

# TREE-RING BULLETIN

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The Tree-Ring Bulletin will publish papers resulting from original research in tree-rings in their relation to climatology, archaeology, and other subjects. Manuscripts should be typewritten in double spacing. The Editor reserves the privilege of returning to the author for revision approved manuscripts and illustrations which are not in the proper form for the printer.

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## ESTIMATED TREE-RING CHRONOLOGY: 150-300 A. D.

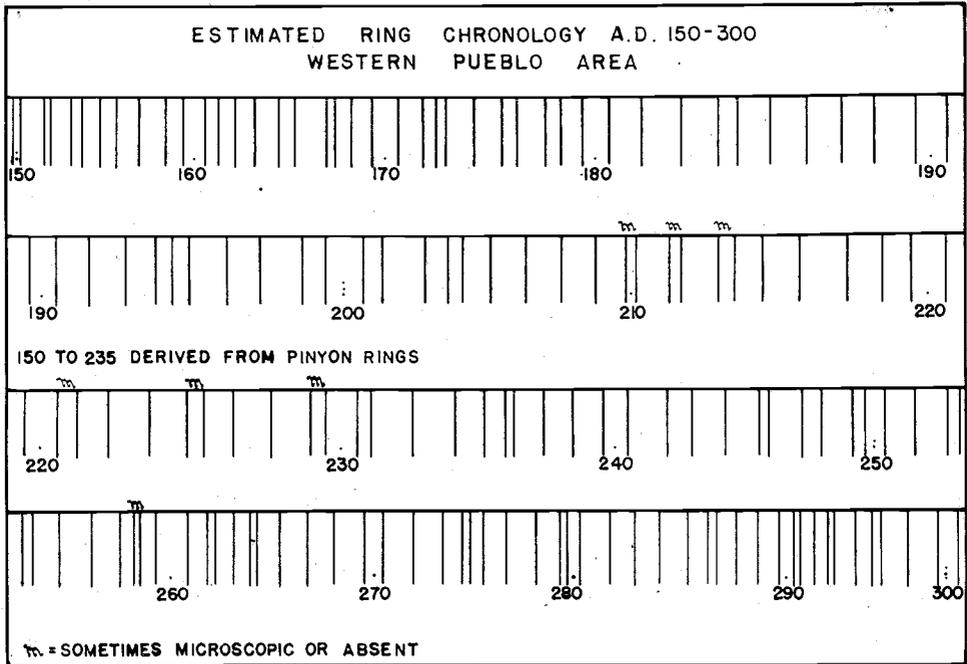
A. E. DOUGLASS

The very early chronology in the southwestern region has been developed from beams found largely in the northeast corner of Arizona.<sup>1</sup> This long chronology, partly shown here, has been called CPC, Central Pueblo Chronology, to distinguish it from a chronology in the vicinity of Flagstaff which extends back into the late 500's, developed in cooperation with Mr. John C. McGregor of the Museum of Northern Arizona, and another long Rio Grande chronology extending to the 1100's and before, developed by Mr. W. S. Stallings of the Laboratory of Anthropology in Santa Fe.

The Central Pueblo Chronology at the present time depends largely upon the specimens collected by Mr. Earl H. Morris at Mummy Cave, south of the Lukachukai Mountains and in various caves in the Red Rock Valley between the Lukachukai and the Carrizo Mountains to the north. This means an extended area covering about 40 miles in a north-south direction. The first specimen in this early chronology was BE-33, secured in 1923 at Mummy Cave. Its importance was recognized in 1927 and its ring sequence began the EPD floating chronology, and determined the zero year of that chronology from the center of that specimen, which proved to be the year 402 A. D. Earlier EPD specimens were largely obtained in the form of charcoal from Mummy Cave, and the best, M-105, 106 and 110, gave superb records through the 300's. Two pronounced drouths in the 300's, namely, from 320-327 and 340-344, produced for a time uncertainties in the counting, but a large number of duplicates

<sup>1</sup> Mr. I. F. Flora of Durango has secured early specimens in Colorado a little to the northeast of this area.

