of them show bimodal or trimodal patterns. Gravels are all angular and probably were transported by icebergs. The amount of Foraminiferal content may be available for one index of productivity of sea water. Coarse sediments distributed at a considerable depth are related to the deep seated shelves around Antarctica.

FORAMINIFERA ASSEMBLAGES OF THE ANTARCTIC OCEAN

Takayasu UCHIO*

南極洋の有孔虫群とその意義

内尾高保*

Planktonic and benthonic Foraminifera in two plankton-net samples and eleven sediment samples of the Antarctic Ocean were studied. The results are in press as Special Publication Nos. 11 and 12 of The Biological Results of the Japanese Antarctic Research Expedition published by the Seto Marine Biological Laboratory of Kyoto University. The abstract is given below.

Only *Globigerina* sp. cf. *G. bulloides* D'ORBIGNY is present in the plankton-net samples, while the species is very rare and *Globigerina pachyderma* (EHRENBERG) is predominant in the sediment samples. The results appear to suggest two interpretations: (1) *Globigerina pachyderma* may occur deeper (than 200 m) in the water column, or (2) *Globigerina pachyderma* may not be planktonic in the region studied, and was deposited in the bottom sediment some time before the present, when the surface water was colder. The writer prefers the first interpretation, because nine out of eleven sediment samples contain glauconite granules indicating rather a slow rate of terrigeneous sedimentation which is to be expected around the ice-covered Antarctica. Thereafter, radiocarbon (C^{14}) dating of the calcareous tests of Foraminifera at a station, where *Globigerina pachyderma* occupies about 97% of total Foraminifera population, has been made by Dr. KIGOSHI of the Gakushuin University, Tokyo. The results gives an age of the sediment containing the Foraminifera tests of approximately 5490 (±370) years, and proves the writer's second interpretation. The first interpretation must be ascertained by future investigation. Even if *Globigerina pachyderma* is found in a pelagic state in a future detailed survey, it will not be contradictory to the fact that the premodern (*ca.* 5490 years old) sediment is exposed at the bottom of the present ocean in the studied area, providing the productivity of *Globigerina pachyderma* is small enough to mask the premodern sediment extensively.

Benthonic Foraminifera assemblages in the eleven sediment samples were studied quantitatively. Bottom sampling was done with a small dredge at all stations except at one station, where a modified Phleger bottom sampler (a short gravity corer) was used. The sediment at all stations is sand except at three where mud is found. The boundary of the two sediment types lies at a depth of *ca.* 850 m. These sediments contain various kinds, sizes and amount of angular and subangular ice-rafted glacial material. A part of sediment sample at a station was preserved in formalin. The rose bengal

* Petroleum Engineering Institute, University of Tokyo.

staining technique was used to distinguish the living Foraminifera from the empty tests. 11 benthonic species were identified as living when collected.

Three faunal assemblages are distinguished, with depth boundaries at *ca.* 850 m and 2000 m based on the frequency distributions (in %) of the empty tests of the benthonic species. These assenblages characteristically consist of two groups of species: (1) indigenous species around Antarctica, (2) cosmopolitan species in the Arctic waters and in the cold, deep waters of the Atlantic, Pacific and perhaps Indian Oceans. In interpretating the benthonic assemblages it is pointed out that the ordinary method of inferring bottom conditions by extraporating the data obtained from the water column cannot be applied to the Antarctic region where the Antarctic Bottom Water is formed in winter. In winter the sea floor at all the stations occupied may be covered by the Antarctic Bottom Water, while in summer, when the present samples were collected, the situation is quite different. According to the summer hydrographic data (ISHINO *et al.*, 1958) Assemblage 1 (depths 350–850 m, shallow depth limit unknown, *Angulogerina angulosa-Epistominella exigua-Ehrenbergina glabra* assemblage) appear to represent the Antarctic circumpolar water and in part the lowermost part of the Antarctic Surface Water; Assemblage 2 (depths 850–2000 m, *Bulimina aculeata* assemblage) the lower part of the Antarctic Circumpolar Water; Assemblage 3 (deeper than 2000 m, *Eponides weddellensis-Epistominella exigua* assemblage) the Antarctic Bottom Water. It appears that the summer hydrographic conditions claerly affect benthonic Foraminifera assemblages but the winter ones do not.

The above interpretation is a simplification of the real situation since the bottom sediment at a station is *ca.* 5490 years old and those at the other stations are also probably pre-modern. If so, it may or may not be correct to correlate pre-modern benthonic assemblages with recent oceanographic conditions. To get a final solution of such a complicated problem it is necessary to collect more sediment samples and to make a C^{14} dating and Foraminifera analysis of each one. Furthermore, the distribution of living benthonic Foraminifera must be studied as a basis for the interpretation of the distribution of empty tests of Foraminifera. Discussions of the geological results obtained by NIINO (1958) and by SHOJI & SATO (1959) in the same area are given in detail from the Foraminifera point of view above mentioned.