PHYSICAL CHARACTERISTICS OF THE OOLITE GRAINS OF THE STE. GENEVIEVE FORMATION*

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The usual hand specimens and thin sections of oolite afford randomly oriented cross-sections of the oolite grains and permit observation in one plane only. They give inadequate information therefore regarding the size, shape, or roundness of the grains. It was found that "chalky" oolite could be successfully disintegrated to yield a high percentage of discrete grains by a procedure known as the "sodium sulfate soundness test"[1] which duplicates roughly the disruptive action of freezing water but produces disintegration more rapidly. The quarry at Anna, Illinois, contains in its upper part a bed of Ste. Genevieve oolite 6½ feet thick which responded well to this procedure. This paper describes the results of a study of the oolite grains freed from six samples taken from the bed, each sample representing a vertical thickness of about 12 inches.

After disintegration each sample was screened into Wentworth size-scale fractions and weighed. The weight and number of oolite grains in a small weighed quantity of each size fraction was then determined and their particle size distribution calculated in percent by weight and percent by number.

Two matters bear critically on the confidence with which subsequent data may be regarded, namely, is the number of unbroken, discrete oolite grains proportionate to the number in the original sample, and to what extent did the disintegration process reduce the size of the freed grains by exfoliation of concentric deposits. Estimates of the abundance of oolite grains indicate that the number freed is roughly proportionate to the number in the original sample. Signs of exfoliation were generally absent in the discrete grains. This evidence and the excellent preservation of small fossils freed along with the oolite grains suggest that exfoliation was probably not an important phenomenon.

Size of Oolite Grains

The results of particle size determinations on the oolite grains in the six samples are shown in Figure 1. Most of the grains are between 0.25 and 0.83 millimeter in diameter. In terms of the Wentworth size scale for sediments, the grains are principally medium and coarse grained if considered on the basis of percent by weight. However, in terms of percent by number the dominant size is medium grained.

The particle-size histograms of the different samples show no consistent trend from the top of the bed downward. Mostly such variations as occur are between the medium- and coarse-grained grades.

The bedding and other characteristics of the stratum from which the

[1] A.S.T.M., Designation C88-46T.

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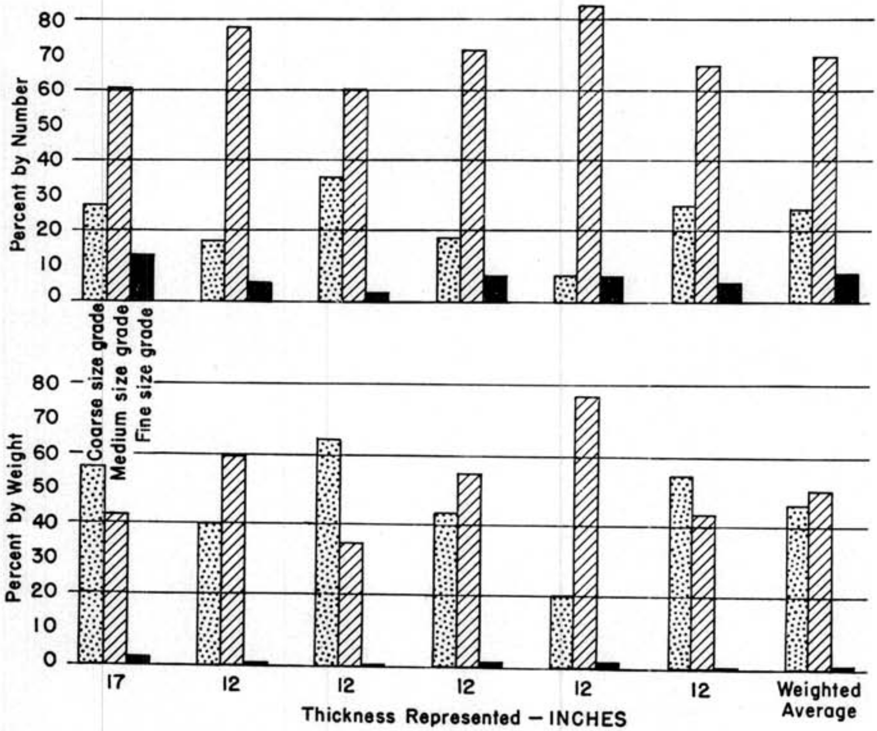

FIG. 1.—Particle-size distribution of oolite grains by weight and number. Reading from left to right the histograms progress from the top of the bed downward.

samples studied were obtained show clearly that it is a clastic rock. The particle-size data indicate conditions of sedimentation which appear to be even more selective than those under which a medium- and coarse-grained sand would be deposited. The restricted size range of the majority of the grains, about 0.6 mm., may be the result of either a high degree of sorting by the transporting medium, limiting factors controlling the maximum and minimum size of oolite grain development, or a combination of both. Erosion during transportation might also be responsible, at least in part, for the grain-size distribution. If this were true, very fine-sized oolite grains should be present. Also, some grains should show evidences of erosion, such as exposure of their internal structure. As neither of these phenomena was observed it is concluded that erosion of grains did not significantly affect particle-size distribution.

Taken together, the foregoing data suggest that the source of the oolite grains was not far from their site of deposition, that they were transported by relatively strong currents or waves, and that conditions in the area of oolite grain formation may have been such as to restrict maximum and minimum oolite size, especially the former.

