PORT AND OCEAN ENGINEERING UNDER ARCTIC CONDITIONS
TECHNICAL UNIVERSITY OF NORWAY

NORWEGIAN OCEANOGRAPHIC AND METEOROLOGICAL BUOY SYSTEMS

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All over the world there is an increasing interest in the collecting of oceanographic and meteorological data from ocean environment by using fixed moored or free floating buoys and platforms.

With Norway bordering on great oceans in the North and the West, it has been a need for Norwegian oceanographers, hydrologists, meteorologists, harbour constructors and naval architects to collect data from these large areas in order to get information for a better understanding of how the weather is formed, to locate the fish shoals, and to learn about how wind and waves act upon piers and harbour installations.

In Norway the development and construction of instruments and buoy systems have been concentrated at a few institutions working in close cooperation. Systems and instruments have been constructed for collecting such data as sea temperature, current speed and direction, water pressure, air temperature, air pressure, wind speed and direction. The areas of operation for the data collecting instruments and buoy platforms are basically the North Atlantic, the Barents Sea, the Norwegian Sea, the North Sea, and the fjords and coastal waters of Norway.

The Norwegian buoy systems in operation today can be divided into two groups:

Surface buoy systems and subsurface buoy systems.

The basic instrument used is a recording temperature and current meter, which completed its development phase at the Chr. Michelsen Institute in 1965. It has been in production by a Norwegian company since then.

The instrument is supplied with sensors for temperature, current speed and current direction measurements, and it is programmed to sample these parameters up to 12 times per hour, and record the information in a 10-bit binary code on magnetic tape.

The buoy station in Figure 1 has a surface float of the toroid type, made of glass-fibre reinforced plastic, fitted with flash-light and radio beacon. The buoy can be moored at 3000 metres depth. Type of mooring cable will depend on the depth. Both galvanized steel wire, polypropylene rope and a combination of these cables have been used.
The current-meter is suspended on the mooring wire, and data are recorded by the instrument on magnetic tape.
This type of surface buoy station has been widely used for long-period oceanographic data collection in coastal waters as well as in open sea.

The toroid surface buoy station will, however, due to the wind and wave forces on the buoy structure introduce noise in the measurements made by the submerged instruments.
This noise can be reduced by using a submerged buoy as shown in Figure 2. The sub-surface float of this station is made as a sphere, having a net buoyancy of 200 kp and a max. operating depth of 1000 metres. The station is provided with an acoustic anchor release unit, and on receiving a coded command signal from the research vessel, a small explosive bolt will detonate and separate the mooring wire from the anchor. Once released, the unit acts as an acoustic beacon, making it easier to locate the station when arrived to the surface.

Up to 3 current meters can be suspended on the mooring wire of this station, and the deepest instrument can be positioned less than 2 metres above the sea bed, if bottom currents are to be measured.
The system is a "silent" one, and it has also the advantage of being a very reliable system, as the dynamic loads on the mooring cable are low, increasing the life time of the system. Moreover, it is the only system which can be used for oceanographic data collection under the ice in Arctic and Antarctic waters.

The telemetering system concept in Figure 3, has an underwater acoustic telemetering link from the submerged instrument to the surface buoy, and a radio link from the buoy to a shore station. In this system, also developed and constructed at the Chr. Michelsen Institute, data will be transmitted in real time from the deep ocean to the shore station. The data are handled in a computer for failure detection, classifying, making average figures etc.
The current meter is a modified instrument of the same type as used in the

other stations. The float is of the spar buoy type, very convenient for instrumentation work, and operating well in rough weather. A telemetering buoy station of this type has been in operation off the west coast of Norway since the end of 1970, and another station will be ready for operation during 1971.

In order to increase the density of the network of meteorological observation stations in the Norwegian Sea and the North Atlantic areas, the Norwegian Meteorological Institute in 1960 decided to develop an automatic weather station for service in anchored or free drifting buoys. The first seagoing buoy of the experimental series was launched in 1963, and in the course of the years up to 1971 Norwegian meteorological buoys have been in operation for more than 1000 days, having transmitted more than 8000 messages of weather data to the receiving station ashore.

