Reports

RV 'Polarstern', the new Polar Research and Supply Vessel of the Federal Republic of Germany

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On 23 March 1983, the 11,000 tons ice-breaking research vessel 'Polarstern' anchored in the harbour of Rio de Janeiro, first port of call after a 3 months' expedition to the Antarctic continent. Most of the scientists left the ship to fly home to Europe, while others embarked for a final leg from South America to Germany.

The ship had left Bremerhaven, her home port, on 27 December 1982, only 18 days after she had been commissioned. 40 scientists and technicians were ready to implement a complex interdisciplinary scientific programme on board, while another 25 used the ship as passengers to the Antarctic, in order to do research there or to replace a wintering-over team. The ship's crew counted 41.

On 20 January 1983, RV 'Polarstern' was welcomed in Cape Town, her first port of call in a foreign country. On 31 January 1983, she arrived under good weather conditions in Atka Iceport, 7 km away from the Georg-von-Neumayer-Station, the permanent station of the Federal Republic of Germany on the Antarctic ice shelf. Later, she continued her way down the Weddell Sea to visit the English station Halley, the Soviet station Druzhnaya, the Argentinian station Belgrano, the German Filchner summer station, and the Polish station Arctowsky. She left the Antarctic again on 16 March 1983.

The programme on board was manifold:
Already on her way to Cape Town, meteorological observations were made. Once in the Antarctic, the meteorological processes in the pack-ice region and at the ice shelf edge received attention. For example, the very cold and dry air over the Filchner Ice Shelf reacts in contact with the open sea of Gould Bay and leads to a phenomenon called "sea smoke", and to a very quick formation of young sea ice, which again influences directly the atmosphere. As pollution is nearly non-existing in Antarctica, chemists collected water and air samples and studied the concentration of trace matters, this allowing the establishment of baselines to which future measurements can refer. Some of the substances of interest were SO2, O3, nitrous oxides, light hydrocarbons and aerosols.

Physical oceanographers continuously checked the horizontal and vertical distribution of water masses in relation to the general circulation system and to the bottom topography.

Glaciologists were interested to learn more about the behaviour of the floating ice shelf, 200 m thick at its outer edge. In this zone where ice, sea and air come together in one point, strong vertical movements appear in the water column, as a consequence of tides and wind induced currents. Obviously the Filchner Trough east of Berkner Island serves as channel through which supercooled water masses from underneath the ice shelf move into the Weddell Sea, and form the Antarctic bottom water which is still tracable in an area as far as the North Atlantic.

Melting and freezing processes underneath the ice shelf are of great interest to glaciologists. Observations assist to establish the mass balance of the Antarctic ice shield. Evidently, the edge of the Filchner Ice Shelf, since 1956, advanced by some 50 km.

Geologists during Antarktis-1 Expedition concentrated their studies on the upper layers of bottom sediments and collected samples by coring. Sediments reflect the progressing and shrinking of the ice shelf during the past in a most accurate way. Evidently, the edge of the Filchner Ice Shelf, since 1956, advanced by some 50 km.

Dredging and trawling resulted in the collection of a large number of boulders once carried by icebergs and which originated from rocks far inland and deeply covered by ice.

At present, 'Polarstern' keeps the world record for catching fish by bottom trawling in the most southerly part of the Southern Ocean.

Marine biologists were surprised by the richness of the bottom fauna near the edge of the ice shelf. At water temperatures of minus 20°C, a bottom community of high diversity with a dominance of sponges and echinoderms lives. The variety of fish species in the catches was much greater than in comparable catches in the North Sea. Most of them are presently not of commercial interest. The pack-ice region is a hardly known area, in which diatoms live either imbedded in ice floes or attached to them. The diatoms obviously reproduce very fast. Newly formed ice turns yellowish-brown within a few days. It seems that krill feeds on those diatoms. In the Antarctic summer, the Weddell Sea is a high production area in comparison with the world oceans. Shortage in krill, however, results in only a small number of seals and penguins.

The food chain in the southern Weddell Sea seems to be different from the general picture in the Antarctic east wind drift region which is governed by krill as the main phytoplankton eater, and by whales, seals, birds and fishes feeding on krill.

Technical Data

The polar research and supply vessel RV 'Polarstern' was specially built for operations in Arctic and Antarctic waters, in particular in the pack-ice zone which is amongst the least known parts of the globe. She allows research work in all natural science disciplines including biology, geology and geophysics, glaciology, physical and chemical oceanography, meteorology and fisheries. She is a strong double-hulled ice-breaker, and her interior is well protected against the cold, so that scientists can comfortably work even at outside temperatures of minus 50°C. This also will permit her to winter-over in Antarctica.

Another specialty is the loading capacity which makes the vessel suitable for supplying polar stations such as the German Antarctic stations, at Atka Bay and on Filchner Ice Shelf. About 4000 tons of supply goods can be carried, including fuel and heavy
vessels. The wide operating radius of the ship's cranes makes it possible to put heavy containers and engines on top of the ice shelf, be it some 10 m above sea-level.

