FLORIDA ATLANTIC UNIVERSITY

Research Ships of Opportunity Program

PROJECT NEPTUNE ATLANTIC

Charles R. Stephan

Harrison A. Hoffmann

Boca Raton, Florida

RESEARCH SHIPS OF OPPORTUNITY PROGRAM

PROJECT NEPTUNE ATLANTIC
FINAL REPORT

This work was sponsored by

OFFICE OF NAVAL RESEARCH
Project NR 104-896
Contract Nonr 4834(00)(01)

Submitted by

Charles R. Stephan
Principal Investigator

Department of Ocean Engineering
Florida Atlantic University
Boca Raton, Florida 33432

May 1968

PROJECT NEPTUNE ATLANTIC
Final Report

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

ABSTRACT:

In July 1965, a scientific party from Florida Atlantic University, Boca Raton, Florida and General Motors Defense Research Laboratory, Santa Barbara, California conducted "Project Neptune Atlantic" using a mobile "Sea Van" laboratory on board the SS EXPORT CHAMPION on its regular cruise from New York to Genoa, Italy. This was the second phase of the Office of Naval Research "Research Ship of Opportunity" project. Its objective was to test the FEASIBILITY of gathering plankton samples from a high speed merchantman (19½ knots) and conduct biological experiments on living organisms at sea. Data for temperature profiles using expendable bathythermograph systems and concurrent navigational, oceanographic and meteorological information also were recorded. Problems associated with power for the laboratory, high speed Jet Net towing equipment, vibration and congestion in the Van during biological laboratory experiments were encountered but the project was successful in carrying out its basic objective. The overall operational costs were low. Cooperation between the scientific party, ship's crew and participating agencies was excellent. This project demonstrated the FEASIBILITY of the RSO concept for obtaining oceanographic data from ships of opportunity, but highlighted limitations associated with gathering and processing living specimens at sea on board fast merchantmen. Future RSO projects should be run as scientific experiments to determine the levels of performance attainable from RSOs.

LIST OF FIGURES

LIST OF FIGURES
(continued)

LIST OF TABLES

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of the many persons who helped make Project Neptune Atlantic possible, but especially wish to recognize the following: Dr. Clinton Maag, Life Sciences Officer of the U. S. Naval Missile Center, Point Mugu, California; Dr. William A. Aron of General Motors Defense Research Laboratory, Goleta, California; Dr. Sidney Galler and Dr. Helen Hayes of the Office of Naval Research for their help and guidance in planning the project; Mr. Frank Carneghe, Electronics Engineer, General Motors Defense Research Laboratory for his cheerful attitude and outstanding work installing, operating and maintaining our equipment; Cadets Richard Brooks, and Brian Starer of the U. S. Merchant Marine Academy who donated their annual leave time to participate in our project; the Captain, officers and crew of the SS EXPORT CHAMPION for their help at sea; the Commander of the U. S. Navy Submarine Squadron at Rota, Spain for the emergency repairs made to our equipment during our short stay at that port; Captain G. R. Miller, Line Operations Officer and the American Export Isbrandtsen Lines for the services of the SS EXPORT CHAMPION; the U. S. Naval Oceanographic Office, and the Sippican Corporation for their technical assistance and support during the project; and, finally, to Mrs. C. Taylor, Secretary, Ocean Engineering Department, Florida Atlantic University, for her patient hard work preparing the many drafts and the final report of this project.

PROJECT NEPTUNE ATLANTIC

FINAL REPORT

Office of Naval Research Project
Nonr 4834(00)(01)

I Preface

1. The objective of Project NEPTUNE ATLANTIC was to determine the feasibility of gathering and processing biological specimens at sea using a mobile laboratory on board a Merchantman during regular operations of that ship. It is a part of an Office of Naval Research general project to test the "Research Ship of Opportunity" concept. In this concept, RSOs are being tested to determine whether they can augment and supplement the limited U. S. oceanographic fleet by utilizing U. S. Merchantmen as economical platforms for oceanographic and biological research. Mobile laboratories placed aboard RSO ships are intended to be used without interfering with the ship's normal operation or schedule.

2. Background

In the fall of 1964, the first 'pre-feasibility' test of this RSO concept was conducted by scientists from the U. S. Navy Missile Test Center, Point Mugu, and the Defense Research Center, General Motors Corporation during a cruise of the SS JAVA MAIL from Seattle, Washington to Hong Kong, B. C. This phase, called 'Project Neptune' was successful in determining that oceanographic data and biological samples could be gathered and stored in a mobile laboratory carried on board an RSO at sea for later processing and experiments ashore. Reports prepared by Dr. Clinton H.Maag, Life Sciences Officer, USN Missile Test Center, and Dr. William Aron of the GM Defense Research Laboratories, Santa Barbara, California, described this phase of the RSO project in detail.

The second phase, Project Neptune Atlantic, is reported herein. It was conducted by a scientific party from Florida Atlantic University, Boca Raton, Florida, and the General Motors Defense Research Laboratory, Santa Barbara, California. The American Export Isbrandtsen Line ship SS EXPORT CHAMPION was used for the project during July 1965, on a regular cruise from New York to Genoa, Italy. Figure 1 shows the Sea Van Laboratory at Florida Atlantic University before the cruise. Figure 2 shows the Van on board the SS EXPORT CHAMPION.

II Objectives

1. The objectives of Project Neptune Atlantic were:

   a) To demonstrate the FEASIBILITY of gathering specimens from a high speed ship (19½ kts.) and perform biological experiments at sea on living specimens so obtained.

   b) To gather associated oceanographic data.

   c) To perform these tasks from a mobile van laboratory on board a high speed U. S. Merchantman using only such ship equipment that would not interfere with its normal operation or schedule.

2. To execute these objectives, a Mobile Science Laboratory similar to that used in the Pacific phase of Project Neptune was air-shipped from the U. S. Navy Missile Test Center, Point Mugu, to FAU at Boca Raton by a Marine cargo transport aircraft. It was refurbished, equipped and outfitted at Florida Atlantic University as a biological and scientific oceanographic laboratory. Figure 3 shows the Van on arrival at Boca Raton. Figure 4 was taken during the Van overhaul. Figures 1, 5, and 6 show the Van used on board the American Export Isbrandtsen Line SS EXPORT CHAMPION ready for use to meet the objective of the project.

3. In greater detail, the project's aims included:

   a) Design, equipping, transporting, loading and operation of a mobile van laboratory on board ship.

   b) Biological sampling tests from a high speed (19½ kts.) merchant ship.

   c) The primary scientific objective was to conduct biological experiments to provide estimations of viability of the samples gathered by a towed Jet Net and, where possible, to measure the oxygen consumption of selected

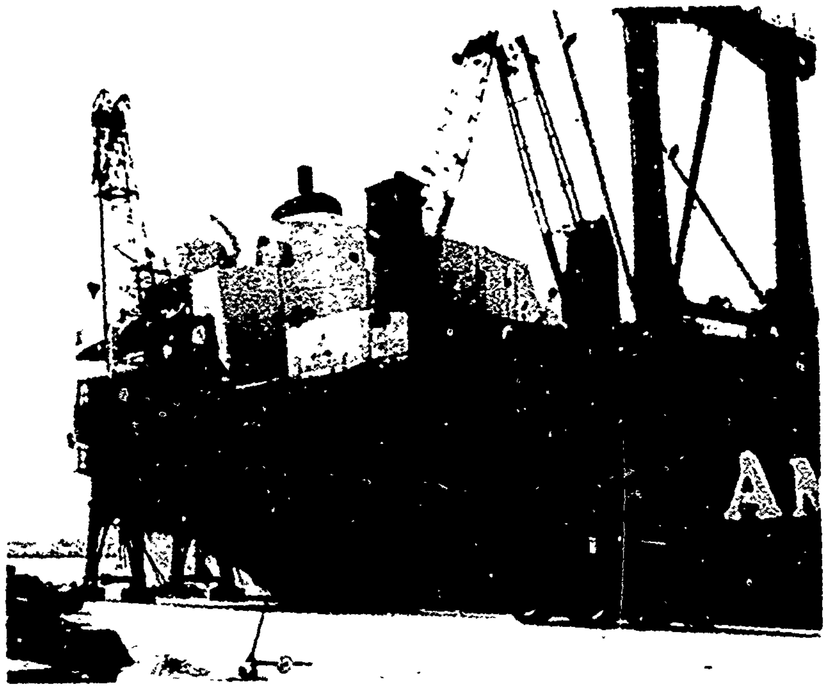


Figure 1 - Sea Van Laboratory at Florida Atlantic University
before cruise

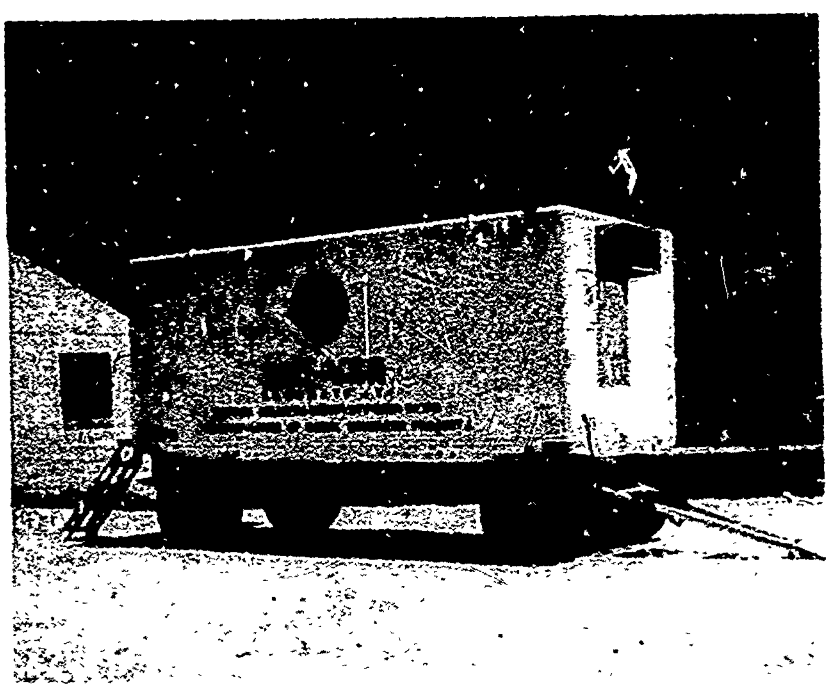


Figure 2 - "Sea Van" in position on board SS EXPORT CHAMPION

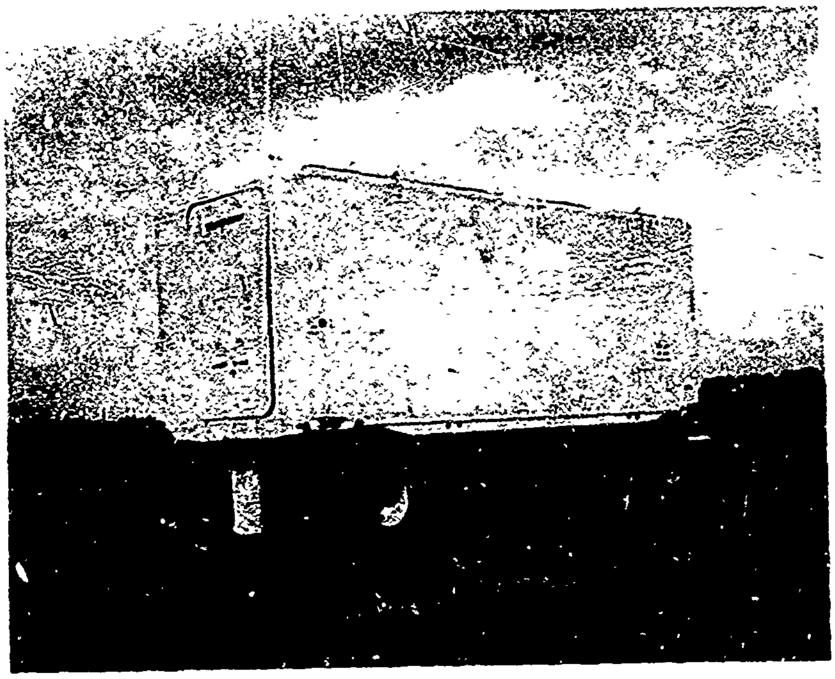


Figure 3 - Mobile Van Laboratory on arrival at Florida Atlantic University, Boca Raton, Florida in March 1965.

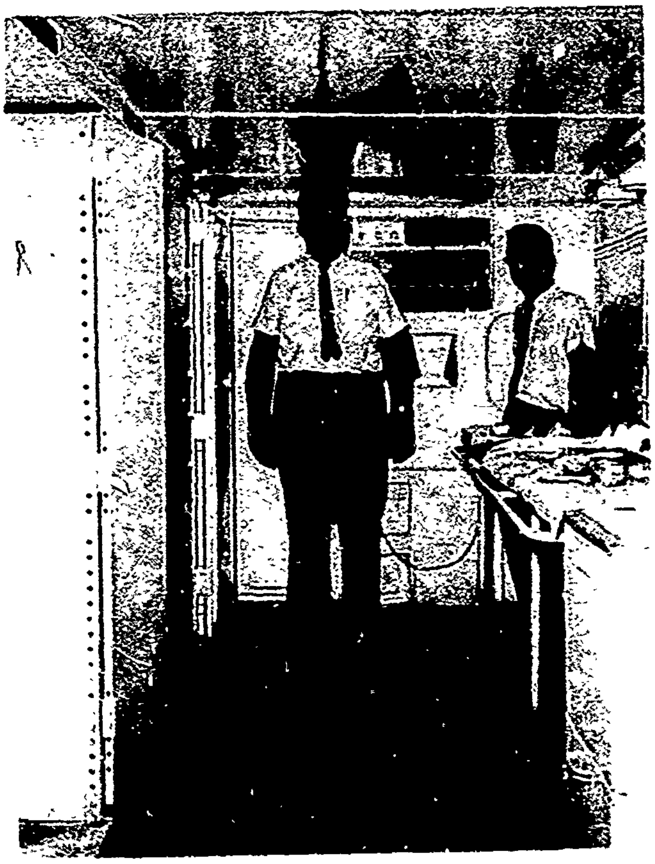


Figure 4 - Van interior during overhaul and refurbishing in April 1965. Mr. Stephan, Project Leader and Dr. McAllister, Professor of Oceanography (FAU) are shown.

Figure 5 - Interior of Van showing equipment being secured before Van transport to SS EXPO. CHAMPION at Hoboken, N. J. View looking forward starboard side.

Figure 6 - Van interior looking aft late in cruise. (Boxes were stowed in right hand corner to the overhead on departure.

types of zooplankton.

4. Project tasks in support of the objectives included:

   a) The development of ocean temperature-depth profiles using expendable bathythermograph systems with readings taken at regular intervals throughout the cruise and during Jet Net towing periods.

   b) Obtaining concurrent surface temperature data using a bucket thermometer.

   c) Obtaining continuous sub-surface temperature readings from temperature probes in the main injection line to the engine condensers.

   d) Obtaining continuous salinity readings from conductivity probes placed in the main injection to the ship's condensers.

   e) Recording concurrent navigation and meteorological data.

   f) Tests of digitized taper in the GMDRL expendable BT recording system.

   g) Tests of various rigging arrangements for biological sampling by Jet Net at speeds up to 19½ kts. Tests of various towing positions for Jet Net.

   h) Personnel utilization studies to ascertain best composition of scientific or technical parties for future RSO cruises.

   i) Study of scientific party-ship relationships, problems and procedures associated with ship operations and utilization.

   j) Cost analysis.

III Personnel

1. The Scientific Party consisted of:

   Mr. Charles R. Stephan, Project Leader; Chairman, Ocean Engineering Department, Florida Atlantic University.

Responsibility: Coordination and project direction, administration, planning and personnel matters.

Dr. Harrison A. Hoffmann, Biological Associate; Associate Professor of Microbiology, Florida Atlantic University. Responsibility: Planning, execution and reporting of biological experiments.

Mr. Albert F. Kellum, Jr., Student Assistant; Student in Biology Department, Florida Atlantic University. Responsibility: Assistant to Dr. Hoffmann.

Mr. Frank C. Carnaghe, Electronics Engineer; General Motors Defense Research Laboratory, Santa Barbara, California.
Responsibility: Electrical-electronic installation, maintenance and repair of Project Neptune equipment.

All members, plus two U. S. Merchant Marine Academy cadets assisted in taking data during the cruise.

2. Two U. S. Merchant Marine Academy cadets were assigned to the Project Neptune team by the Captain of the SS EXPORT Champion. They were Richard Brooks and Brian D. Starer, both Cadets, Third Class, U. S. Merchant Marine Academy, Kings Point, Long Island, New York. These young men volunteered to make the cruise and participate in the project during their summer leave period. Their services were requested and arranged by the American Export Isbrandtsen Steamship Lines. Cadets Brooks and Starer were good seamen who provided outstanding service in rigging, revising, and operating the towing rigs for Jet Net operations throughout the cruise. They also assisted in oceanographic data gathering for the project, operating expendable BT systems, recording and assembling data throughout the cruise. Figure 7 shows the scientific party and Merchant Marine Cadets with the Captain and Chief Engineer of the SS EXPORT CHAMPION.