RING CHARACTERS, 150 TO 300 A. D.



m = SOMETIMES MICROSCOPIC OR ABSENT

Pinyon Series

- A.D.  
 152 small  
 154 very small  
 156 smallish  
 158 locally absent in places  
 167 very small  
 168 smallish  
 172 small  
 173 very small  
 178-181 increasing size  
 184 smallish  
 194-5 small  
 199-201 small  
 204 small  
 210 very small, locally absent  
 212 very small, locally absent  
 214 very small, locally absent  
 221 very small, locally absent  
 225 very small, locally absent  
 229 very small, locally absent  
 231 small

Douglas Fir Series

- A.D.  
 236 very small  
 245 very small  
 253 small  
 258 very small  
 262 small  
 265 very small  
 270 small  
 274 small to very small  
 279 very small to microscopic  
 286 small to very small  
 290-294 very small  
 291 and 294 very small to micro-  
 scopic  
 297 very small  
 302 microscopic, sometimes absent

carried a successful enumeration of the rings through those difficult periods.

The 200's from 235 to 300 have become very well known through a considerable number of Douglas firs of the very highest order of excellence in climatic characters. Hence during that part of the present interval the estimated ring size is well established. Regarding the time between 150 A. D. and 235, we have five specimens that cover important parts of the interval. The longest record is in MLK-152, which, however, has some defects of the nature of lightning scars producing certain eccentricities in the rings at some parts at this general time; otherwise it

tends toward complacency with a few well-marked deficient rings that serve well from cross-dating. Number M-143 is also a Douglas fir extending from 90 to 358 A. D. and relatively free from injuries, and yet it has several narrow zones of reinforced rings that probably mean some special strain or injury in another part of the tree. Three pinyons, however, give us more detailed information regarding this interval, M-159, MLK-110, and MLK-153. M-159 is a core one inch in diameter, and therefore gives only a small part of the original circuit of the tree. Its record extends to a little before the year 200, but some disturbances in the rings, probably omissions, make its inner parts rather uncertain as a guide. MLK-153, however, gives an excellent record all through the 200's, and back to 150 A. D. (see cut), and while its rings become microscopic in ring size near the center, it has been possible to compare opposite radials of the tree and find a very satisfactory correspondence upon which considerable reliance can be placed. This dependability has been verified by MLK-110, a pinyon which has a reliable record after 235, giving a good account of features we know are there. It gives in addition an excellent record back to 199 A. D., judged by its agreement with MLK-153. The rings are smaller and A. D. 210, 214, 221, 225 and 229, which are small in MLK-153, are locally absent; 210 is taken as absent.

There are differences between pinyons and Douglas firs in their manner of record, but in following the pinyon we are probably getting much nearer the actual climatic sequence than if we limited ourselves to the two more complacent firs, and we have the advantage of the fairly complete circuits of the sections. In order to place these early rings on record a half-tone photograph is presented, made through a Zeiss epi-condenser with side illumination on a 45° cut across the grain.

