THE EFFECTS OF VARIATION OF WIND DIRECTION AND VELOCITY IN OKLAHOMA SAND DUNES

by

HARRIET G. BARCLAY[1]

EDITOR'S NOTE: Dr. Barclay's paper from which this abstract has been made by her is scheduled to be presented in full in the Southwest Naturalist. This is a new publication put out by the Southwestern Association of Naturalists and Dr. Barclay expects her paper to be Vol. 1, No. 3, 1956.

Abstract

The sand dunes of northwestern Oklahoma are formed by prevailing south-southwest winds which pick up river sand and deposit it on the north sides of the rivers. Two areas of dunes, each approximately four miles square, located south of Waynoka, Woods County, were observed to show considerable seasonal variation in shape, in surface features, and in the movement of the sand. Studies were made to determine the nature and causes of these variations.

The dune pattern within each area is en echelon or diagonal placement of the dunes due to the south-southwest winds which prevail during the summer and part of the winter months. In the summer the most prevalent dune shape is the typical barchan or crescent, with a curved windward slope marked with ripples, a steep leeward slip face, and long horns to leeward. The leaves of grasses growing on the inside of the horns form concentric patterns in the sand that indicate the eddying air currents in these places. Parabolic dunes, with rounded slip face to leeward, are infrequent and associated with blowouts. The dunes tend in their progression to override each other, leaving shallow hollows and sometimes deep pannes where cottonwood seedlings become established.

Surface patterns during the months of constant wind direction consist of the scouring of former deposits showing cross bedding, and ripple marks which clearly indicate wind direction. Ripple marks, due to the characteristic grain paths shown by Bagnold[2], are at right angles to the blowing sand, with the coarse particles always on the lee side of the ripple. Stronger winds make higher and wider-spaced ripples. Both large and intervening small ripple marks formed by the same wind direction have been measured, the large ones 45 to 68 inches and the small ones 3 to 6 inches from crest to crest.

Winter storm winds come from the west, northwest, and north. They are of sufficient force to alter the typical shape of the barchan. From November until early spring one may observe the barchan crest rolled back toward the south-southwest and the dunes generally rounded in form. The wing-tips or horns are curved back or destroyed and the old slip face becomes covered by sand deposit. Where crest lines are formed at all in the winter they are temporary and constantly changing with the wind direction. After a severe storm a shallow slip face is sometimes formed on the summer windward side, but this, too, is subject to the vagaries of the wind. Temporary miniature dunes are often formed on the shoulders of the barchans, previously marked by shallow, regular ripples. Ripple marks formed in the winter are in new loca-

1. University of Tulsa, Botany Department.

tions on the deposits covering the old slip faces instead of on the summer windward slopes. In other places, where old ripple marks have survived, there has been deflation scouring of the lee sides, making smaller ripples in the opposite direction. On the usually-smooth advancing dune front there were observed, after a severe winter storm, large ripples measuring 20 to 28 inches between crests at right angles to the direction of the north wind. Between these large ripples occurred small, shallow ripples, 2 to 4 inches between crests, at right angles to the direction of the west wind and apparently made after the storm. The tracings of plants on the surface sand show changes of wind direction, as do also the exposures of plant roots which were functional during the growing season.

Aerial views of these Oklahoma dunes show barchan, or very occasionally, parabolic dunes on the advancing front of the dune area, and a tendency of the older dunes to combine into long, transverse lines. This is the reverse of the development suggested by Gilluly[3], and may be due here to the reversal of movement caused by the storm winds.

The sand history of northwestern Oklahoma is a long one, not geologically, but from the human standpoint. Waynoka is built on wind-deposited sand; the surrounding agriculture is on stabilized dunes. Active dunes often move over sand stabilized by vegetation. The road between Waynoka and the Cimarron River bridge is said to have been moved three times in the last fifty years because of shifting sand. A camp site of eighteen years ago, in the lee of the dunes by Dog Creek, is now buried and Dog Creek itself is partially obliterated. There is always the threat of moving sand in this area, but it is suggested from this study that the progression of the dunes would be more rapid without the winter storm reversals.

References Cited

2. Bagnold, R. A , 1942. The Physics of Blown Sand and Desert Dunes. William Morrow and Company.
3. Gilluly, James, et al: Principles of Geology, 1951. W. H. Freeman.