The meteorological buoy, constructed at the Meteorological Institute in cooperation with the Chr. Michelsen Institute, and shown in Figure 4, is a spar buoy of a total length of 6 metres. The top end of the buoy is shaped as a wind wane, and for stabilization purposes the bottom end is extended with a steel pipe and a counterweight.

The buoy is normally used as a free drifting station, provided with 250 metres of steel wire and a small anchor. This secures the mooring if the buoy is drifting into shallow waters, and also serves as a brake against wind drift.

The meteorological elements to be measured are: Air pressure, air temperature, sea temperature, wind direction and wind speed. Data are transmitted in the 4.5 MHz band eight times a day, the transmission being initiated by an internal clock or by interrogation from the receiving station.
Radio location of the buoy position is carried out by two commercial stations with modern direction finders.

When the possibility arose for gathering oceanographic and meteorological data from ocean going platforms by data transmission via satellite, it was decided to build a Norwegian experimental buoy to evaluate such a system. The buoy was named SCOMB-1, the Satellite Communication Oceanographic and Meteorological Buoy.

The development and the testing of the SCOMB-1 system were sponsored by the Royal Norwegian Council for Scientific and Industrial Research (NTNF) and its Space Activity Division. The work has mainly been done in cooperation between the SIMRAD Company and the Chr. Michelsen Institute.

Interrogated by a command signal from a ground station, the buoy is designed to relay meteorological, position and housekeeping data in a digital form back to the ground station via a geostationary satellite. The system concept is illustrated in Figure 5.
For the SCOMB-1 experiment the buoy was moored near Bergen, and the ground station was installed at the Meteorological Institute, Oslo. The only satellite available within the test period was the NASA ATS-III spacecraft, which was stationed at 47°W from 1st December 1970 through January 1971. An agreement was made with NASA to utilize the ATS-III VHF transponder for the buoy experiment during this period.
During the development and testing of the buoy know-how and experience have been gained both as regards technology and field operation. The results will present a valuable background for discussions of the set-up of possible future operational systems.

Like other countries with a need for collecting data from the ocean, Norway has also proceeded with a new buoy technology project, initiated in 1971 by the Chr. Michelsen Institute and the SIMRAD company, sponsored by the Royal Norwegian Council for Scientific and Industrial Research (NTNF).
The aim of the present project is development and prototype construction of buoy systems, data handling systems and sensors for collecting oceanographic and meteorological data from the ocean environment.