3. All hands in the party participated when Jet Net tows were made. The cadets manned the towing winches. The remaining members of the party handled the Jet Nets and deck gear.

4. A regular watch, excluding the biological group, was maintained for routine expendable BT and oceanographic readings which were taken every four hours during the cruise.

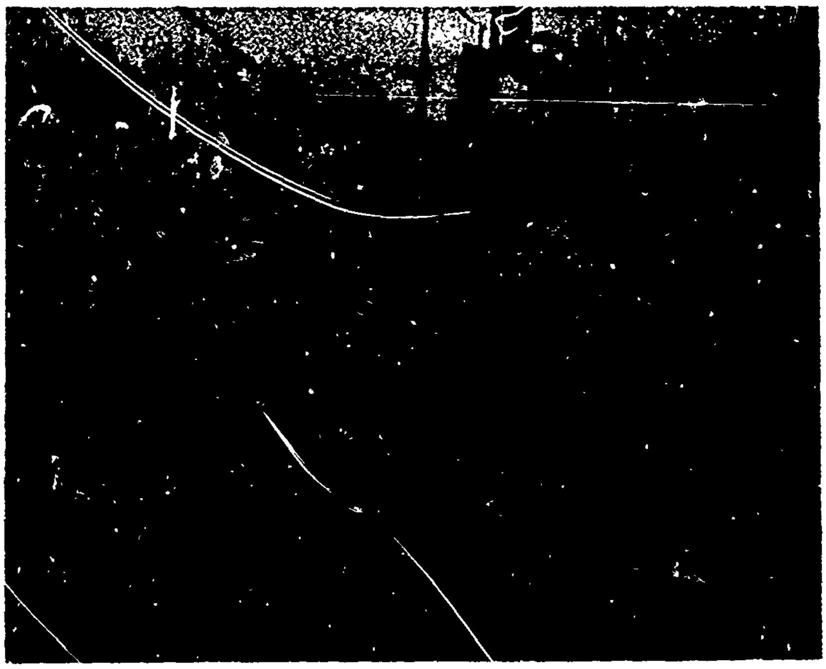


Figure 7 - Scientific Party, Merchant Marine Academy Cadet Assistants and Ship's Officers.

L to R: Ch.Engr. O'Reilly, Dr. H. Hoffmann (FAU), Cadet Starer (USMMA), C. Stephan (FAU), A. Kellum (FAU), Capt. Kelcline, SS EXPORT CHAMPION, F. Carnaghe (GMDRL), Cadet Brooks (USMMA)

5. Mr. Carnaghe maintained all electronic gear. He repaired the engine room conductivity and temperature recorders when they failed during the cruise.

IV Equipment

1. All equipment used during the project with the exception of the SIPPICAN recorder was installed or stowed in the van at Florida Atlantic University prior to departure for the cruise. A detailed list of this equipment is shown in Table I. Expendable supplies carried for the trip, which also were stored in the van, are listed in Table II.

2. Major equipment used during the project is described below:

   a) The high speed Jet Net plankton sampler is shown in Figure 8. Figure 9 shows the Jet Net and its depressor just prior to streaming. The Jet Net is described in detail in the "Primary Evaluation of the Jet Net" report by Dr. William D. Clarke, Senior Research Oceanographer, General Motors Defense Laboratory, Santa Barbara, California.

   b) 1500' of 3/8" wire rope was used to tow the Jet Net. The tow wire, traveling lizard inhaul and Jet Net hanging from the boom are shown in Figure 9.

   c) Two Expendable Bathythermograph Thermometer (BT) systems were used during the cruise. They were operated independently and no attempt at a comparative evaluation was conducted or should be implied. They were:

      (1) GENERAL MOTORS DEFENSE RESEARCH LABORATORY SYSTEM which consisted of a recording console, Figure 10, which had a digitized recorder in the base of the console as part of its recording system, a projector, Figure 11, and 65 expendable BTs manufactured by the Packard Electric Company. An expendable BT is shown swung outboard in the "Ready" position in Figure 12. This system recorded temperature in degrees Farenheit to depths of more than 1000'.

      (2) A SIPPICAN EXPENDABLE BATHYTHERMOGRAPH SYSTEM also was used which consisted of a projector,

TABLE I

EQUIPMENT USED ON PROJECT NEPTUNE ATLANTIC

DESCRIPTION

VEHICLE

Sea Van (Figures 1, 6 and 7)

Description:
- 4 wheel
- Length - 20'
- width - 8'
- height - 11'
- weight - 16,000 lbs (approx.) loaded
- wheel base - 170"
- Navy No. - USN 97-17143
- Manufacturer - Western Electric Company, New York
- Purchased (by Navy) 1952
- Manufacturer's Serial - T-33-241
- Status - Loaned to Florida Atlantic University under Office of Naval Research Contract None 4721(00)
- Van received from Naval Air Missile Test Center, Pt. Mugu, California on 1 March 1965.

MAJOR EQUIPMENT

1 box laboratory tools (forceps, scissors, needles, etc.)
1 stage micrometer
2 syringes (1 small and 1 large)
1 Hemacytometer
5 x ocular and 2 small light bulbs
12 clamps
4 test tube racks
1 pipette rack
2 microscope slide cases
4 tins of air-dryer silica gel
1 alcohol lamp
3 wash bottles
1 test tube drying rack
1 small pan
5 canisters of Petri dishes
1 centrifuge
48 plastic bottles

TABLE I (continued)

1 pH meter
1 thermos bottle
1 plastic tray
1 oven
3 plastic buckets
1 metal beaker
2 ring stands
8 clamps
2 5 gal carboys of distilled H_2O
1 pump (pressure-vacuum) with trap and hose
1 refrigerator
2 aquaria with accessories
1 electric stirrer
2 banks of fluorescent lights
1 flood light
1 heater and stirrer (magnetic)
2 microscope lights
1 Nikon microscope
1 Stereomicroscope (Bausch & Lomb)
1 clock timer
3 bottle brushes
2 sponges
2 battery jars, 8 x 8
1 specimen dish, 8 x 3
4 stainless morton closures
2 stools
1 Electric Console GM Defense Research Laboratory, 5' x 2½' x 2'
1 GM Bathythermograph projector stand GM Motors Defense Research Laboratories
1 Jet Net (GM Defense Research Laboratories) and accesories
2 depressors plus accessories (GM Defense Research Laboratories)
1 voltage regulator, portable
1 electronic console (Sippican Corporation)
1 Sippican bathythermograph projector
1 conductivity meter and accessories in Engineroom (Navy Oceanographic Office)
1 portable salinity test set (Navy Oceanographic Office)
1 reel 1500' 3/8" wire rope, tow wire (Conviber)
1 box shackles, clamps, swivels, thimbles, etc., for tow wire
1 aluminum Boat Hook
2 life vests
3 sets foul weather gear, medium
1 200W soldering gun
1 set high speed drills, 1/16 to 3/8"
1 set (opc) wood bit set
1 pair wire snippers, 14"

TABLE I (continued)

1 clamp on vise, 2¼" jaws
3 flashlights
1 6 volt fisherman's lantern
2 3 wire #14, 50' extension cords
1 clock
1 10' x 10' tarpaulin
1 Propane torch kit
1 3/8" electric drill
1 tool box with miscellaneous tools
1 staple gun
1 pencil sharpener
1 stapler
1 11M-305 bucket thermometers
3 suction flasks (millipore filter)
1 16 mm DL70, Bell and Howell Camera, Serial D61381, with 1", 17 mm and 75 mm lenses and filters
1 35 mm Miranda camera (Japanese), Serial 670499 Florida Atlantic University #11
1 Stenorette dictation machine recorder
1 charger for Stenorette
5 rolls Stenorette tape
1 hunting knife and scabbard
1 Arisco Park stop watch

TABLE II

EXPENDABLE SUPPLIES

USED IN PROJECT NEPTUNE ATLANTIC

1 box chemicals and small glassware
2 boxes of Hypodermic needles
2 boxes of microscope slides
1 box cover glasses
2 1/10 ml. Meas. pipettes
1 spotting dish
2 boxds of chemicals
2 boxes of glass bottles
1-1 liter graduated cylinder
56 test tubes and corks, stoppers and caps
1 box crystallization dishes
3 cans of Petri dishes
1 box vials (12)
1 pr surgeons gloves
1 box containing: 4 flasks, 5 beakers, 4 graduate cylinders (2-100; 1-50; 1-24), 1 thermometer,f fluorescent tubes
1 box centrifuge tubes
1 box electrodes for pH meter
1 can Solox
1 bottle pH7 buffer
1 can Alconox

1 box glassware (flasks and beakers)
1 thermometer
3 canisters of pipettes
1 canister of capillaries
3 glass electrodes
1 pint of ethanol
200' 21 thread 1/2" manila line
1 coil 6 thread 1/4" manila line
1 #1 spool rosin core solder
2 pts. penetrating oil
1 tube silicone rubber
1 32 oz. can isl-xtool dip, red
1 gal. SAE 40 oil
6 rolls scotch electric tape,88
1 doz. "D" batteries
1 6 volt lantern battery
1 pkg. assorted nails, 1 #3d, 2 #6d, 3 #10d
3 Cowhide gloves (prs.)
50 lbs. rags
3 padlocks and keys
2 propane cylinders
Miscellaneous stationery and writing supplies
17 boxes - 65 expendable bathythermographs
10 rolls, 16 mm Kodachrome Type A
5 rolls 35 mm Kodachrome Daylight film
1 box millipore filters

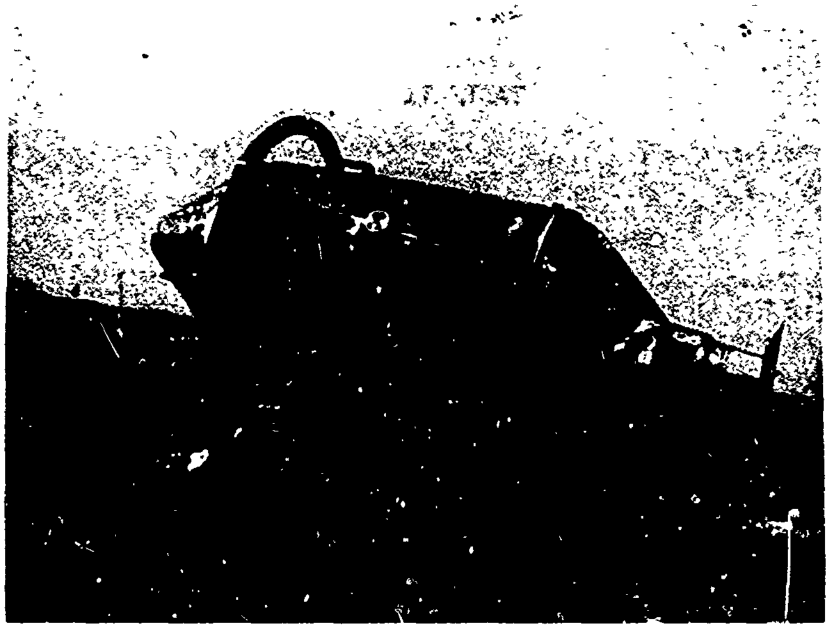


Figure 8 - GMDRL Jet Net

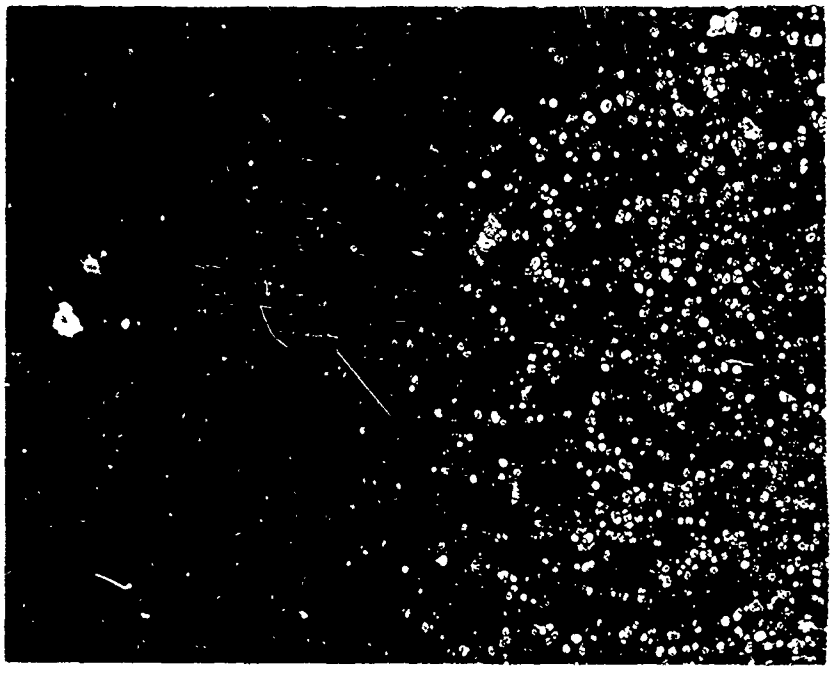


Figure 9 - Jet Net and depressor ready for streaming.

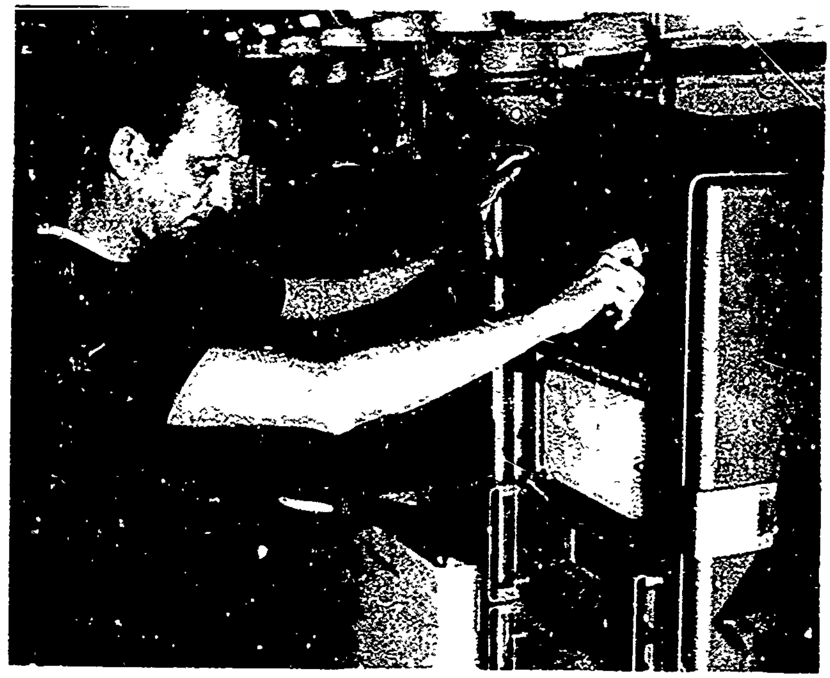


Figure 10 - GMDRL Expendable BT Recording Console

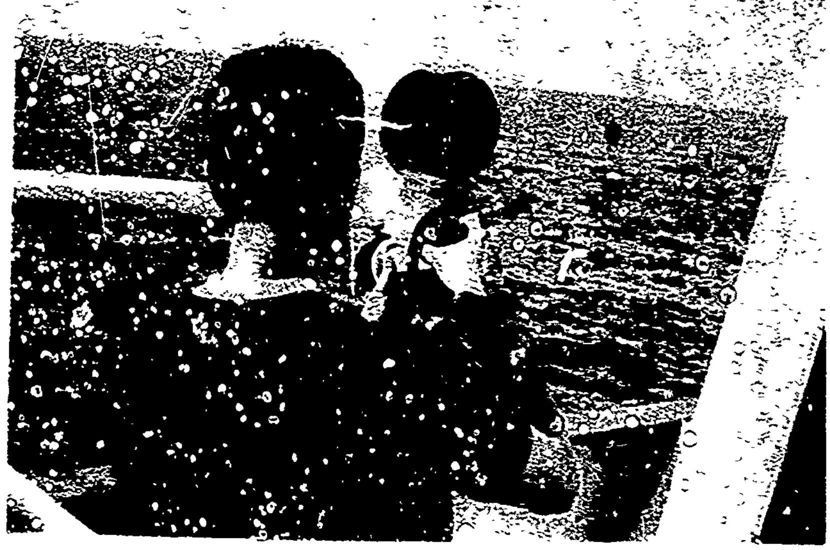


Figure 11 - Loading the GMDRL projector with a Packard Electric Expendable BT

Figure 13, and a recording console, Figure 14. Loading of one of 35 Sippican expendable BTs used during the cruise is shown in Figure 15. This system recorded temperature in degrees Centigrade to depths in excess of 1000'.

d) Laboratory biological test equipment was installed in the Sea Van Laboratory as shown in Figures 16, 17, and 18. These were used for the biological experiments during the cruise, reported in paragraph VI(4) of this report.

e) Continuous salinity measurements were made using a Foxboro recorder with a conductivity probe installed in the main injection line to the ship's main condensor. Salinity was computed from conductivity and temperature readings from the Foxboro recorders.

f) Continuous temperature recordings were made on a Foxboro recorder using a temperature probe installed in the main injection line. The installation included a special flange plate to hold the conductivity and temperature probes and a water sampling spigot, as shown in Figures 19 and 20.

g) A RS-7A portable salinometer test set, manufactured by the Scientific Instrument Corp., was provided and installed in the engine room by the Oceanographic Office as shown in Figure 19. This was used to check the Foxboro readings for salinity measurements. The total installation of Foxboro recorders, portable RS-7A Salinometer test set, main injection line flange, probes and fittings were assembled and installed by the Instrumentation Laboratory of the Navy Oceanographic Office, Washington, D. C.

h) A hand-held bucket thermometer was used to obtain sea surface temperatures.

i) An isolation transformer to convert 220 volt, 3 phase AC to a 220-110 volt, 3 wire system with a neutral ground was installed in the van to provide a safe power supply in the Sea Van laboratory while on board the SS EXPORT CHAMPION.

j) Photographic records were made by a 35 mm still camera supplied by FAU and a 16 mm motion picture camera.

