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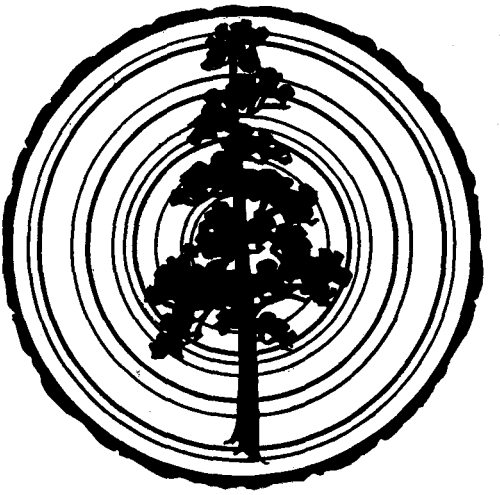

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THE TREE-RING BULLETIN
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MACKENZIE RIVER DELTA CHRONOLOGY

J. L. GIDDINGS, JR.

Stands of white spruce *(Picea glauca)* found growing on the Mackenzie River Delta above latitude 67° N, during a field sampling trip in the summer of 1946[1], include trees more than 500 years of age. The core of one of these, though an indeterminate number of rings short of center, presents, in 6½ inches of radius, a 589-year sequence of annual rings beginning with the ring for A.D. 1357. Two other trees in the same group yielded cores of 476 and 490 rings. Many of the trees sampled are afflicted with some degree of center rot, a singularity also of the northern forest border in Alaska.

In these oldest specimens average ring width does not generally decrease with age, but long-period growth suppressions and releases occur. When such trends are not repeated in the other trees of a group, they are not considered of climatic significance and are removed from growth plots by taking percentage departures from estimated trend lines. Local conditions causing these fluctuations may have been thinning or crowding processes affecting leaf exposure or root nutrition. Experimental sampling shows no relation of these effects to radial variation in a single tree.

The tree presenting the longest continuous ring record (although probably not the oldest of its group) is about 17 inches in diameter, stands between 30 and 40 feet high, and manifests a determined spiral twist, counter-clockwise looking downward, in the stem and branches. The foliage is dense and held close to the stem. Outwardly the tree appears healthy and in no greater danger of dying than any of the surrounding trees, most of which may have withstood for decades a certain amount of center rot. The stand in which this tree grows, near the upper end of the Delta, is being cut with some determination by the Peel Channel, perhaps indicating that when the trees sprouted the present stream was not in close proximity. The trees are aligned along a former bank of what appears to have been a sizeable slough, now at right angles to the Peel Channel and sealed and filled to a point where it is no longer a lake but a swampy trough containing dense willow thickets.

The whole of the Mackenzie Delta appears to be at present, as perhaps for hundreds of years, in a constant state of cutting, depositing, and reforesting. Unlike those of the Mackenzie River proper, the banks of the sloughs of the Delta consist of only a fine silt including no pebbles or sand. The height of these banks and the level ground between existing channels and dormant sloughs averages about 10 feet. The water of sloughs and cut-off lakes shows from the air as greatly exceeding in area the ground surface between. A forest stand the age of that just described appears to owe its existence to freakishness in channel cutting. In three other similar stands,

[1] For the University of Alaska, with funds supplied by Mr. Childs Frick.

sampled at intervals from this point to the lower limit of spruce growth about 30 miles from the Arctic Ocean, stood trees from 450 to 560 years in age of sound wood.

Figure 1 consists of three standardized curves of individual trees, three group mean curves, a Mackenzie Delta mean curve derived from five separate groups, and an inset showing their probable relation to climate. Site M-32 is located at Lat. 67°53′ N, Long. 134°50′W. Three trees from this site are shown individually and as a group mean. The pronounced maximum centering at 1930 is not present in other measured Delta trees. The locations of other group means combined into the smoothed Delta mean curve are as follows: M-30—Lat. 67°43′, Long. 134°37′; M-31—Lat. 67°51′, Long. 134°50′; M-33—Lat. 68°06′, Long. 135°09′; and M-36—Lat. 68°25′, Long. 135°23′. Of these, M-30 and M-36 are plotted in the figure. Circled numbers over curves indicate number of trees averaged.

