TREE-RING BULLETIN

VOL. 19 JULY, 1952 NO. 1

A Quarterly

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PUBLISHED BY THE TREE-RING SOCIETY
with the cooperation of
THE LABORATORY OF TREE-RING RESEARCH
UNIVERSITY OF ARIZONA

Annual Subscription, $2.00 This Issue, 50c

A LARGE INCREMENT BORER

H. L. Transtrom*

Core samples from softwood trees were needed in connection with run-off studies in the Owens River watershed, the major water supply source for the City of Los Angeles. The largest commercially available Swedish increment borer extracts a core which is only 15 3/4 inches long and 5/32 of an inch in diameter; in order to obtain longer and larger cores, enlarged copies of the Swedish increment borer were made in the Department of Water and Power machine shop.

Two core bits of chrome-molybdenum steel were made in the exact form of the core bit of the Swedish borer except that these were 19 and 30 inches long and designed to cut a core 19/32 of an inch in diameter. The shorter bit operated successfully, but when the longer bit was advanced into the tree about twenty-four inches, the elastic wood held its shank in such a vise-like grip that two men could no longer turn it. This difficulty was overcome by increasing the diameter of the screw head and introducing very sharp cutters just back of the head to further cut the wood and assure greater clearance. With these changes satisfactory cores have been secured from pines and firs, but to date the bits have not been tried in hardwoods. Since the original development, several core bits have been made ranging from 19 to 64 inches in length.

This improved core bit is shown in Figures 1 and 2. A cutting lip extends out beyond the first thread for a distance ranging from 1/32 to 1/8 of an inch, depending upon the length of the bit, and cuts out the core as the bit progresses into the tree. It has an inside diameter of 19/32 of an inch, which determines the diameter of the core sample. For the first 3/16 of an inch of its length, the inside diameter of the tube is the same as that of the cutting edge. In approximately the next 3/4 inch the bore flares to a diameter of 11/16 of an inch, which is maintained throughout the shank of the bit. The bit head is hardened and the rear end of the shank is squared to fit a standard two-foot tap-wrench, which is used to screw the core bit into the tree.

In starting the bit, it is better to have only one man turn the tap-wrench and carefully aim the cutting head at the center of the tree until it has penetrated about four inches, when two men may work together on the tap-wrench. Two men are required on the tap-wrench when the cutting head has penetrated deep into the tree to obtain a long core sample. Boring a hard-surfaced tree with a short bit for three or four inches and then withdrawing the bit without breaking the core provides a starting path which is helpful when using longer borers.

*Statistical Section, Power Operating and Maintenance Division, Department of Water and Power, Los Angeles, California. Posthumous publication.

