



AT LEFT is a ring series from a cross section of a sagebrush from the Grand Canyon National Park area. Note how winter rainfall is reflected in annual growth. This 1908-1932 year period, depicted here as "plant growth," is indicated by the heavy line overlying our cover picture of a cross section from the same plant. Compare ring series at left with the cover picture, from which it was taken.

Growth Rings of Sagebrush Reveal Rainfall Records

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Most plant-growth research of an ecological nature is concerned primarily with what is happening today or what will happen in the future. Only rarely do these studies look into the past.

Dendrochronology, the study of tree rings, uses the present only as a starting point from which to explore the past. This science is based upon the fact that some tree species develop growth rings which vary in width from year to year in response to variations in climate. Hitherto, studies in the Southwest have been made only on coniferous trees such as Douglas fir and the pines.

Recently, however, a collection of 700 stem sections of big sagebrush (*Artemisia tridentata*) from seven western states and Baja California, Mexico, has shown that this shrubby plant has the same ring character as do the forest trees. The "ring" is the growth layer of a circular stem as seen in cross section. Some plants, such as big sagebrush, do not develop circular stems as they become older but may assume a variety of unusual shapes.

Distinct Growth Rings

This feature is shown in the photograph on our cover of a specimen from near the Grand View entrance to the Grand Canyon National Park. In spite of the lobed shape, the rings here are distinct and it is easy to tell, by their posi-

Because big sagebrush does not have a definite annual ring, the rings can be counted to determine the age of any given plant or plant community. The oldest plants found, then, indicate the maximum age reached by the species in that area; or they may indicate the time that has elapsed since some catastrophe such as fire, plowing or flooding had occurred.

tion within the ring chronology, the year in which they were formed. Some are narrow, some are wide, indicating differences in rainfall from year to year.

In the diagram at the top of this page, the ring series for the years 1908 through 1932 is compared with winter rainfall (above) and summer rainfall (below) from the park headquarters 20 miles to the west. The amount of rain in both periods for each year is tabulated in the table and is indicated in the diagram by the width of the space bounded by two lines.

Winter Rains Mean Growth

The stronger correlations of growth rate to winter rainfall is shown by the fact that as winter rainfall increases or decreases, so too does the width of the growth ring for the corresponding year. It will be seen that a similar relation between growth and summer rainfall occurs less often.

In 1912, 1918, 1921 and 1925 when summer rainfall totals were nearly twice that in the winter, the ring for each year corresponds in relative size to the winter precipitation. In these years, as in the

average, the heavy portion of the May-October rains came in July, August and September, well after the plant had completed its growth. In contrast, the ring for 1930 more nearly represents the much heavier summer rainfall.

This is explained by an analysis of the monthly data which show that May, June and July rains were substantially above the average and occurred in time to be utilized by the plant during its growing season. In 1920 and 1930, the winter rains were more than twice that of the summer rains; here again, the ring widths parallel the winter rains.

Age of 200 Years

This study has shown that sagebrush produces a growth ring that is sensitive to changes in annual precipitation and sometimes reaches an age of slightly more than 200 years. The use of shrubs in this way thus provides an avenue for climatic and ecologic interpretation outside of the forested areas.

Rainfall, in Inches, at Grand Canyon Nat'l Park Headquarters

	Winter Nov.-Apr.	Summer May-Oct.
1908	9.14	10.27
1909	9.96	6.40
1910	7.85	4.43
1911	10.39	9.95
1912	4.65	7.15
1913	6.86	5.32
1914	9.52	6.34
1915	7.36	4.96
1916	9.62	7.28
1917	6.02	5.25
1918	5.73	10.33
1919	9.50	8.30
1920	10.89	4.20
1921	4.48	10.02
1922	9.19	6.96
1923	9.28	8.15
1924	9.14	6.78
1925	6.85	12.14
1926	8.79	7.40
1927	10.19	12.98
1928	8.08	6.12
1929	6.07	6.93
1930	4.49	8.85
1931	5.14	6.45
1932	10.84	5.25
25-year total	200.03	188.21