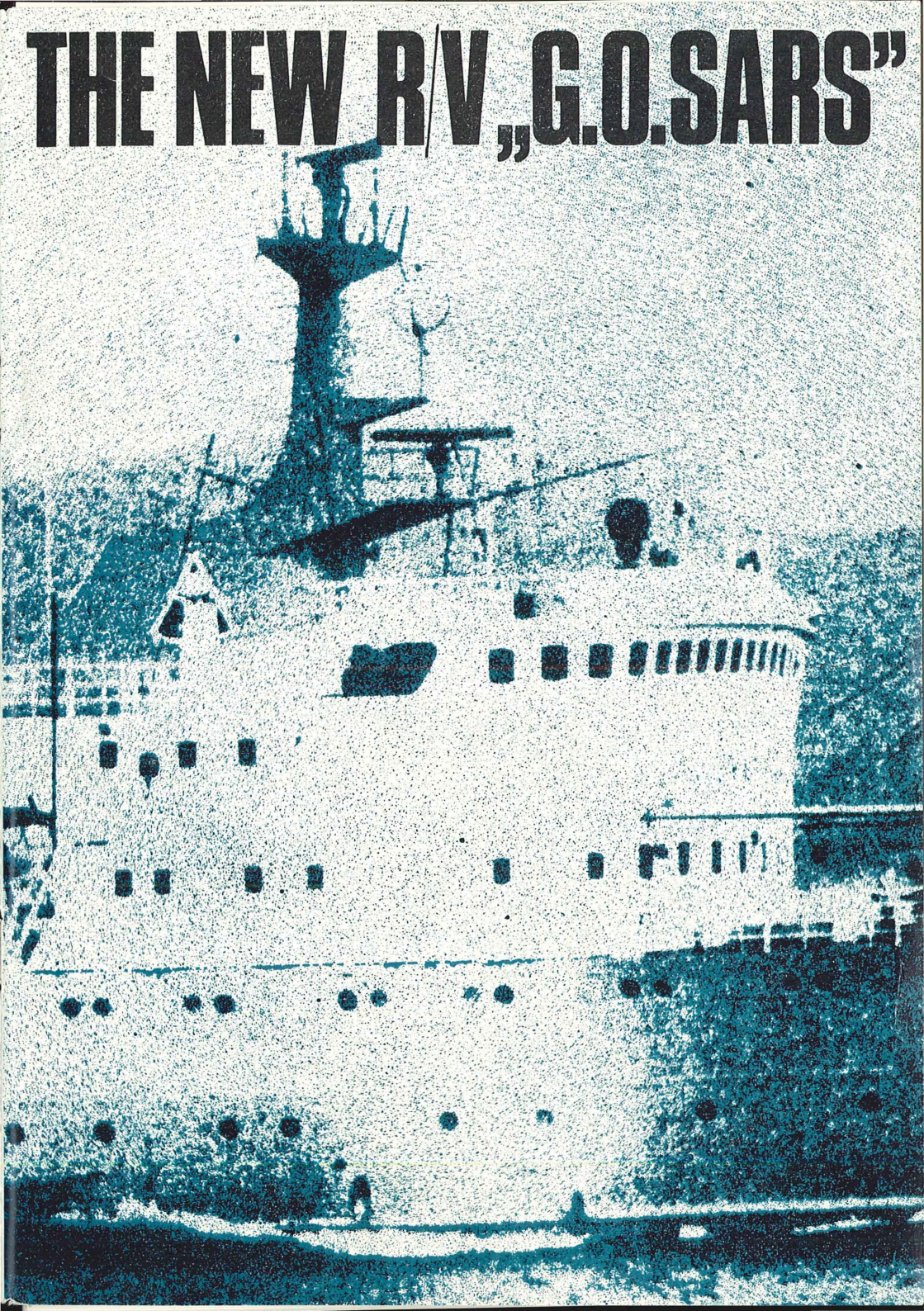
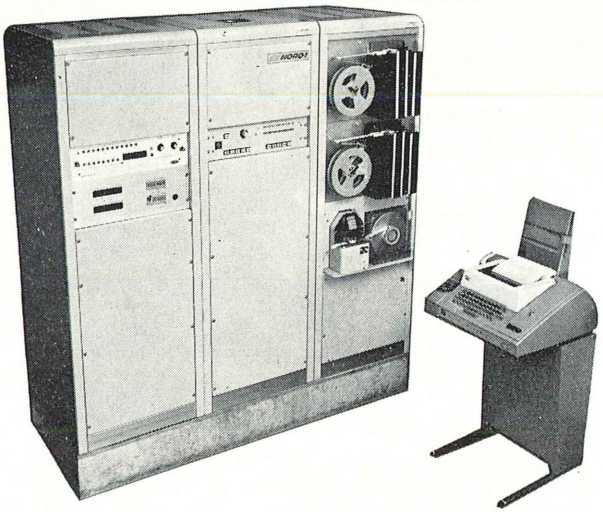
THE NEW R/V „G.O.SARS"





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A/S NORSK DATA-ELEKTRONIKK

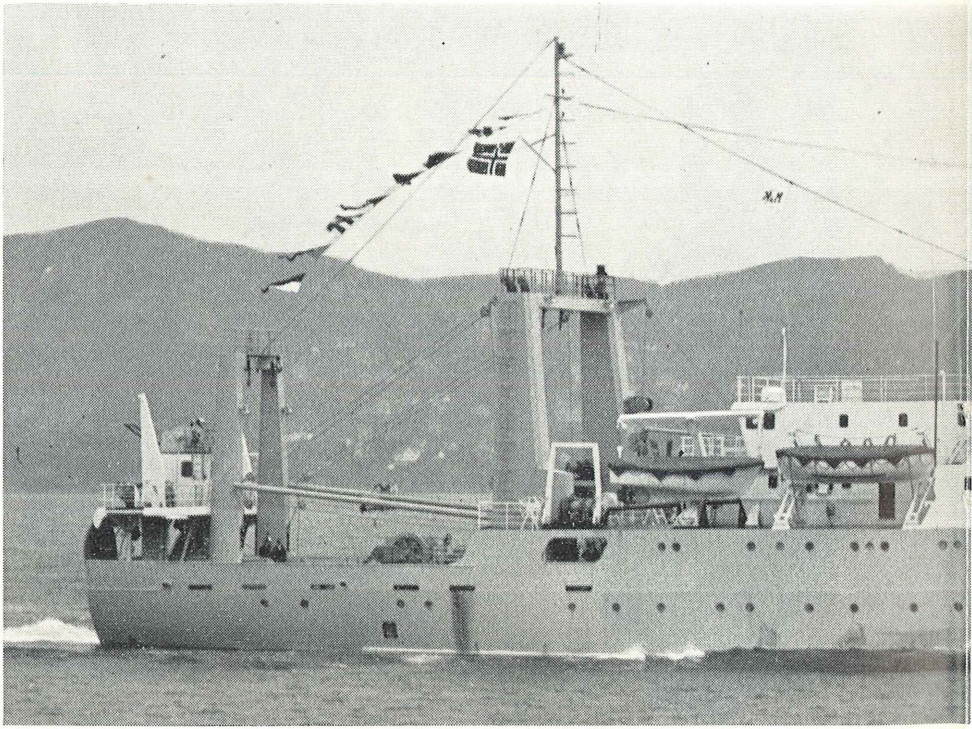
ØKERNVEIEN 145

OSLO–5

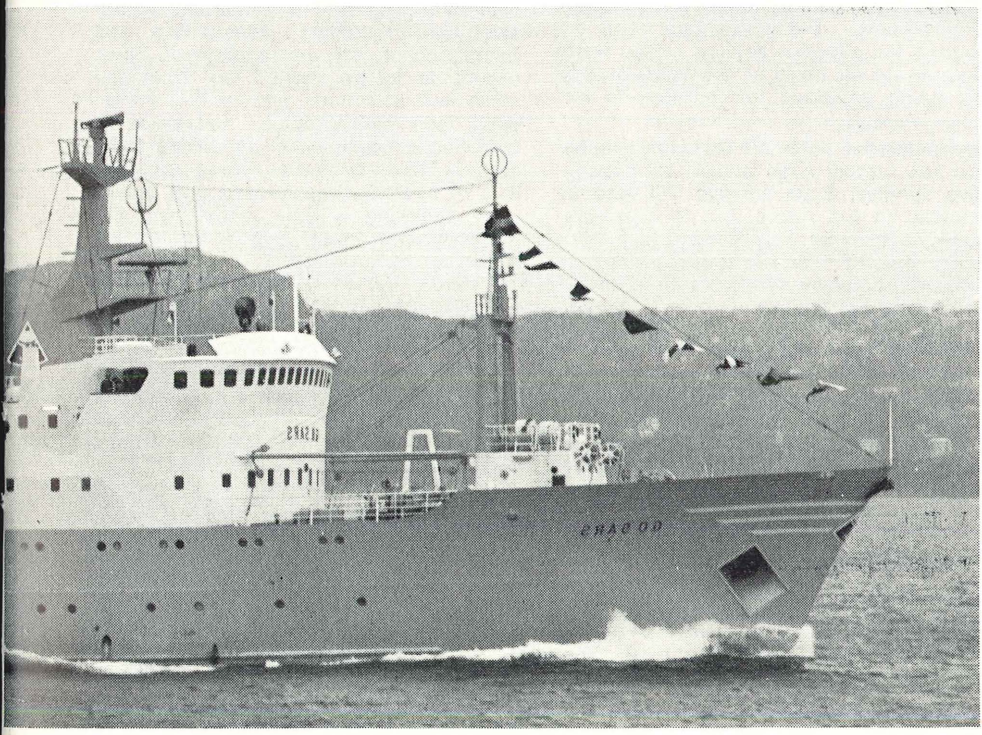
Introduction

This new research vessel is a replacement of the first "G. O. Sars" which now after 20 years service, has been taken out of operation. The new "G. O. Sars" is to fill a main part of the needs for oceangoing research in Norwegian fisheries investigation during the next 20—30 years. An analysis of the expected trend in scope and volume of the research activities to be undertaken by the Institute of Marine Research during the remainder of this century, formed the basis of the planning of the vessel. The first planning was started in late 1964, when a group of three scientists of the Institute together with a naval architect undertook an analysis of the requirements of the vessel in relation to future research

THE NEW R/V "G. O. SARS".



needs. The vessel was designed by the shipyard Bergen Mekaniske Verksteder in collaboration with the Planning Group. The drawing and specification were presented for tender early in 1967 and the construction could start at the yard Mjellem & Karlsen during the summer 1967. During the construction phase a chief engineer and an acoustic expert worked together with the naval architect as inspectors.
During the early planning period two other groups were established, to specify the acoustic instruments and a computercentered data logging system respectively.



The vessel and its work tasks

2.1 Areas of operation and types of research.

The main geographical areas of operation will be the Barents Sea, the Norwegian Sea, the North Sea, and the waters of Iceland, Greenland and the Faroes. Also research in the Northwest Atlantic (ICNAF-area) may be somewhat expanded in the future, and it is furthermore possible that a limited research effort will be required in the temperate zone of the North Atlantic (20-50°N). In a more distant future the vessel may also be used for spesial cruises to the Central and South Atlantic Ocean and to the Antarctic, but those waters will not be part of her normal areas of operation. Consequently, the vessel has been designed for effective service in the North Atlantic at all times of the year, as well as being equipped for journeys to tropical waters.

In traditional fisheries research emphasis has largely been placed on descriptive surveys. Such surveys will also be needed in the future, but it is reasonable to assume that the work will be more directly focused towards the problems of causes and effects, and, hence, the investigations will require a greater degree of specialization than at present. In planning the new research vessel it was therefore considered necessary to provide space and facilities for a variety of work to be undertaken during the same cruise.