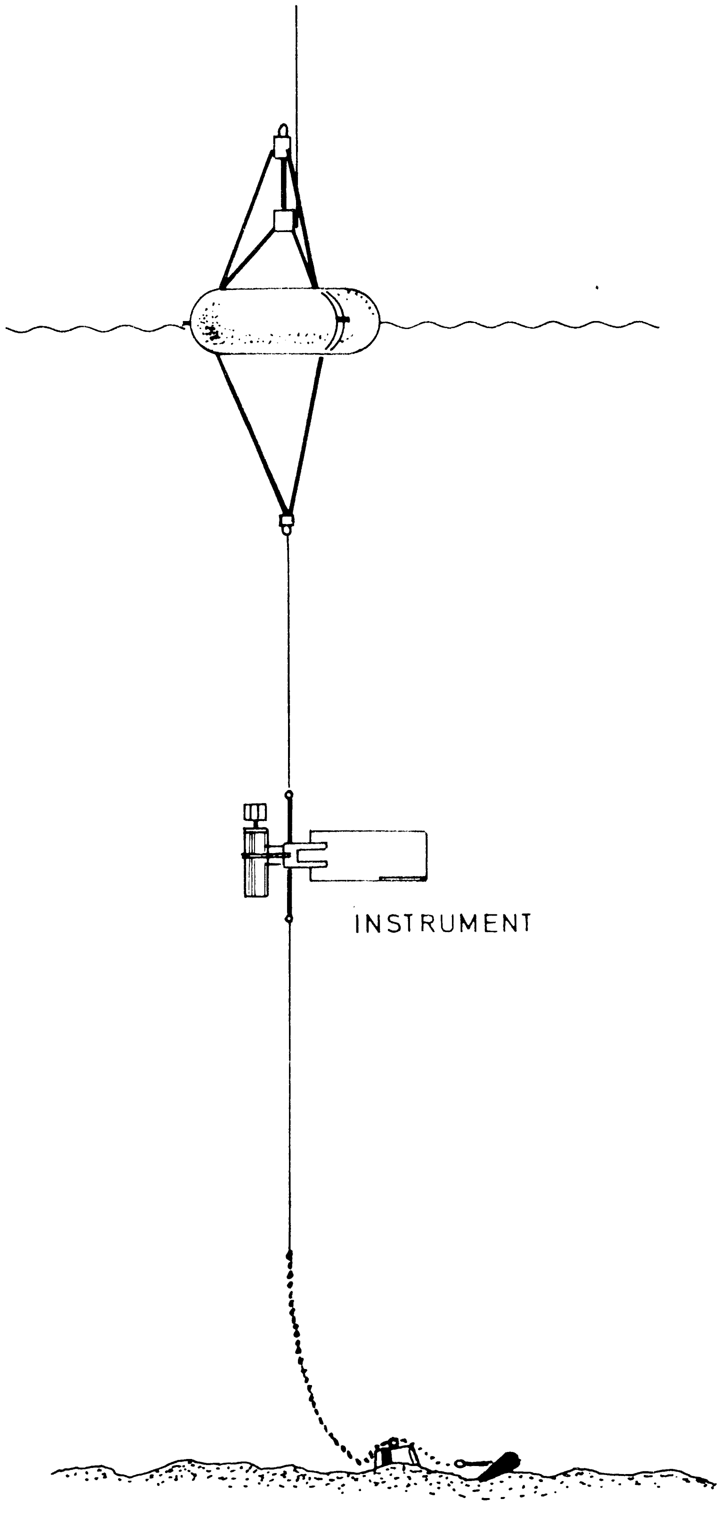

FIGURE 1

TOROID SURFACE BUOY STATION

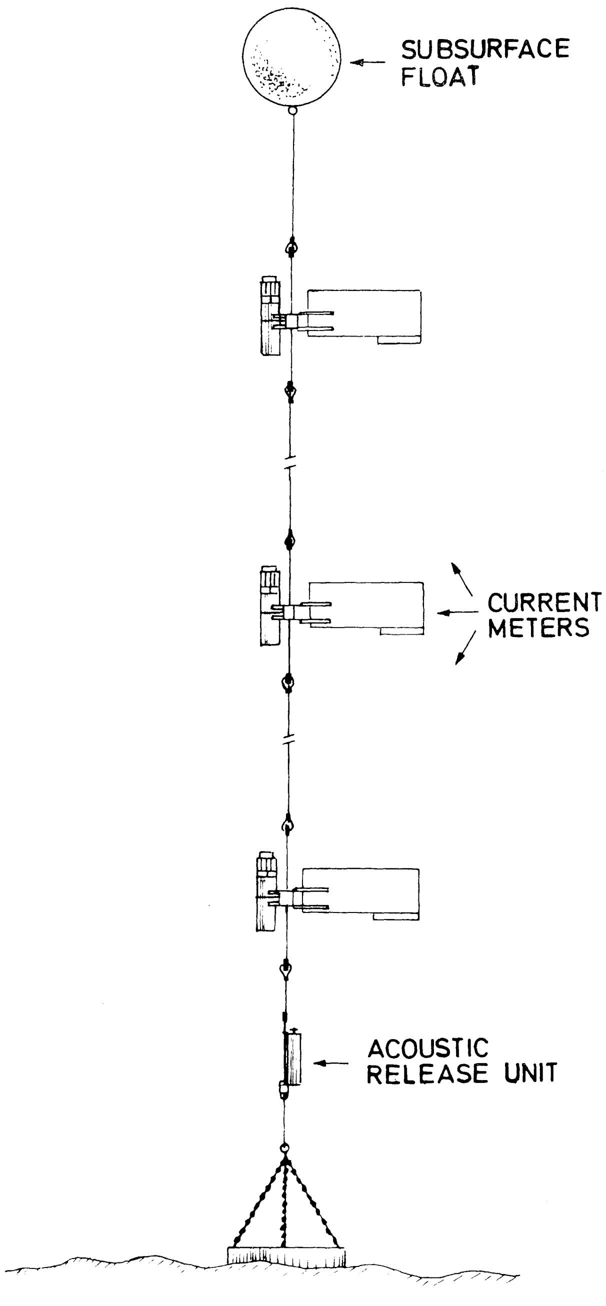

FIGURE 2