The special design of 'Polarstern' as ice-breaker, supply vessel and helicopter carrier is reflected in her bulky shape and her large dimensions. This results in a draught of approx. 10.5 m. The ship's living quarters are comfortable even at long cruises.

RV 'Polarstern' was constructed at Howaldtswerke/Deutsche Werft AG, Kiel, and at Werft Nobiskrug GmbH, Rendsburg, in consultation with SCHIFFKO GmbH and Zentralstelle für Schiffbau und Maschinenbau, both in Hamburg. The special design came from Hamburgische Schiffbauversuchsanstalt. Owner is the Federal Ministry of Research and Technology. Operator is the Alfred-Wegener-Institute for Polar Research in Bremerhaven. The ship is run by the shipping company Hapag-Lloyd Transport and Service GmbH.

On an average, the vessel will be at sea 180 days in Antarctic and 80 days in Arctic waters per year. The long cruising times particularly to Antarctica, will sum up these figures to approximately 320 days at sea per annum.

The ship's data are:

- Overall length: 118 meters
- Length between end perpendiculars: 102 meters
- Maximum beam: 25 meters
- Beam at designed waterline: 24 meters
- Draught: approx. 10.5 meters
- Deadweight: approx. 4,000 tons
- Tonnage: approx. 11,000 grt
- Engine output (4 engines): 14,000 kW (or 20,000 HP)
- Maximum speed: 11 knots
- Economical cruising speed (2 engines): 11 knots
- Classification: Germanischer Lloyd, 100 A 4 Arc 3, MC Arc 3 Aut 16/24, strengthened for hull pressure of 9 kN/mm² in the fore part and 6,5 kN/mm² midships
- Crew: 41
- Passengers: 65

During the first expedition to the Weddell Sea tests on ice-breaking had the following results: Ice 1.5 m thick was cut at slow but continuous speed, sea-ice 3 m thick and with approx. one meter of snow cover, was broken by ramming. In open water, the vessel performed better than most ice-breakers do.

The main propulsion of the ship is produced by two variable pitch propellers in nozzles, driven by four diesel engines capable of burning heavy fuel. A precise positioning is possible by the Joystick single lever steering system. This allows dynamic anchoring, i.e. the ship can keep its position in the open sea without being anchored mechanically.

Scientific Equipment

RV 'Polarstern' is a well equipped multipurpose research vessel. On the wide wood-planked work deck there are 8 winches of various types for oceanographic and plankton work as well as for fishing and other bottom sampling even at the great depths of the deep sea. Two telescope beams can be moved over the vessel's side with a reach of 3 m. There is also a 15 tons crane with a working radius from 4 to 24 m, the head of which can be lowered very near to the sea surface in order to minimize the swinging of the instruments attached to it. Bottom trawling and midwater trawling as well as towing of other heavy gear is done through a movable A-frame at the stern. Sediment cores up to 18 m can be taken. There are also air-gun compressors and facilities for geophysical recording.

The work deck is partly heated to improve working conditions at low temperatures. In case scientists want to do research at some distance of the ship, two helicopters and a 12 m launch 'Polarfuchs' are available. The latter is equipped for shallow water studies in oceanography, biology and geology. Inside 'Polarstern', there are several laboratories which can be supplemented by 12 lab-containers on deck and in laboratory container holds. 9 laboratories serve biology, geology, air and water chemistry and fisheries. There are also a computer room, space for data processing and drawing, and a refrigeration plant serving three chambers of different temperatures down to minus 32°C, where ice and sediment samples can be stored at their original temperatures, and biological samples can be deep frozen. An aquarium with several basins allows transport of living animals to Bremerhaven.

A meteorological station is equipped for receiving weather charts, and to serve as meteorological observatory and radiosonde station. Geomorphologists can use the narrow beam echosounder and the Sea Beam equipment for spatial recording of the sea bottom beyond 500 m of water depth.

There is a special display system on board allowing scientists to receive ship's data (position, speed, direction, drift, water depths, weather data) from 32 plugs all over the ship.

Future Expeditions

Future cruises are planned as follows (subsequent to cruise no. 2, when RV 'Polarstern' tested instruments including Sea Beam in the Iberian deep sea, in May 1983):

Cruise no. 3
From 29 June to 25 August 1983, RV 'Polarstern' will join the preparatory phase of the international Marginal Ice Zone Experiment (MIZEX), between Spitsbergen and Greenland. She will further execute a marine geological programme in the Fram Strait and off northern Norway, and do some biological work off Spitsbergen.

Cruise no. 4
For the ANTARKTIS-II Expedition 1983/84, the ship will leave Bremerhaven on 20 September 1983, and will return around 5 April 1984. This expedition will have several legs on different subjects of investigation. Before reaching Atka Bay, on 11 January 1984, she will make two legs for biological and geological research respectively, as well as air chemical and oceanographic surveys in Scotia Sea, Bransfield Strait and Weddell Sea, using Punta Arenas and Ushuaia as ports of call. After having supplied Georg-von-Neumayer-