was found at depths greater than the thickness of the ice shelf. The water is probably flowing in under the ice shelf in the east and flowing out in the west.

In addition to the authors the following persons from Scripps Institution of Oceanography participated in the collection of physical oceanographic data: W. R. Bryan, H. R. Kaye, K. E. Knutson, J. E. Thomas, and R. E. Yates. The assistance of the Marine Science Division of the USCGC *Glacier* in the data collection is gratefully acknowledged. This work was supported by National Science Foundation grant GV-34905.

Geochemical sampling in the Weddell Sea

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An extensive geochemical sampling program was conducted in the Weddell Sea during January and February 1973. This work was carried out aboard USCGC *Glacier* in conjunction with the physical oceanographic program of the Scripps Institution of Oceanography, and was planned to coincide with the circumpolar south Atlantic portion of the Geochemical Ocean Sections (GEOSECS) survey of the world oceans.

The two main objectives of the geochemical sampling program were to characterize the fundamental source properties of Antarctic Bottom Water as it enters the global circulation and mixing, and to investigate the origins and mixing ratios of the water masses involved in bottom water formation. Sea water samples were collected for a number of chemical and isotopic tracer measurements: D/H and O^{18}/O^{16} ratios to evaluate the roles of freezing, evaporation, and precipitation as they affect salinity and temperature; total inorganic carbon ($\Sigma\ CO_2$), alkalinity, C^{13}/C^{12}, and barium coupled with dissolved O_2, NO_3^-, PO_4^-, and SiO_2 as tracers of dissolution and metabolic processes; 1 tritium and carbon-14 as short and long-lived radioisotopic tracers of circulation, mixing and atmospheric exchange; dissolved noble gases, including He^3, He^4, Ne, and Ar as conservative tracers of exchange and circulation processes; Pb^{210} and Ra^{226} as additional natural radioisotopic tracers of deep sea chemistry; and filtered particulates for studies of the composition of suspended material. In addition, snow and ice samples were collected for tritium, D/H, and O^{18}/O^{16} measurements.

With the exception of alkalinity, which required immediate shipboard measurement, all samples were suitably sealed, extracted, or preserved, and have been returned to laboratories at Scripps Institution of Oceanography, University of Miami, and Massachusetts Institute of Technology, for analysis. The author was assisted in this program by Mr. A. Cahn of the Massachusetts Institute of Technology, who performed the alkalinity titrations and assisted with the nutrient analyses. Other scientists aboard *Glacier* and members of the ship's Marine Science Division generously provided assistance with many aspects of the sample collection. The work was supported by National Science Foundation grants GA-27283 and GX-28162.

Birds of the antarctic ice pack

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Ornithological observations were made on Ross Island at McMurdo during December 24-26 and at Cape Royds during December 27-28. The two-man team boarded USCGCG *Glacier* at McMurdo on December 28 and recorded birds while sailing through the Ross Sea, the South Pacific and the Strait of Magellan before arriving at Punta Arenas, Chile, on January 12, 1973. During January 13-17 the investigators assessed bird populations on Isla Contramaestre and Isla Magdalena off Tierra del Fuego.

While still aboard *Glacier*, they left South America on January 18 and sailed into the Weddell Sea, where they made numerous at-sea observations of birds within the ice pack and in large open areas of the pack. Observations also were made at various places from Cape Norwegia westward along the Filchner Ice Shelf as far as 77°37′S. 47°47′W. At-sea observations were continued until *Glacier* put in at Valparaíso, Chile, on March 7.

A number of seemingly important observations were made, including penguin colonies heretofore unreported, far southern sightings of albatrosses and giant fulmars in the Weddell Sea, and sightings of large numbers of molting arctic terns in the central Weddell Sea. Approximately 150 bird specimens were collected for museum specimens, DDT analysis and internal parasite studies.

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