## AN EFFECT OF STARVATION ON PINE TREES

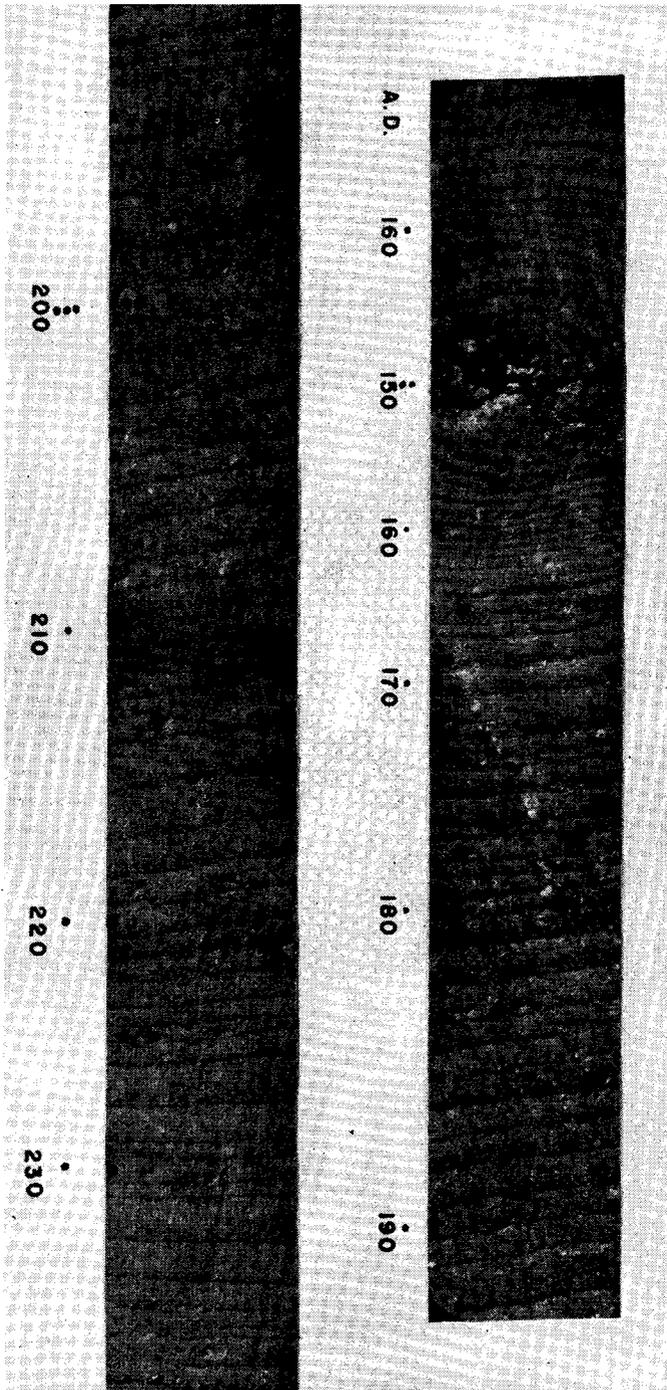
L. F. BRADY

The material on which this paper is based was observed and collected in the course of an unfinished investigation of the effect of plant growth in the disintegration of the dacite boulders at the foot of Elden Mountain near Flagstaff, Arizona.

Five dwarfed pine trees (*Pinus ponderosa*) were found growing in small holes in these boulders, (see cut) and all of them proved, as was expected, to be unusually old for their size; although, owing to the probability of the presence of double or even multiple rings, it is not possible to give their actual age until further microscopic examination of their rings has been completed.

The rock on, or in, which the trees in question grew is a hypersthene-soda dacite, and its surface is characterized by cavities, often with overhanging edges, ranging in capacity from a few hundred cubic centimeters upward, and in depth up to 50 cm. These cavities, only the smaller of which contain much soil and vegetation, appear to be due to the weathering of portions of softer, "drusy" layers in the rock, which may represent old flow surfaces. The soil in the cavities consists largely of unaltered fragments of the rock with about 60% of rock-dust and humus—the former resembling closely that found under the lichens which cover much of the surface of the boulders and being probably due to their action.

As the growing level of the trees was in every case 50 cm. or more above the ground, there is very little probability of any water being available to the roots by capillarity from below through so massive a rock as dacite. As a result the trees were dependent for moisture on the rain

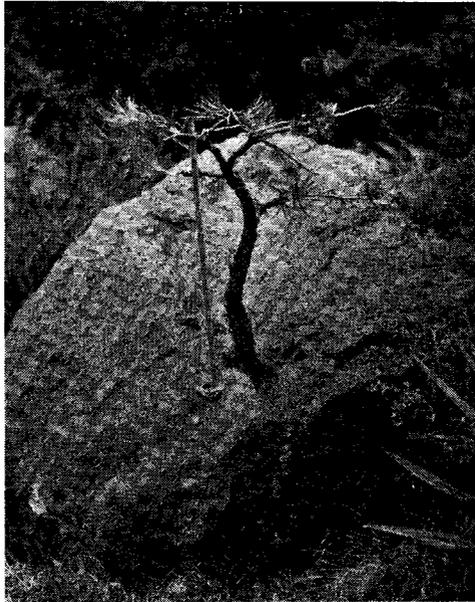


MLK-153, Pinyon, Obelisk Cave, Red Rock Valley, Northeastern Arizona. Magnification about 14 diameters.

which fell on the actual rock surface—and in all probability only a small part of that soaked into the soil pockets in which the trees could reach it. Examination showed that within a few days after a shower the soil in these cavities was “dust dry,” so that one might expect a careful exami-

nation of the rings to show that many of them are multiple, representing growth during several wet periods within a single year and cessation of growth during the intervening droughts.

