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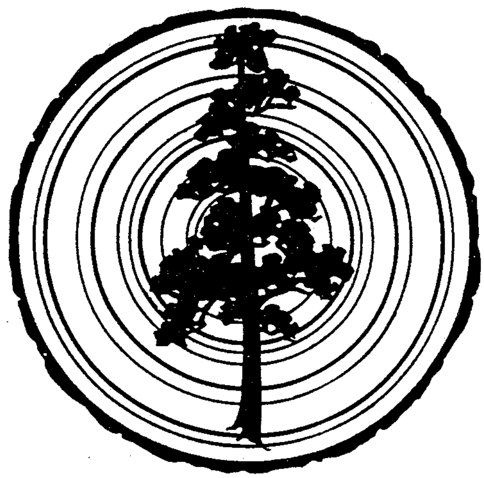

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AUTHORS

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.

In reporting tree-ring data authors are requested to use a tabular form such as appears on the back of Vol. 1. No. 1. Until funds are available authors will be requested to pay the cost of illustration.

Each contributor will be given, free of charge, twenty-five copies of the Bulletin in which his article appears. Reprints may be procured at cost with or without covers if ordered at the time the galley proof is submitted. Manuscripts and illustrations should be sent express prepaid or by registered mail to the Editor-in-chief.

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SOUTHWESTERN DATED RUINS: V

A. E. DOUGLASS

The dates in this list were chiefly determined in connection with the construction of the Southwestern tree-ring chronology which extends back to 11 A. D. In certain parts of it great assistance was given by Dr. E. W. Haury, who made the final complete review of large collections of material and therefore dated a large number of pieces which are included in the number of dated specimens. This refers especially to the charcoal pieces of Pinedale, Showlow and Kintiel. This chronology construction made use of large groups of specimens collected by aid of Mr. Neil M. Judd and under the auspices of the National Geographic Society and other institutions. It included an extensive group of specimens from the vicinity of Flagstaff which I was permitted to see by courtesy of Dr. H. S. Colton, Mr. J. C. McGregor, and the Museum of Northern Arizona. A large proportion of the earlier pieces preceding 700 A. D. were collected by Mr. Earl H. Morris working with the Carnegie Institution of Washington and the University of Colorado. Early important cross dating in these groups was largely done by Dr. W. S. Glock.

A large amount of corroborative work has been done on special collections dated primarily by others. This has usually consisted in a review of most of the pieces in the collection whether dated or not. It therefore has sometimes resulted in the finding of a few additional dates. The most important groups examined in this way are included in this list with the memorandum that my study of the group was for checking purposes.

