WOODS HOLE OCEANOGRAPHIC INSTITUTION

Reference No. 62-15

OCEANOGRAPHIC AND UNDERWATER
ACOUSTICS RESEARCH

conducted during the period
1 November 1961 - 30 April 1962

WOODS HOLE, MASSACHUSETTS

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Woods Hole, Massachusetts

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Submitted to Undersea Warfare Branch
Office of Naval Research

Under Contracts Nonr-1367(00)NR261-102 and Nonr-2129(00)NR261-104

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Paul M. Fye,
Director

ABSTRACT

This is a status report for the six-month's period indicated. It includes the closing phase of a long cruise of CHAIN to the Mediterranean Sea during which circulation of the waters of the eastern Mediterranean were studied and sound transmission, seismic reflection, and shallow thermal structure measurements were made at various places in the Mediterranean and the North Atlantic. During the remainder of the period various geophysical, geological, and hydro-acoustical analyses were conducted at Woods Hole and preparations for the summer cruising season were made.

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INTRODUCTION

This is a status report of Contract Nonr-1367(00) with the Office of Naval Research covering the period 1 November 1961 - 30 April 1962. Research under this contract covers a broad field of physical oceanography and submarine geology and geophysics. During November and December Cruise #21 of the R/V CHAIN to the eastern Mediterranean was completed. The portion of the cruise within this period was devoted to the following projects:

1. A study of the circulation of waters in the far eastern Mediterranean.
2. Sound transmission studies in the eastern Mediterranean in collaboration with staff of the SACLANT Research Center on the research vessel ARAGONESE.
3. Seismic reflection studies and bathymetry in the Tyrrhenian Sea.
4. Geologic studies of the Mid-Atlantic Ridge, including echo soundings, rock dredging, and photography.
5. Studies of thermal structure at shallow depth at various locations in the Mediterranean.

A preliminary report of this cruise is in preparation. The principal achievements of the first half of this cruise were discussed in the last status report (WHOI Ref. No. 62-14). Similar observations were continued during the second half and, in addition, a camera was attached to the towing wire of a rock dredge and photographs of the ocean floor were taken ahead of the dredge as it was sampling the bottom. During one such dredge haul, made in a deep depression near the center of the Mid-Atlantic Ridge, many basaltic rocks, some with glassy outer surfaces were recovered. From preliminary study these rocks appear to be similar to rocks taken from the ridge by Professor Ewing on ATLANTIS several years ago.

During the winter and early spring the data from seismic reflection studies, particularly those taken over flat plains were analyzed, and the geological collections of cruise 19 to the Puerto Rico Trench and cruise 21 of CHAIN to the eastern Mediterranean were studied. Also preparations have been made for starting programs to measure gravity and the total magnetic field during the summer and fall of 1962. The plan is to combine

these studies with continuous seismic reflection observations over the outer ridge, the abyssal plain, and the Bermuda Rise in the North America Basin.

During recent months a series of folios of charts of the major cruises supported mainly by this contract have been issued as WHOI references (see the list of technical reports). On the charts are shown soundings and the location and general nature of other observations made during the cruise. The distribution of these folios, which are bulky, will be limited to the Hydrographic Office and to institutions or scientists having an immediate need for the data.

PAPERS

The following papers prepared under Nonr-1367(00) were published during this period:

WHOI Contribution No. 1216. Improved Techniques of Deep-Sea Rock Dredging by A. J. Nalwalk, J. B. Hersey, J. S. Reitzel, and H. E. Edgerton. Deep-Sea Research, Vol. 8, No. 3/4 (Dec./Jan.), pp. 301-302.

WHOI Contribution No. 1217. Findings made during June 1961 Cruise of CHAIN to Puerto Rico Trench and Caryn Sea Mount by J. B. Hersey. Journal of Geophysical Research, Vol. 67, No. 3, pp. 1109-1116, March 1962.

The following paper has been published under other contracts but is believed to be of interest to ONR, Code 466:

WHOI Contribution No. 1178. Sound Scattering Spectra of Deep Scattering Layers in the Western North Atlantic Ocean by J. B. Hersey, R. H. Backus, Jessica Hellwig. Deep-Sea Research, Vol. 8, Nos. 3/4 (Dec/Jan) pp. 196-210, 1962. Prepared under NSF Grant 9579 and NObsr-72521.

The following papers prepared under Nonr-1367(00) were submitted for publication during this period:

WHOI Contribution No. 1233. The Atlantic Equatorial Undercurrent by W. G. Metcalf, A. D. Voorhis, and M. C. Stalcup. Submitted to Journal of Geophysical Research. Prepared under Contract Nonr-1367(00).

