

AN EXTENSION OF THE DURANGO CHRONOLOGY*

EDMUND SCHULMAN

This supplementary report on the dendrochronology of the Durango, Colorado, area presents a number of additional beam dates which have now permitted separate development of climatic indices for each of the three major datable species found in the ruins of this area.

The analysis of the Earl H. Morris tree-ring collections at the Falls Creek Caves and the associated IGN 7:101 site, north of Durango, has been published in the April, 1949, issue of the *Bulletin*. An additional set of charcoal specimens from the latter site was recently sent to the Tree-Ring Laboratory through the courtesy of Morris, Harold S. Gladwin, and Deric O'Bryan. The dates obtained for several beams in this set support the results of the earlier analysis; the ring indices strengthen the climatic chronology especially in the 200's A.D. Specimen data are summarized in Table 1 and the sequences presented *in extenso* in panel A of the figure. Included in this panel is an excellent record in a wood fragment, DF-6, presented by I. F. Flora in 1939, which has no absent rings in its 100-year series despite an average ring-width of 0.17 mm. Duplicate specimens and numerous short sequences were not included in this extension, except for the two earliest series plotted in panel A, which proved to represent fragments of beam III-4, the earliest Durango record in the April, 1949, report. The Durango group mean in that report has been slightly revised so that it includes only Douglas firs (ponderosa pine specimen DPL-2 was deleted from the averages) and is compared at the bottom of panel A with the group mean of the additional set. On the basis of the new material the date of the assigned absent ring in specimen I-9 of the earlier report has been changed from A.D. 287 to A.D. 286.

A small fragment of unburnt pinyon pine with bark ring clearly intact, from the South Cave at Falls Creek, was received from Morris and R. F. Burgh on October 3, 1949. This specimen, 38-2728, proved to have been cut after the growth for A.D. 198 was complete; it provided a valuable comparison of the chronology in part of the 100's A.D. in different species. This ring sequence is plotted in the insert in panel A.

Two ponderosa pine fragments from the Falls Creek Caves were dated in the 100's A.D. and, with two later pine sequences, are plotted in panel B. The striking minimum in growth during much of the 120's and 130's supports the evidence in the Douglas fir record during this interval and suggests that the corresponding very pronounced minimum in specimen M-143 from northeastern Arizona (considered a possible pest effect and therefore deleted from the index for that area in the April, 1949, *Bulletin*) may possess climatic significance.

In panel C are shown two series from the Falls Creek Caves with end dates in the 500's A.D. The latest, at A.D. 575, is very near the actual bark date.

Pinyon beams obtained by Flora in several localities, mainly in the eastern portions of the Durango area, were dated by growth-curve comparison after the fashion of the Utah datings described in *Bulletin* 15 (1/2), and are plotted in full in panel D. Of particular note is specimen IF-109, which contains an extremely sensitive sequence of some 260 years in less than two inches of radius; the early part of this sequence is plotted in *Bulletin* 15 (4). It is remarkable that the mean growth curve based on these pinyons is so strongly parallel to the index in Douglas fir from Mesa Verde, as shown at the bottom of the panel.

In the lowest panel, E, is shown the chronology in IF-315 from the Durango area, notable for its record of the "great drouth" of the late 1200's, which is well-centered in a comparatively long pinyon series. This 225-year ring sequence in the outer portion of a tree which must have been about 400 years old is particularly instructive as a climatic history, because no cor-

*Sixth report on quantitative master chronologies in the Pueblo area. For previous reports see *Tree-Ring Bulletin*: 12(3) and table in 14(1); 14(2); 14(3); 15(1/2); 15(4).

rection for age trend is needed (i.e., the standardizing line is parallel to the time axis).

The usual data on the plotted series are listed in Table 1; the "heartwood ends" column has, however, been omitted, since sapwood is not determinable by inspection in charcoal and is difficult if not impossible to identify in pinyon and frequently also in ponderosa pine.

Species means of the individually standardized ring sequences are given in Table 2. The number of specimens (trees) on which the index value for any year is based may be found by reference to the diagram in this report and in *Bulletin* 15 (4).

