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# WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts

(14)

WHOI- ~~Reference No.~~ 49-36

(6) OCEANOGRAPHIC RESEARCH

conducted during the period

April 1, 1949 - June 30, 1949.

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

(9)

Periodic Status Report. No. 12

Submitted to the Oceanographic Division

Hydrographic Office (15)

Under Contract No. N6onr-277

Task Order No. I, NR-083-004

With Office of Naval Research

(11) July 1949



APPROVED FOR DISTRIBUTION C.O'D. Iselin
Director

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According to the terms of Contract N6onr-277, Task Order No. I, the work to be performed by the Contractor shall consist of the following:

1. The Contractor shall furnish the necessary personnel and facilities for, and, in accordance with any instructions issued by the Scientific Officer or his authorized representative shall

(a) conduct surveys and research, and analyze and compile data and technical information, prepare material for charts, manuals and reports, and foster the training of military and civilian personnel in the following fields of oceanography:

(i) permanent currents;
(ii) interaction of the sea and atmosphere, including wind waves, swell and surf;
(iii) distribution of organisms;
(iv) characteristics of the sea bottom and beaches;
(v) tides, tidal currents and destructive sea waves; and
(vi) physics and distribution of sea and terrigenous ice*;

and perform the following work in particular:

(1) (Confidential)
(2) collection of analyses of bathythermograph observations**; and
(3) conduct of a wave measurement program in the Atlantic.

* Research in connection with the relations between North Atlantic sea-ice and Arctic weather was transferred to Task Order No. V of Contract N6onr-277 on May 15, 1949 and will be reported in a separate Periodic Status Report.

** The tabulation and filing of bathythermograph observations was transferred to Task Order No. VI of Contract N6onr-277 on May 15, 1949. Observations received and processed during the second quarter of 1949 have been reported in a separate Periodic Status Report covering Task Order VI (Reference No. 49-35)



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This report contains a quarterly summary of work carried out under Contract N6onr-277, Task Order No. I by the Woods Hole Oceanographic Institution under the following headings:



The following Technical Reports have been submitted during the quarter:

Ref. No. 49-26. Report on the Oceanographic Program at Pt. Barrow, Alaska, February-March 1949. Prepared by Wm. G. Metcalf and J. F. Holmes.

Ref. No. 49-27. Bathythermograph Sections of the U.S. Navy Arctic Operations of the Summer of 1946 and 1948 (Restricted). Prepared by Wm. G. Metcalf, E. Shelnut and E. P. Tollios.

## The basic current system of the North Atlantic.

During recent years on a number of occasions the Gulf Stream has been intensively investigated in the sector between Cape Hatteras and the longitude of Halifax. Work in the Grand Banks area and in the Labrador Sea has been resumed by the International Ice Patrol. But as far as the basic current system of the North Atlantic as a whole is concerned, these studies throw light on only a small part of the over-all problem.

Figure 1 is a first attempt to look at the larger picture. Within the limits indicated, it shows the distribution of deep temperature and salinity stations from all sources as of January 1949. The plotted values are the average depth of the 10°C. isotherm to the nearest 100 meters for each one degree square where one or more hydrographic stations have been occupied. The exponents show the number of stations entering into these averages when more than one is available. West of Longitude 55° practically all of the stations have been occupied by the ATLANTIS during the last eighteen years. The U. S. Coast Guard is responsible for most of the stations off the tail of the Grand Banks. The majority of the remaining data is from European expeditions extending back to the earliest days of physical oceanography.

Figure 2 is a systematic contouring of these values, without favoring any particular interpretation. Since the 10° isothermal surface closely corresponds to a surface of constant density, except in the vicinity of Spain and Portugal, these contours must correspond to the permanent currents near the axis of the main thermocline. In other words, if it is permissible to combine these data, from different seasons and from many different years, and if the process of contouring to the nearest 100 meters has sufficiently averaged out internal waves, then under the circulation theorem these contours should closely follow the Stream lines for the depths in question, except where the temperature-salinity correlation has been strongly influenced by the outflow from the Mediterranean.

Since a number of stations combine to produce most of the major features of the current pattern in Figure 2, it is felt that the stronger currents (closely spaced contours) are relatively fixed in position and that the effect of short period internal waves has been minimized. Experience in the western half of the ocean fully supports this view. North and east of the Grand Banks, the basic current pattern is practically unknown.

Regardless of the reliability of the chart as a current map, it can be used to great advantage in the planning of future deep hydrographic stations. It will never be necessary or advisable to cover the whole area evenly with stations. These should be concentrated where the main thermocline has the most slope. In fact, the chief purpose of constructing Figures 1 and 2 was to lay out the present survey of the ATLANTIS during which it is hoped to fill in the relatively blank area between the Grand Banks and the Mid-Atlantic Ridge north of the Azores.

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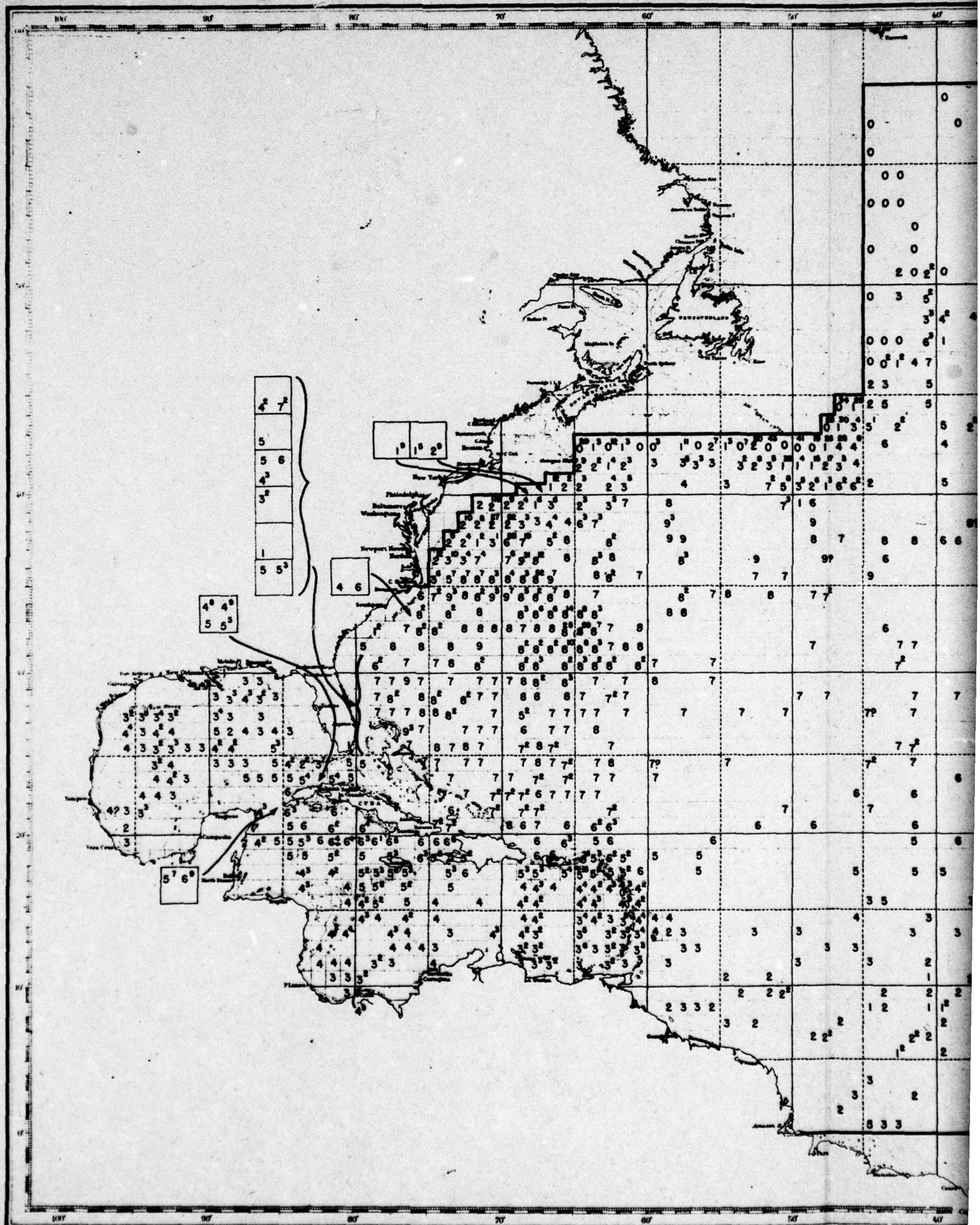
No. 1400 (PLOTTING SHEET)

