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DENDROCHRONOLOGY IN NORTHEASTERN UTAH*

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From both the climatic and archaeologic viewpoints the Uintah Basin and neighboring areas of northeastern Utah have for some years represented perhaps the most important unknowns in Southwestern dendrochronology. Across this region travel the airmasses carrying most of the water which feeds the Colorado River; here are found the hitherto undated ruins of the so-called Northern Periphery of the Southwest.[1]

Field studies of living trees in the summer of 1946 showed the region to be an extraordinarily rich source of tree-ring chronologies. Further field sampling in 1947 and in the spring of 1948, supplemented by a small but notable set of archaeological beams, resulted in the dating of several ruins and the construction of a climatic-archaeological tree-ring index continuous since A.D. 397.

THE CHRONOLOGY IN LIVING TREES

Groves of Rocky Mountain Douglas fir and pinyon pine of maximum age are to be found, it is now becoming clear, in an irregular belt the axis of which is just south of the 40th parallel in western Colorado and eastern Utah. Here, in what is in some respects a border zone between warm-dry and cold-dry climates, ecologic conditions seem to have been specially favorable to the evolution of races of hardy, slow-growth conifers. The long-lived drought conifers in the upper Colorado River Basin, particularly near Eagle and Glenwood Springs, have already been reported.[2] The western limit of this belt appears to be in the West Tavaputs Plateau of Utah, west of the Green River and to the south of the Uintah Basin. In this rain-shadow area east of the Wasatch Mountains, trees of the lower zone of the forest are spottily distributed on the sandstone and shale ledges and dry, rocky slopes deep in the dissected plateau; literally thousands of Douglas firs (often in almost pure though open stands) and pinyon pines may be found which exceed in age 500 years, and in many cases 700 years.

Of the sampled Douglas firs the longest ring series were reduced to four mean growth curves in Figure 1, panel D, as follows:

Sunnyside. 39° 36′ N, 110° 22′ W, elev. 7,200 feet, Whitmore Canyon just north of Sunnyside, Utah. Cores begin 1225, 1354, 1356, 1360, 1535.

Nine Mile C. 39° 48′ N, 110° 20′ W, elev. 6,500 feet, one mile strip along south wall of Nine Mile Canyon, just east of junction of Minnie Maud and Argyle Creeks. Cores begin 1221, 1240, 1326, 1334, 1358, 1510, 1510, 1550, the first four being measured only to 1400. The main Gillin beam collection (from Ruin 13—see below) was obtained in this area.

*Fourth report on quantitative master chronologies in the Pueblo area: see Tree-Ring Bulletin 12(2), 14(1), 14(2), 14(3).

[1]Julian Steward, Mus. Northern Arizona Bull. 5, 1933.

[2]Schulman, Jour. of Forestry 41:422-427, 1943.

Nine Mile B. 39° 46′, 110° 29′ W, elev. 7,000 feet, 5 miles westerly on road from C. Cores begin 1236, 1291, 1433, 1448, 1501, 1520, the first being measured only to 1550.

Nine Mile A. 39° 45′ N, 110° 32′ W, elev. 7,300 feet, 15 miles west and south on road from C. Cores begin 1186, 1204, 1227, 1256, 1270, 1273.

These four group curves were averaged to give the regional index plotted in the figure and tabulated (with the archaeological extension) in Table 2a.

Despite the combination of small annual growth and fair-to-high sensitivity, most increment borings showed very few or no locally-absent rings; several cores were obtained with complete records of over 600 years. On the other hand, Douglas firs on the most critical sites showed a very large number of such rings; e. g., in a 150-year interval 10 rings were omitted *everywhere* on one full section, an archaeological beam. False rings, as in other areas of the same or higher latitudes, were almost non-existent in the two principal conifers; occasional lines of traumatic resin ducts in younger trees were microscopically easily identifiable. All these phenomena are probably related to the lower winter temperature and shorter growing season at this latitude as compared with the main Pueblo area.

The Nine Mile chronology in Douglas fir is applicable over an area as yet undetermined but apparently quite large. Trees of this species sampled in Indian Canyon about 20 miles northwest of the Nine Mile C site and in Willow Creek Canyon in the East Tavaputs Plateau 45 miles southeast show essentially the same chronology. Sensitive Douglas firs of the Yampa Plateau should readily crossdate with the Nine Mile sequence.

Thus far only a limited study has been made of the pinyons of northeastern Utah. Sensitive trees of this species have shown no important differences in chronology from the record in Douglas fir. Two pinyon series have been plotted in Figure 1, panel D, for comparison purposes. Since these represent single trees they contain local variations which would average out in group means; yet the parallelism with the fir, particularly in the more sensitive NNM pinyon, is apparent. The SUN pinyon, of special interest, is considered now in some detail.

