

TREE-RING ANALYSIS AS APPLIED TO THE DATING
OF KIN KLETSO RUIN, CHACO CANYON, NEW MEXICO

by

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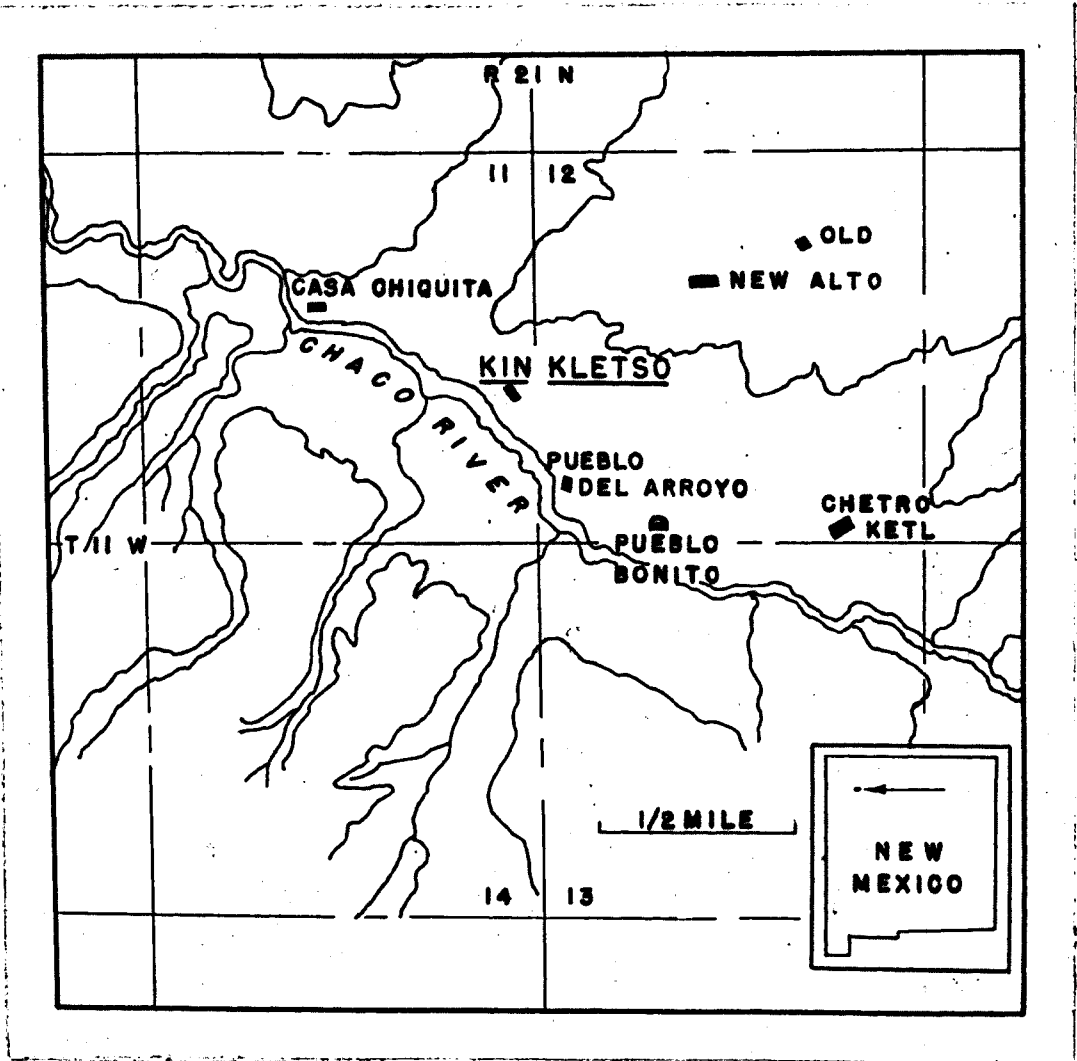
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Plate I. Eastern end of Kin Kletso showing greatest height of standing walls. Picture taken from cliff, looking south. (Courtesy National Park Service)



Map 1. Map of Chaco Canyon area showing location of Kin Kletso.

INTRODUCTION

In September of 1951 the Laboratory of Tree-Ring Research of the University of Arizona received a quantity of tree-ring material recently excavated from the pre-Spanish Indian pueblo of Kin Kletso. The ruin, located in Chaco Canyon National Monument, New Mexico, was excavated under the auspices of the National Park Service by Mr. Gordon Vivian and Mr. Thomas W. Mathews. Since the writer at that time was engaged in a comprehensive study of all tree-ring specimens from the Chaco Canyon area, it seemed advisable to incorporate the Kin Kletso material into the same project. It soon became apparent, however, that a satisfactory analysis of the Kin Kletso tree-ring specimens would require considerably more time and effort than had originally been anticipated and, in fact, such analysis was deemed to be of sufficient scope to warrant the preparation of an individual report. This paper, therefore embodies the results of some six months of accumulative study (expended over a two year period) on the Kin Kletso tree-ring material.

The problem, specifically, was to date as many as possible of the Kin Kletso specimens and to evaluate the established dates so as to determine the chronological placement of the ruin. By employing the tree-ring dating system devel-

oped at the University of Arizona by Dr. A. E. Douglass, a total of seventeen¹ dates was obtained from approximately 575 specimens. To those who have had experience in tree-ring work it will come as no surprise to learn that perhaps seventy-five percent of the total time devoted to the project was spent working on specimens that yielded no dates.

The laboratory analysis of artifactual materials encountered at Kin Kletso has not as yet been completed and, of course, the excavation report has not been published. It must be pointed out, therefore, that the section of this paper dealing with the integration of the tree-ring dates and the history of Kin Kletso is based on dendrochronological evidence alone and consequently suffers accordingly in comprehensiveness. Thus it is evident that any conclusions which purport to synthesize dates and archaeology are necessarily subject to possible re-evaluation by the archaeologists who carried out the actual excavation of Kin Kletso.