The inset shows superimposed curves of five group means from 1926 to 1945, inclusive, and the plotted values available for mean July temperature at Aklavik, N.W.T. (Lat. 68°13′, Long. 135°00′).

Tree growth becomes sparser upon leaving the high banks of the main channel of the Mackenzie for the sloughs of the Delta, but timber everywhere exists on the banks into which the present streams are cutting. Growth is often slow, and rings near center seldom average wider than those near bark in the trees sampled. Such a tree lacking age curve, if spared by the shifting streams, might be expected to reach great age. The same conditions do not prevail above the Delta. Fort Good Hope seems to mark a point below which, on the river, timberline characteristics of twisted trunk and close-held foliage prevail. Above Fort Good Hope and into the headwaters, including the lower Liard River and the whole of the Fort Nelson River drainage, trees more than 200 years of age are strongly exceptional and pronounced age curve is the rule.

Why should the white spruce reach great age near the extreme limit of tree growth and fail to do so in the more tolerant upriver environment? In an overall view of forest fronts as constantly changing phenomena which take advantage of climatic releases to march up the mountain sides and toward the northern latitude barrier, it becomes difficult to explain, at the edge itself, the high stability and uniform growth represented by the long-lived trees.

Casual observation of these oldest stands does not lead one to assume that the seedlings from which they sprang represent the first of an advancing forest border. One prefers to picture those seedlings as sprouting in the shade or near vicinity of other stocky and ancient trees which had lived perhaps as long before.

This view is not refuted by an examination of similar stands at the latitude barrier in western Alaska, nor at timberline elevations in the Alaskan interior. Spruce trees growing at the northwestern limit, on the Noatak River, north of the Arctic Circle in Alaska evince characters similar to those of the Mackenzie Delta. Here again, center rot has thus far prevented early-ring dating in trees believed to have lived for more than 500 years. In the Alaska Range, spruce trees not at the northern forest border but at an analogous timberline at elevations of from 2800 to 3200 feet, have the same appearance as Mackenzie Delta trees, and the oldest often are rotten near center. One sound tree, about 14 inches in diameter, with an inner

Figure 1. Growth records in the Mackenzie River Delta. Curves 32-1, 32-2, and 32-3 represent standardized ring-widths of individual trees; 36, 32, and 30 represent standardized group means, the number of trees in each group being noted along the curves by circled figures; the lowermost curve is a regional mean of five groups of trees, two of which have not been separately plotted here.

date of 1434, indicates that interior timberline trees approximate the great age of Mackenzie Delta trees, although those in nearby valley bottoms at elevations of less than a thousand feet seldom live longer than 200 years.

Comparison of tree growth on the Mackenzie Delta with weather records from Aklavik[2] shows no strong relation to precipitation but marked agreement to mean July temperature. This contrasts with northwestern Alaska tree-growth, which has been shown to agree best with mean June-July temperature[3]. Maximum growth in the Alaska trees takes place during the latter half of June and early July, while the first cells of 1946 wood were observed in the Mackenzie trees on the second day of July. Temperature of the growing season thus appears here, as in Alaska, to form the principal control of crossdating quality.

Longevity in trees at northern extremes seems to be linked with the specific climatic stress of temperature, excessive twist in stem, a consequent thinner average ring, and a reinforced stocky trunk. Morphological and ecological studies are needed in the area. Whatever the cause, we may look to these northernmost American trees for proof of borderline stability for at least five centuries.

[2] Meteorology of the Canadian Arctic, Dep't. of Transport—Air Service Branch, Meteorological Division, Form 9000, 1944.

[3] J. L. Giddings, Jr., Some Climatic Aspects of Tree Growth in Alaska, Tree-Ring Bulletin 9(4), Fig. 3, 1943.

DATES FROM A SURFACE PUEBLO AT MESA VERDE

TERAH L. SMILEY

This report presents the first tree-ring dates from a surface pueblo, Pipe Shrine House, in Mesa Verde National Park*.

