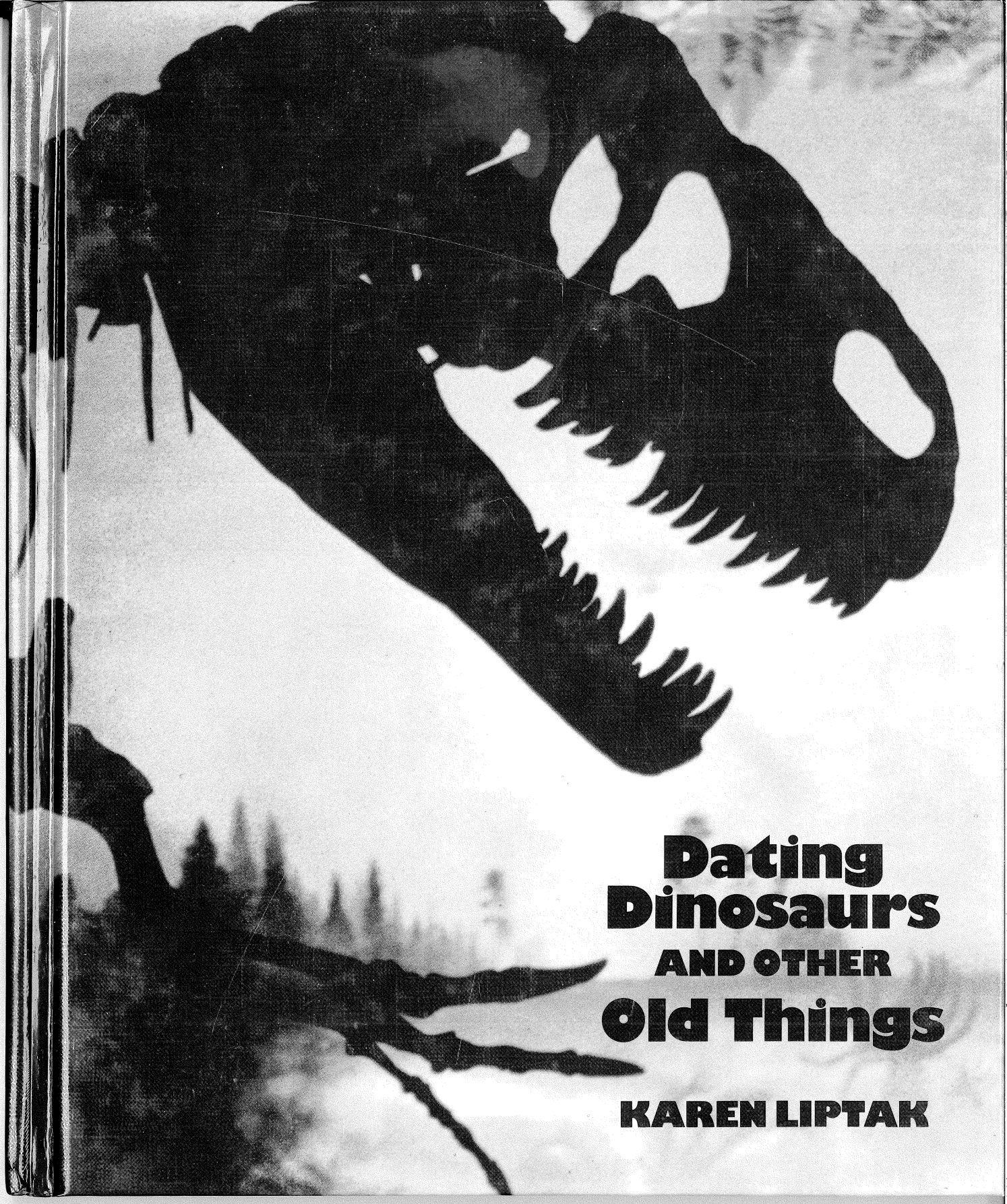

Dating Dinosaurs AND OTHER Old Things

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SECRETS TREES TELL

Have you ever examined a tree stump and noticed the circles on it? These are the growth rings that are laid down annually. By counting the rings of certain trees, scientists can tell many things, including the age of the tree. In fact, tree-ring counting is the most accurate dating tool we have today.

Although people have been curious about growth rings for many centuries, it wasn't until the 1920s that dendrochronology became popular. The "father" of tree-ring science is Dr. Andrew Ellicott Douglass, an astronomer and founder of the University of Arizona's Tree-Ring Laboratory in Tucson.