The early recorded history of Kin Kletso is much the same as the early history of the rest of Chaco Canyon.²

The first mention of Kin Kletso occurs in Lieut. James H. Simpson's diary of a military reconnaissance, published in

1. Of these seventeen dates, fifteen were obtained from the Kin Kletso material excavated by Vivian and Mathews and the remainder from specimens collected by Dr. Florence M. Hawley. See page 8 of this report.

2. An excellent discussion of the history of research in the Chaco Canyon is given by Brand, 1937, pp. 18-29.

1852,³ wherein the pueblo is referred to as Site No. 8. W. H. Jackson in his report of 1878⁴ presents the results of several days spent in the Chaco Canyon mapping and exploring. Jackson continues to use Simpson's nomenclature and in his detailed map⁵ of the Chaco Canyon ruin area Kin Kletso retains the name of Site No. 8. Jackson, incidentally, took a number of photographs on his trip but, unfortunately, he was experimenting with the then new flexible film and none of his pictures were successful.

Occasionally in the literature of Chaco Canyon the ruin of Kin Kletso is called Yellow House as well as Site No. 8. The term Yellow House is a direct translation from the Navajo words kin (house) and kletso (yellow). Both the names Kin Kletso and Yellow House were evidently first used by S. J. Holsinger, who as a special agent for the United States General Land Office published in 1901 a rather full report on the activities of the Wetherill's diggings in Pueblo Bonito as well as taking notes on most of the larger Chaco Canyon ruins.⁶

The first scientific excavation of Kin Kletso was

3. Simpson, 1852, pp. 30-48, 131-133.

4. Jackson, 1878, pp. 431-450.

5. Ibid., opposite p. 451.

6. Vivian, Gordon. Personal communication dated March 27, 1953. Unfortunately, there are only one or two photostatic copies of Holsinger's report extant and these are said to be impossible to obtain.

started in 1934 by the New Mexico State Museum under the supervision of Edward Ferdon, Jr. but only a few rooms and Kivas A and B (see Figure 2) were cleaned out and no publication of the results has ever been released. During the period following Ferdon's work there was some unrecorded testing in four of the Kin Kletso rooms but no serious digging was undertaken until Vivian and Mathews started in 1951.⁷ Clearing of rooms was continued in the summer of 1952 and, at the time of this writing, laboratory analysis of pottery and artifacts and supplementary testing of the site are in progress.

⁷ Vivian, Gordon. Personal communication, dated March 27, 1953.

CHAPTER I

LOCATION AND DESCRIPTION OF KIN KLETSO

Kin Kletso Ruin is situated in New Mexico in the Chaco Canyon National Monument on the north side of the Chaco River close to the central part of the eastern line of Section 11, Township 21 North, Range 11 West. Pueblo Bonito is located approximately one-half mile to the southeast of Kin Kletso; Casa Chiquita is about one-half mile downstream to the northwest; Pueblo Del Arroyo lies less than one-half mile to the south southeast; and Pueblo Alto is about three-fourths of a mile to the northeast on the mesa top. (see map 1).

The elevation of the canyon floor on which Kin Kletso is constructed is close to 6000 feet above sea level. Immediately to the north of the ruin a steep sandstone scarp rises some 125 feet and behind these cliffs a series of less spectacular upward gradations continue to the mesa top about 350 feet above the canyon floor. Across the river and a half mile or more to the south the opposite cliff rises almost 100 feet and continues to ascend by low scarps to about 300 feet above the bed of the canyon.

The environment of Chaco Canyon today may best be described as being typical of a cold desert.¹ There is

1. Brand, Hawley, Hibben, et al., 1937, p. 45.

evidence, however, that the environment of the Chaco Canyon has undergone changes in the last thousand years² principally resulting in different land forms, a shifting of floral and faunal assemblages to the desert type, and the recession of forest borders.³ Weather records collected at Pueblo Bonito show that the rainfall now (1937) averages 8.18 inches a year and that the mean annual temperature is 49.4°F.⁴ An excellent discussion of the geology, landforms, drainage, climate, water supply, flora, and fauna of the Chaco Canyon is to be found in the Tseh So Report.⁵

Kin Kletso Ruin itself is relatively small compared to the enormous pueblos of Bonito and Chetro Ketl but nevertheless there are at least fifty-five ground floor rooms, not including five circular kivas, and many of the remaining walls show that there were originally three stories (see ground plan map Figure 2 and Plate IV). The ruin is roughly rectangular in shape with the long axis oriented in an east-west direction. Shaped sandstone blocks, quarried from the neighboring cliffs, were utilized in the construction of Kin Kletso and the masonry, for the most part, is seemingly of Hawley's Type 8⁶, i.e., rubble core faced with

2. Brand, Hawley, Hibben, et al., 1937, p. 43.

3. Hawley, 1934, pp. 65-70

4. Brand, Hawley, Hibben, et al., 1937, p. 44.

5. Ibid., pp. 39-49.

6. Ibid., pp. 88-89.

blocks chinked with small spalls. Of necessity, a detailed and comprehensive archaeological description of the ruin can not be given in this paper and the interested student must await the forthcoming Kin Kletso report by Vivian and Mathews.

The preceding detailed description of the ruin is intended to provide a general impression of the site and its location. It is not intended to be a complete description of the site. The site is a large, rectangular structure, approximately 100 feet long and 50 feet wide. It is built of adobe masonry and is surrounded by a low wall. The interior of the structure is divided into several rooms. The largest room is at the east end of the structure and is approximately 40 feet long and 20 feet wide. It contains a large, rectangular platform or altar. The other rooms are smaller and are located along the west and south walls. The site is located on a hillside and is surrounded by a low wall. The site is in good condition and is well preserved.

