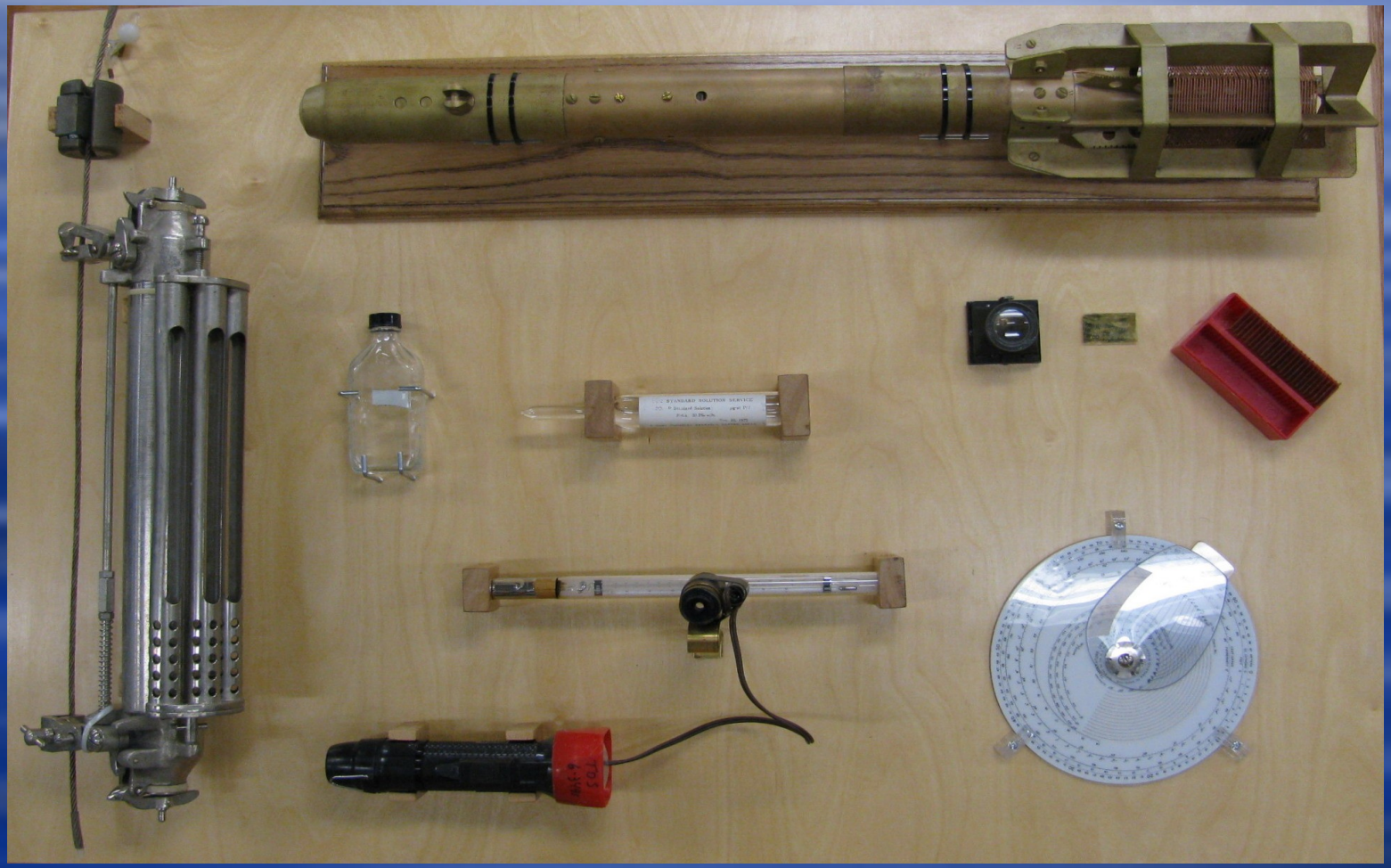
Physical Oceanography

Twentieth Century Tools of the Trade

by

BIO Oceans Association



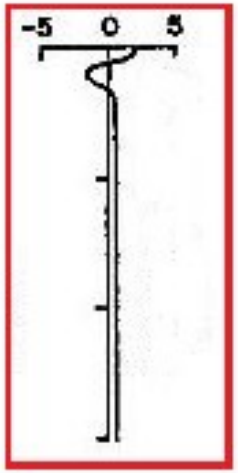
- “The basic goal of oceanographic study is to obtain a clear and systematic description of the oceans, sufficiently quantitative to permit us to predict their behaviour in the future with some certainty”

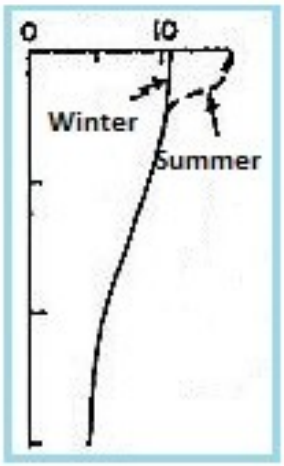
G.L.Pickard - 1964

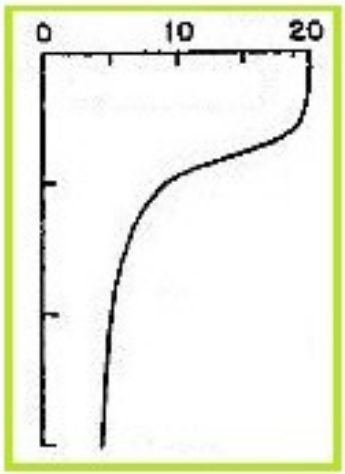
50 years ago the oceans were considered to be:

- Source of food, chemicals and power
- Transportation avenue
- Dump for industrial waste
- Weather maker
- Important factor in the design of piers, breakwaters, etc.