Emphasis has been given to facilities for effective sampling of organisms, with a variety of fishing gears, plankton gears and other instruments. Equally important are continuous and rapid measurements and recordings from hydrographic sondes and acoustic devices and fixed mounted sensors. Good facilities for experimental work have also been provided in such fields as primary production measurements, serology, physiology and fish behaviour.

To cope with the great capacity of this vessel and the expected mass of data to be collected, a system for rational data recording and logging was designed. This system includes also processing and analysis of certain types data. Finally, an increasing demand for rapid dissemination and presentation of progress and preliminary results has been foreseen.

2.2 Sequence of operations.

The main principle here has been to provide a practical and logical location and crouping of the different work processes, and to facilitate immediate change-over from one operation to another without having first to undertake extensive time-consuming dismounting and reshuffling of gear and equipment. Thus, fishing is to be carried out from the stern and starboard side of the shelter deck, and hydrographic- and plankton sampling on both sides amidships adjacent to laboratories. Launching and hauling of hydrographic buoyes and geological sampling will be made from the foredeck, and operation of towed bodies from the stern bridge.

To enable full control and direction of all research activities, both in accordance with the overall aims and program for the cruise, but also in accordance with the observations made underway, the vessel incorporates an Operations Centre from which all operational activities of the cruise are coordinated. The sequence of operations and flow of data is outlined in Fig. 1. Continuous measurements by fixed sensors in the surface layer (temperature, salinity or conductivity, incident light, water transparency etc.) are fed directly into the data logging system. Most of these parameters are also monitored on special recorders in the Operations Centre. Figure 14.

Similary, signals or data relayed by cable from vertically lowered or towed bodies may go directly on line to the Data Cen-

Fig. 1 Sequence of Operations and flow of data

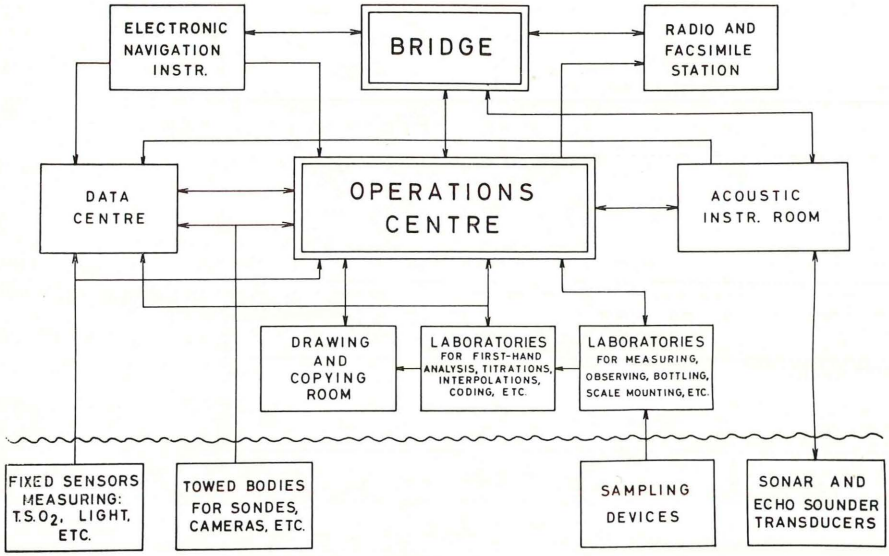


Fig. 14 Operation Center

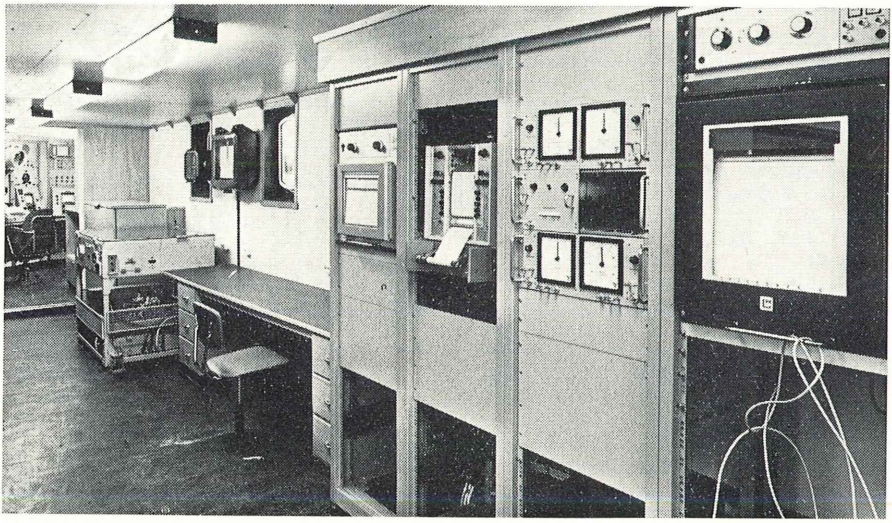


Fig. 2 General arrangements

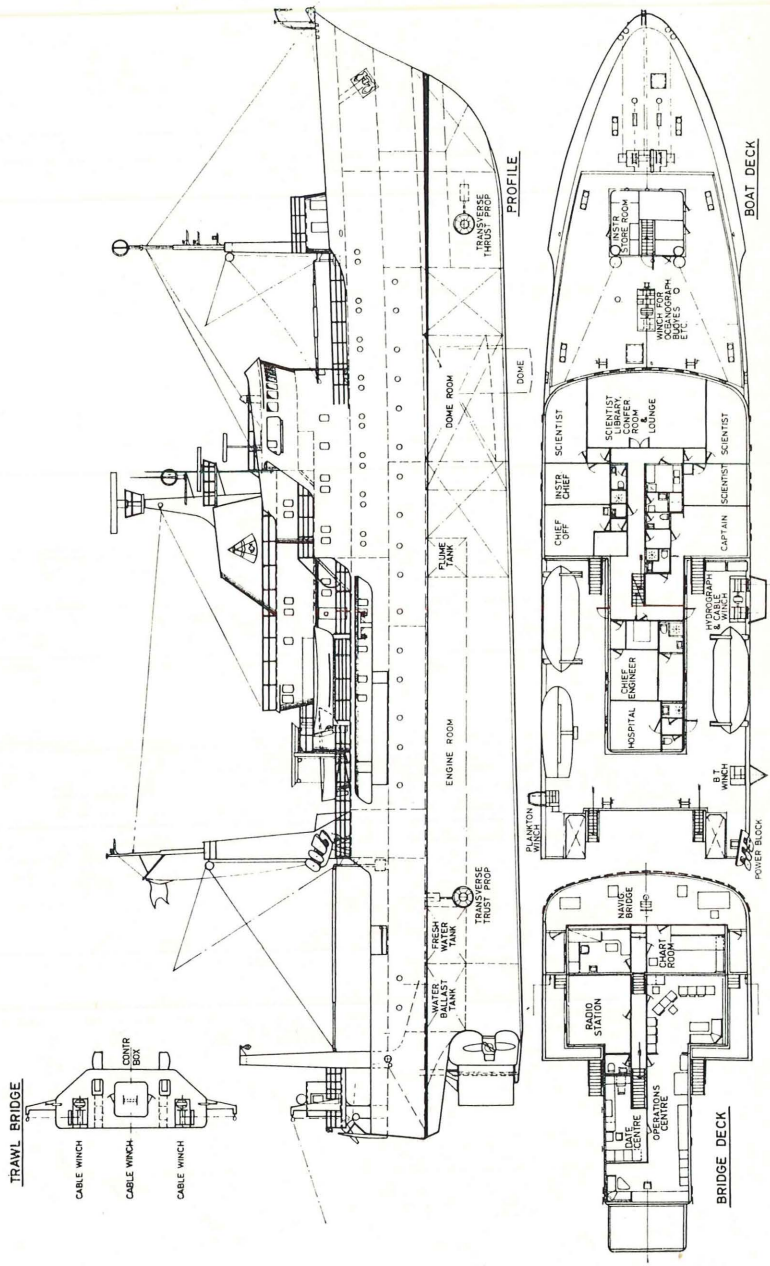
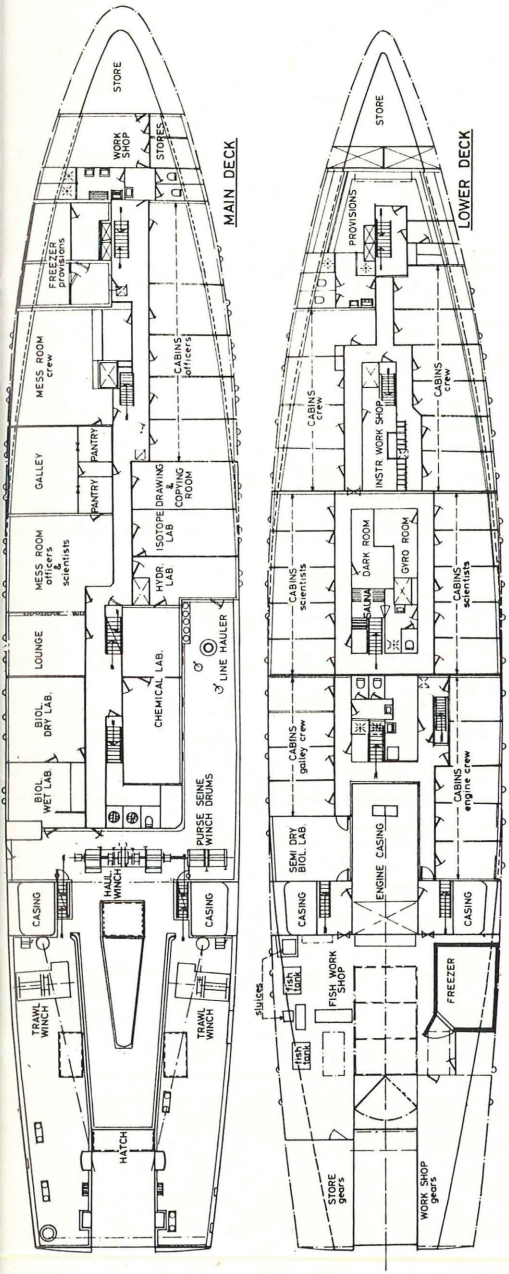


Fig. 3 General arrangements



tre (measurements of hydrographic parameters by sondes) or will be displayed first in the Operations Centre.

Sampling of fish catches, plankton hauls etc. are made in relevant deck laboratories. The material then proceeds to the dry laboratories where first hand analysis (titrations, calculations, interpolations), compilation and coding for data storing is performed. In this form the observations are transmitted off line to the Data Centre for storage and further processing, and/or the results are being evaluated in the Operations Centre. All acoustic instruments will be controlled and operated from the Acoustic Instrument Room, situated adjacent to the Operations Centre. The acoustic observations will be recorded or displayed in this room. Certain data are transmitted to the Data Centre for logging and further processing.

2.3 Layout of research facilities.
The general arrangement is shown in Figures 2 and 3.

Fish catches which are first landed on the shelter deck proceed through a hatch to the Fish Work Shop on the main deck, were sampling, measuring, tagging and other biological observations are performed. The first hand treatment of samples and observations, mounting of scales and otoliths etc. will be carried out in the semi-dry laboratory next door. Fish offal are disposed off through a sluice on the port side in the Fish Work Shop. Here tagging tanks are also situated, the tagged fish being released through the sluice arrangement. Adjacent to the Fish Work Shop are stores and a workshop for fishing gears, and on the starboard side a freezer and cold store for fish samples and bait.