THE 975-YEAR PINYON PINE

On the first visit to Sunnyside in 1946 several pinyons were noted whose appearance indicated extreme over-age; these stood on the crest of a 400-foot ridge northeast of the junction of Whitmore and Bear canyons, some two miles north of the town. In these trees a sector as much as one-half or more of the main stem was entirely bare and surmounted by characteristically branchless snags, a relatively narrow lifeline of cambium under bark providing the link between the remaining living branch or two and the roots. All the stem borings in these were partial, because of rotted tree centers.

One of the largest pinyons, some 25 inches in diameter above the root flares, had one living branch, almost a foot in diameter at its junction with the stem four feet above the base. The core from this branch proved undatable because of erratic growth and extremely crowded rings, but a simple count indicated the branch to be over 800 years old.

Since it was hoped the central rings of this tree would provide the ring record in the gap between the living trees and the archaeological beams, it was cut down in May, 1948, and a section from the two-foot level brought to

the laboratory*. The central portion, though decayed, was nevertheless present in entirety and proved to have a pith ring date of A.D. 975. Thus this tree, SUN 2522, exceeded the previous record age for either pinyon or Rocky Mountain Douglas fir by over 100 years and crossed the gap (see below) with a long overlap. Unfortunately, its ring record has much lower chronology value than that in the associated firs, though it may be precisely dated throughout.

In felling this pinyon—only one other living tree has been cut down during the writer's ten years of field sampling—the main branch was first lopped off, laying bare the complete length of the 1946 boring. It could thus be noted that a thin sheath of resin had been deposited over the entire surface of the bore-hole. It is estimated that this branch, sound and bushy, would have kept the tree alive for at least another hundred years, though the decay of the main stem would have proceeded apace.

THE CHRONOLOGY IN ANCIENT TREES

Collections. The supersensitive ring chronology in the Nine Mile trees led immediately to a search for excavated beam material. It was soon found, however, that only a discouragingly small number of Douglas fir and pinyon pine specimens were available, for very few expeditions had worked in this region. On the other hand, the extremely slow growth in most Douglas firs resulted in long series from even the fragments of excavated charcoal.

The Thorne specimen. In September, 1934 a section of Douglas fir from Nine Mile Canyon, showing marvelous sensitivity, was sent to the Laboratory by Leo C. Thorne†. Despite the sensitivity and length of the sequence —about 275 rings could be counted on the 4-inch radius—no crossdating of this specimen with the Central Pueblo Chronology could be obtained at that time, a failure attributed to differences in chronology between the two regions.

The Gillin collection. Through the courtesy of Charles E. Dibble of the University of Utah, sections were obtained in August, 1946, from six logs of Douglas fir excavated by Gillin[3] in Nine Mile Canyon. Attempts to date these just after excavation had led to the same conclusion as that just noted for the Thorne specimen. Though limited in number, the relatively great length of the individual sequences made this collection highly representative; it remains the only extensive group thus far in hand.

On a visit to Gillin's Ruin 13 at Nine Mile Canyon in 1947 a small but datable charred section was picked up, NNM-9 (see below). Another fragment at that site proved to be a discarded piece of beam NNM-3.

The Reagan Collection. A bag of over 100 small charcoal fragments from Long Mesa Ruin, 40 miles southeast of the Gillin sites, was contributed in December, 1946 by W. S. Stallings. These specimens had been sent to the Laboratory of Anthropology at Santa Fe by Reagan in August, 1931, with

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*I am indebted to R. B. McAllister, Soil Conservation Service, Price, Utah, who helped cut this resin-saturated tree.

†Photographer for A. B. Reagan. See Archaeological Finds in the Uintah Basin in Utah, Wisconsin Archaeologist 11:162-171, 1932. It was this specimen which excited the writer's curiosity as to the nature of the chronology in living trees of the area and led eventually to the analysis here reported.

[3] John Gillin, Univ. Utah Bulletin 28 (11), 1938.

the following note. "Charred beams of the first roof of the south circular room of Long Mesa Ruin of Hill Canyon about 40 miles south of Ouray, Utah. The first roof was burned. Then at a later time this building was repaired and a crosswall was placed on the fallen debris of the former roof."

Largely because of the pronounced sensitivity and crossdatability all these fragments could be reduced to just four different beams.

The Dinosaur Monument collection. Several small pieces of pinyon pine and some fragments, of doubtful datability, of juniper and hardwoods, obtained by the University of Colorado Museum in preliminary work in Yampa Canyon in northwestern Colorado, were sent to the Laboratory early in 1948 through the courtesy of Earl Morris and Robert F. Burgh. It is probable that the pinyon specimens will be dated when a sufficiently large collection from this area is available.