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CHAPTER II

DATING OF THE TREE-RING SPECIMENS

The tree-ring material excavated by Vivian and Mathews from Kin Kletso consisted of both wood and charcoal specimens collected from thirty-one different locations throughout the ruin. Of these thirty-one samples, nine were individual beam sections of wood and the rest were assorted lots, mostly of charcoal, ranging in content from one fragment to two hundred fragments. Those lots consisting of fragmentary material usually contained pieces from a number of original trees.

In addition to the material received from Vivian and Mathews, the Laboratory of Tree-Ring Research had on file four specimens collected and studied by Dr. Florence M. Hawley in the early 1930's.¹ These four specimens had been catalogued as YH-1 through 4 but the YH designation has since been changed to CKK in keeping with the rest of the Kin Kletso pieces. Of the four specimens studied by Hawley, two (CKK-2 and CKK-3) were from one original log dated and reported on by Hawley² in 1934, one (CKK-1) was a core taken

1. Dr. Hawley was then associated with the Laboratory of Tree-Ring Research, University of Arizona, and is now with the Department of Anthropology of the University of New Mexico.

2. Hawley, 1934, Plate I.

from a beam also sampled by Vivian, and one (CKK-4) was evidently dated by Hawley but has never before been published (see Table 1).

Species present in the tree-ring samples from Kin Kletso included western yellow pine (*Pinus ponderosa*), piñon pine (*Pinus edulis*), Douglas-fir, (*Pseudotsuga taxifolia*), juniper (*Juniperus scopulorum?*),³ and oak. Since the collection of archaeological tree-ring specimens is not intended to provide a complete sampling of the various species of trees that might be found in a ruin, the enumerated species present in the tree-ring material are not to be considered as an absolute representation of the dendro-ecology of prehistoric Chaco Canyon.

The techniques used in dating the Kin Kletso tree-ring specimens were the usual ones employed by the Laboratory of Tree-Ring Research.⁴ Preliminary work included cataloguing the material, preserving and wrapping the specimens,⁵ and surfacing⁶ both wood and charcoal pieces in preparation for reading and study. All specimens that were of sufficient length and sensitivity to indicate the possibility of yielding a date, were reproduced in the form of skeleton

3. There is some uncertainty as to the proper identification of the juniper species from Kin Kletso.

4. Douglass, 1940b. Also Stallings, 1949, and Glock, 1937.

5. Douglass, 1940b, pp. 6-7. Also Hall, 1946, pp. 26-27.

6. Douglass, 1941, pp. 28-34.

plots.⁷ As the number of such plots increased and cross-dating between plots was recognized, they were incorporated into a site composite skeleton plot, i.e., a skeleton plot showing the representative average annual ring widths of all the plotted specimens that have been crossdated from a particular site. The site composite skeleton plot was then matched against the Central Pueblo Chronology Master Plot⁸ until the place of greatest agreement was found. With this background as a guide the individual specimens were checked against previously dated specimens from the Chaco Canyon area. Final substantiation of the dates was assured by the independent checking of the specimens by another dendrochronologist.⁹ The dating on all Kin Kletso specimens has been confirmed by Mr. Terah L. Smiley of the Laboratory of Tree-Ring Research. Since specimens CKK-26-1 and CKK-27-1 were of special interest (see page 28), they were double checked by Dr. A. E. Douglass before being released as dated.

Table 1 presents in tabular form a listing of all of the dated tree-ring specimens from Kin Kletso. In addition to the inner and outer dated rings of each specimen, Table 1 gives the room locations where the specimens were found within the ruin, the form of the specimen as received by the laboratory, the species, and, in the case of the measured pieces; the mean ring width in millimeters and plot scale.

7. Stallings, 1949, pp. 11-13.

8. Douglass, 1940a, Insert.

9. Haury, 1935, p. 102.

The letter symbols following the beginning and ending dates are of extreme importance in the archaeological interpretation of those dates and thus attention is called to the following explanations. The letter "p" used after some of the inner rings means that the ring is the pith ring of the specimen and absence of the symbol shows that the pith ring was not present. A terminal date with the letter "e" indicates that although there are no bark cells present on the specimen (and thus can not conclusively be said to be a cutting date), the outermost ring extends around the circumference of the specimen in a consistent manner. With such specimens it is believed that the bark has probably sloughed off at the cambium layer of cells (between the bark and the wood) and that no rings are missing from the outer part. The symbols "v" and "vv" are used when the outer ring is variable or very variable around the circumference of the specimen. Such conditions usually indicate that rings have been lost from the outside but there is no way of telling how many. Charcoal fragments must frequently be assigned "v" or "vv" designation since only a small part of the original tree cross section may be represented and there may be fifty or more rings lost or there may be none gone.

Since the basis for all tree-ring dating is founded on the crossdating that exists among various trees which were growing during the same interval of time,¹⁰ the measured