WHOI Contribution No. 1242. Coral Banks Occurring in Deep Water on the Blake Plateau by D. F. Squires, T. R. Stetson, and R. M. Pratt. Submitted to American Museum Novitates. Prepared under Contracts Nonr-1367(00) and NObsr-72521.

WHOI Contribution No. 1270. Predicting Sonic Pulse Shapes of Underwater Spark Discharges by D. D. Caulfield. Submitted to Deep-Sea Research. Prepared under Contract Nonr-1367(00).

WHOI Contribution No. 1282. Self-Contained Portable Tape Recording System for Use by Scuba Divers by L. L. Breslau, J. M. Zeigler, and D. M. Owens. Submitted to the Bulletin de l'Institut Oceanographique de Monaco. Prepared under WHOI contracts Nonr-1367(00) and Nonr-2196(00) and contract Nonr-1841(174) with the Massachusetts Institute of Technology.

The following paper was submitted for publication under another contract but is believed to be of interest to ONR, Code 466:

WHOI Contribution No. 1269. A Precisely Timed Submersible Pinger for Tracking Instruments in the Sea by L. L. Breslau, J. B. Hersey, H. E. Edgerton, and F. Birch. Submitted to Deep-Sea Research. Prepared under Contract NObsr-72521.

The following technical reports were submitted during this period under Contract Nonr-1367(00):

WHOI Ref. No. 61-40. A Light-Weight Towed Transducer Enclosure for Echo Sounding by S. T. Knott, and W. E. Witzell. (Unclassified)

WHOI Ref. No. 62-7. Track Charts, Bathymetry, and Location of Observations. CHAIN Cruise #11, Atlantic Ocean - Caribbean Sea, 26 January - 22 March 1960. (Unclassified)

WHOI Ref. No. 62-8. Track Charts, Bathymetry, and Location of Observations, CHAIN Cruise #13, Atlantic Ocean, North Sea and Baltic Sea, 30 June - 13 November 1960. (Unclassified)

WHOI Ref. No. 62-9. Track Charts, Bathymetry, and Location of Observations, CHAIN Cruise #17, Atlantic Ocean, Romanche Trench and Mid-Atlantic Ridge Survey, 1 February - 17 May 1961. (Unclassified)

WHOI Ref. No. 62-10. Track Charts, Bathymetry, and Location of Observations, CHAIN Cruise #19, Atlantic Ocean, Puerto Rico Trench, North Wall and Outer Ridge, 13 June - 7 July 1961. (Unclassified)

The following technical reports were submitted under other contracts but are believed to be of interest to ONR, Code 466:

WHOI Ref. No. 61-26. Seasonal Variations in Acoustic Transmission Losses over Long Paths in North America Basin (U) by L. Baxter and Helen S. Graham. (Confidential). Prepared under Contract Nonr-2866.

WHOI Ref. No. 61-28. A Miniaturized Precision Time Source for Use in Self-Contained Instruments by L. L. Breslau. (Unclassified). Prepared under Contract NObsr-72521.

WHOI Ref. No. 61-29. Thermistor Chain Hydrophone String by D. D. Caulfield. (Unclassified) Prepared under Contract NObsr-72521.

WHOI Ref. No. 61-35. Report on ATLANTIS Cruise #266, June - July 1961 by T. R. Stetson. (Unclassified) Prepared under Contract NObsr-72521.

OCEANOGRAPHY

Thermistor Chain Observations (Dr. A. D. Voorhis).

Observations of Spatial Spectra of Internal Waves.

During CHAIN Cruise 21 a number of FM magnetic tape recordings of temperature fluctuations of the seasonal thermocline were made while underway from thermistors mounted at constant depths in the thermistor chain. During this report period we have studied some of these fluctuations for their spectral spatial power density.

Figure 1 shows the power spectra obtained from internal waves observed at depths of 45 and 85 meters on 5 September 1961 at 29°17'N, 37°51'W. Temperature fluctuations at the two depths were recorded continuously for 2.5 hours while the ship was underway at 11 knots on course 085° true azimuth. The two spectra shown represent, therefore, the results from a sample track about 50 kms. long. During this run the mean near-surface temperature structure showed a mixed layer with negative vertical temperature gradient of 0.013°C/meter penetrating to a depth of 30 meters which overlay a seasonal thermocline with negative vertical temperature gradient of 0.10°C/meter extending to a depth greater than the bottom of the thermistor chain (110 meters). At Woods Hole the FM tape recordings were sampled in real time at 10-second intervals, corresponding to 55-meter intervals of horizontal travel, for a total of 900 samples and power spectra computed by the method of Tukey*. This method allows one to compute for a finite sample, a smoothed approximation of a spectral power density $G(f)$ as a function of frequency f , which in our case is defined by

$$\int_0^{\infty} G(f) df = \lim_{\theta \rightarrow \infty} \frac{1}{\theta} \int_0^{\theta} (\Delta T)^2 dt$$

where ΔT is the fluctuation of temperature at time t from the mean over a time interval θ . The spectra shown give the computed approximation of the

* The Measurement of Power Spectra. Blackman, R. B. and J. W. Tukey, Dover Publications, N. Y., 1959.