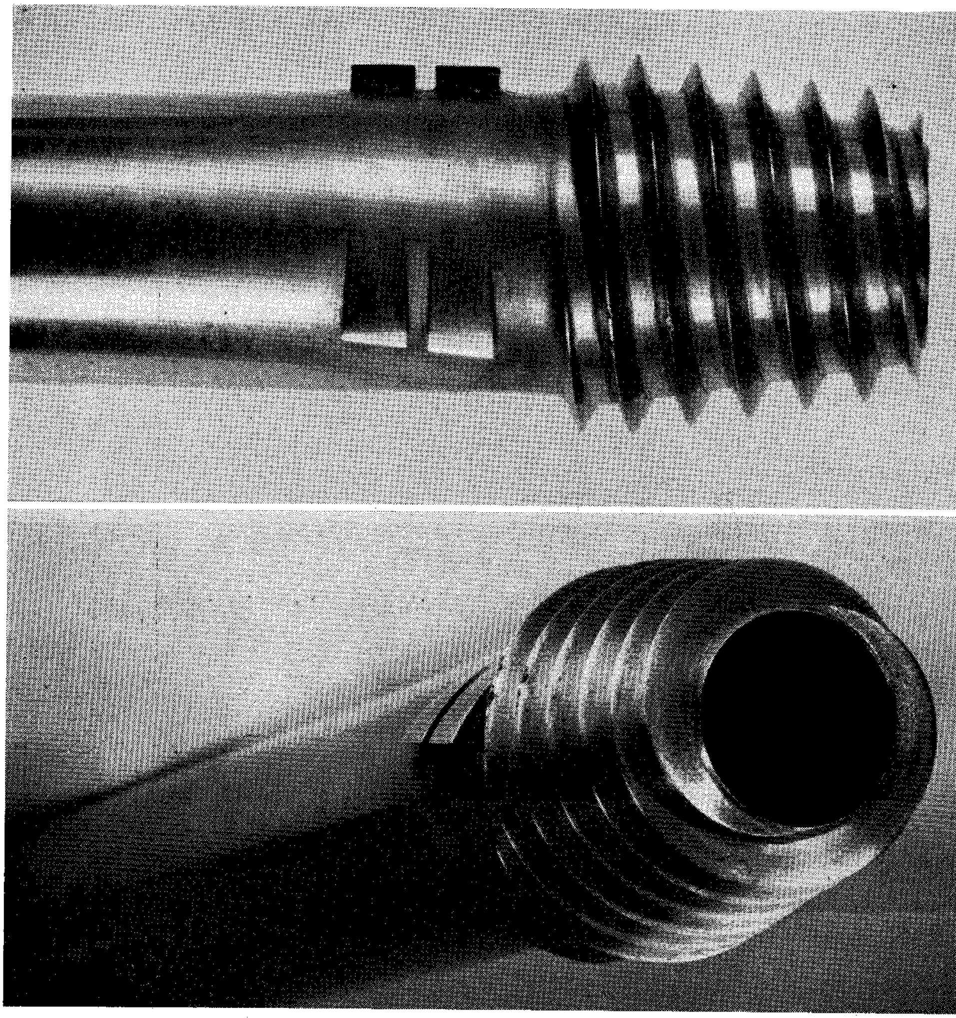

Fig. 1. The rear-of-thread cutters in this tree borer help to relieve binding.

When the cutting edge at the tip of the bit is rotated the screw thread forces it to move forward into the tree 1/3 inch per revolution. The pressure brought to bear by the screw, combined with the rotary motion of the cutting edge, causes a core to be cut out radially inside the trunk of the tree. During the cutting operation the core remains stationary while the bit rotates freely around it. This free rotation results from the increased inside diameter of the bit throughout almost its entire length.

After the boring has reached the desired depth, a thin semi-circular section of tubing, called a core breaker, is inserted between the bit and the core until it jams against the core in the conical tip of the bit. Rotating the bit in either direction causes the core to break off at its tip inside the tree. The core usually comes along when the core breaker is removed from the bit, but if it should not do so, it can easily be pushed out of the bit with a pencil or stick after the bit has been withdrawn from the tree.