¹⁰ Douglass, 1946, pp. 16-20

TABLE 1

Dated Specimens from Kin Kletso Ruin

Specimen Number	Specimen Location	Form	Species	Mean Ring-Width mm.	Plot Scale	Inner Ring A.D.	Outer Ring, A.D.
CKK-1(YH-1)	Room 50	1" Core	PP	--	-	Same spec. as CKK-5	
CKK-2(YH-2)	Unknown	Wd. sec.	PP	1.24	2	1047p	<u>1124c</u>
CKK-3(YH-3)	Unknown	Wd. sec.	PP	--	-	Same spec. as CKK-2	
CKK-4(YH-4)	Unknown	Wd. frag.	PP	--	-	1005p	<u>1063v</u>
CKK-5	Room 50	Wd. sec.	PP	1.05	2	1000p	<u>1076c</u>
CKK-6	Room 50	Wd. sec.	PP	--	-	1029p	<u>1076c</u>
CKK-7	Room 12-11	Wd. sec.	PP	1.32	2	1028p	<u>1123c</u>
CKK-8	Room 37-50	Wd. sec.	PP	--	-	1066p	<u>1124c</u>
CKK-9	Room 32	Wd. sec.	PP	1.11	2	985p	<u>1059c</u>
CKK-10	Room 36-32	Wd. sec.	PP	--	-	1063p	<u>1124v</u>
CKK-11	Room 21	Wd. frags.	PP	--	-	1014p	<u>1076c</u>
CKK-12-1	Room 7	Ch. frags.	PP	--	-	1031p	<u>1100vv</u>
CKK-12-2	Room 7	Ch. frags.	PP	.82	2	1018	<u>1108vv</u>
CKK-12-3	Room 7	Ch. frags.	PP	--	-	1062	<u>1112vv</u>
CKK-15-1	Room 15	Ch. frags.	PP	--	-	1058	<u>1117vv</u>
CKK-25-1	Room 5	Ch. frag.	PP	--	-	1050	<u>1088c</u>
CKK-26-1	Room 24	Ch. frags.	PP	.81	2	1140p	<u>1178v</u>
CKK-27-1	Room 24	Ch. frags.	PP	1.08	2	1145	<u>1171vv</u>
CKK-27-2	Room 24	Ch. frags.	PP	--	-	1083p	<u>1128c</u>

p - pith ring present*

v - outside ring variable*

vv - outside ring very variable*

c - outside ring consistent*

* See page 11.

Wd. - wood

Ch. - charcoal

sec. - section

frag. - fragment

PP - ponderosa pine

Dates checked by T. L. Smiley
and A. E. Douglass, 1952.

ring series (see Figure 1) is used here as a substitute for actual ring photographs to illustrate the crossdating among the different specimens. Not all of the dated Kin Kletso specimens are represented by plots in the measured ring series but only those with the best and longest records and which collectively cover almost the entire interval of time to be found in the Kin Kletso ring chronology.

In order to insure accuracy, specimens were measured along a straight line whether or not that line was the true radius of the tree. A procedure of this nature frequently made it impossible to measure the inner or outer few rings of any given specimen and sometimes when dealing with fragmentary material it was necessary to measure several different radii of that particular specimen in order to cover the optimum range of rings. When different radii were measured they were treated as separate specimens in all computations (see measured plots of CKK-12-2 and CKK-26-1, Figure 1, A and B).

Each ring of each specimen was measured on a plotting micrometer scale¹¹ to the nearest 0.01 millimeter. These measurements were then recorded in sequential order, year by year, and plotted on coordinate paper to a definite scale (see Table 1 for plot scale of measured specimens). Trend lines were established by the eye-fitted method¹² using the

11. Douglass, 1943, pp. 5-8.

12. Schulman, 1946, p. 22, and 1953, p. 27.

points of a twenty year running mean as a guide. With the trend lines serving as a base from which percentage departures of growth could be expressed, the tree-ring indices (see Table 2) were then computed on a year by year percentage basis using a normal, or average, year as one having an index of 100 percent. Indices below 100 percent are considered to be deficient years and those above 100 percent are of greater than average growth. The resultant tree-ring indices for the Kin Kletso material were then plotted (see KIN KLETSO MEAN, Figure 1B) and for easy visual comparison the standardized means of the Flagstaff area of Arizona,¹³ and the Rio Grande area of New Mexico¹⁴ were also added.

Specimens CKK-27-1 and CKK-26-1 were measured and plotted (see Figure 1A) but because only two specimens were represented and since both were of such short duration, no indices were computed or standardized mean plotted. Even without a standardized mean plot, however, the crossdating with the Flagstaff and Rio Grande area means is readily discernible.