# PILOT CHART OF THE NORTH ATL



HART OF THE NORTH ATLANTIC OCEAN

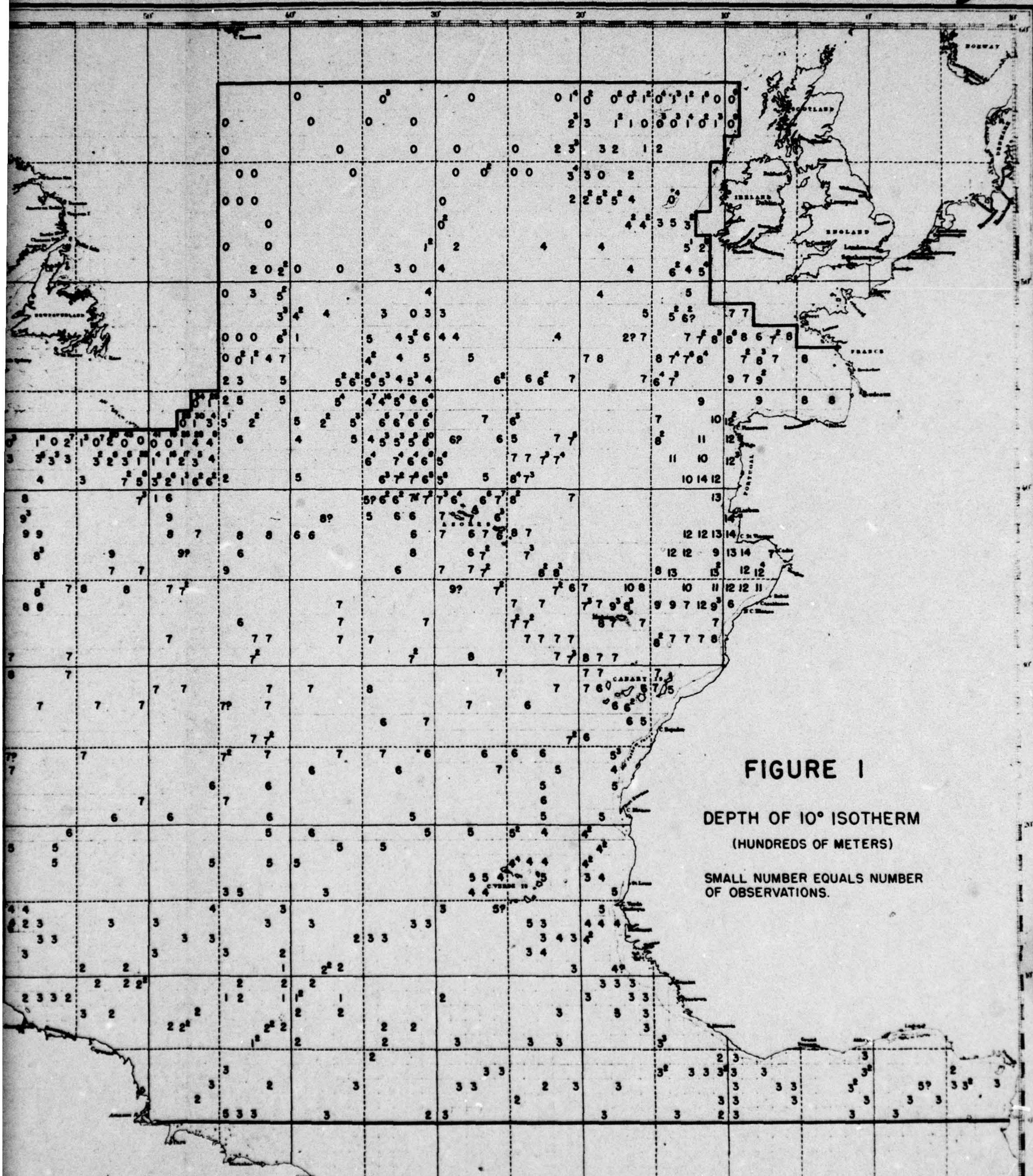



FIGURE I

DEPTH OF 10° ISOTHERM

(HUNDREDS OF METERS)

SMALL NUMBER EQUALS NUMBER OF OBSERVATIONS.

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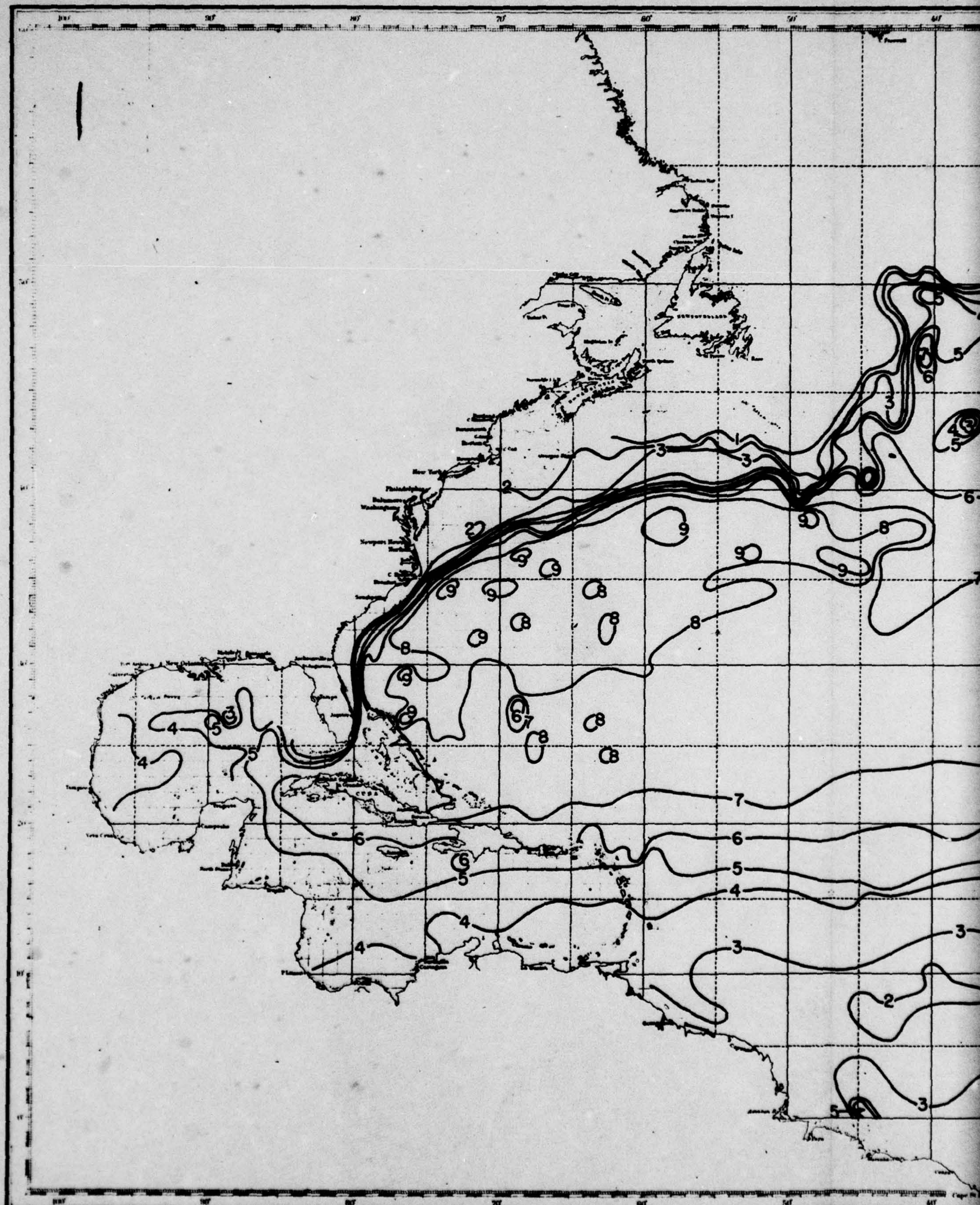
No. 1400 (PLOTTING SHEET)