The Peabody collection. In June, 1948, the writer reviewed, with Donald Scott and J. O. Brew, at Harvard University, the small number of wood artifacts obtained by these and other members of a reconnaissance expedition of the Peabody Museum in northeastern Utah in 1931. Only one long sequence of Douglas fir was found in the collection, specimen A-7869, which proved datable and contained 185 rings in a radius of slightly over one-half inch; the average ring-width of 0.08 mm is substantially less than that in any other dated beam in the Southwest.

Dating the collections. It seems desirable to present in some detail the dating operations, which involved some special features. The results are summarized in Table 1.

Table 1. Dated specimens in northeastern Utah

Specimen no.	Site	Form[1]	Species[2]	Mean ring-width, mm[3]	Plot scale[4]	Inner ring, A.D.[5]	Heartwood ends, A.D.	Outer ring, A.D.[6]
NNM-1	Nine Mile X	Sec.	DF	0.36	1	665 p	908	951 + v
NNM-2[7]	Nine Mile X	Sec.	DF	0.44	1	708 p	.....	915 + vv
NNM-3	Nine Mile X	Sec.	DF	0.18	2	806 p	1025?	1145 + b
NNM-5	Nine Mile 13	Sec.	DF	0.27	2	894 p	1042	1090 v
NNM-6	Nine Mile 13	Sec.	DF	0.30	2	725 p	1015	1055 + v
NNM-7	Nine Mile 13	Sec.	DF	0.68	1	936 p	1023	1061 c
NNM-8	Nine Mile 13	Sec.	DF	0.30	2	397 p	.....	768 vv
NNM-9	Nine Mile 13	Sec.	DF	0.23	2	760 p	.....	970 + vv
HLL-1	Long Mesa	Ch frags.	DF	*[8]	2	798 p	.....	957 vv
HLL-2	Long Mesa	Ch frags.	DF		2	886 p	.....	1012 vv
HLL-3	Long Mesa	Ch frags.	DF		2	850 p	.....	991 vv
HLL-4	Long Mesa	Ch frags.	DF		2	911 p	.....	1073 vv
A-7869	Nine Mile Area	Sec.	DF	0.08[9]		760 p	885?	924 vv

[1]Sec—wood section; ch frags.—charcoal fragments.
[2]DF—Douglas fir.
[3]Over measured interval plotted in the figure.
[4]1—standard vertical scale of 0.5 mm ring-width per scale division on margin of Figure 1; 2—0.25 mm per scale division.
[5]p—pith ring present.
[6]b—bark present;
a—outside ring constant along outer face of specimen—probably very few or no rings lost;
v—outside ring variable, possibly 5 or more rings lost;
vv—outside ring very variable, probably many rings lost;
+—outer rings very crowded, probably some absent.
[7]These have been renumbered, the equivalent numbers in the Univ. of Utah set being: 2, "Donated"; 3, 8-1; 5, 13-2; 6, 13-3; 7, 13-4; 8, 13-5. Site X of NNM-2 is probably the same as that of NNM-1.
[8]1A-0.61; 1B-0.40; 2A-0.43; 2B-0.35; 2C-0.26; 3A-0.40; 3B-0.20; 4A-0.30; 4B-0.31.
[9]Specimen received too late to include in Figure 1.

