Preliminary Study of Lake Michigan Sediments At Evanston, Illinois

Jean P. Todd

Northwestern University, Evanston, Illinois

The phrase "microscopic reconnaissance" might be coined as one fitting the present study of the bottom deposits of Lake Michigan. For it was conducted on the generalized basis of a preliminary survey and was yet limited to an area of only one-quarter square mile. This area extended in one dimension the length of the Northwestern University campus beach, slightly more than half a mile; in the other dimension it extended half a mile out from shore. Forty stations were located by means of buoys. This was found to be the most practical method of obtaining successive samples from the same location, and such samples were required in order to make a study of the shift of sediment or change in profile during the period of investigation. The buoys were arranged to give four sampling courses of ten stations each, trending normal to the shoreline. On these courses 214 soundings were taken during a two-week period in August. Fifteen more were taken after a lapse of four weeks. Accompanying the last 134 soundings, bottom samples were collected with a modified clamshell snapper form of sampler.

The position of the buoys was repeatedly checked with an alidade during this time and no shift in position was observed. This indicates that there were at least no bottom currents of strength sufficient to move the sixty-pound weights used as anchors for the buoys.

The data from the soundings were plotted as a series of profiles. These in only one or two instances showed variation of more than two inches, which is within the probable error of reading the sounding line. This was over the period of six weeks, during which time several storms occurred. Thus the bottom does not seem to be subject to either active erosion or active deposition. These profiles show a relatively steep slope of the lake bottom in the first 200 feet off shore. The bottom of greater depths is of extreme flatness and gentle slope. The line of the north course is notably deeper than the three to the south, however, giving the deepest recorded sounding of twenty-two feet at its outer end.

Two distinct types of sediment were brought up from the bottom: one a fine grained sand, the other a pebble-clay complex. These are not scattered promiscuously but follow a definite pattern. The gravel and clay lie in a belt roughly parallel to the shore and at the base of the relatively steep off-shore slope, and in a second zone, normal to the shore, along the line of the deeper north course. This second zone is thus again at the base of a slope or perhaps a trough, as the slope of the bottom on to the north is unknown. This correlation of topography and type of sediment corresponds with the results of the previous, more extensive survey of the bottom deposits of Lake Michigan made by Hough.[1] He also noted the presence of

[1] Hough, J. L., The bottom deposits of Southern Lake Michigan: Jour. Sed. Petrology, Vol. 5, pp. 57-80, 1935.

similar clay-pebble material in depressions. It is believed that these areas represent exposures of glacial till, in places overlain by lag concentrates of the coarser constituents of the till.

Mechanical analyses were made of the 103 sand samples. The measurement of the fractions separated by sieving were made volumetrically. The accuracy of this method was compared with gravimetric measurement. It was found to be fully as great in sands of the particular size frequency distribution as those studied. Because of the rapidity of the method it is thought to be a valuable laboratory technique.

The median diameter was determined from the cumulative curve and the quartile coefficients of sorting and skewness were computed according to the formulae of Trask.[2] The median ranges from .091 to .125 millimeters if 7 of the 103 analyses be excluded. These 7 range on up to .45 mm., but are in each case specimens adjacent to the till areas and are thought to be transitional to the average type of sand. This therefore places the sands all within Wentworth's grade size of "very fine sand."

Sorting ranges from 1.13 to 1.37, again 7 samples being excluded, 6 of the 7 being transitional to the clay-pebble deposits. This denotes an exceptionally well sorted sediment, as Trask's lower limit of sorting was placed at 1.26.

Skewness ranges from 1.69 to .97, excepting 9 specimens separated from the others by distinct gaps in value. Seventy per cent of the samples fall between 1.01 and .99. As unity denotes perfect symmetry about the mode it is evident that the skewness of the Lake Michigan sands is not great.

The median, sorting and skewness show no variation between specimens taken before and after a storm, nor any systematic variation either laterally or with increase in depth. The coefficients are, however, somewhat in error because of the lack of a 150 mesh sieve in the Tyler series used in the analyses. The geometric progression was thus broken at the critical point in the size distribution where over 50 per cent of the sand is concentrated. Hence the slopes of the cumulative curves, in their steepest portion, are not accurately defined. The data read from these curves is thereby in error.

A set of histograms drawn for the samples of any one course shows a consistent increase of fine material with increase in depth. This is a result to be expected if currents gradually diminish in transporting power with distance from shore. A less well defined, yet consistent increase in percentage of fine material is noted laterally from north to south. This may indicate that the zone of clay and pebbles on the north course is an area of scour by long-shore currents from the north which diminish in transporting power with distance from this zone and hence deposit increasing amounts of fine material.

From fifteen heavy mineral separations made on material from the southern two courses a notable concentration of heavy minerals was found to occur at points one-quarter mile from shore on both courses. On one course this concentration correlates with an increase in coarseness of the sand. This is not the case on the other course. There is, however, enough evidence to suggest that at this distance from shore some change in wave action occurs. The nature of the change is unknown, but remains a problem inviting further investigation.

The fauna, consisting mainly of gastropods and plecypods has been kept separately by sample. It has not as yet been identified, but there are sug-

[2] Trask, P. D., Origin and Environment of Source Sediments of Petroleum, pp. 67-76, Gulf Publishing Co., Houston, Texas, 1932.

gestions of variation in relative abundance as well as of species with variation in depth and type of bottom. One such correlation has been established. The largest of the gastropods, *Goniobasis liviscens* cf. *Michiganensis* F. C. Baker, is not found in a single sandy specimen but occurs with almost every clay-pebble one. Its habitat is thus defined either by the type of bottom material, or, if these till areas represent points of more active current action, perhaps it is this which is the important environmental factor.

The present study has thus established a control to which future studies of the distribution of sediments and topography of the lake bottom may be referred. It has also, I hope, pointed out avenues of approach, and some problems for future investigation.