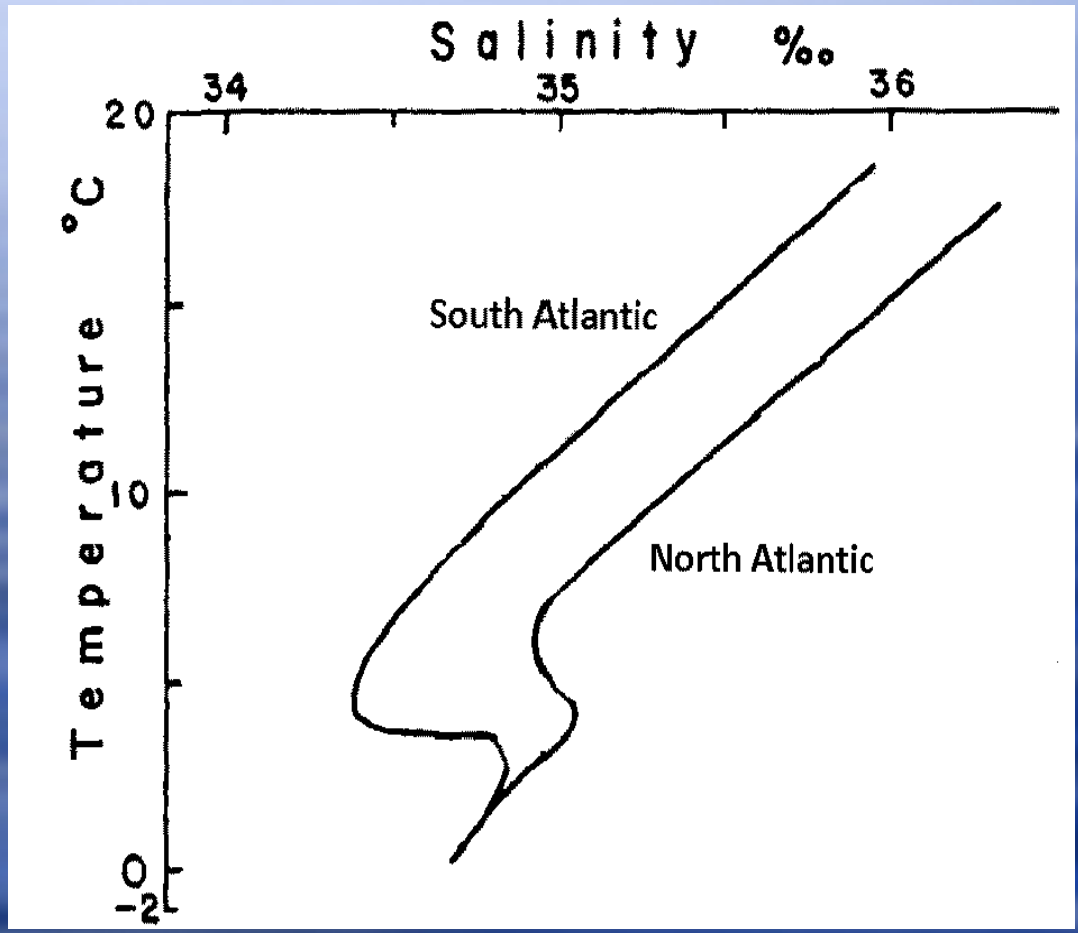
Temperature and salinity of ocean waters vary with depth and geographic location.



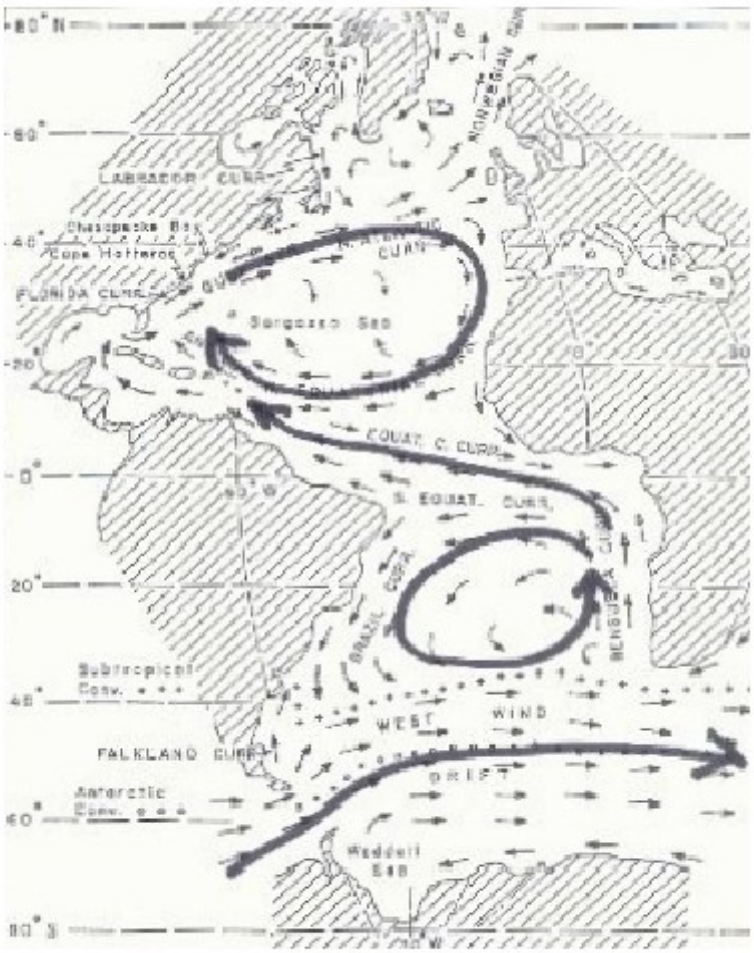




- The relationship between temperature and salinity of ocean waters at various depths at a particular location identifies the original source of the water masses there.

