XIV. OKLAHOMA CLIMAGRAPHS AND BIOTIC REGIONS*

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The climapragh, or more accurately, the hythergraph has proven of considerable value in the depiction of climatic characteristics, especially from the biological standpoint, as it expresses graphically the climatic rhythm and not merely totals of the two most important factors, rain'all and temperature. The biota of a given region is adjusted, not primarily to the total rainfall or the total accumulated temperatures of the local climate but to the climatic rhythm. Other factors, of course, are effective. but temperature and rainfall are quite obviously among the most important, and the hythergraph is the most convenient me-

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thod of portraying, graphically, the climatic rhythm, in so far as it is concerned with these two factors. The method was first introduced, probably, by Ball, who published an account of his method of graphically representing climate in the Cairo Scientific Journal in 1910. He used temperature and atmospheric humidity in his diagrams. Griffith Taylor of Australia was the first to substitute rainfall for mean monthly humidity as one component of the chart. Humidity records are generally unsatis'actory and are not recorded for many stations, while rainfall records are almost universally available.

The method used in representing the climatic rhythm of a given station is il ustrated in Figure 1, which illustrates the data for Oklahoma Lity (heavy lines). The vertical component represents temperature (Fahrenheit), while the horizontal scale represents rainfall (inches). The mean rainfall for January at Oklahoma City is 1.17 inches and the mean temperature is 37.1°F. Thus, for that month a dot is placed at a point 1.17 divisions on the scale from the left margin, and 37.1 divisions from the lower margin. Similar y, for February a dot is placed to represent 1.1 inches rainfall and 38.5° F. and so on for the entire year. Then the points are connected in order and we have a graphic representation of the climate of the station considered. The salient characteristics of the climatic rhythm can be pointed out: Minimum temperature and minimum rainfall in December, January and February. Maximum rainfall in May, maximum temperature in July and August, etc.

For reasons given above the climatic differences between the major biotic regions (climatic formations) are especially well shown by this method, and it occurred to the writer that the state o. Oklahoma, lying as it does in a region in which the climatic gradient is comparatively steep might furnish interesting material for study by this method. The results, preliminary in form, of such a study are presented herewith.

Climagraphs were made for all Weather Bureau stations in the state for which records covering fifteen years or more were available. The observations at all stations do not cover the same period of years, so that an error is introduced on this account. It is hoped that a more thorough study may be made later in such a manner that this error may be eliminated.

Figure 1 contains, in addition to the climagraph for Oklahoma City those o' Idabel, McCurtain County (light lines) and Kenton, Cimarron County (broken lines) to illustrate the climatic



extremes of the State. The former is the most southeasterly station considered and the latter lies farthest to the northwest. The contrast in the figures is obvious. All three have May as the month of maximum rainfall and July and August as the warmest At all three stations January and February are cold months. menths, but the minimum rainfall is in the late autumn at Idabel and during the winter at the other stations. The small amount of rainfall at Kenton places the graph so far to the left that it barely touches that for Oklahoma City at any point, while the higher temperature at Idabel during the autumnal period of little rain causes the figures to overlap in this region. The May rainfall maximum at Oklahoma City is as great as that at Idabel, but no other month approaches it, while at Idabel January, March, April. June and July all have more than four inches of rainfall. The figure for Tahlequah, Cherokee County is much like that for Idabel, but without the autumn rainfall minima. It shows. a similar high point in March. Vinita, Bartlesville and Pawhuska are similar, but cooler and drier during the winter months

Other series of stations with similar climagraphs are a) Mc-Alester, Hartshorne, Ho'denville and Ada; b) Muskogee and Tulsa; c) Okmulgee, Cushing, Chandler, Oklahoma City, Paule Valley, Ardmore, Ravia and Healdton; c) Newkirk, Ponca City, Stillwater, Kingfisher, and Chickasha; d) Mangum. Enid and Ada; e) Cheyenne, Woodward and Beaver. Within these graphs the variations, on a north and south line, are main'y in the vertical position of the graph and do not involve differences in the shape of the climagraph. The following are illustrated in Figure 2, as examples of the series:

- a) McAlester (heavy lines)
- b) Oklahoma City (Fig. 1)

c) Kingfisher (light lines)

d) Enid (broken Enes)

Differences here are not as marked, of course, as in Figure 1, but show a progressive change. McAlester as compared with Idabel shows much less rainfall in the winter and a higher May maximum as well as the absence of the extremely dry autumu. The form of the graph more nearly approaches that of Oklahoma City, but is noticeably farther up and to the right than the latter. Kingfisher does not differ greatly from Oklahoma City, but the angle representing the May rainfall maximum is much less acute. In the Enid figure this angle has become very obtuse. The figures in the next group (not illustrated) may be described as intermediate in form between those of Enid and Kenton. It is much more instructive, of course, to study the entire collection of climagraphs together but the expense of illus



Fig. 3.

tration is too great to allow presentation here of the entire series. Figure 3 is a map of the state on which is represented an attempt to divide the area into climatic regions as indicated by the ckmagraph types outlined above. It is of considerable interest to note that there is a close general agreement between this map and various vegetation maps which have been published, for example, that of Shreve (1917, Geol. Rev. Vol. 34). Idabel and Tahlequah lie in Shreve's Deciduous Forest Area, Idabel close to the border of the Southwestern Emergreen-Deciduous Forest. The stations represented by graphs a, b, and c lie in his Grassland-Deciduous Forest Transition area, while those of groups d and e lie in the Grassland area. Kenton, alone, of the stations considered lies in the Grassland-Desert Transition area.

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Further studies should take into account, not only averages, but critical years which have a very great influence in delimiting the distribution of species at or near the borders of their range.