# INTRODUCTION

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ABSTRACT

The Wetherill Mesa Archeological Project devoted a portion of its funds and personnel to an attempt to reconstruct the past climate at Mesa Verde National Park. Data for this study were obtained from the thorough tree-ring dating of the archaeological excavations, from environmental measurement stations, and from measurements of tree growth.

The results of the dendrochronological study on Wetherill Mesa include very long tree-ring chronologies; large clusters of dates from each site excavated on Wetherill Mesa; and a tentative climate reconstruction for Mesa Verde.

The discovery by Dr. A. E. Douglass, in the first quarter of this century, that the pattern of wide and narrow tree-rings in different trees growing under the same climatic conditions could be used to establish relative and absolute chronologies has had a tremendous effect on Southwestern archaeology. Shortly after Douglass' work with modern tree-ring chronologies was publicized, several archaeologists, notably Clark Wissler of the American Museum of Natural History, realized the potential value of tree-ring dating to archaeologists and sent a collection of archaeological wood to Douglass. After determining that relative tree-ring chronologies could be obtained from archaeological wood, Douglass, with funds provided by the National Geographic Society, began an intensive collection of wood specimens from archaeological sites — especially at Pueblo Bonito, which was being excavated by a National Geographic Society expedition under Neil M. Judd. In 1929 the relative, or "floating," tree-ring chronologies of many ruins in the Southwest were cross-dated with the modern tree-ring chronology, thus providing absolute dates for many Southwestern sites (Douglass 1935).

Because Douglass' initial work in tree-ring dating was the result of his attempt to correlate sunspots and climate, he realized the possibility of using tree-ring data for reconstructing past climates. The analysis of climatic effects on tree-growth in the Southwest was continued by several of Douglass' students; probably the most significant contributions were made by Edmund Schulman. Most correlations between climate and tree growth were made by comparing either rainfall or runoff for a year or a part of a year with the total ring width for the same year. Although high correlation coefficients were often obtained, little more could be said than that there was, indeed, a correlation. Data were not available that would permit an actual climatic reconstruction from tree-rings (Schulman 1956).

In spite of the early interest in climatic interpretations from tree-ring data, most archaeological tree-ring work in recent years has been concerned entirely with the derivation of absolute tree-ring dates. This has been due to an absence of funds for making detailed comparisons of tree-growth and climate and to a lack of personnel trained in climatology or plant physiology and in dendrochronology.

## INCEPTION OF THE PROGRAM

The National Geographic Society donated funds to the National Park Service for the Wetherill Mesa Archeological Project under the stipulation that this money be used for other than the costs of site excavation and stabilization. It was decided that part of these funds could be used to attack the problem of reconstructing the prehistoric environment of the area — hopefully to provide an understanding of the effects of this environment on the day-to-day lives of the prehistoric population.

Late in 1958 Osborne asked Terah L. Smiley, then acting director of the Laboratory of Tree-Ring Research at The University of Arizona, that the laboratory handle all the dendrochronological work for the project. Smiley made arrangements for the dating of archaeological specimens under the supervision of Bryant Bannister, of the same laboratory. Osborne then asked both Bannister and Smiley for suggestions as to how the project might best build on the Douglass and Schulman work; how it might, with the expenditure of moderate funds, make an important contribution to dendrochronology and to paleoclimatology. Smiley suggested, early in the summer of 1959, that two long tree-ring transects, crossing Mesa Verde east-west and north-south, be made. Cores would be taken from trees at regular intervals along the transects and observations of the ecological and physiographic changes would be made around and between the cored trees. In this way, it was hoped that minute changes in the climate of the Mesa Verde could be recorded and that these data would provide a base for the understanding of modern climate and some microclimates. The correlation of modern climate with modern tree growth would provide a model for the study of past climate through past tree-rings.

While this plan was being studied the decision was made to install environmental measurement stations in various environments on Mesa Verde. The resulting climatic data would provide a desirable contribution to knowledge useful to the plant and animal ecologists, to the soil scientist, and in the final interpretation of Mesa Verde anthropology and human geography. The installation of these stations and the training of personnel to run them was under the direction of John Marr, Director of the Institute of Arctic and Alpine Research, University of Colorado. The actual responsibility of collecting this data fell to project ecologists James A. Erdman and Charles L. Douglas.

During this period Smiley became full-time director of the Geochronology Laboratories and William G. McGinnies became director of the Laboratory of Tree-Ring Research. Shortly thereafter Bannister informed Osborne that the laboratory was adding a person to its staff who would be able to implement our interest in paleoclimatology.

