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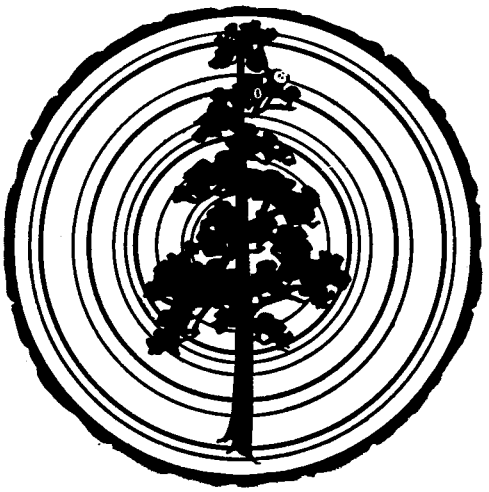

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NEW METHOD OF SURFACING WOOD SPECIMENS FOR STUDY

NATHAN A. BOWERS

ABSTRACT

In preparing cross-grain wood surfaces for examination, the old method of sanding a considerable area at once can now be superceded by a new method called *abrasive cutting along a line*. This article describes a machine which uses this new method to obtain a very superior finish excellent for microscopic study, quicker than the old method and without need for highly skilled operators. The machine is primarily for use in laboratories where considerable numbers of specimens need to be given "readable" surfaces.

An important part of the program in a progressive tree-ring laboratory is research and development aimed at improvement of mechanical equipment needed in all phases of collection, preparation, and analysis of tree-ring specimens. An article on a power-driven coring tool for taking cores up to six feet long was published in the *Tree-Ring Bulletin*, Vol. 23, Nos. 1-4. The following is a report on a new method for laboratory preparation of cross-grain wood surfaces for microscopic study. In a later issue there will be an article on improved equipment for taking short cores in the field.

Ever since tree-rings have been systematically studied in the cross-sections of wood samples, sanding the surfaces by various means has been one of the standard methods of preparation for close examination by hand lens or microscope. However, in order to avoid the smearing effect which seemed to be inevitable when working with very small grit sizes for the final finish, the use of razor blades was often substituted. Smearing is an inherent result in the conventional sanding process because particles removed by the abrasive at the start of a pass across the area being sanded must be dragged all the way across the area of contact with the belt, gathering other particles on the way. These fine particles may be ground into the surface in a way that clouds the clear definition of cell structure.

While the razor blade makes individual cuts in which the rings are clearly defined and easily readable, even the best operator can hope to produce only a succession of individual cuts — a wavy surface not in a true plane. The two main objections to the razor method have been that it is a very slow process and requires a highly skilled operator. Thus for a long time some method has been needed that would eliminate these difficulties and enable a relatively unskilled operator to quickly prepare a surface finish suitable for microscopic study.

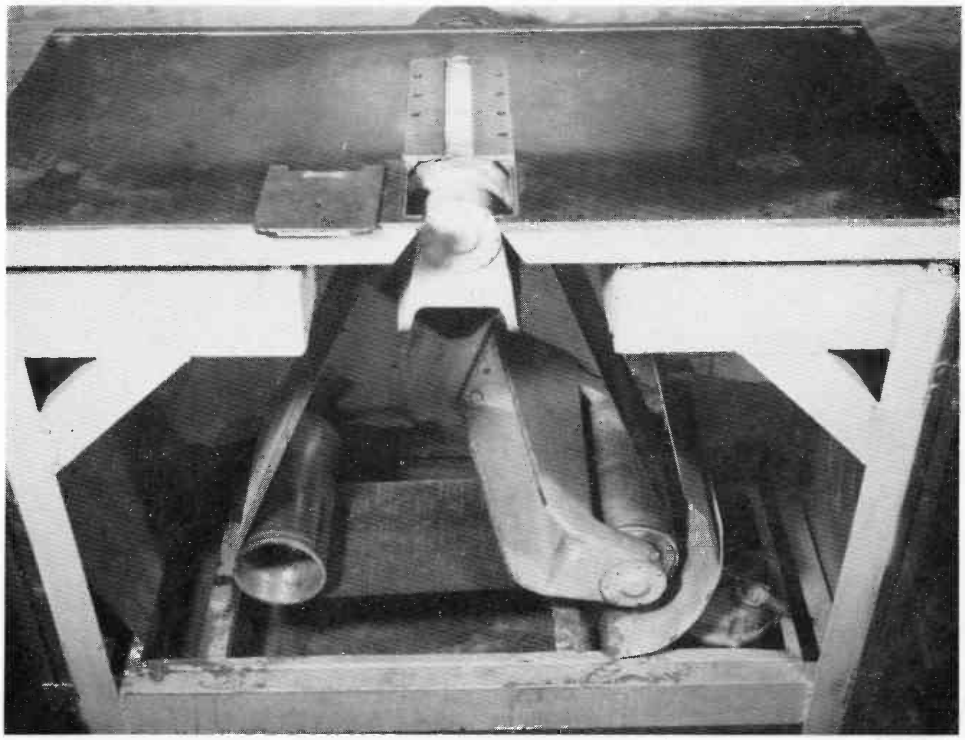

FIG. 1. The sanding machine.

These objectives have been achieved, it is believed, by a machine designed and built expressly for the Laboratory of Tree-Ring Research at The University of Arizona. It is a heavy-duty, stationary, abrasive-belt sander using the same commercially-available abrasive belts widely employed in ordinary sanding machines. With this machine (Fig. 1), familiarly known as the "BVX," the important difference from other sanding devices is that the belt contacts the specimen being surfaced only along a line instead of over an entire area all at once.

This method eliminates the possibility of smearing since no particles abraded from the specimen are carried across the finished surface. The resulting finish consequently is like that obtained with a razor, and the advantages are particularly marked as the surfacing progresses and belts with the finer grits are used.

To provide a durable machine which would be largely an experiment, the first BVX was built to a heavy-duty pattern and weighs almost three quarters of a ton. It takes endless belts, 12 inches wide and 96 inches long, which are readily available commercially in all grit sizes. However, unlike the ordinary belt sander, the BVX uses three pulleys, two of which are in the lower part of the machine while the third is just below a narrow slot in the table top (Fig. 2). The length of the slot is slightly more than the 12-inch belt width and the pulley is at a level such that its top surface is below the table top by a distance equal to the fabric thickness of abrasive belts with the finest grits.

Thus when a belt passes over the upper pulley the depth of the cut taken off is the distance by which the abrasive surface extends above the table top. Hence the depth of the cut made in a wood surface passed over

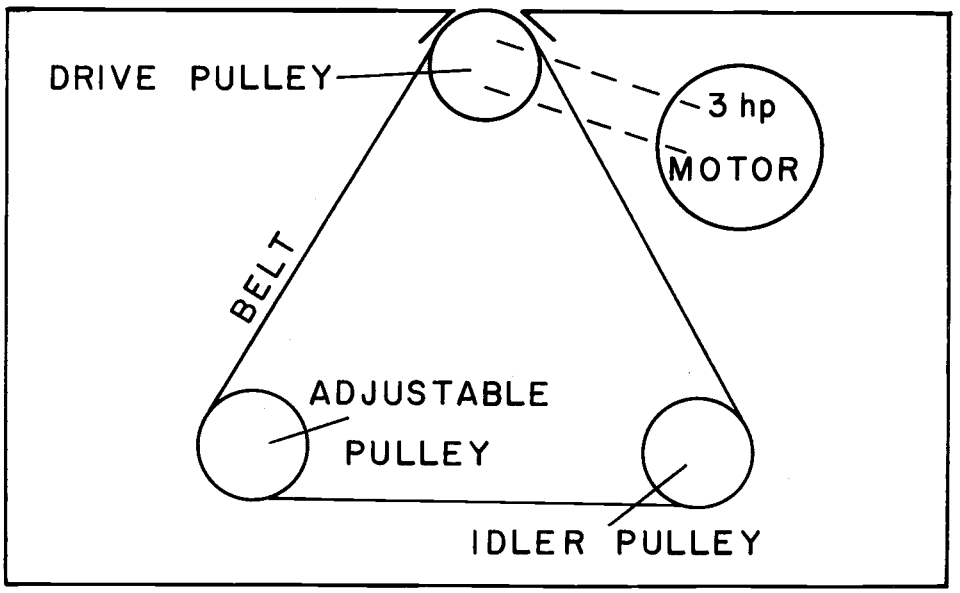

FIG. 2. Schematic sketch of details of sanding machine.

the moving belt is equal to the depth or thickness of the abrasive above the supporting fabric. With coarse grits the cut is deeper than with fine grits but, in either case, once the specimen passes beyond the very narrow zone or line along which it contacts the abrasive, there is no further contact and the finish of the sanded surface thereafter remains undisturbed.

In final stages of working down to the ultimate finish, only very fine cuts are made and a very small amount of wood is removed at each pass. Throughout the abrasive cutting, the machine automatically works the finished surface to a perfectly true plane without the need of a specially trained operator.

Usual practice in preparing for a sanding session on the BVX is to lay out a considerable number of specimens on the machine's ample top (24 x 48 inches). Each of the specimens is then worked across the first or coarse-grit belt. This would be a 40, 80 or 100-grit size, according to the roughness or smoothness of the original surface of the specimen. The belt then would be changed to the next finer grit size; all specimens again worked across the belt and so on down to the finest grits to be used.

This plan makes it economical, timewise, to use a considerable number of grit sizes with relatively little time loss, per specimen, chargeable to changing belts. When working for the best possible surface finish the sanding continues to the finest grit sizes available. However, on some easily read sections all useful purposes will be served by a finish obtainable without going all the way to the smallest grits. Such specimens can be set aside whenever inspection, preferably with a hand lens, shows the surface free from scratches and rings easily readable. A complete set of belts that have been found useful on the BVX includes grit sizes 40, 80, 100, 150, 220, 320 and 400.

It its original form the machine was built with provision for water jets directed against the belt at strategic points to wash off swarf and to provide cooling that would eliminate friction burns on the specimens. This scorching effect had been encountered to notable degree in experiments that preceded design of the BVX. However, from first operation of this machine

it was apparent that an advantage of abrasive cutting along a line would be freedom from danger of scorching the surface of a specimen. So small an area is subjected to friction and the exposure is so brief that no harmful amount of heat is generated. The water jets, therefore, were never needed and ultimately were removed.

Two features of the BVX deserving special mention are the adjustable table top and the grooved rubber surface of the pulley that operates in the slot. Adjustment of the table top is accomplished by four screws, one at each corner, with locking nuts to firmly hold a finally selected setting. Maximum range of elevation change is less than a half inch.

All three pulleys have the same six-inch diameter, but while the two lower pulleys are steel, with a slight crown to keep the belt centered, the slot pulley is a true cylinder (no crown) and carries a thick, solid-rubber tire in which deep, spiral grooves of rectangular section have been made to provide flexibility in the gripping areas where the belt transmits pressure to the pulley beneath.

The design of this pulley plus the rugged construction of the machine as a whole are given much of the credit for four years of uninterrupted operation. Had the BVX been in some commercial plant it would be expected that the same trained personnel would have had it constantly under supervision, giving it expert care and handling. In the Laboratory, however, the requirements were that the machine would be expected to operate without highly skilled attention and the work of preparing specimens is assigned to graduate students some of whom come and go at relatively frequent intervals. In the four years of operation some two dozen men have been "broken in" as BVX operators.

Design of the BVX was begun after, and was based on, some two years of experimental work in search of the best method of preparing surfaces of large transects for microscopic study. When preparations for actually building a trial machine were being made, W. J. Vossbrinck, President of the Tool and Abrasive Engineering Co. of San Jose, Calif., was consulted. Much credit for details of the design goes to him and it was his company in San Jose that built the machine and installed it in the laboratory in Tucson.

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COMPARISON AND ANALYSIS OF MODERN AND PREHISTORIC TREE SPECIES IN THE FLAGSTAFF AREA, ARIZONA*

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ABSTRACT

The types of wood identified from tree-ring specimens of 78 archaeological sites in the area of Flagstaff, Arizona were analyzed for changes through time. The sites span a period from Basketmaker III through Pueblo III times. Most of the specimens are from constructional materials. The wood identifications were also compared with the tree types growing on the sites today (1960).

The analyses show that there is a great uniformity of types of wood used and the relative percentages of the various woods throughout the time span. This uniformity exists regardless of the location of the site geographically, or in relation to the modern tree distribution.