# PILOT CHART OF THE NORTH ATLA



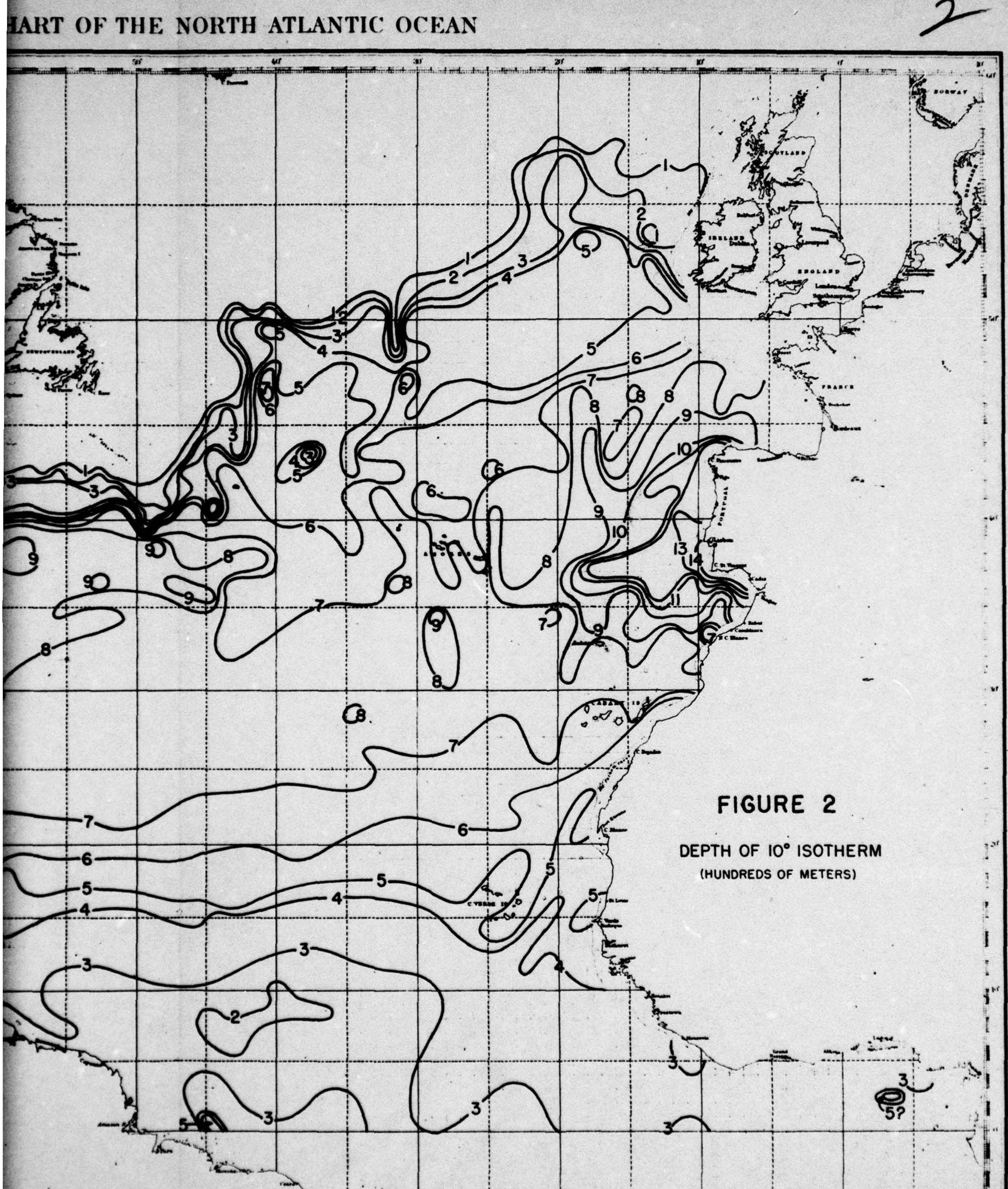



FIGURE 2

DEPTH OF 10° ISOTHERM
(HUNDREDS OF METERS)

It may be instructive to list here the questions which we have asked ourselves on the basis of Figure 2 and for which, to some extent, it is hoped that the present ATLANTIS cruise will provide answers. These are contained in a memorandum to the Chief Scientist which is as follows:

1) The underlying purpose of the cruise is to test out in a new area some of the ideas which we have developed by studying the Gulf Stream along this coast.

   a) Is meandering a local phenomenon or does the axis of the Stream continue to follow a snake-like course in mid-Atlantic?

   b) Is the bottom topography the controlling factor east of the Grand Banks?

   c) Does the steep slope of the main thermocline continue to underlie the abrupt changes in the surface layer?

   d) Is the branching of the Gulf Stream east of the Grand Banks real and is it related to bottom topography?

   e) Is the preliminary chart of the 10° isothermal surface a good surface current chart?

   f) Does the most northern branch of the Gulf Stream continue as a swift, narrow current?

2) Secondary purposes related to these are:

   a) To fill in the gaps in the network of deep hydrographic stations.

   b) To provide data for Sofar.

   c) To add to the store of chemical data from the Atlantic.

   d) To extend the detailed bathythermograph survey into an important area.

For all of these purposes, the most critical factors will be to cover as much mileage as possible, and to obtain the best and most detailed navigational record possible. This is the first time we have attempted detailed work in a region of strong current without the help of loran.

3) The important practical applications of this survey will be in the construction of better sonar charts and submarine supplements.

4) To this basic program has been added as much geology and geophysics as can be accomplished without serious interference.

   a) Acting as the shot boat for CARYN on the leg out towards Bermuda.

   b) Reflection shooting (and bottom reflectivity).

   c) About twenty deep cores.

   d) Incidental scattering layer data and plankton hauls.

   e) Towing the magnetometer.

   f) Tests of implosion bombs.

   g) Studies of bottom reflection coefficient in deep water.

This is a very full program and it cannot be laid out in any detail in advance. Where you go will depend on where the Gulf Stream goes. How often it will be profitable to stop for hydrographic stations will depend on whether or not unexpected conditions are encountered. Because of gravel dropped by ice, bottom coring may be difficult, if not impossible in the more northern part of the area.

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Looking again at Figure 2 somewhat more broadly, a very basic problem is at once apparent. Neglecting the disturbing factor of the Mediterranean water, it is evident that only a few of the contours close, as would be expected if the system was entirely wind-driven. It can be argued that in a rough sort of way the diagram separates the part of the energy due to the winds from the part of energy due to heating in the tropics and cooling in the north. It is clear that at least half of the contours carry the water far enough north so that it will not find its way directly back into the trade wind current. Thus, on the basis of Figure 2, the North Atlantic permanent current system seems to be about half wind-driven and about half a "heat engine". The supply of water to be cooled at the surface in the north and therefore to sink is much greater than had been anticipated.

Unfortunately, some of these tentative conclusions are more or less blasted by Figure 3, which is a plot of the depth of the 5° isothermal surface. This roughly marks the lower limit of the main thermocline and is much more strongly influenced by the Mediterranean water. Nevertheless, there seem to be important differences between the 5° and 10° levels in the northeastern area.