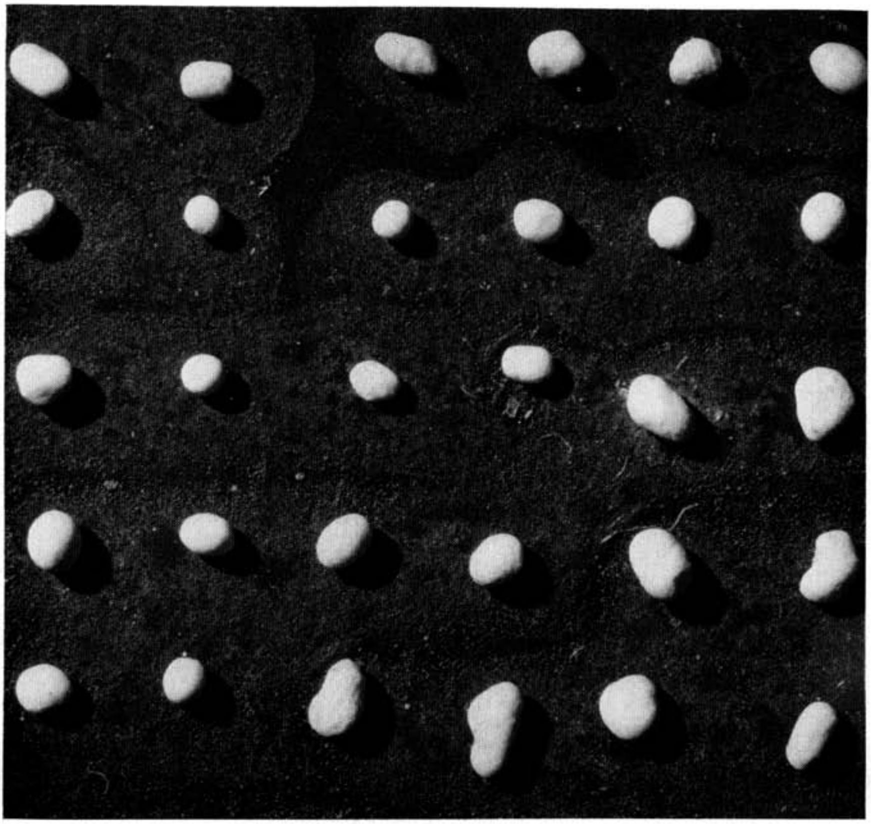

FIG. 2.—Typical oolite grains from the coarse size grade. X 10.

SHAPE AND ROUNDNESS OF OOLITE GRAINS

Roundness determinations were made from photographs of 60 grains of each size category selected at random from the various samples. Figure 2 shows grains of the coarse sand grade. Figure 3 gives the results of classification of the grains by Krumbein's scale for roundness determination.[2] The arithmetic mean roundness values on the chart are very similar and indicate little difference in the over-all roundness of the size fractions. The coarse sand fraction, as shown by the histograms, is notably different from that of the other two size-grades. One difference is the longer 0.9 roundness bar and the shorter 0.8 and 0.7 bars. This may be interpreted as being the result of increasing roundness accompanying the growth of the oolite grains. The reason for the greater percentage of grains with 0.6 roundness in the coarse sand grade is not understood. There is some evidence, however, which suggests that the centers in these oolite grains have

[2] Krumbein, W. C., Measurement and geological significance of shape and roundness of sedimentary particles, Jour. Sed. Pet., vol. 11, pp. 64-72, 1941.

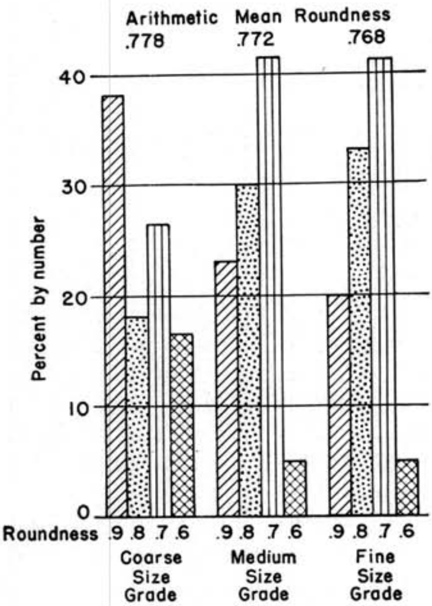

FIG. 3.—Roundness of oolite grains by size grades. Arithmetic mean roundness value is shown above each histogram.

low sphericity, are fossils or comparatively large fragments of fossils, or other types of material, and that the number of concentric deposits is small and therefore insufficient to eliminate the original angularity of the central grains.

Interesting light is shed on the reliability of roundness or shape interpretations from thin sections by a consideration of figure 2. It is evident that random sections through the oolite grains would be very misleading in many cases. A diagonal section through the elongate grains in the upper left hand corner would show an oval cross-section whereas a section at right angles to the long axis would give a circular section. Similarly erroneous results would be obtained with many of the oval or roughly triangular grains.

SUMMARY

The oolite grains of the Ste. Genevieve limestone bed studied have the size characteristics of a well sorted medium- and coarse-grained sand and do not appear to have been transported far. Their roundness values are all higher than 0.5. There is suggestive evidence that the growth of oolite grains is accompanied by an increase in roundness. The three dimensional shape character of the oolite grains suggests that detailed shape interpretations from thin sections may be misleading.