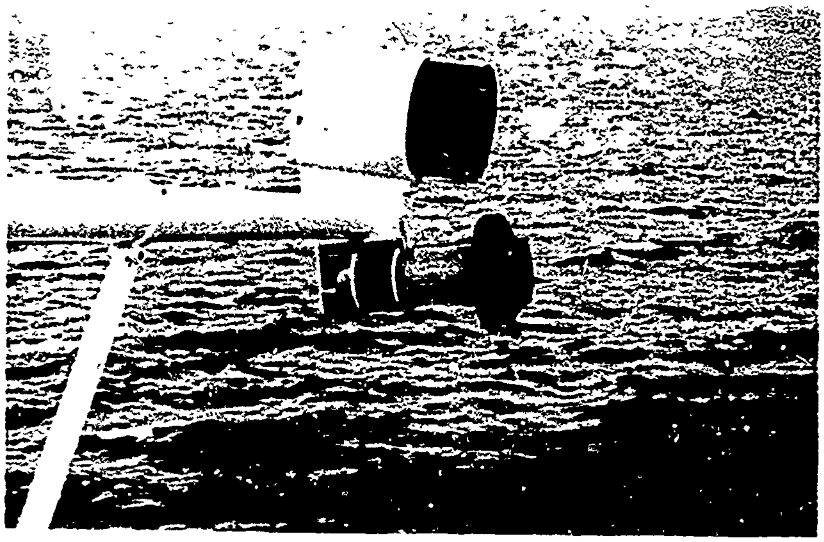


Figure 12 - GMDRL Projector with Packard Electric Expendable BT.

Figure 13 - SIPPICAN Expendable BT projector.

Figure 14 - Sippican Expendable BT System Recording Console.

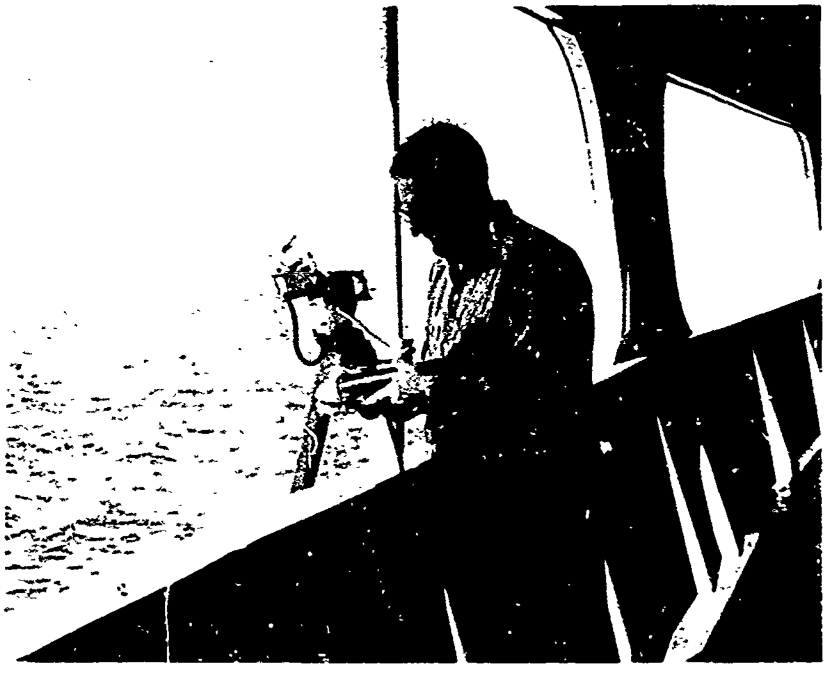


Figure 15 - Loading Sippican expendable BT into projector.

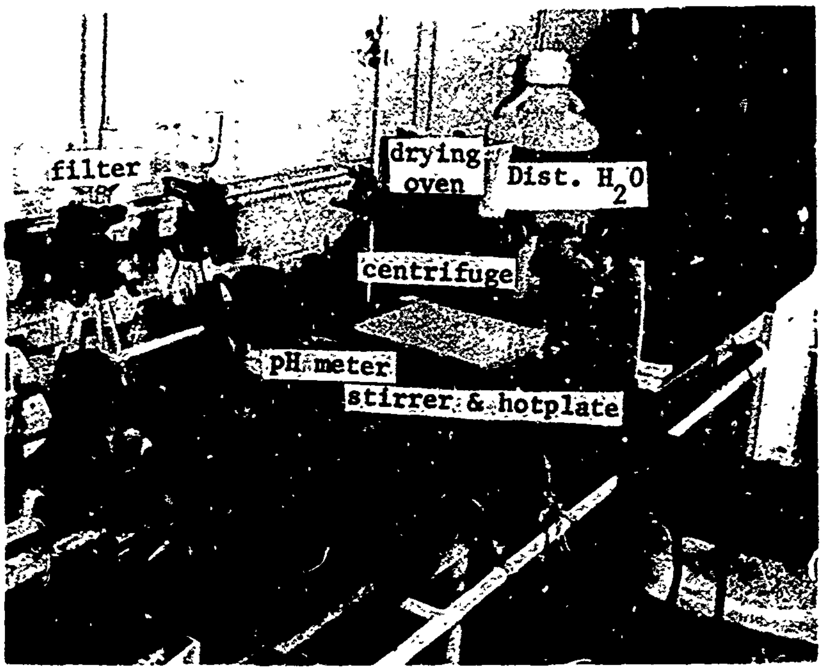


Figure 16 - Biological Laboratory Equipment in Van.

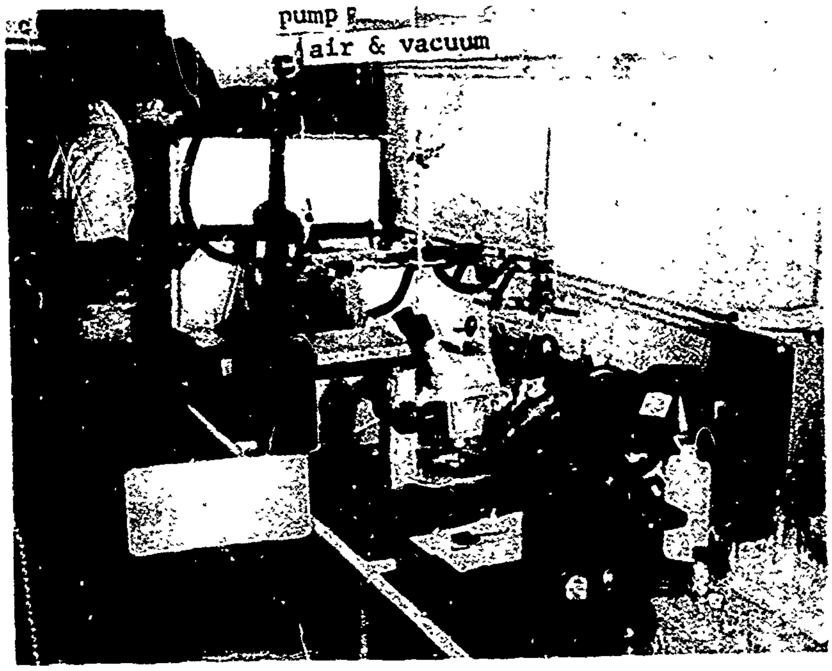


Figure 17 - Biological laboratory equipment in Sea Van.

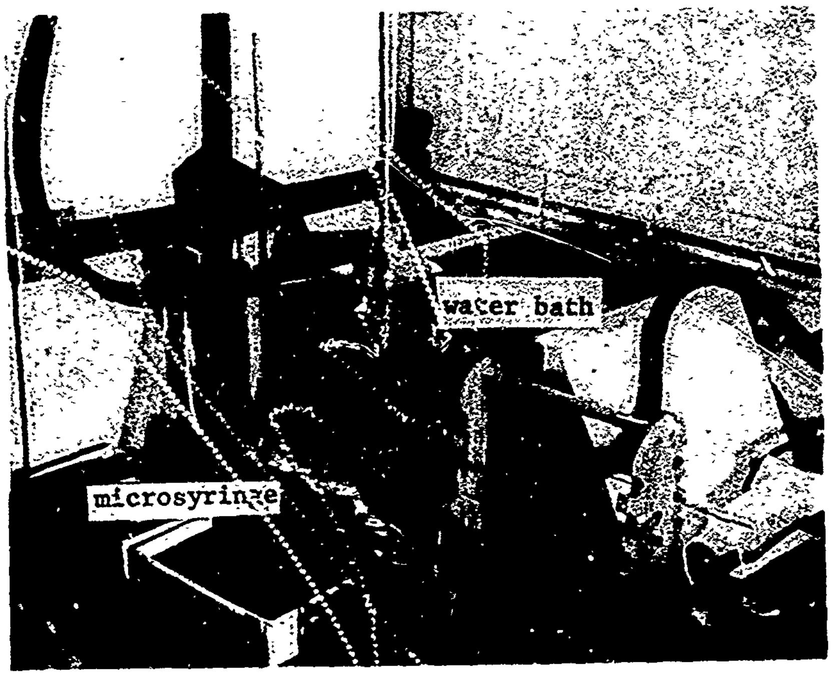


Figure 18 - Biological laboratory equipment in Sea Van.

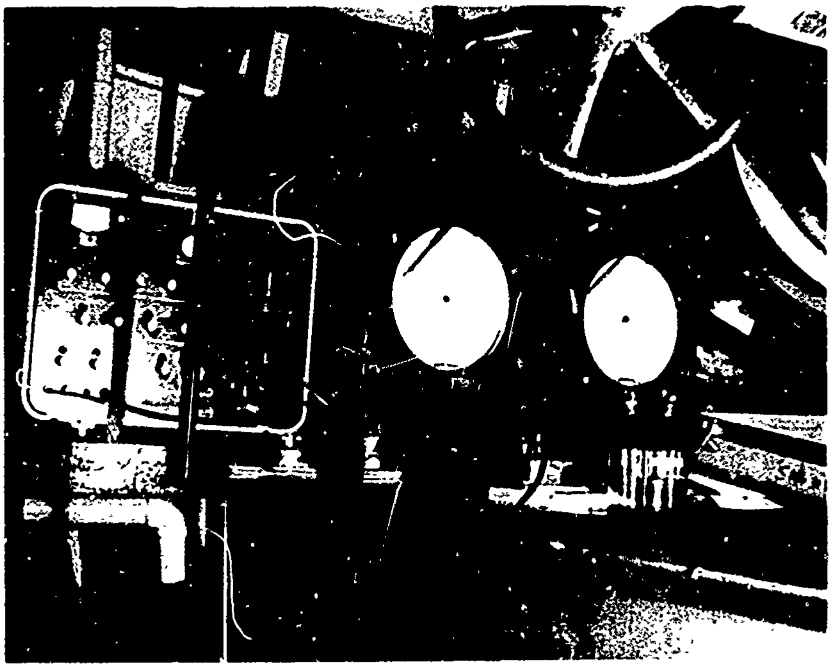


Figure 19 - RS 7A Portable Salinometer Test set (left), Foxboro temperature and conductivity recorders for salinity installed in SS EXPORT CHAMPION engine room. (NODC Installation)

Figure 20 - Water sampling spigot (top), temperature and conductivity probes in specially made flange in Main Injection line to ship's condenser (NODC installation)

A 16 mm documentary film of the project operations was made during the cruise.

k) Miscellaneous records, supplies and expendable equipment listed in Table II were carried and utilized during the cruise.

V Cruise Preparations

1. Proposal

After the successful completion of the pre-feasibility tests in the Pacific in the fall of 1964, discussions were held with Dr. Galler and his associates in the Office of Naval Research relative to a second phase of the RSO project to be held in the Atlantic in the summer of 1965. Reports of the Pacific phase prepared by [1]Dr. William Aron of the General Motors Defense Research Laboratory, Santa Barbara, California, and a preliminary report on Project Neptune, prepared by Dr. Clinton Maag, Mr. William E. Evans, and J. Clifford Broman of the U.S. Navy Missile Test Center, were reviewed. Based on these reports and additional information supplied by other participants in the Pacific cruise, Florida Atlantic University submitted a proposal on February 15, 1965, to conduct the second phase of the RSO project, a feasibility test of the RSO concept in the Atlantic Ocean, during the summer of 1965. The Office of Naval Research assigned a project with task number NR 104-896 to Florida Atlantic University.

2. Receipt of Van

Planning was started for the cruise to start in June or July 1965. A mobile Science Van Laboratory provided to FAU on a previous ONR equipment loan contract was shipped to Boca Raton in March 1965. Figure 4 shows the Van on its arrival. Modifications, overhaul, and refurbishing are shown in Figures 5 and 6.

3. Plans

A series of biological experiments were planned by Dr. Harrison Hoffmann, Biological Associate for the project to test the feasibility of measuring oxygen consumption

[1]"Ships of Opportunity Program, Preliminary Feasibility Study" March 1965, Dr. W. Aron, GMDRL

of selected specimens of zoo-plankton that could be gathered by use of the high speed Jet Net biological sampler. After tests were outlined, orders were prepared for the purchase, loan or manufacture of equipment to perform them. Jet Net biological samplers were supplied by the General Motors Defense Research Laboratory, Santa Barbara.

4. Shipline Negotiations

Inquiries were made to various Atlantic Ocean ship lines regarding space and services for the scientific party, Van and project equipment. Advance planning dates were established. Several ship lines responded. A final choice had to be made between the Moore-McCormack Lines who offered services in a new 21 knot merchantman with passenger accommodations during a cruise to North European ports in June 1965, and the American Export Isbrandtsen Line which offered a choice of two 19½ knot merchant ships with crew accommodations during cruises between New York and Mediterranean ports in June and July. After consideration of the schedules, a shipping strike involving the Moore-McCormack Steamship Line, and the possible effect of the high 21 knot speed on Jet Net sampling in the Moore-McCormack ship, the American Export Isbrandtsen ship SS EXPORT CHAMPION was chosen. A cruise from New York to Genoa, Italy from July 9-26, 1965 was selected. Throughout these negotiations, both ship lines were very cooperative and helpful. This cooperation continued throughout the planning period and cruise operations.

5. Purchase Orders

Purchase orders were prepared for equipment and supplies during March and April and suppliers alerted to insure early delivery. Orders were ready in early May. Contract delays postponed their execution until June 7, 1965. Execution of orders, follow-ups, and last minute substitutions made June extremely hectic. However, all major pieces of equipment, materials and supplies were received by July 1, installed or stored in the van, and final preparations made for shipment of the van to Hoboken, New Jersey where the EXPORT CHAMPION would load between July 7 and 9, 1965.

6. NODC Preparations

Concurrent with the above, representatives of the U. S. Navy Oceanographic Office visited a sister ship of the EXPORT CHAMPION to obtain measurements for fabrication of the continuous recording conductivity and temperature equipment together with specifications for the manufacture of a flange plate housing for the temperature and conductivity probes in the main injection line. The installation in the EXPORT CHAMPION (Figures 19 and 20) was made by NODC personnel during that ship's visits to East Coast ports in early July.

7. The General Motors Defense Research Laboratory expendable BT console projector and electronic equipment were shipped from Santa Barbara to Boca Raton and installed in the van by Mr. Carnaghe in June 1965. The Sippican BT equipment was shipped to New York and installed in the Sea Van while at the Hoboken pier on 7 July 1965. The Sippican BT equipment was shipped to New York and installed in the Sea Van while at the Hoboken pier on 7 July 1965.

8. Van Transportation to Port of Embarkation

Last minute receipt of several important pieces of biological test equipment made final preparations hectic, but all equipment was installed or stored in the Sea Van for transportation to New York by July 1, 1965. The Van was loaded on a low-boy trailer at Boca Raton for shipment to Hoboken, New Jersey on July 2, 1965. It could not be towed on the road for long distances because of weak tires and an inadequate towing bridle. It was shipped with wheels on. Experience showed that it would have been wiser to remove the wheels from the van before shipment, (Figure 21), and stow the Van on board ship without wheels attached.

9. Travel

The three members of the scientific party from FAU departed from Boca Raton on July 5th and met with Mr. Carnaghe of the General Motors Defense Research Laboratory in Hoboken, New Jersey on July 6th.

10. Pierside Operations

The Sippican Expendable BT equipment was installed in the

Figure 21 - Van on low bed trailer with wheels removed. (During shipment from Pt. Mugu to El Toro, California, March 1965) (Recommended for future transportation.)

Van at Pier A, Hoboken, New Jersey on July 7, 1965. Power for the air conditioner and preliminary testing of equipment was provided to the Van from a 3 wire single phase 220 volt system while awaiting loading at the pier.

