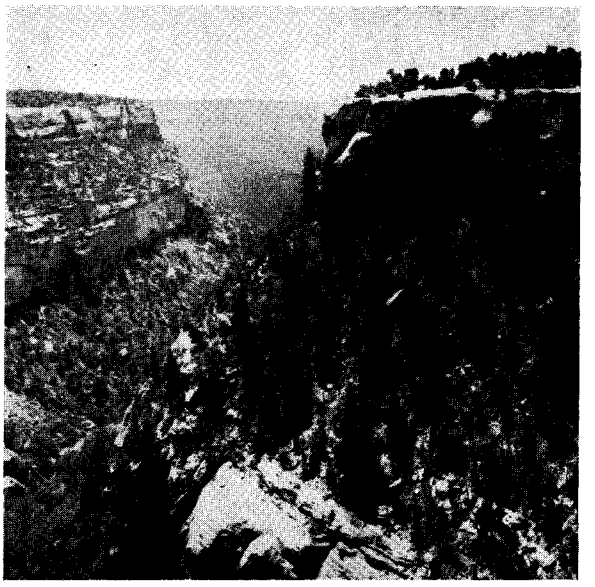

Outpost of Douglas Fir in Dry Climate. Fewkes Canyon, Mesa Verde, Colorado.

inch increment cores. The photograph herewith shows a grove of firs (locally called spruces) near the outlet of Fewkes canyon, seen from Sun Temple point. The superb crossdating character in these trees was proved by a visit to the grove and a half-dozen borings, testing young and old trees and upper and lower sides. The slope was perhaps a little steeper than at the site of IF-20; rocks, loosened, rolled down 100 feet before stopping. Large rocks were apparent and the soil was obviously very limited indeed. There could be no source of water supply from above and as the grove reached down to the top of a cliff there was no chance of conservation of water from other localities. These trees must exist on the moisture that comes in the annual precipitation, and it is believed their character is such that they represent first and foremost the precipitation of the preceding winter and secondarily in very rare cases an effect of the summer rains. The photograph tells the story of trees that show splendid crossdating.

CLASSIFICATION OF FALSE ANNUAL RINGS IN WEST TEXAS PINES

EDMUND SCHULMAN

Capping Mt. Locke (elev. 7,200 feet), about 200 miles east-southeast of El Paso, is a small stand of pinyon pine, including also about half-a-dozen ponderosa past the sapling stage. Borings of all of the latter and some pinyon were taken on May 6, 1939; several full sections were supplied by Dr. C. T. Elvey of the McDonald Observatory on Mt. Locke.

Numerous false rings were recognized in all specimens. For the interval 1908-1939, 147 of the 372 rings in 12 specimens contained one or more false rings. The two youngest ponderosa, both with pith at 1907, showed only 20 rings free of 'doubles' out of 62; the two oldest ponderosa, with pith at 1846 and 1855, showed 130 with no 'doubles' out of 175. While at first glance extra rings seemed so complex as to make impossible the assignment of absolutely correct dates to the ring record (the prime essential in tree-ring analysis), further study completely resolved their identity.

As a working hypothesis, the Douglass criterion for false rings (those with hazy outer boundary), almost universally applicable to pines in the Pueblo area, was applied here also and a tentative dating assigned. Fine crossdating was found not only in ring thickness but also in the false rings, many of which appeared consistently in about the same form* throughout

*In studying false rings, the following facts about the extra latewood were found useful: (1) type of outer limit (i.e., hazy, semi-sharp, sharp); (2) position—early, middle, or late in earlywood of annual, or in latewood of annual; (3) color and extent; (4) thickness, including preceding earlywood, in per cent of the total annual growth.

the group from Mt. Locke and also in two ponderosa from Madera Canyon about 15 miles west.

The possibility was considered that microscopic rings for 1904, 1910, and 1917 might be examples of annual-like false rings. But no specimens showed them with hazy outsides; in some specimens the last two were either locally or completely absent. Thus, again on the basis of the Arizona experience, these rings were called true annuals.

The comparison with the rainfall records of El Paso and Fort Davis (20 miles south of Mt. Locke) completely substantiated the dating. It was evident that winter precipitation had a dominant influence on the ring thickness although it amounted to only about a fourth of the annual total. Thus, 1904, 1910, and 1917 were outstanding minima in terms of November-April precipitation. It seems probable that in a majority of years only the earliest part of the summer rains are made use of for radial growth by these Texas trees. But many of the cores collected in early May showed that no diametral increase for 1939 had yet begun, while others showed a little growth; nevertheless, the winter rainfall of this year was normal. Thus a conservation of the effect of the winter rains is indicated.