13. Douglass, 1947, pp. 14-15.

14. Smiley, Bannister, and Stubbs, 1953. Unpublished manuscript.

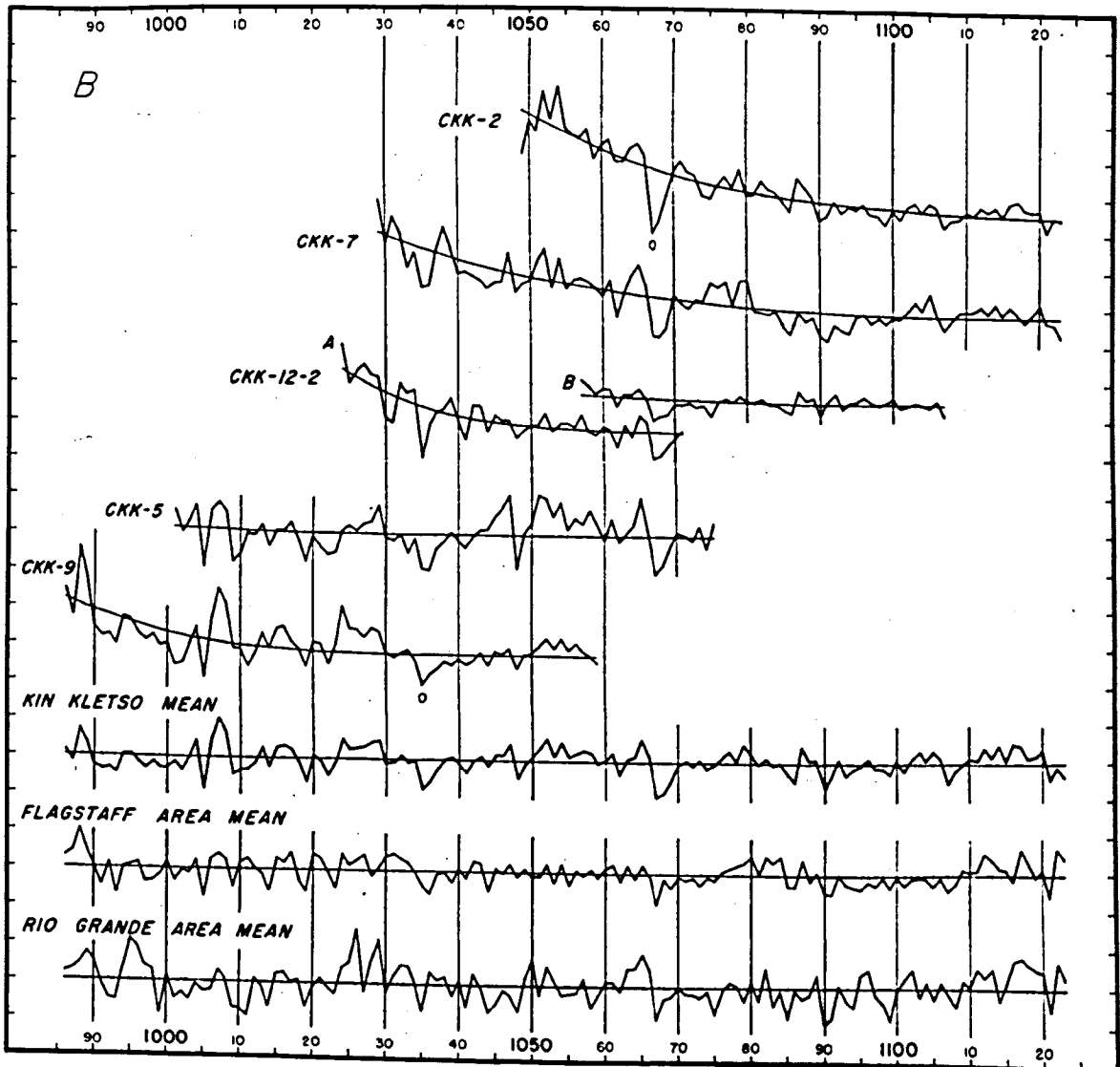
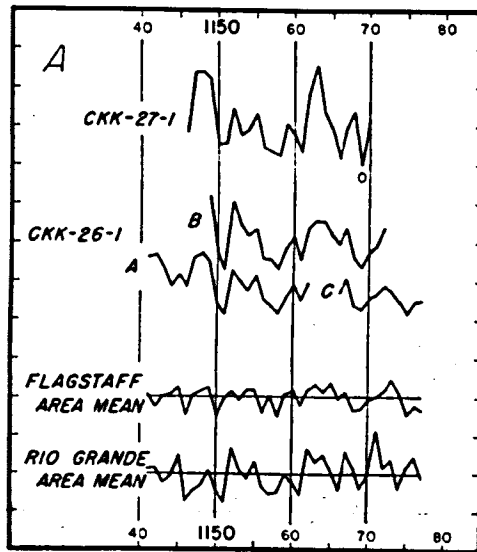


Figure 1 (A and B). The measured ring series.

TABLE 2

Tree-Ring Indices of Dated Specimens from Kin Kletso Ruin
 Ring-Widths in Per Cent of the Growth Trend

A.D.	0	1	2	3	4	5	6	7	8	9
980	---	---	---	---	---	---	114	84	173	138
990	74	66	70	58	106	107	85	71	89	71
1000	73	90	66	100	142	13	148	203	169	55
1010	66	68	87	129	79	129	134	125	89	38
1020	109	92	55	92	156	126	127	132	143	148
1030	88	91	112	91	99	20	42	78	100	106
1040	88	67	100	110	83	116	117	142	51	89
1050	107	132	159	113	150	111	122	130	123	98
1060	105	122	68	109	116	160	117	5	19	51
1070	97	103	93	105	82	97	115	133	101	148
1080	123	97	112	97	100	71	48	142	109	111
1090	38	63	110	64	83	98	115	86	85	73
1100	107	80	113	133	106	134	117	45	81	100
1110	117	110	142	118	147	106	154	149	114	121
1120	140	56	90	64	---	---	---	---	---	---

CHAPTER III

DATING OF THE RUIN

A tree-ring date can be defined as the calendar year with which the outermost ring in any given tree-ring specimen has been equated. Tree-ring dates by themselves have little or no intrinsic value for the archaeologist until they have been integrated with the cultural environment to which they apply but, at the same time, it is a mistake to summarily inject tree-ring dates into archaeological phenomena without first giving careful consideration to the body of information pertaining to the tree-ring specimens involved. For example, the tree-ring dates from Kin Kletso range in time from 1059 A.D. to 1178 A.D., a span of just under one hundred and twenty years. Without being cognizant of the singularities of each individual specimen one might be tempted to say that Kin Kletso was built about 1059 and abandoned around 1178, or that Kin Kletso was being constructed throughout the entire period, or some other equally unsubstantiated interpretation. The fallacy involved in this line of reasoning may appear to be obvious, yet it is the type most frequently encountered in the misapplication of tree-



Plate II. Rooms 36 (left) and 28. Date of A.D. 1124v from second story beam of Room 36. Looking south. (Courtesy National Park Service)

ring dates.¹

There are three categories of basic information that an archaeologist should first consider before attempting to use tree-ring dates for interpretative purposes. The first category involves the use to which the dated specimen was originally put; the second factor concerns the relationship between the date of a dated specimen and the context in which it was found; and the third consideration is one of understanding the limiting conditions inherent in a given dated specimen because of the loss or illegibility of outer rings. The first two of these three categories require data that can only be supplied by the archaeologist who has recovered the specimen; the third category falls logically into the province of the tree-ring analyst who dates the specimen but it is the responsibility of the archaeologist to understand the dendrochronologist's symbols used in defining the specimen's condition (see page 11).

The dated specimens from Kin Kletso Ruin serve nicely to illustrate the interpretive processes under discussion. Consider for the moment the aboriginal uses to which the

1. The use and abuse of tree-ring dates has not gone unnoticed by other writers. One of the best (and most vitriolic) of the discourses on this subject is contained in the last few chapters of H. S. Gladwin's report "The Chaco Branch, Excavations at White Mound and in the Red Mesa Valley", Gladwin, 1945, pp. 100-152. Gladwin has undoubtedly cut quite a swath in dendrochronological circles, but the writer feels that Gladwin's greatest contributions to tree-ring research have been in some of his articles of this nature.