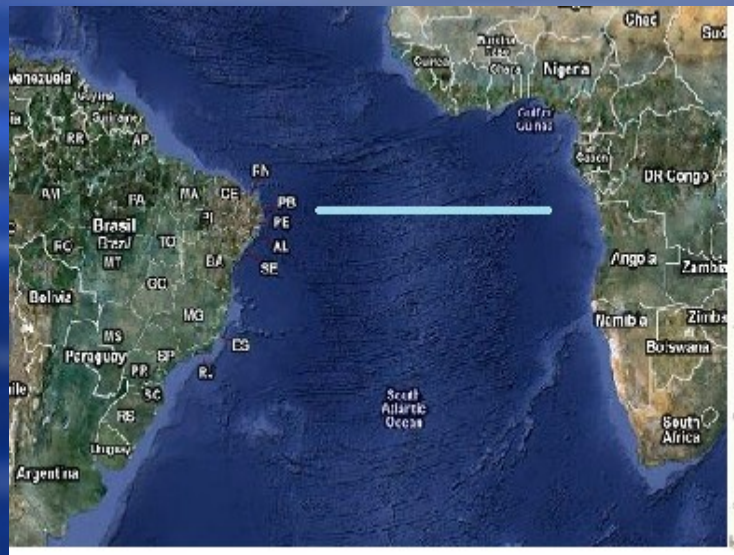


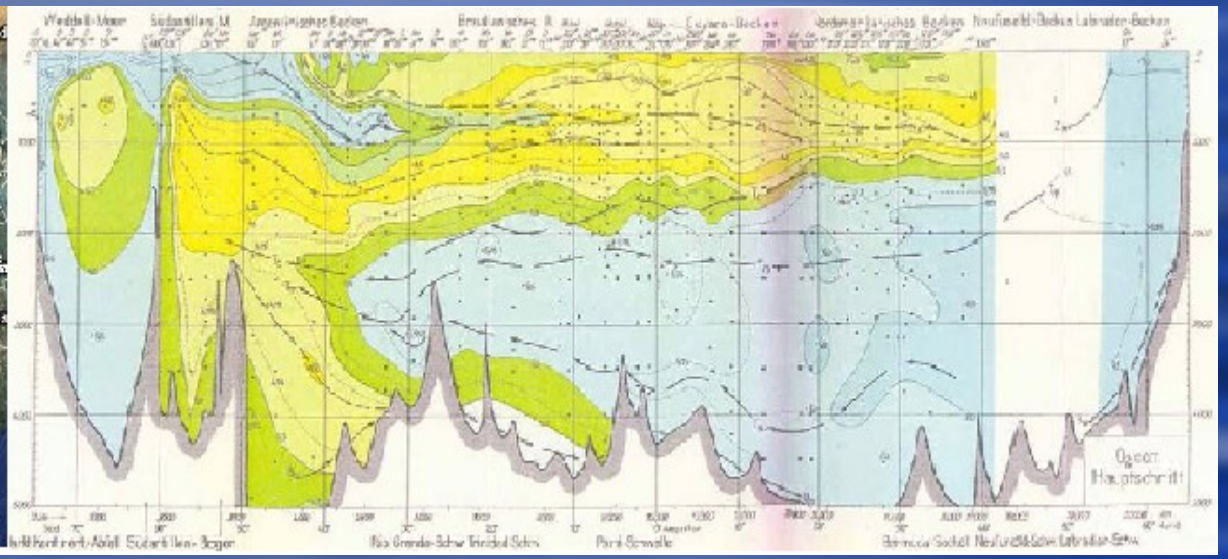
- Temperature and salinity act like a dye and can be used to show how water masses move about in the oceans.



Atlantic Ocean Surface Circulation

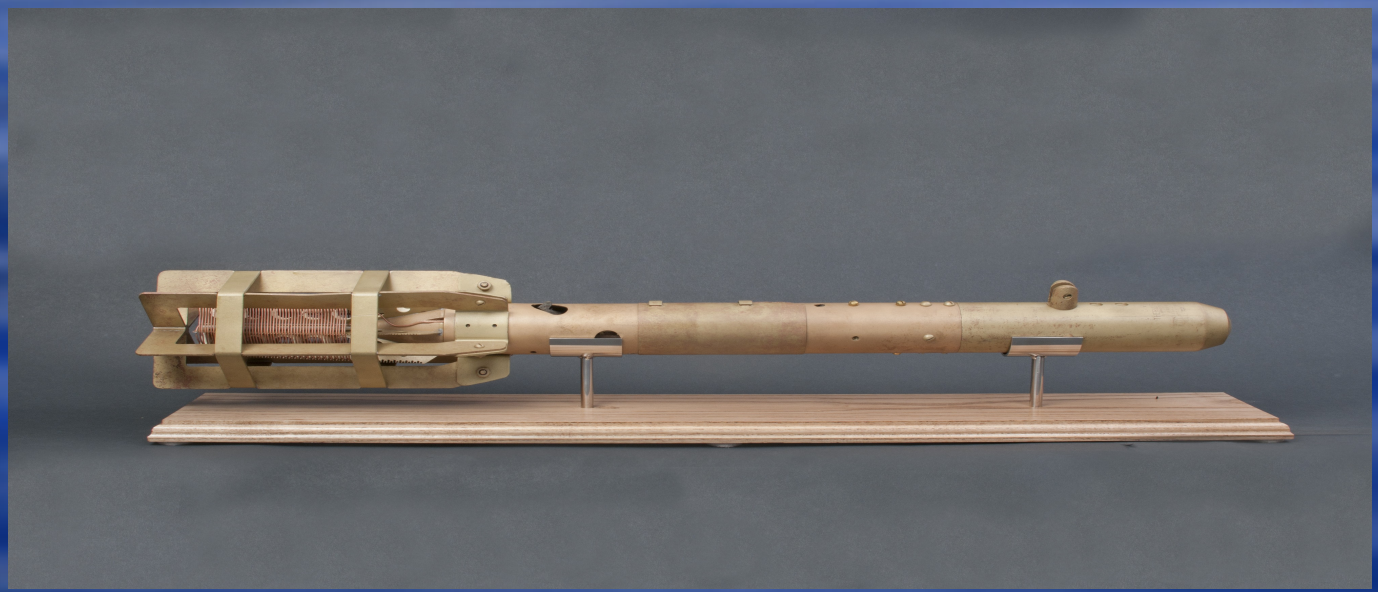
- Other ocean properties like dissolved oxygen (DO2) and nutrients indicate biological productivity.
  - This DO2 distribution was obtained during the Meteor expedition of 1925-1927.