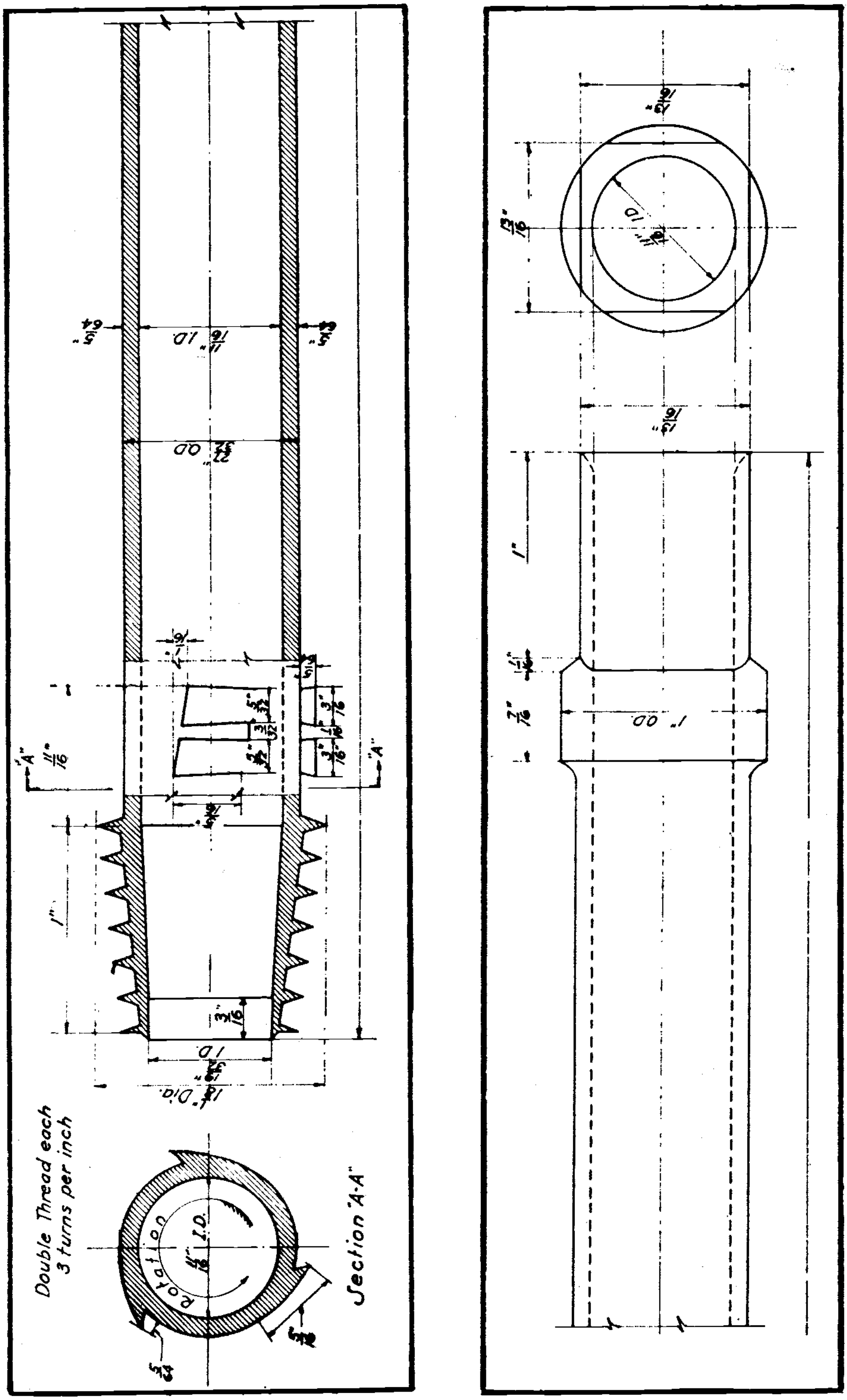

Fig. 2. Details of construction of bit. Upper: front end. Lower: squared shank.

SPRUCE SAMPLES FROM THE COPPER RIVER DRAINAGE, ALASKA

WENDELL OSWALT

In Alaska the first tree-ring studies of living spruce were confined to "altitude timberline" stands of the interior region around Fairbanks;[1] when it was later realized that tree-ring chronologies could be used to date Eskimo ruins, the scope of these studies was broadened to include "tree-line" or "latitude timberline" spruce on or approaching the western coast of Alaska.[2] Since emphasis was upon the regions mentioned above, the area south of the Alaska Range was not studied until the summer of 1951 when the writer sampled spruce stands in the Copper River drainage.[3] The 200 increment borings comprising the collection represent 15 stands in a roughly Y-shaped area from along the Richardson Highway south of Summit Lake, down the Chitina Road, and over the Tok Cutoff, covering approximately 250 miles of highway. The area was sampled 1) to determine the type of ring record for the region, 2) to analyze the ring records with reference to climatic data, and 3) to serve as a time scale for the dating of recent archaeological wood that may be discovered in the locality.

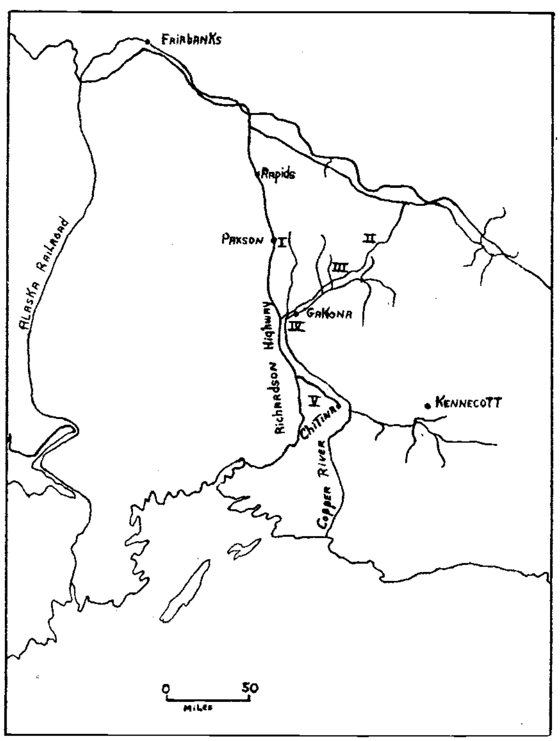

Fig. 1. The Copper River drainage. Roman numerals indicate the approximate location of the sampled groups of spruce.