After each tree was cut at the ground level, the cavity was washed out as completely as possible with a portable pressure pump, the larger rock fragments picked out, and the volume of the pocket measured roughly by filling it to the original soil level with water from a graduated vessel.



A twenty-five year old Western Yellow Pine growing in a natural rock cavity near Flagstaff.

Where possible the boulder was then split with chisel and wedge, and search made for penetrating roots.

Portions of these specimens have been sent to Dr. A. E. Douglass for further examination.

The following field notes will give an idea of the growing conditions of the five specimens:

No. 1. Marked as "seedling," August 1933. Resembled a two year old tree when collected in June, 1937. Volume of soil, 400 cc.; area of drainage, large.

No. 2. About 30 cm. high; no measurable increase in height in the last two years. Volume of soil, 1100 cc.; area of drainage, 1300 square cm. Age 12+ years. Diameter (without bark) 14 mm.

No. 3. No previous observation; shows spiral thickening of rings. Height 25 cm.; volume of soil, 500 cc.; area of drainage about 2000 square cm. Diameter, 12 mm. Age ? 20+ years.

No. 4. Extreme case of starvation; foliage much reduced. Volume of soil, 350 cc.; area of drainage, 500 square cm. Age 10-12 years. Diameter 5 mm.

No. 5. No change in size or appearance since first seen in 1934. Volume of soil, 850 cc.; area of drainage, 4500 square cm., (but most of the rain must have overflowed the soil area). Foliage about 25% of normal tree of similar size. Diameter 33 mm., height 60 cm. Age, 25+ years.

These trees were obviously growing under extremely unfavorable conditions as regards soil and moisture—in effect they were “pot-grown” specimens—and their abnormally slow growth may be due partly to recurrent drought and partly to a deficiency of nitrogen and sulphur, neither of which are present in the dacite. The amount of these elements supplied by the humus formed by wind-deposited vegetable matter might well be insufficient for normal growth, even with an adequate water supply. Only one of the specimens showed any considerable penetration of the rock by roots. Tree No. 5 had a few roots penetrating the felsitic ground-mass of the rock to a maximum depth of 25 cm. Below the bottom of the cavity in which its main root system was, the material having been partly hydrated by percolating rain water.

The illustration of Tree No. 5 shows its strong resemblance to the pot-grown Japanese trees, which by careful and studied starvation are kept alive and apparently healthy to a great age, although completely dwarfed. The amount of soil in which this tree grew to an age of at least 25 years is less than that contained in a five inch flowerpot.

## DATES FROM KING'S RUIN

GORDON C. BALDWIN

King's Ruin is located about 35 miles northwest of Prescott, Arizona, in Yavapai county. The ruin lies nine miles northwest of Midway Station on the property of the King brothers. This site was excavated during the summer of 1932 by an expedition from the Arizona State Museum under the direction of Dr. Byron Cummings.

The ruin stands on the west bank of Chino Creek, one of the headwaters of the Verde, at an elevation of about 4500 feet. House remains consist of 12 rooms, representing an original group of eight rooms with four additional rooms having been built later along the eastern and southern sides. Wall construction was massive, being of clay with a central core of river boulders, averaging two feet in thickness. From the amount of wall debris in the rooms and from the present height of the walls, from three to six feet, at least a part of the structure was originally two stories in height.

About 100 yards to the east of this group was a large refuse mound in which 55 burials were uncovered, together with the floor of a large oval pithouse and the remains of a second such structure.<sup>1</sup>

The wall construction and ground plan of the village indicate a late Pueblo II or early Pueblo III period of culture, and this is borne out by the pottery. Ninety-five percent of the pottery is plain ware, chiefly Prescott Gray Ware, with a very little intrusive Elden Corrugated and Deadman's Fugitive Red.<sup>2</sup>

The five percent of decorated ware is mainly local Verde Black-on-gray and Verde Black-on-brown. Intrusive decorated pottery consists of Walnut Black-on-white, the most abundant type, Deadman's Black-on-white (this possibly is Holbrook Black-on-white), a few sherds of Wupatki Black-on-white from the later section, and a few sherds of Citadel and Kayenta Polychromes. Thus the dated pottery types range from Pueblo II through Pueblo III, from about 1000 to 1300 A. D. The