It is evident that it will be worth while to refine such large scale studies by using density rather than temperature and by bringing in isentropic mixing. Mr. Bumpus has begun such a study of the Mediterranean outflow.

## An hydraulic model of Barataria Bay in Louisiana.

The following is a description of a model study undertaken by Mr. von Arx for the Freeport Sulphur Company. It is included here because the necessary background for such work was forwarded by this contract and because of the rather obvious Naval applications of this technique.

Very late in 1948, the Freeport Sulphur Company requested the Woods Hole Oceanographic Institution to undertake construction of an hydraulic model of the area roughly 25 miles square in which their Louisiana mines are located (See Chart 1273 USC&GS). In this large area the average depth of water is of the order of only three feet, necessitating either a very large model or a highly distorted smaller model. For reasons of limited space and keeping expense within reasonable bounds, it was decided to build the model eight feet square, employing a horizontal scale of 1/20,000 and a vertical scale of 1/192; that is, a vertical exaggeration of the order of 1/100. The model was constructed on a strong bed of 2 x 12 inch fir arranged to form a tight network of triangular voids not more than 16 inches on a side, and covered with 3/4-inch marine plywood in steps so cut that the treads had the shape of the intervals between successive 12-foot contours in the prototype. This staircase was boxed in by a heavy combing, caulked, and covered with hardware cloth. Over this a 4-inch thickness of Hydrocal B-11 (precision pattern-maker's $CaSO_4$ plaster) was cast as a monolith in which the intricate modeling of the bays and islands could be cut with rotary tools. The layout of the land and islands was projected from the top of a tower at a height of 16-feet above the model surface, traced off, and routed so that sea level lay 1/4-inch below the land surface. The soundings were then entered on the sea level surface from the same lantern slide, and additional soundings entered from the original data sheets provided by the U. S.

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# PILOT CHART OF THE NORTH ATLAN

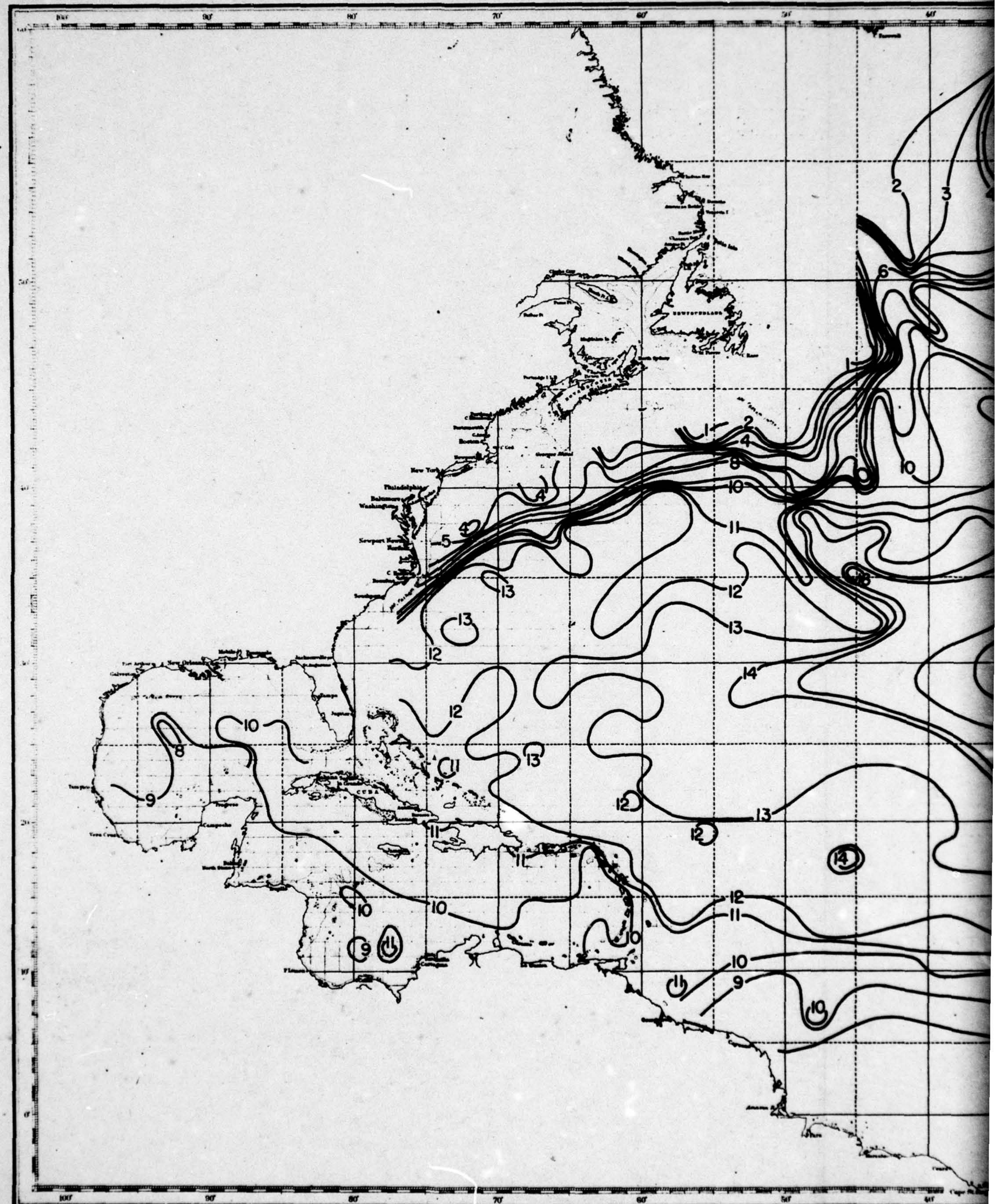

CHART OF THE NORTH ATLANTIC OCEAN

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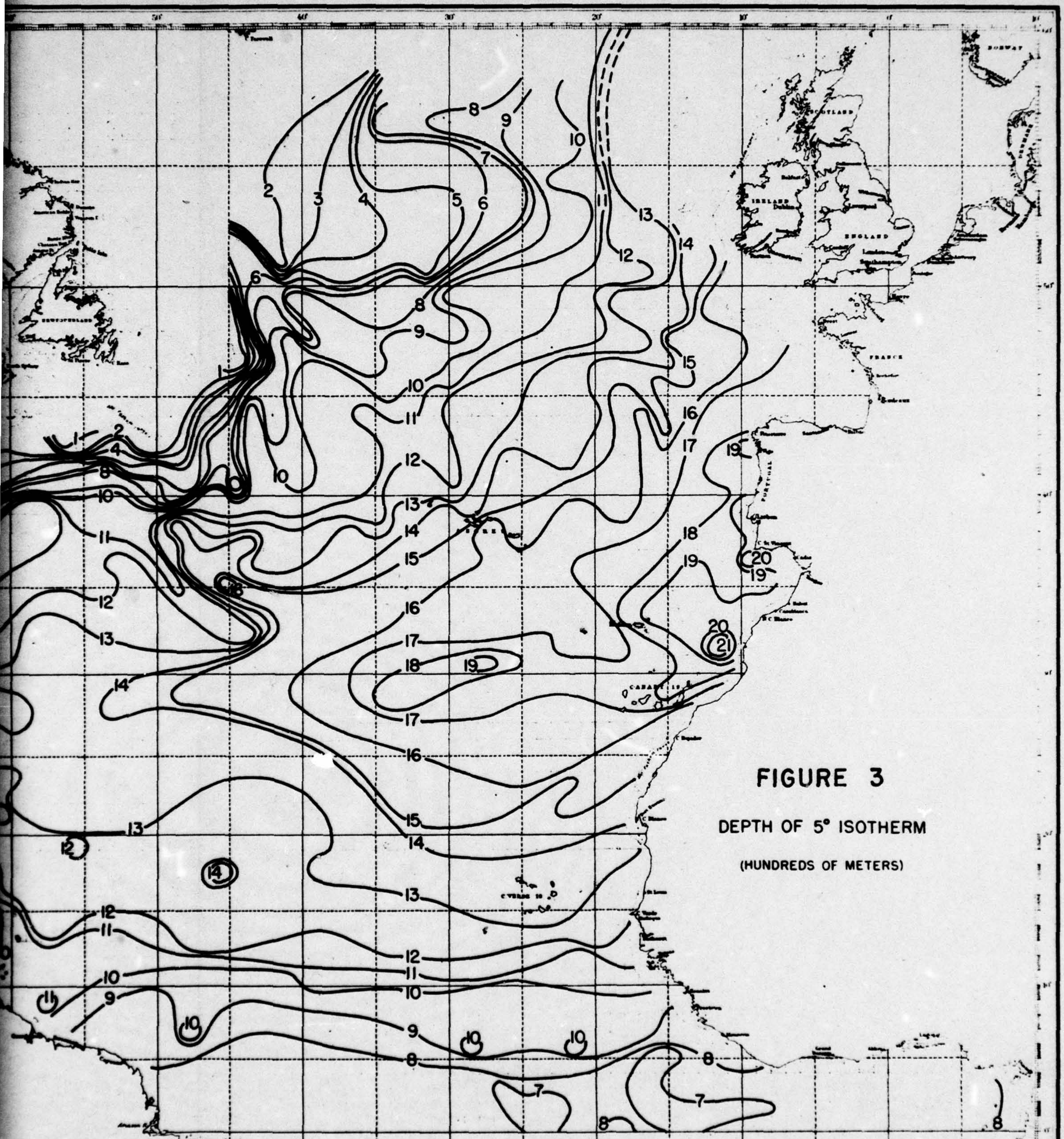



