

Annual Subscription, \$1.50

Single Copy, 50c

THE TREE-RING BULLETIN
 Editor-in-chief.....Dr. A. E. Douglass
 Managing Editor...Dr. Edmund Schulman
 Associate Editors:
 Arctic Studies....Mr. J. L. Giddings, Jr.
 Botany.....Dr. Charles J. Lyon
 Archaeology....Mr. W. S. Stallings, Jr.

THE TREE-RING SOCIETY
 President.....Dr. A. E. Douglass
 Secretary.....Mr. Harry T. Getty
 Tree-Ring Laboratory
 University of Arizona
 Tucson, Arizona

HEMLOCK CHRONOLOGY IN NEW ENGLAND

CHARLES J. LYON*

The rings of the eastern hemlock (*Tsuga canadensis* (L.) Carr.) have now been measured at sufficiently widespread sites in New England to permit consideration of the extent to which crossdating is possible across this area. Except for the state of Maine, as yet untouched by the work, the region is only about 150 miles from east to west and 250 miles from north to south. Compared with the Pacific Coast where fair crossdating has been found for airline distances up to over 700 miles, and Scandinavia with some persistence up to 600 miles, New England would seem to be small enough to allow crossdating in old trees or timbers of a single species within its borders.

Although hemlock has been cut extensively for lumber ever since Colonial days, trees with over 100 rings can be found easily in all sections and virgin growth is commonly over 300 years old. Due to lack of circuit uniformity, all measurements must be based on more than one radius. This means complete sections of the trunk; these, however, are rarely available except from trees cut for timber. Selection of trees for analysis has therefore been very limited. Most workers have sought an index of the annual growth rate at the site rather than the best data for chronology of a particular area. Some exceptions to this were possible in the wake of the 1938 hurricane that swept in an arc through Boston northward into New Hampshire.

Since hemlock has been found particularly reliable for crossdating work, it is possible that careful selection of trees is not essential. For the ordinary problems of archeology, it is rather desirable to have a dated chronology from trees that grow in the same general forest situations from which the problem timbers come. Since these forests are often on low ground, unfit for cultivated fields, it is advisable to test the results of measurements from such sites along with those from upland forests. Certainly the hemlock timbers of old structures were not selected originally, and little choice is offered now in dating them except to use several timbers rather than depend on the one with the most rings, for example.

The areas for the available data on hemlock ring measurements in New England, only part of which have been printed, may be described briefly as follows:

1. New Hampshire (and adjoining towns in Vermont).
 - a. Five sites in a belt across the mid-latitudes of the state, sampled and measured by Lyon, with data from a sixth site supplied by Douglass. Reported by Lyon in *Ecology* 17: 457-478, 1936.
 - b. Mixed forest at an elevation of 2000 feet in Northern New Hampshire (town of Cambridge). Unpublished data from one excellent tree about 400 years old, obtained by Lyon in 1945 from section supplied by the N. H. Department of Forestry and Recreation.
 - c. Pisgah Forest in the southwestern corner of the state (town of Ashuelot). Virgin growth on high ground, felled by the hurricane. Four trees over 200 years old, sectioned and measured by Lyon in 1941, with assistance at the site from Stephen Spurr of the Harvard School of Forestry.

*Department of Botany, Dartmouth College, Hanover, New Hampshire.

Table 1. Dates of Minima in Hemlock Growth.