Site No.	Name	Cultural Stage	No. of Specimens	Range of Dates
	FLAGSTAFF AREA			
NA 1531*[1]	Elden Pithouse	Pueblo I	3	708—x-855
NA 1920B*	(Bonito Terrace)	Pueblo I	1	860
NA 1925B*	(Bonito Terrace)	Pueblo I	2	833-859
NA 1959	(Sunset Crater)	Pueblo I	1	784
NA 2551*	(Baker Ranch)	Pueblo I	1	685—x
NA 2798*	(Baker Ranch)	Pueblo I	12	710—x-927—x
NA 2800*	(Baker Ranch)	Pueblo I	4	680—x-792±
NA 192B*	(Deadman's Flat)	Pueblo II	1	925
NA 408*	(Jack Smith Tank)	Pueblo II	10	912-976
NA 862*	(Medicine Valley)	Pueblo II	11	914-1060—x
NA 1238*	(Medicine Valley)	Pueblo II	5	926-1066
NA 1625B	(Medicine Valley)	Pueblo II	1	1045—x
NA 1625C*	(Medicine Valley)	Pueblo II	2	930±4
NA 1680*	(Medicine Valley)	Pueblo II	16	880—x-909±10
NA 2001*	(Medicine Valley)	Pueblo II	2	826÷x-906—x
NA 2001B	(Medicine Valley)	Pueblo II	1	1008±2
NA 2002A*	(Medicine Valley)	Pueblo II	9	1114±6[2]
NA 450*	Wupatki	Pueblo III	69	1073-1205
—	Citadel	Pueblo III	2	1192-1260
—	Fewkes' Ruin J	Pueblo III	1	1192
—	Turkey Hill Pueblo	Pueblo III	9[3]	1168-1278
—	Elden Pueblo	Pueblo III	1	1162
	SEGI (TSEGI) AREA			
NA 2542*[4]	(Pithouse)	Pueblo II	1	1018
NA 2543*[4]	Ladder House	Pueblo II?	2	1066±8
NA 2521*[4]	Turkey House	Pueblo II-III	1	977±3
NA 2630*[4]	Ken-aki	Pueblo II-III	2	1124-1130±3
NA 2507*[4]	Swallows Nest	Pueblo III	2	1250±5
NA 2515*	Betatakin	Pueblo III	13	1242-1277
NA 2519*[4]	Kiet Siel	Pueblo III	24	1106—x-1286
NA 2536*[4]	Twin Caves	Pueblo III	15	1110—x-1280
—	Rubbish Ruin (near Kiet Siel)	Pueblo III	1	1257
—	Little Granary House, Navajo Mountain[5]	Pueblo III	1	1259
	HOPI AREA			
RB 551[6]	(Black Mesa)	Pueblo II	13	1074-1078
—	Kokopki (Kokopnyama)	Pueblo III-IV	43[3]	1269-1435
—	Shipaulovi	Pueblo IV	2	1550—x-1588
—	Kawaika	Pueblo IV	33	1357-1495
Tusayan: 7:1*[7]	Awatovi	Pueblo IV	27	1332—x-1602—x
—	Chakpahu	Pueblo IV	16	1377-1390—x
—	Oraibi	Pueblo IV-V	131	1370-1779
—	Shungopovi	Pueblo IV-V	46	1408-1728
—	Walpi	Pueblo IV-V	12	1417-1712
	GANADO AREA			
—	Kintiel	Pueblo III	200[3]	1255-1285
—	Rincon Red House (Kin-Klee-Chee)	Pueblo III	2	1126-1130
—	Klagetoh, large ruin	Pueblo III	1	1112
—	Klagetoh, small ruin	Pueblo III	1	1126
—	Kinnazinde	Pueblo V	11[3]	1720-1804
	RED ROCK VALLEY			
Canyon de Chelly: 8:3* (Gila Pb. Surv)	Broken Flute Cave	Basket-Maker II(?)-III	8	354—x-647