FIGURE 3

DEPTH OF 5° ISOTHERM

(HUNDREDS OF METERS)

W.H.O.I. APRIL 1949

(PLOTTING SHEET)

Coast & Geodetic Survey. Soundings were realized by routing between carefully drawn contours. The steps were then blended with hand tools. The resulting surface is probably accurate to 0.01-inch vertically and 0.05-inch horizontally. Sea level was established as a level plane through repreated checks with a precise transit on a pair of rails from which the routing tools were suspended.

Froudean scaling of time, velocity and discharge were used successfully except at the passes connecting the bays with the Gulf of Mexico. Here the velocities were too high as were the Reynolds numbers in the model. It was thought that this departure came from too smooth a bottom and insufficient attention to the roughness (Manning) factor. Roughness was artifically increased by means of screens (20 x 20 mesh) in the passes and this not only brought the velocities into agreement with Froudean scale but corrected the scale of turbulence. To verify its kinematic behavior, the flooded model was carefully compared with data from a week of field observations and the detailed field reports of H. A. Marmer, S. A. Lynch and V. H. Brogdon. No serious discrepancies appeared and the times of slack water and magnitudes of velocities at a large number of points were gratifying correct.

The auxiliary equipment for producing tides, winds, rainfall and industrial discharge was also scaled by Froudean laws.

The <u>tide machine</u> employs three drums which displace water and raise the level in the model sinusoidally at rates in accordance with the time scale of 1/1440 (one minute per day). Each drum is driven by a scotch yoke through a stroke of 2-inches, the semi-diurnal drum having a size determined by the sum of the amplitudes of the $M_2$, $S_2$ and $N_2$ components and a speed number of the average of the component speed numbers, a diurnal drum of a size determined by the amplitude of the $O_1$ component and a speed number of the $O_1$ component, and a second diurnal drum of a size determined by the sum of the $K_1$ and $P_1$ components and driven at the average speed of these two which is precisely a mean solar day per 360°. Thus, the second diurnal drum is run at one cycle per minute and the other two at 30.5 seconds and 64.5 seconds per cycle respectively. This combination produces a succession of great diurnal tides yielding to lesser semi-diurnal tides at intervals of two "weeks", a progression characteristic of this region of the Gulf.

The winds are generated by tank-type vacuum cleaner blowers mounted at the cardinal and intercardinal points. Each is controlled by a switch at a central console and its rate of pumping controlled by a single Variac. Thus, it is possible to vary the wind speed and direction to reproduce the weather as it occurred during certain periods of interest to the sponsors in accordance with the records of the U. S. Weather Bureau reports from Grande Isle, Louisiana. Calibration of the wind machines was accomplished by observing the rate at which the surface layer of water in the model is propelled at the steady state. It was assumed that in 15 model miles of fetch an equilibrium surface current should be of the order of 2 to 3% of the wind speed. By this measure, it is possible to produce winds of hurricane force from the simultaneous draught of three blowers running at full speed. Due to the vertical exaggeration of the model, the wave height is much too small and because of the small horizontal scale the wave length is too large.

Rainfall, which amounts to 5 feet per year on a watershed of some 800 square miles to the north of the modeled area and drains into the area at the rate of 430,000,000 cubic feet per day, according to Marmer, is introduced at the north end of the model in scaled quantities by means of a pump attached to the tide machine. This pump draws water from the Gulf and causes a closed circulation system for the rainfall, and also exhausts a current of water through a venturi which produces a slow counterclockwise circulation of the Gulf water in agreement with currents derived from the slope of the dynamic topography of the off-shore waters. The difference in density of the rain water and sea water in the prototype is considerable but in a distorted model these density differences must be reduced by the distortion ratio and thus are closely approximated by a homogeneous fluid.

Industrial wastes are introduced into the model through copper tubes imbedded in the plaster terminated at their proper geographical positions. The nether ends are attached to open glass cups at the level of the water in the model. Each glass cup has a calibrated dropper tip over it and the droppers are fed by a 100 cc hypodermic syringe closed by a motor-driven worm. Thus, one may know how much industrial waste is being introduced by counting drops per minute and converting this count into millions of gallons per day in the prototype through the convenient conversion factor of one drop per million scale gallons. The industrial waste is simulated with acid of such concentration that when mixed with a given number of volumes of ambient model water will turn an indicator solution of Brom Cresol Green with which the model is filled, from yellow to blue. The model water is set to a known alkaline state (blue) such that for a given acid strength the color change will occur at a predetermined dilution. In this way the industrial waste, more concentrated than a certain dilution figure, is represented by yellowed water and the more dilute solutions by a very pleasant blue color pervading the whole model and varying in intensity with the depth of water.

Continued discharge of industrial waste eventually extends its boundaries to a point where the color change has not occurred before it is discharged into the Gulf portion of the model. As the yellow of unneutralized acid reaches the Gulf, a base of identical strength is introduced at the same discharge rate into the Gulf at the circulating venturi. Thus, the Gulf and rain water drainage is rendered chemically infinite and retains quantitatively its alkaline condition so that the model can be run indefinitely to study the steady states of waste distribution under a variety of "weather" conditions produced by the wind machines. The water for the rainfall system is withdrawn from the Gulf upstream from the base interior so that the rainfall water supply has no excess of base.

The results of the model studies are recorded photographically in color by means of two cameras (1) a 35 mm microfilming camera operated once every 7.5 seconds producing 8 exposures per model day and (2) a 16 mm movie camera operated at 1 exposure every second yielding 60 exposures per model day and a contraction of time when projected at 16 frames per second to 1 model day per 3.75 seconds. Light for photography is provided by 12 No. 2 photofloods in reflectors yielding a total of 6000 watts illumination in controllable quantities for producing uniform lighting. An electric clock graduated in model hours, days and weeks is mounted in the field of view so that the elapsed time from the beginning of each experiment is automatically totalized. Similarly the contribution of each of the tide drums is integrated and indicated by a traveling pointer on a scale large enough for the cameras to record the height of water to 0.05 foot. The same integrator is coupled with a pen which writes a record of the tides on a paper tape moving at 1/2-inch per minute. The wind direction is indicated by a small banner on a circular card near the center of the model. This banner is limp enough to fall slack when no wind is blowing and furnishes proof of that fact to the cameras.