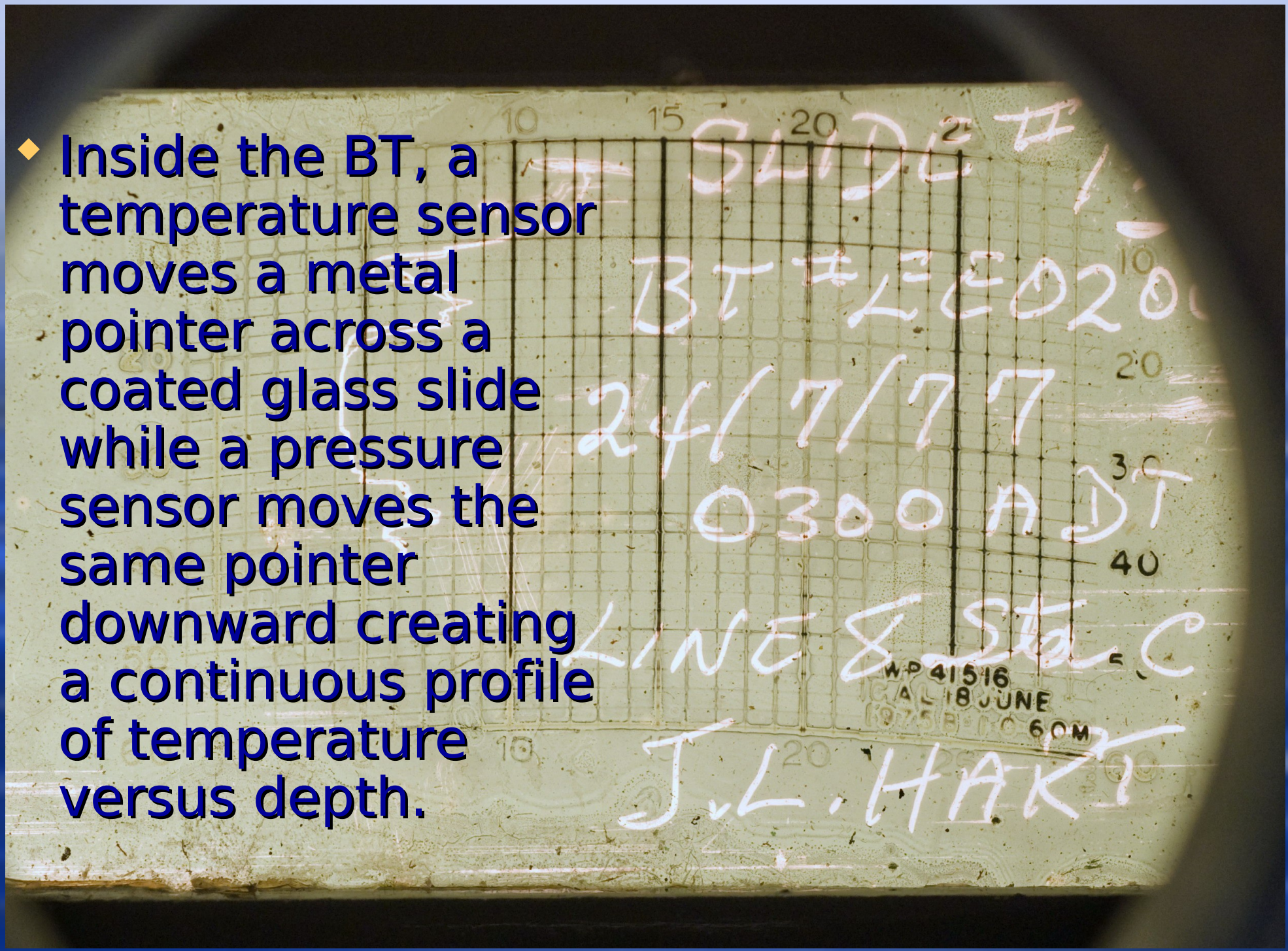




Bathythermograph

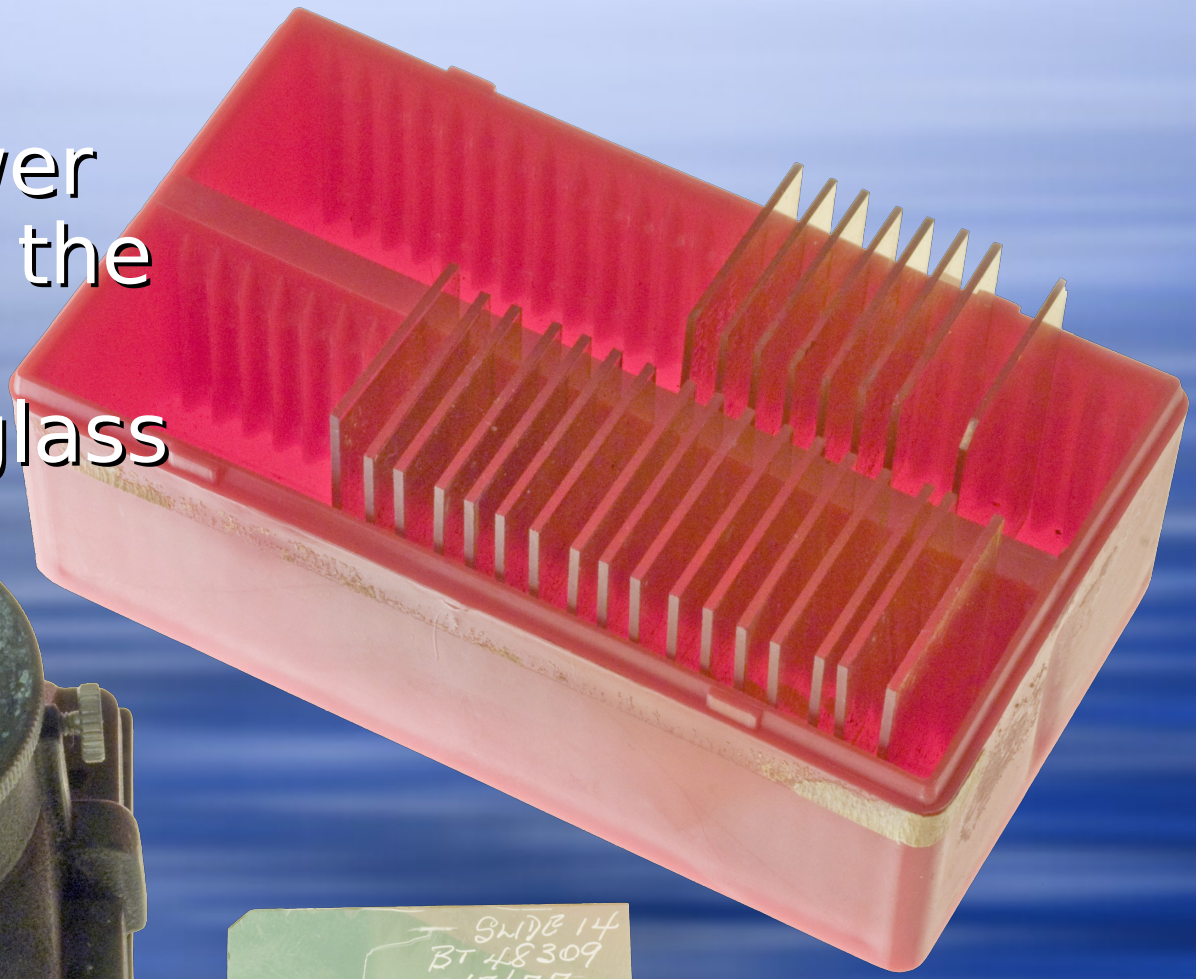
Oceanographers used a bathythermograph (BT) to measure temperature at various depths. Because of its streamlined shape, it can be launched and recovered from a moving ship.

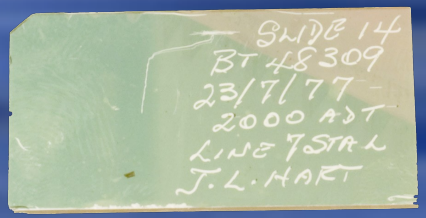




- Inside the BT, a temperature sensor moves a metal pointer across a coated glass slide while a pressure sensor moves the same pointer downward creating a continuous profile of temperature versus depth.

- A special calibrated viewer is used to read the temperature profile on the glass slide.