Site No.	Name	Cultural Stage	No. of Specimens	Range of Dates
Canyon de Chelly: 8:4* (G.P.S.)	Obelisk Cave	Basket-Maker III	7	477-488
—	Cave 1. (Morris)	Basket-Maker III	2	654-655
—	Cave 2. (Morris)	Basket-Maker III	17	642-759
—	Cave 6. (Morris)	Basket-Maker III	13	553-674
—	Cave 7. (Morris)	Basket-Maker III	3	666-674
—	Cave 8. (Morris)	Basket-Maker III	3	637-666
—	Bennetts Peak (3 mi. W.)	Pueblo I	11	675—x-857
—	Hospitibito (Bernheimer)	Pueblo III	1	1229(8)
—	Prayer Rock Cave	Pueblo III	1	1277(8)
—	Tocita (W. of Bennetts Peak)	Pueblo III	1	1126
	CHINLEE AREA			
—	Mummy Cave, tower	Pueblo III	36	1253-1284
—	Mummy Cave, east part and talus	Basket-Maker II(?)-III	28	348-666
—	Cave 1 at Mummy Cave	Pueblo I(?)	2	701-787
—	Sliding Ruin	Pueblo I(?)-II	8	833-957
NA 2185*(1)	White House	Pueblo III	14	1060-1275
—	Mindeleff's No. 15	Pueblo III	1	1011
	MESA VERDE AREA			
—	Step House	Basket-Maker III	1	625
—	Earth Lodge A	Basket-Maker III	6	612
Colorado: B:9:2*(9) (G.P.S.)	(Durango)	Basket-Maker III	1	650
Site 33 (Morris)	(Johnson Canyon)	Basket-Maker III-Pueblo I	8	831
Site 25 (Morris)	(La Plata)	Pueblo I(?)	2	836-845
—	Grand Gulch, Utah	Pueblo II(?)	2	1132-1135
Colorado: A:5:1* (G.P.S.)	Lowry	Pleblo II-III	1	987—x
—	Solomon Ruin	Pueblo III	2	1089
—	Oak Tree House[illegible]	Pueblo III	2	1112-1184
—	Spring House	Pueblo III	1	1115
—	Balcony House[illegible]	Pueblo III	4	1190-1272
—	Square Tower House[illegible]	Pueblo III	5	1194-1259
—	Spruce Tree House[illegible]	Pueblo III	21	1019—x-1274
—	Cliff Palace[illegible]	Pueblo III	5	1175-1273
—	Buzzard House[illegible]	Pueblo III	1	1272
—	Jug House	Pueblo III	1	1066
—	Ruin 16[illegible]	Pueblo III	4	1174-1265
—	Long House[illegible]	Pueblo III	10	1184-1273
—	Hemenway House[illegible]	Pueblo III	2	1172-1184
—	Painted Kiva[illegible]	Pueblo III	1	1202

NORTHWESTERN NEW MEXICO

Site No.	Name	Cultural Stage	No. of Specimens	Range of Dates
—	Aztec National Monument	Pueblo III	41	1110-1121
LA 1868*(12)	Gobernador Canyon	Pueblo V	1	1732±3
	CHACO CANYON AREA			
—	Pit House in Wash near Pueblo Bonito	Pueblo I	2	777±10
—	Kinbiniola*	Pueblo II	2	1120
—	Hungo Pavi*	Pueblo II-III	4	942-977
—	Pueblo Bonito	Pueblo II-III	67	828-1130
—	Pueblo del Arroyo	Pueblo III	30	1052-1101
—	Penasco Blanco*	Pueblo III	5	1056-1087
—	Chetro Ketl*	Pueblo III	5	1053-1073
	LITTLE COLORADO AREA			
—	Allantown(13)	Pueblo I-II(?)	13	823—x-1009
—	Kiatuthlanna	Early Pueblo III	1	1015±15
—	Showlow	Pueblo III-IV	461(3)	1174-1382
—	Pinedale	Pueblo III-IV	80(3)	1150-1375
—	Chavez Pass	Pueblo IV	2	1381
—	Hawikuh	Pueblo IV	3	1381-1480
	FORT APACHE AREA			
—	Kinishba*	Pueblo III-IV	4(14)	1238-1306

* See also other installents of this series.
(1) Museum of Northern Arizona Survey.
(2) Possible building in 900's. See McGregor's list, Tree-Ring Bulletin, Vol. 4, No. 4, April 1938, p. 6.
(3) Most of these dated by E. W. Haury.
(4) Reviewing Museum of Northern Arizona Collections, dated by John C. McGregor.
(5) Specimen collected by Arthur Woodward.
(6) Rainbow Bridge-Monument Valley Expedition, 1937. Reviewing of specimens dated by A. H. Schroeder, A. M. Withers, and F. H. Scantling.
(7) Gila Pueblo Survey. This includes reviewing of specimens collected up to 1938 and dated by E. T. Hall, A. Peterson, A. H. Schoeder and A. M. Withers.
(8) Confirming date by W. S. Glock.
(9) Reviewing I. F. Flora collection.
(10) Includes original callection and also reviewing H. T. Getty's collection for Mesa Verde National Park.
(11) Reviewing H. T. Getty's collection for Mesa Verde National Park.
(12) Laboratory of Anthropology Survey.
(13) F. F. H. Roberts collection mostly dated by Carl F. Miller.
(14) Reviewing specimens of Florence Hawley Senter and G. C. Baldwin.