Hydraulic models have been used for many years for studies of ships hulls, waves, silting and flooding of rivers, dam construction, sluiceways, silting of harbors, testing proposed breakwater, riprap, and dock locations and many other engineering purposes. This model was undertaken (1) to provide experimental data on the distribution of the industrial wastes from the Freeport Sulphur Company's Louisiana mines and (2) to determine the effectiveness of highly distorted models of bays and estuaries as aids in future studies of ecology or contamination near shore. It is believed that this area is fully as complicated as most bays and estuaries of the coasts of the United States in shape and hydrography; yet the relative ease with which this model was verified for kinematic similarity and partial dynamic similarity suggests that this technique may be useful in the future for solving contamination problems of many kinds, especially those in which hydrology, meteorology and oceanography combine to produce complicated and variable flow patterns.

Hydrographic surveys off East Coast of U. S. between Miami, Florida and Cape Hatteras.

In May, R.V. CARYN made one hydrographic section and two bathythermograph sections in the Gulf Stream off Miami, in cooperation with University of Miami Marine Laboratory. Institution personnel instructed Miami personnel in the use of oceanographic instruments at sea and aided them in collecting hydrographic, chemical and plankton data. Twenty-two bathythermograph and multiple sea sampler sections were made across the continental shelf between Miami, Florida and Beaufort, North Carolina. This cruise was under the supervision of Mr. Bumpus aided by Messrs. Miller, Krance and Snelling.

Messrs. Hayes, Miller and Abel participated in a U.S. Fish and Wildlife Service survey aboard the R.V. ALBATROSS III in the continental shelf area between Oregon Inlet and Cape Fear during the period from 17 May to 15 June. The Institute of Fisheries Research of the University of North Carolina also participated in this survey. During this cruise hydrographic stations were occupied off the North Carolina coast out to as far as the one thousand fathom curve. Chemical analyses of oxygen and phosphorous phosphate content were done aboard ship. Bathythermograph and multiple sea sampler sections were also made. The hydrographic results of these several cruises are now being studied.

__Hydrographic stations in the Brownson Deep.__

In March and April, during ATLANTIS Cruise #154, two deep Nansen bottle lowerings were made in the Brownson Deep north of Puerto Rico. The depths attained were slightly greater than 6,800 meters, or approximately 900 meters above the bottom. The outstanding feature of both stations was a slight positive temperature gradient below 5,700 meters, with a minimum temperature of 1.97°C. A preliminary analysis indicates that this gradient is close to the adiabatic gradient for sea water. Corresponding salinity determinations are not yet completed. This study is being carried out by Mr. Pollak.

__Underwater photography.__

Mr. David M. Owen joined the ATLANTIS in Miami, Florida on April 8, and in the following two months assisted Mr. David Barnes and Mr. Robert Price in the operation of a high-speed underwater movie camera built and used on W.H.O.I. Contract NOrd-9500 with the Bureau of Ordnance. During this time, the Institution Ewing-type underwater camera was also tested. Two photographs (camera focus three feet) in the scattering layer were obtained. One of the photographs contains two streaks which are possibly Euphausids. During the return trip to Woods Hole, Mr. William Shultz assisted Mr. Owen in rigging the camera to fire ten flashbulbs instead of one. Two long-distance photographs were made in the scattering layer with this adaptation, showing no sizeable organisms within fifty feet. The light source was then directed to the bottom, and two photographs were obtained on the continental shelf covering an area of 289 square feet.

In the latter part of June, Mr. Owen experimented further with this camera during a six-day cruise of the U.S. Fish and Wildlife Service R.V. ABBATROSS III conducted in the Georges and Browns Bank region. With two camera cases strapped to the pole, several stereoscopic bottom photographs of large areas were obtained. With a camera-to-bottom distance of 25 feet, 400 square feet of the bottom was covered, compared with a ten-foot distance and approximately 36 square foot coverage with previous cameras. Mr. Owen plans to use a shorter camera-to-bottom distance in the future in order to obtain a more pronounced stereoscopic relief, and this will enable the camera to operate in shoaler and less transparent water.

## Tables and graphs for specific volume anomaly.

Upon completion of salinity determinations of all ATLANTIS hydrographic stations in the Mediterranean Sea, standard oceanographic analyses of these stations were started. Since existing tables for computing specific volume anomalies were considered inadequate, a set of graphs was constructed covering only the ranges of salinity and temperature found in the Mediterranean. These graphs have smaller intervals of the arguments than Sverdrup's tables and can be read to one more decimal point than the recently completed Hydrographic Office graphs. This work is being carried out by Mr. Pollak.

## Salinity titrations and calibrations of thermometers.

During the period April 1 to June 30, the following salinity samples have been titrated:

| | |
|---|---|
| ATLANTIS Cruise #151 | 960 |
| CARYN Cruise #6 and #7 | 350 |
| ATLANTIS Cruise #154 | 40 |
| Barnstable Harbor | 22 |
| U. S. Public Health Service | 39 |
| | 1411 |

This work was carried out by two full-time technicians under the supervision of Mr. Penrose. Following is a tabulation of the number of reversing thermometers Mr. Penrose has received and calibrated during the quarter:

| | | |
|---|---|---|
| Thermometers received: | National Museum | 11 |
| | U.S. Fish and Wildlife Service | 39 |
| | Hydrographic Office | 20 |
| | | 70 |
| Index calibrations completed: | U.S. Fish and Wildlife Service | 9 |
| | National Museum | 9 |
| | Hydrographic Office | 30 |
| | Scripps Inst. of Oceanography | 14 |
| | | 62 |

Pressure factors determined: Scripps Inst. of Oceanography 4

Equipment for determining index corrections of reversing thermometers and for determining the pressure factor of unprotected thermometers has been developed. Since the inception of the thermometer calibration program in the latter part of 1946, statements of calibration have been issued for 272 thermometers including 13 for which the pressure factor has been determined. Figure 4 is a view of the calibration room.

Operation CROSSROADS supported the development of the index calibration equipment and calibration of 75 thermometers during the first year and one half. These thermometers had been borrowed from various agencies for use during Operation CROSSROADS.

During the past year, the Woods Hole Oceanographic Institution has supported the development of the pressure factor equipment and maintenance of all the calibrating gear. Index calibrations have been completed on 197 thermometers and pressure factors determined on 13 thermometers. Index corrections of main protected thermometers with range greater than 12°C. are determined at each 4°C. point including the ice point; those with range less than 45°C. are checked at each 5°C. point. Index corrections of auxiliary thermometers are determined at 0, 10, 20 and 30°C.