Table 1. Dated Specimens from the Durango Area¹

Specimen No.	Site	Form	Species	Mean Ring-Width, mm.	Plot Scale	Inner Ring, A.D.	Outer Ring, A.D.
2728	Falls Creek	¼ sec.	PNN	0.43	1	140 p	198 c
III-2	IGN 7:101	ch. ¼ sec.	DF	0.46	1	096	188 c
III-4A	IGN 7:101	ch. fr.	DF	0.38	1	102	188 c
DF-6	Falls Creek ²	fr.	DF	0.17	2	143	243 c ²
I-14	IGN 7:101	ch. fr.	DF	0.76	½	189	280 vv
I-5	IGN 7:101	ch. ¼ sec.	DF	0.67	1	201 p	285 vv
FILL-1	IGN 7:101	ch. fr.	DF	0.47	1	241	316 vv
I-X	IGN 7:101	ch. ¼ sec.	DF	0.86	½	238 p	321+v
I-Y	IGN 7:101	ch. fr.	DF	0.72	1	253	324 vv
I-11	IGN 7:101	ch. fr.	DF	0.97	½	265	318 vv
ADE-27	Falls Creek	ch. fr.	PP	0.43	1	120	179 vv
ADE-33	Falls Creek	ch. fr.	PP	0.25	2	148	194 vv
AB-1 ⁴	Falls Creek	fr.	PP	1.02	½	206	260 vv
DPL-2 ⁴	IGN 12:1 ⁸	¼ sec.	PP	1.32 ⁵	½	254	349 vv
AC-8	Falls Creek	ch. fr.	DF	0.33	2	451	543+vv
AC-21	Falls Creek	fr.	PP	0.31	2	493	575 v
IF-109	Cornelius Cave ⁸	fr.	PNN	0.17 ⁶	5	669	930+vv
IF-110	Cornelius Cave ⁸	sec.	PNN	0.28	2	796 p	945+vv
IF-210	Cueva Grande ⁸	¼ sec.	PNN	0.75	1	826 p	921 vv
IF-209	Cueva Grande ⁸	sec.	PNN	0.47	1	838 p	955 vv
IF-203	Cueva Grande ⁸	sec.	PNN	0.43	1	826 p	1016 vv
IF-206	Cueva Grande ⁸	sec.	PNN	0.67	1	853 p	931 vv
IF-309	?	sec.	PNN	0.31	2	876 p	1072 vv
IF-315	Gobernador ⁸	¼ sec.	PNN	0.43	2	1171	1394 v

¹See *Bulletin* 15(4), 1949, for symbol code.

²Fragments adhering to the outside are probably bark. Heartwood ends at A.D. 202.

³I. F. Flora locations. Cueva (Cava) Grande is in the Pine River drainage; a number of associated pinyons were dated in this series but have lower climatic worth and were omitted.

⁴Listed in first Durango set in Table 1, *Tree-Ring Bulletin* 15(4), 1949. DPL-2 was also plotted in that report.

⁵Over interval 254-349. Plotted in 15(4).

⁶Over interval 670-915.

Table 2. Tree-Ring Indices for the Durango Area, Southwestern Colorado: Ring-Widths in Per Cent of the Growth Trend
A. Douglas Fir

A. D.	0	1	2	3	4	5	6	7	8	9
90	.....	.....	.....	.....	.....	.....	.....	100	95	111
100	101	91	100	147	106	75	108	80	76	77
110	136	136	125	139	106	93	73	97	79	106
120	40	37	36	33	63	57	80	84	77	65
130	87	41	84	111	96	115	116	83	165	100
140	128	139	135	142	131	78	137	103	118	135
150	53	95	114	135	65	144	148	86	74	29
160	97	122	104	147	109	51	144	49	91	88
170	154	148	19	121	99	100	44	125	49	94
180	106	71	134	154	107	101	130	143	174	79
190	45	122	132	112	73	105	136	107	96	43
200	108	25	78	140	128	75	128	101	109	148
210	64	95	118	95	51	48	90	66	52	78
220	96	136	130	123	164	91	98	155	149	37
230	97	64	167	180	129	103	39	101	96	59
240	128	106	105	128	74	51	121	98	51	117