In the late 1890s, Douglass began to suspect that some kinds of trees could be dated by examining their growth rings. These rings are generally laid down during the tree's annual spring-summer growing seasons. Douglass noticed that certain trees produced growth rings that varied in width from year to year. They would produce a narrow tree ring during a poor growing season and a wide tree ring during a good growing season.

Over the years, trees that lived through the same climatic conditions exhibited a similar pattern of narrow and wide rings. These patterns could "crossdate" with each other. That is, the rings would look very much alike, reflecting the same span of time.

Dr. Douglass set out to build a tree-ring chronology that would go as far back in the past as possible. First, he gathered samples from living trees. Using a hand-powered tool, he extracted a pencil-wide core from the center of each tree. (Core holes are self-healing and do not harm the trees.)

The outermost ring of the living trees represented the current year. By making patterns from the outermost ring inward, Douglass extended his tree-ring chronology as far back as the oldest living sample he could find. Then he dated dead trees, matching each one's last outside ring (which represented the year in which the tree was cut down) with an inside ring of a living tree. He always looked for the one unique place

HOW TO READ A BACKYARD TREE STUMP

Tree stumps are good for sitting on. They are also valuable age indicators. Here's some idea of what scientists do. They count the rings from the outside in. If the tree was just cut, they know that the outermost ring is the current year. Otherwise, they make a graph of the ring pattern and then compare it with a master graph of growth patterns from the same region. If the patterns match at some point, they can be crossdated. If you have some tree stumps near you, see if you can make patterns and compare them.

where the patterns matched. Once he found that place, he could crossdate his samples and extend his tree-ring chronology further and further back in time.

Next, Douglass crossdated wood that came from historic structures in the American Southwest. These included samples from Hopi Indian pueblos, Spanish missions, and pioneer log cabins. After success with these samples, he began testing his technique on prehistoric Indian ruins. Once again, things looked promising.

However, for a long time, Douglass's chronology had gaps, places where he could not match trees with each other. Instead of an absolute chronology for the Southwest, he had what he called a "floating chronology."

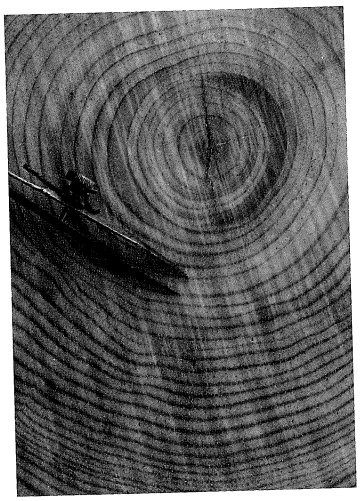
Meanwhile, people speculated on the age of the prehistoric Indian ruins in the region. Some said that they were two thousand years old. Others said that they were five thousand years old, or five hundred years old. The only thing known for sure was that the structures must have been built before the Spanish explorers arrived there in the 1600s, because the Spaniards wrote about them.

Douglass began working with archaeologists to date a major excavation site known as the Pueblo Bonito in Chaco Canyon, New Mexico. For ten years Douglass and his team prepared longer and longer chronologies. Yet a gap in the records of prehistoric ruins from the area still remained.

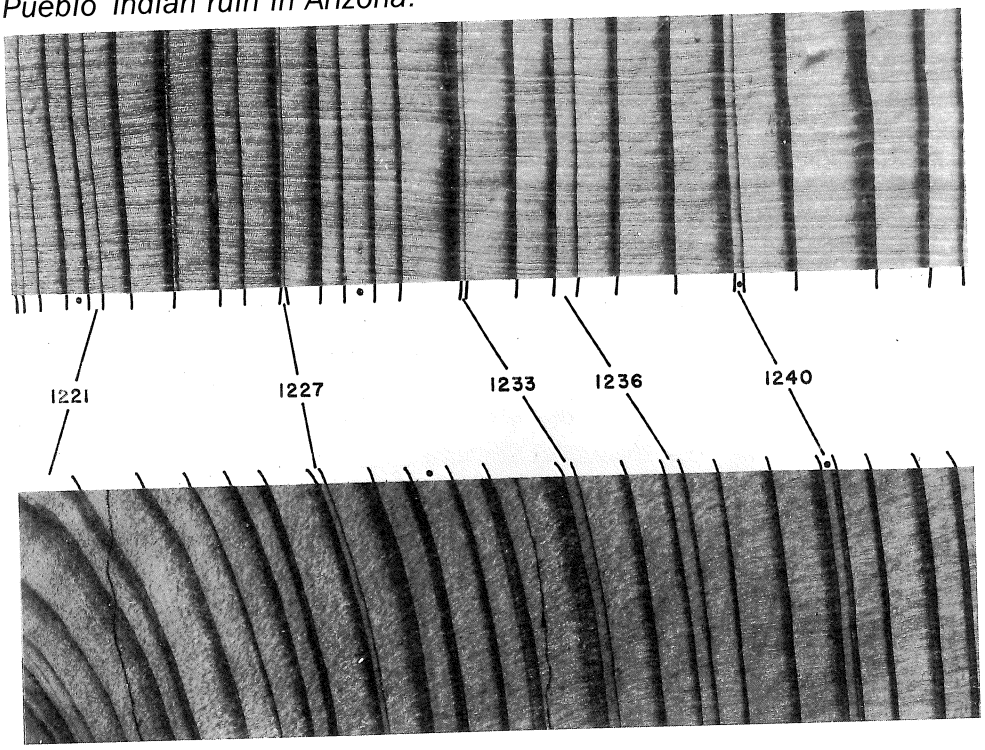
Then one day in 1929, in Show Low, Arizona, two of Douglass's students showed him a new sample they had just found. Douglass labeled the sample HH-39. (HH stood for Haury and Hargrave, the students' last names.) Douglass made graphs of the sample's ring pattern and, after many hours of examination, announced to his startled students, "Gentlemen, we have bridged the gap."