The location and general lay-out of the deck machinery for fishing operations (trawling, purse seining and long lining) can be seen from Figures 2 and 3. It is noted that in order to gain space in

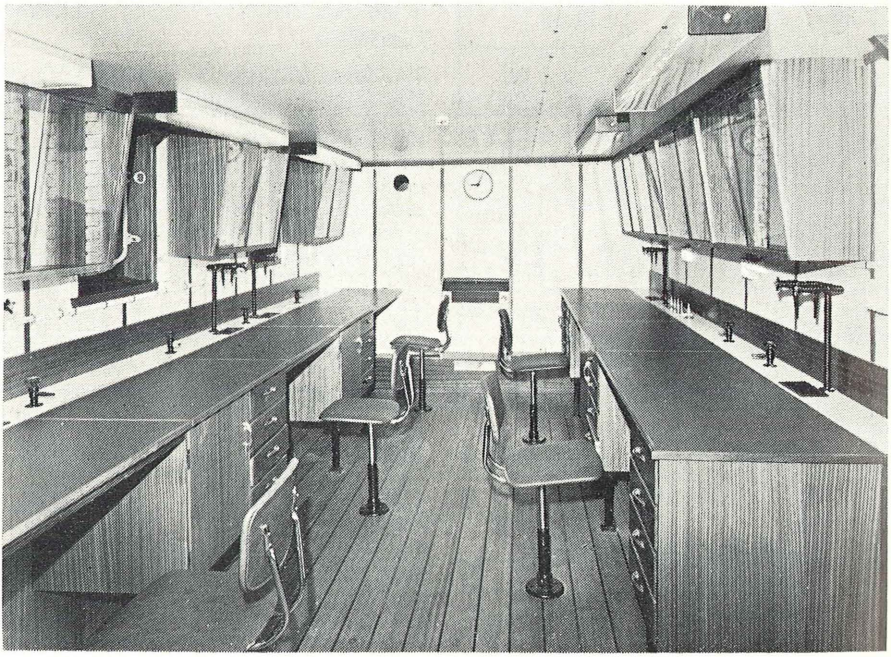
the central area of the ship the main trawl winch is split, and a smaller hauling winch is installed in the front end of the fishing deck. Through a detachable axle link this winch is also driving the purse drums.

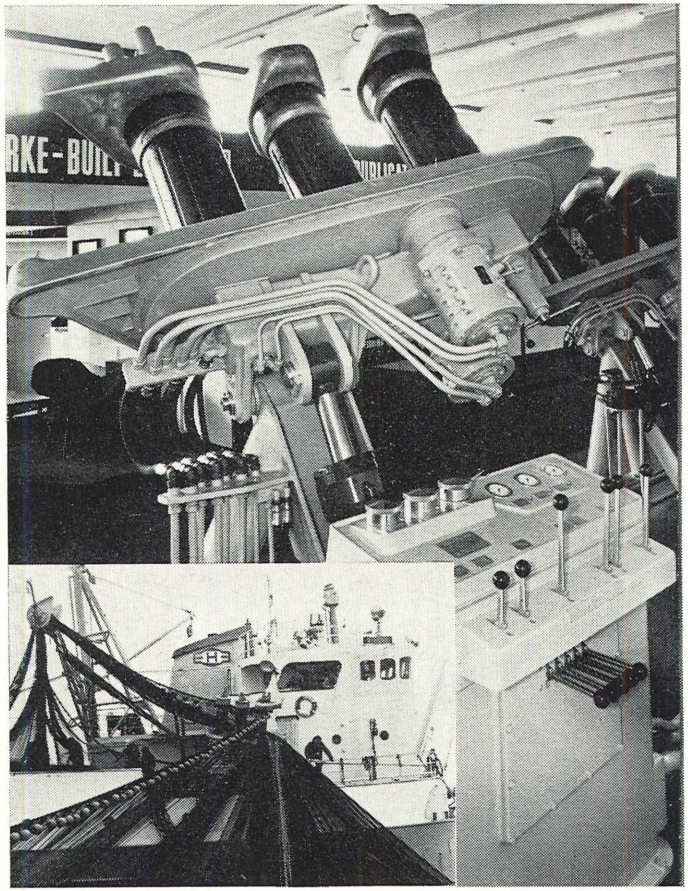
A dry laboratory for physiological, serological and microbiological work is situated next to the Biological Wet Laboratory on the port side of the shelter deck. On the starboard side the Chemical and Isotope Laboratories are connected with the Hydrographical Laboratory. The Drawing- and Copying Room is also situated on the shelter deck to provide easy access and communication with the other laboratories. Figure 15.

Three cable winches are located on the stern bridge. Winches for planton and hydrographic work are situated on the boat deck with controls on the shelter deck. These winches have also extra drums for electric cables. On the fore castle deck there is a special winch for launching and hauling of oceanographic buoys and for operating geological bottom samplers.

The Operations Centre, from which the overall activities of the cruise are directed and coordinated, is placed on the

Fig. 15 Chemical Laboratory





M/S G. O. Sars is equipped with
TRIPLEX seine winch
Type 603/360 /2A Super

Technical data:

Main rollers:		
Maximum theoretical hauling power:	12 000	kg
Maximum hauling speed:	30	m/min.
Lowest hauling speed:	5	m/min.
Numbers of speeeds:	6	
Required power for pump:	40	kw 54 HP
Maximum working pressure:	140	kg/cm^2
Pump capacity:	160	c/min.
Cork line rollers		
Maximum theoretical hauling power:	2 500	kg
Maximum hauling speed:	40	m/min.
Lowest hauling speed:	0	
Numbers of speeds:	3	

Speeds variable between fixed speeds.

TRIPLEX

P. BJØRSHOL MEK. VERKSTED
Langøy near Kristiansund N.
Telephone: Langøy, Nordmøre, no. 10

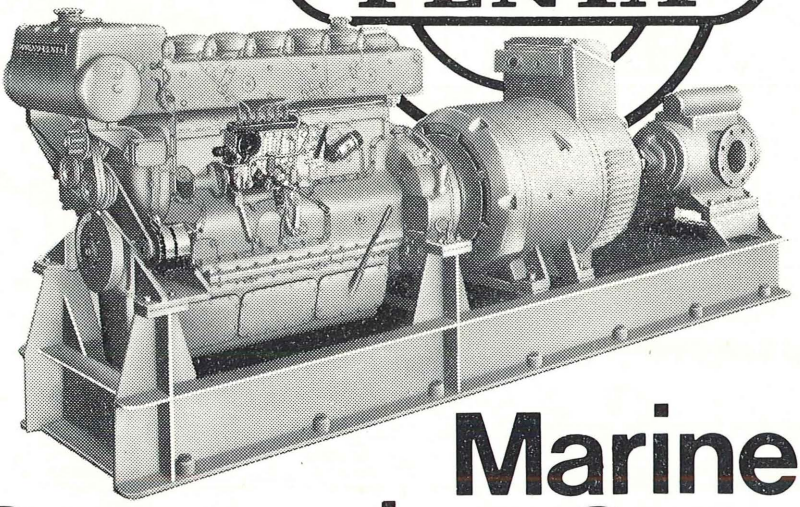
bridge deck level adjacent to the Data Centre and the Acoustic Instrument Room. Here a variety of recorders and a plotting table are located, and from this room there is intercommunication to all laboratories and operational work spots onboard. There is also direct intercommunication between the Acoustic Instrument Room and the Navigation Bridge.

For a detailed accont of the acoustic installations of the vessel reference is made to Section 4.1. Similarly, the data logging and processing system is described in section 4.4.

On the top of the bridge, in the artificial funnel, a baloon house for meteorlogical observations is planned. Part of the funnel can swing open hydraulically when balloons are to be released.

The power that drives modern auxiliary machinery

VOLVO PENTA



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In spite of their rugged construction, these sets are lightweight and compact. The engines have a low fuel consumption; they run quietly and without vibration.

Supervision is facilitated by an automatic control unit which stops the set and/or gives warning should the temperature of the coolant become too high or the lubricating-oil pressure fall below a predetermined level. The engine may be fitted with an electric or compressed-air starter as required; it is freshwater cooled.

The sets are designed to permit complete servicing without removing engine or generator from the bedplate. Volvo Penta's worldwide network of service stations ensures minimum delay if such attention is required.

All Volvo Penta generating sets have been tested and approved by the principal classification societies.

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Ship Description

This section gives a more detailed technical description of the vessel, its machinery and equipment.

3.1 Main dimensions.
Lengt over all 70,00meters=229'8"
Maximum Beam 13,30meters=43'3"
Depth from main deck 5,15meters=16'5"
Depth from shelterdeck 7,45meters=24'3"
The gross register tonnage is 1500 tons and the displacement fully equipped and with all fuel tanks and fresh water tanks filled up is about 2000 tons.

3.2 Class.
The ship is built to fullfill the requirements of "Det Norske Veritas", class + 1A1, stern trawler, Ice C. The hull itself except for the rudder and ruddershaft is strengthened to the requirements of Det Norske Veritas, class Ice A. The equipment and accomodations fulfill the requirements of «Skipskontrollen» for ship used for research purposes and ocean-going fishing vessel. The ship is allowed to sail on unrestricted waters.

3.3 The Engine Room.
The engine plant consists of four 835 Hp turbocharged diesel engines, Normo, type LSM, coupled, to a reduction gear produced by A. G. Weser. The gearbox has hydraulic clutches for each engine. The total power out put through gearbox to propellershaft is 2500 Hp. This means that three of the four engines can be run simultanously to the propeller. The propeller is a four-bladed variable pitch stainless steel propeller.
The engines are coupled to the gearbox, two at the front end and two at the aft end. The two front engines are also connected to 575 KVA electric generators (Nebb) installed between the engines and the gearbox. The two aft engines are on their free ends coupled through disc clutches to hydraulic pumps for trawl- and purse seine winches. Lub oil pumps for the four engines are directly driven. All other pumps for the engine plant, gearbox and propeller plant are electric. In addition to the main engines, gear and variable pitchpropeller plant, the engine room includes the following equipment:
On starboard gallery deck (metioned from the front):
Cooling plants (air condition, freezing and cooling stores), auxilliary engine, hydraulic system for scientific winches, boiler, lub oil and fuel oil purifiers.
On port gallery deck are installed:
4 transformers (380 V – 220 V), one transformer stabilized current (25 kw) for scientific instruments, fresh water generator (2,5 tons/24 hrs.), cooling pumps for main engines (two for fresh water and two for sea water), hydraulic system sliding doors, gear oil pumps, fresh- and sea water pumps with pressure tanks, air compressors and compressed air vessels.

In the casing on starboard side are installed Triplex power block pumps. In the casing on portside are installed pumps for remote cotrol of all hydraulic winches, and the pump plant for hydraulic cylindres for operating the gallows on deck.
Figure 4 shows the engine plant and engine room.

