XXXVII. THE AGE OF ROUNDED SAND GRAINS

G. E. Anderson, Department of Geology, University of Oklahoma.

The conception has long been prevalent that the wind is a much more efficient agency in the rounding of sand grains that is water. From this has been developed the geological doctrine that sandstones and sands composed of rounded or sperical grains are of eolian origin and consequently may have been deposited under desert conditions.

Experiments to determine the relative rate of wear by wind and water have been in progress by the writer for the last several years. The results of the experiments indicate that the rate of wear by either wind or water is an exceedingly slow process and in fact much more slow than had been expected. The experiments also bring out very strikingly that the rate of wear on sand submerged in water is considerably more rapid than the wear on dry sand when rolled over an equal distance. Thus instead of having a ratio of the rate of wear of 29 to 1 as was suggested long ago by Mackie from his studies and field observations, the experiments indicate a ratio of from 1.5 : 1 to 4.5 : 1 in favor of water. If this is the true condition in nature, it is evident that water actually accomplishes a great deal more rounding of sand grains than does the wind. It was long ago observed that dune sands were made of the more equidimensional grains or the more rounded grains which may however, be due to the fact that the wind will roll more easily the more rounded grains than angular grains which will be left behind, this being a process of selective sorting by the wind.

The rate of wear by both wind and water is so slow that after some 500 miles of wear in a rotating barrel there is no perceptible rounding of the grains so far as can be determined by the microscope and quartz crystals of definite angular outlines do not show distinctive wear after traveling this distance. Microscopic determination therefore as to whether a sand is wind or water worn seems hopeless.

It should also be noted that the original source of the sand found in the field hardly admits of direct determination for wind will carry sand irrespective of topography and altitude so we can hardly escape from the conclusion that the source of wind sand is heterogenous in character and may be derived from various sources

and several geological formations containing sand in different stages of rounding. Similarly the source of sands found in streams and along their banks, as dune sand, on continental Europe and the British Isles may have been carried for some considerable distance by the Pleistocene ice and may even have come through this source from the Scandinavian Peninsula. Furthermore all geological formations earlier than the Pleistocene may have contributed through glacial erosion to the sands now found in these areas,, and over which the ice is known to have moved.

While the conclusions obtained from these experiments are to be regarded as provisional, they may be summarized asfollows:

1. From the exceedingly slow rate of wear which has taken during the experiments, it does not appear likely that sand grains in a single journey from the central part of a continent to the sea would experience sufficient wear to become rounded. For such rounding, the sand will probably make several such journeys, through more than one cycle of erosion, transportation and deposition.

2. It follows that sand grains approaching spherical shape may be of very considerable age. No such grains should be regarded as having been derived during the present cycle of deposition, from their source the igneous rocks.

3. The presence of more rounded grains as well as a larger number of rounded grain in dunes than on the beach is due to the selective sorting by the wind. Rounded grains are rolled more easily than the more angular or flat-shaped grains. This sorting action by the wind, leaves the relatively flat and angular grains on the beach or in the river flats; so that while the wind may have done the sorting of the more rounded grains, it may not have been the most important agent in their rounding.

4. Sand grains in agitated water are rolled comparatively gently, while the wind is less able to roll grains. Due to the higher velocity of the wind, the grains are carried in suspension, and as the velocity diminishes settle into the pore spaces of the sand over the dune surface. While the smaller sand grains are so carried by the wind at high velocity in suspension, they are not being rounded but may become more angular due to breaking on collision with the surface of the ground. In water the fines are carried in suspension, leaving the grains which are large enough to be rounded, free to collide; for the film of water which is supposed to surround submerged sand appears to be non-existent in so far as sand grains of sufficient size to be rounded, are concerned.

5. Wind blown sand or sand rolled dry appear to be covered with the fine material which produces a coating over the surface of the sand grains. This serves as a protective coating and actually may prevent wear of the dry sand grains, which due to the coating may appear more round than they in reality are.

6. The action of the water of the beach is believed to be a more potent factor in the rounding of sand grains than is the wind for the water along the beach is in constant motion, moving the sand forward and back, while sand in dunes is in motion only periodically, at comparatively long intervals, when the wind velocity exceeds ten miles per hour., Furthermore, only a small portion of the sand of the dune may be in motion over the surface of the dune, even when the wind is sufficiently high to roll the sand.