SUBSURFACE BUOY STATION

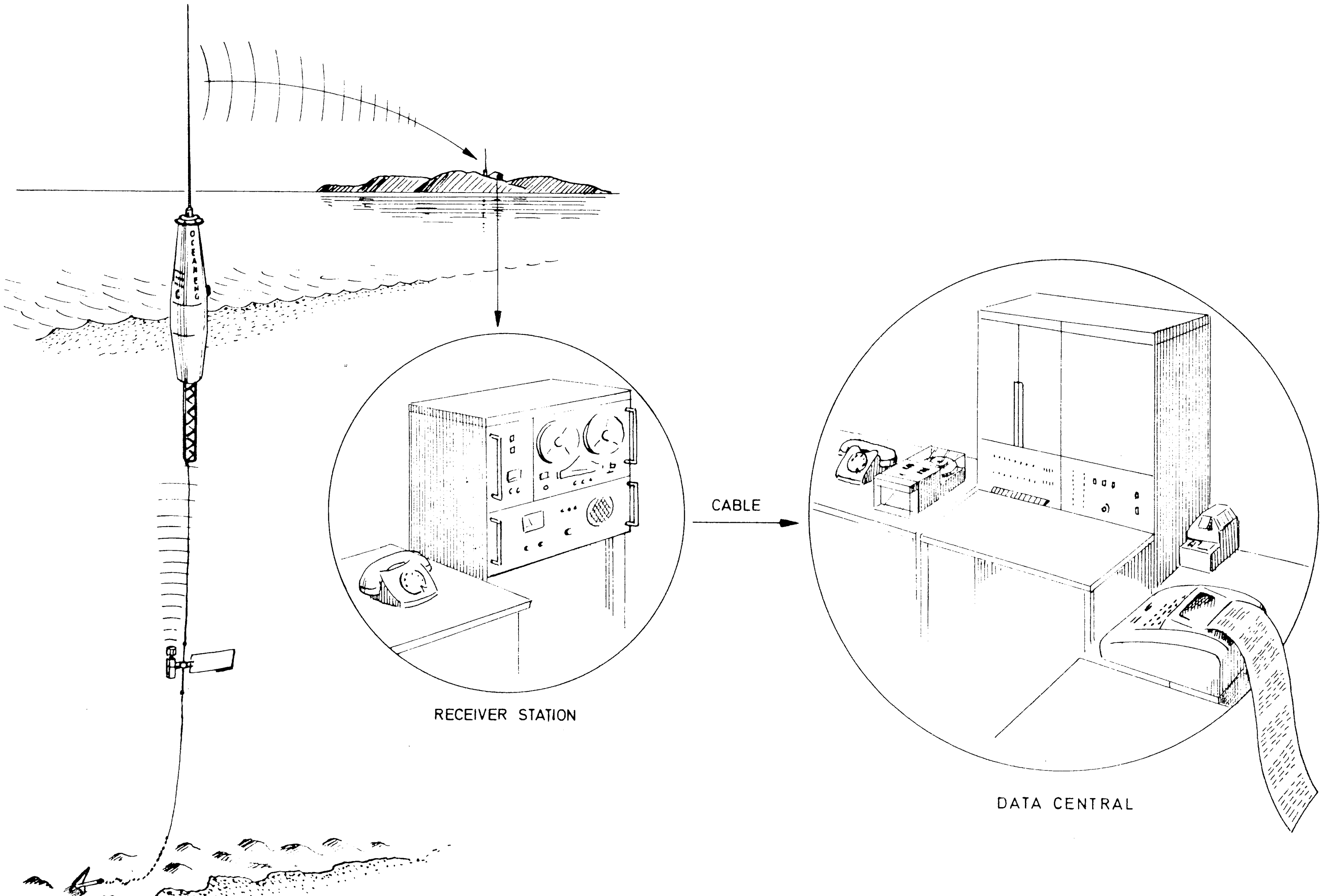

FIGURE 3
TELEMETERING BUOY SYSTEM

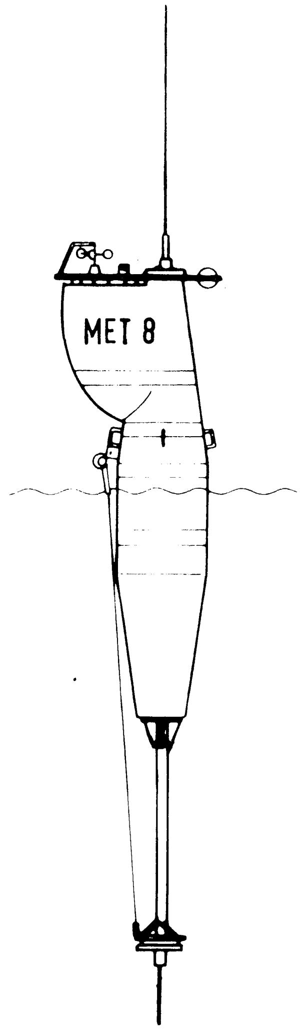

