5. SEDIMENT

Amongst the physical environmental factors, the nature of the substratum has the greatest influence on the distribution and abundance of the benthic population. The significance of sediments as an important abiotic factor in the qualitative and quantitative distribution of bottom fauna has been recognised by several workers (Thorson, 1957b, 1958; Sanders, 1959; Brett, 1963; Muus, 1967; Johnson, 1971; Bloom et al., 1972). The granulometric composition and the percentage of organic matter in the substratum are the most important factors which influence the distribution and abundance of bottom fauna. The nature of the sediment in any particular area is determined by the complex interaction of a large number of factors, namely, (1) factors determining the source and supply of sedimentary material; (2) factors determining the transportation, and (3) factors determining the deposition. If the interaction of the various factors remains stable over a period of time, the nature of the sediment will continue substantially unchanged. Any short term or long term change taking place in any one of these factors will be followed by alteration in the nature and composition of the sediment. During the process of transportation and deposition, the sediment is subjected to physical and chemical adjustment which are reflected in its characters. Thus the sediment
of any particular region is a unique assemblage of matter retaining its own character and complexity (Nelson, 1962). The nature of the sediment in an area, may in turn give an indication of the factors operating in the transportation and deposition of sediments in that particular region. All these clearly show the importance of the study of sediments in understanding the complex of ecological factors significant to benthic organisms.

Studies on the physico-chemical aspects of the sediments in the Cochin Estuary are very few. Josanto (1971b) conducted an investigation on the grain size distribution of sediments of the Cochin Backwaters. Veerayya and Murty (1974) have also studied the distribution of sediments in the Vembanad Lake. Murty and Veerayya (1972) have given an account of the distribution of organic matter in the Vembanad Lake. However, a detailed investigation on the sediments of the Cochin Estuary covering all the seasons of the year is lacking. The present study covers an year-round investigation of the grain-size characteristics and percentage of organic matter of the sediments in the Cochin Estuary.

Results and Discussion

5.1. Grain Size:

The details of the texture of the sediments are
given in Tables 11 to 15 and figures 6 and 7. The nature of the bottom observed during the course of the present investigation showed that the composition of the sediment varies markedly from station to station (Fig. 6). From the type of the sediment studied, the area under study comes under four different categories:

(1) Stations covered by clayey-silt with very little sand fraction - stations I and II;
(2) Station with a dominance of sand fraction - station III;
(3) Station covered by sand, silt and clay in more or less equal proportions - station IV;
(4) Station covered by sandy mud - station V.

Percentage Distribution of Different size Fractions of Sediments:

Station I

At the mouth of the estuary in station I, the sediments are of clayey silt. The silt content varies between 41.26 to 72.33%. The clay content of the sediment ranges from 21.10 to 49.15%. In station I, sand percentage is low and it varies between 0.34 to 23.99. The sand percentage was relatively high during pre-monsoon period in both the years of investigation.

Station II

The sediment was characterized by high fraction (
Fig. 6. Sand, silt and clay percentage of the sediments from stations I to V.
Fig. 7. Seasonal variations in the sand, silt and clay percentage of the sediment at stations 1 to 5.
silt and clay (clayey silt in terms of texture). The percentage of silt and clay content varies between 32.56 to 75.03 and 22.12 to 55.75 respectively. The sand percentage is very low and it varies from 0.55 to 17.30.

Station III

Composition of sediment at this station differed drastically from that of stations I and II. The percentage distribution of sand in the region under study indicates that higher percentage values occur only in the sediments of station III near Thevar region and the sand fraction varies between 28.40 and 89.19%. Percentage of silt content varies between 1.26 and 45.42 and that of clay between 3.03 and 33.66.

Station IV

In station IV, sand, silt and clay percentage is more or less equal in proportion — and it ranges from 13.59 to 80.48, 4.20 to 53.91, and 6.43 to 47.90 respectively.

Station V

The station V comes under the category of substratum with sandy mud. The percentage of silt and clay is somewhat equal in proportion and it ranges from 11.95 to 63.03% and 1.60 to 49.90% respectively. In majority of the
samples, sand percentage is low and it ranges from 4.81 to 81.70. The high percentage of sand is observed only in a few samples during South West Monsoon period in the second year of observation.