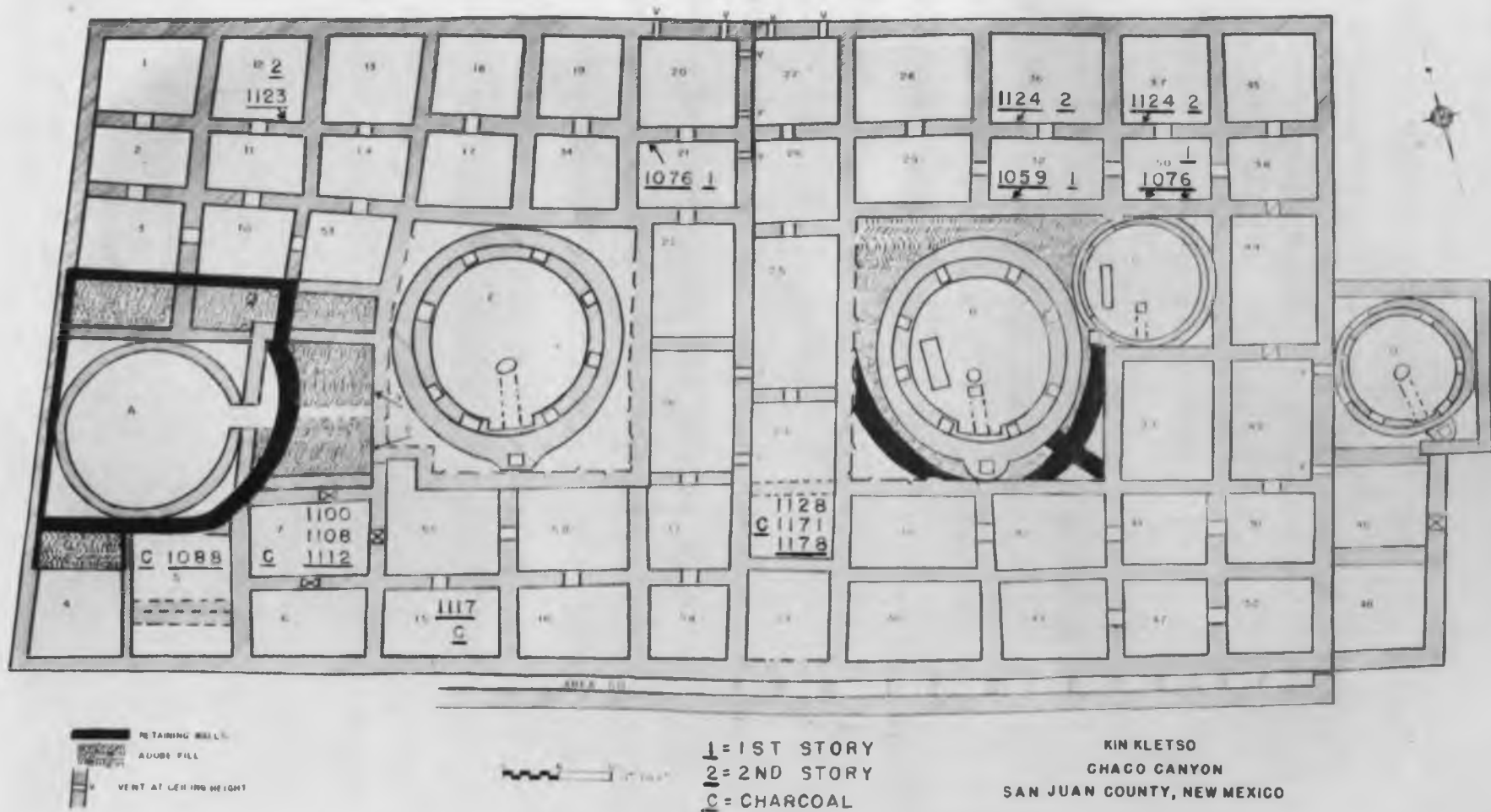
specimens were originally put. Generally speaking, we may say that a given specimen was initially used either for construction purposes or for non-construction purposes. Specimens used for construction purposes would include the timbers used in the main framework of a dwelling or utilitarian unit as well as secondary roofing materials and assorted props, braces, and supports. The bulk of tree-ring dates from archaeological sites in the Southwest are from construction specimens and these can be referred to as construction dates. Of the seventeen Kin Kletso tree-ring dates, nine (CKK-2, and CKK-4 through CKK-11) are construction dates.²

It is apparent that when dealing with construction dates, we are, in the main, dating events, i.e., the time of building of the unit from which the specimen or specimens came. Consequently, construction dates are most useful in the following circumstances: when determining the time that a room or particular unit was built; when determining the time of the building of a group of rooms or an entire pueblo; and when determining the actual order of room by room development of a pueblo, as was possible at the Canyon Creek Ruin reported on by Haury.³

2. Even though the exact provenience of specimens CKK-2 and CKK-4 is unknown, it is assumed that they are construction pieces since one is a wood quarter section from a beam end and the other is a full section from a large wooden beam. Since these two specimens can not be assigned specific locations, however, they have been dropped from the discussion on interpretation.

3. Haury, 1934, pp. 55-58.

Figure 2. Ground plan map of Kin Kletso. (Courtesy National Park Service)



It should be understood, of course, that the value of the results achieved in any of the three circumstances just cited must depend on the number of dated specimens in proportion to the size and type of site and how well those specimens represent an adequate spatial coverage of the ruin.

Since there are only seven construction dates from Kin Kletso, interpretive evaluations are necessarily limited. Of course, there are few ruins in the Southwest that do satisfy ideal dating conditions and in such cases (Kin Kletso included) one can only do the best with what information is available.