Reversing Thermometer

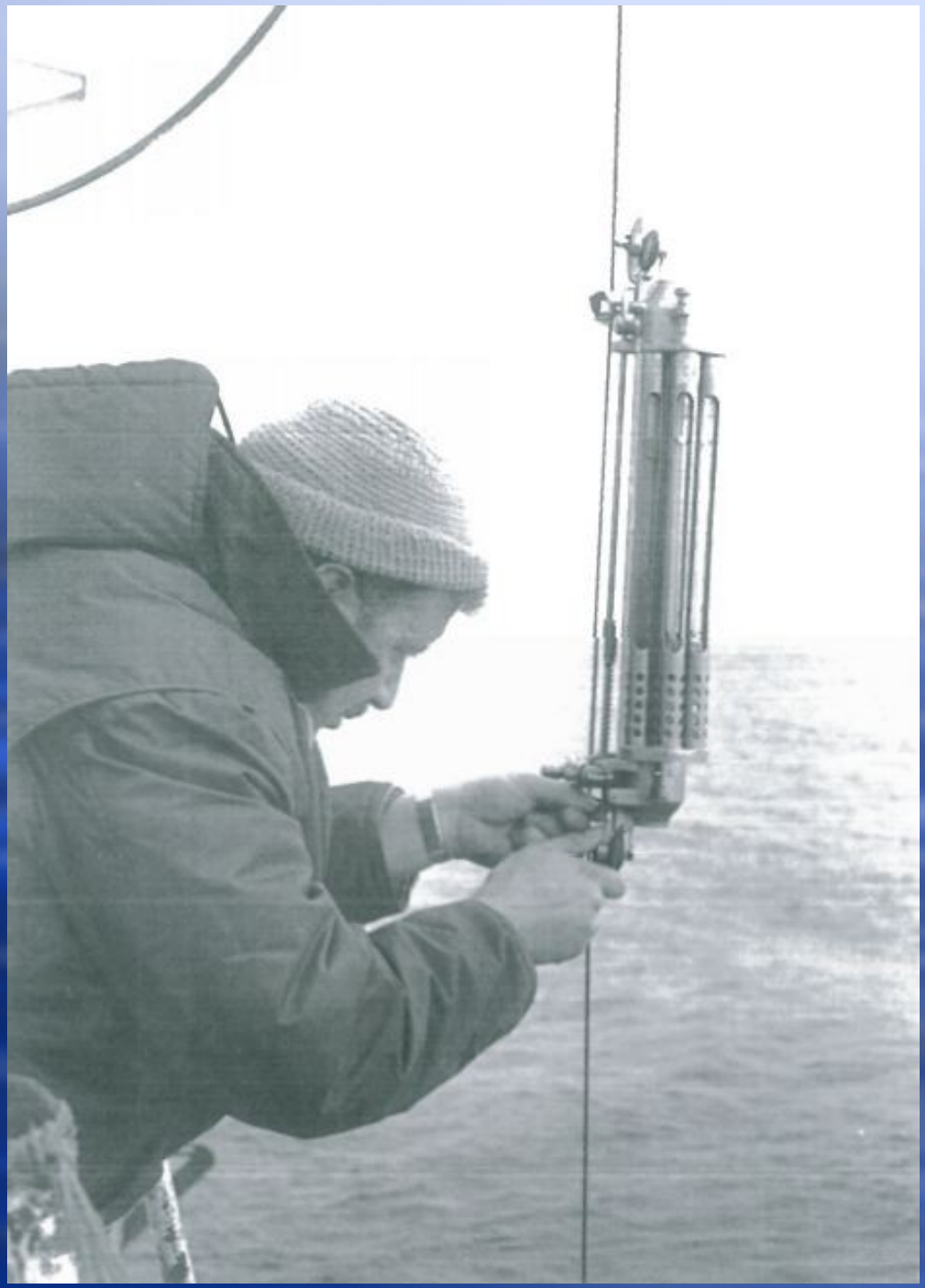
- Prior to the advent of modern electronics in the 1970s, ocean temperatures were measured by very accurate mercury-in-glass reversing thermometers.

The mercury column in these thermometers is specially arranged so that, if the thermometer is tipped upside down, i.e. “reversed”, the column “breaks” preserving or storing the reading at the instant the thermometer was inverted. The thermometer is enclosed in a sealed glass case to protect it from the effects of ocean pressure.

This “protected” thermometer is usually accompanied by a second one that has a small hole in its outer protective case. This allows sea water to penetrate and compress the mercury column. The difference between the temperatures recorded by the two thermometers is a measure of the depth at which they were inverted.

Knudsen Water Bottle

- Prior to the advent of modern solid state electronic sensing systems, salinity was established by collecting samples at various depths for subsequent laboratory analysis.



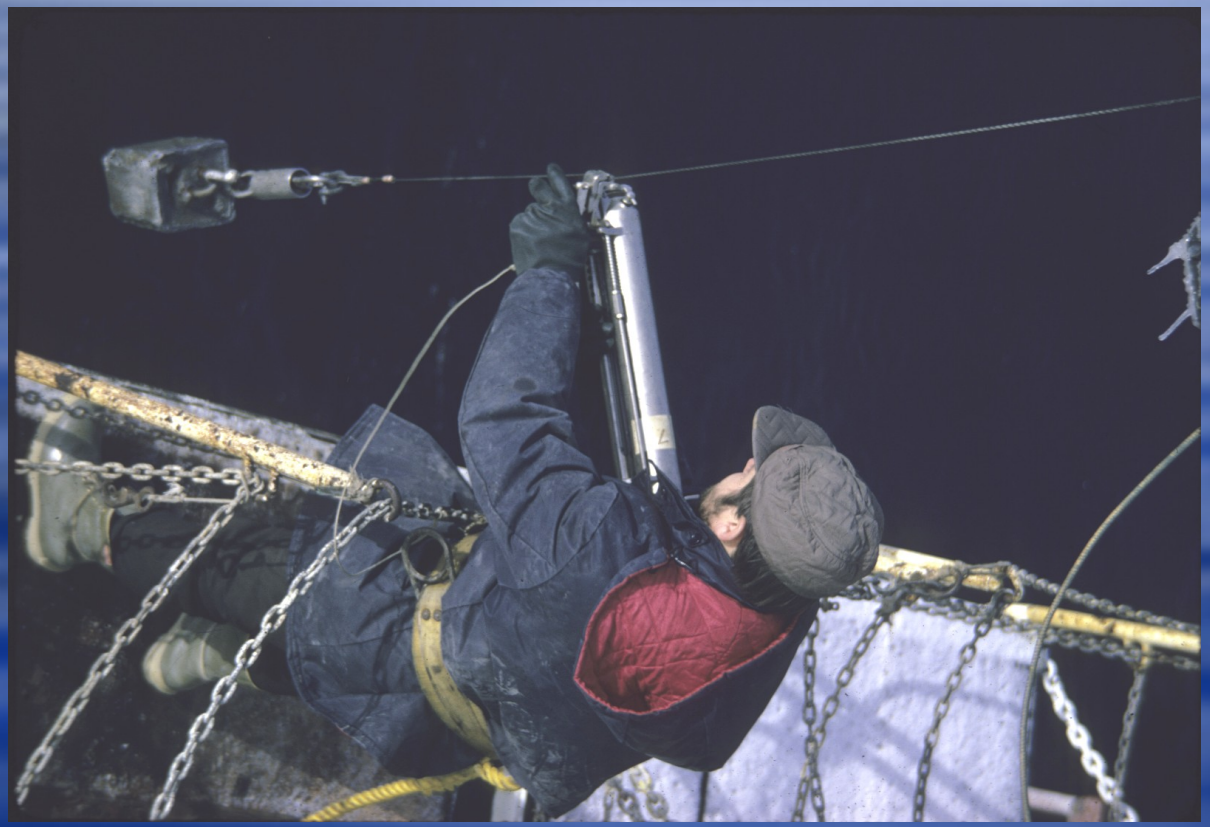
- Reversing thermometers are placed in the tubes on the outside of the Knudsen bottle, its end caps are locked in the open position then it is attached to a wire.