11. Loading and Securing the Van

Due to cargo loading delays and in-port schedule changes, the Sea Van was not loaded on board the EXPORT CHAMPION until the morning of July 9, 1965, the sailing date. Loading operations and details of securing the van on board are shown in Figures 22 - 28. The deck position for the van, designated by the ship's First Mate, was the best position possible for the work to be performed. A space abaft the deckhouse was considered but insufficient clear space was available to accommodate the van. A position farther forward would have interfered with cargo handling operations. In the position chosen there was no interference with ship's work even from the after-hold #6 which was adjacent to the van's position. Access to the van was never blocked in port or at sea.

The van was secured to the deck as shown in Figures 24 - 27. There was no shifting of the van during the cruise. Vibration was a problem even though the van stood on inflated tires on deck. Under certain conditions the vibration appeared to be accentuated through the tires. The amount of vibration within the van varied with the loading conditions of the ship. Vibration hampered laboratory biological work on specimens when microscopes were used. Electronic gear installed in the van was not adversely affected by the ship's vibration. There was no noticeable effect on the van from rough seas since none occurred during the cruise.

12. Electrical Difficulties

When the Van was installed on deck, the power was run to the Van. Ship's power had been previously described as 3 wire, single phase, 220 volt, similar to that used on the pier and at FAU. However, on connecting power to the Van on the ship, it was found that the ship's power system was 3 phase 220 volt. Both this and the ship's service 110 volt system were grounded to the ship. Initial checks showed that when hooked up normally, all electrical equipment in the Van was ungrounded and potentially dangerous.

Figure 22- Loading preparations at Pier A, Hoboken, N. J.
Hoisting bridle being lowered into position.

Figure 23 - Sea Van being positioned on deck. Hoisting bridle attached.

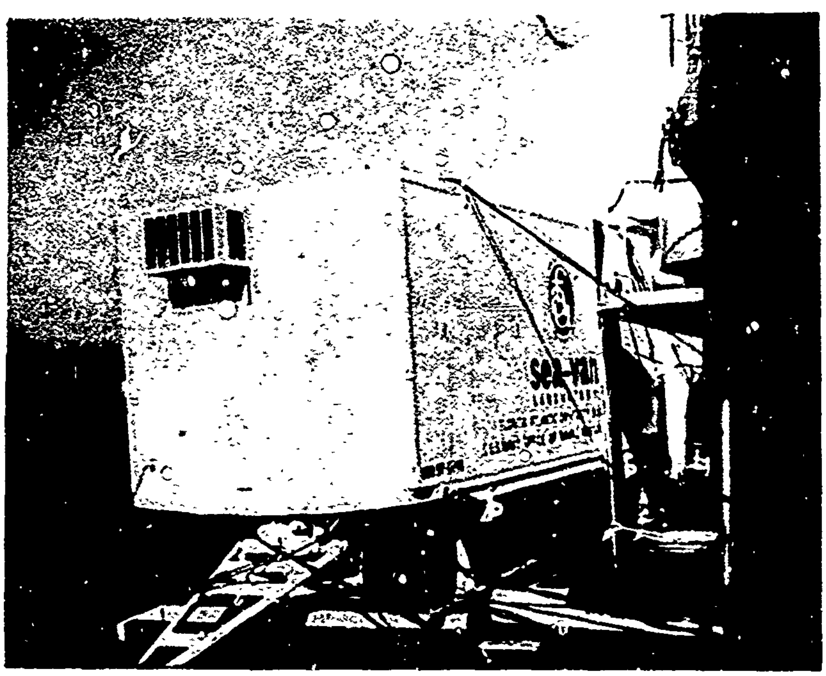


Figure 24 - Sea Van secured on deck of SS EXPORT CHAMPION

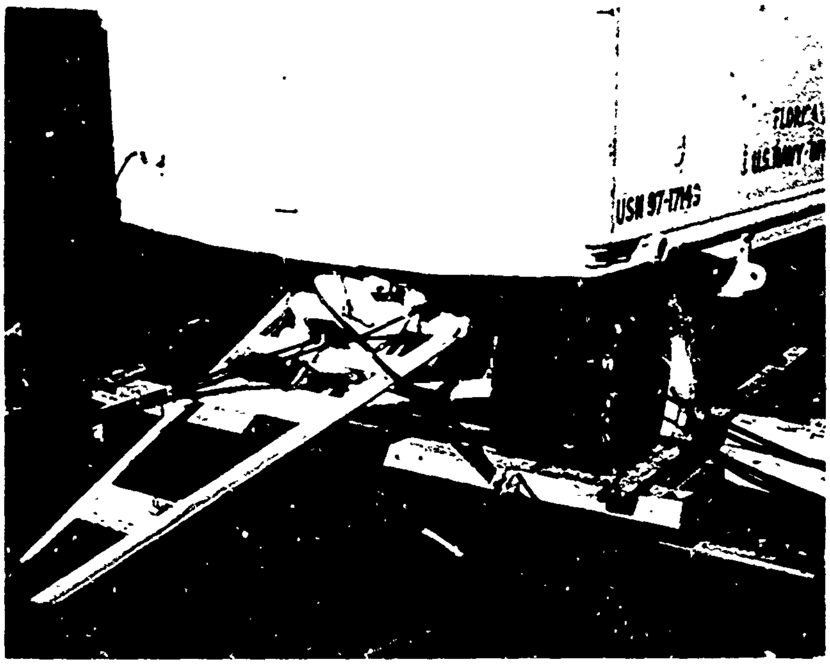


Figure 25 - Securing details. Front wheels.

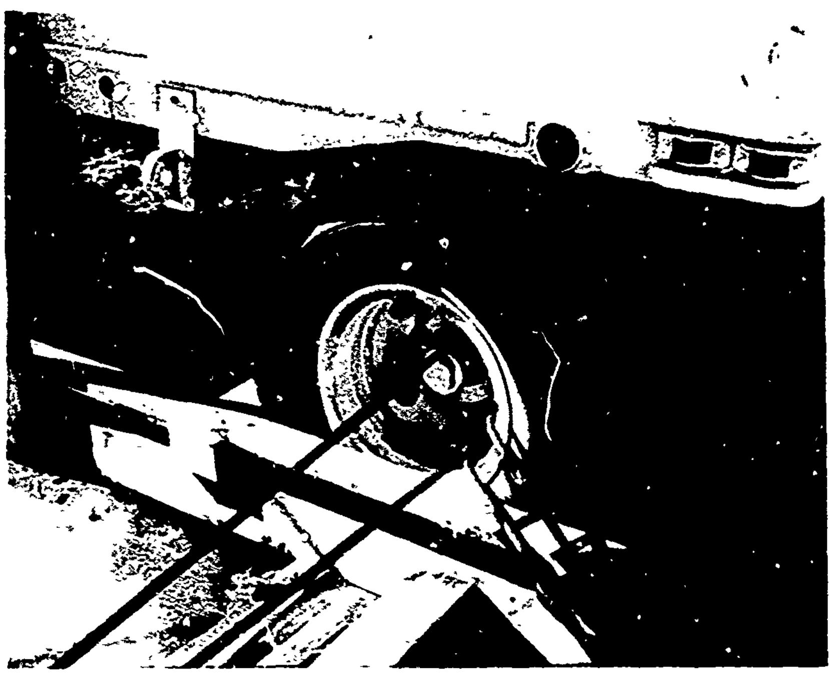


Figure 26 - Securing details. Rear wheels

Figure 27 - Holding down lines.

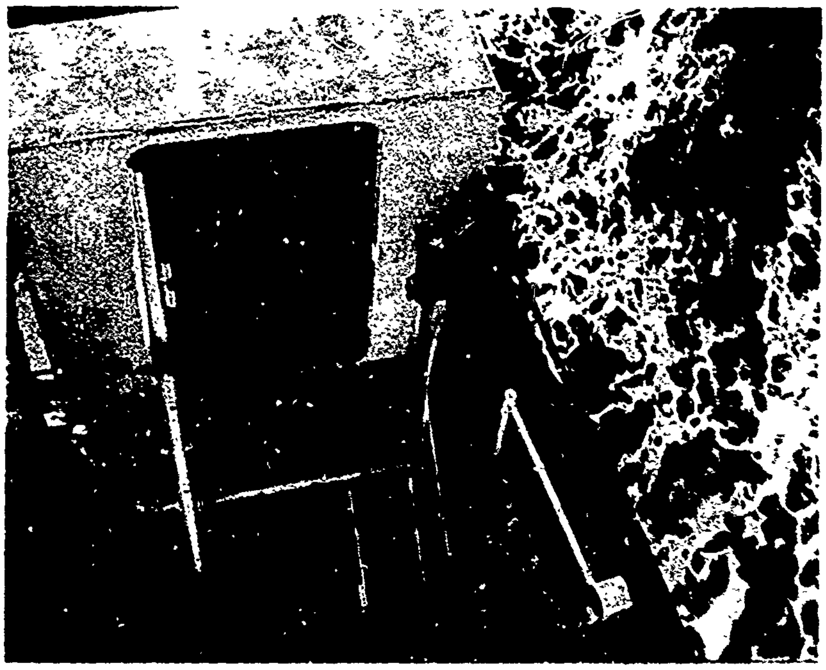


Figure 28 - Van access, after end. (Note GMDRL Projector near rail.)

Since the Van's air conditioner required 220 volts and all other electrical services in the Van required 110 volts, it was necessary to purchase and install an Isolation transformer to convert the 220 volt 3 phase system to a 3 wire 110 volt system with a neutral ground. All equipment was checked with final tests being made less than one hour before the scheduled sailing time. The technicians and engineers from GM Defense Lab, Sippican Corp., and the ship's engineering department cooperated excellently during this difficult period. The electrical system in the SS EXPORT CHAMPION may be unique, but it is strongly recommended that all details of electric power on future RSO ships be checked carefully before the van laboratory is loaded. In this case, inaccurate and incomplete information was received that did not indicate a problem before the van was on board ship and hook ups started.

13. Customs procedures did not present a problem. Equipment lists similar to Table I and Table II were appended to Treasury Department Form 4455 and submitted as "U. S. Navy equipment used on a U. S. Navy project." The form and lists were presented to the Customs Office at New York City prior to departure. An endorsed copy was received which was used to clear the van and its contents through customs on its return to New York in August 1965. There was little difficulty involved in this procedure. Passports were handled on an individual basis and the American Export Ship Line did not require special insurance for equipment or personnel during the cruise.

14. Cash Fund

On the advice of Dr. Maag, project leader in the Pacific Project Neptune, a $200 cash fund was provided to the Project Leader for emergency purchases during loading operations and the cruise itself. The availability of these funds expedited the purchase of the transformer mentioned in paragraph 12 above, and permitted last minute purchases of incidentals necessary for the cruise. Any future project leader should have a similar cash fund.

15. The SS EXPORT CHAMPION sailed at 10 P. M., July 9, 1965, for Rota, Spain. All project equipment was installed, tested, and with the exception of difficulties with the Foxboro recorders in the engine room, all equipment operated satisfactorily.

VI Discussion

1. The Ship

The SS EXPORT CHAMPION is one of the newer cargo liners of the American Export Isbrandtsen Line. Its characteristics are:

Type - C-3-5-46B
Length - 493'
Beam - 73'
Draft - 22'
Displacement - 24,000 tons (12,532 dead weight
11420 gross tonnage)
Cargo Holds - 6
Cargo Handling Equipment - Ebel Cargo Handling Gear
Cargo Handling Gear - 20 booms, 2 cranes
Cruising Speed - 18½ knots
Cruising Radius - 6500 miles
Propellers - 1
Engines - Aft

The ship is pictured in Figure 29. The SS EXPORT CHAMPION was a stable and comfortable platform for the project.

2. The cruise for Project Neptune Atlantic started from Hoboken, New Jersey on July 9th; and proceeded to Rota, Spain, arriving July 17th; Cadiz, Spain on July 19th; Cartagena, Spain, July 21st; Naples, Italy, July 24th; and Genoa, Italy, July 26th. The weather throughout the cruise from New York to Genoa, Italy was excellent. Only one rainy day was experienced with little wind, and the ship rolled more than 3-4° on only one occasion when it rolled to 10° to 12° for a few hours. There was no spray problem on deck or in the vicinity of the Sea Van.

After departure from Naples, the scientific party secured all gear and prepared the van for return to the United States. The scientific party left the ship at Genoa, Italy on July 26th and returned to the United States by air. The locked van rode the ship from Genoa for the remainder of the SS EXPORT CHAMPION'S cruise, returning to Hoboken, New Jersey on August 10, 1965. There it was off-loaded, cleared through customs and returned to Florida Atlantic University, Boca Raton, Florida, by a commercial carrier on a low-boy trailer.

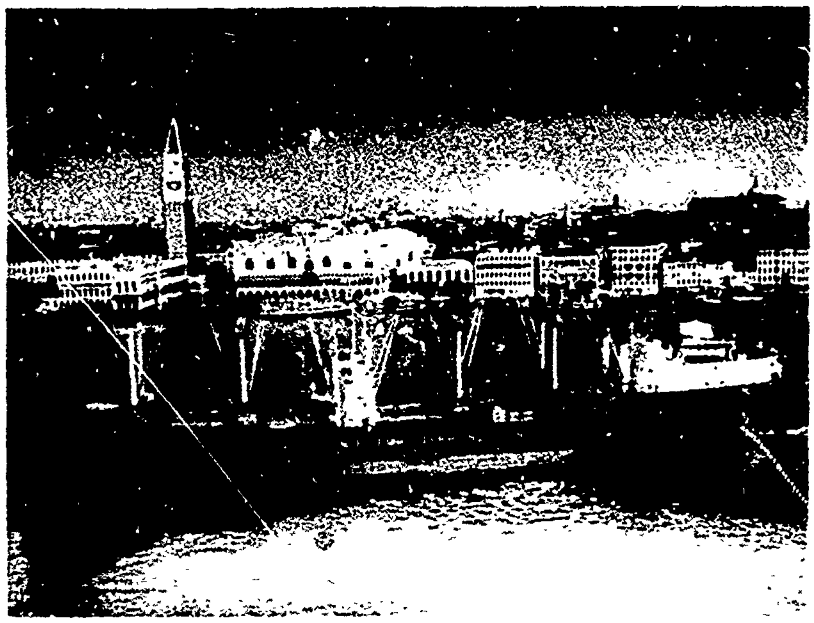


Figure 29 - SS EXPORT CHAMPION (American Export Isbrandtsen Photograph)

3 Biological Sampling (Jet Net Tows)

Biological samples were gathered using the GMDRL Jet Net. It was intended to conduct at least two tows per day to obtain plankton samples, one near dawn and one after sunset. Just prior to streaming the Jet Net, and upon its recovery, expendable BT drops were made using the Sippican equipment to record temperatures in centigrade to depths of 1000 feet. Surface temperature readings were obtained using a hand-held bucket thermometer before and after each tow. Concurrent navigation and meteorological data were recorded during each tow.

A description of the Jet Net towing operations follows. The initial towing position, Station #1, Figure 30, was forward of the Sea Van laboratory on the starboard side just forward of the afterdeckhouse as shown in Figure 30. An after-tending cargo boom was rigged with 1500 feet of 3/8" steel tow wire. The boom was swung outboard with the tow point after 30' outboard of the ship's side. The tow point was about 40' above the water. The Jet Net was assembled and filled with clean sea water. The net was hoisted over the side with the depressor attached, and swung clear of the water. The traveling lizard inhaul was rigged as shown in Figures 31 and 32. When swung outboard and ready, the Jet Net and depressor were lowered slowly until the depressor just touched the surface of the water, Figure 33. At that point, the tow wire was paid out as rapidly as possible until the Jet Net streamed about 500' astern of the tow point. At a 500' tow length it is estimated that the Jet Net towed at a depth of between 50' and 60' below the surface. There was little difficulty launching the Jet Net from the initial Station. The tows varied from 15 to 30 minutes in duration. Serious difficulties were experienced during recovery operations. The violence with which the Jet Net left the water is shown in Figure 34. In practically every case, when towing from the initial towing Station #1, the suction of the ship's screw caused the Jet Net and tow wire to be pulled sharply against the side of the ship damaging the Jet Net in many cases. Several 16 mm motion pictures taken during this operation show the difficulties encountered during these recoveries. After the fourth tow resulted in damage to the net, the towing point was shifted forward on the starboard side to position #2 shown in Figure 30. In this position, about 200' forward of the propeller, it was not possible to pay out the towing line more than 180'

TOWING ARRANGEMENTS

S.S. EXPORT CHAMPION

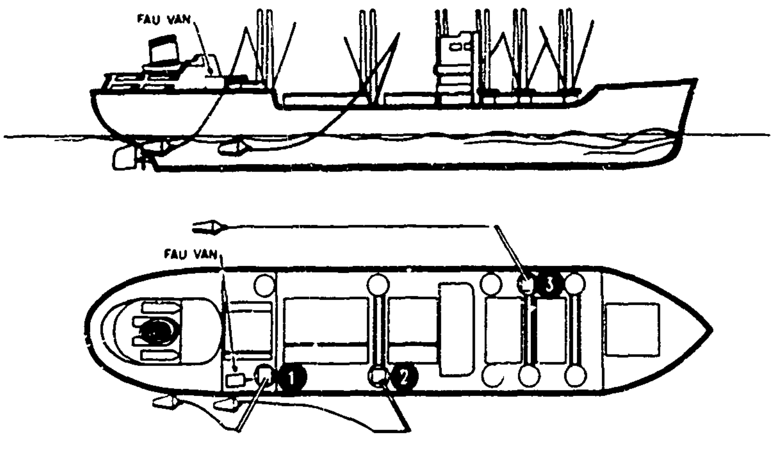


Figure 30 - Jet New Towing Stations
#1 - 1st Towing Station
#2 - 2nd Towing Station
#3 - 3rd Towing Station

Figure 31 - Inhaul travelling lizard rig on Jet Net tow line.