Only the sites constructed during Pueblo I times are different. This group is restricted to the present ponderosa pine limits, and they did not yield a single specimen of either juniper or oak, both of which are found in all the other time divisions.

Douglas fir, ponderosa pine, piñon pine and *Populus* sp. occur in relatively consistent percentages throughout the time span, despite the change in dwelling type from pithouses to pueblos. Since the Indians used trees other than those closest at hand for building purposes, they had to haul large quantities of wood from the areas where the trees grew. Distances to the nearest places where the wood types can be found today are as much as 15 miles from the sites. Some strong motivation must have inspired so great an expenditure of effort, but the reason is not apparent.

INTRODUCTION

This study is based on data gathered as a part of the Northern Arizona Project which was conducted by the Laboratory of Tree-Ring Research of The University of Arizona under grants from the National Science Foundation. The purpose of the project was to improve the archaeological dating in the area of Flagstaff, Arizona by re-examination of dendrochronological materials which had been previously dated, and by examination of more recently excavated wood and charcoal materials. The modern tree species considered here are those observed by the author at the various sites during the summer of 1960. The prehistoric tree species are those of the tree-ring specimens, mostly from constructional materials, obtained during the excavations of the sites. The archaeological taxonomic assignments are those made by Thomas P. Harlan, a member of the project staff, whose work on the project also formed the basis for his master's thesis (Harlan 1962).

As a part of the standard examination of tree-ring material an identification is made as to genus, and to species whenever possible. This is done prior to the attempt at dating, so that nearly all specimens have a taxonomic identification, whether or not they are datable. The archaeological data was compiled by the author from Harlan's work-sheets. A small percentage of the identifications were accompanied by question marks. Botanical assignments of pieces of wood and charcoal are sufficiently difficult that a certain identification is not possible in every case. When tabulating the results

* I wish to thank those people whose cooperation has made the publication of this paper possible. The personnel of the Museum of Northern Arizona contributed the use of facilities and graciously contributed their time while the field work was in progress. Marvin A. Stokes, Thomas P. Harlan, Harold C. Fritts, Bryant Bannister, and my wife Mercedes assisted with the manuscript. The work on which this paper is based was supported by the National Science Foundation.

the question marks were ignored, and the suggested assignment was taken as the true one. Since the number of specimens is large (4094) and the conclusions are based on gross percentages, small errors in botanical assignments are not significant.

The archaeological sample is a limited one, as it includes only a portion of the sites known in the area. Many of the known sites have not been excavated, and not all of the excavated sites have yielded wood or charcoal materials. The locations of the sites included in this report are shown in Figure 1.

The sites have been grouped into the five time divisions to facilitate checking for variations through time.

Basketmaker III. Only one site, north of Winona, is included from this time horizon. Since there is only one BMIII site, it can provide only minimum evidence. That is to say at least the species found there were used by BMIII peoples, but additional woods may also have been used.

Pueblo I. Twelve pithouse sites fall within this group. Three lie just north of Flagstaff, and nine are scattered along US 89 north of Flagstaff.

Pueblo I-II. The pithouses of these five sites were built during PI times, but occupied into Pueblo II times. It will be seen in the analyses that these sites are very similar to the PI sites and unlike the PII sites. They are all close together, east of US 89 and north of Flagstaff.

Pueblo II. This group of pithouse sites is the largest (37) and the most widely distributed. Scattered along US 89 north of Flagstaff are 24 sites. Nine sites are located north and east of Winona. One is located on the drainage south of Deadman Wash, another just north of Flagstaff. There is a site at Grand Falls on the Little Colorado River, and one at the extreme western edge of the area shown on the map, just below the inset map.

Pueblo III. There are 23 pueblo sites of this time horizon. The occupation of three of them, the sites along Grapevine Canyon, may extend into Pueblo IV times. Four sites are located in Walnut Canyon. Eight sites are scattered along US 89 north of Flagstaff. Four are located along Deadman Wash, and another four are north and east of Winona.

MODERN TREE DISTRIBUTION

The Flagstaff area is one of great ecological variation. Conditions range from desert along the Little Colorado River, to the barren tops of the San Francisco Mountains which are above the timberline. This is a range in elevation from less than 4500 feet to just under 13,000 feet. The two situations occur within 35 air miles of each other. In this region the flora and fauna vary greatly. The diverse biota of this area formed the basis for Merriam's (1890) classic study. Using these plant and animal communities he attempted to set up life zones for the North American continent. Although the causes he proposed for the zonation have not withstood the test of time and further research, the life communities he defined are still the basis for floral and faunal zones in the western U.S. (Daubenmire 1938).

The tree types and the areas considered in this report fall within four of Merriam's life zones: 1) the Canadian or Balsam Fir Zone, in which the principal tree type is the Douglas fir *(Pseudotsuga taxifolia)* with aspen *(Populus tremuloides)* occupying areas where the Douglas fir have been removed by fire or other causes. This community grows approximately between 9,200 and 8,200 feet elevation. 2) The Neutral or Pine Zone occurs from about 8,200 to 7,000 feet and is occupied by a ponderosa pine *(Pinus ponderosa)* forest. 3) The Piñon Zone is located approximately between 7,000 and 6,000 feet. The trees in this zone are the piñon pine *(Pinus edulis)* and the junipers *(Juniperus* sp.). 4) The Desert Zone is found between about 6,000 and 4,000 feet, and in it the vegetation is desert scrub (Merriam 1890).

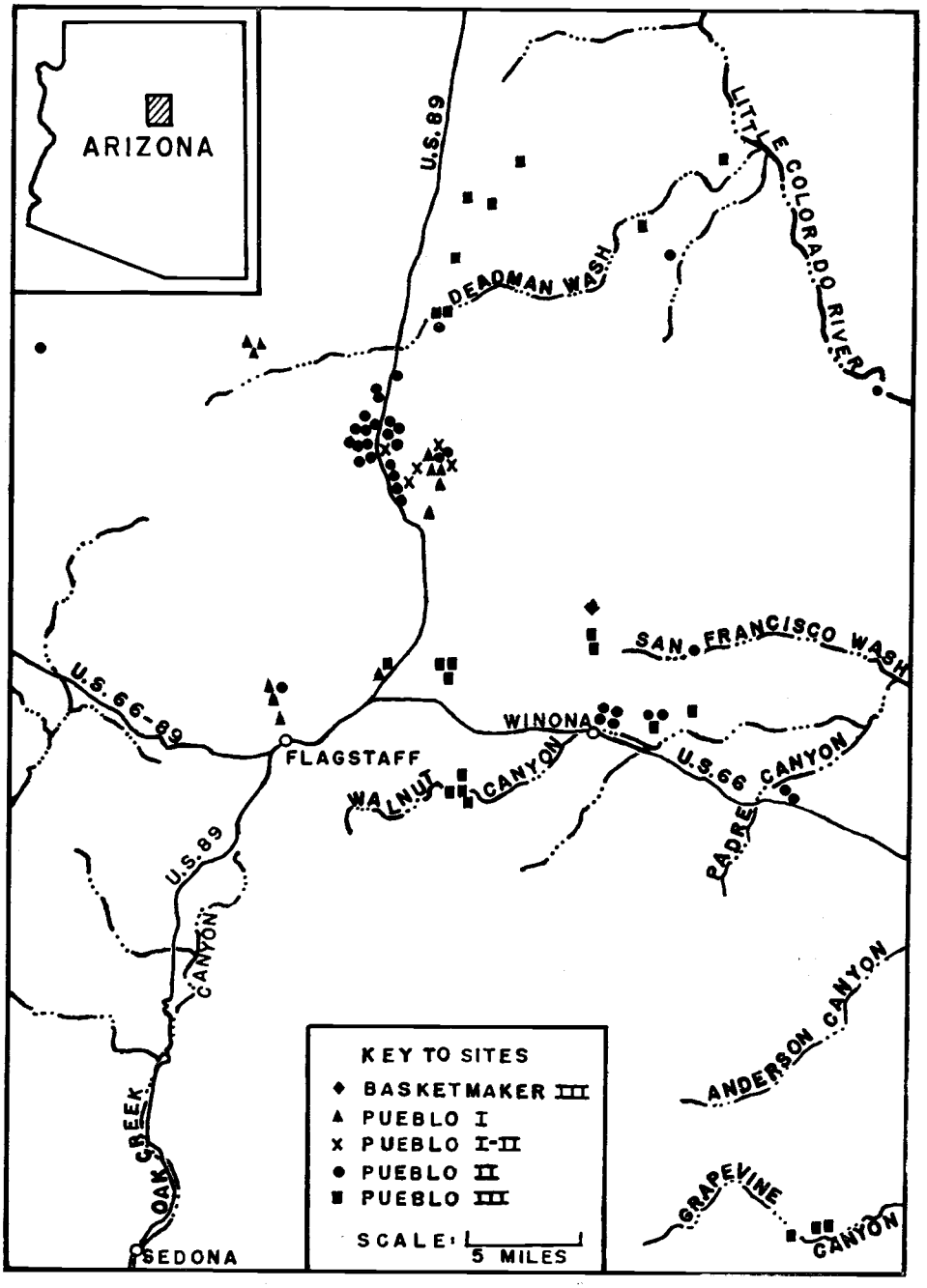

FIG. 1. Location of the archaeological sites.

Daubenmire (1943) uses the same floral communities, but prefers more descriptive terms, calling the first three of Merriam's life zones listed above the Douglas Fir, the Ponderosa Pine and the Juniper-Piñon Zones respectively. Oosting (1956) following more recent concepts recognizes the communities as climax floras, identifying them as the Douglas Fir, Ponderosa Pine and the Piñon-Juniper Climaxes respectively.

For the purposes of this paper a narrowly defined set of tree zones will be used: a) the Douglas fir zone, in which Douglas fir and aspen grow (corresponding to the Douglas Fir Climax). b) The ponderosa zone, in which ponderosa grows exclusively (corresponding to the Ponderosa Pine Climax). c) The piñon-juniper zone, in which only piñon pine and juniper grow (corresponding to the Piñon-Juniper Climax). d) The overlap zone, which is formed by the overlap of the edges of the ponderosa and piñon-juniper zones (corresponding to the transition area between the Ponderosa Pine and the Piñon-Juniper Climaxes). In nature, life zones grade into one another in an area of transition, rather than changing abruptly from one life community to another. In the overlap zone ponderosa pine, piñon pine and juniper grow to maturity side by side. e) The desert zone, where the vegetation is predominately scrub brush (corresponding to the Desert Zone). f) The juniper zone, in which juniper is the only tree type (probably corresponding to the transition between the Piñon-Juniper Climax and the Desert Zone). Juniper grows at a lower elevation than piñon, but the junipers in this area are usually short and scrubby, and more nearly resemble bushes than trees.

Two additional types of trees need to be considered, but they cannot be limited to any of the above zones. They are oak *(Quercus* sp.) and cottonwood *(Populus deltoides* and *P. trichocapra).* These trees are found along the major drainages in the region. Cottonwood seems to be rare in the area, few of them were observed. Oak is common in all the deep canyons which cut through the ponderosa, piñon-juniper and overlap zones, such as Walnut Canyon, San Francisco Wash and Grapevine Canyon.

Although each of the zones considered lie one below the other as a whole, the boundaries interfinger complexly. While Merriam's elevation figures (listed above) give a general idea of the elevations at which the life zones occur, there is no rigid altitudinal delineation. In the areas of transition, small differences in such factors as shelter and water supply cause the patterning of the zone boundaries to be complex. For example, in the overlap zone, only piñon and juniper trees may be found growing on the more exposed face of a hill, while ponderosa trees alone are found growing on the more sheltered face of the hill, and all three tree types will be growing together on the other sides of the hill.

Deep canyons in the region permit the extension of trees of one zone into other zones. For example, ponderosa pine grow in Anderson and Grapevine Canyons while the plateau is covered with piñon and juniper. Walnut Canyon is an example of double extension. Ponderosa forest covers the plateau, and some ponderosa are found in the canyon itself. In the most sheltered parts of the north side of the gorge grow the higher elevation Douglas fir. On the more exposed slopes grow piñon and juniper of the lower zone. This double intrusion into the ponderosa zone is possible in Walnut Canyon because of its extreme depth in relation to its width. The Douglas fir present here are the only ones which were noted growing below the top of the ponderosa zone. Although some intrusions are to be expected at the upper edge of the zone, it is interesting to note that Walnut Canyon lies many miles from the upper edge of the ponderosa zone. Indeed, the canyon is close to the bottom of this zone. The archaeological sites in Walnut Canyon are the only ones close to living fir trees.

