

## Comments and Communications

### Foraminifera and Deep Sea Stratigraphy

In a recent paper, Fred B. Phleger, Jr., (*Medd. Oc. Inst. Göteborg*, 1948, P. 16) describes the distribution of pelagic foraminifera in a submarine core, raised by the Swedish Deep Sea Expedition from the Caribbean Sea. The faunal variations are interpreted in terms of relative temperature, and a tentative correlation with the general quaternary stratigraphy of the North American continent is made.

There is, however, another interesting statement in Phleger's paper. He writes:

There were certain samples and groups of samples in this core which contained a very high percentage of broken and somewhat eroded specimens; this occurrence is shown in figure 1. The breakage was not due to the process used in the preparation of the samples for study, since most of the samples contained little or no broken material. The specimens were broken and partially eroded either during or after deposition. The significance of these layers of broken material is not apparent to the writer.

The present author has had the opportunity of studying deep sea cores, and those belonging to the collections of the Swedish Deep Sea Expedition. The phenomenon mentioned has been found to be common to tropical and subtropical deep sea sequences. The zones with broken foraminifera, in all observed cases, were found in a typical petrographic environment. From Phleger's diagram (Plate I), it appears that the "broken specimens" were restricted with two exceptions to zones where deposits were made in warm water. In pelagic sediments, zones rich in crushed shells are characterized by many traces of mud-eating bottom organisms, by a comparatively high concentration of dark organic matter, and by a lowered concentration of calcium carbonate. Some of these relationships were indicated by Roger R. Revelle (*Carnegie Inst. Wash. Publ. 556*, 1944) on a regional basis. Revelle, however, does not try to explain them.

It seems certain that the conditions mentioned indicate epochs when mud-eating organisms extensively reworked the sediment, crushing especially the larger and more fragile shells. The increased influence of the mud-eaters on the sediment may be caused either by a decreased rate of sedimentation or by an increased number of mud-eating organisms at the deep sea bottom. If the ecological conditions at the deep sea bottom change so as to favor a growing number of mud-eaters per surface unit, one is inclined to assume a contemporaneous increase also of other benthonic organisms. The size and structure of the benthonic shells render them fairly resistant against crushing. Their relative abundance is, therefore, strongly increased in the reworked zones. If, however, the amount of benthonic foraminifera is calculated in terms of number per weight unit of sediment, this number seems to be almost constant and identical, both in layers with a low and in those with a high degree of crushing.

The first alternative, therefore, seems to give the most

adequate explanation for the observed conditions. If the rate of sedimentation is low, a layer will be reworked by organisms several times before being covered thickly enough to prevent the penetration of digging animals.

In a pelagic environment the changes in growth of sediment are largely dependent upon variations in the amount of biogenous material, mainly calcareous and siliceous shells, which subside to the bottom. This amount is in turn determined by the production of organisms, especially in the surface layer of the ocean and by the decomposition and dissolution of the subsiding matter. No traces of dissolution have hitherto been observed on entire shells in the zones of crushing. The stratification mentioned is, therefore, thought to be caused mainly by changes in the production of plankton. Periods designated by Phleger as warm are thus characterized by a low production; whereas, during periods which Phleger assumed were cold, the surface layer of the ocean seems to have been more fertile, locally or regionally.

The displacement, during the ice ages, of cold water zones at the divergences of the equatorial current system is thought to be the main cause of changes in distribution of heat in the equatorial surface layer of the ocean.

A closer study of these phenomena is being carried out on sediment cores brought home from the eastern Pacific area by the Swedish Deep Sea Expedition and results will be published in reports of the expedition.

GUSTAF ARRHENIUS

Kagghamra, Grödinge,  
Sweden

### A Folliculinid from Northwestern Iowa

The genus *Folliculina* is one of six genera of sessile, loricate, heterotrich, ciliate Protozoa, placed by A. Kahl in the family Folliculinidae Dons (In F. Dahl, ed. *Tierwelt Deutschlands unter der angrenzenden meeressteile*. Jena: Gustav Fischer, 1935). The distribution of the folliculinids has been discussed by E. A. Andrews (*Trans. Amer. micro. Soc.*, 1948, 67, 61). Of about thirty species which have been described for this family, all are marine except *F. boltoni* Kent, which is found in fresh water. Andrews states that *F. boltoni* has been reported from England, France, Switzerland, Uruguay, and questionably from Vancouver Island, British Columbia.

During July and August, 1948, about thirty specimens of a folliculinid were obtained from Little Millers Bay, Lake Okoboji, Dickinson County, Iowa. A few specimens were obtained from the same locality during July 1949. The animals were found on slides which had been suspended in the lake: (1) near the surface less than 1 m from the shore, and (2) near the bottom (depth of about 2 m) about 10 m from the shore. The lake at this point has a sandy bottom with a profuse growth of aquatic plants. The shore is bordered by rocks covered with diatoms, algae, fresh-water sponges, and other sessile and creeping forms.