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 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 under der angrenzenden meeresteile.* 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.

Although the organism has not been found in sufficient numbers to make a complete study of its life cycle or of its structure, a study of living and of stained specimens leaves no doubt that it is a folliculinid, probably *Folliculina boltoni* Kent. Insofar as can be determined, this is the first unquestionable record of a fresh-water folliculinid from North America, and is the first time that a folliculinid has been found so far from the seacoast.

JOHN MEACHAM HAMILTON
Park College and the Iowa Lakeside Laboratory, Parkville, Missouri

Photographing Graphs for Publication

Gutsell's note (*Science*, 1949, **110**, 403) on the preparation of graphs for publication suggests a method which is extremely roundabout and quite unnecessary. He proposes working on the reverse side of graph paper in order to eliminate the graph lines in photographic reproduction of charts.

No high order of photographic skill is required to make use of graph rulings and still eliminate them from photographs. I use Dietzgen millimeter cross-section paper #338, the light green lines of which are held back very well when the desired chart is photographed through a green filter (X2 or X3) onto contrast process film.

The method is simple; if standard lighting is always used, other data are readily standardized and any quantity of charts may be easily and satisfactorily prepared.

HAROLD RAOUL WAINERDI
Editor, M D
Brooklyn, New York

Hotchkiss Reaction and Structure of Polysaccharides

A method of staining polysaccharides based on oxidation with periodic acid followed by combination of resulting aldehydes with fuchsin sulfurous acid has been published by Rollin D. Hotchkiss (*Arch. Biochem.*, 1948, **16**, 131). The required conditions for a positive reaction are supposed to be two adjacent free hydroxyl groups. The reaction has been used for testing polysaccharides in solution. Jorpes, J. Erik, Werner, Birgitta, and Åberg, Bertil (*J. biol. Chem.*, 1948, **176**, 277) used this method in an attempt to detect the presence of such hydroxyl groups in heparin trisulfuric and monosulfuric acids, chondroitin sulfuric acid, and hyaluronic acid.

As far as our experience goes, the presence of two adjacent free hydroxyl groups within the chain of the polysaccharide does not bear any relationship to a positive Hotchkiss reaction. Numerous sugars having such groups, such as cellobiose, methyl α-D-glucopyranoside, methyl *n*-acetyl-α-D-glucosaminide, give a negative reaction, while hyaluronic acid and chitin, which yield a strong positive reaction, consume only a very small amount of periodic acid (0.1–0.4 mole for each repeating unit). Under the same conditions, starch, glycogen, and cellulose consume one molecule of periodic acid for each pair of adjacent free hydroxyl groups.

Since the information bearing on the mechanism of the Hotchkiss reaction is only fragmentary, we consider it unsafe to use this reaction for identification of polysaccharide structure.

ROGER JEANLOZ
The Worcester Foundation for Experimental Biology, Shrewsbury, Massachusetts

Categories of Availability or Validity of Zoologic Names

Recent publication by one of us (Smith, H. M., *Science*, 1947, **106**, 11) of a note on the use of the expressions *valid* and *available* in describing the status of scientific names prompted the other two to write him that experience in other groups of animals might modify the conclusions that he had reached. Comparison of usage in our three widely separated fields (herpetology, entomology, and paleontology) has led to substantial agreement on a set of terms and definitions different from those previously held by any of us. It is thought that these conclusions may be of interest to others, for the categories involved are not clearly understood by all taxonomists, and the terminology is often confused in practice. Particularly confusing are the uses of *valid* or *validly* by different writers for several of the categories.

Zoological names appear to fall into four categories in respect to their nomenclatural status. (1) All names that have appeared in print (in the broadest sense) must be considered for possible acceptance into scientific nomenclature. (2) Printed names that meet all the publication requirements of the *International Rules of Zoological Nomenclature* are automatically accepted into nomenclature. (3) Names published in full accord with the *Rules* are nomenclaturally acceptable if they are not preoccupied by another name of the same spelling. (4) From among the nomenclaturally acceptable names, there is only one which, because it is the oldest or has been judicially accepted, can be properly used to the exclusion of all others under a given set of circumstances.

The first of these categories generally has not been given a name, although *printed, published,* and *occupied* have all been used. We believe that *printed* is not sufficiently descriptive since a printed label should be excluded, and *occupied* implies "in nomenclature" and so is more appropriate in the second category. *Published* appears to be logically applicable to all names that have appeared in print (in the broadest sense). Most published names are accepted into nomenclature, but some fail to meet requirements of the *Rules* and are disregarded in nomenclature; examples are vernacular names, names without referrants (*nomina nuda*), and names printed in mediums not qualifying as scientific publications.

Names in the second category have generally been cited as *published,* but *available* has also been used. In the customary sense, however, not all these names are available for use, since some are junior homonyms; and to be exact in this usage, *published* must be modified by "under the *Rules.*" The term *occupied* may be applied appropriately to those published names that do meet the requirements of the *Rules* as to publication. *Occupied* names include all names published according to the technical requirements of the *Rules*—all names that are ac-