After the borings with short, complacent, or erratic ring records were eliminated from the series 44 selected samples, some from each of the boring stations, were measured, plotted, and then compared with other samples from the same stand. Cross-dating within each stand was quite satisfactory, and where the ring records of two closely situated stands (within 20 miles of each other) were almost identical in ring pattern they were consolidated. As a result of selection and elimination the analyzed collection was reduced to five groups with a total of 33 measured specimens. The groups are described as follows (see map, Figure 1):

Group I, Paxson, 1750-1950. The four measured specimens comprising this group are from near timberline[4] north of Paxson (timberline in the Copper River drainage varies from 2500 to 3000 feet and is known to extend as low as 2000 feet.[5]). The stand is situated on a steep hillside of coarse glacial till with little soil cover to support the moss patches, spruce, and scattered willows. This, like many other highway stands, has been cut over in recent years.

Group II, Menasta, 1755-1950. The seven measured samples of this group are from two stands separated by approximately 15 miles. Four samples are from a few miles east of Slana and near timberline. The stand has a thick moss carpet. The three other borings in the group were collected approximately 5 miles east of Menasta Pass in the Tanana River drainage. These trees were at timberline growing on glacial till covered by a thin soil and moss layer. The timberline spruce ring records for the Tanana watershed (in the immediate area) agree in detail with those from the adjacent Copper River drainage.

Group III, Slana, 1700-1950. Ten borings from two stands were combined to form this group. Four of the trees are from a few miles west of Slana in a stand of old spruce. Many of these trees have rotten cores and others have been blown over. Birch are scattered among the spruce and there is a thick, mossy undercover. The area is moist, but this condition was probably caused by the diversion of a small stream during recent highway construction. The six other measured specimens are from a few miles west of Chistochina, in a stand where there are scattered alders as well as spruce.

Group IV, Gakona, 1780-1950. The seven samples from a single boring station, just east of Gakona at an altitude of approximately 1500 feet, comprise the most sensitive group in the series but have the shortest ring sequence. This cutover stand has Labrador tea (*Ledum* sp.) in addition to the usual undergrowth of moss and scattered willows.

Group V, Chitina, 1723-1950. The last group of the series includes five measured samples from a single stand 17 miles north of Chitina and at an altitude of approximately 2000 feet. This stand is rather dense and there is little underbrush among the trees. What undercover there is includes moss and Labrador tea.

Before comparing the Copper River series with other Alaskan tree-ring material it is necessary to define the recognized chronologies for northern Alaska. Two uniform ring sequences have been identified: the first of these, "Series A Dating," includes trees at or near one of the limits of spruce growth, whether it is at tree-line toward the western coast or at timberline on a mountain side in interior Alaska. The second uniform ring record, "Series B Dating," is found in the Yukon River valley from Fort Yukon to Stevens Village. There is also a zone of transition between Series A and B dating where spruce are found with ring records embodying features of both chronologies.[6] However, only the Series A Dating is of value in this study. Typical of this ring pattern for interior Alaska is the Alaska Range series of 28 timberline spruce samples collected along a 120 mile area from Rapids west to the Alaska Railroad[7] (see map). A mean of this series is compared with the individual Copper River groups in Figure 2. Indications are that the ring records of the com-

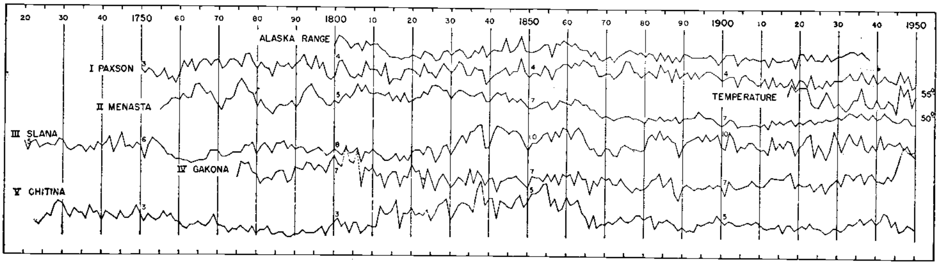

Fig. 2. The individual Copper River groups compared with Giddings' Alaska Range series and with Copper River mean temperature for June-July.