The auxillary engines consist of one harbour set Volvo Penta/Nebb of 135 kVA. and one emergency set Lister/Nebb of 30 kVA. The electric plant for the vessel is rather complicated, and to give the readers an idea of the dimensions, some details will be given. The power plant consist as mentioned before of two AC main generators with a total out-put of 1150 kVA and one harbour set of 135 kVA. The main current is 380 V, 3-phase, 50 cycles. The two main generators can be run in parallell.
A great number of consumers onboard uses 220 V, 50 cycles. For this purpose

Fig. 4 Engine Control Room

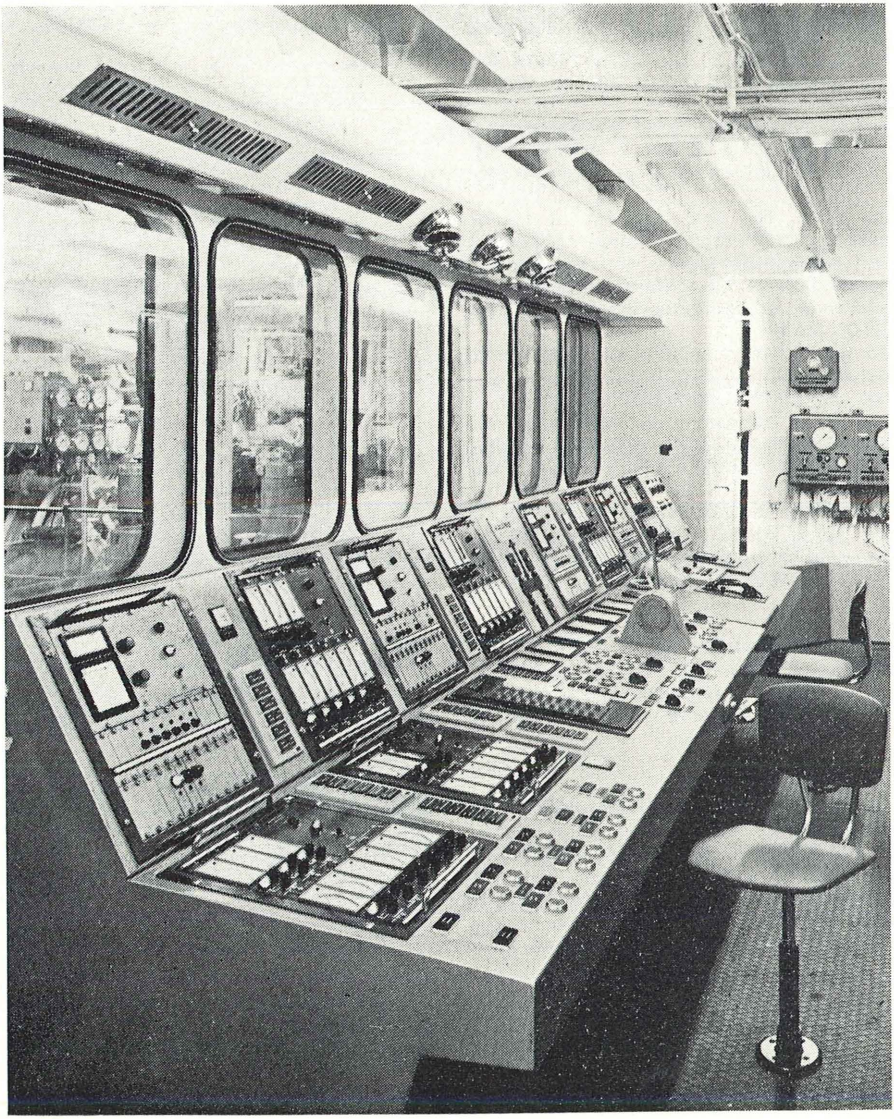
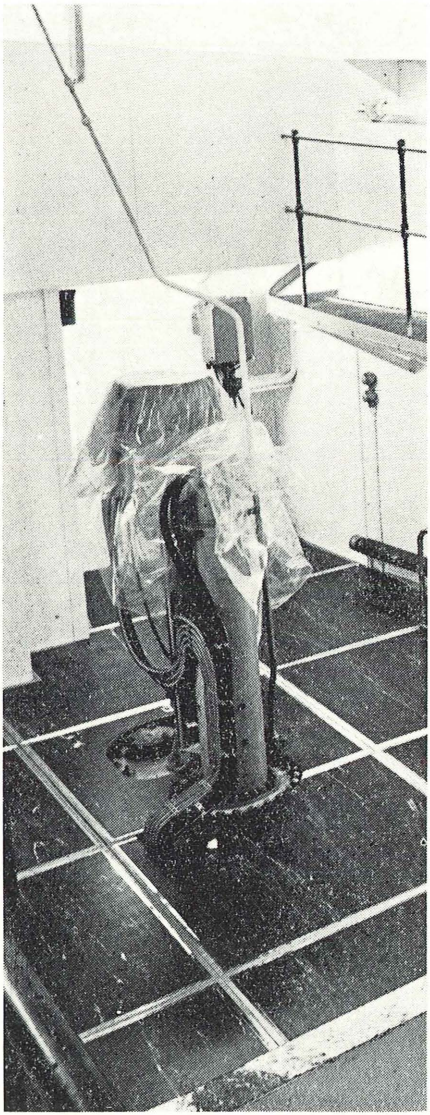


Fig. 6 Sonar Room

and also for having a possibility for using the shore connection which in Norway is 220 V, 50 cycles, there are four transformers with a total out-put of 500 kVA.
The main swithchboard in the engine control room is about 7 meters long. About 30 distribution boxes are located around in the different compartments of the ship. The total amount of cables used for connection between consumers and main switchboard and for internal connection of the different electric and electronic components, is approximately 55000 meters.
To avoid the possibility of interference between 380 V / 220 V cables and signal cables for electronic equipment, it has been necessary to make seperate cable ducts for each group of cables. In addition to this it has also been necessary to mount the signal cables between the hydroacoustic equipment in the sonar room and the racks in the acoustic instrument room in pipe lines. A view of this arrangement can be seen in figure 6.

3.4 Speed, stability etc.
The speed stated in the contract is 15 knots. Model tests of the ship have been carried out by the Ship Model Basin in Trondheim. The same research centre has also carried out the necessary tests for the propeller.
To obtain good working possibilities for the ship when operating in rough waters, an anti-rolling device based on the Flume Stabilization System has been installed. The necessary calculations and model tests for this purpose have been carried out by the firm John MCMullen.

3.5 Cruising range.
With a fuel oil capacity of 420 m^3 and a fresh water capacity of 86 m^3 in addition to the fresh water generator with a capacity of 2.5 tons each 24 hour, the cruising range for this ship will be about



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HYDRAULIC
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NORMO
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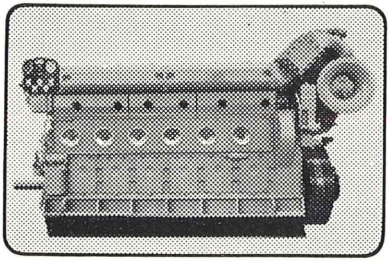
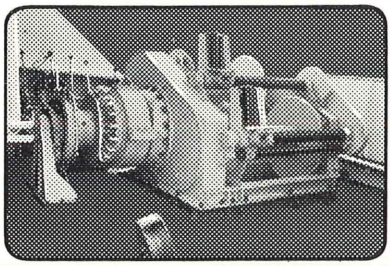
COMBINING TO MAKE G. O. SARS THE MOST VERSATILE VESSEL OF ITS TYPE



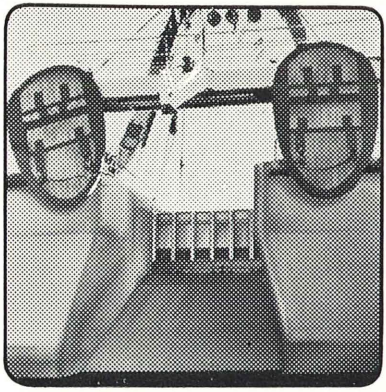
NORMO DIESEL MULTI-ENGINE PROPULSION PLANT:

4 ENGINES
TYPE LSM—6

3440 BHP.



NORWINCH LOW PRESSURE HYDRAULIC WINCH MACHINERY: (8 DIFFERENT WINCH TYPES)



BMV HYDRAULICALLY OPERATED BULLWARK GATE & FISH HATCH, PLUS OVAL TRAWL BOARDS & DERRICK SWINGER.

A.S BERGENS MEKANISKE VERKSTEDER
TELEFON 98 040 - TELEX 42133 - TELEGR.ADR.: NORWINCH - NORMO

10 000 nautical miles. This allows a medium cruising speed of 10 knots for more than 40 days.

3.6 Manoeuvering ability.

The ship is equipped with a Simplex rudder and an electro hydraulic steering engine (Frydenbø Mekaniske Verksted, Bergen), run by two separate oil pumps. The steering consol in the wheelhouse is electrically connected to the pilot valves of the steering engine pump. The steering consol is connected with the gyro compass (Anschütz), and includes an auto-pilot of the same make.

Two side thrusters, (Kamewa, 200 Hp), with variable pitchpropellers are installed fore and aft. The front thruster tunnel can be closed off at each end when not used to prevent noise which might affect the acoustic instruments. It is known that the fluctuation of water through a tunnel for a side-thruster placed in the aft ship very often disturbs the waterflow to the propeller and causes noise. To avoid this or to decrease this effect, the aft edge of the tunnel has been formed and constructed after streamline tests of the ship model.

A Deccometer and a Decca track plotter are mounted in the manoeuvering consol in the wheelhouse to facilitate manoeuvering on observation stations (see Figure 9).

3.7 Description of hull and accomodation.

The hull, and all superstructions are built of steel and all welded, except the wheelhouse which is welded aluminium. Both steel plates and steel profiles for the hull and the supestructure have been shotblasted and painted before being put into production.

The ship has two throughout decks, main deck and shelterdeck and one extended forecastle deck.

Below the main deck are the following compartments: (mentioned from the foreend of the ship):

Storeroom, forpeak and chain-locker forward of the collision bulkhead. Aft of the collision bulkhead the air conditioning plant and the side-thruster are situated. Next there is a centre divided fuel oil tank. Aft of this tank is the room for the hydroacoustic bottom equipment, (Sonar Room).

Between the sonar and the engine room there is a centre divided tank for water ballast. In this area is also located the flume stabilization tank.

At the front end of the engine room is a separate control room with the main switchboard, and the main manoeuvering and control desk.

All the bulkheads and floors which divide the control room from the engine room are insulated to reduce the noiselevel inside the control room (about 10–15 decibel below the noise-level in the engine room).

In aft part of the engine room is a separated workshop. Here is also the installation for the aft side-thruster.

Aft of the workshop there are fresh water tanks, ballast tank and fuel oil tank, all centre divided.

On the main deck there are seven different compartments divided from each other by steel bulkheads. In addition to stores, showers, washrooms, and a total of 29 single-berth cabins the following special rooms are located on this deck: electronic workshop, gyroroom, dark room, dry laboratory and a handling room for fish.

In the bulkheads between compartment 2 and 3, 3 and 4 and 5 and 6 there are installed hydraulically operated steel sliding doors. They can be operated either locally or from the wheelhouse and also from the emergency station on shelterdeck. Alarm-bells and alarm-lights are arranged at each door.

Fig. 9 View of wheelhouse

On the port side of this room there are two aluminium aquaria, and between these a double working-table. The measuring, weighing and marking of the fish is done here. There is in connection with this table a sluice through the shell plating, for sliding the fish overboard. Furthermore on the aft port side of this compartment a pressure tank for keeping fish coming up from deep waters in placed. The inside pressure in this tank can be up to 5 kg/cm^2. On the shelterdeck (mentioned from the bow) there are in addition to stores, ships workshops, 5 single berth cabins, galley and mess rooms the following special rooms: One semi-wet laboratory, one dry laboratory, two chemical laboratories, one isotop laboratory, a drawing room and a wet hydrographic laboratory. From the hydrographic laboratory a vertical well goes through the bottom of the ship. A lift in the well can be hoisted up and be secured about 1,5 meters above the floor in this room. In the bottom position which can be locked, the undermost plate of the lift is flush with the well shell-plate. This arrangement allows the mounting of scientific instruments, under bottom of the ship. As can be seen from the general arrangement drawing, the handling of the fishing gear will take place on the aft part of the shelterdeck. Midship on starboard side there is a line-hauler. Forward of the casing on starboard side is the purse seine winch, driven from the central gear winch through a dismountable shaft. This last winch is placed in the centre of the ship just behind the deck house.

