

## THE RELATION BETWEEN THE SIZE OF WAVE-FORMED RIPPLE MARKS, DEPTH OF WATER, AND SIZE OF THE GENERATING WAVES

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### ABSTRACT

Ripple marks are among the most frequently observed minor shore forms which are found preserved in sedimentary rocks. Their importance lies in the possibility of determining from a study of their characteristics something of the environment under which the rock containing them was formed.

Of the three classes of ripple marks, those formed by wind, by running water, or by waves, the last is the most difficult to investigate. This is because of the variable conditions under which they form and the difficulties of making observations beneath the wave-covered surface. Perhaps the most important question regarding the meaning of wave-formed ripple marks is that of the relation existing between the size of ripple marks, the depth of water, and the size of the waves causing their formation.

For the purpose, if possible, of determining these relations a study was made of ripples formed under controlled conditions in a tank. This was supplemented by a series of observations along the shores of Lake Michigan and some of the nearby smaller lakes. The waves formed in the tank were probably a series of individual waves rather than a wave series. Therefore the wave size was judged by wave height alone. This study indicated that with a fixed water depth the size of the sand ripples varies directly with the size of the generating waves and that with a fixed wave size the ripples became smaller as the water becomes deeper.

These results were substantiated by studies along the shores of Lake Michigan and some of the smaller lakes. However, in these studies it was found that the length of the waves as well as their height is a factor in the size of the ripple marks produced. For example, a wave 5 inches high and 40 feet long on Lake Michigan caused ripple marks 6 inches wide in water 18 inches deep while on a smaller lake a 5-inch wave 7 feet long caused the formation of ripple marks 2 inches wide in 7 inches of water.

It is evident from this that fossil ripple marks tell little as to the depth of water in which they were formed. Large waves may produce the same size of ripple marks at considerable depth that smaller waves produce at lesser depth. The largest ripple marks are formed in shallow water by large waves, but small waves also form small ripples in shallow water. In extremely deep water the sand ripples are always small. It was also found that sometimes ripple marks are large near shore and decrease in size with depth but sometimes they increase in size as the water gets deeper. If, as the waves approach the shore, the lessening in wave size due to loss of energy in friction is small as compared with the rate of shallowing the ripples will be larger near shore, but if loss of energy is faster than loss of depth the ripples will be smaller near shore. The former occurs with a steeply sloping bottom; the latter with a gently sloping bottom.

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