The sediment distribution pattern of an estuary depends on the sediment source, the texture of the sedimentary material supplied, the bottom topography and hydrographic features of the estuary. The bottom sediments in an estuary comprise the sediment load brought from the rivers as well as the material transported from the sea into the estuary by the flooding tide. Percentage distribution of different size fractions of the sediments varies from coarse to fine components. In terms of the texture of the sediments, sand is more confined to the middle region of the area under study, at station III, near Thevara. One conspicuous feature in the mouth of the estuary is that the sand fraction shows a decreasing trend. On the other hand, the silt and clay percentages show an increasing trend towards the mouth of the estuary. Clayey silt is mostly confined to the stations I and II. The presence of predominantly finer fractions of the sediments, especially silt and clay (clayey silt in terms of texture) in the mouth of the estuarine region is understandable as when the sedimentary material enters the marine conditions, it gets flocculated (Postma, 1967) and settles to the bottom. Gopinath and Qasim (1971) have already reported that silt
in the estuarine area occurs during the pre- and post-monsoon periods, while the flushing of finer materials from the estuarine region to the sea takes place during the monsoon period.

5.2. Organic matter

A review of the earlier works shows that detailed accounts on the distribution of the organic matter content of the sediments in the Cochin Estuary is very scanty. Murty and Veerayya (1972) have given an account of the organic matter content of the sediments in relation to the distribution pattern of the sediments and hydrographic features.

The composition of sediment varies markedly from place to place. Therefore it is envisaged that there is a variation in the degree of concentration of organic matter in the silt-clay fraction of the sediment collected during the period of investigation. The organic matter contents of the sediment of the estuarine region range from 2.95 to 5.02%. The values are given in Tables 11 to 15. On an average, the sediments from the station I (with an average of 3.95%) and station II (with an average of 3.89%) near the mouth of the estuary have the highest content of organic matter. The sediments from station IV with an average of 3.67% have the lowest concentration of organic matter.
In general, the percentage of organic matter present in the estuarine sediment is high. All clay minerals except kaolin bind organic matter (Sanders, 1956) and the area with a high percentage of clay is capable of having a high proportion of organic matter. Since organic matter is trapped predominantly by clays and to a lesser degree by fine silts, coarse silts, and sands (Russel, 1950), the maximum organic matter is to be expected in the sediment with maximum clay. Thus there is a correlation between organic matter and clay content. The main reason for such a close correlation between organic matter content and texture of sediment has been attributed to the similar settling velocities of organic matter and fine mineralogous particles.

In the present study, although there is a certain amount of overlapping of values, it can be seen that finer sediments have higher percentage of organic matter than coarser sediments. This is quite in agreement with the findings of several workers (Emery and Rittenberg, 1952; Bader, 1954; Van Andel and Postma, 1954; Trask, 1955; Rao, 1960, 1967; Naidu, 1968; Murty et al., 1969; Murty and Veerayya, 1972; Dora and Borreswara Rao, 1975). The present data clearly show that the silty clay in stations I and II near the barmouth of the estuary contains a higher percentage of organic matter than in station IV, where sand, silt and clay fractions are more or less in equal
proportions. The distribution of organic matter in the estuarine sediments follows broadly the grain-size distribution pattern, in that the finer sediments, viz., silty clays and clayey silts have higher percentage of organic matter and the sands have a lower percentage of organic matter content with the other type of sediments sharing values in between.

The organic matter content of the estuarine sediment is generally dependent on sources like (i) land - through run off, and (ii) overlying waters - through organic productivity. With the influence of five rivers joining at different points, the source from the land is evident.

A comparison made with the sediments of the Chilka Lake on the east coast of India shows that, in general, the sediments of Cochin Estuary have a higher percentage of organic matter than the sediments of Chilka Lake. The average organic matter content of the Chilka Lake is 1.36% (Venkataratnam, 1967) which is much lower than the average for Cochin Estuary (3.78%).