Aft of the casing starboard and portside are mounted splitt trawl winches. These have a minimum pull of 18 tons. All winches are low pressure hydraulic winches (Norwinch).

On the open part of the shelterdeck there are 4 flush hatches, one to the engine room and three to the room for fish handling. One of these is hydraulicly operated and combined with the stern door.

Over the trawl slip in the aft part of the ship is a combined trawl gallow and platform. On the platform is the trawl control box. On this platform there are also three hydraulic winches for towed bodies, two with hydraulically operated gallows. On the forecastledeck there is a masthouse and a samsonpost. Two derricks, each of a lifting capacity of 3 tons, are connected to hydraulic derrick turners and derrick lifters. An instrument workshop for scientific instruments is arranged inside the masthouse. For buoys handling bottom sampling etc. there is an hydraulic winch aft of the masthouse. This winch has three drums, one for scientific purposes, and two for the cargo-runners. On starboard side is an hydraulically operated gallow. In front of the masthouse is a hydraulically operated windlass.

In the deckhouse of the extended forecastledeck is combined meetingroom/ library. Furthermore on this deck are cabins for three officers and four senior scientists. On the open part of his deck are three hydrographic winches with hydraulically operated gallows and a Triplex powerblock.

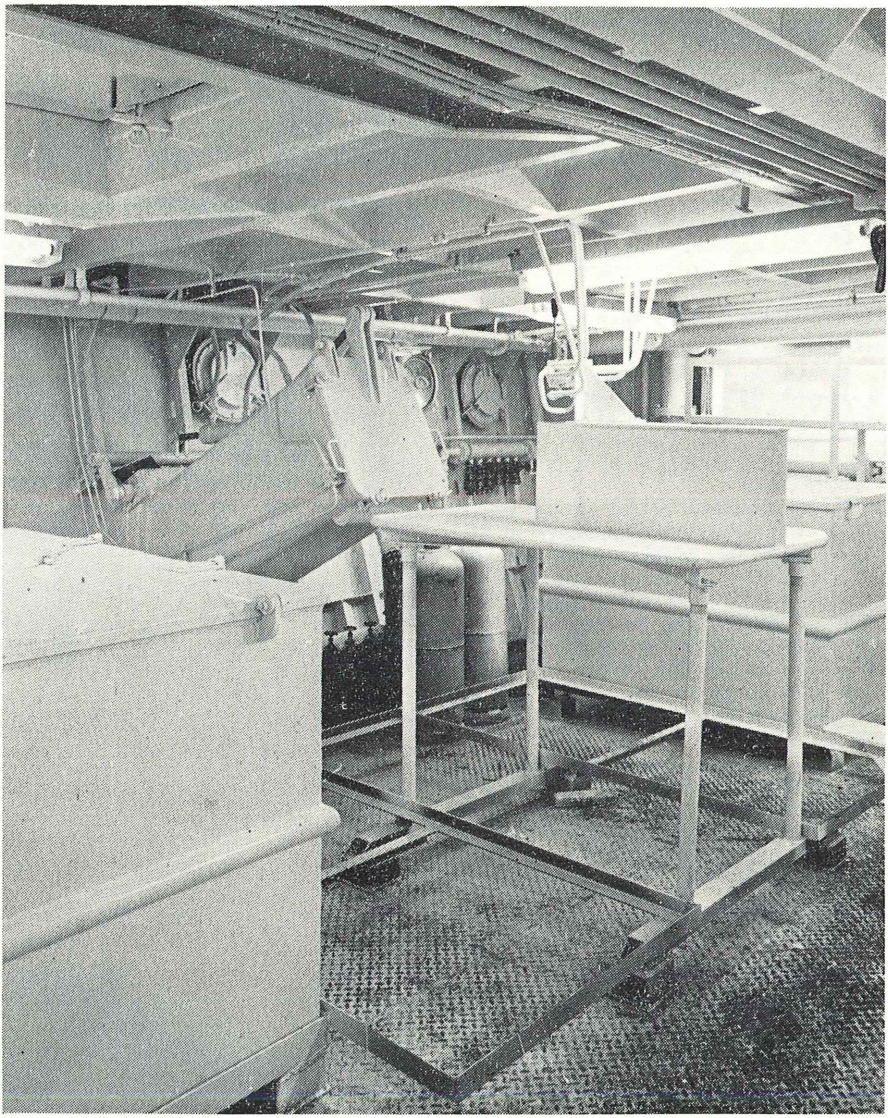
In the deckhouse on the top deck are following compartments:

Wheelhouse, chartroom, cabin for the radio operator, wireless room, room for hydro-acoustic instruments, Observations Centre and the room for the electronic computer.

Besides the hydro-acoustic equipment, scientific equipment and the electronic computer which are all described separately the following electronic equipment is installed:

1 10 cm radar, (R.C.A.)
1 3 cm radar, (Decca)
1 radio direction finder, (Plath)

Fig. 10 Fish Sampling Room, Marking Tanks, Sluice



1 radio direction finder, (Taiyo)
1 Loran, (Furuno)
1 radio transmitter, (Nera)
1 radio receiver, (Nera)
1 VHF telephone, (Nera)
1 radio telephone, (Simrad)
3 deccometers, (Kongsberg Våpenfabr.)
2 Decca track plotters, (Kongsberg Våpenfabrikk)
1 plotting table, (A.R.L., Mk X)
1 faximile receiver, (Taiyo)
1 electric log 0—16 knots, (Bergen Nautik)
1 electric log 0—8 knots, (Bergen Nautik)

Attempts have been made to keep the noise-level in laboratories and accommodations as low as possible. There are three different kinds of noise which affect people and instruments, namely: airborn noise, structural born noise and seaborn noise.
To avoid the effect of the airborn noise caused by the running machines in the engine room this room on all bulkheads in engine casings against accommodation and laboratories are insulated. The auxilliary engine and the four main engines are surrounded by insulated boxes, which are expected to reduce the noise-level with about 10 decibel. To reduce the effect of the structural born noise, the foundation for the main engines and the reduction gear has been built as a very heavy construction. All rotating machinery except main engines and reduction gear, bilges- and ballast-pumps are mounted on rubber pads.
In the engine room the shell plates in the area of the engine- and reduction gear seatings have been covered with 3 layers of iron-strengthened concrete to a total thickness of 150 mm.
The seaborn noise which affects the operation of hydroacoustic instruments is caused by the propeller and the vibrations of shellplates which again is caused by the running machinery. The propeller itself has been tested in a

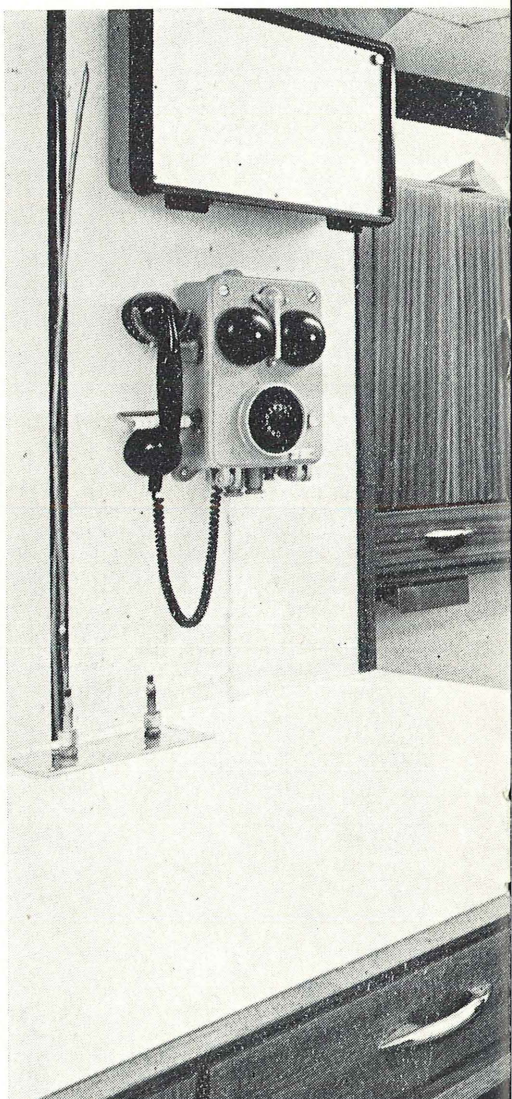
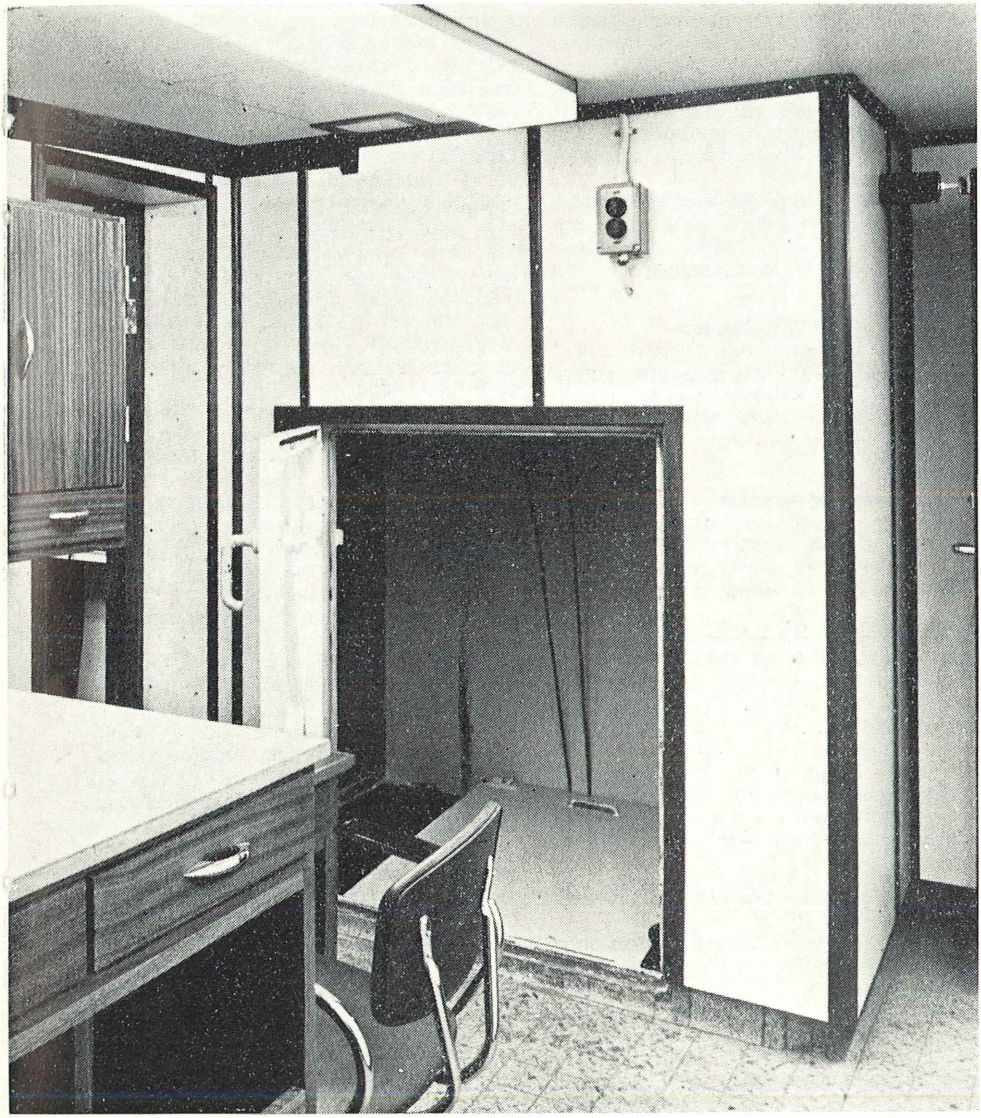


Fig. 11 Hydrographical laboratory, Well and Lift



model basin for this purpose. Special attention has also been paid to the form of the sternframe and to the clearances between tips of propellerblades and the hull. The form of the stern-tube buss has been designed in co-operation with The Ship Model Basin and the propeller manufacturer.
To avoid vibration of the shell-plates near the hydro-acustic bottom installation, the plates in this area have also three layers of concrete as described for the engine room.