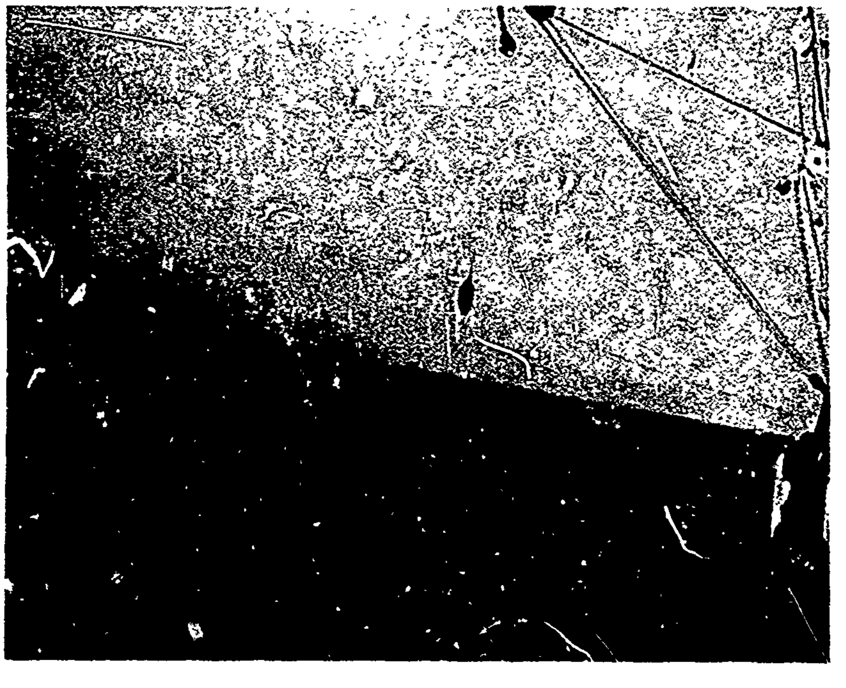


Figure 32 - Inhaul rig as Jet Net is swung out for tow.

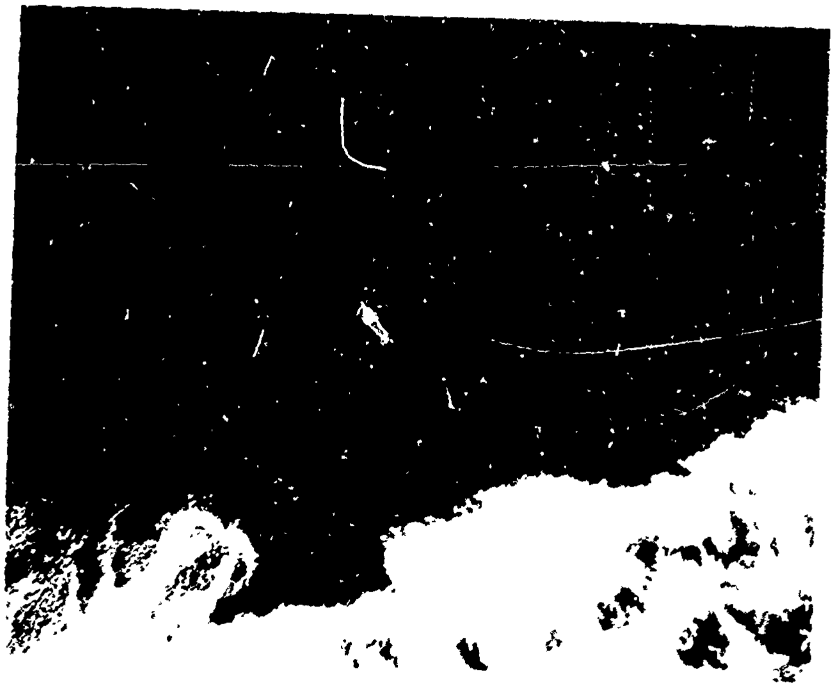


Figure 33 - Jet Net lowered to point where depressor enters water.

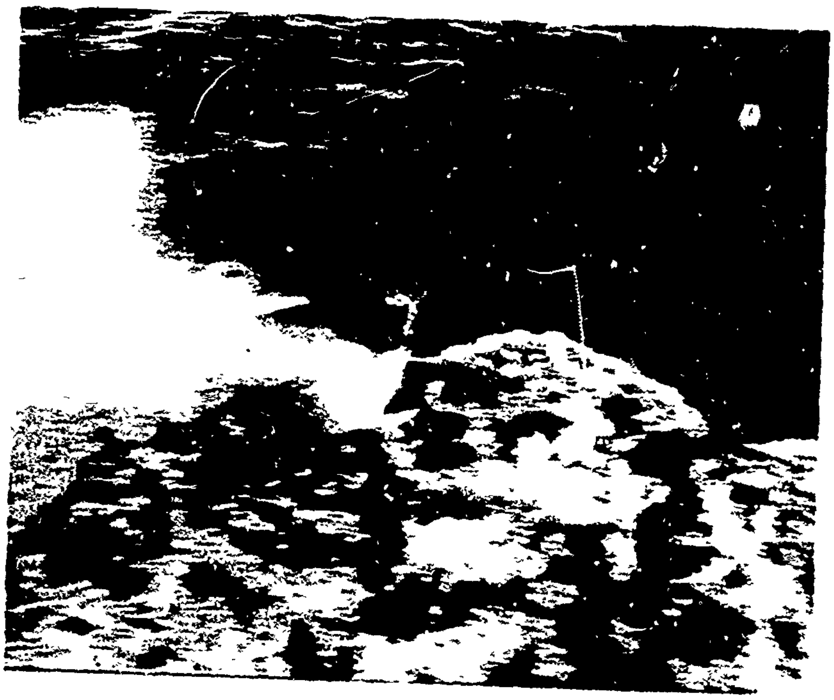


Figure 34 - Typical Jet Net recovery at 19½ knots.

to be sure that neither the Jet Net nor the wire could foul the propeller. Some tows from this point, including No. 9 which provided a large quantity of plankton for biological experiments, were successful. In most cases, however, the Jet Net continued to be drawn into the side of the ship on recovery and the Jet Net damaged. Biological specimens in the Jet Net also were damaged. By July 16th, both Jet Nets were so badly damaged that they could no longer be used or prepaired on board. A picture of one of the damaged Jet Nets is shown in Figure 35.

On July 17, 1965, SS EXPORT CHAMPION moored at Rota, Spain. Upon request to the Commander, U. S. Navy Submarine Squadron based at Rota, Spain, the USS HOLLAND Repair Department repaired the damaged Jet Nets in one day. Biological tests now could be continued during the Mediterranean part of the cruise. On departure from Rota, Spain, the towing point for the Jet Net was shifted to the port side of the ship forward of the bridge structure, position #3 in Figure 30. At this point about 300' forward of the propeller, a tow of about 250' was possible. While there were a number of erratic tows due to interactions between the depressor and the bow wave at speeds of 19½ knots, the Jet Net no longer slammed into the ship's side on recovery.

Due to the difficulties mentioned above and the fact that plankton samples were sparse in many tows, the time and tow period lengths for the samplings were varied. The results are discussed under the Biological Studies section of this report. When plankton samples were obtained, the biologists worked on them for periods between 6 and 8 hours, or in some cases, even longer in order to carry out the project' scientific objectives. A total of 15 tows were made, of which 12 provided samples for examination. Five tows provided sufficient specimens for oxygen uptake measurements, and only one tow, number 9, taken south of Santa Maria Island in the Azores, contined ideally adequate material for experimental use. Details of the biological studies are reported in paragraph 4 of this section of the report.

A summary of Jet Net tows made follows:

JET NET TOWS

			Starting Position		Ship	Results
No.	Date	Time	Lat.	Long.	Speed	and Comments
1	7/10	1000-1015	39°-58'N	69°-44'W	18 kts	Test run, Jet Net hit side of ship on recovery
2	7/10	1812-1842	39°-28'N	66°-12'W	18	Jet Net hit side ship and was damaged (limited samples)
3	7/11	0855-0910	38°-41'N	61°-04'W	18.5	New net tried-damaged hitting side of ship. (limited samples)Jet Net repaired. No evening tow.
4	7.12	0543-0910	38°-09'N	53°-24'W	19.1	Tried swinging ship on recovery to keep Jet Net from hitting side of ship.Unsuccessful. Net damaged again.No samples.Shifted tow position forward to #4 cargo hold boom. See position #2 on Figure 30.
5	7/12	1835-1850	37 -55'N	48 -07'W	19.1	Performance improved.Tow line limited to 250' to keep Jet Net and wire from fouling propeller.Few samples.

No.	Date	Time	Starting Position Lat.	Long.	Ship Speed	Results and Comments
6	7/13	0615-1645	37°-44'N	43°-34'W	19.1	Satisfactory tow. Few samples.
7	7/13	2010-2025	37°-29.5'N	38°-01'W	19.0	Satisfactory tow. Some samples.
8	7/14	1512-1520	37°-07.5'N	30°-46.5'W	19.0	Net and depressor slammed into side of ship on drop. Tried second time. Same result. No samples.
9	7/15	0620-1637	36°-50.2'N	25°-07'W	19.4	Good tow. Many specimens. (Biological Sample #8) Ship just south of Santa Maria Island, Azores.
10	7/15	1510-1525	36°-47'N	21°-38'W	19.4	Tried double depressor (unsuccessful). Good run for Jet Net but few samples for test.
11	7/16	0600-0615	36°-41'N	15°-44'W	19.3	Jet Net dove for ship on launch on each of 3 tries. No samples. Net damaged badly.

17 July arrived Rota, Spain. USS HOLLAND Repair Force repaired two damaged Jet Nets for us. Rerigged touring point to starboard side forward of bridge (see position #3 on Figure 30).

No.	Date	Time	Starting Position Lat.	Long.	Ship Speed	Results and Comments
12	7/20	2025-2040	36°-05'N	04°-57'W	21	Tow taken passing through Straits of Gibraltar. (Note speed over ground.) Good tow from this position. Very few biological samples.

21 July arrived Cartagena, Spain.

No.	Date	Time	Lat.	Long.	Ship Speed	Results and Comments
13	7/22	2243-2258	37°-46'N	01°-11'E	19.5	Good tow. Biological samples sparse.
14	7/23	1325-1340	38°-32'N	07°-04'E	19.5	Jet Net towed very erratically. Depressor lost. No samples.
15	7/23	1800-1820	38°-46.5'N	09°-01'E	19.5	Good Tow. Some samples received.

24 July arrived Naples, Italy.
Jet Net secured for shipment.

Results of the Jet Net tows can be summarized as follows:

Towing from any point forward of the propeller on a high speed ship will result in the suction of the tow and wire into the side of the ship as it reaches the area abreast the propeller. A tow point at or astern of the propeller with the tow boom rigged as far outboard as possible is required. A ship with engines and superstructure after, which requires the tow point forward of the propeller is not suitable for towing oceanographic gear. If forced to use such a ship, the tow point must be as far forward as possible with the length of tow line short enough that no chance will exist to foul the propeller. See Figure 30 showing the tow points used in Project Neptune Atlantic, and Figure 36 for an ideal towing arrangement.

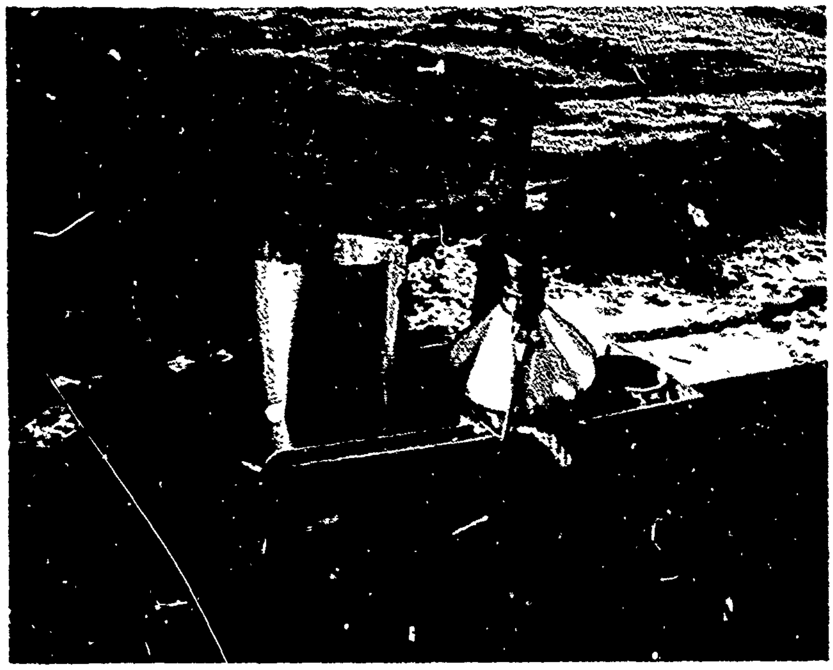


Figure 35 - Jet Net damaged by hitting side of ship during recovery operations.

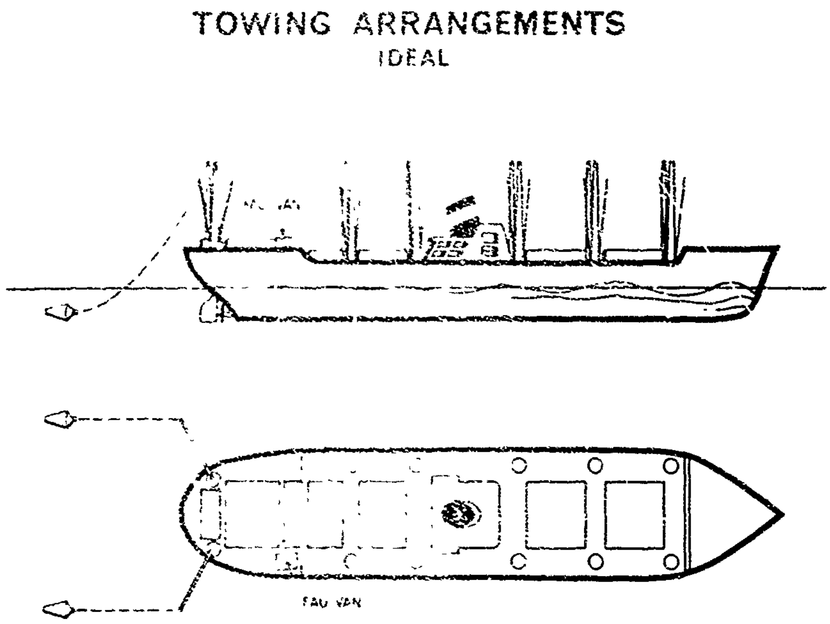


Figure 36 - Ideal Jet Net towing arrangement.

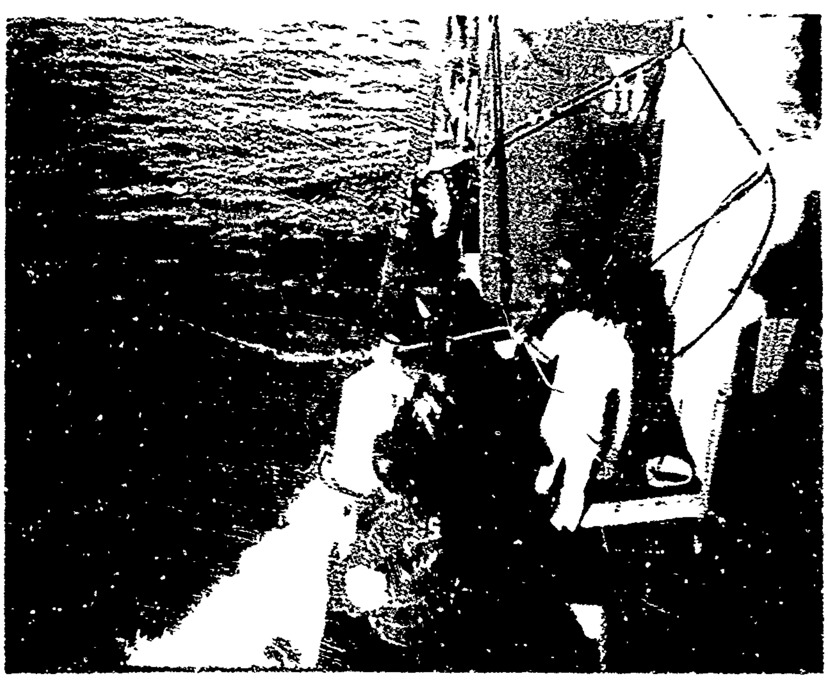


Figure 37 - Jet Net being hoisted over the side for biological sampling tow.