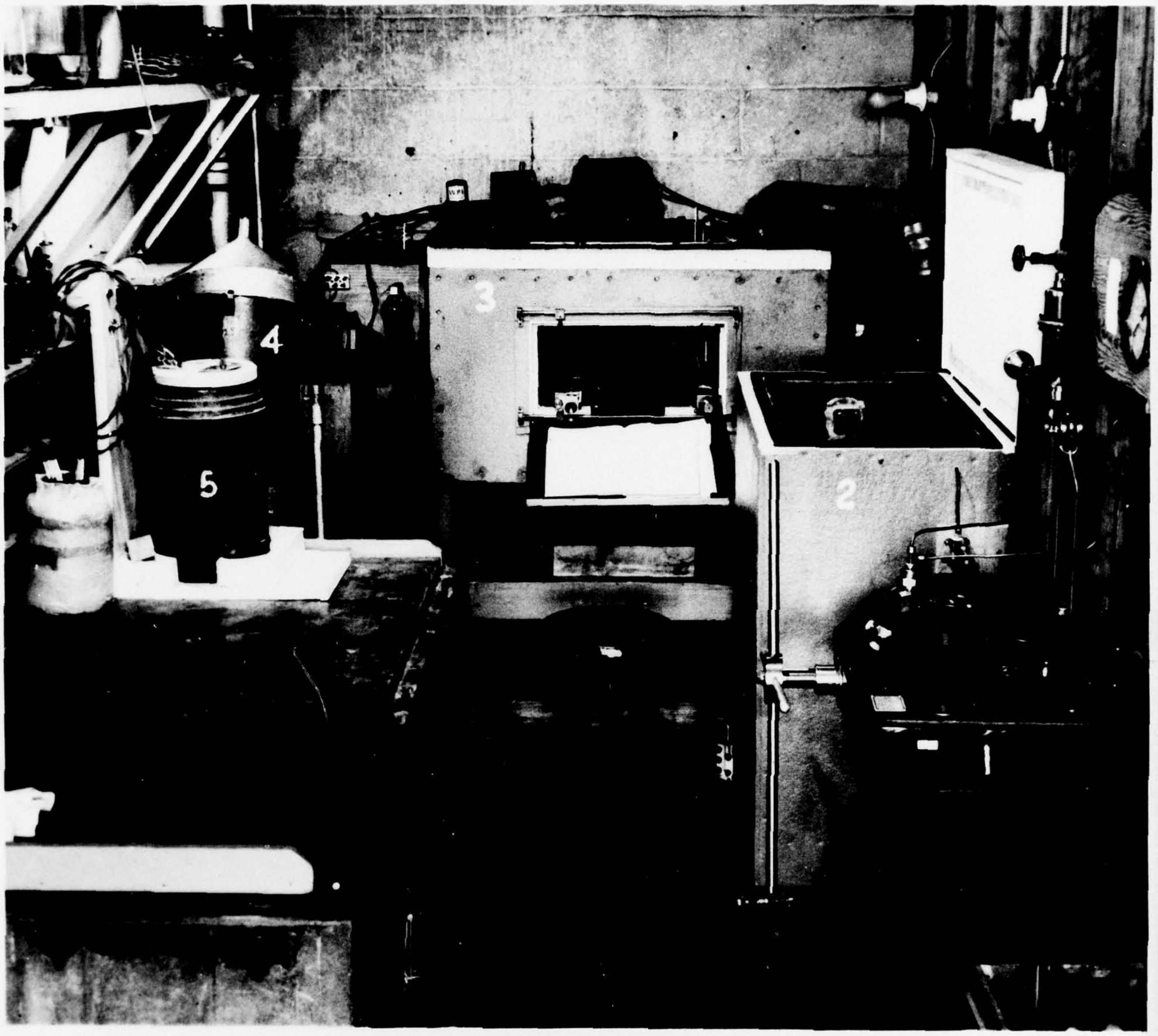
$V_0$ is determined when it is not adequately known.

A Statement of Examination is issued for each thermometer upon completion of calibration. During the past ten months, the owners of the thermometers have been charged the following fees for the calibration service.

| | |
|---|---|
| Ice point determination | $2.00 |
| Each other point of the main thermometer | 1.75 |
| Pressure factor, per pressure point | 7.50 |

Contract N6onr-277, Task Order No. 1 paid for calibration of thermometers for a period of two months before the above prices were established.

As a part of the calibration procedure, each thermometer is examined to check whether mercury sticks in the upper chamber, whether it breaks off properly, whether there are gas bubbles in the mercury and whether graduations




LEGEND

1- FLUID PRESSURE SCALE.
2- WATER BATH FOR PRESSURE VESSEL.
3- TEMPERATURE CALIBRATION TANK.
4- ICE POINT CALIBRATION TANK.
5- WATER BATH FOR BUCKET THERMOMETER CALIBRATION.

FIG. 4

are correctly spaced and clear. Whenever possible, the usual techniques are employed to eliminate the gas bubbles and sluggish action in order to provide accurate operation of the thermometers. Those which do not respond to the usual manipulation are returned to the owners with a service charge of $2.00.

146 thermometers belonging to U. S. Navy Hydrographic Office, Fish and Wildlife Service (Pacific), Fish and Wildlife Service (Atlantic) and Bermuda Biological Station are awaiting calibration.

<u>Arctic Oceanography</u>.

On April 5, Mr. Metcalf returned from a two month's stay at the Arctic Research Laboratory, Pt. Barrow, Alaska. A short report for general distribution was drawn up describing the oceanographic program at Pt. Barrow, and a more detailed report was compiled for the Chief of the Division of Oceanography, Hydrographic Office. These reports were submitted in June.

The bathythermograph profiles from the 1946 and 1948 arctic supply expeditions were drawn up and submitted to the Hydrographic Office as a supplement to the report of the 1948 Arctic Summer Operation.

In addition, Mr. Metcalf was engaged in briefing observers for arctic work both at Pt. Barrow and aboard the Navy ice-breaker going to the Baffin Bay region this summer. Mr. William Butcher was briefed and equipped for continuing the Pt. Barrow work as an assistant to Mr. Bates of the Hydrographic Office. Originally scheduled to be in Pt. Barrow for the months of June and July, Mr. Butcher was held up a full month due to a delay in the writing of his Navy orders.

Mr. Donald Martineau and Mr. Edgar Hichens were briefed and equipped for the ice-breaker trip to leave in July. Their work will be a continuation of the work done the three previous summers by Lt. Moreau, USCG, (1946) and Mr. Metcalf (1947,1948).

During this period, work has been progressing slowly on a lightweight arctic winch being made by Mr. Lloyd Hoadley. The winch, originally designed as a bicycle-type pedal-operated winch, is being modified to accommodate a small gasoline engine interchangeably with the bicycle arrangement.

The features aimed for in the design of this winch are:

(a) 10,000 feet of 1/16th inch cable capacity,
(b) minimum weight,
(c) ease of assembly and disassembly without the use of hand tools,
(d) small packing space when disassembled.
(e) ease of operation and assembly by a man wearing heavy arctic mittens.

<u>Auxiliary Sea Sampler</u>.

The Auxiliary Sea Sampler is a bathythermograph which is saddled with a single sea sampler bottle. It is arranged to trap sea water at the lowest depth of the instrument's traverse when used underway. This is accomplished by utilizing the deep dive attachment, a standard accessory for the bathythermograph and a plug to keep the bottle open. The plug is pulled out, closing the bottle, when the deep dive attachment is disengaged. See accompanying photograph (Fig. 5).

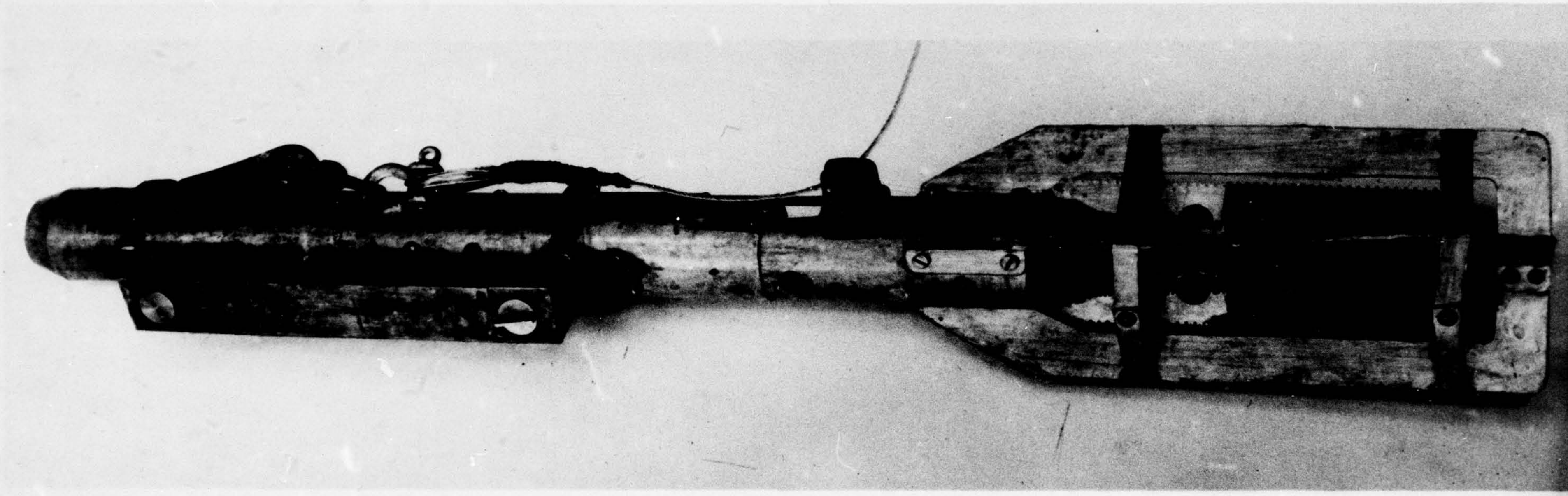
<u>Ocean wave analyses</u>.

