and Adak. These unconformities cut across the spilitic sequence and early Tertiary marine sediments on Attu, the early Tertiary sediments on Kiska, and the old deformed marine sediments and pillow lavas on Umnak and Adak Islands. On Attu, subaerial conglomerate and lava flows overlie the unconformity. On the other islands, lava flows associated with the late Tertiary to Recent stratovolcanoes overlie the unconformities. Unalaska has both deeply eroded dioritic batholiths and a stratovolcano, but an unconformable contact between the two has not yet been found.

Paleontological evidence for confidently correlating the various unconformities is lacking. All of them, however, are overlain by subaerial volcanic rocks and underlain by marine sediments and geosynclinal volcanic rocks. Although these unconformities perhaps differ somewhat in age from island to island, they seem to represent a major uplift of probable middle Tertiary age that extended the length of the Aleutian chain and, perhaps, signaled the birth of the present Aleutian Island Arc.

Normal faults and broad open folds characterize the structure of the Aleutian Islands. Evidences of deep burial or strong compressional tectonic forces, such as thrust faults, isoclinal folds, or strong regional metamorphism, are absent. Most of the faulting occurred during the middle Tertiary uplift, but some faulting has continued to the present.

The late Tertiary to Recent history is one of stratovolcanism involving eruption of calc-alkalic rocks, severe glaciation, and several changes in sea level relative to the land. Today, the Aleutian Island Arc is an area of many active volcanoes and earthquakes, a restless segment of the earth's crust, that contains a record of volcanism and crustal deformation beginning in pre-Tertiary time.

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Received March 8, 1954.

## Long-Term Recovery of Metabolic Products from Rats[1]

FOR many metabolic studies in rats, it is desirable to collect quantitatively, for periods of several weeks, respiratory gases and unmixed excreta uncontaminated with food. A technic has been developed that accomplishes this and avoids any possibility of cross-contamination between urine and feces. Without interrupting collections, blood may be withdrawn and materials may be injected intravenously, intraperitoneally, or subcutaneously.

The hindquarters of an animal are enclosed in a plaster of paris cast, which extends upward to support a bottomless wide-mouthed glass jar of appropriate size that is placed around the animal's head and forequarters (Fig. 1). An airtight seal between the animal and the glass jar is made by cementing a 1-in.-wide belt of sheet rubber around the shaved body of the anesthetized animal midway between the front and hind legs. A sleeve of sheet rubber is cemented to this belt and turned up over the outside bottom of the jar. Enough cotton sheet wadding is wrapped around the body to allow freedom for breathing but, at the same time, to restrict the animal so that it cannot reach and damage the rubber sleeve with its claws or teeth. Better results are obtained if the cast is not padded about the legs. While the cast is being applied over the sheet wadding, jar, and hindquarters of the animal, the hind legs are extended at right angles in the same horizontal plane as the trunk. To prevent contamination of the cast and resulting loss of the excreted products, the plaster is cut away liberally around the external excretory organs.

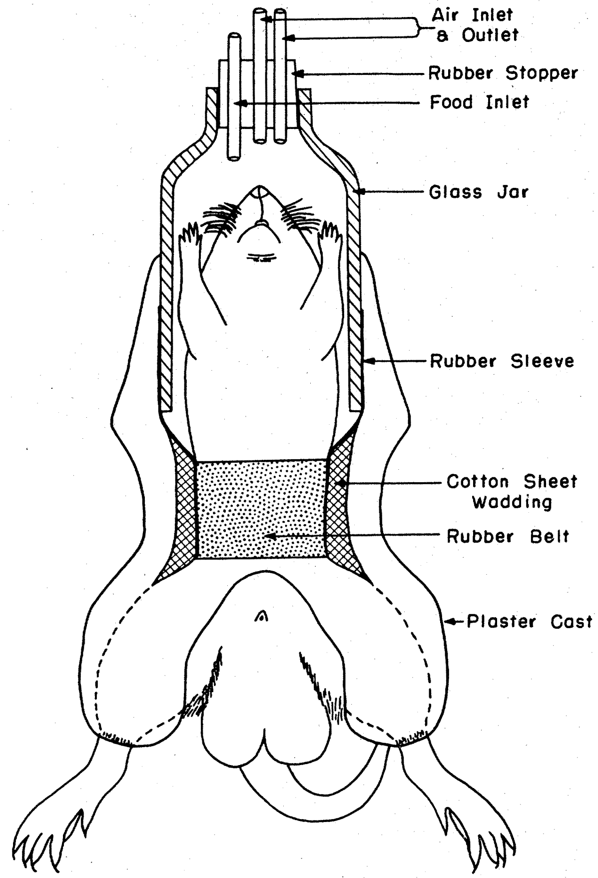


FIG. 1. Diagram showing position of rat with relation to other parts of the assembly.

The encased animal is suspended over small beakers that serve as collecting dishes for the excreta. Complete separation and collection of urine and feces are easily accomplished with male animals but may be less successful with females. The mouth of the glass jar is closed with a rubber stopper that has three holes,

[1] This research has been aided by grants from the Otho S. A. Sprague Memorial Institute and the Douglas Smith Foundation for Medical Research of the University of Chicago.

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.