The GMDRL Jet Net provided a small number of samples during Project Neptune Atlantic. In Dr. Clark's preliminary evaluation of the Jet Net, he estimated that it should operate effectively up to 22 knots. Experience during this project makes a realistic estimate of 17½ to 18 knots as the probable upper limit of usefulness of the Jet Net as it is now constructed. Figures 37 - 41 show the sequence of streaming and recovery of the Jet Net from the EXPORT CHAMPION during Project Neptune Atlantic. The procedures for opening and removing plankton samples from the Jet Net are shown in Figures 42 - 49. Captions beneath the pictures explain the operation.

4. Biological studies during Project Neptune Atlantic constituted the primary scientific objective of the project. A report of these studies follows:

BIOLOGICAL STUDIES

The biological phases of project Neptune Atlantic primarily were directed to an estimation of the viability of sampled plankton, and, where possible, to measurement of oxygen consumption by selected types of zoo-plankton.

It was expected that quantities of plankton in mid-ocean would not be large, but the small numbers of organisms found in the samples collected were, nevertheless, disappointing. The apparent distribution of the various types of plankton in the total sample was relatively consistent at all collecting stations along the course. However, to a taxonomist, significant differences in the proportions of various species might be obvious. For example, the distinctive copepod Sappharina was observed at only one station, approximately six miles south of Santa Maria Island, Azores.

From a total of 15 tows with the Jet Net, 12 provided samples for examination, and 5 contained sufficient viable organisms for oxygen-uptake measurements. Only one sample (No. 9) was considered entirely satisfactory for experimental use.

It was not possible to make a meaningful quantitative estimate of the kinds or numbers of plankton collected in the Jet Net. With a 40-mesh net, the smaller forms such as dinoflagellates, diatoms and other algal types pass through unless trapped in gelatinous masses of fish eggs or the mangled mass of protoplasm from other organisms. The apparent relative percentages of living, dead and damaged specimens varied from tow to tow. It is not known whether

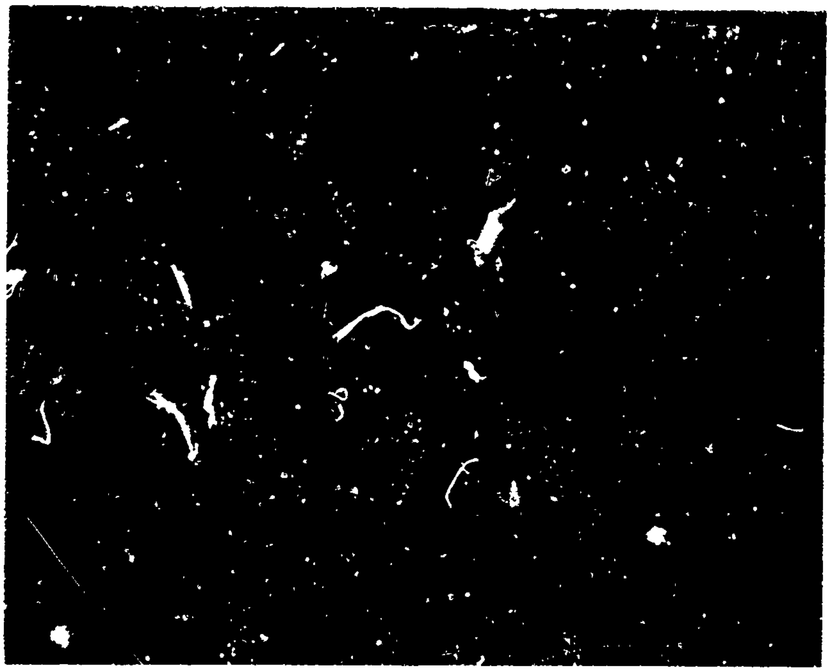


Figure 38 - Jet Net with depressor ready for launching.

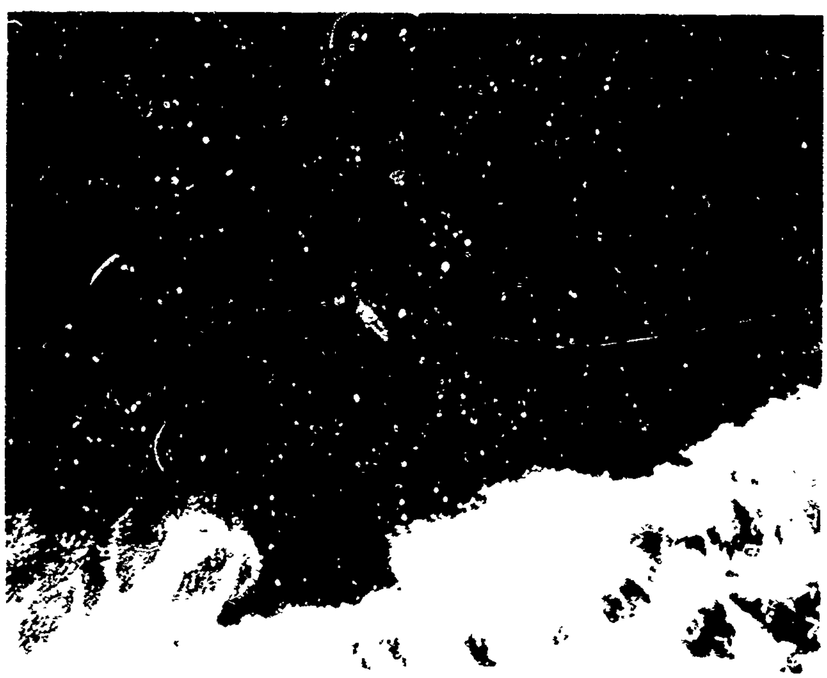


Figure 39 - Jet Net entering water.

Figure 40 - Jet Net leaving water on recovery at Station #3
Port side forward.

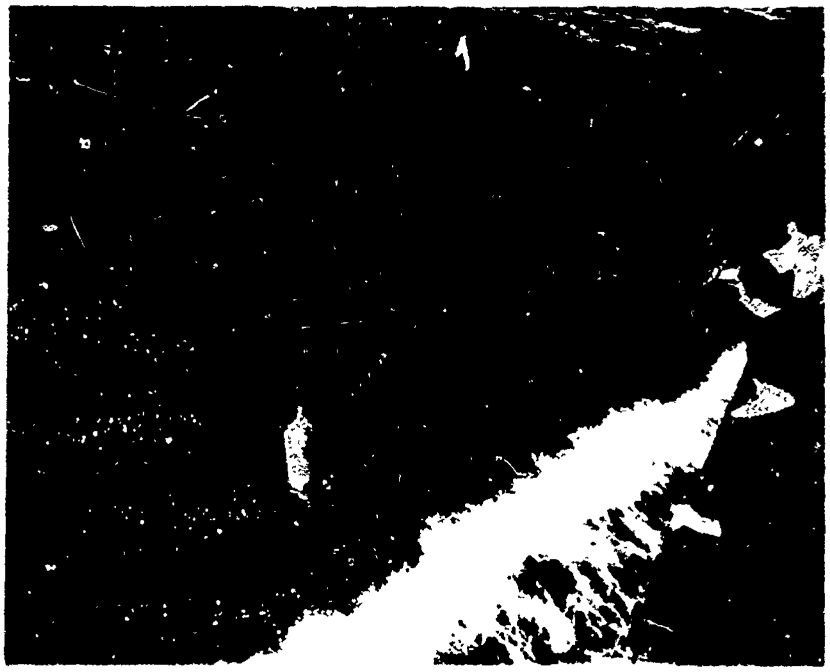


Figure 41 - Jet Net being hauled aboard after recovery.

Figure 42 - Loosening top of Jet Net after recovery.

Figure 43 - Opening Jet Net.

Figure 44 - Removing plankton net.

Figure 45 - Washing plankton net, with water from Jet net
to deposit specimens in lower net.

Figure 46 - Removing lower plankton trap.

Figure 47 - Placing lower collection trap into beaker.

Figure 48 - Washing plankton specimens from trap to beaker.

Figure 49 - First examination of samples from tow.

this variation was due to the frequent re-entry of the Jet Net during recovery or to differences in the numbers and kinds of plankton entering the net. It is probable that both factors are involved. It seems logical to assume that as the organisms were crushed or torm, there was a continuous washing out and loss of the organismal debris. It is also possible that the living organisms collected may have represented only those caught during the last short period of the tow. Only two tows were run for 30 minutes rather than the usual 15 minutes. There was no significant difference in the quantity of plankton obtained with the longer towing time. It was estimated that the total quantity of zoo-plankton material recovered 50% was crushed and torn, 45% was relatively undamaged physically, and only 5% was alive and apparently unharmed. Pteropods, ostracods, copepods, and copepod nauphlii showed a high survival rate, while arrow worms, polychaetes, doliolids, salps, and shrimp-like forms seldom were obtained physically intact.

The greater part of each sample was preserved for further examination.

<u>METHODS</u> - After recovery of the Jet Net, the inner net was removed, placed in a plastic bucket and washed down with residual sea water obtained from the Jet Net casing. The lower trap of the inner net was then removed and the plankton washed from it into a battery jar with the same sea water. The final volume contining plankton varied from one to three liters. Ideally, free-floating or swimming zoo-plankton would be transferred to test bottles by dipping the bottles directly into the suspending water (as was the case with sample number 9). However, the samples were generally so sparse that a further concentration was made by pouring the sample into a Millipore Filter and filtering away all but 10 to 20 ml. This residual volume of sample was transferred to a crystallizing dish with any material on the filter. From this small volume (20 to 30 ml) plankton material could be further transferred with pipettes of appropriate size. Copepods were maintained alive in this dish held in a water bath at 20°C for as long as 40 hours.

Copepods were the only undamaged living organisms collected in sufficient numbers for use in oxygen-uptake measurements. Depending on the number of these organisms available, the animals were transferred to 37 ml, clear glass-stoppered bottles (1) by dipping the bottles as indicated previously, (2) by decanting from the crystallizing dish, or (3) by removal of individual organisms with a medicine dropper.

After initial oxygen measurements, the stoppered bottles were held in a water bath for six hours at the temperature recorded at

10 meters by the bathythermography during the net tow. The bottles were exposed to low intensity incandescent light of approximately 75 luxes.

Oxygen measurements were run with a micro-method modifier from Winkler by Fox and Wingfield (Journ. Exp. Biol. 15_437; 1939). Micro-syringes suitable to this method were obtained from Cole-Parmer, Chicago, Illinois. (Nos. 7870 and 7874.)

After the terminal oxygen measurement, copepods in the bottles were collected on pre-weighted millipore filter pads and washed with distilled water prior to drying. The filters with samples were stored in Petri dishes for transport to a land-based laboratory. During later transport of the Sea Van many of these dishes were broken, and dry weights are not available for these samples. When it was not practical to count copepods at the time of initial transfer to the bottles, they were counted on the filter prior to drying.

No attempt was made to select copepods on the basis of size or species, and the organisms were not examined individually after the oxygen experiements to determine whether all animals were living at the end of the test. Either or both of these factors may have contributed to variation in the values given in the following table.

Sample	copepods	Temp. °C	ul O_2 uptake/37 ml /6 hrs.	ulO_2 uptake/hr /copepod
6	20	21	43.9	0.35
7A	20	20	31.0	0.26
7B	20	20	37.5	0.31
9A	32	20	53.7	0.28
9B*	29	20	49.4	0.28
9C*	37	20	61.9	0.28
12A**	18	22	61.0	0.56
12B	17	22	39.3	0.39

*Animals maintained for 34 hrs. in water bath prior to testing.
**Organic debris in this bottle may have contributed to high value.

Plates and slants of sea water agar stocked in the Sea Van were used to isolate aerobic bacteria from sea water samples taken from the Jet Net and from the ship's main injection system. Ten apparently different isolates were obtained which will be maintained for future characterization.No fungi were observed on any of the plates.

DISCUSSION AND RECOMMENDATIONS - Working space in the Sea Van was not adequate, instruments and equipment required most of the bench space available, and work could not be performed efficiently or comfortably. Space for biological work should be doubled.

Vibration in the after section of the EXPORT CHAMPION was excessive at the cruising speed of 19 knots. When this motion was reinforced by the tires and springs of the Sea Van, microscopy and the use of micro-techniques by usual methods were impossible. Examination of living organisms under these conditions was possible only by the use of an adaptation of the technique described by Dean and Hatfield (Turtox News, January 1963). A small square of "Saran" plastic wrap was placed over the partially filled concavity of a microculture slide. Contact of the plastic film with the water damped out most of the vibration without damage to the organisms.

If the use of the Jet Net is to be continued, some study should be given to making a faster recovery from the water. With conventional ships' winches, the Jet Net breaks the surface, loses some of its contained water, and then, unless over a trough, re-enters the water on the return swing of the tow line. The re-entry of water at high speed into a partially empty net subjects the trapped plankton to great physical shock and undoubtedly contributed to the damage observed.

A more serious disadvantage of this system is the shallow depth at which the net towed. A depth of 8 to 10 meters usually does not reach the thermoclines or the optimum light intensities where plankton are believed to be most abundant. Towing from the stern would obviate this problem.

Whether studies of zoo-plankton obtained at high speeds with the Jet Net can contribute much to the knowledge of marine biology, I do not claim to know. It would seem that valid quantitative data are essential. For this purpose the total of the plankton entering the net much be maintained in a whole and usable condition for physiological studies. It is obvious that the quantity of water passing through the net and the depth of the net must be known. These conditions were not satisfied with existing equipment.

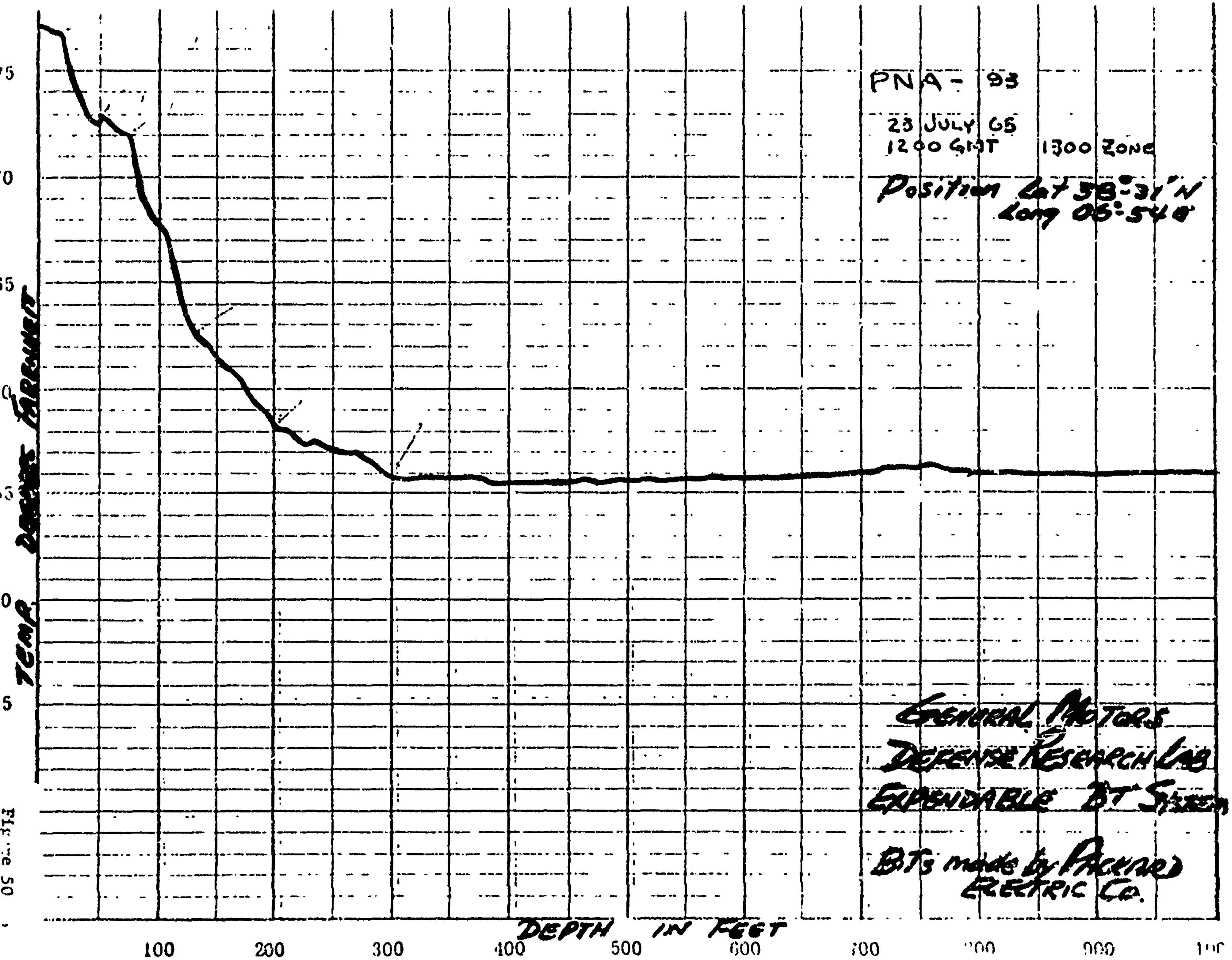
In any case, to obtain meaningful answers to problems of plankton ecology or of marine biology in general, a study of all the organisms and their inter-actions within a given ecosystem is required. To this end all of the organisms present at a given station must be collected and related. I suggest that a system which would pump or force sea water from a trailing depressed hose to a continuously operated basket centrifuge might be a more practical approach to the collection of a total plankton sample.