TABLE 1. Number of sites by tree zone.

Zone	*BMIII*	*PI*	*PI-II*	*PII*	*PIII*	*Total*
Ponderosa		8	4	7	8	27
Overlap	1	4	1	15	6	27
Piñon-juniper				13	4	17
Juniper				1	5	6
Desert				1		1
Total	1	12	5	37	23	78

Table 1 lists the sites of each age group according to the tree types which were observed growing there, that is mature trees of a given type were growing within a distance of a few hundred feet of the site.

Table 1 shows that sites of the PI and PI-II groups are restricted vertically to the ponderosa and overlap zones. If additional archaeological work confirms that a real altitudinal restriction exists for sites constructed during PI times, then controlling factors, ecological or cultural, can be sought. The fact that all the PI construction lies within the present ponderosa limits does not necessarily mean that it did so during PI times, as the position of the ponderosa limits may have changed. The sites of the PII and PIII groups are not vertically restricted.

A detailed analysis, site by site, and for the sites of each zone as a whole, failed to show any correlation whatsoever between the modern tree types and the archaeological wood types.

SPECIES OF THE ARCHAEOLOGICAL MATERIALS

Six types of wood were identified from the archaeological specimens: *Pseudotsuga taxifolia, Populus* sp., *Pinus ponderosa, Pinus edulis, Juniperus* sp., *Quercus sp.* Three of the genera could not be identified as to species, but as far as *Quercus* and *Juniperus* are concerned this is not important. Oak comprises only .2% of the total specimens and juniper cannot be assigned to a zone on a species basis. With the third genus, *Populus*, specific difference is important. The specimens could be either the high altitude aspen, or the lower altitude cottonwood. Species assignment of *Populus* would lend greater insight to the problem of distances traveled to obtain the various kinds and quantities of wood.

There is a direct correlation between the number of specimens from each site and the number of species present from each site. The more specimens collected, the more species represented. Unfortunately, 30% of the sites have six or fewer specimens. This correlation of the number of species with the number of specimens should encourage archaeologists to make more thorough collections of tree-ring materials.

Table 2 tabulates the number and percentage for each species of the archaeological specimens, for each cultural time level, and the overall total. The table shows a general similarity in the percentage distribution of each species through the time horizons, except for juniper and oak. There is too little oak on which to base conclusions, but the percentage of juniper is high enough to justify some generalizations. On the basis of this sample, it would seem that peoples of the PI and PI-II periods did not use juniper. The people both before and after this time span used juniper, so that PI peoples must have been familiar with this wood. The fact that PI peoples used piñon is a certain indication that they came into contact with juniper trees. The most likely explanation for this lack of use is cultural preference.

The other four types of wood listed in Table 2 were used in some quantity in all the cultural time divisions. These four types of wood, fir,

TABLE 2. Numbers and percentages of the species of the archaeological specimens.

	BMIII	*PI*	*PI-II*	*PII*	*PIII*	*Total*
Pseudotsuga taxifolia		99	27	346	233	705
		30%	13%	15%	20%	17%
Populus sp.	2	3	14	164	36	219
	....	1%	7%	7%	3%	5%
Pinus ponderosa	12	180	144	1309	540	2185
	....	55%	73%	56%	46%	53%
Pinus edulis	27	43	12	403	251	736
	....	13%	7%	17%	21%	18%
Juniperus sp.	21			112	107	240
	....			5%	9%	6%
Quercus sp.	4			1	4	9
	....			....	....	....
Total	66	325	297	2335	1171	4094

ponderosa, piñon and *Populus*, do not grow in the same ecological zone at present, nor is there reason to suppose that they did in the past. Since few of the sites are near areas which allow the growth of all the trees in close proximity, as Walnut Canyon, all of the woods were probably not readily available near most of the sites. The majority of the sites have wood from several zones, and therefore the inhabitants had to walk some distances to obtain them all. One might assume that for construction the Indians would use the nearest suitable wood, but this does not seem to be the case. One might also expect a change in types or frequency of wood, as construction styles changed from pithouses to pueblos. Again the data in Table 2 do not support this idea, as the types and percentages of wood used remain constant.

The wood specimens had to be hauled to each site from varying distances, depending on the proximity of the ecological zones in which the trees grew. Distances from some of the sites to the nearest places where trees of th types used archaeologically grow today are as much as 15 miles. If some of the *Populus* sp. is aspen, then the minimum distances are even greater. At the larger sites in the area the wood specimens number well up into the hundreds. The larger sites also tend to be farther into the desert area, hence farther from the trees. It is clear that a great deal of effort was expended to transport large quantities of wood to the sites, sometimes over distances of several miles. Some sort of strong motivation, perhaps cultural, must have existed to inspire so much work.

The question naturally arises whether the floral zones were at different elevations in the past. Indeed, with a record spanning about 700 years, data bearing on this problem was one of the hoped for results. However, since the Indians consistently used so many kinds of wood, and in the same percentages, it is impossible to tell if the floral zones moved up, or down, or stood still.

One possible explanation for the many varieties of wood used can be advanced by pointing out that the various types have different physical properties, and were used for different purposes. Juniper is different from *Populus* and both are different from Douglas fir, ponderosa and piñon in terms of texture, splitting properties, hardness, etc., to give weight to this argument. However, this hypothesis does not account for the presence of two or three of the piñon, ponderosa and Douglas fir group at many of the sites. These three species, which comprise 88% of the total specimens, are similar in character, particularly the two kinds of pine. Ponderosa seems to have been the favorite kind of wood, 53% of the total, with piñon and Douglas fir next at 18% and 17%. *Populus* and juniper were used in minor amounts, 5% and 6%.

SUMMARY

Based on the data available, the following conclusions seem to be valid: the only correlation between the distribution of the sites of the various time groupings and the present tree zones is that those sites constructed during PI times are restricted in vertical distribution to the present ponderosa pine limits. There is no correlation of the types of wood found archaeologically with the types of trees growing on the sites today. The greater the number of specimens from an archaeological site, the greater the number of species present. Douglas fir, *Populus sp.*, ponderosa pine and piñon pine were used by the inhabitants from BMIII times through PIII times in relatively constant percentages. Juniper (and oak?) was used throughout this time span except at sites constructed during PI times. This represents only minor change in wood types and percentages in approximately 700 years, despite change in dwelling type from pithouses to pueblos. Trees from various ecological zones were used, regardless of the geographic location of the site. This requires the transportation of large quantities of wood from various distances, some perhaps as far as 15 miles. Ponderosa was most commonly used, lesser amounts of Douglas fir and piñon were used, and minor amounts of juniper, *Populus* sp. and oak were used. No light is shed on the altitudinal positions of the prehistoric floral zones.

DAUBENMIRE, R. F.
1938 Merriam's Life Zones of North America. *Quarterly Review of Biology*, Vol. 13, pp. 327-32. Baltimore.
1943 Vegetational Zonation of the Rocky Mountains. *Botanical Review*, Vol. 9, pp. 325-93. Lancaster.

HARLAN, T. P.
1962 A Sequence of Ruins in the Flagstaff Area Dated by Tree-Rings. MS, master's thesis, The University of Arizona, Tucson.

MERRIAM, C. H.
1890 Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado, Arizona. *United States Department of Agriculture, North American Fauna*, No. 3, pp. 1-136. Washington.

OOSTING, H. J.
1956 *The Study of Plant Communities*. Second edition. W. H. Freeman and Co. San Francisco.

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TREE-RING DATES FROM THE NAVAJO LAND CLAIM
II. THE WESTERN SECTOR

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ABSTRACT

Presented in this article are the dates of specimens collected from the Western Sector of the Navajo Land Claim. Of the 1283 specimens processed, 482 were dated. This is a dating percentage of 38 percent. All but one of these dated specimens were *Pinus edulis* Englm. The Western Sector has been divided into four areas; from west to east they are (1) Havasu Canyon, (2) Navajo Mountain, (3) Lower Little Colorado, and (4) Chinle. Indices for all areas except the Chinle are presented.

THE WESTERN SECTOR

The Western Sector is geographically much larger than the previously described Northern Sector (Stokes and Smiley 1963), and the number of specimens for the area is much larger — 1283 specimens processed for the Western Sector as compared to 237 processed for the Northern Sector. Most of the Western Sector lies within the state of Arizona. The portion outside of the state boundary is located between the Arizona-Utah state line and the San Juan River. The areas within the sector, as listed in the code index (Table 1) are Havasu Canyon Area, Navajo Mountain Area, Lower Little Colorado Area, and Chinle Area.

The northern boundary of the sector is the San Juan River (see Fig. 1) from the four-corners to the junction with the Colorado River. The western boundary follows the Colorado River south and west to the eastern edge of Grand Canyon National Park. From there, the line swings south, passing through Red Butte and Flagstaff to the vicinity of Mormon Lake, then northeast up to the Arizona-New Mexico state boundary. At the southern end of the Chuska Mountains, the line of demarcation swings north to the San Juan River, completing the Western Sector collection area.

The specimens from the three other sectors, the Northern, Southern and Eastern, were for the most part collected from areas peripheral to the present day Navajo Reservation. This was due to the Tribe's interest in attempting to define areas of use and habitation outside of their reservation. The Western Sector, however, includes a large number of specimens collected on and around the Black Mesa region of Arizona, in the middle of the present-day reservation area. The dates from these specimens were used by the Navajo Tribe in presenting their case regarding the Navajo-Hopi boundary dispute. Consequently, more effort was made to collect a greater number of specimens from this particular area. Approximately 1600 specimens were submitted to the Laboratory of Tree-Ring Research, a total of 1283 specimens were examined, and dates were derived from 482 of these. The dates for the specimens are given in Table 2.

Most of the specimens received were *Pinus edulis* Englm. A small number (11) were of the Juniperus species, but none of these were dated. Also included in the collection is one specimen of *Mahonia* (barberry), two specimens of *Quercus* (oak), and two specimens of *Picea* (spruce). One of the two *Picea* specimens, NLC 207-8, was dated (see Table 2).

The procedures followed in dating, and in presenting the data derived, are as described in Part I, The Northern Sector. Complete cross-sections were used and every effort was made to find the outermost ring. The area

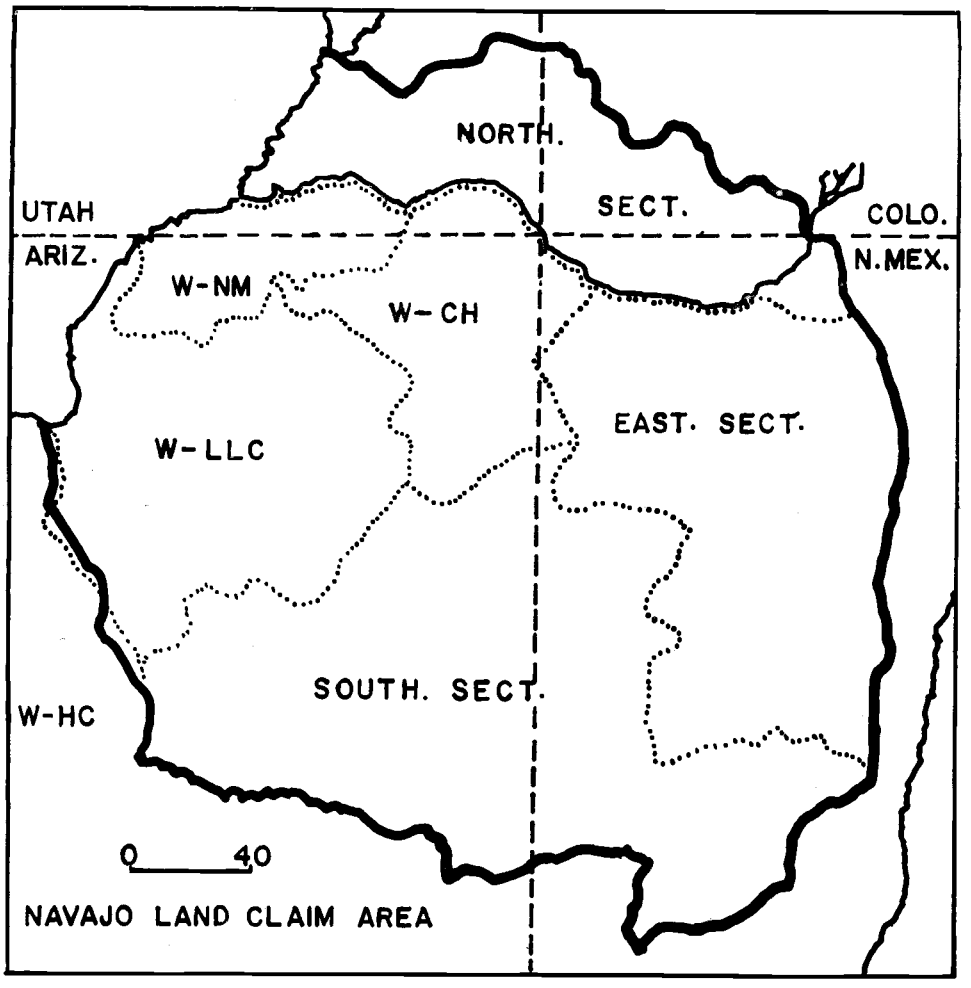

FIG. 1. Map of the Navajo Land Claim. Areas of the Western Sector are indicated by letter designations and are defined by the dotted lines. The three other sectors are also shown. The heavy line shows the approximate limits of hogan collections.