pared areas are quite similar; diagnostic rings for both series are 1804, 1817, 1830, 1839, 1845, 1856, 1872, 1883, 1889, 1904, 1912, 1919, and 1924. The faint latewood for 1783, which is present in nearly all of the timberline spruce of northern Alaska,[8] is also found in one group of the Copper River series. This distinctive ring is present in 3 (out of a possible 3) trees from Group I, Paxson, but is not found in any other group of the series. It is of note that there are local changes in ring record for the Copper River series; for example, in Groups I, II, and III the 1842 and 1866 rings are not distinctive but in Groups IV and V these rings are quite small. Another example of this type of change is apparent for the 1927 ring which is large in Groups I and II but small in Groups III, IV and V. Thus it may be seen that in the Copper River drainage there are slight changes from the Series A ring pattern, and it is probable that in tracing similar spruce stands farther south and east a point will be reached where Series A will not be identifiable as such but will have changed gradually as the climatic influences change.

When it was determined that the Alaska Range and Copper River series had essentially the same ring pattern, a mean of the latter series was made and compared with Giddings' combined mean for the White Mountains and the Alaska Range, representing Series A timberline for interior Alaska, and Giddings' combined mean for Noatak and Koyuk, representing Series A tree-line for the western coastal region[9] (Figure 3). The above comparison indicates that all three series embody the same basic ring pattern with regional variations. Diagnostic rings for all three groups are 1804, 1807, 1826, 1845, 1856, 1866, 1883, 1912, and 1919. Thus there is an overall ring uniformity from the Kotzebue Sound region across interior Alaska and south to include the Copper River drainage, a distance totaling approximately 700 miles.

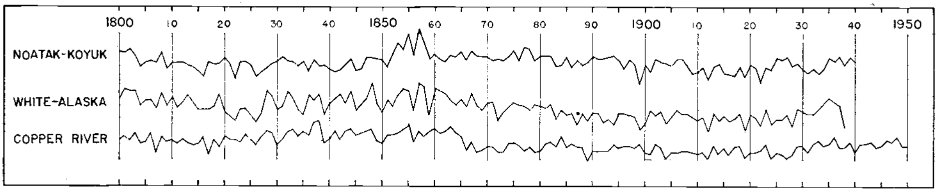

Fig. 3. A mean of the Copper River spruce series compared with other groups for the interior and coast of northern Alaska.

Table 1. Mean Ring-Widths in Groups of Spruce from the Copper River Drainage. Unit .01 mm.

Group I, Paxson

A.D.	0	1	2	3	4	5	6	7	8	9
1750	40	35	40	37	30	34	38	29	32	26
1760	35	48	42	50	37	45	50	48	43	48
1770	50	40	43	50	50	46	42	54	54	46
1780	40	46	42	40	32	46	43	43	45	40
1790	45	48	54	45	40	53	40	46	32	29
1800	34	48	50	40	34	30	35	32	50	40
1810	40	38	34	46	26	30	30	29	40	42
1820	40	37	34	46	37	37	32	38	46	42
1830	37	42	50	46	35	35	43	40	40	26
1840	30	35	37	40	43	35	38	38	53	38
1850	34	37	37	35	45	42	30	42	43	46
1860	46	43	48	45	51	50	45	45	35	35
1870	37	37	32	35	40	51	50	38	38	34
1880	37	40	37	34	46	38	42	29	43	34
1890	37	38	30	38	34	37	40	40	37	35
1900	30	34	35	35	24	35	37	32	30	27
1910	27	34	22	35	26	29	26	27	34	22
1920	32	30	26	37	22	27	24	32	27	32
1930	32	32	35	38	34	34	42	32	29	38
1940	29	32	37	32	30	29	42	30	37	22
1950	27	....	....	....	....	....	....	....	....	....