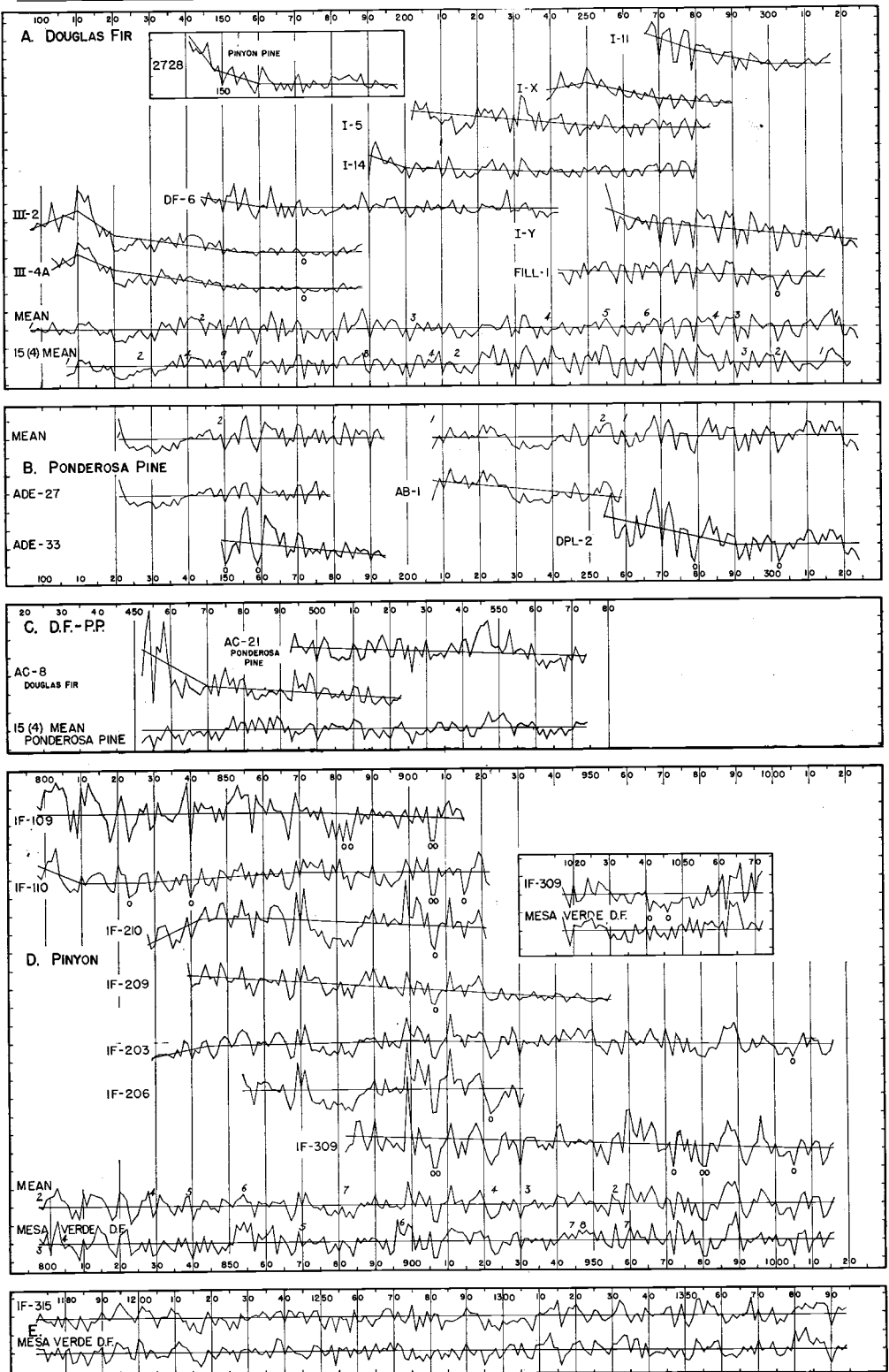


Fig. 1. Measured ring-widths in dated specimens from the Durango area. Trend lines superposed; zeros below the curves indicate locally-absent rings; figures along the mean curves represent the number of specimens on which these curves are based.

