Ocean 11

Ocean Tools

Following in the footsteps of those pioneering oceanographers, today's scientists have overcome many of the challenges of the deep by using more sophisticated tools. They can send manned submersibles and sampling devices to plumb the ocean depths, taking photographs and samples of animal life and sediment to bring back to the surface for further study. Even space technology enters the picture. Satellite photos taken of the ocean provide a wide range of information, including water temperature and depth, seafloor topography, and the plankton populations. Using sonar and satellite data, scientists have been able to generate a new map of the ocean floor, thirty times more accurate than the best previous map. This map shows the ruggedness of the Mid-Ocean Ridge as it bisects the Atlantic Ocean. This contrasts to the relatively flat Pacific Ocean floor, its vast expanse broken up by more than a thousand newly discovered underwater volcanoes stretching from Hawaii to the Aleutians.

The development of new technologies for underwater exploration has led to exciting and lucrative expeditions. Photographs of the doomed Titanic taken by remote cameras from a submersible craft as it probed deep in the North Atlantic captured the imagination of the world. Recently declassified information about the locations of sunken World War II vessels has attracted adventurers and investors who would like to bring up rich cargoes. The old romantic notion of diving for Spanish pieces of eight from pirate shipwrecks in the Caribbean has been replaced by the idea of using sonar and other sensors to locate sunken submarines carrying gold. But whether in pursuit of knowledge or profit, all of these activities contribute to our understanding of the ocean.

Fridtjof Nansen, pioneering Norwegian oceanographer and polar explorer.

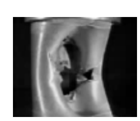
With 13 men, his 123-foot schooner *Fram* ("forward") sailed on 22 June 1893 to the high Arctic with the specific purpose of being frozen into the ice. *Fram* was designed to slip up and out of the frozen ocean, and it drifted with the pack ice to within about 4 degrees of the North Pole. This whole adventure took nearly four years.

The ship's 1,650-kilometre drift proved that no Arctic continent existed beneath the ice.

In 1908 Nansen became the first professor of oceanography.

Nansen Bottles

With the plankton net, marine biologists were able to collect microscopic plants and animals from any depth. An inner net traps the specimens within the larger net, which has a collecting jar attached to the trailing end.



Questions

Concepts: Oceanographers use special tools to enable them to study the chemical and physical properties of the ocean.

1. Upon what did early oceanographers depend?
2. When were very small marine animals studied?
3. Describe the current meter.
4. How was the depth of the ocean measured?
5. Why was that method not good?
6. How does the depth recorder work?
7. Why is a corer used?
8. How does the corer work?
9. What does the Nansen bottle collect?
10. How does it work?

Answers:

1. Early oceanographers depended on chance discoveries of deep-sea objects pulled aboard ship by dredge nets and grappling hooks.

2. Small marine organisms were studied when fine, mesh nets were made small enough to trap them and collect them efficiently.

3. The current meter is used to determine the speed and direction of ocean currents. It has a propeller that is turned by the current. Recording components indicate the number of revolutions per unit of time and from this the current speed is calculated. It also has a system to indicate the average current direction.

4. The depth of the ocean was first determined by the use of measured ropes or cables, called lead lines.

5. This method was not accurate. It was difficult to use, as well.

6. The depth recorder operates on the echo-sounding principle. A device sends sound waves from the ship's bottom to the floor of the ocean. These waves are reflected back from the ocean bottom to the ship, much as an echo would be. The time is recorded and calculated for the time for transmission and reception of the sound wave.

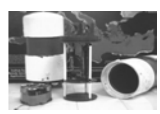
7. A corer is used to collect samples of the ocean bottom substrate.

8. The corer is attached to a steel cable and lowered to the ocean floor. A heavy weight on top drives the hollow tube into the sediment. When the corer is returned to the ship, the sediments within the tube are removed for study.

9. The Nansen collecting bottle is used to collect water samples at different depths.

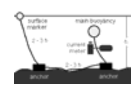
10. This collector is so constructed that it can trap a sample of water at a specific level, below the surface. The line with the bottle is taken aboard the ship for examination.

Bottom Pressure Sensor



Current Meter

- Conductivity
- Temperature
- Current direction
- Current speed



Temperature Profiler

10 Temperature sensors in 20m cable.

Atmospheric Sensor

- Air Pressure
- Wind direction
- Wind Speed
- Temperature

Atmospheric Pressure Sensor

ADCP Buoy

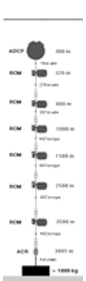
GPS – Magellan

- 12 Satellite receiver
- Built-in database displays worldwide cities and nautical navaids including lighted and unlighted buoys, fog horns, radio beacons

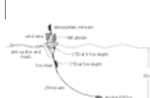
Part of the working deck with the A-frame at the stern of the Australian research vessel *Franklin*, seen during the deployment of a surface buoy for meteorological and oceanographic measurements.

Plan of the main deck of the Australian research vessel *Franklin*, showing the main scientist accommodation and laboratory arrangement:
wet laboratory (CTD and multiple water sampler area)
operations room (echo sounder, ADCP, CTD, towed vehicle and thermosalinograph controls and displays)
computer room (terminals for data processing and analysis)
chemical laboratory (salinity, nutrient and oxygen analysis)
electronic workshop (instrument preparation)
An additional laboratory for chemical or biological work is located on a lower deck. One container laboratory can be placed on the work deck and connected with the chemical laboratory through a water-tight doorway.

Research vessels are expensive to operate (US$15,000 - US$25,000 per day at sea). For many decades they were the only available type of platform for data collection on the high seas. The advent of deep-sea moorings, satellites and autonomous drifters has reduced their importance, but research vessels still are an essential tool in oceanographic research.

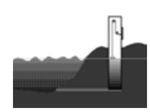


Subsurface moorings are used in deep water in situations where information about the surface layer is not essential to the experiment. The main buoyancy at the top of the mooring line is placed some 20 - 50 m below the ocean surface. This has the advantage that the mooring is not exposed to the action of surface waves and is not at risk of being damaged by ship traffic or being vandalised or stolen. This figure shows a typical deep-sea mooring. The main buoyancy is at the top of the mooring line. To protect the mooring against fish bites, wire is used for the upper 1000 m or so of the mooring line, while rope is used below.



A design example for a meteorological surface mooring. This particular mooring was designed for rain measurements, so it carries a wind vane which turns the rain gauge always into the wind, eliminating interference from the buoy's superstructure. Two self-recording CTD systems are attached to the mooring to measure changes of salinity and temperature produced by the rainfall.

Tide Gauge



The gauge is connected to the sea below the level of the lowest tide via a narrow tube. Rapid fluctuations of sea level produced by (for example) wind waves cannot penetrate this tube because its small diameter does not allow rapid transport of water through it.

CTDs

Today's standard instrument for measuring temperature, salinity and often also oxygen content is the CTD, which stands for **c**onductivity, **t**emperature, **d**epth. It employs the principle of electrical measurement.

The CTD on the left is designed for deep ocean measurements. Its sensors for temperature, conductivity and pressure are contained in the small packages at the bottom corners of the frame. The main cylinder houses the control and data processing electronics. The entire package is lowered on a conducting cable and connected through the sets of electrical underwater connectors at the top.