indices, Tables 3 through 6, and Fig. 2, represent the standardized growth curves. Incorporated in each set of indices are the measurements of 4 to 6 old hogan specimens and 3 or 4 modern specimens. For convenience in presenting the data, the Lower Little Colorado Area was divided into an "eastern" and "western" division. All of the eastern division represents specimens collected for use in the Navajo-Hopi boundary dispute. No indices are presented for the Chinle Area because too few specimens were collected from that area to allow a representative selection to be made. Therefore, the Western Sector indices (Table 7) do not contain samples from all of the designated collection areas.

TABLE 1. Index Code for Western Sector.

Western division of Western Sector

HC: Havasu Canyon area
- LH: Lower Havasu

NM: Navajo Mountain area
- NC: Navajo Creek
- OC: Oljeto Creek
- PC: Paiute Creek

LLC: Lower Little Colorado area
- B. Bodoway
- C: Coconino Plateau
- D: Deadman's Wash
- SF: San Francisco Wash

Eastern division of Western Sector

LLC: Lower Little Colorado area
- BC: Burnt Corn Wash
- DO: Doyanescla Mesa
- DZ: Dzildajinnah (Black Mountain)
- HT: Hooshdodiito Mesa
- J. Jeehdazaii (Pitch Point)
- LM. Lone (Low) Mountain
- LO: Lower Oraibi
- LP: Lower Polacca
- M: Moencopi Wash
- MB: Moqui Buttes
- MD: Middle Dinnebito
- MJ: Middle Jeddito
- MO: Middle Oraibi
- MP: Middle Polacca
- NJ: North Jeddito
- OP: Owl Point
- P: Pinyon
- SM: Salinas Mesa
- TS: Tse Chizzi
- UC: Upper Dinnebito
- UO: Upper Oraibi
- WE: Wepo Wash

CH: Chinle area
- LC: Lower Chinle
- UC: Upper Chinle

TABLE 2

WESTERN SECTOR

Western Half

NLC	*Group*	*Specimen*	*Tree-Ring Laboratory Date, A.D.*
		HAVASU CANYON AREA	
244	W—HC—LH—P	Hogan 1	1842± p—1918 inc
243	W—HC—LH—P	Corral 1	1850± p—1909 inc
1024	W—HC—LH—U	Structure 2	1824 p—1894 inc G
1754	W—HC—LH—DD	Hogan 3	1707±nc—1793 inc G
1753	W—HC—LH—DD	Sheep Corral	1743± p—1881 +
222	W—HC—LH—II	Hogan 1	1754± p—1862 +
224	W—HC—LH—II	Sweat Hogan	1775 p—1858 + B
1838	W—HC—LH—II	Corral	1621 p—1844 + inc
1750	W—HC—LH—JJ	Hogan 3	1787± p—1866 c
1751	W—HC—LH—JJ	Hogan 9	1646± p—1731 +
1752	W—HC—LH—JJ	Sheep Corral	1760± p—1867 inc
1032	W—HC—LH—Supai 4	Corral	1781± p—1904 + G
		NAVAJO MOUNTAIN AREA	
497	W—NM—NC—C	Hogan 1	1721± p—1877 + G
498	W—NM—NC—C	Hogan 1	1751± p—1874 inc
499	W—NM—NC—C	Hogan 1	1723±nc—1885 + G
502	W—NM—NC—C	Sheep Corral 2	1741± p—1881 +
503	W—NM—NC—D	Hogan 2	1805 p—1892 G
505	W—NM—NC—D	Hogan 2	1678± p—1884 +
506	W—NM—NC—D	Hogan 2	1812± p—1894 G
508	W—NM—NC—D	Hogan 2	1763± p—1895 G
509	W—NM—NC—D	Sweat Hogan	1801± p—1887 inc G

TABLE 2. (Continued)

NLC	Group	Specimen	Tree-Ring Laboratory Date, A.D.
511	W—NM—NC—D	Sweat Hogan	1774± fc—1895 G
514	W—NM—NC—D	Sweat Hogan	1796± p—1894 G
526	W—NM—NC—F	Hogan 1	1685± p—1878 +
3530	W—NM—NC—N	Hogan 5	1611 p—1804 + inc
3532	W—NM—NC—N	Hogan 5	1598 p—1788 + inc G
3535	W—NM—NC—N	Hogan 5	1617 p—1776 + inc G
3536	W—NM—NC—N	Hogan 5	1627 p—1788 + inc G
3574	W—NM—NC—N	Hogan 5	1661 p—1815 inc G
3575	W—NM—NC—N	Hogan 5	1626± p—1807 + inc G
3541	W—NM—NC—O	Hogan 1	1524 p—1818 inc G
3537	W—NM—NC—P	Hogan 1	1682± p—1862 + inc
3556	W—NM—NC—V	Hogan 1	1700 p—1819 inc G
3557	W—NM—NC—V	Hogan 1	1718 p—1884 inc G
3559	W—NM—NC—V	Hogan 1	1745± p—1879 + inc G
3560	W—NM—NC—V	Hogan 1	1749 p—1883 inc G
193	W—NM—OC—B	Sweat Hogan	1717 p—1857 +
190	W—NM—PC—A	Hogan 1	1646± p—1883 + c
191	W—NM—PC—A	Hogan 1	1605± p—1835 +
3527	W—NM—PC—K	Hogan 1	1625± p—1882 + inc G
3522	W—NM—PC—N	Hogan 1	1587± p—1782 + inc G
3523	W—NM—PC—N	Hogan 1	1668± p—1848 + inc G
3521	W—NM—PC—O	Hogan 4	1619± p—1799 + inc G
3517	W—NM—PC—P	Hogan 1	1722 p—1864 inc G
3519	W—NM—PC—P	Hogan 1	1751± p—1863 inc G
3551	W—NM—PC—S	Sweathouse 1	1680± p—1820 inc
3553	W—NM—PC—S	Sweathouse 1	1627± p—1806 inc G
3567	W—NM—PC—U	Hogan 1	1611 p—1845 inc c G
3568	W—NM—PC—U	Hogan 1	1576± p—1829 + inc G
3569	W—NM—PC—U	Hogan 1	1723 p—1860 inc G B
3570	W—NM—PC—U	Hogan 1	1629 p—1830 + inc G
3571	W—NM—PC—U	Hogan 1	1623 p—1859 inc G
3572	W—NM—PC—U	Hogan 1	1614± p—1851 + inc G
3573	W—NM—PC—U	Hogan 1	1630 p—1860 inc G

LOWER LITTLE COLORADO AREA

706	W—LLC—B—E	Hogan 1	1783± p—1907 inc
257	W—LLC—B—M	Rockshelter	1711 fc—1898 G
1817	W—LLC—C—A	Hogan 2	1642 p—1833 +
349	W—LLC—C—B	Hogan 1	1614± p—1786 + G
350	W—LLC—C—B	Hogan 1	1647± p—1793 G
351	W—LLC—C—B	Hogan 1	1648± p—1797 G
352	W—LLC—C—B	Hogan 1	1612 p—1793 G
3385	W—LLC—C—B	Hogan 1	1601± p—1709 + inc G
3378	W—LLC—C—B	Hogan 2	1611 p—1787 + inc G
3379	W—LLC—C—B	Hogan 2	1626 p—1772 + inc G
3381	W—LLC—C—B	Hogan 2	1613± p—1794 + G
3383	W—LLC—C—B	Hogan 2	1649 p—1790 + inc G
353–4	W—LLC—C—B	Hogan 2	1657 p—1803 + G
355	W—LLC—C—C	Hogan 1	1625± p—1825 +
356	W—LLC—C—C	Hogan 1	1670 fc—1833 inc
1821	W—LLC—C—C	Hogan 1	1641±nc—1788 +
3422	W—LLC—C—D	Hogan 1	1630 p—1798 +
3423	W—LLC—C—D	Hogan 1	1649 p—1794 +
3424	W—LLC—C—D	Hogan 1	1634 p—1758 + inc
3428	W—LLC—C—D	Hogan 1	1604 p—1745 + inc
3429	W—LLC—C—D	Hogan 1	1626± p—1790 + c
3432	W—LLC—C—D	Hogan 1	1632 p—1812 + inc
361	W—LLC—C—D	Hogan 2	1619± p—1763 +
362	W—LLC—C—D	Hogan 2	1623 p—1782 + G
364	W—LLC—C—D	Hogan 4	1670 p—1789 + inc
3410	W—LLC—C—D	Hogan 5	1665± p—1766 + inc
3412	W—LLC—C—D	Hogan 5	1607± p—1751 + inc G
3413	W—LLC—C—D	Hogan 5	1627 p—1773 + inc
3414	W—LLC—C—D	Hogan 5	1639± p—1828 + inc G
3418	W—LLC—C—D	Windbreak 6	1617 p—1789 + inc

TABLE 2. (Continued)