At various depths specified by the oceanographer, the winch operator stops the winch so that additional bottles can be attached to the wire.

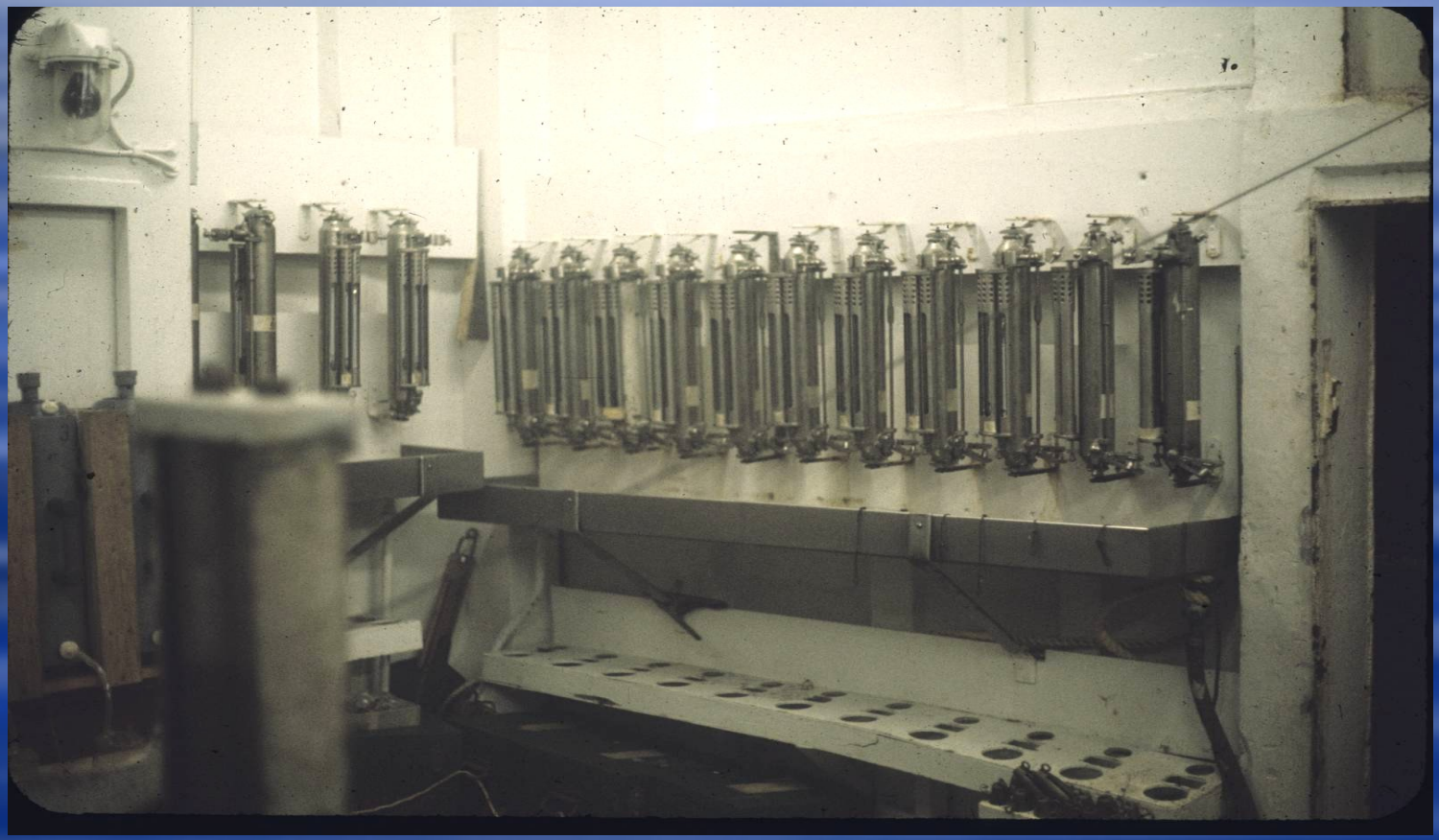
Messenger

- When the string of water bottles reaches the required depth, the winch is stopped. A weighted messenger is attached to the wire and released. It slides down the wire to the first bottle causing it to invert, close the end caps and release another messenger which then trips the next lower bottle in the string.

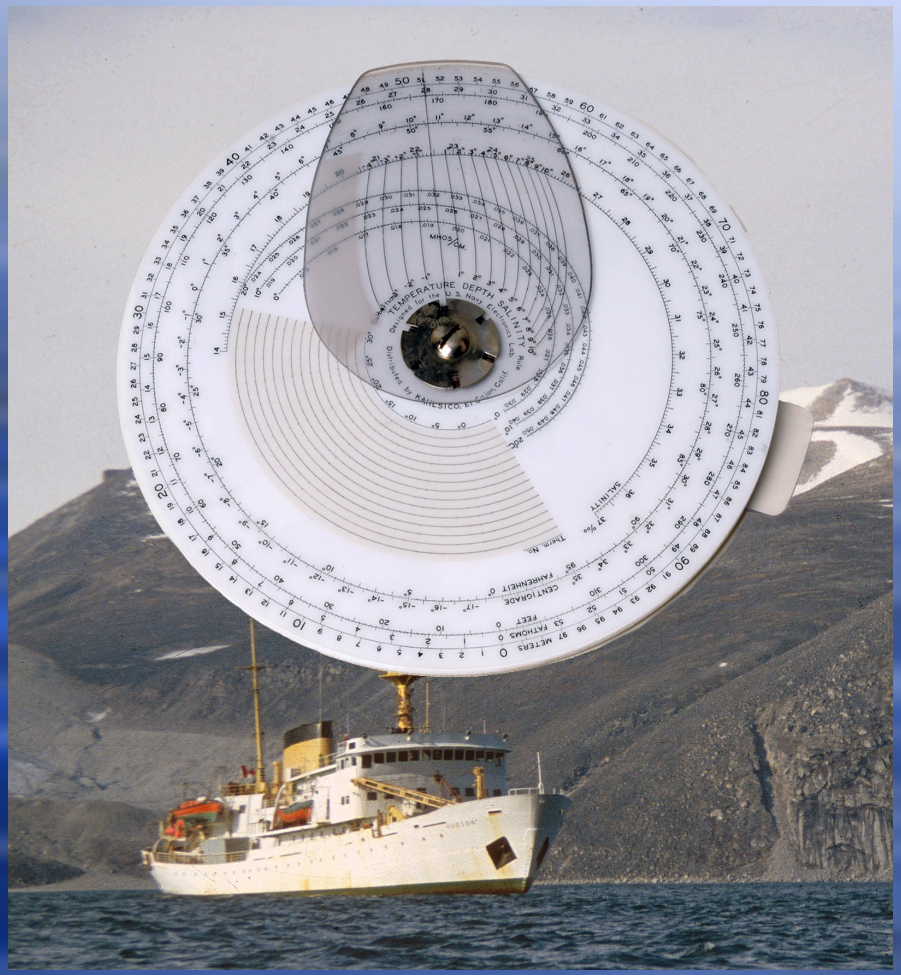
If the cast is to a very deep depth, it may be up to two hours before the bottom-most bottle is tripped. Once all the bottles have tripped, the wire is hauled in and the bottles are removed.