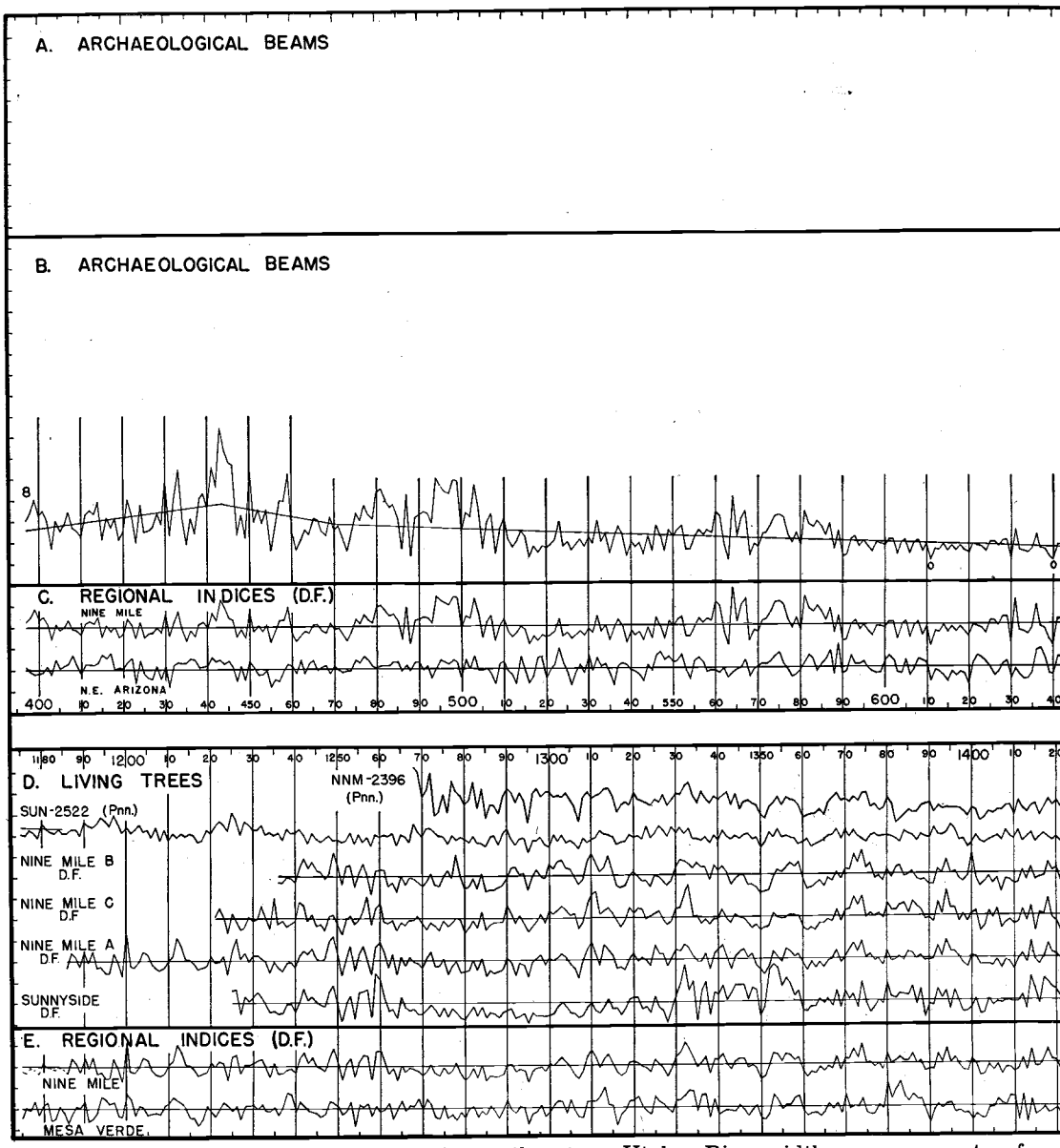
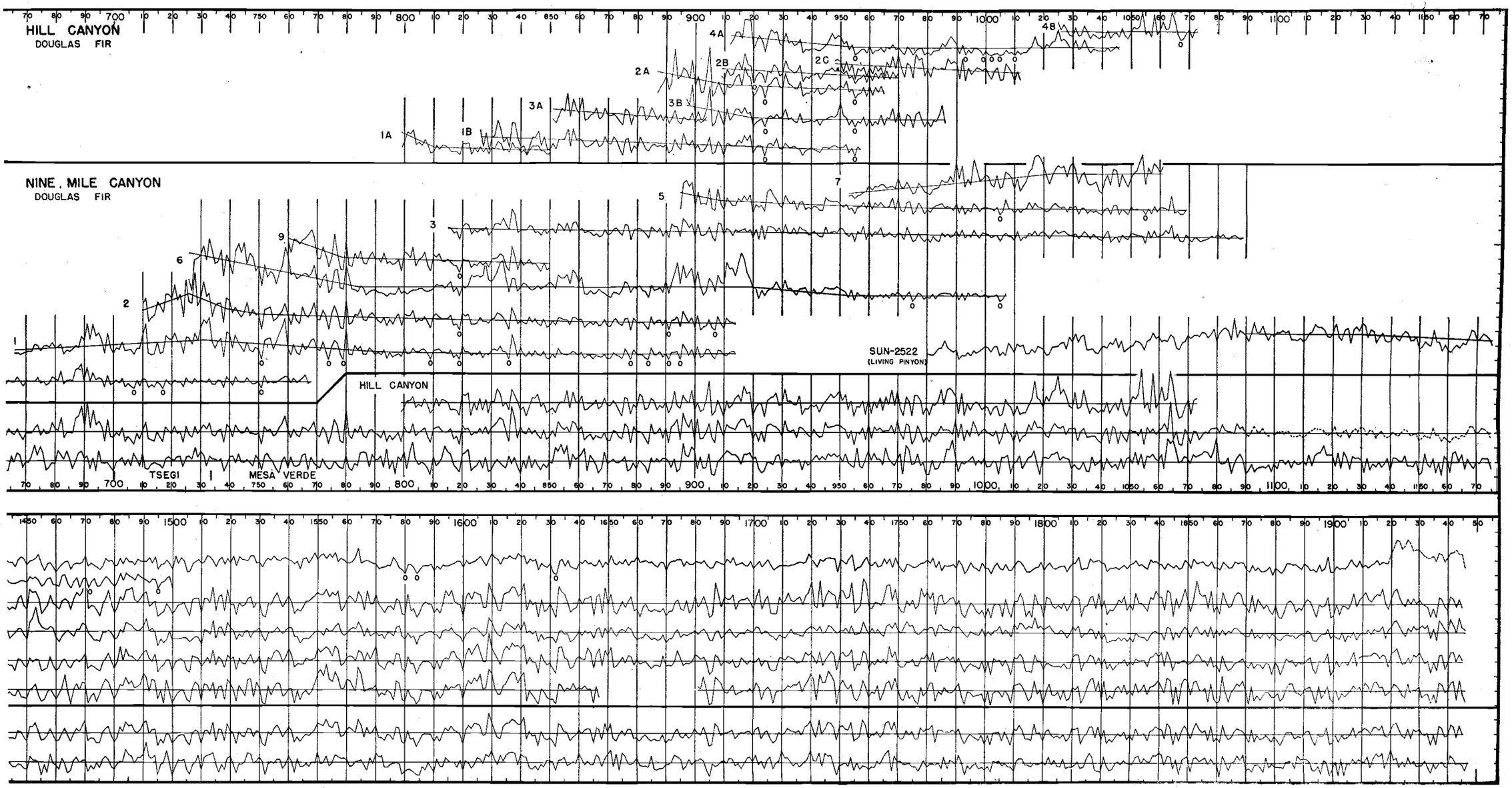