5. For a Temperature Profile during the cruise, expendable BT recordings were taken every 4 hours using the GM Defense Research Laboratory equipment with Packard Electric Expendable BTs. This system recorded temperatures in degrees Centigrade to a depth of 1000 feet. A sample BT trace is shown in Figure 50. 63 Packard expendable BT drops were made during the cruise. The GMDRL equipment included a digitized taper for recording temperatures and depth for each drop. Tapes and recordings of this nature can have an important application to an environmental data collection system such as the Navy ASWEPS project.

   The digitized tape recording, which can be run through a radio teletype machine offers an excellent system for transmitting BT records immediately after they are taken at sea An environmental data system could use this rapidly transmitted data from many ships at sea if such a system were installed in U. S. Merchantmen. During this cruise, data from several BT traces were transcribed on to BT log forms PRNC-NODC 3167/10 and then transmitted to the Navy Weather Center at Rota, Spain by the ship's radio operator. This was a slow and tedious process. The use of direct transmission from digitized tape on a RATT circuit offers great promise.

   Expendable BT recordings were also made at the start and conclusion of each Jet Net tow using the Sippican equipment. Figure 51 is a sample of such a record. A total of 28 such recordings were made.

   Check off lists were provided for each equipment. When followed, the operations of both equipments were simple. The Merchant Marine Cadets operated both equipments with no difficulty after a very short instruction period. These systems could be operated by regular ship's personnel if required. Both systems worked well with few casualties. Good BT records were provided. The digital taper of the GM equipment, which was a developmental model, required frequent checking during the cruise.



PNA - 93
23 JULY 65
1200 GMT
1300 ZONE
Position Lat 58
Long 05
General Motors
Defense Research Lab
Expendable BT System
BTs made by Packard
Electric Co.
TEMP. DEGREES FAHRENHEIT
75
70
65
50
45
DEPTH IN FEET
100
200
300
400
500
600
700

Figure 50

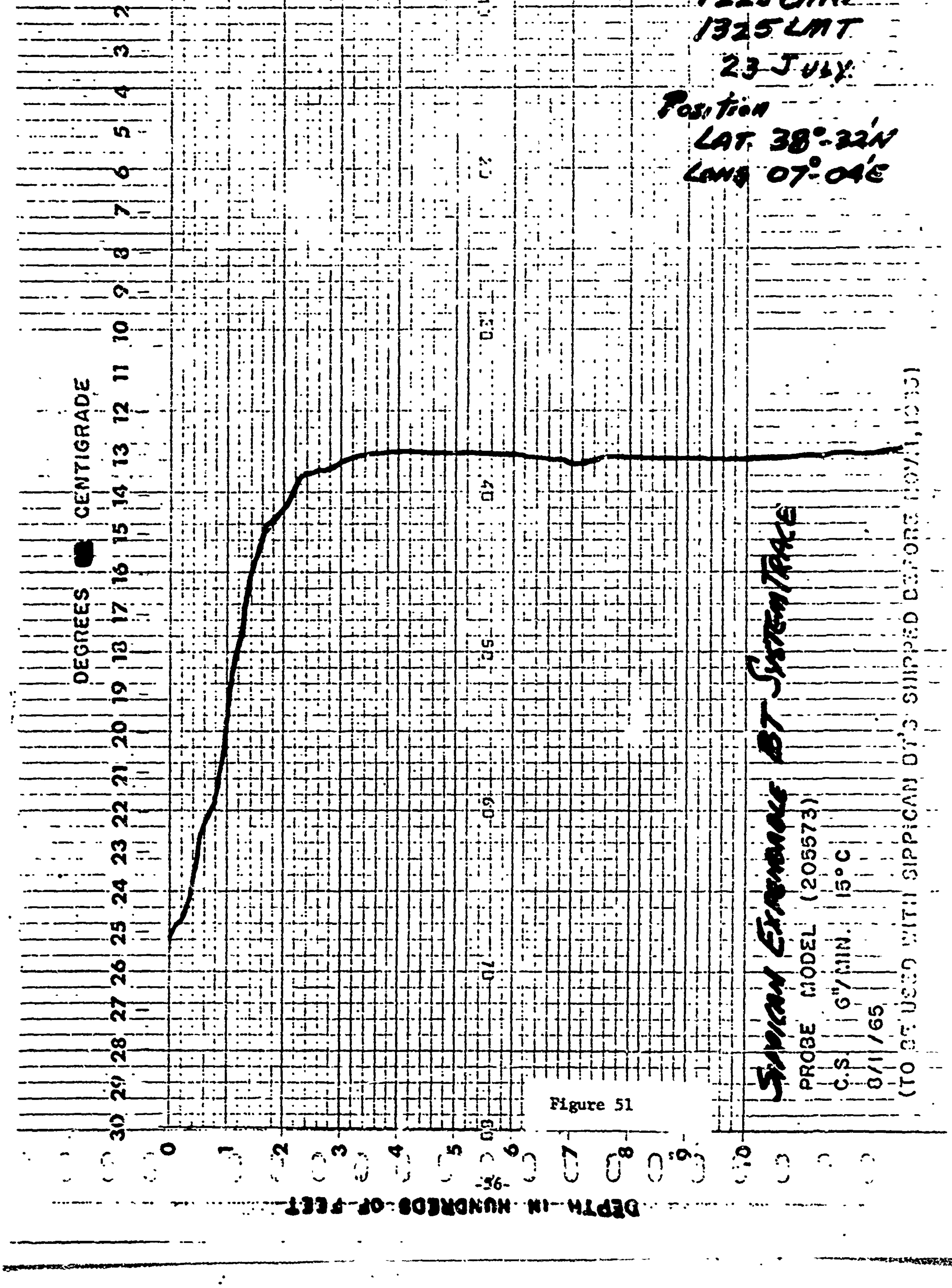

1225 GMT
1325 LMT
23 July
Position
Lat. 38°-32'N
Long 07°-04'E
DEGREES CENTIGRADE
30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2
0 1 2 3 4 5 6 7 8 9 10
DEPTH IN HUNDREDS OF FEET
Sippican Expendable BT System Trace
PROBE MODEL (205573)
C.S. 6"/MIN. 15°C
8/1/65

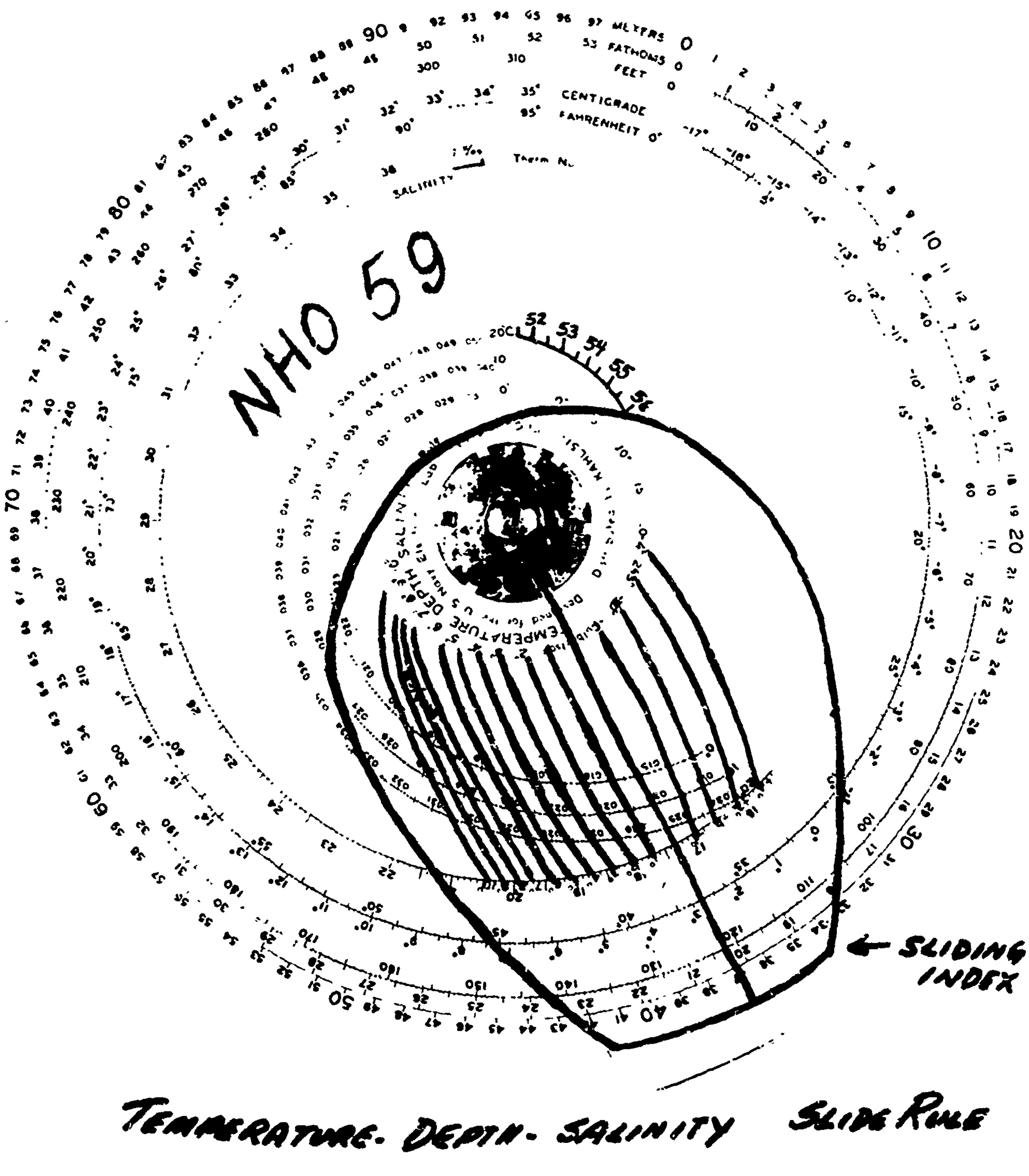
Figure 51

6. Constant salinity and temperature determinations were attempted using a Foxboro recorder connected to temperature and conductivity probes installed in the main injection line of the ship's condensers. Early difficulties were experienced due to slipping of the paper records on the spindles. Also, on 15 July 1965, the temperature probe carried away in the main injection line. It is not known whether it was broken off by impact or vibration caused metal fatigue failure. The proble was replaced by the engineering force of the ship at Rota, Spain on 17-18 July.

7. Daily Salinometer checks were made using the Model RS-7A portable induction salinometer made by Industrial Instruments, Inc. The salinometer was installed in the engine room by U. S. Navy Oceanographic Center for checking the accuracy and performance of the conductivity probe and Foxboro recorder. Checks using the RS-7A equipment indicated that conductivity probe was indicating salinity about .5 parts per 1,000 low during the cruise. Conversion of Foxboro Recorder readings into salinity, using the NH059 Temperature-Depth-Salinity circular rule, Figure 52, was unsatisfactory. The maximum MHOS/cm reading of .50 on the 20°C scale was exceeded most of the time. The curve was extropalated to .56 but the accuracy of the computations were degraded in the process. Design of a new Temperature-Depth-Salinity slide rule is recommended. Cooperation of the Insturment Laboratory of NODC was excellent in designing, installing and removing the equipment package for this part of the project.

8. Correlation of time, position, meteorological data, ocean temperature profiles, salinity, and their relationship to biological samples obtained must be done ashore. However, the fact that the data could be taken by a small scientific party based in a mobile van laboratory on a RSO ship is significant in the test of the feasibility of the system.

9. Ship's position for the various events was obtained from the EXPORT CHAMPION'S navigational plot. Celestial fixes, LORAN and dead reckoning by the ship's navigator were used for plotting the ship's position. The accuracy of positions in a number of cases are doubtful, but it is believed that an accuracy of approximately 3-5 miles was maintained. For bottom surveys or small area oceanographic observations, much more accurate positioning



TEMPERATURE- DEPTH- SALINITY SLIDE RULE

FIGURE 52

would be required. Future RSO projects should consider a "Transit" or similar system for more accurate navigation.

10. The following navigation and meteorological data was recorded for each event, including Jet Net tows and expendable BT drops:

    Run Number
    Type of Run, i.e., Jet Net tow, BT Drop, etc.
    Time (Local and GMT)
    Latitude
    Longitude
    Course
    Speed
    BT Trace Number
    Bucket Themometer Reading
    Main Injection Temperature
    Main Injection Salinity
    Wind Direction
    Wind Speed
    Air Temperature
    Visibility
    Cloud Cover
    Sea State
    Barometer Reading and
    Remarks regarding the Event

11. The Van was adequate as a base of operations and central station for transport, storage, electronic installations and record keeping. It had inadequate space for conducting scientific biological work. Figure 53, 15 and 17 show the crowded working laboratory space in the Van. The crowding was particularly evident during scientific experiments and observations of living specimens. Immediately after each tow, both biological activities and oceanographic data recording centered in the van. At these times the van was very crowded. The van had to carry working supplies, expendable BTs and electronic equipment as well as act as biological laboratory equipment. The party used the van for recording and working on data. Redesign or a larger van are recommended for future cruises involving biological experimental work at sea.

12. Wear and abrasion on some of the fittings in the Jet Net tow line became pronounced after repeated tows. Figures 54 and 55 show the war of the swivel shackle pins after

Figure 53 - Biological work bench showing crowded working conditions.

Figure 54 - Wear in towline swivel shackle after 15 tows.

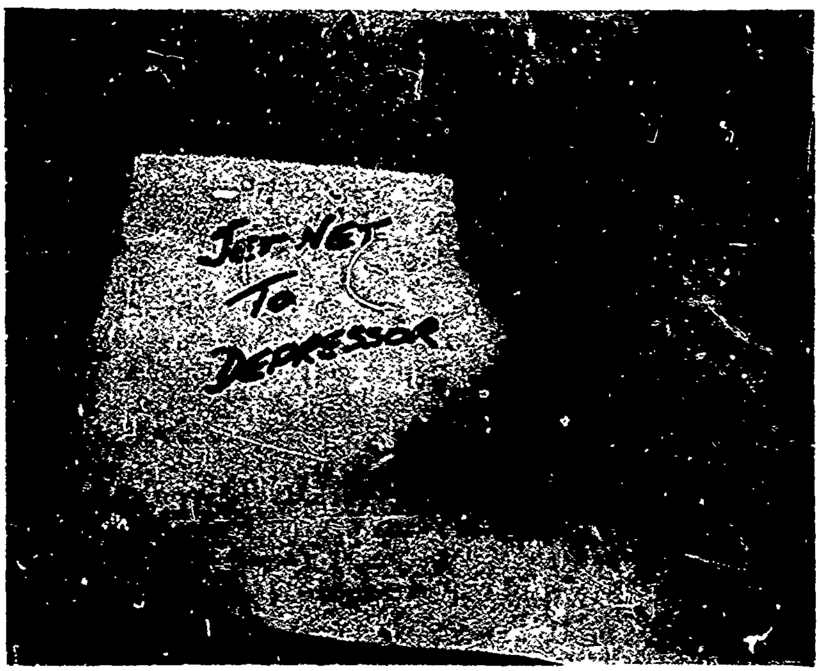


Figure 55 - Wear in swivel shackle to depressor after 15 tows.

15 tows. Repeated inspections are required to prevent failures and loss of towed equipment.

13. Scientific Party - ship's officers - and crew relationships were excellent throughout the cruise. The van was secured in place by ship's personnel, power provided, booms rigged with special tow lines, etc., on request to the Ship's First Officer or Chief Engineer. During the first day or two, the ship's officers and crew members watched project operations from a 'respectful' distance, showing a "reserved" willingness to help. From the start of the cruise, the officers and crew of the ship were invited to inspect the van and watch our operations. Every opportunity was taken to explain the purpose and procedures of the project. In a very short time, Porject Neptune Atlantic was the "ship's project" and a fine and friendly relationship was established that lasted throughout the cruise. When our Jet Net was damaged, the engineers repaired them willingly and expeditiously. When we had towing difficulties, the Captain and Deck Officers did all possible to help correct them. The towing rig was shifted twice after the initial positioning by the ship's Boatswain and the Merchant Marine Cadets. There was no evident of 'labor relations' difficulties or 'Union' opposition to anything attempted or done during the cruise.

14. Throughout the planning, loading and off-loading periods, shipline officials, longshoremen and forement cooperated fully. When it was learned that the van was not scheduled for early loading on July 9th, a request to the Shipline representative changed the schedule quickly so that the van could be loaded and tested on board as early as possible. In view of the power difficulties that developed, this cooperation did much to insure the success of the cruise. Captain G. R. Miller, Line Operations Officer of American Export Isbrandtsen Lines, coordinated details for the project in an outstandinly cooperative and efffic-ient manner. Captain Kilcline, his officers and crew were equally cooperative and helpful throughout the cruise.

15. Accommodations for the Scientific Party were adequate but inconvenient. Mr. Stephan was quartered in the Captain's Sea Cabin on the Bridge Level forward. Dr. Hoffmann occupied a ship's officer's room aft. Mr. Carneghe and Mr. Kellum occupied two bunks in the ship's Sick Bay which, since there were no sick patients during the cruise, was

not a problem. The accommodations, which were all that were available, met minimum requirements. Originally it had been planned that two members of the party would occupy the Cadets' quarters. However, their presence on the cruise cancelled that. In future RSO projects more adequate and convenient quarters for the scientific party should be provided. No space was available for auxiliary laboratory space in the SS EXPORT CHAMPION.