THE VALUE OF TREE-RING ANALYSIS IN ENGINEERING

ROY LASSETTER

Climatic records as obtained from the annual growth of trees has led to the adaptation of the tree-ring technique in the field of engineering.

To those who are interested in the problem of water storage and utilization, it is fundamentally important to have some idea of climatic trends, the time span of drouth and maximum years, and the sequence of their occurence. The length of recorded climatic data is scarcely great enough to warrant its use in trend studies, but by using the available precipitation and run-off records to establish a relationship to tree growth values an approximation of hydrological conditions can be obtained for the length of time covered by an established growth curve.

It is true that the value of tree-ring analysis in interpreting past rainfall and run-off conditions has been the subject of considerable discussion, both for and against. But it is the belief of the writer that if those who have based their criticisms on their own untrained ovservations would go deeper into the specialized technique as set forth by those trained in tree-ring analysis many of their points of argument would be refuted.

There have been several studies made which definitely show the value of the tree-ring technique as an aid to hydrological problems. It is the purpose of this paper to report the problems and methods employed in a dendrochronological-hydrological study in northeastern Tennessee.[1]

The problems studied were:

1. The adaptation of the tree-ring technique to tree growth in the area.
2. The determination of the degree of relationship between tree growth and hydrological phenomena.
3. If a suitable relation existed, to compute the approximate precipitation and run-off from tree growth values as far back as the growth curve extended.
4. If possible, to learn something of climatic trends in the area.

It was believed that the conifers of the area would yield the best results but samples of many species of trees were collected to determine those best suited for such a study. Of the non-porous woods collected the two species best suited to the study were pine **(Pinus echinata)** and cedar **(Juniperus virginiana)**. There is also a definite possibility of using the oak **(Quercus alba)** of the area. Several reasons led to the use of the pine in preference to the two other species of wood named. The fact that the pine is more widely distributed throughout the area and that the oldest stands grow on slopes and ridges above the valleys are perhaps the most important reasons for its selection other than the legibility and sensitivity of its ring record.

The cedars of the area are by far the longest lived of the species studied but for several reasons, it was thought wise to use them only as secondary to the pine. The chief reasons being that there is little cedar left in the area, and that which is left, in most cases, grows directly on cliffs or in similar locations where there is a scarcity of soil, causing a hypersensitivity of growth rings and the questionable legibility of its ring records.

The following table gives a summary of the species and number of living trees collected:

SPECIES	NUMBER	SPECIES	NUMBER
Pine	640	Basswood	2
Cedar	291	Ash	2
Oak	257	Cucumber	2
Popular	78	Elm	2
Maple	16	Sweet Gum	2
Hickory	14	Black Gum	2
Chestnut	12		
Beech	6	Total	1,328

Of the pine approximately 90% had ring records sensitive enough to be cross-dated.

Twenty-five of the oldest and most sensitive pines were selected for final measurement and correlation purposes. Their selection was made so as to have a uniform distribution over the area which the hydrological data represented. After careful cross-dating[2] these specimens were measured, plotted, standardized, and an average growth curve established.

Precipitation and run-off values were obtained for both calendar and water years. It was believed that the water year (October 1 to September 30) which corresponds more nearly to the growth year, would yield the highest degree of correlation. This assumption was found to be true except when the correlation of smoothed values was attempted. The process of smoothing seemed to correct mechanically the lag between growth and calendar year precipitation values.

The correlation studies yielded coefficients ranging from .53 to .71, which is extremely high considering the unmeasurable conditions affecting tree growth, precipitation, and run-off. Equations were computed from the correlation figures by which the values of precipitation and run-off could be approximated when only the tree growth values were known. To determine the significance of these approximated values, precipitation figures were computed from the equations and plotted against observed values. The average error between computed and observed values was slightly less than ten percent over the past sixty years.