A quick appraisal of the seven construction dates from Kin Kletso shows that there are two periods about which the dates cluster (see Table 3). These clusters are at 1076 and 1124 A. D.⁴ Correlating these clusters with location and, specifically, with the building stories from which the individual specimens originated, it is easy to see that there is one obvious inference that can be drawn, i.e., the first story of Kin Kletso was built in 1076 A.D. or shortly afterwards and the second story was added some forty-eight years later around 1123-1124 A.D. Naturally, additional construc-

4. CKK-10 has been assigned a date of 1124 "v" rather than "c" because the outside of the specimen is badly fractured and fragments are missing so that the final ring can not be considered as consistent. It is the writer's opinion, however, that no rings are gone beyond 1124 and that the tree was felled in that year.

TABLE 3

Specific Location of Dated Specimens from Kin Kletso Ruin

Construction Dates				
Specimen Number	Outer Ring, A.D.	Form	Story	Location
CKK-2	1124c	wood	?	Unknown
CKK-4	1063v	wood	?	Unknown
CKK-5	1076c	wood	first	South wall, Room 50, East side.
CKK-6	1076c	wood	first	South wall, Room 50, West side.
CKK-11	1076c	wood	first	North wall, Room 21.
CKK-7	1123c	wood	second	Wall between Rooms 11 and 12.
CKK-8	1124c	wood	second	Wall between Rooms 37 and 50.
CKK-10	1124v	wood	second	Wall between Rooms 36 and 32.
CKK-9	1059c	wood	first	South wall, Room 32.
Non-Construction Dates				
Specimen Number	Outer Ring, A.D.	Form	Location	
CKK-12-1	1100vv	charcoal	Room 7, firepit at top of fill.	
CKK-12-2	1108vv	charcoal	Room 7, firepit at top of fill.	
CKK-12-3	1112vv	charcoal	Room 7, firepit at top of fill.	
CKK-15-1	1117vv	charcoal	Room 15, intentional fill.	
CKK-25-1	1088c	charcoal	Room 5, intentional fill.	
CKK-26-1	1178v	charcoal	Room 24, ash lens 9" to 10" above floor.	
CKK-27-1	1171vv	charcoal	Room 24, ash lens 8" to 9" above floor.	
CKK-27-2	1128c	charcoal	Room 24, ash lens 8" to 9" above floor.	

tion dates would help either to confirm or repudiate this inference but on the basis of present dendrochronological evidence alone it seems acceptable to claim that Kin Kletso underwent at least two building periods.

It is interesting to note that the year 1124 is represented on the specimens CKK-2, CKK-8, and CKK-10 by just a few cells of a new season's growth and that the year 1123 on specimen CKK-7 is a full ring that has completed its growth. Thus, there may have been as little as two weeks difference in the cutting times for the four specimens.

Non-construction specimens may represent a variety of original uses including room furnishings such as wall pegs and shelves, various furniture supports, wooden artifacts, and a wide assortment of pieces, usually charcoal, found in trash middens, firepit areas, and room fill. Eight of the Kin Kletso dates are of the non-construction type representing firepit charcoal and miscellaneous charcoal pieces from room fill (see Table 3).

Non-construction dates must receive interpretive evaluations different from those given construction dates. The emphasis given to non-construction dates should not be directed toward the dating of events, but rather, non-construction dates should be used in conjunction with construction dates in delimiting periods, for, non-construction dates, particularly firepit material, are more likely to be later than construction dates from the same ruin. It is

reasonable to assume that the gathering of firewood by the inhabitants of a pueblo would continue until the pueblo was completely deserted and that any tree-ring dates obtained from firepit charcoal may well approximate the time when the ruin was abandoned. Through judicious use of construction dates in determining the time of building of a pueblo and non-construction dates in arriving at an approximation of the time of abandonment of a pueblo, the period of the structure's occupation may be delimited and time horizons for associated artifactual materials may be more clearly defined. A thorough understanding, therefore, of the original use to which a dated tree-ring specimen was put may well add a third dimension to what would otherwise be a two dimensional picture.

It is recognized, of course, that in some ruins of long occupation, new building activity among the inhabitants continued for the life of the pueblo. Under such circumstances repair beams or timbers from late rooms may give construction dates that can be used exactly as non-construction dates in delimiting periods. It must be pointed out, however, that construction dates from later building developments in sites of long occupation are likely to be from re-used timbers and so of no use in defining periods of occupation.

The eight non-construction dates from Kin Kletso range from 1088 to 1178 A.D. Except for CKK-27-2 (1128c) all of the specimens are marked "v" or "vv" and so probably have a number



Plate III. South wall of Room 50 showing two first story beams in situ. Both timbers are dated at A.D. 1076c. (Courtesy National Park Service)



Plate IV. North wall of Room 11.
Notice the three story construction.
(Courtesy National Park Service)

of rings gone from each. As a group, the non-construction dates are considerably later than the construction dates, and as such can be used to indicate one end of the period of occupation. This does not mean that Kin Kletso was abandoned in 1178 but it does mean that the ruin was occupied at least that long.

Perhaps the most important fact to come from the Kin Kletso project is that the ruin was not abandoned before 1178 A.D. The two dates of 1171vv and 1178v are almost fifty years later than any other tree-ring date from the Chaco Canyon area.⁵ It has long been held by many archaeologists that the pueblos of Chaco Canyon were abandoned in the early twelfth century, presumably by 1130 A.D.⁶ The writer would like to emphasize that this belief has been in vogue largely because construction dates alone have been used in making interpretations. It is true that some charcoal fragments from trash middens have been dated⁷ but for the most part the collection and study of non-construction specimens from Chaco Canyon has been ignored. The writer is of the firm conviction that when non-construction specimens from Pueblo Bonito and Chetro Ketl are studied⁸ they will produce dates considerably later than

5. Smiley, 1951, p. 19.

6. Hawley, 1934, p. 78. And Brand, Hawley, Hibben, et al., 1937, p. 117.

7. Hawley, 1934, pp. 33-34.

8. Non-construction specimens (firepit material) from Pueblo Bonito and Chetro Ketl have been received by the Laboratory of Tree-Ring Research but as yet time has not permitted their analysis.