4. Scientific Instrumentation.

It is not possible here to give a full description of all the scientific equipment on board. However, a brief presensentation of the more permanently installed part of the instrumentation is given below.

4.1 Acoustic instruments.

Figure 7 shows the arrangement of instruments and operational controls in the Acoustic Instrument Room. The instruments are mounted in 11 standard 19″ racks.
An analysis of the future research programs resulted in an operational requirement for four echo sounders. By selecting the working frequencies at 12, 38, 50 and 120 kHz it was possible to meet the partly conflicting requirements of long range, high resolution and simultaneous operation. Apart from frequencies the four echo sounders are all identical, having the same main features and controls.

Simrad Scientific Sounder EK12BR-12, rack no 3, d, f, g.
The sounder working at this frequency is used for continuous recording of the depth and sub-bottom examinations. With a frequency of 12 kHz useful recordings from the greatest depths can be obtained – i.e. down to 10 000 m. At this low frequency the sound energy will penetrate deep into the sea floor, giving greater information about the structure. To increase the penetrating ability even further, the echo sounder is equipped with an extra transmitter for 10 kw pulse power output. Thus 10 db increase in the source level is obtained. The transducer used for this sounder has a beamwidth of 14° anlongship and 18° athwartship.

Simrad Scientific Sounder EK38AR-38 kHz, rack no 10, d, e, f, g.
This is a "general purpose" echo sounder suitable for many tasks. Measurements of target strength will be performed with this equipment. Its amplification characteristics make a direct reading of target strength possible from depths of 3 m – 230 m.
Under normal noise conditions and sea floor structure this echo sounder will record the ocean bottom down to a depth of 3000 m. Objects of – 30 db target strength are recorded down to 750 m.
The signal-to-noise ratio may be improved by increasing the source level with an extra 10 kW transmitter.
Three different beam widths may be chosen:
a) 4,5° x 4,5°, b 4,5° x 19°, c) 40° x 4,5°. (Beamwidths are alongship and athwartship respectively). This transducer is mounted on a stabilized platform which eliminates roll and pitch improving the correlation between successive echoes.

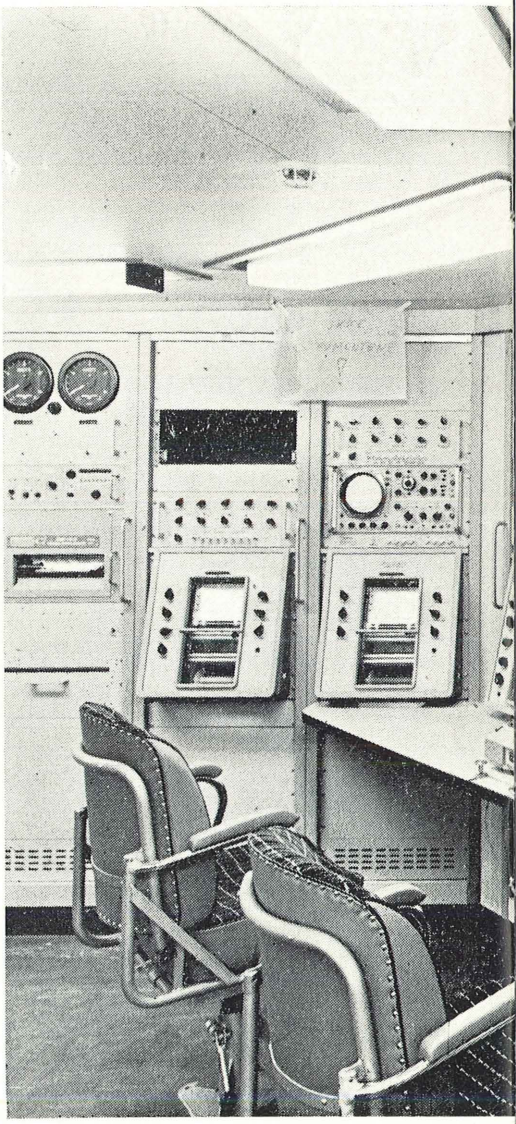
Simrad Scientific Sounder EK50AR- 50 kHz, rack no 8, d, e, f, g.
The echo sounder will be employed mainly in an attempt to identify the targets. For this purpose it is of great importance to measure target strength in in an easy manner.
The frequency 50 kHz was chosen partly because of the requirement for high resolution and partly to be able to use a transducer of reasonable size. The transducer beamwidth is 25° x 5° or 25° x 10° optional (alongship x athwartship).

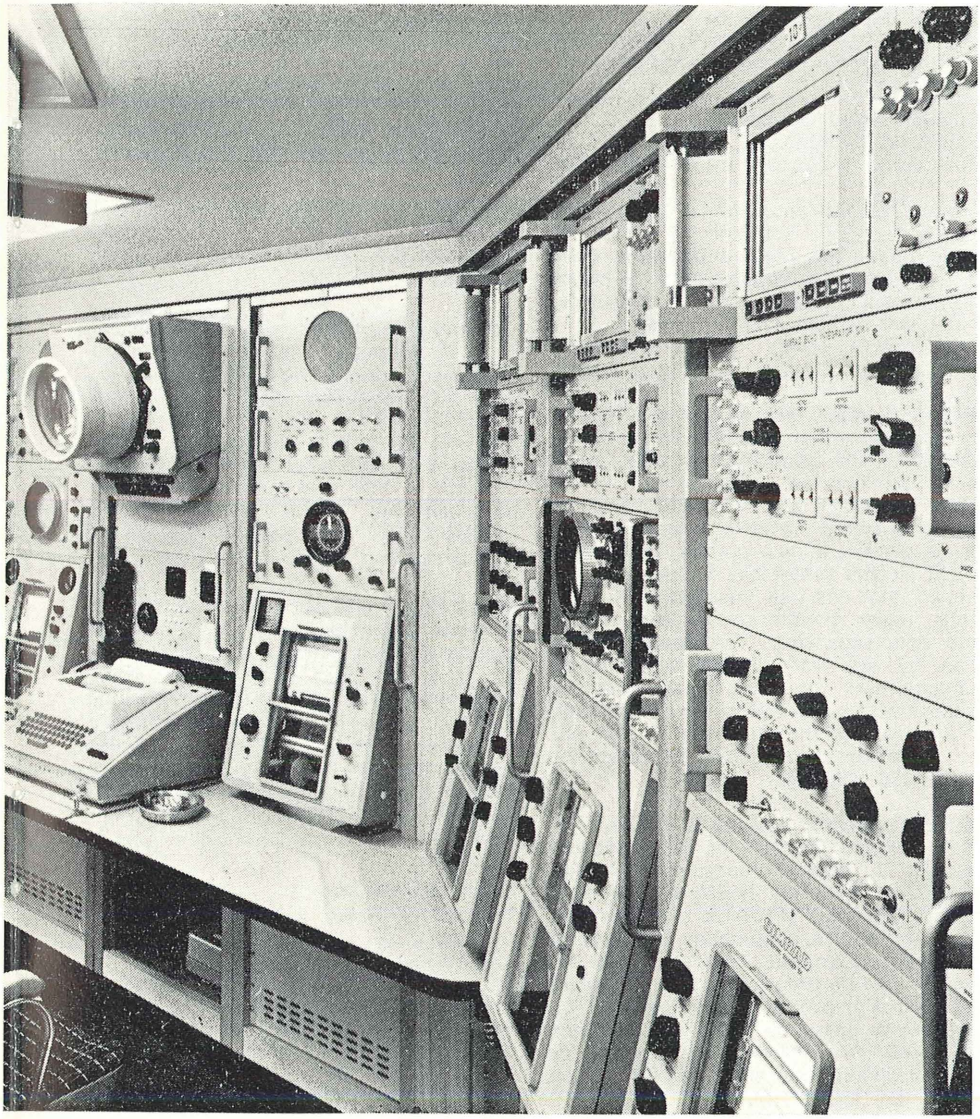
Fig. 7 Acoustic Instrument Room

Simrad Scientific Sounder EK120AR-120 kHz, rack no 4, b, e, f, g.
When high resolution is the main requirement this echo sounder should be employed. The depth resolution is 10 cm when using a pulse length of 0,1 m sec. The transducer has a beam width of 4°. With normal noise and bottom conditions the sea floor may be registered down to a depth of 1000 m. A target with a target strength of −30 db may be recorded at a depth of 400 m.
The transducers for the 50 kHz sounder and the 120 kHz sounder are mounted on the same stabilized platform. The 38 kHz transducer is mounted on a separate stabilized platform. All echo sounder transducers are mounted in two blisters on the hull to reduce noise.

Simrad Survey Sonar SU-18 kHz, rack no 7, a, b, c, d, e, f, g.
This is a long range sonar, which at 15 knots is able to detect schools with target strength of 0 db at 3000-5000 m under favourable sonar conditions. 18 kHz was chosen to favor the long detection range, and at the same time avoid interference from the echo sounders. The transducer is installed in a streamlined retractable dome designed for an operational speed of 20 knots. The transducer is stabilized against the roll and pitch of the ship. Together with azimut stabilization this increases the detection ability. Transducer beam width are: 12° x 10° or 12° x 20° in the horizontal and vertical planes respectively.
The control panel for the stabilized transducer is placed in rack no 1, d.

High Frequency Sonar-120 kHz.
This sonar equipment is employed at close ranges (1–500 m) and has a range resolution of 10 cm. The transducer is tiltable from 5° upwards to 90° downwards, and the beamwidth is 4° (circular). Display units consists of a paper recorder and a PPI scope.





Simrad trawl eye, rack no 11.
This is a trawl-sonde arranged for both surface-looking and down-looking sounding.

Supplementary equipment.
Stabilized platforms.
The echo sounder transducers are mounted on platforms which is stabilized against the roll and pitch of the vessel, allowing ± 20° roll and ± 7° pitch. Even under the most unfavorable conditions, the total angular error between the transducer axis and the perpendicular will be less than 3° (rms).
The control panels for the stabilized platforms are situated in rack no 1, e, f.

Echo integrator, rack no 8, 9 and 10, a,b.
In order to obtain quantitative measurements of the registered signals, each echo sounder can be connected to an echo integrator with a special recorder which presents the voltage received during a predetermined interval. The instrument on this vessel has 6 channels, this means that one can integrate in 6 different layers simultaneously and record the data separately. The depth interval can be set from 0–200 m on each channel and the total interval can be shifted within a 0–500 m vertical interval. The output of the integrator is also fed to the vessel's centralized computer for automatic logging.

Special recorder, rack no 2, c, d, e, f.
For detailed studies of the received echoes a special recorder (Precision Graphical Recorder (PGR) or Precision Depth Recorder (PDR) is available and can be used in conjunction with any of the echo sounders. This additional recorder can be programmed for recording of echoes at various depth intervals. The recording paper is 11″ wide. A rack mounted 11″ recorder was chosen for this installation but any type of PGR and PDR may be incorporated.