Figure 1. Growth records in northeastern Utah. Ring-width measurements of dated beams are plotted in panels A and B; trend or standardizing lines are superposed. Zeros below the curves indicate locally-absent rings. The number of specimens on which the living-tree series of panel D are based may be found, for any interval, from the group data on page 2. To avoid overcrowding, the vertical scale of the growth curves plotted in panels A and B is omitted, but may be found in all cases by reference to Table 1, sixth column, the absolute minimum of each curve being at or near 0.0 mm.



The two individual pinyon series of panels B and D are plotted for comparison purposes only, except for the interval 1090-1185 of SUN 2522, which has been standardized to give tentative indices across the gap in the Douglas fir records. The comparison curve for Mesa Verde, plotted below the Nine Mile index in panels C and E, has been extended back preceding A.D. 733 by the Tsegi and northeastern Arizona sequences to A.D. 397; most of this extension is part of the early Pueblo area chronology, to be published shortly in detail in this Bulletin.

Table 2a. Tree-ring indices for Douglas fir in Nine Mile Canyon area, northeastern Utah: ring-widths in per cent of the growth trend*

A.D.	0	1	2	3	4	5	6	7	8	9
390	....	....	....	....	....	....	....	127	146	184
400	136	149	117	41	113	86	102	130	88	81
410	66	118	127	117	145	56	106	80	102	52
420	71	138	108	44	120	47	66	72	96	75
430	158	55	120	174	87	34	81	53	115	122
440	98	164	130	228	196	138	134	51	86	46
450	170	78	101	76	105	25	74	128	130	192
460	67	28	50	76	67	104	104	77	68	116
470	85	93	61	30	76	131	111	151	127	114
480	189	197	166	147	157	121	37	188	19	126
490	134	142	138	112	236	218	205	200	236	234
500	92	148	135	227	160	41	118	146	28	100
510	134	68	47	66	97	81	13	49	30	52
520	47	56	72	134	50	66	40	57	74	52
530	85	65	141	70	100	30	88	124	97	18
540	75	53	69	28	91	39	135	97	39	116
550	93	124	140	47	47	97	124	107	124	117
560	206	185	71	00	270	111	185	219	26	74
570	67	119	127	161	204	207	195	125	86	133
580	71	232	176	160	188	160	120	176	56	140
590	21	28	102	121	71	97	68	47	91	87
600	85	111	111	32	100	112	37	97	114	48
610	88	00	63	60	95	60	86	61	88	63
620	42	96	86	82	55	116	118	92	132	133
630	06	214	66	61	49	82	189	83	78	26
640	00	122	116	76	120	93	65	103	75	106
650	108	124	118	97	139	83	17	172	88	98
660	00	36	118	64	118	90	79	119	74	44
670	93	93	91	124	147	77	111	85	91	162
680	119	108	197	55	96	95	94	193	205	275
690	135	294	129	247	148	171	135	34	182	65
700	61	96	73	128	36	65	43	17	92	46
710	108	167	54	45	37	104	62	36	132	104
720	89	138	93	102	29	141	84	63	137	90
730	120	146	122	162	80	74	106	118	29	152
740	126	67	144	113	92	98	132	93	88	83
750	93	13	138	107	120	73	83	125	157	212
760	121	60	118	80	68	130	123	104	135	166
770	78	67	134	100	20	98	183	141	38	25
780	243	77	55	121	96	139	74	60	110	117
790	86	81	60	107	37	79	47	68	99	35
800	133	98	96	152	75	99	109	124	75	26
810	120	133	135	105	99	102	121	51	70	12
820	143	117	124	79	96	91	123	88	133	84
830	125	145	164	199	181	110	37	273	197	56
840	133	93	86	129	85	113	81	55	116	52
850	67	109	66	168	138	116	136	97	170	157
860	106	138	48	70	84	50	78	63	59	98
870	40	41	104	101	66	52	155	133	24	135
880	102	102	91	54	18	155	85	96	126	56
890	127	26	134	151	183	49	228	173	130	183
900	45	187	52	56	93	156	64	24	180	124
910	67	149	131	122	113	159	184	186	132	144
920	51	98	36	104	32	143	155	140	133	115
930	74	178	109	104	119	63	131	128	105	80
940	64	118	85	68	72	167	134	137	140	149
950	147	125	116	57	110	15	101	85	128	50
960	152	60	135	110	126	104	106	107	148	89
970	175	95	52	156	145	18	53	144	95	31
980	67	34	98	76	98	142	114	116	111	86
990	181	63	156	41	113	72	172	132	78	108
1000	124	98	84	77	112	21	62	161	102	92
1010	36	111	37	73	82	157	113	176	131	136