H. R. Seiwell read a paper entitled "The Principles of Time Series Analyses Applied to Ocean Wave Data" before the National Academy of Sciences on April 25, 1949. This paper will be published in the September 1949 Proceedings of the National Academy of Sciences.

<u>Symposium on Application of Auto Correlation Analysis to Physical Problems</u>.

A Symposium was held at Woods Hole Oceanographic Institution for the Office of Naval Research on June 13 and 14 on the uses of auto correlation analysis for various types of scientific problems. Ten papers on this subject were presented and discussed. About sixty scientists representing the following laboratories were in attendance.

| | |
|---|---|
| Marine Physical Laboratory | San Diego, Cal. |
| Evans Signal Laboratory | Belmar, N. J. |
| Naval Research Laboratory | Anacostia, Md. |
| Electronics Research Laboratory, Harvard University | Cambridge, Mass. |
| Naval Ordnance Laboratory | White Oaks, Md. |
| Coles Signal Laboratory | Redbank, N. J. |
| Servo-Mechanism Laboratory, M.I.T. | Cambridge, Mass. |
| Psycho Acoustic Laboratory, Tufts College | Medford, Mass. |



AUXILIARY SEA SAMPLER

FIG. 5

| | |
|---|---|
| Psycho Acoustics Laboratory, Harvard University | Cambridge, Mass. |
| Cruft Laboratory, Harvard University | Cambridge, Mass. |
| Airborne Instrument Laboratory | Mineola, N. Y. |
| U.S. Navy Underwater Sound Laboratory | New London, Conn. |
| Research Laboratory of Electronics, M.I.T. | Cambridge, Mass. |
| Psychological Laboratory, Brown University | Providence, R. I. |
| Department of Geology, Columbia University | New York, N. Y. |
| Department of the Army, Office of the Chief Signal Officer | Washington, D. C. |
| Department of the Navy, Office of Naval Research | Washington, D. C. |
| Department of Mathematics, M.I.T. | Cambridge, Mass. |
| U. S. Bureau of Standards | Washington, D. C. |
| Department of the Navy, Bureau of Ships | Washington, D. C. |
| National Research Council, Committee on Undersea Warfare | Washington, D. C. |
| General Electric Co., Aeronautical and Ordnance Division | Schenectady, N. Y. |
| Department of Meteorology, N. Y. U. | New York, N. Y. |
| Stevens Institute of Technology | Hoboken, N. J. |
| Woods Hole Oceanographic Institution | Woods Hole, Mass. |

**Assistance to Hydrographic Office.**

Mr. Wehe reached New York aboard the U.S.S. MAURY (AGS-16) on June 6 and submitted a preliminary report of his oceanographic work which will be included in the ship's report of the cruise. He secured all the necessary information for the final report from the ship except the positions of the bottom and salinity samples which are dependent on the smooth sheets that are to be plotted. He expects to obtain these positions before the MAURY leaves again in the fall.

Mr. Wehe plans to report in person to the Hydrographic Office early in July.

**Cooperation with University of Washington.**

Mr. Arnold Clarke returned to the Institution on June 1 having completed his assignment beginning September 28, 1948 at the University of Washington in Puget Sound under the supervision of Dr. C. A. Barns under contract with Office of Naval Research. During this period, he participated in twenty field trips in R. V. ONCORHYNCHUS and aided in the working up of the STD records. A report has been submitted for file with this Institution covering in detail the behavior of the STD and resulting trouble shooting and repair.

Cooperation with University of California.

Mr. Henry Stommel departed Woods Hole for San Diego on June 21. He will be attached to the Marine Physical Laboratory and Scripps Institution of Oceanography for a period of about six months as a visiting lecturer and investigator.

# PERSONNEL

| ASSIGNMENT | NAME | TITLE | TOTAL MAN DAYS* |
|---|---|---|---|
| GENERAL TASK ASSIGNMENT | C. O'D. Iselin** | Director | |
| | A. C. Redfield | Associate Director | |
| | F. C. Ryder | Assistant to Director | |
| | Jeanne M. Backus | Secretary | |
| | | | 38 |
| HYDROGRAPHIC OBSERVATIONS AND ANALYSES | Robert Abel | Chemist (part-time) | |
| | Edward Penrose | Research Associate in Physics (part-time) | |
| | Eugene Krance | Hydrographic Technician | |
| | Dean Bumpus | Oceanographer (part-time) | |
| | Wm. Metcalf | Research Associate in Arctic Oceanography | |
| | Theodore Wehe | Hydrographic Technician | |
| | Arthur Miller | Hydrographic Technician | |
| | Irving Schell | Research Associate (part-time) | |
| | L. V. Worthington | Hydrographic Technician (part-time) | |
| | Carlyle Hayes | Hydrographic Technician (part-time) | |
| | Jonathan Snelling | Hydrographic Technician (part-time) | |
| | Martin Pollak | Physical Oceanographer (part-time) | |
| | William Butcher | Hydrographic Technician (part-time) | |
| | Arnold Clarke | Hydrographic Technician (part-time) | |
| | Philip Malicoat | Hydrographic Technician (part-time) | |
| | Frank Mather | Hydrographic Technician (part-time) | |
| | David Owen | Hydrographic Technician (part-time) | |
| | Donald Martineau | Hydrographic Technician (part-time) | |
| | Edgar Hichens | Hydrographic Technician (part-time) | |
| | | | 656½ |
| CURRENTS AND WAVES | Barbara Bunker | Statistical Technician (part-time) | |
| | Mary Gifford | Statistical Technician | |
| | Henry Stommel | Physical Oceanographer | |
| | William von Arx | Physical Oceanographer (part-time) | |
| | H. R. Seiwell | Physical Oceanographer (part-time) | |
| | Richard Dimmock | Technician | |
| | Louise Dudley | Secretary-Technician (part-time) | |
| | Dorothy Yarnold | Laboratory Helper (part-time) | |
| | Louise Allen | Laboratory Helper (part-time) | |
| | Mortimer Datz | Technician (part-time) | |
| | Thomas Duke | Research Assistant (part-time) | |
| | Hans Panofsky | Research Associate (part-time) | |
| | | | 403½ |
| PHOTOGRAPHY AND DRAFTING | Claude Ronne | Photographer (part-time) | |
| | John Stimpson | Draughtsman (part-time) | |
| | Eva Shelnut | Draughtsman (part-time) | |
| | Ann Hazelton | Ozalid Operator (part-time) | |
| | | | 34½ |

PERSONNEL (cont'd)

| ASSIGNMENT | NAME | TITLE | TOTAL MAN DAYS* |
|---|---|---|---|
| MISCELLANEOUS SHOPWORK AND LABORATORY ASSISTANCE | Electronics, Carpentry, Chemical Analyses, Machine Shop, Instrumentation, and Typing | | $84\frac{1}{2}$ |

* Man Day consists of 8 working hours.
** Time not included in figures for man days.

GRANT TOTAL 1217

[redacted]

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts

Reference No. 49-36

OCEANOGRAPHIC RESEARCH

conducted during the period

April 1, 1949 - June 30, 1949.

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Submitted to the Oceanographic Division
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Under Contract No. N6onr-277
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With Office of Naval Research

July 1949

APPROVED FOR DISTRIBUTION ____________
Director

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[redacted]