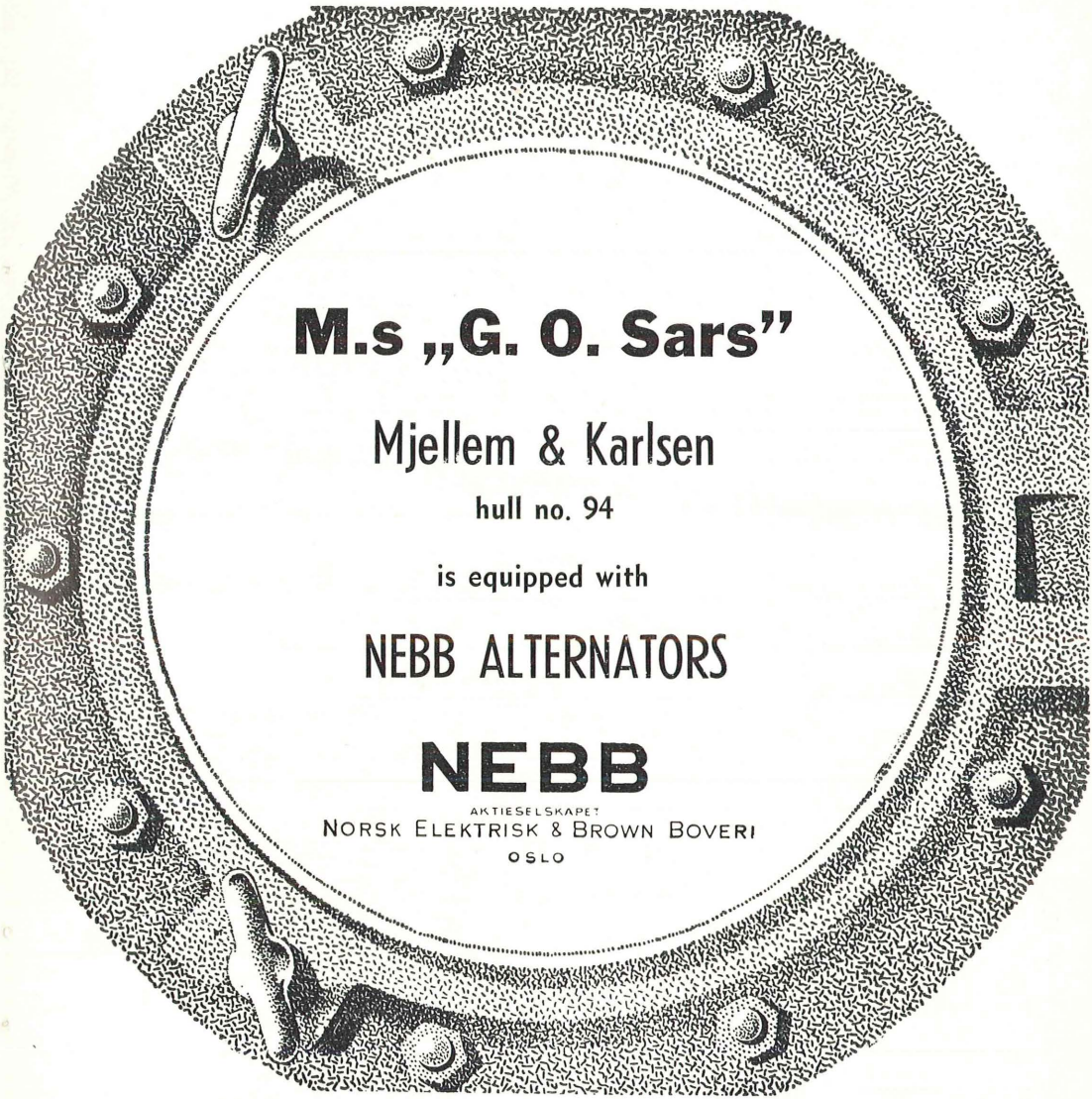
Oscilloscopes, rack no 4 and 9, c, d.
The echo sounders can also be connected to a storage oscilloscope which is used as a "scale expander" for detailed studies of echoes at a chosen depth interval. This method is used for determining the target strength of a particular object.

One of the two permanently installed oscilloscopes can also be used for calibration of the echo sounders and sonar equipment.

Calibration equipment, rack no 1, a, b, c.
The permanently installed calibration equipment permits the operator to measure the sensitivity, source level and directivity pattern of the search equipment. In addition to the standard instruments the calibration equipment also includes a test hydrophone which can be positioned in the desired location relative to the echo sounder and sonar transducers.

Digital Depth Indicator, rack no 3, b.
A digital depth indicator is available for remote depth indication and to provide the computer data system with depth information. The digital depth indicator has 3 displays located in the Acoustic Instrument Room, Chart Room and the Hydrographical Laboratory. The depth is displayed with 3 digits. The digital indicator may be connected to any of the sounders.

Other instruments:
Transmitter Pulse Suppression Unit – rack no 1, g.
Log Panel – rack no 2, a, b.
Radar – rack no 6, a, b.
Intercom – rack no 6, e, f.
Teleprinter – rack no 6, g.
Tape Recorder – rack no 9, h, i.
Gated Signal Detector and Computer Interface Unit-rack no 11, a.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4.2 Facilities for use of fishing gears.
Two main requirements have formed the basis for the design and arrangements of the vessel with regards to its adaption to fishing operations viz: 1) that unit operations, single hauls or sets can be performed with an efficiency and a catching power comparable to commercial operation, and 2) that the four main fishing gears: bottom trawl, mid-water trawl, purse seine and bottom long line, can all be used at any time and with a minimum of switch-over delay. It is clear, however, that the vessel could not be designed for continuous effective fishing operations, the main obstacle to this being lack of deck space for handling gear.

4.3 Other sampling and measuring devices.
Facilities have been made for convenient sampling of small organisms with a number of other gears.
Different types of sondes, U.W. cameras etc. will be operated from the aft cable winches. A Besset Berman TSD sonde model 9040 with 3000 m cable will be operated from the large starboard winch which also carries one drum with 7000 m wire for Nansen bottles.
Fixed sensors are installed for continuous measurements of temperature, salinity and water transparency of the surface water. There are water intake also for autoanalyser and planktonsampling. Devices for continuous measurement of several meteorological parameters are included.

4.4 The Computer System.

The ship is equipped with an on-line computer system which enables automatic data collection and also makes further processing of the data possible while at sea. A block diagram of the data system is shown in Figure 12. The computer is a NORD-1 machine with 16 bit word length, full parallell operation. 7 programmable registers, 16 priority interrupt levels, memory cycle time of 1.7 μ sec. hardware floating point arithmetic and a 16 K core memory. Pheripherals include three teleprinters, two paper tape punches, a paper tape reader, a drum plotter, a 24 channel multiplexer with a 12 bit analog-to-digital converter and a spesial fast 10 bit analog-to-digital converter. Figure 13.

Various instruments are connected to the computer and give analog or digital inputs. The computer controls the logging of the different parameters, performs signal averaging and converts the electrical output signals from the instruments to physical units.

The readings are partly monitored by a real time clock and partly by the ship's log. On hardware interrupt from the real time clock Decca position and meteorological observations are read. The logging of the ship's course and speed, temperature, salinity and transparancy in the surface layer are governed by interrupts generated by the ship's log. Further echo depth and six echo integrators are read on log interrupt.

A special feature of the data system is the processing of hydroacoustic data. Very fast sampling of the envelope of the fish echo is done, the sampling rate is close to 50 kHz. This sampling is monitored by hardware interrupts from the echo sounders.

On hydrographic stations the computer will perform on-line sampling of signals from the TSD-system and convert these signals to temperature, salinity and depth simultaneously with the lowering of the probe.

The data system has also facilities for reading of bouy data (current, temperature, conductivity and depth) which are recorded on magnetic tape in the bouy instruments.

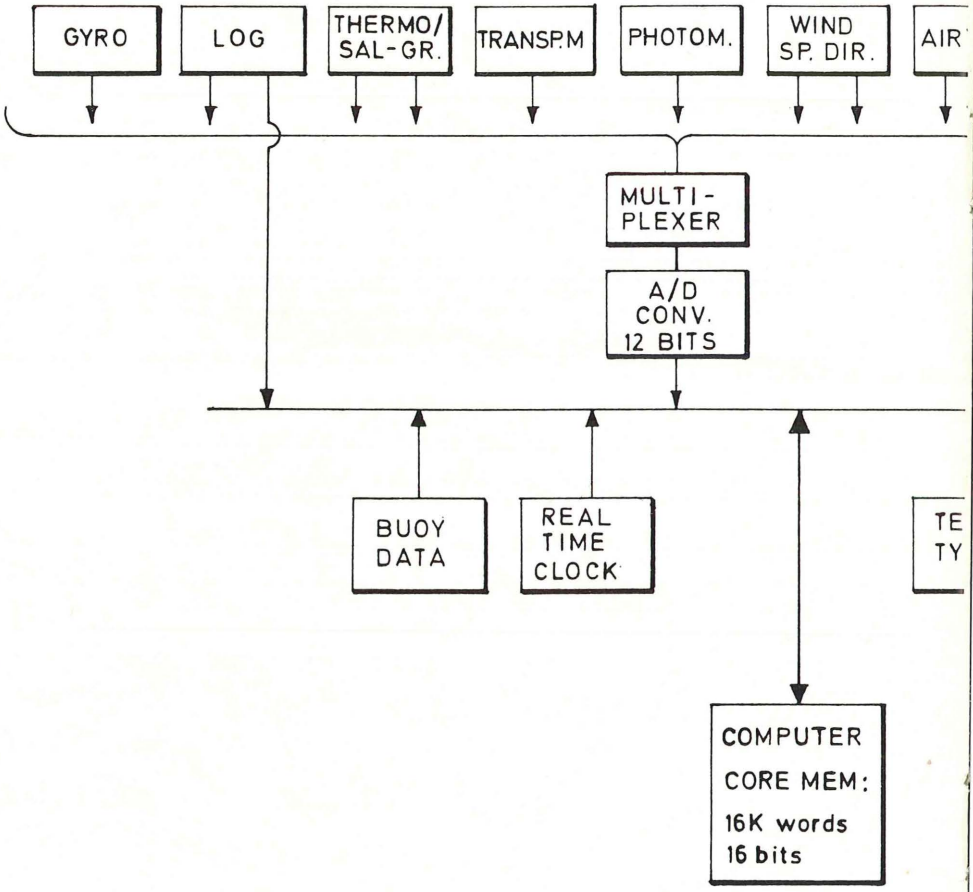
The various real time programs of the on-line system are operated in a multiprogram mode monitored by the computer's priority interrupt system. Programs for processing of the data have lower priority than sampling activities, and they are initiated by software interrupts from the priority levels where the sampling is done.

Among other things the on-line processing undertakes convertion of the hyperbolic Decca coordinates to geographical positions. The position of the ship may also be updated from an initial fixed position by dead reckoning. Measured wind speed and direction are corrected for ships speed. From echo integrator data the amount of fish per unit surface is computed. Prosecing of charateristics of single fish echoes are utilized for classification or identification of the echoes.

The lowest priority interrupt level can be used for off-line processing when the computer is not busy with real time programs on higher levels. Examples of such off-line work are routine computations on hydrographic, chemical or biological data, plotting of charts and so on.

The complete on-line system is programmed in assembly language, but for off-line purposes FORTRAN can also be applied.