## Recent Tree Growth and Climate

Harold C. Fritts, a physiological ecologist, joined the staff of the Laboratory of Tree-Ring Research in 1960. Immediately interested in our problems, he pointed out that the environmental measurement program was a made-to-order base for providing a model for dendroclimatological studies. He suggested that dendrographs and dendrometers, which measure day-to-day changes in tree growth, be installed on selected trees at or near the environmental measurement stations. By correlating tree-growth data with data obtained from the weather stations, the modern aspect of tree-growth response to climate should be easily derived. Projection of these data into the past would then depend upon an intensive study of old and long series of tree-rings and the equating of their variations to climatic environment as this was understood at the modern level. He also pointed out that replicated samples from selected stands along the transects would allow more meaningful statistical analyses and would be more desirable than a continuous tree-ring transect.

Previous work at Mesa Verde indicated that the Wetherill Mesa Project could expect a large quantity of material for tree-ring dating from its excavations, and work by Schulman (1947) had paved the way for climatic analysis in the area. The installations and replicated tree-ring samples that Fritts needed were made. David G. Smith and Thomas P. Harlan collected

samples and conducted the necessary summer field work while Erdman and Douglas serviced and observed the tree growth measurement devices at the same time that they performed the other tasks connected with the environmental measurement stations. The results of these tree-ring studies are presented elsewhere (Fritts, et al. 1965; Fritts 1965).

## THE ARCHAEOLOGICAL TREE-RING SERIES

The archaeological aspect of the tree-ring program for the Wetherill Mesa Archeological Project was the responsibility of Bryant Bannister. Bannister suggested that it would be advisable for the project to have one person, trained at the tree-ring laboratory and working in the field with the archaeologists, who could collect, catalog, preserve, and examine all archaeological tree-ring material obtained from the excavations on Wetherill Mesa. This plan would, in effect, return to the collecting methods used by Douglass and others in the infancy of Southwestern dendrochronology, wherein a person trained in the Douglass method would be in the field collecting, cataloging, and often dating specimens obtained from an excavation.

Although this method was employed for several years, during the 1930's, by the end of World War II most archaeological tree-ring material was being collected by archaeologists with little or no training in dendrochronology. This was primarily because the number of people trained by Douglass was far less than the number of excavations producing datable wood and charcoal. The Wetherill Mesa Archeological Project, therefore, was to be unique among recent excavations in the Southwest in having, essentially, a full-time dendrochronologist on hand for collecting and dating.

Unfortunately, regardless of how well they are thought out, plans often do not materialize completely. At the beginning of its first field season in 1959, the project was without a full-time dendrochronologist — and none seemed likely to be available for some time. Therefore, Arthur H. Rohn, a project archaeologist who had training at the Laboratory of Tree-Ring Research, supervised the collection and preparation of specimens obtained during the first field season. Nichols joined the project as dendrochronologist in 1960 and collected and dated the tree-ring material from Long House and Mug House in 1960 and 1961 and from Step House in 1962. In 1962 and 1963 other tree-ring specimens were collected by archaeologists Hayes and Swannack from their own excavations, and these specimens were dated by Thomas P. Harlan. Although the original archaeological tree-ring program was not carried out for the length of the project, the next best thing did occur. Of the more than 1,900 wood and charcoal specimens obtained from the project's excavations only two individuals did the actual dating, Harlan and Nichols, and all specimens from a single site were examined by the same individual. Both Harlan and Nichols were trained in tree-ring dating by Bannister and their work in the laboratory was closely supervised by him throughout the course of the project. Thus, there was excellent continuity in the dating program for the Wetherill Mesa excavations.

Because it was hoped that the tree-ring specimens obtained by the project would strengthen both the archaeological and modern tree-ring chronologies for the Mesa Verde, as well as provide basic material for Fritts' climatic and paleoclimatic analyses, dated specimens were selected for measurement. The width of each ring in every specimen selected was measured to the nearest 100th of a millimeter. These measurements were converted to tree-ring indices by the use of an IBM 7072 computer (Fritts 1963) and have been used to develop a very long tree-ring chronology for Mesa Verde.

We believe the Wetherill Mesa Archeological Project to have had one of the most intensive dendrochronological programs in the history of Southwestern archaeology. The results have been well worth the efforts expended. The great number of dates from archaeological wood and charcoal — more than 500 individual dates from over 1,900 specimens — has not only given gross dates for individual sites, but these have permitted extended understanding of and speculation about the lives of the people who constructed the dwellings in prehistoric times. We have been able to determine sequences of construction within and between ruins and in many cases to date the introduction and dying out of artifacts, styles, and practices. We have also been able to show that tree-ring data may be used for a climatic reconstruction (Fritts, et al. 1965; Fritts 1965). A very significant contribution of the Wetherill Mesa Archeological Project's dating program is that it points the way for other such efforts. There is no doubt that tree-ring dates and data may be put to better use than simply to give absolute beginning and ending dates for archaeological construction. When subjected to continuing analysis, the data that they offer may help us to understand more about the prehistoric inhabitants of the Southwest than any other single set of archaeological evidence.

It is truly fitting that the National Geographic Society should have given the prime support to the project's tree-ring work and that The University of Arizona should have done a major share of the laboratory work and trained the personnel. That is the way it started out nearly a half-century ago.

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