		()=faint		boldface=pronounced		
New Hamp.	Boston Area	So. West New. Hamp. (4 trees)	No. West Conn. (2 trees)	New London Conn. (Avery)	No. East Conn. (4 trees)	Northern Penn. (Meyer)
1705		1704-05 1716-17	1706-07 1716			1705 , 1711 1715-16
1720						(1721)
1723		1723 1728	1723 1728			1723 1729
			1731			1733
		1736	1736			(1736), 1738
1741		1739-40	1741			(1740)
1743		1743				1742
1748-49		1748-49	1748-49			1747
1754-55		(1755)	1755 1758			1754 1756
1762		1762			1760	(1759)
1767 (-68)		(1768)	1766			1767
1770			1770			1771
		1775	(1775)	1774		
1779-80			1778	1777	(1779)	(1777)
		1784		1780	1784	
				1786-87		1786
		1793	1792	1792±1	(1791)	1793
1798-99			1798		1798	1795
		1799-00	(1800)	1800±1		1800
1804			1804		1804	1805
1806			1806	1806	(1806)	
			1810	1811		1810-11
1820-21	1818	1820	(1819)	1819	1816	1821
1826	1826	1825-26	1826	1826	1824-25	(1827)
1829	1829		1829	1829	1829-30	(1830)
1832	(1832)			1832		
1836	(1836)			(1836)	1834-35	
	1838	1837-38	1837	1838	(1838-39)	1838
1841		1841	1841	(1840)		1840
	1843	1843		1843	1843	
				(1846)	(1846)	1845
1849-50		1849	1850	1849		1849-50
	1852			(1852)		
1853-54	(1854)	(1853)	(1855)	1855-56	1855	1854
	1856	1856	1857			1856
1859	(1859)	1858	1859			
1862	1864	1864	1862-63	1864	1863	1863
	1866	1866	1867	(1866-67)		1866
1869	1870		(1869)			1870
1873	1873	(1873)	1871-73	1873	1872	1874
1877	(1876-77)	1879	1877	1876	1877	1878 , 1880
	1883		(1883)	1883	1883	(1882)
1885	1885			(1885)		1886
	1890	1888	1888	1890	(1888)	1889
	1893			(1893)		1892-93
1895-96	1895-96	1895-96	1895-96	1895-96	1895	1896-97
1899-00	1899	1900	1899	1899-00	1901, 04	(1900), 1905
1911	1911		1911	1911		1912
1914	1914	1914	1914	1913		1915
1918	1918					1919
1920	1920	1919-20	1920	1920		1921
1923	(1923)	1923	1924	(1924)	(1923-24)	(1925)
	1926	(1926)	(1926)	1926	(1926)	1927
	(1929)		1932	1932	1930	1932
1934	1934			1937	1934	1935

2. Boston district. Four upland forest sites in eastern Massachusetts as reported by Lyon in *Ecology* 24: 329-344, 1943. Several trees selected from hurricane throw at each site.
3. Connecticut sites.
 - a. Yale Forest at Union, in northeastern section of state, as described by Lutz in *Tree-Ring Bull.* 10: 26-28, 1944. Data based on four trees that grew in a swamp forest.
 - b. Ledge and ravine near New London (southern shore of state), as described by Avery, Creighton and Hock in *Amer. Jour. Bot.* 27: 825-831, 1940. Fifteen trees sectioned, all over 100 years old.
 - c. Mohawk Forest in northwestern corner of state (town of Cornwall). Two old trees from low ground, measured in 1941 by Lyon from sections cut by Dr. Raymond Kienholz, State Forester.

In addition, it was of interest to compare the hemlock chronology of these New England forests with the data supplied by Meyer (*Tree-Ring Bull.* 7: 20-23, 1941) from virgin stands of hemlock in northern Pennsylvania. The airline distance of this site is approximately 300 miles from the nearest site sampled in Connecticut.

In accord with common usage, the possible similarity in the response of hemlock growth to climatic factors was sought in the years in which minima of ring growth were found. These are shown in the seven columns of the table, with the minima rated as faint (year in parentheses), average (unmarked date) and pronounced (in boldface)).

Among the six New England areas represented, the agreement is, on the whole, uncertain and variable. Many years are repeated across the table but only a few years, like 1806, 1829, 1843, 1883, 1895, 1920, and 1926, appear in most of the first six columns. Allowing for individual drouth years at each area, the first three columns show a fair agreement between sites in New Hampshire and the Boston district, with the trees of the forest in southwest New Hampshire differing most from the others. The likeness among the three groups of Connecticut trees is no better, with the swamp trees of the northeast corner giving the most disagreement. The lack of agreement between the New London site and other places can be understood on the basis of its nearness to the ocean. It is rather probable that measurements from upland trees in the interior of the state will give data more in harmony with those of the New Hampshire and Boston areas. Failing this, they should at least provide considerable crossdating between the interior sections of Connecticut and Massachusetts. Hemlocks in the western half of the latter state have not yet been used for tree-ring studies although the species is common there.

On the basis of information now available and in view of the discrepancies shown by considerable work in the general longitude of the Boston area, for any problem of dating hemlock timbers in the New England area it will be advisable and probably necessary to establish a local chronology, preferably within 50 miles of the site. Even then an undated sequence of less than 100 rings cannot be placed with any confidence. For a long run, of years, dependence is to be placed on the matching of some strong, widely-spaced minima. Between them will occur many inconsistencies; some of the minima will miss agreement by one year. For any two sequences that actually do crossdate, each will also show some other years of minimum growth increments not represented in the other. This can be permitted, provided one does not show a maximum growth in the same year that a minimum growth was recorded in the other.

Of the crossdating possibilities between New England and Pennsylvania, little need be said. With a few exceptions, narrow rings in Pennsylvania come either a year later or a year earlier than a drouth effect is registered in New England.