Site Location. Mesa Verde, in southwestern Colorado, is a very large mesa with sharp escarpments on all sides. The entire mesa is dissected with canyons which, with the exception of Mancos Canyon, are usually dry. The latter cuts the mesa into two smaller mesas, the northern one comprising the park area. This area has a high northern escarpment, with an elevation of approximately 8,000 feet, and slopes gently southward where it terminates at Mancos Canyon at about 6,000 feet. The southern half of the park area is thickly covered with juniper and pinyon trees; the northern half is believed to have been largely denuded within the last two hundred years by forest fires. Pipe Shrine House is located on the northern fringe of the forested area, four miles north of park headquarters at Spruce Tree House.

In 1922, J. Walter Fewkes of the Smithsonian Institution excavated several ruins of the so-called Far View group of surface pueblos, Pipe Shrine House being one of them. Since tree-ring dating was relatively unknown, all beam material was just so much rubble, and little attempt was made to preserve the wood beams and charcoal.

Although Fewkes stabilized the walls of the ruins as the rubble was cleared from around them, rain and frost make repairs to these exposed walls a constant chore. It was while making such repairs to Pipe Shrine House that the charcoal used in this study was uncovered in the kiva ventilator shaft; the specimens were recently sent to the Tree-Ring Laboratory for analysis.

Specimen Treatment. When first removed from their individual wrappings the specimens were found to be quite brittle and in many cases broken into small pieces. They were bound with string, tagged, immersed in a saturated solution of paraffin in gasoline until all air had been expelled, and set aside for a day to dry[1].

Examination soon indicated that the specimens fell into two sets, each set constituting what had originally been a separate beam. The best radial section (based on freedom from internal cracks, knots, and distortion) was chosen for surfacing[2] and study.

Dating. Set A was the first to be studied after the surfacing had been completed. The central growth of this two-inch log, probably a branch, was far off center and compression rings formed the long radius. On the long radius the centermost rings were too indistinct to be read with certainty. The short radius had many missing rings, making dating difficult and measuring almost impossible. A skeleton plot of the best section of the set, MV-421, consisting of 80 rings, was matched with the master chronology for this area[3] at A.D. 1135-1214. To check the results of this matching the skeleton plot was tried all along the length of the master (1936 years) but at no other point could any satisfactory similarity be found. All other specimens in this set were matched against the plotted specimen and they agreed closely.

* Critical dates have been checked by A. E. Douglass. The writer is indebted to Edmund Schulman for aid in the preparation of this report.

[1] See also Hall, Tree-Ring Bull., 12:26-27, 1946.
[2] Scantling, Tree-Ring Bull., 12:27-31, 1946.
[3] Douglass, Tree-Ring Bull., 6:39, 1940 (Western Pueblo Chronology); Schulman, Tree-Ring Bull., 12:18-24, 1946 (Mesa Verde Chronology).

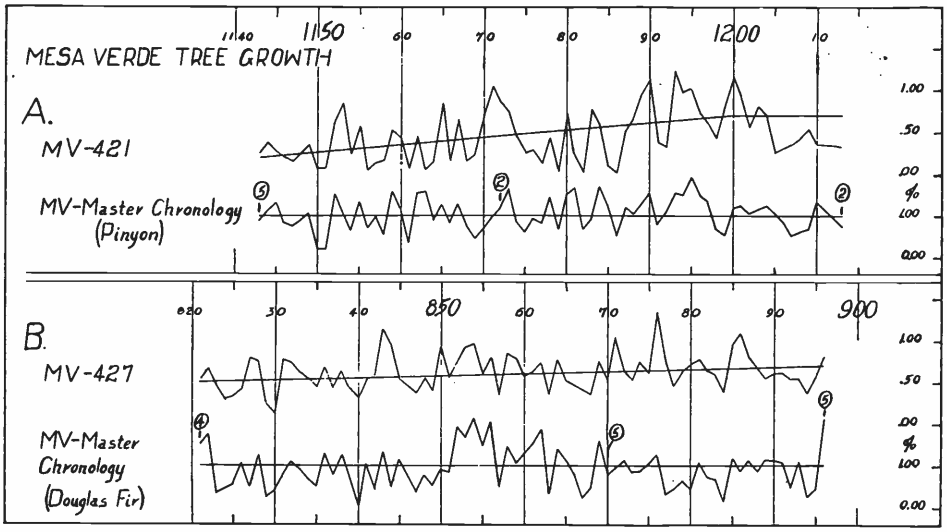

Figure 1. The ring-widths in millimeters, of specimens MV-421 and MV-427, both of pinyon pine charcoal, compared with the standardized mean growth curves giving the local master chronologies. Estimated trend lines are plotted on the specimen curves. The circled figures along the master curves represent the number of trees on which the curves are based.

