one of which is used for the introduction of food, and the other two for the inlet and outlet of air.

Food is prepared as a paste and forced into the jar with a syringe. A healthy animal keeps itself and the sides of the jar clean. Food cannot collect under the animal if the front of the jar is tilted slightly downward. The outlet hole is connected to the appropriate collecting system, which is maintained under sufficient negative pressure, from a vacuum line, to provide an adequate supply of air to the animal.

Animals have been maintained without ill effects in this assembly for as long as 3 wk. It appears that the time could be extended indefinitely. The disadvantage of such a system is the enforced inactivity of the animal, which brings about changes in energy requirements and may alter the metabolic pattern of a material under investigation (*1*).

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Received January 28, 1954.

The Smaller Foraminifera in Correlation and Paleoecology

PROBLEMS arising in connection with the study of assemblages of western and central Pacific smaller Foraminifera of Cenozoic age have brought into focus certain advantages and disadvantages of these organisms in age determination, stratigraphic correlation, and paleoecologic interpretation.

Benthonic (bottom-dwelling) species, so far as is known, are characteristically responsive to variation in the sedimentary environment even between closely juxtaposed depositional sites. At the same time, they may be little affected by age difference, even as great as that between Miocene and Recent epochs.

Planktonic (floating) species are subject to wide and geologically rapid dispersal by ocean currents and, thus, should be well suited for use in long-range correlation. The planktonic species, however, are generally limited in their occurrence to open-sea facies and, thus, are available for correlation only between such facies. Planktonic species are commonly good indicators of temperature and may be interpreted to suggest direction of flow of oceanic currents, but they have little bearing on bottom paleoecology except as contributors to the sediment.

Benthonic species, on the other hand, are commonly provincial and may become good local paleoecologic indicators with further knowledge of their living habits and associations.

The apparent correlation of seemingly identical but widely separated planktonic assemblages is commonly weakened by (i) rarity or lack of associated fossils that might support or oppose the indicated age, (ii) rarity or lack of intervening occurrences of the same assemblage, and (iii) incomplete knowledge of the lineages of the species involved.

In a similar vein, the use of benthonic Foraminifera in paleoecologic interpretation is severely limited by the lack of authentic information about the precise relationships of living species to their environments. Empty shells of Foraminifera, being of small size (0.2 to several millimeters in diameter, in some examples smaller) are rather easily distributed outward as well as moved either upward or downward from their actual living sites. Displacement by gravity, or even by delicate currents, can best be detected by use of a protein test on wet-collected samples. Normally, bottom sediments yield only a minority of living specimens within a matrix including many empty shells of the same forms. Strangers to the living fauna found among these empty shells provide evidence of this sort of dissemination, detection of which is impossible in dry samples. Two examples of the mixing of faunas have been recognized in (i) brackish, estuarine forms occurring in bay facies and (ii) reef forms occurring in lagoon facies; and there are undoubtedly others.

Present and contemplated investigations that will lead toward solutions of the current problems are

1) Search for other kinds of planktonic fossils that give the same answers as the floating Foraminifera.

2) Search for new records of planktonic Foraminifera, especially distinctive planktonic assemblages in datable association with other types of fossils whose position in the standard time scale is believed established.

3) Study of additional occurrences of the already known planktonic assemblages, from submarine dredge-samples, drilled wells, and elevated deposits.

4) Careful study of ontogeny and phylogeny as applied to speciation and lineages, especially among the known or supposed planktonic forms.

5) Study of the floating characteristic at various levels within the oceans, as it applies to species and genera not commonly regarded as planktonic to determine its influence on distribution of the Foraminifera.

6) Study of the benthonic fraction of largely planktonic populations from known depths in Recent seas.

7) Determination of the physical and chemical factors that affect the distribution patterns of living species and possibly affect the evolutionary development of species and genera.

Studies such as these suggested here promise significant help toward more accurate use of fossil Foraminifera, both as facies indicators and in long-range correlation.

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Received March 8, 1954.