Dr. Bryant Bannister, the former head of the University of Arizona's Tree-Ring Laboratory, calls this "probably the most dramatic moment in the history of American archaeology."

The two edges of a single growth ring are pointed out in this picture of a cross section of a pine tree.



This Douglas fir shows cross dating between two samples of wood from a prehistoric Pueblo Indian ruin in Arizona.



In sample HH-39, Douglass had found the place where the floating chronology could be anchored in time. Now he could extend his tree-ring chronology back through the entire length of the floating chronology. He could show that Pueblo Bonito had been occupied between the eleventh and thirteenth centuries. But he could do more than that. He could pinpoint the calendar ages of prehistoric Indian ruins throughout the Southwest. Since this historic discovery, hundreds of thousands of samples from southwestern prehistoric ruins have been dated with dendrochronology.

Today, tree-ring chronologies in the United States go back nearly ten thousand years. This time range is made possible by a very important and long-living tree: the bristlecone pine. This often bizarre-looking pine is among the earth's oldest living things. By using living and dead samples of it, scientists have built a tree-ring chronology that goes back ninety-six hundred years.

Tree-ring records are used in many archaeological studies. Pieces of charcoal (burned wood), as well as preserved timbers, are dated to tell us many things about the people who used them. Some scientists use these data to determine the behavior of ancient people. For instance, some communities apparently adapted well to sudden climatic changes, while others disappeared from the area. The evidence is a gap in datable wood used for construction sites, indicating a time when no one lived in the area.

But dendrochronology deals with more than archaeological mysteries. It is also used to investigate climate changes on time scales ranging from a few years to thousands of years. In North America, scientists are using tree-ring records to develop a climatic map season by season, going back to the year A.D. 1600. Climatic changes are also being mapped on a global scale with tree rings.

Other changes in the environment can also be studied with tree rings because the chemical composition of each ring can be analyzed.

Pueblo Bonito was the first major ruin in the Southwest to be reliably dated by the tree-ring method.

Some bristlecone pines in the White Mountains of California are 5,000 years old, making them the oldest living things on earth. After scientists determined the age of these trees, the bristlecone pine was put under the protection of the U.S. Forest Service.

As Dr. Bannister explains, "We can look at a ring for 1621 from Arizona, and we can compare the chemical components from 1621 in Siberia, and in Tasmania as well. That makes tree-ring science immensely powerful, both as a dating tool and as a measure of past environmental changes."

This brings us back to radiocarbon, which is absorbed by every living tree. This radiocarbon can be analyzed in each individual tree ring. In the early days of radiocarbon dating, a major error was caught by checking radiocarbon dates with those obtained from tree rings. The error came from a mistaken assumption that the amount of radiocarbon in the atmosphere never changes.

When scientists compared radiocarbon results with tree-ring readings, they were surprised to find that the radiocarbon supply has varied through the ages. Today, radiocarbon dates for the past ten thousand years (as far back as tree-ring dating can go) can be corrected.

But even the highly precise tree-ring research has limitations and requires scientists to be detectives. They must carefully examine every site from which datable wood comes. For instance, a piece of wood may have been reused, making it older than the rest of a particular structure. Or, an old beam could have been replaced with one that was newer than the original structure. Then, too, wooden objects found inside a ruin may be younger or older than the ruin itself. Scientists try to overcome these problems by analyzing several samples from one site and by using more than one dating method whenever possible.