NLC	Group	Specimen	Tree-Ring Laboratory Date, A.D.
365	W—LLC—C—E	Hogan 1	1657± p—1796 + G
366	W—LLC—C—E	Hogan 1	1719 p—1839 inc
3401	W—LLC—C—E	Hogan 1	1622 p—1820 inc G
3402	W—LLC—C—E	Hogan 1	1604± p—1798 inc G
3403	W—LLC—C—E	Hogan 1	1620 p—1809 + inc G
3404	W—LLC—C—E	Hogan 1	1610 p—1837 + inc G
3405	W—LLC—C—E	Hogan 1	1616± p—1792 + inc G
3406	W—LLC—C—E	Hogan 1	1610 p—1826 + inc G
370	W—LLC—C—F	Hogan 2	1660 p—1759 +
371	W—LLC—C—F	Hogan 2	1660± p—1765 inc
374–5	W—LLC—C—F	Sheep Corral 1	1659± p—1809 +
376	W—LLC—C—F	Corral 2	1661 p—1779 + G
713	W—LLC—C—G	Hogan 1	1635 p—1788 + G
2364	W—LLC—C—H	Hogan 7	1594± p—1735 + inc G
214	W—LLC—C—I	Corral 8	1679± p—1832 +
391	W—LLC—C—R	Hogan 1	1743 fc—1865 G
392	W—LLC—C—R	Hogan 2	1614± p—1869 G
382	W—LLC—C—T	Hogan 2	1648± p—1823 + G
395	W—LLC—C—Z	Hogan 1	1702± p—1858 +
806	W—LLC—C—CC	Hogan 1	1618 p—1795 inc
804	W—LLC—C—CC	Hogan 10	1616 p—1828 + G
3433	W—LLC—C—MM	Hogan 1	1647 p—1746 + inc G
3435	W—LLC—C—MM	Hogan 1	1639± p—1771 + inc G
3436	W—LLC—C—MM	Hogan 1	1683 p—1824 + inc G
3450	W—LLC—C—MM	Hogan 4	1580± p—1744 + inc
3453	W—LLC—C—MM	Hogan 5	1610± p—1792 + inc
3454	W—LLC—C—MM	Hogan 5	1625± p—1788 + inc G
3455	W—LLC—C—MM	Hogan 5	1637 p—1788 + inc G
3456	W—LLC—C—OO	Hogan 1	1614 p—1751 + inc G
3457	W—LLC—C—OO	Hogan 1	1644± p—1786 + inc G
3459	W—LLC—C—OO	Hogan 1	1646 p—1757 + inc G
3461	W—LLC—C—OO	Hogan 1	1625 p—1729 + inc G
3462	W—LLC—C—OO	Hogan 1	1660 p—1814 + inc
3463	W—LLC—C—OO	Hogan 1	1633 p—1757 + inc
3464	W—LLC—C—OO	Hogan 1	1628 p—1726 + inc
3465	W—LLC—C—OO	Hogan 1	1630 p—1711 + inc G
3466	W—LLC—C—OO	Hogan 1	1625 p—1713 + inc
3467	W—LLC—C—OO	Hogan 1	1639± p—1822 + inc G
3468	W—LLC—C—OO	Hogan 1	1630 p—1711 + inc G
3469	W—LLC—C—OO	Hogan 1	1641 p—1809 + inc G
3470	W—LLC—C—OO	Hogan 1	1639 p—1742 + inc G
3471	W—LLC—C—OO	Hogan 1	1656 p—1825 C G
3499	W—LLC—C—OO	Hogan 2	1590± p—1795 inc G
3472	W—LLC—C—OO	Hogan 3	1648 p—1829 + inc G
3476	W—LLC—C—OO	Hogan 3	1699 p—1830 + inc
3477	W—LLC—C—OO	Hogan 3	1638± p—1796 + inc G
3478	W—LLC—C—OO	Hogan 3	1678 p—1805 inc G
3485	W—LLC—C—OO	Hogan 3	1416± p—1776 + inc G
3486	W—LLC—C—OO	Hogan 3	1578 p—1778 + inc G
3487	W—LLC—C—OO	Hogan 4	1540 nc—1782 inc G
3488	W—LLC—C—OO	Hogan 4	1560 p—1764 inc G
3489	W—LLC—C—OO	Hogan 4	1637± p—1756 inc G
3490	W—LLC—C—OO	Hogan 4	1587 p—1770 inc G
3492	W—LLC—C—OO	Hogan 4	1663 p—1786 inc G
3493	W—LLC—C—OO	Hogan 4	1564± p—1781 inc
3494	W—LLC—C—OO	Hogan 4	1593 p—1728 + inc G
3495	W—LLC—C—OO	Hogan 4	1630± p—1776 + inc G
2383	W—LLC—C—PP	Windbreak 1	1656 p—1746 + inc
207–8	W—LLC—D—A	Hogan 1	1834 fc—1911 inc
347	W—LLC—SF—I	Game Corral	1794± p—1884 +
348	W—LLC—SF—I	Game Corral	1679±nc—1885 +
334	W—LLC—SF—K	Hogan 1	1705 nc—1826 + inc
335	W—LLC—SF—K	Hogan 2	1808± p—1875 + G
341	W—LLC—SF—L	Hogan 1	1696± p—1870 G
342	W—LLC—SF—L	Hogan 2	1741± p—1813 + G
343	W—LLC—SF—M	Hogan 1	1781± p—1893 + G
204	W—LLC—SF—O	Hogan 2	1716 p—1854 +

TABLE 2. (Continued)
Eastern Half

NLC	Group	Specimen	Tree-Ring Laboratory Date, A.D.
		LOWER LITTLE COLORADO AREA	
576	W—LLC—BC—B	Hogan 3	1762± p—1868 inc
578	W—LLC—BC—B	Hogan 4	1803± p—1868 G
577	W—LLC—BC—B	Sheep Corral 5	1686± p—1869 inc
580	W—LLC—BC—C	Hogan 1	1809± p—1868 G
581	W—LLC—BC—C	Hogan 2	1808± p—1868 G
582	W—LLC—BC—C	Sheep Corral	1685± p—1848 +
894	W—LLC—BC—I	Hogan 1	1608± p—1803 +
895	W—LLC—BC—J	Hogan 1	1746± p—1869 B
896	W—LLC—BC—J	Shelter 2	1726± p—1869 G
897	W—LLC—BC—K	Ch'indi Hogan 1	1619± p—1870 inc G
898	W—LLC—BC—K	Ch'indi Hogan 1	1594± p—1842 +
899	W—LLC—BC—L	Hogan 1	1637± p—1853 inc
900	W—LLC—BC—L	Hogan 1	1564± p—1787 +
2212	W—LLC—BC—P	House 3	1610± p—1798 + inc
2213	W—LLC—BC—P	House 3	1602 p—1765 + G
2214	W—LLC—BC—Q	Hogan 1	1625± p—1850 + inc
2216	W—LLC—BC—S	Hogan 1	1555± p—1824 + inc G
2225	W—LLC—BC—T	Hogan 1	1640 p—1844 inc G
2226	W—LLC—BC—T	Hogan 1	1580 p—1819 + inc G
2227	W—LLC—BC—T	Hogan 1	1660± p—1838 + inc G
2228	W—LLC—BC—T	Hogan 1	1628± p—1841 + inc G
2230	W—LLC—BC—X	Hogan 2	1570± p—1808 + inc
2231	W—LLC—BC—X	Hogan 2	1569± p—1846 + inc
2229	W—LLC—BC—X	Smithy 1	1406± p—1830 + G
675	W—LLC—DO—B	Hogan 1	1793± p—1898 G
677	W—LLC—DO—B	Hogan 6	1779± p—1901 inc G
679	W—LLC—DO—D	Hogan 1	1658± p—1874 + G
681	W—LLC—DO—E	Hogan 1	1760±nc—1854 + c
682	W—LLC—DO—F	Hogan 1	1748±nc—1858 + G
699	W—LLC—DO—F	Sheep Corral	1670± p—1798 +
683	W—LLC—DO—G	Hogan 1	1646± p—1788 inc
684	W—LLC—DO—G	Hogan 2	1640±nc—1772 inc
686	W—LLC—DO—H	Sweat Hogan 1	1724±nc—1844 +
667	W—LLC—DO—L	Sweat Hogan 5	1636± p—1808 +
671	W—LLC—DO—P	Hogan 4	1760± p—1874 inc
672	W—LLC—DO—P	Sheep Corral 2	1722± p—1869 inc
904A	W—LLC—DO—Q	Hogan 2	1704± p—1858 inc
909	W—LLC—DO—V	Hogan 1	1649 p—1869 inc G
912	W—LLC—DO—V	Hogan 2	1611± p—1875 inc G
661	W—LLC—DO—V	Hogan 3	1608± p—1878 G
907A	W—LLC—DO—Y	Hogan 1	1700± p—1897 inc G
908A	W—LLC—DO—Y	Lamb Pen 2	1646± p—1899 + inc G
915	W—LLC—DO—Z	Hogan 1	1676± p—1874 + inc G
913	W—LLC—DO—Z	Hogan 3	1640± p—1873 + inc G
914	W—LLC—DO—Z	Hogan 3	1677± p—1871 + G
916	W—LLC—DO—Z	Hogan 7	1615± p—1803 +
573	W—LLC—DZ—B	Sheep Corral 3	1766 p—1843 +
598	W—LLC—DZ—D	Hogan 1	1679± p—1805 +
599	W—LLC—DZ—D	Hogan 2	1812± p—1875 G
600	W—LLC—DZ—D	Hogan 3	1813± p—1874 G
596	W—LLC—DZ—G	Sweat Hogan 1	1691± p—1805 +
935	W—LLC—DZ—K	Hogan 4	1659± p—1808 inc
939	W—LLC—DZ—L	Corral 2	1680± p—1872 + G
940	W—LLC—DZ—L	Corral 4	1694±nc—1893 + G
941	W—LLC—DZ—M	Hogan 1	1625±nc—1856 inc
942	W—LLC—DZ—M	Hogan 2	1624± p—1852 inc
943	W—LLC—DZ—M	Hogan 2	1547± p—1807 +
944	W—LLC—DZ—M	Sweathouse 6	1590± p—1858 G
945	W—LLC—DZ—N	Hogan 1	1594± p—1701 +
688	W—LLC—HT—C	Hogan 1	1815± p—1870 inc
924	W—LLC—HT—C	Hogan 1	1656± p—1872 inc G
691	W—LLC—HT—C	Hogan 2	1726± p—1841 inc
925	W—LLC—HT—C	Hogan 2	1721 fc—1869 inc G
926	W—LLC—HT—C	Hogan 3	1733± p—1870 inc G
689	W—LLC—HT—C	Hogan 4	1772± p—1865 + G

TABLE 2. (Continued)

NLC	Group	Specimen	Tree-Ring Laboratory Date, A.D.
936	W—LLC—HT—C	Hogan 5	1740± p—1869 inc G
690	W—LLC—HT—C	Hogan 6	1729± p—1870 G
927	W—LLC—HT—C	Hogan 6	1722± p—1866 inc
698	W—LLC—HT—D	Hogan 3	1659±nc—1797 +
693	W—LLC—HT—D	Hogan 4	1686± p—1817 inc
1725	W—LLC—J—B	Hogan 1	1627± p—1795 +
1726	W—LLC—J—B	Hogan 2	1648 p—1828 + inc
1731	W—LLC—J—C	Hogan 2	1633± p—1724 +
1733	W—LLC—J—C	Hogan 3	1692± p—1854 +
1738	W—LLC—J—E	Sheep Corral 3	1657± p—1808 +
876	W—LLC—J—H	Hogan 1	1639± p—1840 +
877	W—LLC—J—H	Hogan 3	1643± p—1798 +
880	W—LLC—J—J	Hogan 1	1601± p—1723 inc G
882	W—LLC—J—K	Hogan 1	1650± p—1778 + G
1723	W—LLC—LM—G	Hogan 2	1640 fc—1773 +
1724	W—LLC—LM—H	Hogan 1	1800± p—1891 inc
886	W—LLC—LM—M	Hogan 1	1563± p—1858 c
887	W—LLC—LM—M	Hogan 1	1645± p—1807 G
888	W—LLC—LM—N	Hogan 1	1718±nc—1926 C G
889	W—LLC—LM—N	Hogan 1	1837 p—1926 c G
890	W—LLC—LM—N	Sheep Corral	1679±nc—1926 c G
891	W—LLC—LM—P	Hogan 1	1803 fc—1932 c G
892	W—LLC—LM—P	Hogan 1	1603± p—1932 B
893	W—LLC—LM—P	Hogan 2	1620± p—1932 G
2610	W—LLC—M—D10	Hogan 1	1651 p—1811 +
2611	W—LLC—M—D10	Hogan 1	1634 p—1817 + G
2612	W—LLC—M—D10	Hogan 1	1631 p—1804 + G
2427	W—LLC—M—B24	Hogan 1	1690 p—1878 inc G
2662	W—LLC—M—B24	Hogan 1	1795 p—1878 c G
2663	W—LLC—M—B24	Hogan 1	1820 nc—1878 c G
2592	W—LLC—M—D7	Hogan 1	1743 p—1860 c G
2600	W—LLC—M—D8	Windbreak 1	1706± p—1895 c G
2602	W—LLC—M—D8	Corral 3	1824 p—1898 inc G
2615	W—LLC—M—D12	Hogan 3	1786± p—1900 + G
2623	W—LLC—M—D13	Hogan 1	1693± p—1823 +
2624	W—LLC—M—D13	Hogan 1	1745± p—1838 + G
2632	W—LLC—M—D13	Hogan 1	1630 p—1871 inc G
2626	W—LLC—M—D13	Hogan 2	1699 p—1871 inc
2627	W—LLC—M—D13	Hogan 2	1705± p—1853 inc G
2628	W—LLC—M—D13	Hogan 2	1702 p—1846 inc G
2629	W—LLC—M—D13	Hogan 3	1642± p—1809 +
2630	W—LLC—M—D13	Hogan 3	1609 p—1804 + G
2199	W—LLC—M—E	Hogan 1	1709± p—1875 inc G
2200	W—LLC—M—E	Hogan 1	1673± p—1805 inc
2904	W—LLC—M—E8	Hogan 1	1762 p—1860 inc G
2905	W—LLC—M—E8	Hogan 1	1730± p—1859 inc G
2906	W—LLC—M—E8	Hogan 1	1774 fc—1857 + G
2907	W—LLC—M—E8	Hogan 1	1762± p—1857 + G
2908	W—LLC—M—E8	Hogan 1	1784± p—1860 inc G
2909	W—LLC—M—E8	Hogan 1	1768 p—1852 + G
2910	W—LLC—M—E8	Hogan 1	1737± p—1859 inc G
2911	W—LLC—M—E8	Hogan 1	1788 nc—1859 inc G
2913	W—LLC—M—E9	Hogan 1	1570± p—1759 +
2915	W—LLC—M—E9	Hogan 1	1580 fc—1782 + G
2919	W—LLC—M—E9	Hogan 4	1515± p—1789 +
2922	W—LLC—M—E9	Hogan 6	1743 p—1860 c G
2922A	W—LLC—M—E11	Hogan 1	1800 p—1897 c G
2923A	W—LLC—M—E11	Hogan 1	1761 p—1898 + c G
2924A	W—LLC—M—E11	Hogan 1	1807 p—1898 + c G
2975	W—LLC—M—E21	Hogan 1	1743± p—1898 c G
2977	W—LLC—M—E21	Hogan 1	1724 p—1888 + G
2979	W—LLC—M—E21	Hogan 2	1720± p—1897 c G
2980	W—LLC—M—E21	Hogan 2	1826 p—1897 c G
2981	W—LLC—M—E21	Hogan 2	1798 p—1898 inc G
2982	W—LLC—M—E21	Hogan 2	1829± p—1898 inc G
2983	W—LLC—M—E21	Hogan 2	1814 p—1898 G
2984	W—LLC—M—E21	Hogan 2	1783± p—1898 G
2756	W—LLC—MB—BB	Hogan 1	1776± p—1887 inc G B
2236	W—LLC—MB—G	Antelope Corral	1687 p—1849 inc G
2237	W—LLC—MB—G	Antelope Corral	1684± p—1819 inc G

