Growth Rings of the Oak as Related to Precipitation in Illinois

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The investigations of Douglas (1) on the relation between the width of the growth rings of western conifers to climatic phenomena are now well known. Within the range of the eastern deciduous forests several investigators have shown a correlation between tree ring width and precipitation. Among the more recent contributions are those of Diller (2) on the beech in Indiana; Lyon (3) on the pines and hemlocks of New England; Robbins (4) on the oaks in Missouri; and Lyons (5) on the oaks and cottonwoods of Iowa. The reports of other investigators are cited in the bibliographies of the authors mentioned above, but no one seems to have investigated any of the trees of Illinois.

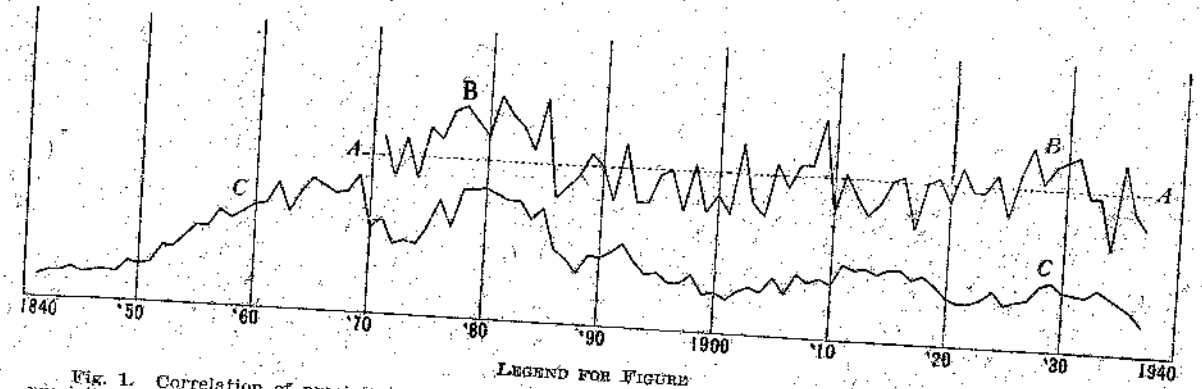
During the past year an opportunity was afforded the writer to examine a section of a red oak, *Quercus borealis*, grown in an open stand on morainic upland soil, on the Chicago Tribune Farm near Wheaton, DuPage County, Illinois. The tree was about 29 inches in diameter, three feet from the ground. It had produced some leaves in the spring of 1937, but had died, from unknown causes, later in the summer. When it was cut down in the late autumn a section made about three feet from the soil permitted the counting and measuring of the growth rings. The smoothing of the cut surface by a carpenter's plane and the application of white shellac to the planed surface made the measurement of the rings comparatively easy. Under a magnifier the rings were measured along three radii and the width of each ring recorded in millimeters and tenths of millimeters. The averages of the data for the three radii were plotted, giving a fluctuating growth curve. Ninety-six rings were distinguishable showing that the tree was approximately a century old. The measurements along the three radii agreed fairly well.

The life history of the tree may be divided into four well marked periods. The seedling period extended over some two decades during which the growth in diameter increased from one-tenth to one-fourth of an inch per year. This was followed by a sapling or youthful tree stage extending over three decades during which there was a maximum rate of increase in diameter, an inch being added about every third year.

Maturity may be said to have begun when the tree was a half century old. Under normal conditions this would have continued for at least a century in the red oaks but in this individual an untimely end came in four decades before the tree had lived half its usual span. During this middle life diameter-increase averaged a fifth of an inch per year.

A premature decline seems to have begun with the drought years of the early 30's and death occurred in 1937 when the tree was approximately a century old, for since 96 growth rings were counted it is safe to assume that the seedling was at least four years old before it reached the height of three feet from the ground where the section of the trunk was made.

The rainfall records are from the Chicago Weather Bureau 30 miles distant. They began in 1871 and are plotted for the calendar year against a mean of 32.86 inches. Lyon and others have shown that the rainfall during the late winter and spring is most important for tree growth and that a closer correlation between growth and precipitation is obtained by using a year extending from October to September. It was thought, however, that for the purpose of this study the calendar year would be most convenient and sufficiently accurate.



LEGEND FOR FIGURE

Fig. 1. Correlation of precipitation and tree growth. Annual precipitation *(B)* plotted against mean annual precipitation *(A)*. Width of annual rings of oak tree *(C)*.

Comparing the graph representing precipitation with that representing growth one period of more than average rainfall centers about the year 1880 and during that period the growth response was marked. It was followed by more than a decade during which precipitation was below the mean and this too is reflected in the lowering of the growth curve for the decade ending about 1900.

If a closer analysis be made it will be found that for at least 46 of the 66 years for which the record is available there is a positive correlation between precipitation and growth as represented in the graphs. It is also evident that for some 10 other years the growth curve may be explained by the carry-over of the rainfall excess or deficiency from the preceding year.

We may conclude from this that in one instance a very close correlation is evident between the precipitation for the calendar year in Illinois and the increase in diameter in a red oak tree shown by the thickness of its annual growth ring.

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