16. Expenses charged to the project by the American Export Isbrandtsen Line for loading, services, passenger fees, etc., were as follows:

Loading, discharging and securing Van	$200.00
Subsistence and Lodgings	
4 men/17 days @ $7.27/day	494.36
Overtime, rigging, fitting, etc.	84.96
Total	$779.32

Cost/day (17 days) $45.84

These charges are considerably less than those that would be charged on a ship where the scientific party occupied passenger space. For instance, the charges quoted by Moore-McCormack Lines for space, services, and passenger accommodations on the MORMACDRACO from New York to North Europe were:

Loading and securing Van	$200
Passenger Space	
4 passengers @ $540	2160
Off loading	100
Overtime (est.)	100
Total	$2560

Cost/day (30 days) $85.30

It is probable that the costs would vary between these limits depending upon the accommodations available, number in party, etc. However, in neither case was a charge made for deck space for the van. One can expect these charges to be added in future cruises. This will appreciably increase the costs indicated above.

17. Equipment and Techniques used during this project for the collection of temperature profiles with expendable BT systems using digitized data recorders could be employed for rapidly transmitting data to oceanographic data collection centers from Research Ships of Opportunity. Data recorded directly on digitized tape could be sent over RATT circuits to give real time temperature profile data from many points in the ocean to the oceanographic center minutes after the data was obtained. Use of such a system in ASWEPS, Fleet Numerical Weather Central or other oceanographic environmental data systems should be tried and perfected. A simple diagram of such a system circuit is shown in Figure 56. An automatic processing program for Bathythermograph Data is described in the Fleet Numerical Weather Facility, Monterey, California, Technical Note #22, by LCdr Samples, USN, dated July 1966. Use of digitized tape transmissions over RATT circuits could greatly reduce time and errors for oceanographic data transmissions

18. Containerized Laboratories similar to the laboratories pictured in Figure 57 that can easily be handled ashore, or flatbed transport vehicles and on board ship should be used in future RSO experiements or operations. The containerized laboratory "Conlab" pictured in Figures 57 and 58 made by the Twin Hull Boat Company of Hasbrouck Heights, New Jersey, is a sample of a well designed "Sea Van Laboratory" that would match deck container stowage fittings on Merchant Ships now in use that carry containerized freight. Containerized Laboratories of this nature can be purchased or leased for future RSO operations as needed. Different sized "Containerized" laboratories can be used for operations having different space requirements.

VII Conclusions

1. Subject to limitations and restrictions noted in other sections of this report, Project Neptune Atlantic demonstrated the FEASIBILITY of the RSO concept. Using a transportable laboratory on board a Merchantman, it was possible to gather living specimens at cruising speeds and perform biological tests on them at sea, without interfering with the ship's normal routine.

2. The GM Defense Research Laboratory Jet Net operated marginally at speeds in excess of 18.5 knots. Many specimens gathered were mangled or damaged during the tow or violent pounding that occurred during recovery operations. Redesign of the Jet Net for high speed towing or development of a new system when living samples are required, is indicated.

3. Biological laboratory working space in the Project Neptune Sea Van was inadequate. A refrigerated water bath is needed in future biological laboratories.

4. Towing arrangements in Research Ships of Opportunity with engines and superstructure aft are unsatisfactory unless the tow points are abreast or abaft the ship's propellers and well outboard.

5. Laboratories for RSOs should be transported and secured on board ship <u>without</u> wheels. They should be designed to match standard container dimensions and fittings for "Containerized Freight" units using different sizes to match different needs. See Figure

6. Ocean temperature-depth profiles can be made rapidly and effectively by using expendable BT systems. Technicians or ship's personnel can be trained readily to operate the equipment. The use of digitized tapers which compatible radio transmitting equipment (RATT) can provide a rapid system to gather many simultaneous temperature-depth readings from ships at sea for processing at Oceanographic Data Centers.

7. Greater positioning accuracy is needed for plotting scientific or synoptic data from RSOs. This will be difficult until a 'Transit' or similar satellite navigation system is available for use in merchantmen or it can be installed in RSO mobile laboratories.

8. Personnel accommodations for project personnel on board SS EXPORT CHAMPION were barely adequate. If the RSO concept is adapted in the U. S. Merchant Marine, provision for the scientific and/or technical participants should be provided regularly. Costs for this space as well as subsistence must be considered in future cruises.

9. No labor, Union, administrative or operational problems were encountered in this project that adversely affected the RSO concept. Cooperation was excellent throughout.

10. Constant reading temperature and conductivity measurement equipment performance was erratic. Protable Salinometer test sets did not operate well in engine room spaces.

VIII Recommendations

1. Continue the development of the RSO concept. Conduct future RSO projects as scientific experiments to determine the scientific levels of performance that can be attained using Mobile Science Van laboratories and associated equipment on board ship.

2. Improve Jet Net performance at high speed or use this equipment on slower RSO ships. Tow from a point abaft the ship's propellers.

3. Utilize various sizes of "Containerized" Laboratories for RSO ships and match them to available space and ship vittings. Remove wheels from towable van laboratories when on board ship. Check ship's electrical power system carefully to insure compatibility with the van installation.

4. Plan deck space, accommodations and services for RSO laboratories and personnel in the building plans of new U. S. Merchant Ships or those undergoing major overhaul.

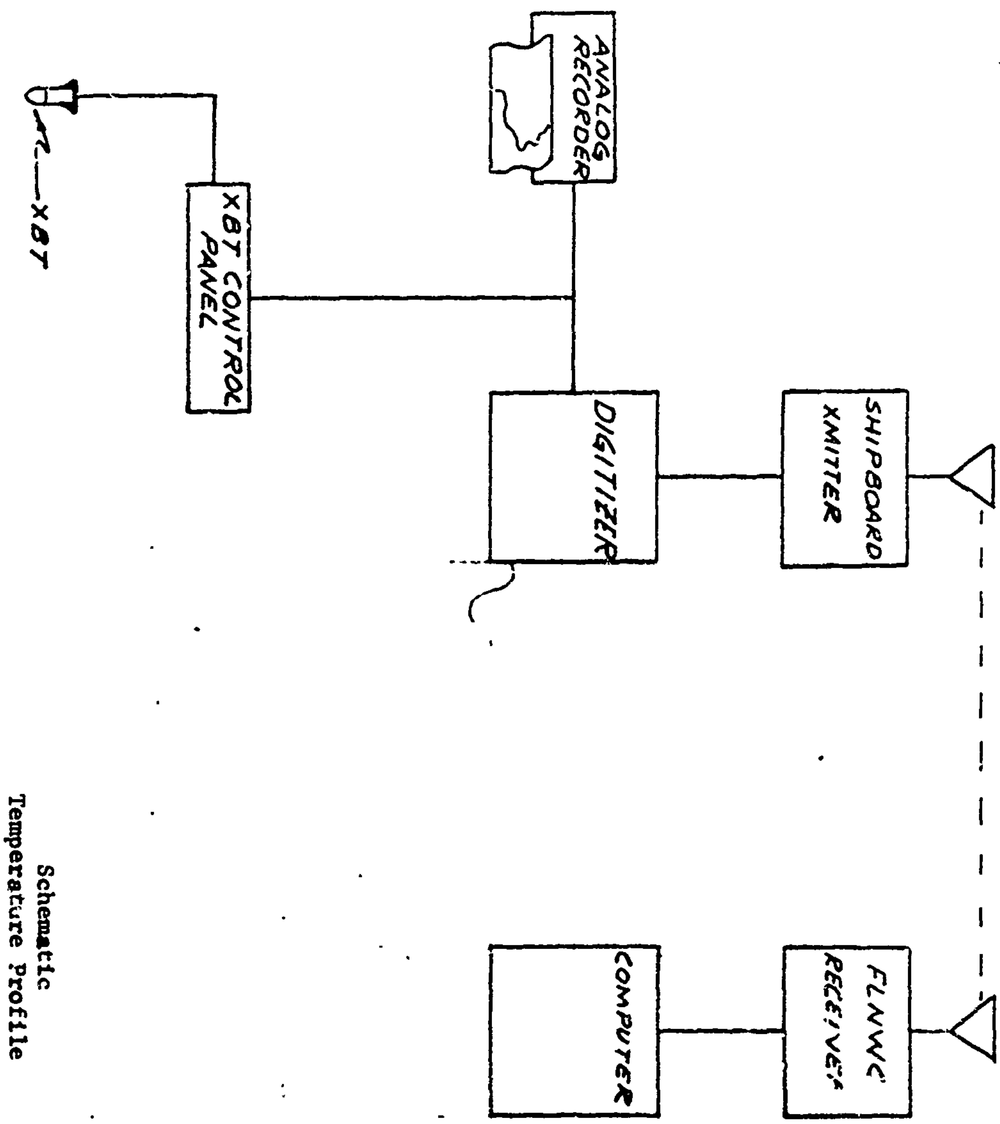
5. Develop and test a temperature-depth recording and telemetry system using shipboard expendable BTs with digitized taper, RATT facilities and receivers to provide accurate data rapidly to Oceanographic Centers used in ASWEPS or similar oceanographic environmental data analysis systems.

GM DEFENSE RESEARCH LABORATORIES
GENERAL MOTORS CORPORATION

REPORT NO.	PAGE	JOB NO.	PAGE

TITLE

PREPARED F.C.C. DATE 10-15-66
CHECKED
APPROVED

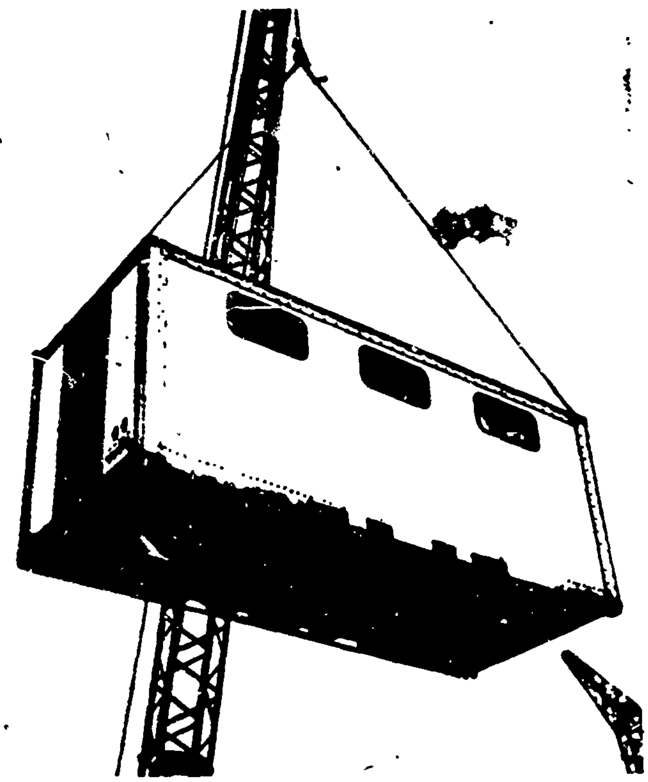


Schematic
Temperature Profile
Recording and Transmission
System

Figure 55

Figure 56

DISTRIBUTION:



SPECIFICATIONS

Dimensions:	Outside 20' x 8' x 8' Inside 19'6" long, 7' 9¼" wide, 7' 3½" high - 1120 cu. ft.
Frame:	All aluminum
Panels:	Seamless fiberglass sheets sandwiched over ¾" marine plywood
Floor:	1⅛" finished oak
End Doors:	Full length - full width open 270°
Hinge Pins:	Stainless steel
Entry Door:	Steel joined type - 30" - 76" - open 180°
All Joint Caulking:	Butyl and Neoprene
Lighting:	Overhead florescent
Electrical:	110 V - 60C - strip outlet
Windows:	6 - 18" x 36" - safety
Fittings:	Thru container type
Handling:	By Crane or Fork Lift
Securing:	Bottom of container to deck by corner casting interlock
Stacking:	3 high with interlock
Weight Empty:	3850 pounds
Loading Capacity:	20,000 pounds

OPTIONAL EQUIPMENT

Wheels	Air piping
Air Conditioning	Screens
Heating	Additional port lights
Berths - bureaus - lockers - desks	Doors
Toilet	Stairs to upper trailer or trailer deck
Sink	Railing at top
Lab tables, bottle or equipment racks	Extra tie-downs
Electronic racks	Hatches
Water piping, tanks	Partitions
Saltwater piping	Heavy Machinery tie-downs

Figure 57 - "Containerized" laboratory "CONLAB" manufactured by Twin Hull Boat Co., Route 17, Hasbrouck Heights, N. J.

Figure 58 - "CONLAB" Containerized laboratory

REFERENCES

Aron, W. 1965. Ships of opportunity program, preliminary feasibility study. GM Defense Res. Lab., Santa Barbara, Calif., 38 p.

Clarke, W. D. undated. Preliminary Evaluation of the Jet Net, GM Defense Research Laboratories, General Motors Corp., Santa Barbara, California, 4 p.

Francis, S. A. and G. C. Campbell 1965. A Low Cost Expendable Bathythermograph, Sippican Corporation, Marion, Mass. Marine Sciences Instrumentation, Vol 3, Plenium Press 1965, pp 85-89.

Robertson, A. 1966. RSO Program, Project Neptune Limnos, Spec Report #28, Great Lakes Research Div., University of Michigan Ann Arbor, Michigan.

Robertson, R. M. 1965. General Motors Research Laboratories BT-X (Expendable Bathythermometer) Teletype Transmission Tests with Destroyer Development Group (USS EDSON DD946) report dated March 3, 1965. GM Def. Res. Lab., Santa Barbara, California.

Sample_, L. C. LCdr, USN July 1966. Automatic Processing of Bathythermograph Data FNWF BT-ADP Technical Note #22, Fleet Numerical Weather Facility, Monterey, California.

Sippican Corp. Undated. Seppican Expendable BT System description, 9 pages, Sippican Corp., Marion, Mass.

Twin Hull Boat Co. Undated. "Conlabs" Specifications and Optional Equipment, Div. of R. E. Brooks Co., Route 7, Box 159, Hasbrouck Heights, New Jersey.

Westwick, G. M. and C. H. Maag August 1965. Mobile Scientific Laboratories: Flexibility, Self Sufficiency, Utility, Feasibility; U. S. N. Missile Center, Pt. Mugu, Calif., pub. NMC-MP-65-5, 7 pages.

OPERATING MANUALS

Experimental Bathythermometer, (XBT) Operating Manual Feb. 1966. Packard Electric Div. of G. M. Corp., pub. OM66-01, GM Def. Res. Lab., Santa Barbara, California, 22 pages.

Packard Electric BTX with Teletype Output April 1965. G. M. Def. Res. Lab., Santa Barbara, California, TR65-22, 19 pages.

Model RS-7A Portable Indusction Salinometer, Instruction Manual and Conversion Tables 1964. Industrial Instruments, Inc. 89 Commerce Road, Cedar Grove, New Jersey. A-29994-D.

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

Florida Atlantic University Boca Raton, Florida 33432	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

RESEARCH SHIP OF OPPORTUNITY PROGRAM
PROJECT NEPTUNE ATLANTIC

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final Report 1965-1968

AUTHOR(S) (First name, middle initial, last name)
Charles R. Stephan
Harrison A. Hoffmann

REPORT DATE June 10, 1968	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS 12
CONTRACT OR GRANT NO. Nonr 4834(00)(01) PROJECT NO. NR 104-896	9a. ORIGINATOR'S REPORT NUMBER(S) Florida Atlantic University Ocean Engineering Department No. 1	
	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	

DISTRIBUTION STATEMENT

Distribution of this document is unlimited

SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Office of Naval Research Washington, D. C.

ABSTRACT

In July 1965, a scientific party from Florida Atlantic University, Boca Raton. Florida and General Motors Defense Research Laboratory, Santa Barbara, California conducted "Project Neptune Atlantic" using a mobile "Sea Van" laboratory on board the SS EXPORT CHAMPION on its regular cruise from New York to Genoa, Italy. This was the second phase of the Office of Naval Research "Research Ship of Opportunity" project. Its objective was to test the FEASIBILITY of gathering plankton samples from a high speed merchantman (19½ knots) and conduct biological experiments on living organisms at sea. Data for temperature profiles using expendable bathythermograph systems and concurrent navigational, oceanographic and meteorological information also were recorded. Problems associated with power for the laboratory, high speed Jet Net towing equipment, vibration and congestion in the Van during biological laboratory experiments were encountered but the project was successful in carrying out its basic objective. The overall operational costs were low. Cooperation between the scientific party, ship's crew and participating agencies was excellent. This project demonstrated the FEASIBILITY of the RSO concept for obtaining oceanographic data from ships of opportunity but highlighted limitations associated with gathering and processing living specimens at sea on board fast merchantmen. Future RSO projects should be run as scientific experiments to determine the levels of performance attainable from RSOs.

DD FORM 1473

Unclassified

Security Classification

Unclassified

Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Research Ships of Opportunity						
Project Neptune Atlantic						
Jet Net						
Expendable Bathythermometer (XBT)						

Unclassified

Security Classification