A.D.	0	1	2	3	4	5	6	7	8	9
1020	120	79	66	124	160	132	128	143	86	124
1030	122	131	45	107	129	72	72	77	77	43
1040	29	98	134	29	145	125	24	109	67	37
1050	123	108	110	78	124	22	137	101	126	89
1060	118	128	162	110	315	52	105	20	16	124
1070	90	26	109	104	52	84	104	98	124	129
1080	135	103	156	119	107	106	99	164	129	143
1090	92	76	107	147	108	109	132	99	78	104
1100	92	108	107	114	108	113	80	79	78	86
1110	73	82	108	110	136	127	125	116	94	90
1120	106	142	89	78	116	122	68	114	128	113
1130	141	135	88	120	114	69	95	112	80	72
1140	80	105	90	82	108	124	116	84	86	99
1150	51	60	85	74	66	138	84	86	44	75
1160	50	39	64	76	59	85	77	108	149	142
1170	97	110	133	124	109	75	72	91	82	64
1180	117	100	90	84	96	84	65	140	114	72
1190	141	93	144	65	71	45	45	136	94	27
1200	222	78	71	95	141	131	85	62	54	64
1210	101	122	204	167	106	102	85	56	65	73
1220	119	98	122	111	35	143	152	63	107	104
1230	112	124	131	96	49	117	64	65	84	88
1240	69	134	162	115	144	99	96	77	140	181
1250	115	33	110	139	49	119	152	145	35	167
1260	171	118	62	87	28	102	67	89	83	76
1270	57	71	103	62	48	90	60	74	112	61
1280	32	45	86	44	103	27	49	47	47	57
1290	102	103	66	81	76	19	73	87	92	66
1300	108	98	119	137	114	91	53	34	70	136
1310	170	138	86	128	148	104	63	46	61	111
1320	118	110	94	84	64	124	104	83	43	82
1330	137	157	205	178	137	88	108	134	55	124
1340	121	149	103	76	115	126	125	82	93	80
1350	30	40	94	153	146	113	146	141	117	130
1360	65	40	60	55	81	64	89	79	132	71
1370	126	123	171	125	195	103	107	84	101	77
1380	148	104	116	133	117	116	143	99	114	65
1390	76	74	147	107	176	107	130	87	70	65
1400	121	100	42	54	95	68	97	48	81	81
1410	62	77	121	70	164	85	84	122	170	120
1420	114	76	76	115	172	153	138	151	147	78
1430	115	137	136	85	103	59	152	74	49	93
1440	112	145	55	87	64	67	58	114	104	70
1450	46	144	142	172	114	49	59	81	127	86
1460	49	51	97	134	91	45	94	132	111	148
1470	185	49	66	61	34	34	101	130	148	87
1480	39	75	146	109	178	152	158	115	106	126
1490	167	183	95	120	127	15	56	32	99	89
1500	29	56	78	88	86	43	18	102	119	109
1510	32	117	120	90	176	50	128	127	47	165
1520	115	109	30	107	80	79	132	128	74	116
1530	117	32	12	110	87	128	155	126	73	104
1540	140	119	36	71	40	68	92	82	99	124
1550	167	159	150	194	145	137	175	171	73	80
1560	120	139	122	100	191	156	71	137	94	108
1570	145	69	67	45	87	82	53	138	133	39
1580	25	118	57	61	05	49	87	97	95	92
1590	41	79	40	91	137	114	148	119	106	97
1600	22	120	157	132	167	165	157	85	92	241
1610	186	128	79	66	147	171	173	198	186	165
1620	167	212	62	115	84	87	15	115	69	59
1630	71	48	10	166	152	114	107	51	78	91
1640	124	100	121	133	130	32	132	132	52	170
1650	106	165	62	52	91	119	85	128	129	68
1660	73	47	75	93	63	48	60	52	52	94
1670	37	57	54	100	137	80	70	92	67	85