A.D.	0	1	2	3	4	5	6	7	8	9
250	120	110	139	87	151	158	122	68	41	110
260	113	60	47	118	101	60	119	120	156	130
270	49	149	143	149	27	85	147	143	110	16
280	168	133	133	142	132	80	49	91	155	123
290	132	14	100	78	40	163	120	89	103	126
300	123	120	22	68	134	129	80	55	42	96
310	106	116	90	68	109	134	163	186	118	139
320	79	60	90	76	31	.....	.....	.....	.....	.....
450	.....	.....	58	132	174	26	121	112	184	114
460	55	73	56	33	98	71	67	61	57	89
470	106	72	158	61	145	187	109	143	81	138
480	148	67	93	58	55	76	70	93	93	84
490	111	93	64	50	224	125	144	108	211	183
500	59	102	139	130	76	96	84	128	62	78
510	170	164	63	58	178	67	46	76	112	67
520	44	88	90	129	.....	.....	.....	.....	.....	.....

B. Ponderosa Pine

A. D.	0	1	2	3	4	5	6	7	8	9
120	.....	212	129	73	50	59	40	47	59	63
130	54	21	33	61	42	35	80	42	85	92
140	101	106	99	122	113	139	148	94	96	120
150	31	71	111	128	65	193	226	111	61	21
160	108	190	167	154	156	94	156	52	98	78
170	175	168	44	108	101	148	71	142	65	98
180	110	70	61	182	124	49	144	116	140	131
190	36	126	146	96	83	.....	.....	.....	.....	.....
200	.....	.....	.....	.....	.....	.....	.....	34	76	108
210	69	107	153	107	99	105	130	83	106	99
220	120	164	119	150	140	103	105	110	88	53
230	41	28	74	41	31	46	46	53	30	30
240	74	78	104	106	78	63	169	122	48	55
250	103	101	156	113	154	171	166	65	50	125
260	89	39	45	120	62	76	130	147	210	150
270	42	150	185	132	15	111	111	110	20	00
280	95	102	150	196	117	156	75	76	143	138
290	140	15	42	104	05	133	108	53	110	144
300	105	112	00	38	89	104	66	117	126	118
310	177	165	112	88	148	113	174	170	118	142
320	50	36	70	52	07	54	01	50	97	91
330	141	173	165	104	110	68	65	142	145	160
340	72	53	106	116	67	71	220	70	100	.....
390	.....	.....	.....	.....	.....	.....	.....	.....	.....	69
400	79	32	44	58	95	121	95	161	119	76
410	79	71	91	108	116	107	107	132	148	117
420	74	110	67	26	98	107	98	103	90	46
430	122	92	108	150	164	146	138	147	131	116
440	120	165	107	101	130	150	60	57	113	47
450	103	99	32	58	75	00	67	45	87	122
460	79	52	75	20	77	101	66	86	93	63
470	100	46	87	40	74	106	104	172	88	137
480	136	78	153	92	164	129	74	164	102	173
490	146	79	116	42	104	81	87	107	121	122
500	39	86	122	105	105	99	92	98	81	92
510	140	127	101	49	109	105	75	76	117	83
520	56	93	116	138	79	86	08	92	73	70
530	110	75	93	122	121	83	91	133	116	86
540	98	123	60	66	121	127	153	200	137	137
550	154	166	140	145	65	115	124	114	103	124
560	99	56	88	32	84	61	81	94	45	89
570	84	136	116	108	124	151	111	131	83	98
580	111	124	112	136	123	126	123	132	83	152
590	57	66	139	112	120	137	125	131	147	99
600	129	141	104	61	90	104	117	89	142	127
610	96	42	92	88	85	52	74	95	96	78
620	07	112	91	111	114	99	64	133	150	125
630	126	121	119	80	50	96	138	130	138	138
640	107	134	114	126	145	37	59	82	105	129
650	87	80	01	100	111	118	135	116	126	100
660	47	52	100	73	68	156	132	111	116	118
670	110	105	97	126	150	132	130	87	103	84
680	73	81	77	129	.....	.....	.....	.....	.....	.....