FIGURE 4
METEOROLOGICAL BUOY

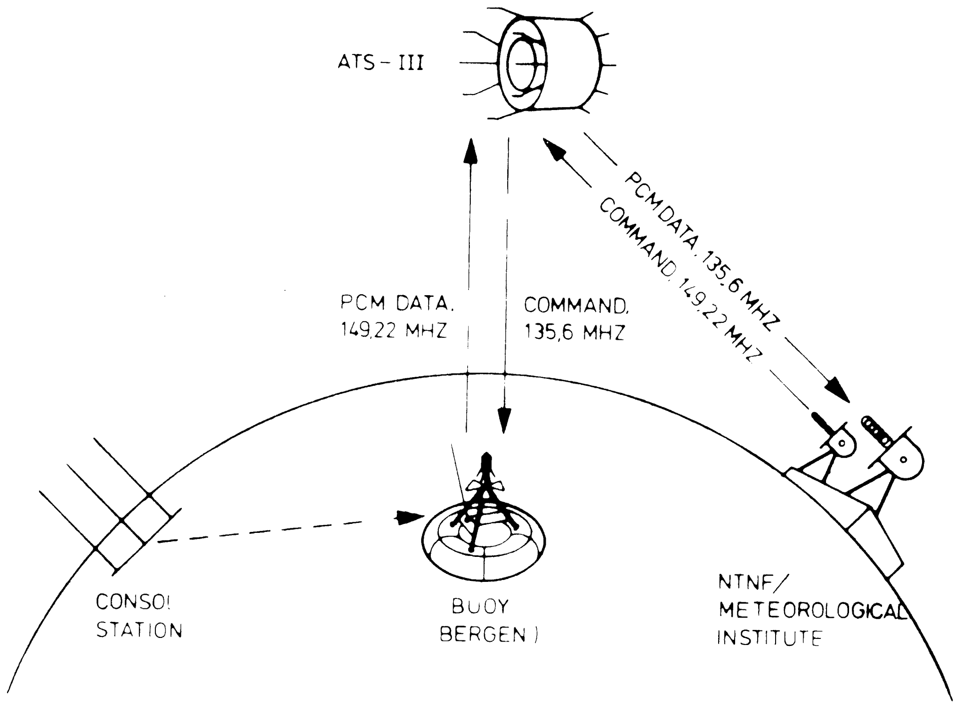

FIGURE 5

SCOMB - 1 TELEMETRY AND COMMAND SYSTEM