1. For complete details concerning the site see Spicer, E. H., and Caywood, L. R., *Two Pueblo Ruins In West Central Arizona*. University of Arizona, Social Science Bulletin No. 10, 1936.
2. See Colton, H. S., and Hargrave, L. L., *Handbook of Northern Arizona Pottery Wares*. Museum of Northern Arizona, Bulletin 11, 1937, for a complete description of the various pottery types listed above.

local pottery was constructed by paddling, and is relatively crude in comparison with the intrusive types from further north and east.

Sixty-four fragments of charcoal, all pinyon or juniper, were found in two of the older rooms of the pueblo, and 16 juniper specimens were recovered from the two pithouses in the refuse mound.

Of these specimens, 37 from the pueblo were sufficiently sensitive and had long enough records to give a good sequence and crossdate with each other. A fairly good sequence was obtained for 94 years, with all except the first few rings and the last few covered by at least 12 specimens. However, as doubles increase in trees growing toward the forest border, being very common in the pinyon and juniper zone, one would expect to find a number of doubles in these specimens. That expectation is fully realized, mid-lines being particularly common.

In order to compare this record of 94 years with the master chart one should have, if possible, a master chart from the same area and of the same type of wood. None are to be had at present for this area, and one from Flagstaff of pine had to be used, that being the nearest known area to Chino Valley. As was to be expected, there were some discrepancies in the two areas, as there is a difference in altitude as well as in the difference between pine and pinyon. But upon checking this sequence with the standard plot from Flagstaff it was found that the plot from 960 to 1025 A. D. matched in extremely well, with only a few minor variations. The small rings of 964, 968-9, 972, 975, 980, 981 (absent), 984, 991-2-3, 1005, 1019, and 1022 showed up in the new sequence, and served to prove that this was the correct date. However, a few new ones were added in this sequence, 987 being smallish, 999-1000 small, 1008-9 smallish, 1011-12 small, and 1022 microscopic.

The first building date in this pueblo seems to indicate a date of  $1028 \pm 1$ , and the second building date, which is less certain than the first, being derived from four specimens with small, rather complacent rings,  $1065 \pm 15$ .<sup>3</sup>

3. This dating has been fully checked by Dr. A. E. Douglass and Mr. H. T. Getty.

Room Number	Piece Number	Outside Dated Ring	Inside Dated Ring	Approximate Radius in MM	Kind of Wood	Type of Specimen	Estimated Rings Lost At Outside	No. Absent In Series	Estimated Bark Date
6	KR-1	1027	960	50	Pnn	Chcl. sec.	1	1	1028 $\pm$ 1
6	6	1026	978	33	Pnn	Chcl. sec.	2	1	1028 $\pm$ 1
6	10	1026	954	53	Pnn	Chcl. sec.	2	1	1028 $\pm$ 1
6	12	1028	965	40	Pnn	Chcl. sec.	0	1	1028
6	19	1027	985	30	Pnn	Chcl. sec.	1	1	1028 $\pm$ 1
5	23	1026	974	31	Pnn	Chcl. sec.	2	1	1028 $\pm$ 1
6	30	1023	970	20	Pnn	Chcl. sec.	Few	1	1028 $\pm$ 1
6	31	1048	987	18	Pnn	Chcl. sec.	Few	1	1065 $\pm$ 15
6	35	1036	975	21	Pnn	Chcl. sec.	Many	1	1065 $\pm$ 15
6	46	1050	955	38	Pnn	Chcl. sec.	Few	1	1065 $\pm$ 15
6	48	1026	961	43	Pnn	Chcl. sec.	2	1	1028 $\pm$ 1
6	55	1026	970	23	Pnn	Chcl. sec.	2	1	1028 $\pm$ 1
6	64*	1048	955	41	Pnn	Chcl. sec.	Few	1	1065 $\pm$ 15

\*The remaining 24 specimens all have short records, from 17 to 40 rings, and, for lack of space, are not tabulated here. All are included in the series from 971-1027 A. D.