Group II, Menasta

A.D.	0	1	2	3	4	5	6	7	8	9
1750	....	....	....	....	....	29	34	35	42	42
1760	40	45	42	42	54	56	51	45	48	40
1770	34	29	42	40	43	56	61	54	48	46
1780	34	40	32	29	26	32	35	34	35	38
1790	34	37	48	53	56	50	43	42	35	35
1800	40	37	43	46	43	48	58	50	56	48
1810	46	48	46	45	48	40	45	38	48	38
1820	40	43	43	50	46	54	56	54	51	51
1830	43	48	51	51	48	45	45	48	50	40
1840	40	45	50	46	50	40	43	40	43	38
1850	34	34	35	37	40	40	32	35	42	40
1860	38	37	43	42	37	37	32	32	27	24
1870	26	24	21	22	24	26	26	22	22	21
1880	19	24	22	21	26	21	22	21	26	19
1890	22	24	24	26	30	27	24	24	22	19
1900	16	19	22	21	14	16	16	16	18	18
1910	16	19	13	22	19	21	19	21	22	16
1920	21	19	21	24	19	21	21	24	22	24
1930	27	24	27	30	29	27	30	27	24	29
1940	24	26	30	27	22	21	21	26	26	19
1950	19	....	....	....	....	....	....	....	....	....

Group III, Slana

A.D.	0	1	2	3	4	5	6	7	8	9
1700	21	21	24	29	30	29	26	27	24	26
1710	30	27	30	27	34	45	42	35	40	37
1720	37	27	35	37	29	32	34	32	32	38
1730	37	29	27	29	32	30	26	30	27	35
1740	30	35	42	26	34	45	30	32	29	35
1750	32	19	34	40	37	34	29	22	22	19
1760	19	18	18	14	16	18	18	19	27	27

A.D.	0	1	2	3	4	5	6	7	8	9
1770	27	21	21	22	26	26	26	34	32	35
1780	24	30	35	30	26	35	35	37	29	34
1790	29	30	30	26	27	29	30	27	22	26
1800	29	27	22	30	26	27	30	16	27	26
1810	29	26	22	19	19	21	26	18	22	18
1820	27	29	29	24	34	30	16	22	34	35
1830	26	30	38	45	37	50	50	54	56	32
1840	32	46	54	53	51	46	50	50	45	37
1850	29	37	37	42	46	48	38	50	43	53
1860	51	42	50	53	46	37	30	32	26	26
1870	32	30	26	24	34	35	34	30	30	29
1880	30	43	46	42	51	42	45	40	38	22
1890	34	38	42	43	45	40	46	42	43	46
1900	34	32	50	43	29	35	34	38	38	34
1910	30	32	27	45	32	38	34	42	40	26
1920	34	37	45	48	24	37	30	21	32	51
1930	42	29	40	50	40	37	48	34	30	37
1940	32	48	34	40	38	37	42	34	37	29
1950	30	....	....	....	....	....	....	....	....	....

Group IV, Gakona

A.D.	0	1	2	3	4	5	6	7	8	9
1780	35	26	30	32	29	37	38	38	27	29
1790	43	42	40	48	46	40	45	43	37	48
1800	54	46	43	66	50	46	61	22	43	38
1810	43	34	37	21	34	38	38	22	35	34
1820	45	38	40	21	43	30	19	30	37	30
1830	22	27	34	30	26	42	27	40	35	26
1840	32	34	19	27	30	34	34	35	30	27
1850	22	35	34	34	29	37	29	37	26	37
1860	35	37	26	40	32	32	16	30	26	35
1870	32	34	27	27	34	27	22	19	24	21
1880	22	26	32	34	38	26	29	35	18	11
1890	24	27	26	21	24	22	24	27	24	27
1900	26	14	30	26	22	24	26	27	32	27
1910	26	26	30	35	34	34	34	37	40	24
1920	29	27	27	29	21	26	29	19	27	30
1930	34	27	38	38	34	37	40	29	37	38
1940	32	32	30	37	34	42	56	67	62	61
1950	56	....	....	....	....	....	....	....	....	....