A. D.	C. Pinyon Pine									
	0	1	2	3	4	5	6	7	8	9
140	.....	92	81	94	92	108	154	100	93	126
150	41	82	124	148	51	109	144	86	46	03
160	104	257	180	120	101	30	97	34	97	28
170	122	189	04	82	55	134	98	97	52	64
180	173	166	146	154	177	193	148	128	212	90
190	53	67	133	99	89	55	91	87	39	.....
.....
670	100	100	75	131	168	63	82	75	56	87
680	150	125	100	150	174	162	75	82	131	175
690	75	112	119	168	181	168	187	106	75	131
700	82	138	125	75	31	19	31	38	75	50
710	69	81	31	94	100	81	93	50	63	137
720	106	144	81	63	87	175	132	106	87	100
730	100	118	81	125	75	88	106	144	00	81
740	144	88	06	100	75	87	112	119	13	75
750	81	44	162	69	112	144	19	06	69	118
760	38	137	75	125	56	112	150	75	137	56
770	44	44	156	25	56	81	138	106	87	81
780	150	144	119	88	194	169	88	200	112	137
790	106	119	137	218	106	125	119	81	101	90
800	143	158	161	207	141	131	107	39	89	30
810	177	108	174	165	159	156	125	80	28	51
820	182	164	133	03	35	55	130	139	184	42
830	78	163	129	115	79	51	108	67	151	154
840	27	92	86	134	122	85	88	65	140	130
850	113	95	126	143	166	120	122	38	122	113
860	115	97	121	119	114	126	77	17	62	178
870	96	174	116	87	89	77	96	48	42	73
880	46	89	33	62	24	82	107	93	110	99
890	148	91	78	126	87	88	90	73	92	227
900	127	88	172	136	84	148	07	01	101	102
910	119	207	105	114	123	55	116	129	145	177
920	124	55	22	28	43	117	104	63	127	102
930	20	91	92	100	121	75	106	70	90	83
940	149	138	136	81	102	120	163	130	98	114
950	105	60	96	68	35	151	120	118	40	208
960	203	137	105	163	103	155	195	149	84	69
970	136	114	08	162	142	50	130	29	98	21
980	03	03	88	91	63	125	189	213	190	217
990	143	47	18	55	119	95	177	155	120	79
1000	100	32	37	67	69	00	76	140	156	64
1010	129	128	128	12	29	75	126	140	84	24
1020	160	60	64	96	192	116	100	168	152	128
1030	120	80	64	100	100	52	48	100	108	92
1040	116	00	64	44	24	44	00	52	48	48
1050	76	76	80	16	80	36	52	144	80	92
1060	132	208	08	192	188	184	268	48	96	216
1070	96	192	220	.....	.....	.....	.....	.....	.....	.....
.....
1170	.....	.....	81	139	95	83	86	60	124	51
1180	116	86	53	42	120	72	23	86	74	97
1190	143	106	93	118	166	196	164	132	113	76
1200	132	176	146	150	111	44	104	108	111	166
1210	134	134	79	86	23	74	12	02	86	140
1220	93	51	108	90	83	21	79	28	120	90
1230	88	104	113	111	134	118	86	108	134	141
1240	69	143	136	97	132	129	60	97	139	141
1250	53	23	93	108	07	106	86	88	02	148
1260	72	72	106	72	42	81	90	136	146	143
1270	76	134	74	65	97	166	07	108	32	130
1280	65	114	111	16	69	69	67	74	90	104
1290	153	122	118	116	65	09	81	32	37	05
1300	67	44	58	69	62	86	83	49	02	99
1310	116	106	120	149	136	197	25	104	150	141
1320	117	134	108	56	79	134	122	74	65	81
1330	99	130	192	169	99	56	97	111	62	150
1340	111	93	106	104	108	143	152	23	76	169
1350	53	23	79	201	204	97	185	152	155	95
1360	106	46	62	99	76	102	93	116	208	65
1370	134	62	55	93	146	37	69	53	97	104
1380	134	146	134	166	146	134	171	169	169	148
1390	25	97	143	127	138	.....	.....	.....	.....	.....