Outstanding years of thin rings are 1934, 1928, 1917, 1910, 1907, 1904, 1895, 1887, and 1880. The similarity to the record since 1934 of the series of thin or locally absent rings in the late nineties implies a possible pest outbreak at that time. Very thick rings are usual for 1923, 1920, 1914, 1913, 1908, 1906, 1905, 1886, 1885, and 1879. Frost rings are rare, but several are present near 1850, close to the centers of the older ponderosa, and show good crossdating.

The extra rings in these pines fall into two types: (1) a latewood false ring, commonly with hazy to semi-sharp outside boundary and (2) an early-wood false ring, commonly with semi-sharp boundary.

The extra ring appearing in the latewood region is occasionally emphasized by a discontinuity between the thick flattened cells of its final growth and the following moderately open cells characteristic of latewood well before the season's end. Unless examined under high power and in the most favorable illumination, such false rings, called semi-sharp, might be mistaken for annuals. Most of the latewood false rings however, are of hazy outer boundary and easily classified. Considering the group as a whole, even the semi-sharp false rings of the latewood type offered no difficulty in identification, since for every specimen showing such character several showed the same ring with hazy boundary.

Earlywood false rings tend to be semi-sharp and are sometimes not easily differentiated from true annual rings except under the compound microscope. Such rings were found in most or all specimens for the years 1906, 1916, and 1928. The latewood of this type consists usually of only a few cells, so that there is some similarity to what Douglass has called a midline in Arizona pines. It differs from the latter in showing a tendency to a gradual change from early to latewood type of cell on its inner boundary, rather than an abrupt change of type at both limits, and consists of perhaps half-a-dozen or more cells rather than only two or three as in the midline. But the small number of cells gives it an apparently sharp annual-like outside. In the present collection of twelve specimens, the semi-sharp early-wood false ring appeared only in the young and comparatively fast-growing specimens, in which the latewood of the true annual is rather dark and composed of dozens of cells even for the drouth rings. Thus in young trees a fairly dependable solution of such uncertain rings may be made on the basis of cell count.

The preceding criterion probably cannot be applied to old trees, in which microscopic rings may be numerous. However, while no specimens more

than a century in age could be located on the site examined, the older ones in the group show the usual tendency for suppression of false rings with advancing age. But a more definite solution of these earlywood false rings is obtained by crossdating with the pinyons, in which all extra rings were of the diffuse-boundary type.

No examples were found in any specimen of the extreme case of a false annual ring with truly sharp annual-like boundary, such as can be laid down by the Monterey pine.

THE CHRONOLOGY IN OL-12, A DISSECTED PONDEROSA

E. SCHULMAN AND G. C. BALDWIN

To determine the variability within a single tree, complete studies were made of the rings at 10 levels from base to top in the trunk of a normally sensitive ponderosa (OL-12) from the Flagstaff area. The results, supplemented by studies of tip growth and of branch and root rings, have been published by Glock.[1] We consider now some further details in the chronology, especially with reference to climate.

Locally absent rings[2]*—an extreme case*: The only appearance of the 1902 ring was as a lens of about .07 mm average thickness on only 2 mm of the circuit of section G, (33 ft. level). If we assume that the proportions of ring growth as observed on the 10 sections apply to the tree as a whole, it then appears that in 1902 only about one four-thousandth of the cambium was active. In 1903 about 25000 times as great a volume of wood was laid down as in 1902. The average yearly volume growth in the 1920's was apparently about 80000 times that for 1902 and about 300 times the growth for 1904 (next in smallness to 1902). These are striking illustrations of overaccentuation of drouth by the tree-trunk.

False rings: The consistent distribution of false rings throughout the stem of OL-12 is shown in the accompanying table. All rings are listed for which doubles, no matter how faint, appeared in any section.

For studies of rings and climate, inquiry may be directed primarily to the main portion of the stem. It is one of the principles of selection of climatic trees that basal regions be avoided; thus a sample, commonly taken on the uphill side, may be five to seven feet above the base. Since section B came from the 7½ foot level and section G from just within the branches, we can appropriately examine in particular the region between these limits. All false rings which are spotty in distribution, and present on no section of B to G inclusive for as much as one-fourth of the circuit, were separated from the more consistent false rings of table 1a.

From table 1a, we see that in 26 out of 28 cases, false rings appearing in section B appeared also in section G and in all of the intervening slabs. Likewise, 27 out of 34 false rings appearing in G could be followed downward to section B, with few or no complete failures in between; four of those which faded out were the relatively youthful rings of 1774, '86, '89, and '92.

None of the 20 scattered and weakly developed doubles of table 1b appears as double in section B, and but few appear in any of the lower sections. The greater tendency for doubling in the upper and therefore younger portions of the stem[3] is well shown. A similar but weaker tendency for doubling near the base is also indicated, as in 1868, '27, '11, and '10.

[1] W. S. Glock: Principles and Methods of Tree-Ring Analysis. Carnegie Inst. Wash. pub. 486, Washington 1937.

[2] *Ibid.*, pp. 48-51.

[3] *Ibid.*, p. 53.