By further computation from the equation, approximate precipitation figures were carried back three hundred years. This span showed several interesting extremes. Drouth and wet periods exceeding in duration and extremity observed occurrences were encountered but the average approximated precipitation for the total of three hundred years was almost identical to the observed average of sixty years.

In conclusion it should be stated that a thorough investigation of the trees available in the area was made and a careful and extensive treatment given the data derived from both tree growth and hydrological phenomena. The results of the correlation study were highly consistent among themselves. The degree of dependence of tree growth upon precipitation appears to be such as to indicate that while precipitation is the most important factor influencing growth there are other important factors which also exert their influence. Temperature is perhaps the next most important as disclosed by a study using the Thornthwaite Precipitation Evaporation Index.

The relationships derived from tree growth appear to be satisfactory enough to be of definite value in approximating past hydrological conditions. In no other manner can values of similar significance be obtained, and it is the hope of the writer that a closer harmony will exist between the engineer and the dendrochronologist in their climatic research.

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1. The writer wishes to take this opportunity to thank Mr. Albert S. Fry, Head Engineer, Hydraulic Data Division, Tennessee Valley Authority, for his permission to use some of data derived from the Dendrochronological-Hydrological Study in the Norris Basin.

2. Cross-dating was first determined in the area by Dr. Florence Hawley Senter in the early summer of 1934.

RECENT TREE-RING WORK IN ALASKA

J. L. GIDDINGS, JR.

Tree-ring research in Alaska has been continued during 1938 by the Childs Frick Laboratories, through the University of Alaska, in connection with the collection of Pleistocene fossils from the frozen silt deposits of the Fairbanks region. As a basis for this work considerable atttention is being given to the growth of living trees as revealed in borings. Highly satisfactory results have been obtained from timberline trees.

Timberline in central Alaska ranges from 2800 feet to 3400 feet, depending upon the exposure. Timberline conditions are approximated also at altitudes as low as 2000 feet around the crests of unprotected domes. Spruce trees at timberline have, as a rule, particularly straight trunks and dense, symmetrical foliage. Except on wind-swept ledges trees are not deformed. Present in the trunk, however, and even in the branches, is a strong twist upward, or outward, to the right; and the trunk tends to be stocky and heavy at the base, though never actually dwarfed. These trees grow slowly, forming rings very sensitive to climate. Cross-dating qualities are present even in the earliest rings.

On a trip in June, 1938, to Eagle and Twelve-Mile Summits, about 100 miles north of Fairbanks, borings were obtained which give a growth record more than 300 years long. The plots of these borings show a high degree of identity. Though rings are sometimes microscopic, only two cases of actually missing rings have been observed. At Fairbanks, borings were taken on the nearby Ester Dome, Pedro Dome and Coffee Dome, and the records were found to be almost year for year the same as those from Eagle and Twelve-Mile Summits.

Naturally the question arose as to how far this particular record extended, whether it was to be found on the south side of the Tanana Valley in the rugged Alaska Range. In late August and early September an extended trip was made on foot from the Steese Highway to the railroad across 120 miles of the north slope of the Range. At all points where tongues of timber reach to the slopes of the high mountains borings were made. These have been found easily datable on a standard plot from Twelve-Mile Summit, over 200 miles away. Some variations occur from valley to valley across the range, but these are always minor in quality, disappearing when plots from several locations are standardized. Borings of standing dead timberline trees are as easily datable as those for which the last ring is known to be 1938. One boring of a dead tree 18 inches in diameter presents 443 rings, the outside date being 1877. The earliest date of this tree is then 1434 A. D. Two more records were obtained which are over 400 years long, and many are over 300 years.

The timberline record carries down the slopes to the valley bottoms with only a decrease in sensitivity, or rather, a decrease in the number of trees giving a consistent record. The record itself does not change. It is to be concluded from the evidence of timberline trees that climatic conditions have been for several centuries uniform over the whole area from the Yukon River south to the Alaska Range. Future work will delineate the extent of this range, and will determine the points where overlap of records occurs.