TABLE 2. (Continued)

NLC	Group	Specimen	Tree-Ring Laboratory Date, A.D.
2238	W—LLC—MB—G	Antelope Corral	1640± p—1840 + inc G
2852	W—LLC—MB—JJ	Hogan 2	1719 p—1900 + G
2853	W—LLC—MB—KK	Hogan 1	1670 p—1898 inc
2822	W—LLC—MB—NN	Hogan 1	1720± p—1817 inc G
2825	W—LLC—MB—NN	Sweathouse 4	1726± p—1887 c B
2827	W—LLC—MB—OO	Hogan 1	1796 p—1902 + inc G
2829	W—LLC—MB—PP	Hogan 1	1790± p—1875 inc G
2836	W—LLC—MB—PP	Hogan 3	1670± p—1875 inc G
2842	W—LLC—MB—QQ	Shelter 2 Yei'i Baghan	1773 nc—1886 + inc
2843	W—LLC—MB—QQ	Hogan 4	1770 nc—1887 inc
2844	W—LLC—MB—QQ	Hogan 4	1598± p—1777 + inc
2342	W—LLC—MD—GGG	Hogan 4	1697± p—1916 inc G
2343	W—LLC—MD—GGG	Hogan 4	1694± p—1916 inc G
2643	W—LLC—MD—JJJ	Windbreak 4	1450± p—1760 +
2645	W—LLC—MD—KKK	Hogan 1	1503 p—1782 +
2650	W—LLC—MD—KKK	Hogan 4	1571± p—1790 +
2652	W—LLC—MD—KKK	Hogan 4	1621 p—1770 +
2653	W—LLC—MD—KKK	Hogan 5	1624± p—1795 inc
2647	W—LLC—MD—KKK	Corral 2	1633 p—1811 inc
2656	W—LLC—MD—KKK	Corral 6	1497 p—1740 +
2742	W—LLC—MJ—A3	Sweathouse 1	1800 fc—1884 inc B
2744	W—LLC—MJ—A3	Hogan 2	1731± p—1892 inc G
2745	W—LLC—MJ—A3	Hogan 2	1820 fc—1893 inc G
2747	W—LLC—MJ—A3	Hogan 2	1812± p—1892 inc
2749	W—LLC—MJ—A3	Hogan 3	1720± p—1856 inc G
2751	W—LLC—MJ—A3	Hogan 3	1750± p—1856 inc G
2770A	W—LLC—MJ—A7	Hogan 1	1719± p—1878 inc G
2771A	W—LLC—MJ—A7	Hogan 1	1770 nc—1873 inc G
2250	W—LLC—MJ—DD	Antelope Corral	1637± p—1772 inc G
2252	W—LLC—MJ—DD	Antelope Corral	1699± p—1798 + inc G
2253	W—LLC—MJ—DD	Antelope Corral	1701± p—1795 + inc G
2254	W—LLC—MJ—DD	Antelope Corral	1699± p—1806 + inc G
970	W—LLC—MJ—G	Hogan 1	1711 nc—1878 + G
972	W—LLC—MJ—G	Hogan 1	1687± p—1864 + G
973A	W—LLC—MJ—H	Sweat Hogan	1686 p—1876 + G
2279	W—LLC—MJ—HH	Game Corral 1	1691± p—1809 inc G
2286	W—LLC—MJ—HH	Game Corral 1	1694± p—1811 inc G
2292	W—LLC—MJ—HH	Game Corral 1	1663 p—1804 + inc
2268	W—LLC—MJ—II	Game Corral 1	1624± p—1822 + inc G
2272	W—LLC—MJ—II	Game Corral 1	1655± p—1810 + inc
2273	W—LLC—MJ—II	Game Corral 1	1685± p—1817 inc G
2274	W—LLC—MJ—II	Game Corral 1	1694± p—1826 G
2418	W—LLC—MJ—III	Yei Hogan 7	1593 p—1797 inc G
2667	W—LLC—MJ—QQQ	Hogan 1	1670 fc—1811 + inc
2675	W—LLC—MJ—QQQ	Hogan 1	1670 fc—1804 + inc
2681	W—LLC—MJ—QQQ	Hogan 3	1647 p—1807 inc G
2693	W—LLC—MJ—SSS	Hogan 3	1600± p—1720 inc
2694	W—LLC—MJ—SSS	Hogan 3	1644 p—1854 + inc G
2696	W—LLC—MJ—SSS	Hogan 3	1635± p—1879 inc G
2697	W—LLC—MJ—SSS	Hogan 3	1609± p—1867 +
2698	W—LLC—MJ—SSS	Hogan 3	1695± p—1868 + G
2699	W—LLC—MJ—SSS	Hogan 3	1690 p—1882 + G
2700	W—LLC—MJ—SSS	Hogan 4	1611 nc—1797 +
2706	W—LLC—MJ—SSS	Hogan 4	1519± p—1793 c
2707	W—LLC—MJ—SSS	Hogan 4	1610 fc—1806 + G
2718	W—LLC—MJ—WWW	Windbreak 2	1716 nc—1858 inc G
2728	W—LLC—MJ—XXX	Hogan 1	1656± p—1880 + G
2730	W—LLC—MJ—XXX	Hogan 2	1829 fc—1878 G
2731	W—LLC—MJ—ZZZ	Hogan 1	1780 nc—1861 + inc G
2735	W—LLC—MJ—ZZZ	Hogan 3	1729 nc—1883 + inc G
2736	W—LLC—MJ—ZZZ	Hogan 3	1644± p—1887 + B
2871	W—LLC—MO—L	Hogan 4	1708 p—1835 inc G
655	W—LLC—NJ—AA	Hogan 1	1680±nc—1855 inc
1710	W—LLC—NJ—B	Sheep Corral 2	1609± p—1703 inc
657	W—LLC—NJ—BB	Hogan 1	1684± p—1816 inc
1713	W—LLC—NJ—D	Hogan 2	1617± p—1730 +
1714	W—LLC—NJ—D	Hogan 2	1649± p—1776 +
872	W—LLC—NJ—DD	Hogan 3	1765± p—1868 G
871	W—LLC—NJ—EE	Corral	1568± p—1800 +
863	W—LLC—NJ—F	Hogan 1	1623± p—1795 +

TABLE 2. (Continued)

NLC	Group	Specimen	Tree-Ring Laboratory Date, A.D.
864	W—LLC—NJ—F	Hogan 1	1646± p—1858 inc
865	W—LLC—NJ—F	Sheep Corral	1600± p—1860 + G
874	W—LLC—NJ—FF	Hogan 1	1720± p—1867 G
875	W—LLC—NJ—FF	Hogan 3	1630± p—1857 G
866	W—LLC—NJ—H	Hogan 1	1804± p—1888 inc G
867	W—LLC—NJ—H	Hogan 1	1727± p—1893 + G
868	W—LLC—NJ—H	Hogan 3	1808 p—1860 + G
869	W—LLC—NJ—J	Hogan 1	1769± p—1890 G
870	W—LLC—NJ—J	Hogan 1	1693± p—1898 c G
1783	W—LLC—NJ—K	Hogan 1	1650± p—1757 +
1784	W—LLC—NJ—L	Hogan 1	1792± p—1900 inc G
1785	W—LLC—NJ—N	Hogan 1	1810± p—1858 inc
1788	W—LLC—NJ—N	Hogan 4	1686± p—1843 + G
638	W—LLC—NJ—P	Hogan 2	1660± p—1814 G
641	W—LLC—NJ—P	Hogan 7	1573±nc—1748 +
642	W—LLC—NJ—P	Sheep Corral	1606± p—1802 +
651	W—LLC—NJ—W	Sweathouse 1	1651± p—1784 +
1706	W—LLC—OP—P	Hogan 1	1712± p—1804 inc
1728	W—LLC—OP—T	Hogan 2	1644± p—1711 inc
1729	W—LLC—OP—U	Hogan 1	1786±nc—1860 inc G
1718	W—LLC—P—F	Game Corral	1593±nc—1710 inc
1717	W—LLC—P—I	Game Corral	1628± p—1754 +
1744	W—LLC—P—N	Hogan 1	1602± p—1804 +
1747	W—LLC—P—N	Hogan 4	1682± p—1807 +
904	W—LLC—P—R	Hogan 3	1634± p—1817 + G
705	W—LLC—SM—A	Sheep Corral 4	1649± p—1760 +
603	W—LLC—SM—B	Hogan 1	1600± p—1738 +
606	W—LLC—SM—D	Hogan 1	1661± p—1773 +
607	W—LLC—SM—D	Hogan 3	1620± p—1732 +
614	W—LLC—SM—E	Hogan 1	1610± p—1711 +
615	W—LLC—SM—E	Hogan 2	1617± p—1756 +
619	W—LLC—SM—G	Hogan 2	1769± p—1879 G
623	W—LLC—SM—I	Sheep Corral 2	1612± p—1817 +
633	W—LLC—SM—N	Hogan 1	1641± p—1756 +
632	W—LLC—SM—N	Sweat Hogan 3	1618± p—1722 +
1759	W—LLC—SM—P	Hogan 2	1720±nc—1821 +
1762	W—LLC—SM—Q	Sweathouse 1	1653± p—1784 +
1764	W—LLC—SM—T	Hogan 1	1630± p—1813 + inc
1765	W—LLC—SM—T	Sheep Corral 2	1644± p—1752 +
1770	W—LLC—SM—U	Hogan 4	1619± p—1826 +
1772	W—LLC—SM—V	Hogan 1	1649± p—1761 +
1773	W—LLC—SM—V	Hogan 3	1629± p—1782 +
1774	W—LLC—SM—V	Hogan 4	1639± p—1871 + G
1775	W—LLC—SM—W	Hogan 1	1676 nc—1800 +
1780	W—LLC—SM—X	Hogan 3	1724± p—1860 + G
1781	W—LLC—SM—X	Hogan 4	1587± p—1766 inc
974	W—LLC—TS—I	Unit 1	1662± p—1893 inc G
1715	W—LLC—TS—B	Hogan 1	1686± p—1817 inc
1740	W—LLC—TS—D	Hogan 1	1679±nc—1853 inc
1741	W—LLC—TS—D	Hogan 3	1710 nc—1858 G
1734	W—LLC—TS—E	Hogan 1	1533± p—1666 inc
1735	W—LLC—TS—F	Hogan 1	1564± p—1759 +
883	W—LLC—TS—H	Hogan 1	1602 p—1856 inc G
884	W—LLC—TS—H	Hogan 1	1746± p—1856 G
885	W—LLC—TS—H	Hogan 2	1598± p—1743 +
2188	W—LLC—UC—A	Hogan 1	1634± p—1843 + inc G
2191	W—LLC—UC—B	Hogan 1	1585± p—1849 + inc G
2198	W—LLC—UC—D	Hogan 1	1545 p—1834 + inc G
2208	W—LLC—UC—G	Hogan 2	1707 p—1877 + inc G
2209	W—LLC—UC—G	Hogan 3	1687 p—1866 + inc G
2217	W—LLC—UC—H	Hogan 1	1681 p—1856 + inc G
2218	W—LLC—UC—H	Hogan 1	1691± p—1850 + inc G
2221	W—LLC—UC—I	Hogan 4	1714± p—1856 + inc G
2409	W—LLC—UC—II	Hogan 2	1601± p—1888 inc G
2317	W—LLC—UC—W	Hogan 1	1466± p—1842 + inc
2316	W—LLC—UC—X	Hogan 2	1469± p—1839 + inc
2315	W—LLC—UC—X	Sweathouse 1	1766± p—1895 c B
2318	W—LLC—UC—Y	Hogan 1	1570± p—1780 + inc
2320	W—LLC—UC—Z	Hogan 1	1643± p—1887 + inc
2322	W—LLC—UC—Z	Hogan 6	1746± p—1869 + inc G