1130 A.D. After the last new timbers were cut for the construction of the Chaco Canyon pueblos, there is no reason to believe that the entire population immediately left for parts unknown or that new building activity did not continue with the use of salvaged beams.⁹

The second category of basic information necessary for the interpretation of tree-ring dates involves the problem of determining whether the date of a dated specimen is a true representation of the age of the context in which the specimen was found. This problem resolves itself into several components which are distinguished chiefly by a matter of degree. Thus a few year's difference between the time of cutting of a timber and the time of its use for building purposes is a relatively unimportant matter, but a lag of many years, as in the case of a deadwood date or re-used timber, is of extreme importance when it comes to interpretation.

In the first case where a lag of a few years is involved, the reasoning is that timbers were cut and allowed to season before being used. Dr. Deric O'Bryan¹⁰ has suggested that all tree-ring dates from construction logs, firewood, or arti-

9. A similar view has been expressed in the aforementioned (Footnote 1, page 19) discourse by Gladwin. Gladwin, 1945, pp. 150-152.

10. O'Bryan, 1949, pp. 155-156.

facts¹¹ should be considered as a year or so too early for the time of the specimen's use. Dr. Emil W. Haury, on the other hand, points out that it can not definitely be shown that the practice of seasoning wood prevailed in ancient times.¹² Both writers agree, however, that a few years of elapsed time between the cutting and use of a specimen is a rather trivial factor and can not have a very decisive effect upon interpretation.

Re-used timbers and deadwood dates present an altogether different problem. Instances have been known where deadwood trees have remained standing for as long as 126 years¹³ and timbers salvaged from older ruins may antedate their re-use by almost any number of years. Without going into all the ramifications of re-used and deadwood timbers, suffice it to say, that the problem, when it does occur, can be solved by only two methods. First of all, if the date in question is obviously much too early for the archaeology then it can be assumed that the specimen has been re-used or is an example of the use of deadwood. In cases less clear-cut recourse must be

11. O'Bryan evidently does not give proper recognition to the fact that a large percentage of wooden artifacts have lost a great many outside rings in the process of being shaped and that there exists the possibility that artifacts would assume the status of heirlooms. Consequently dates from artifacts should be treated with caution.

12. Haury, 1935, p. 104.

13. Schulman, 1946, p. 23.



Plate V. Chaco style Kiva B. Notice juniper logs in position atop banquette. Looking south. (Courtesy National Park Service)



Plate VI. Southwest corner of Room 37. Date of A.D. 1124c from second story. (Courtesy National Park Service)

made to the phenomenon of date clustering which, of course, presupposes enough dates to establish a foundation on which to base deviations. If the bulk of the dates congregate around one or more time periods, then deviations from the normal can easily be spotted. By the same method dates from repair or replacement timbers can also be determined. As a general rule, the whole question of the use of deadwood, re-used, and repair specimens is confined to construction dates.

The seven construction dates from Kin Kletso do not provide an adequate basis for definitely distinguishing out-of-context dates but the implication that specimen CKK-9 (1059c) is an example of a re-used timber can not be overlooked.

The third factor to be considered by the archaeologist when dealing with tree-ring dates concerns the limiting conditions inherent in the specimen itself. Unfortunately, all tree-ring dates are not bark or "cutting" dates. Most tree-ring specimens, in fact, have lost all trace of bark and sometimes an undetermined number of their outside rings as well. The question, then, is how close is the date of a dated specimen to the year in which the tree died? Only in cases where bark cells are actually present on the specimen can it be definitely stated that the assigned tree-ring date is the year in which the tree died. In all other cases where bark is not present there is some cause for doubting that the tree-ring date and the year of the tree's death coincide. Except when the symbol "c" is used (see page 11), meaning that the

outside ring is probably the final one, there may be anywhere from a hundred or so to no rings gone from the outside of the specimen. Sometimes with wood specimens it is possible to estimate the number of destroyed rings by utilizing the heartwood-sapwood contact date¹⁴ but with charcoal, estimation is virtually impossible.

It is evident that the symbol following the date should be just as important to the archaeologist as the date itself. For example, the archaeologist who is confronted with the two tree-ring dates of 1130B and 1130vv knows that in the case of the first specimen the tree died in the year 1130 but the second specimen may have come from a tree that died anywhere from 1130 to 1230. Naturally, the same interpretive qualities can not be attached to both specimens.

Problems arising from non-bark tree-ring dates can sometimes be resolved through the observance of their relationships to date clusters. For instance, if a group of logs from a room give ten dates of 980B, three dates of 980c, and one date of 963vv, it is safe to assume that the 963vv date is not an example of a re-used timber but more likely has had seventeen rings lost from its outside. If the date were 963B, then the re-used theory would be the most consistent.

Applying these principles to the Kin Kletso specimens, it would appear that CKK-4 (1063v) is probably not a re-used

14. Douglas, 1939, pp. 3-6.

timber such as CKK-9 (1059c) but rather is an example of a beam which originally had an additional ten or so rings.

* * *

In summary, there are three classes of basic information necessary for the interpretation of tree-ring dates. The first class concerns the way in which a dated specimen was originally used; the second category deals with the relationship between a dated specimen and the context in which it was found; and the final factor involves the degree of similarity between the tree-ring date of a specimen and the year in which the original tree died. By applying interpretive processes implicit in these three categories to the seventeen tree-ring dates from Kin Kletso, two major conclusions based on dendrochronological evidence alone can be drawn: first, Kin Kletso underwent at least two building periods wherein the first story was constructed about 1076 A.D. and the second story about 1124 A.D.; and, second, Kin Kletso was occupied at least until 1178 A.D.

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