The oceanographer then begins the task of recording temperatures and drawing off water samples.



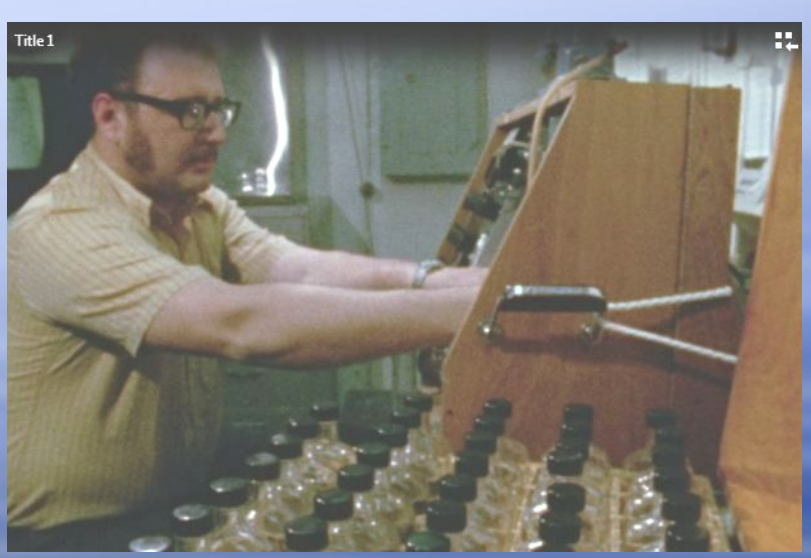
The temperature readings are obtained from the reversing thermometers using a special illuminated magnifier.

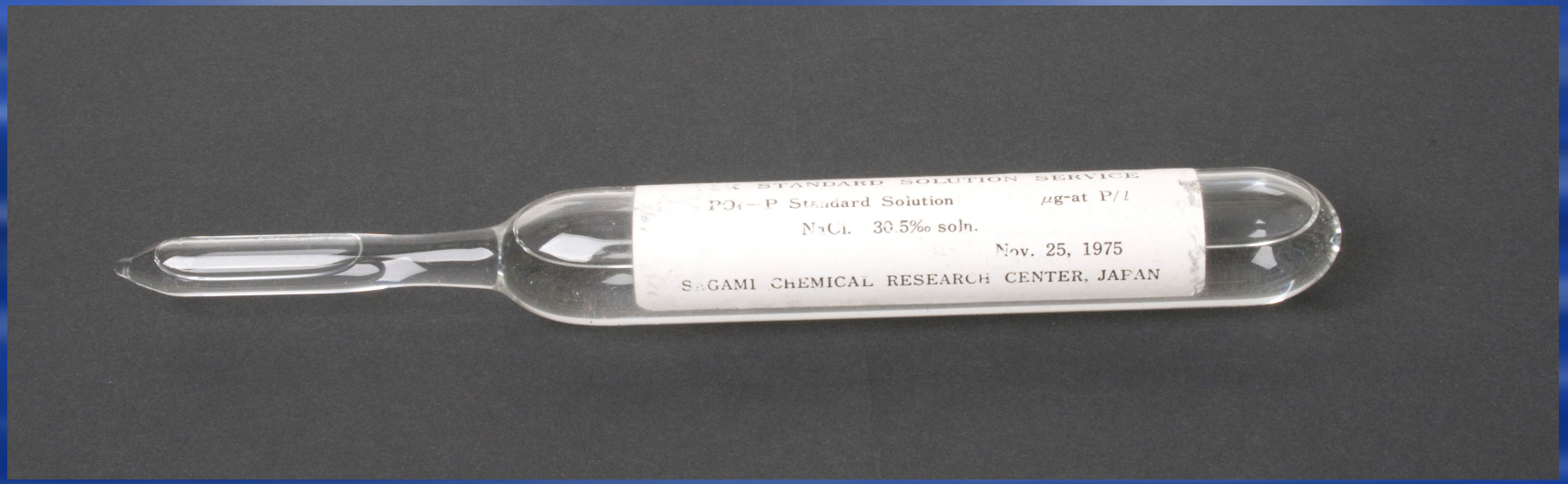


Prior to the advent of sea-going computers, oceanographers would use special slide rules to convert thermometer readings to temperature and depth

- Water samples are drained into sterile bottles for laboratory analysis to determine:
  - -salinity
  - - dissolved oxygen
  - - nutrients

- The electrical conductivity of the sample is compared to a standard sample of sea water to establish its salinity or salt content.