TABLE 2. (Continued)

NLC	Group	Specimen	Tree-Ring Laboratory Date, A.D.
2417	W—LLC—UC—PP	Smithy 5	1488± p—1846 inc G
861A	W—LLC—UO—A	Hogan 1	1700± p—1879 +
862A	W—LLC—UO—B	Hogan 1	1767± p—1919 + c
2327	W—LLC—UO—BB	Hogan 1	1631± p—1815 + inc G
863A	W—LLC—UO—C	Hogan 1	1571± p—1835 + G
863AI	W—LLC—UO—C	Hogan 1	1570± p—1833 + G
864A	W—LLC—UO—C	Hogan 1	1687± p—1854 + G
2331	W—LLC—UO—DD	Hogan 3	1698± p—1873 + inc
2328	W—LLC—UO—DD	Fortified Crag 1	1650± p—1790 + inc G
411	W—LLC—UO—E	Hogan 2	1617± p—1744 +
416	W—LLC—UO—F	Hogan 2	1632± p—1779 +
2387	W—LLC—UO—FF	Hogan 1	1560± p—1857 inc
2388	W—LLC—UO—FF	Hogan 1	1630 p—1857 + inc G
423	W—LLC—UO—H	Hogan 2	1655± p—1809 inc
2393	W—LLC—UO—KK	Hogan 6	1591 p—1850 inc G B
2394	W—LLC—UO—LL	Hogan 6	1804± p—1882 inc G
2396	W—LLC—UO—LL	Hogan 7	1608 p—1743 + inc
2398	W—LLC—UO—NN	Hogan 3	1634 p—1894 inc G
946	W—LLC—UO—O	Hogan 1	1619± p—1728 inc
947	W—LLC—UO—O	Hogan 1	1647 p—1817 + G c
951	W—LLC—UO—P	Hogan 2	1473 p—1792 + inc
2400	W—LLC—UO—PP	Lean-to	1710 p—1866 inc
952	W—LLC—UO—Q	Hogan 3	1485± p—1795 inc
953	W—LLC—UO—R	Hogan 1	1384± p—1622 + inc G
954	W—LLC—UO—R	Hogan 1	1498± p—1804 + inc
955	W—LLC—UO—R	Sweathouse	1380± p—1672 +
2407	W—LLC—UO—TT	Hogan 3	1626± p—1877 inc
404	W—LLC—UO—V	Hogan 1	1683± p—1809 +
408	W—LLC—UO—V	Hogan 5	1630± p—1808 +
2224	W—LLC—UO—X	Hogan 3	1529± p—1743 + inc
2265	W—LLC—WE—H	Sweathouse 5	1680 fc—1867 + G
2296	W—LLC—WE—K	Hogan 2	1687 p—1900 + inc
2297	W—LLC—WE—K	Windbreak 3	1820± p—1935 c G B
2298	W—LLC—WE—K	Windbreak 4	1813± p—1939 inc G
2299	W—LLC—WE—K	Windbreak 4	1838 p—1935 inc G
2301	W—LLC—WE—K	Windbreak 5	1725± p—1935 inc G
2302	W—LLC—WE—K	Windbreak 6	1843± p—1935 inc G
2304	W—LLC—WE—M	Hogan 6	1740± p—1921 + inc G
2293	W—LLC—WE—O	House 1	1601± p—1850 + inc
		CHINLEE AREA	
199	W—CH—LC—A	Hogan 1	1831 p—1921 G
3581	W—CH—UC—I	Room 1	1630 fc—1745 + inc
3582	W—CH—UC—I	Room 1	1615± p—1741 +
3584	W—CH—UC—I	Room 1	1650 p—1758 inc
3586	W—CH—UC—I	Room 1	1608± p—1761 inc
3587	W—CH—UC—I	Room 2	1610 nc—1761 inc
3588	W—CH—UC—I	Room 2	1673 p—1761 inc
3592	W—CH—UC—I	Room 3	1595± p—1752 + inc
3593	W—CH—UC—I	Room 3	1610 nc—1755 + inc
3594	W—CH—UC—I	Room 3	1605 p—1754 + inc G B
3595	W—CH—UC—I	Room 3	1649 p—1752 +
3596	W—CH—UC—I	Room 3	1579 nc—1760 inc
3602	W—CH—UC—I	Room 4	1626± p—1761 inc
3603	W—CH—UC—I	Room 4	1610 nc—1751 inc
3604	W—CH—UC—I	Room 5	1599 p—1757 inc

Explanation of symbols used with dates: p—pith ring; nc—indicates that the pith was gone from the specimen and that the inside dated ring is "near center"; fc—used when the pith is gone from the specimen and the inside dated ring is determined to be quite far out from the pith; ±—center portion is difficult to date and this symbol indicates a ring count only; +—indicates that either the outermost rings are very small and a ring count only could be made to the outside, or that the outermost dated ring is one just preceding what is usually a small, micro or absent ring which may be missing from the specimen; inc—indicates that the outside ring of a specimen is incomplete in growth; c—outermost ring is complete in growth; C—outermost ring is continuous around the circumference of the specimen, implying that the date is close to the cutting date; G—beetle galleries present; B—bark present on the specimen.

TABLE 3. Indices for the Havasu Canyon Area. These were derived from six hogan specimens and four modern specimens.

A.D.	0	1	2	3	4	5	6	7	8	9
1620	.....	.....	.....	.....	.....	.....	.....	102	88	106
1630	113	112	75	98	106	150	120	112	98	101
1640	128	123	120	112	118	143	92	106	90	112
1650	91	104	101	75	52	104	147	131	82	81
1660	118	107	119	116	94	82	95	80	56	69
1670	42	60	110	97	125	85	85	103	108	93
1680	145	152	135	154	103	82	74	125	124	125
1690	127	123	158	118	108	139	115	105	112	115
1700	90	108	85	51	71	124	116	67	83	103
1710	130	99	136	135	105	93	91	98	146	116
1720	154	91	57	117	78	100	127	91	99	68
1730	94	112	141	107	114	46	100	74	130	34
1740	68	108	51	128	103	165	156	124	65	145
1750	71	73	64	57	70	82	93	89	113	103
1760	109	82	110	78	128	78	89	72	79	78
1770	72	110	83	56	71	103	94	118	71	99
1780	104	111	89	134	176	77	98	135	71	96
1790	73	113	101	104	59	98	80	64	70	85
1800	62	55	87	64	98	47	61	62	44	73
1810	46	87	80	24	55	52	108	74	84	90
1820	20	64	35	77	96	107	113	102	136	89
1830	102	126	89	137	125	126	99	126	143	168
1840	144	128	117	151	176	107	119	48	142	161
1850	156	106	139	129	135	118	81	43	110	66
1860	75	77	132	69	91	108	144	144	169	110
1870	79	51	41	49	114	96	77	94	65	28
1880	42	43	61	70	102	114	110	88	110	121
1890	169	129	137	108	74	134	75	124	122	14
1900	41	69	33	107	22	139	174	220	193	157
1910	155	159	124	86	124	117	157	139	98	121
1920	132	70	91	104	98	109	122	114	106	44
1930	112	69	102	82	86	120	68	121	123	66
1940	133	143	134	121	122	102	84	46	79	118
1950	68	16	144	148	102	121	37	.....	.....	.....

TABLE 4. Indices for Navajo Mountain area. These were derived from four hogan specimens and three modern specimens.

A.D.	0	1	2	3	4	5	6	7	8	9
1590	.....	.....	.....	.....	.....	.....	104	107	108	106
1600	24	78	132	174	166	124	125	70	92	96
610	87	64	60	40	88	110	132	88	97	97
620	133	134	114	36	57	79	29	87	50	72
1630	62	83	43	71	83	110	68	57	56	109
1640	131	113	101	100	120	84	101	121	42	87
1650	96	125	99	108	15	120	104	114	60	100
1660	115	155	106	102	97	68	107	74	58	51
1670	30	97	99	115	131	98	95	107	88	68
1680	130	121	92	107	76	01	88	147	126	133
1690	81	96	152	116	68	97	75	102	104	100
1700	90	150	80	43	102	108	104	71	82	112
1710	131	109	120	133	146	116	126	107	122	126
1720	169	149	74	140	106	143	151	126	67	68
1730	82	103	133	70	106	33	121	79	105	90
1740	61	126	96	155	110	130	152	124	37	138
1750	101	124	74	49	136	74	91	79	143	142
1760	150	122	103	87	153	62	140	148	130	77
1770	90	130	79	14	94	81	92	122	65	91
1780	68	97	138	142	176	102	118	148	83	74
1790	40	98	110	134	89	130	87	86	118	104
1800	103	69	94	78	101	102	53	117	62	103
1810	77	122	115	46	107	105	134	94	70	61
1820	58	111	18	54	70	92	147	71	143	70
1830	178	138	106	145	114	125	94	123	123	134
1840	146	126	73	124	132	40	132	19	123	132
1850	131	77	168	97	110	109	99	57	96	80
1860	73	08	113	76	34	109	99	96	142	104

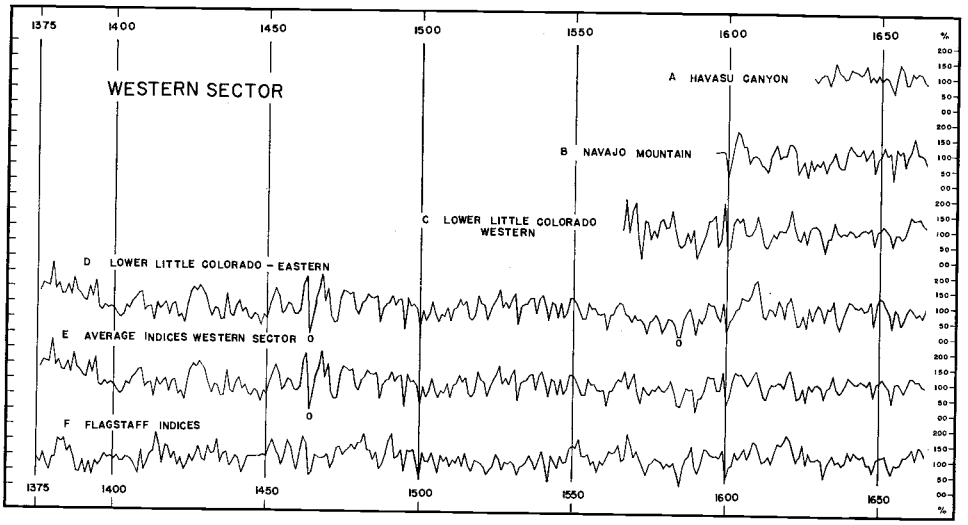

FIG. 2. Standardized indices for the Western Sector. The Flagstaff indices (Douglass 1947) are given for comparison. Locally absent rings are indicated by zeros.

TABLE 4. (Continued)

A.D.	0	1	2	3	4	5	6	7	8	9
1870	51	95	111	60	102	80	87	148	119	67
1880	67	40	35	22	101	99	93	61	90	111
1890	138	110	150	120	84	94	27	113	101	00
1900	46	69	07	93	06	122	124	137	115	131
1910	151	147	145	118	152	125	108	131	86	118
1920	134	55	133	146	131	139	140	147	136	120
1930	105	96	91	54	109	94	86	128	105	97
1940	84	151	119	45	100	72	11	51	103	113
1950	69	06	127	100	91	.....	.....	.....	.....	.....