A.D.	0	1	2	3	4	5	6	7	8	9
1680	134	103	86	145	92	12	26	169	144	88
1690	102	103	111	122	62	88	108	103	107	107
1700	86	133	144	63	109	120	64	38	51	112
1710	96	101	134	122	116	115	120	91	144	156
1720	191	128	76	195	101	133	179	171	146	53
1730	147	158	134	124	178	51	65	84	196	158
1740	67	97	92	118	77	99	176	188	123	180
1750	99	62	67	123	93	117	66	61	140	113
1760	137	131	158	39	126	125	115	117	112	129
1770	108	134	68	31	70	95	81	68	58	92
1780	29	90	24	104	105	110	56	117	73	25
1790	137	126	163	128	64	66	55	173	103	114
1800	49	118	132	89	77	90	73	101	52	74
1810	139	134	144	34	82	101	150	150	79	148
1820	59	127	39	65	49	82	107	85	120	63
1830	95	61	138	94	97	103	58	122	128	153
1840	139	137	67	173	149	29	118	57	125	160
1850	124	69	131	179	135	114	129	59	158	53
1860	77	45	162	95	64	83	122	141	132	122
1870	87	47	131	49	94	69	72	97	75	49
1880	83	57	25	64	112	115	115	70	85	78
1890	97	121	120	62	23	106	83	96	145	32
1900	45	97	49	95	72	80	106	150	81	121
1910	123	146	134	109	150	152	131	161	96	85
1920	136	173	181	134	91	78	139	74	136	120
1930	139	107	96	105	27	92	29	158	141	86
1940	93	168	155	80	164	102	(73)	(110)	.....	.....

Table 2b. Tree-ring indices for Douglas fir in Hill Canyon, northeastern Utah: ring-widths in per cent of the growth trend*

A.D.	0	1	2	3	4	5	6	7	8	9
790	.....	.....	.....	.....	.....	.....	.....	.....	.....	39
800	67	114	116	143	68	89	74	127	88	26
810	55	126	76	125	115	101	53	57	46	14
820	158	150	166	13	100	49	129	46	119	29
830	113	103	199	164	76	101	50	193	154	110
840	49	72	10	74	134	133	160	72	102	32
850	46	61	33	85	107	100	185	64	173	111
860	98	144	55	59	78	93	123	61	79	137
870	85	82	114	92	48	09	132	125	21	85
880	65	161	140	54	65	132	112	55	83	65
890	105	31	72	180	79	64	152	116	97	184
900	50	101	41	55	126	246	12	38	119	67
910	13	112	69	85	133	156	112	216	163	175
920	14	65	99	88	03	114	131	141	164	85
930	88	193	111	112	90	89	144	22	60	59
940	85	71	84	38	85	111	137	161	136	151
950	180	117	157	57	112	04	72	70	114	21
960	123	30	108	66	135	49	143	93	189	88
970	181	64	18	146	112	14	151	152	118	22
980	76	18	86	84	113	192	95	188	202	184
990	147	25	166	13	97	52	97	108	95	56
1000	79	65	19	64	80	17	21	124	86	71
1010	13	81	22	36	36	84	128	252	136	120
1020	76	148	116	176	192	285	164	199	148	81
1030	69	176	62	77	190	96	30	74	60	40
1040	56	43	107	38	78	103	53	138	52	10
1050	86	148	131	162	334	66	107	34	307	66
1060	110	217	120	134	325	223	69	00	10	79
1070	127	28	124	138						

*The number of trees on which these data are based, for any dates, may be determined from the figure (beam data) and from the tree-group descriptions on page 2.

In analysing the Thorne specimen, NNM-1, the entire circuit had been carefully examined and a number of rings found which were present only along short arcs. That not all locally-absent rings were discoverable in this way became clear when the Gillin collection, NNM-2 to NNM-8, was obtained, for the immediate crossdating with NNM-2 (marked "Nine Mile Donated" on the original beam) showed eight rings present in the more open series of the latter which were completely omitted on the Thorne specimen. The eventual crossdating with other beams brought to light two more rings completely omitted in *both* of these specimens.

The bulk of the Gillin collection differed characteristically in chronology from NNM-1 and NNM-2. Tendency to complacency and to what seemed to be suppression effects with resultant excessive crowding of rings, associated with extremely small average ring-width and evidence for much variation in chronology from tree to tree, made the crossdating work by skeleton plots very uncertain. Direct crossdating on the wood in the usual fashion was obtained after much labor between only two of these specimens.