Group V, Chitina

A.D.	0	1	2	3	4	5	6	7	8	9
1720	....	....	....	21	19	24	29	27	38	43
1730	40	30	26	35	30	30	24	37	29	32
1740	22	32	29	27	24	32	26	26	29	38
1750	30	21	29	26	22	26	32	27	29	22
1760	21	16	14	19	19	21	19	18	21	29
1770	19	18	16	11	14	13	18	14	11	18
1780	10	13	13	18	10	10	11	11	6	6
1790	10	10	13	11	11	11	13	18	8	18
1800	21	26	18	21	11	21	21	11	14	19
1810	18	18	38	30	30	35	45	16	32	30
1820	37	29	32	29	35	24	32	42	43	46
1830	26	30	40	43	42	40	34	58	67	40
1840	48	48	26	45	43	38	37	46	51	38
1850	45	53	53	56	62	62	40	48	35	37
1860	50	42	43	46	34	29	18	30	18	21
1870	21	24	22	26	29	26	24	26	30	30
1880	27	29	30	18	26	24	27	24	21	16
1890	19	14	16	14	22	21	22	26	24	32
1900	27	22	26	24	21	21	22	24	22	26
1910	22	19	18	19	19	22	13	21	21	16
1920	19	21	19	24	19	19	18	13	14	19
1930	19	16	19	24	22	26	29	24	27	29
1940	24	27	35	34	21	27	16	18	22	21
1950	19	....	....	....	....	....	....	....	....	....

Giddings, in his comparison between the Series A Ring pattern and climatic data for northern Alaska,[10] has recognized the correlation between the small annual ring and a low mean temperature for the growing season (June and July). An attempt was made to correlate temperature and ring growth in the Copper River valley, since the spruce trees of this region have been shown to belong to Series A Dating and therefore subject to the same climatic influences as other Series A trees. The temperature records for the Copper River drainage are meager and it was necessary to draw upon climatic data at a considerable distance from the boring stations. The temperature graph in Figure 2, just below the Paxson Group, represents a mean of June and July temperatures (from Chitina, 1917-22; Kennecott, 1923-47; and Gulkana (near Gakona), 1948-50[11]). The Kennecott temperature data, which comprise most of the graphs are from a recording station 2300 feet above sea level. This factor would have considerable influence upon the temperatures and while it would be desirable to have such information from near timberline the possibility of local conditions modifying the data must not be overlooked. A comparison between the temperature graph in Figure 2 and the individual Copper River groups indicates that only Group 1, Paxson, correlates with the temperature graph; the correlation is, however, sketchy except for the period from 1944 to 1950, when it is remarkably clear. It is difficult to understand why there is a recognizable parallel between two widely separated areas and absence of correlation in the intermediary region. This phase of the Copper River survey demands a detailed study of temperature and timberline ring growth for a single growing season before any conclusions can be reached.

In summary, it may be said that the timberline ring record for Copper River spruce is essentially the Series A pattern as it appears from Kotzebue Sound and across interior Alaska. There are, however, recognizable departures from the Series A Dating such as the absence of the 1783 faint late wood (south of Paxson) and slight ring variations which give the Copper River series a regional distinction.

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[1]J. L. Giddings, Jr., *Tree-Ring Bull.* 5:16, 1938.
[2]J. L. Giddings, Jr., *Tree-Ring Bull.* 7:10-14, 1940.
[3]This survey was sponsored by a grant from the University of Alaska. The writer is indebted to Dr. Ivar Skarland of the Univ. of Alaska for making time for the laboratory study available while the writer was a member of the Univ. Museum staff. The writer is also grateful to Dr. J. L. Giddings for his criticism of this study.
[4]Timberline as used in this report refers not only to spruce growing at their maximum altitude but also to those approaching this limit.
[5]F. H. Moffit, *U. S. Geological Survey Bull.* 498 pp. 16-17, 1912; F. H. Moffit and A. G. Maddren, *U. S. Geological Survey Bull.* 374, p. 18, 1909.
[6]J. L. Giddings, Jr., *Tree-Ring Bull.* 9:26-32, 1943.
[7]J. L. Giddings, Jr., *Univ. of Ariz. Bull.* 12: *Univ. of Alaska. Pub.* 4, pp. 12-18, and Table 4, 1941.
[8]Giddings, p. 72, 1941; W. Oswalt, *Tree-Ring Bull.* 16-27, 1950.
[9]Giddings, 1941, p. 30, Fig. 3, and Tables 3 to 6.
[10]Giddings, pp. 26-32, 1943.
[11]*U. S. Weather Bureau Annual Summaries* for Alaska.