TABLE 5. Indices for the western half of the Lower Little Colorado area. These were derived from six hogan specimens and three modern specimens.

A.D.	0	1	2	3	4	5	6	7	8	9
1560	.....	.....	.....	.....	.....	.....	99	198	89	161
1570	189	74	06	131	129	69	100	75	129	137
1580	106	109	163	103	53	43	53	93	61	102
1590	07	35	59	87	131	133	149	47	70	189
1600	34	43	123	142	128	142	89	84	88	108
1610	148	104	55	43	66	92	78	102	100	98
1620	122	170	114	76	68	103	57	106	117	116
1630	106	66	28	76	77	130	98	87	95	88
1640	105	99	85	93	102	107	99	111	53	100
1650	106	117	103	91	50	89	91	74	86	116
1660	150	137	140	144	123	115	85	60	54	86
1670	23	71	94	114	122	61	51	104	100	82
1680	105	107	99	106	56	60	60	90	111	129
1690	138	143	162	166	119	140	127	105	121	135
1700	70	112	93	46	74	107	79	89	67	100
1710	100	103	117	90	82	72	68	114	142	129
1720	157	127	77	95	67	96	132	110	83	68
1730	85	88	144	59	85	51	100	52	96	50
1740	83	123	47	151	114	164	173	163	53	159
1750	88	103	52	70	97	107	133	141	112	116
1760	107	80	91	48	155	95	140	109	108	88

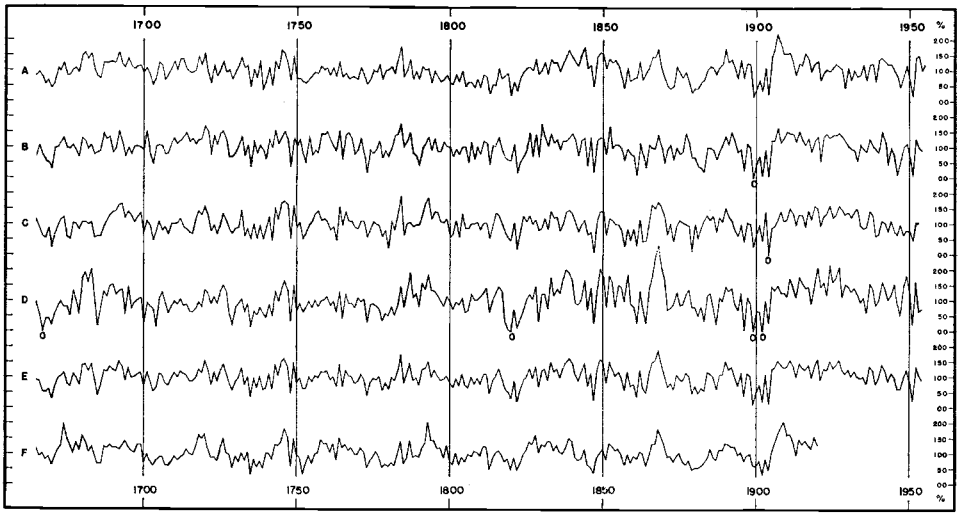

FIG. 2. (Continued)

TABLE 5. (Continued)

A.D.	0	1	2	3	4	5	6	7	8	9
1770	84	109	109	58	84	108	100	96	59	78
1780	20	111	80	134	190	65	102	107	92	98
1790	99	135	166	185	116	140	140	108	106	117
1800	58	69	111	58	134	88	86	102	103	108
1810	78	104	105	54	99	136	130	102	76	57
1820	45	107	20	79	127	109	129	101	115	79
1830	89	120	84	143	122	124	78	103	141	147
1840	136	106	72	100	113	67	74	09	112	142
1850	144	63	120	114	100	99	82	29	84	48
1860	82	34	116	43	47	103	164	151	172	158
1870	128	66	102	43	97	113	106	102	96	11
1880	98	63	88	111	129	114	126	74	123	108
1890	152	127	112	79	61	98	42	104	102	25
1900	66	98	45	140	00	85	94	113	141	109
1910	116	150	136	97	132	129	91	144	113	159
1920	153	95	128	135	159	121	135	159	149	131
1930	138	120	140	150	95	85	90	143	130	60
1940	67	111	106	72	112	77	66	97	63	79
1950	73	43	104	104	.....	.....	.....	.....	.....	.....

TABLE 6. Indices for the eastern half of the Lower Little Colorado area. These were derived from six hogan specimens and three modern specimens.

A.D.	0	1	2	3	4	5	6	7	8	9
1370	.....	.....	.....	.....	.....	.....	135	159	155	153
1380	226	141	160	126	125	155	119	179	135	126
1390	108	102	149	115	168	82	73	90	80	86
1400	78	60	48	59	90	78	103	112	128	133
1410	72	84	86	39	100	78	88	100	57	93
1420	98	50	60	32	92	131	150	139	157	142
1430	123	82	54	84	79	44	47	130	65	54
1440	90	107	70	82	53	46	68	59	27	64
1450	52	92	122	149	124	65	78	103	96	66
1460	65	78	163	188	00	54	114	144	196	107
1470	154	62	38	42	118	144	140	131	136	81
1480	66	102	110	133	122	120	124	39	86	100

TABLE 6. (Continued)

A.D.	0	1	2	3	4	5	6	7	8	9
1490	104	127	95	114	117	14	122	94	100	86
1500	21	81	46	66	108	68	44	68	60	92
1510	44	86	92	119	96	112	58	49	66	131
1520	105	99	50	83	106	120	150	90	110	88
1530	118	138	36	96	102	104	122	124	72	122
1540	134	96	51	110	104	58	109	60	78	125
1550	123	109	82	57	59	110	91	93	74	73
1560	75	23	71	74	99	112	107	75	69	49
1570	72	56	58	45	11	50	58	75	53	12
1580	35	60	57	41	01	00	57	77	95	59
1590	07	63	45	68	115	105	105	73	54	114
1600	18	54	66	92	97	131	126	121	139	177
1610	189	129	71	62	97	92	75	125	106	64
1620	119	132	85	39	43	76	33	101	58	88
1630	109	92	53	98	92	123	51	26	64	96
1640	123	116	103	99	108	89	93	121	37	108
1650	135	128	103	83	33	100	83	42	62	88
1660	105	92	74	84	69	97	56	00	41	43
1670	21	58	82	97	80	80	48	134	101	54
1680	170	190	159	201	117	19	78	129	112	147
1690	152	118	132	136	55	145	72	94	103	109
1700	20	94	80	73	14	104	128	91	59	81
1710	98	87	103	84	88	65	62	74	95	79
1720	135	124	88	114	90	132	149	130	54	19
1730	79	89	105	61	90	13	66	52	77	58
1740	44	88	48	131	97	138	163	135	32	151
1750	66	93	62	78	99	78	101	81	100	102
1760	113	84	98	62	128	42	122	91	91	78
1770	111	96	106	27	86	90	83	73	34	59
1780	52	80	52	83	149	79	127	190	113	125
1790	81	160	137	185	135	132	119	101	82	115
1800	100	71	97	88	109	61	69	123	104	105
1810	116	126	142	63	104	126	146	134	33	06
1820	00	72	11	42	70	106	122	106	147	32
1830	124	124	75	177	116	140	126	172	203	193
1840	168	93	89	108	169	69	141	27	131	206
1850	181	79	183	162	79	151	145	97	187	92
1860	81	27	133	76	26	136	181	238	280	208
1870	173	70	76	90	128	86	87	121	138	78
1880	81	49	81	33	115	125	74	24	114	99
1890	148	133	143	90	70	125	06	114	94	00
1900	64	66	00	100	27	148	134	150	127	127
1910	114	172	143	111	176	157	142	144	90	150
1920	208	144	160	116	218	163	175	210	110	154
1930	144	129	142	121	95	109	62	156	138	83
1940	102	163	134	101	118	154	88	53	144	182
1950	127	21	161	66	72	.....	.....	.....	.....	.....

TABLE 7. Western Sector indices. Average of areal indices from the Havasu Canyon area, Navajo Mountain area, and the eastern and western divisions of the Lower Little Colorado area. The period of 1376 to 1566 is represented by only one group — the eastern half.

A.D.	0	1	2	3	4	5	6	7	8	9
1370	.....	.....	.....	.....	.....	.....	135	159	155	153
1380	226	141	160	126	125	155	119	179	135	126
1390	108	102	149	115	168	82	73	90	80	86
1400	78	60	48	59	90	78	103	112	128	133
1410	72	84	86	39	100	78	88	100	57	93
1420	98	50	60	32	92	131	150	139	157	142
1430	123	82	54	84	79	44	47	130	65	54
1440	90	107	70	82	53	46	68	59	27	64
1450	52	92	122	149	124	65	78	103	96	66
1460	65	78	163	188	00	54	114	144	196	107
1470	154	62	38	42	118	144	140	131	136	81

TABLE 7. (Continued)

A.D.	0	1	2	3	4	5	6	7	8	9
1480	66	102	110	133	122	120	124	39	86	100
1490	104	127	95	114	117	14	122	94	100	86
1500	21	81	46	66	108	68	44	68	60	92
1510	44	86	92	119	96	112	58	49	66	131
1520	105	99	50	83	106	120	150	90	110	88
1530	118	138	36	96	102	104	122	124	72	122
1540	134	96	51	110	104	58	109	60	78	125
1550	123	109	82	57	59	110	91	93	74	73
1560	75	23	71	74	99	112	103	136	79	105
1570	131	65	32	88	70	60	79	75	91	75
1580	71	85	110	72	27	22	55	85	78	80
1590	07	49	52	78	123	119	119	76	77	136
1600	25	58	107	136	130	132	113	92	106	127
1610	141	99	62	48	84	98	95	105	101	86
1620	125	145	104	50	56	86	40	99	78	96
1630	98	88	50	86	90	128	84	70	78	98
1640	122	113	102	101	112	106	96	115	56	102
1650	107	118	102	89	38	103	106	90	72	96
1660	122	123	110	112	96	90	86	54	52	62
1670	29	72	96	106	115	81	70	112	99	74
1680	138	143	121	142	88	40	75	123	118	134
1690	125	120	151	134	88	130	97	102	110	115
1700	68	116	85	53	65	111	107	80	73	99
1710	115	100	119	111	105	87	87	98	126	113
1720	154	123	74	117	85	118	140	114	76	56
1730	85	98	131	74	99	36	97	64	102	58
1740	64	111	61	141	106	149	161	137	47	148
1750	82	98	63	64	101	85	104	98	117	116
1760	120	92	101	69	141	69	123	105	102	80
1770	89	111	94	39	84	96	92	102	57	82
1780	61	99	90	123	173	81	111	145	90	98
1790	73	126	129	152	100	125	106	90	94	105
1800	81	66	97	72	111	75	67	101	78	97
1810	79	110	111	47	91	105	130	101	66	54
1820	31	89	21	63	91	104	130	95	135	68
1830	123	127	89	151	119	129	99	131	152	161
1840	149	113	88	121	148	71	116	26	127	160
1850	153	81	152	126	106	119	102	57	119	72
1860	78	36	124	66	50	114	147	157	191	145
1870	108	70	83	61	110	94	89	116	105	46
1880	72	49	66	59	118	113	101	62	109	110
1890	152	125	136	99	72	113	38	114	105	10
1900	54	76	21	110	14	124	132	155	144	131
1910	134	157	137	103	146	132	125	140	97	137
1920	158	91	128	125	152	133	143	158	125	112
1930	125	104	119	102	96	102	77	137	124.	76
1940	97	142	123	85	113	101	62	62	97	123
1950	84	22	134	105	88	121	37	.....	.....	.....

DOUGLASS, A. E.
1947 Photographic Tree-Ring Chronologies and the Flagstaff Sequence. *Tree-Ring Bulletin*, Vol. 14, No. 2, pp. 14-15. Tucson.

STOKES, M. A. and T. L. SMILEY
1963 Tree-Ring Dates from the Navajo Land Claim. I. The Northern Sector. *Tree-Ring Bulletin*, Vol. 25, Nos. 3-4, pp. 8-18. Tucson.

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