A new attack was then made. All ring-widths were measured and the complete individual growth curves compared. Though such comparisons have long been used[1] in presenting the evidence after the dating was solved, this method as a dating *tool,* tho much more laborious than the skeleton plot, proved useful in meeting the difficulties in chronology above noted, particularly since the chronology in the living trees had in the main been found free of false and locally-absent rings. With this aid, all of the NNM specimens were joined into one floating series with the exception of NNM-8. A tentative match of the mean standardized growth curve of the crossdated specimens with the Mesa Verde mean growth in Douglas fir was made, very strong in some decades but too variant in others to allow confidence in its validity.

The unmatched section NNM-8 showed great wear on the outside and no sapwood. On the unusual possibility that it might have lost hundreds of rings and thus antedate the others, its growth curve was minutely checked against the early Pueblo chronology. It was with some astonishment that it was found to match the northeastern Arizona record in the fifth and sixth centuries; by good fortune, a large number of outstanding indicator years and decades were common to the two regions in those centuries and happened to be well recorded in NNM-8. Although the dating seemed conclusive, it entirely preceded the tentatively dated sequence of the other Nine Mile beams. On a trip to Salt Lake City in January, 1948, the log of NNM-8 at the University of Utah Museum was again sectioned at a critical level. An additional half-inch of wood more recent than any on the original section was found; it carried over 100 rings and gave a long and decisive overlap between the two segments of the Nine Mile archaeological sequences, thus verifying all dates. The complete sampling some months later of the 975-year pinyon, described above, joined the archaeological to the living-tree sequence in Douglas fir.

With the master chronology for the Nine Mile area now established, the dating of all remaining specimens in Table 1 was a simple matter of curve matching followed by wood-to-wood testing of ring details. The Hill Canyon sequences are plotted in parallel with the Nine Mile records in the figure, and thee standardized growth index is given in Table 2b.

[1]Douglass, Smithsonian Report for 1931, 304-312.

The cutting date of A-7869 seemed to be near A.D. 900 at first, since the cut section showed nearly the same outside date around the entire circuit; however, the small number of associated sapwood rings led to minute examination near a knot elsewhere on the specimen. Some 25 additional microscopic rings showed up, indicating a cutting date possibly no earlier than A.D. 950. As already shown on NNM-8, the loss of outside rings from beams of Douglas fir of this region may occasionally be much greater than is common in other areas, a fact which must not be lost sight of in archaeological interpretation of material from future excavations.

It would appear from Table 1 that ruins in Nine Mile Canyon carried construction dates in the 950's, 1060's, and 1150's; Long Mesa Ruin showed building activity later than A.D. 1073.

CORRELATIONS

The average 50-year correlation coefficient, Mesa Verde growth *vs.* Nine Mile *C* for the relatively well-based interval of the 800's and 900's is shown in Table 3 to be +0.38, of the same order of magnitude as that between the living-tree growth indices. This compares with a general average for like data of +0.68 for Mesa Verde *vs.* Tsegi and +0.57 for Mesa Verde *vs.* Flagstaff[5].

Table 3. Correlation Coefficients between Southwestern Indices

	MV:NM-C	MV:NM	MV:So. Ariz.
800-849	+.32		
850-899	.44		
900-949	.31		
950-999	.46		
Mean, 800-999	.38		
1650-1699	.40	+.37	+.52
1700-1749	.33	.54	.54
1750-1799	.43	.49	.55
1800-1849	.44	.67	.62
1850-1899	.50	.67	.39
Mean, 1650-1899	.42	.58	.52

Local variations in chronology seem to be particularly strong in the Tavaputs area. However, the mean of the four Nine Mile groups, representing an area of some 50 square miles, probably gives a good first approximation to the climatic chronology of the Uintah Basin area. The regional mean coefficients in Table 3, columns 3 and 4, indicate that there is about as much general variation in chronology between Mesa Verde and Nine Mile some 200 miles to the north-northwest as between Mesa Verde and southern Arizona[6] some 350 miles to the south-southwest.

As in other papers of this series, detailed analysis of the climatic indices here developed is postponed until the network of Southwestern indices is essentially complete.

It is now evident that, in terms of tree-ring history, the Uintah Basin and neighboring areas represent an exceedingly rich archaeological source of material. Innumerable ruins await exploration; Douglas fir beams, and perhaps also those of pinyon pine, from such ruins should not only provide immediate archaeological dating but add important extensions to the climatic history of a critical region of the Southwest.

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[5]Schulman, Tree-Ring Bulletin 14(3), 1948.

[6]Schulman, Bull. Amer. Meteorological Soc. 23:213, 1942.