

CHAPTER 1

Some Historical Background on Dendrochronology

*Chapter Contributors: W.J. Robinson, E. Cook, J.R. Pilcher,
D. Eckstein, L. Kairiukstis, S. Shiyatov, and D.A. Norton*

1.1. Dendrochronology in Western North America: The Early Years *W.J. Robinson*

The systematic study of tree rings in western North America began with an intuitive insight by an astronomer, Andrew Ellicott Douglass. He was, before the turn of the 20th century, working at the Lowell Observatory in Flagstaff, Arizona, and was interested in the cyclic nature of solar activity, particularly sunspots, and its relation to terrestrial climate. Since the written record of solar activity extended further back in time than the record of terrestrial weather, he envisioned tree growth as a proxy measure of climate. Douglass' investigation began in 1901 and was based on the following premises: that the rings of a tree are a measure of its food supply; that the food supply depends largely on the amount of available moisture, especially in drier climates where the quantity of moisture is limited and the life struggle of the tree is against drought rather than competing vegetation; and that therefore the rings are a measure of precipitation (Douglass, 1914, page 321). His method involved first the preparation of a tree-growth curve, and for this purpose pine (*Pinus*) trees growing in the environs of Flagstaff were chosen. In addition to convenience, these trees had two obvious advantages. First, the moisture available to the trees was primarily in the form of precipitation and, second, the average age of the trees was nearly 350 years, with some more than 500 years old (Douglass, 1914, page 322). This latter quality allowed a large backward extension of the growth curve in the record of a single tree.

As he worked on the growth curve, Douglass noticed that the same pattern of thick and thin rings could be identified in different trees that grew during the

same time period. He also noticed that the same patterns were evident in trees growing near Prescott, Arizona, which was nearly 100 miles southwest of Flagstaff and more than 300m lower in elevation. The recognition of the recurrent patterns in the rings was the first step in the formation of the fundamental principle of all tree-ring investigation, which is referred to as cross-dating.

Cross-dating was first established experimentally by Douglass in 1904 when he recognized the ring pattern in a dead stump that allowed him to specify the actual date of cutting – a fact that was verified by the man who had cleared the land. For the next decade Douglass continued his work on rings as climatic indicators and on the establishment of long growth curves. He succeeded in cross-dating living trees growing as far away as southern Arizona (Douglass, 1914, page 325) and devoted much effort in the investigation of the Sequoia of California, which at that time held promise of extremely long growth records. It was during this period that Douglass' long association with the University of Arizona began in 1906.

At the end of this period of the development of the basic principle of dendrochronology, the cross-dated sequence extended back in time nearly 500 years, based mainly on Flagstaff-area trees.

Archaeological Studies

Although Douglass never lost sight of tree growth as a climatic indicator, an event occurred in 1914 that led him off on a tangent. This was the potential application of the dating of tree growth to past events in man's history. In that year Douglass delivered a paper to the Carnegie Institution of Washington on the relationships between tree growth and climatic cycles. The substance of the paper came to the attention of Clark Wissler of the American Museum of Natural History who offered Douglass some beams for his general inspection (Douglass, 1935a, page 10). These materials were received in 1916 and were sections of living trees growing near prehistoric ruins. As a result of his examination of the sections, Douglass became convinced that trees from as far as northwestern New Mexico had a potential of cross-dating with his Flagstaff trees (Douglass, 1921, page 27).

A few years later Earl H. Morris sent Douglass a small selection of prehistoric beams from the Aztec Ruin and from Pueblo Bonito in Chaco Canyon. The sections from Aztec were immediately cross-dated among themselves, but not those from Pueblo Bonito. In hopes of obtaining an exact age correspondence of the Aztec beams, Douglass tried futilely to match them to the three-millennia Sequoia record. Later in 1919, Douglass visited Morris at the Aztec Ruin and secured 37 additional specimens. These, with the original pieces, formed the basis for the first relative, often referred to as *floating*, chronology. As a result of this initial success, Douglass formulated the dating technique that ultimately proved successful. In a letter to Wissler in 1919, he stated that the technique "consists in obtaining groups of timbers of different ages so that one group will overlap another, and after combining them by cross-dating, we may bridge over a great many hundred years in the past." Wissler's response to this