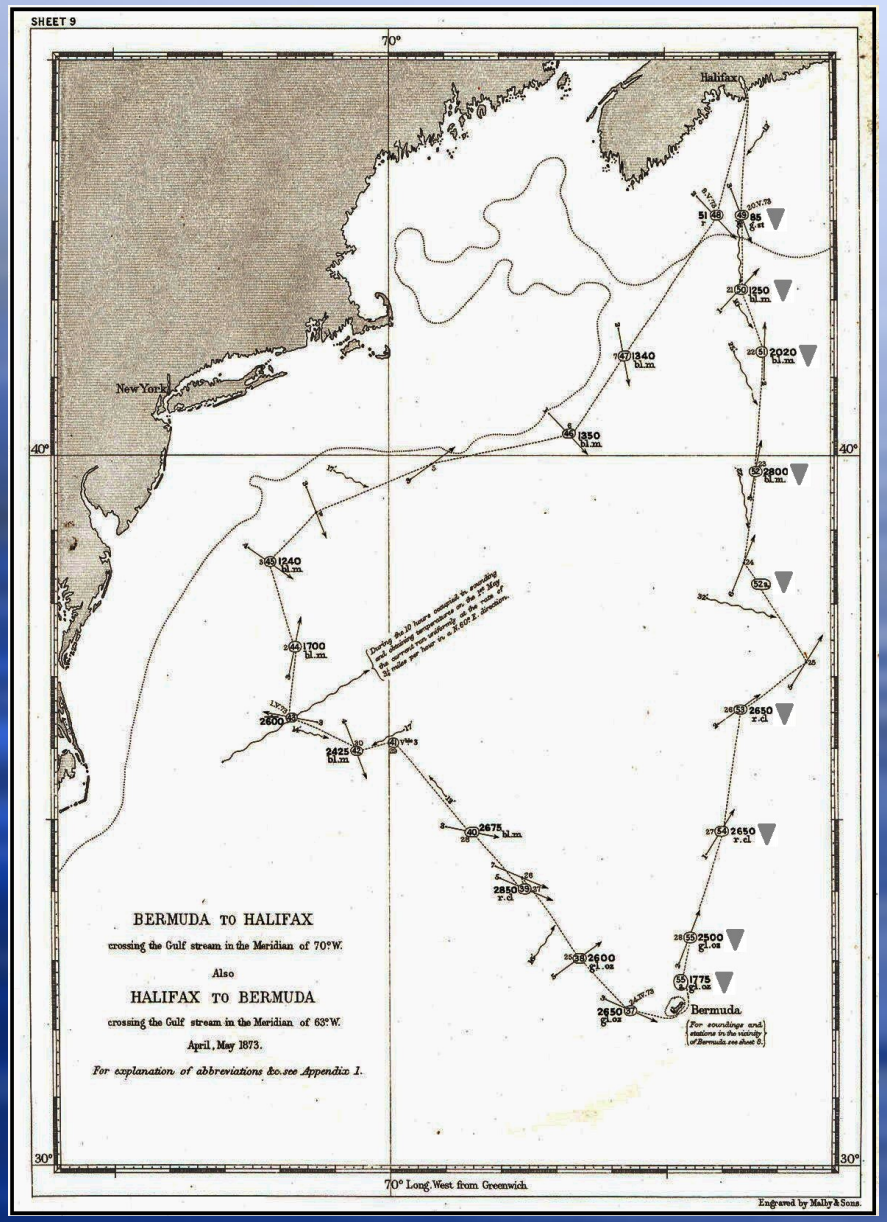


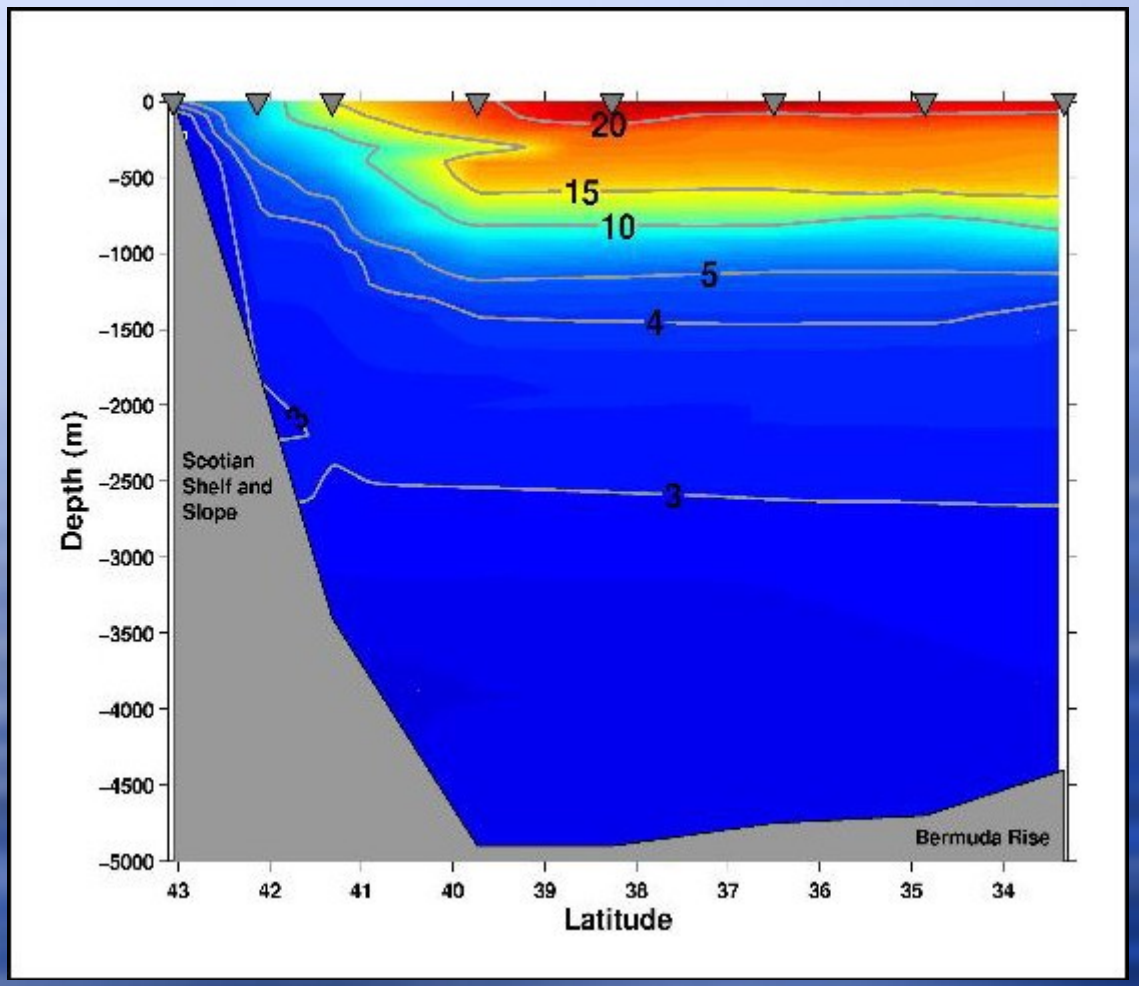


The amount of oxygen and nutrients dissolved in the sample is determined by chemical analysis.

In 1873, the Challenger Expedition measured water temperature profiles at various locations between Halifax and Bermuda using equipment similar to that exhibited here

H.M.S. Challenger under Sail, 1874.





Challenger Temperature Section

Halifax to Bermuda

May 1873

This display was created for the BIO Oceans Association by:

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with financial assistance from
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