Fig. 12 Block diagram of Data System



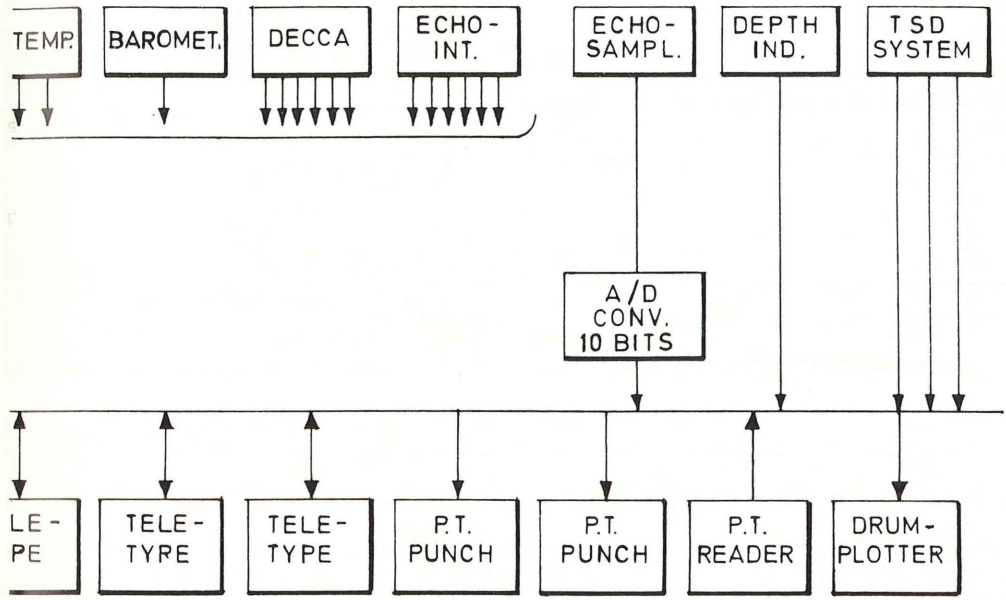
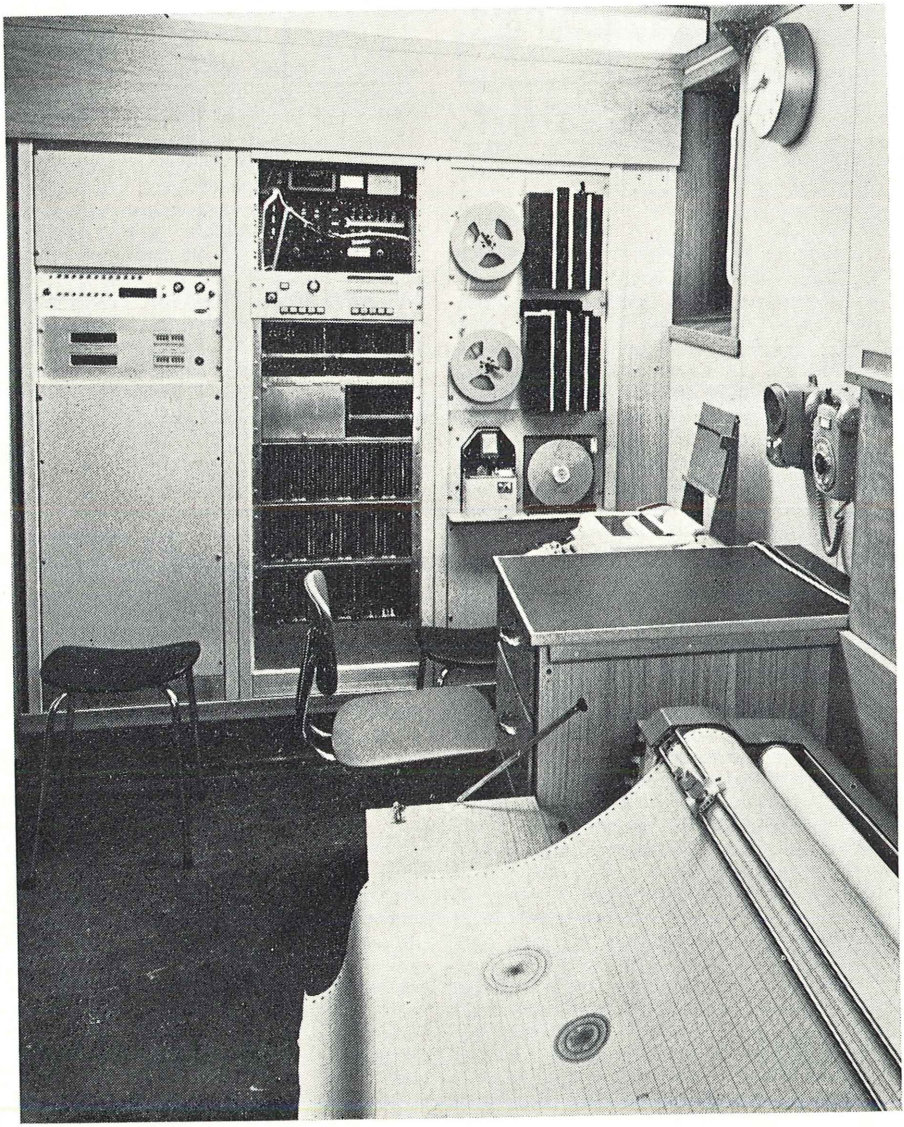

TEMP.
BAROMET.
DECCA
ECHO - INT.
ECHO - SAMPL.
DEPTH IND.
TSD SYSTEM
A/D CONV. 10 BITS
LE - PE
TELE - TYRE
TELE - TYPE
P.T. PUNCH
P.T. PUNCH
P.T. READER
DRUM - PLOTTER

Fig. 13 Data Center



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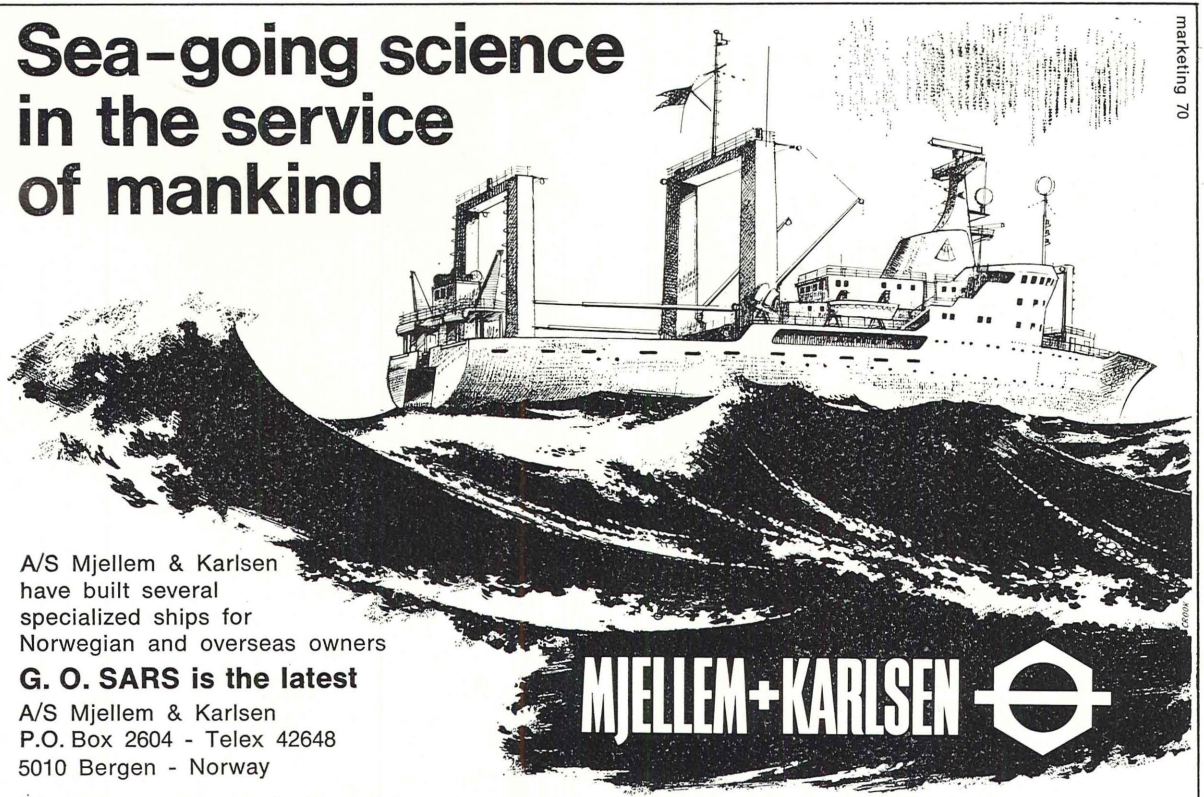

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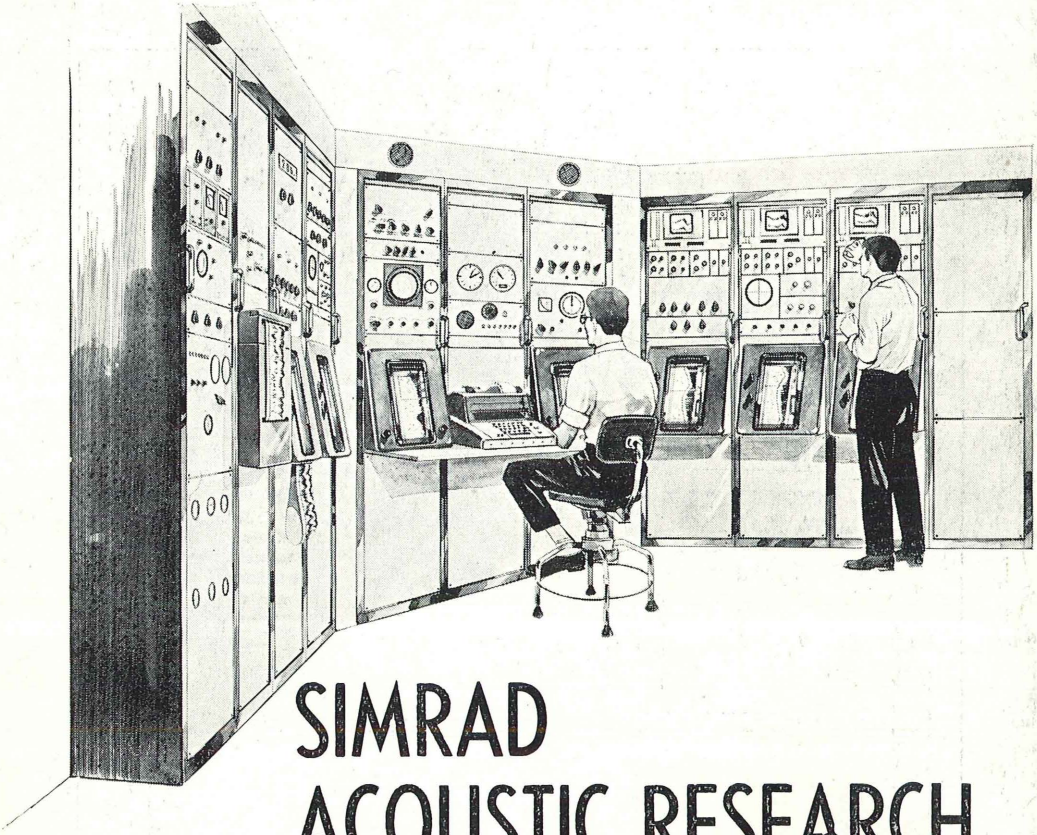

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