It is believed that less than ten rings are missing from the outside of MV-421. However, an estimate of rings lost in charcoal specimens may be very approximate since the amount of sapwood, if any, is not evident. The fairly low estimate here is based on the consistency in outside date around the circuit of the specimen.

Set B, like set A, was originally one log with a diameter of about five inches. It was soon seen that the chronology was totally different from that in the first set. The surfaced specimen of this group, MV-427, was plotted and the 75-ring plot matched against the master chronology. As the local pinyon chronology extended back to only A.D. 1019 and no agreement had been found to that point the Douglas fir chronology for this area was substituted. In the 800's the plot fitted the master plot with unmistakable similarity. The outermost ring dated A.D. 896 and the inner 821. Another specimen from this set, MV-426, contained an additional two rings making its outermost ring date A.D. 898. Rings lost from the outside of the log would undoubtedly carry the date well into the 900's.

No false rings were found in any specimen of either set; this freedom from double rings is not surprising in pinyon.

After dates of sets A and B had been established by skeleton plot comparisons all specimens were checked, directly on the wood, year by year, against previously dated Mesa Verde specimens.

Measuring. With respect to charcoal, internal cracks, penetration by roots of plants growing on the ruins, heat distortions, and generally broken conditions make the ring-widths very difficult to measure. To these factors is added the difficulty in the decade marking of such material which is so useful in the measurement process. For these reasons, check measurements of difficult intervals were made.

The mean ring-width is .50 mm for MV-421 and .62 mm for MV-427.

Conclusion. No final dating of the construction of an entire ruin or site can be based on two specimens, of course, but dates on two such sensitive specimens as those of this report perhaps offer a good beginning for such a dating.

The problem of relationship in time between the cliff-dwellings and the surface pueblos has always confronted Mesa Verde Park personnel. It is hoped that more material will be available soon to carry on the study of this problem.

NOTE ON THE DATING OF PIPE SHRINE HOUSE

DON WATSON

The dates just obtained for Pipe Shrine House mark a most important step in the dating of Mesa Verde ruins for they are the first tree-ring dates that have been obtained from surface pueblos. These dates, however, present a question that will no doubt be encountered more and more as additional dates are obtained from similar ruins. The span between the two dates, 898+ and 1214+, seems too long for a single occupation. Pipe Shrine House is a small pueblo of about 20 rooms and a single kiva, and a 300-year occupation is debatable.

The charcoal that yielded the dates was found in the horizontal tunnel of a ventilator which Fewkes missed during his excavation in 1922.* In his report Fewkes stated, "The stones and plastering of the inner walls of the kiva indicate everywhere a great conflagration." The ventilator tunnel, when excavated during repair work in 1938, was found to contain a large amount of burned roof clay and charcoal, undoubtedly from the burned kiva roof.

There is ample evidence that the Pipe Shrine House area was occupied over a long period of time. Surface sherds range from Modified Basket Maker to Classic Pueblo, and Fewkes pictures early pottery which he states came from the Pipe Shrine cemetery. In 1938 a small portion of the kiva wall collapsed, revealing an earlier wall behind it, and there are other evidences of earlier ruins underlying the entire Pipe Shrine area.

The walls of the south and east portions of Pipe Shrine House, as Fewkes stated, "compare very well with the best on the Mesa." The date of 1214+ is evidently from the late occupation. The date of 898+ should perhaps be considered to represent a reused beam from an earlier ruin in the area.

* Archeological Field-Work on the Mesa Verde National Park, Colorado, Field Season of 1922. (From Explorations and Field-Work of the Smithsonian Institution in 1922).