FIGURE 1 - SPATIAL POWER SPECTRA OF INTERNAL WAVES

power density as a function of the frequency at which the internal waves are encountered by the moving ship. Shown also is a scale corresponding to horizontal distance traveled which we call the apparent wave length of the internal waves. The latter becomes the true wave length if the velocity of the internal waves is much less than the speed of the ship. An estimate of internal wave velocities from the density stratification of the water column indicates that this is probably the case here, hence our curves closely correspond to the spatial distribution of the internal wave spectral power density as observed along the track of the ship.

The spectra at both depths are quite similar and show a continuous distribution of internal wave energy over wave lengths from 100 to 5000 meters with a strong concentration of energy at the long wave-length end. The small peaks appearing in the spectra are not statistically significant. We believe such spectra will show a maximum at wave lengths in excess of 5000 meters and that samples over longer tracks, perhaps as much as 100 to 200 kms, are needed to resolve a spectral maximum. Other records are being analyzed to determine whether such internal wave spectra depend on ship's heading, which would give us information concerning the directional spectrum of the waves.

Thermistor Chain Instrumentation (Mr. G. Erlanger).

A more reliable thermistor chain harness is needed due to the frequency of wire insulation failure in the existing harness. It was decided that the substitution of fewer, heavier wires for the many twisted pairs now in use would be desirable. Both FM multiplexing and switching circuits were considered to permit the use of a cable containing few wires, all common to approximately 50 thermistors.

A circuit has been developed using switching circuits which will permit serial sampling of any number of thermistors at rates of up to 100 thermistors per second with a three wire cable. Switching modules are placed at each thermistor station on the chain and connected by the cable containing signal, power and ground leads.

This system will be tested at sea during July. The number of signal leads will be increased to three to permit continuous interpolation between thermistors for the presentation of a contoured record. Circuit modules are presently being manufactured. A rugged five-wire cable has been designed and

necessary modifications to the readout equipment are being carried out.

An attempt is being made to eliminate the servo system in the present contour recorder to permit more rapid scanning of the string of thermistors. If this can be accomplished more closely spaced temperature samples will result. Also under consideration are methods of thermistor data storage suitable for computer inspection of the thermal structure.

Sound Velocity Measurements (Dr. Hays, Mr. Birch, and Mr. Caulfield).

The sound velocimeter was used at the following stations during CHAIN Cruise 21:

34°29.5' N	29°43.5'E	3 Nov. 1961
34°21.2' N	31°25.3'E	4 Nov. 1961
34°04.5' N	32°46.0'E	5 Nov. 1961
38°55.3' N	15°13.8'E	15 Nov. 1961
40°29.5' N	12°46.7'E	17 Nov. 1961
34°23.0' N	10°55.5'W	29 Nov. 1961
31°17.0' N	20°15.0'W	2 Dec. 1961
29°07.0' N	31°14.0'W	5 Dec. 1961
28°58.0' N.	40°02.0'W	8 Dec. 1961

A series of combined hydrographic-sound velocimeter lowerings were planned for the return trip across the Atlantic. Messrs. Metcalf and Stalcup joined the cruise at Monaco for this purpose. However, one velocimeter was lost during a night lowering, and the other one developed erratic faults which ended the program. This velocimeter has been completely reworked, and we have ordered two more replacements. This enables us to have two velocimeters on a ship making many lowerings, and one available on a ship making occasional lowerings. During the coming summer, a large number of lowerings in the Bermuda-Eleuthera area is planned from ATLANTIS.

Bathymetry Logs (Mr. Dunkle).

As of May 31, 1962 a series of four cruise navigation reports had been completed. All were supported mainly by this contract and were issued as WHOI References (see list of technical reports for CHAIN Cruise 11, 13, 17, and 19). Each report contains a number of track charts showing the

ship's track over the entire cruise except for special surveys. All types of observations made during the cruise are noted by suitable symbols as legends along the ship's track. The location of special surveys are noted and shown in detail on separate charts. Soundings are read at equal time intervals, usually every five minutes, and at changes in slope. They are written along the ship's track as often as space permits. The distribution of these folios, which are bulky, will be limited to the Hydrographic Office and to institutions or scientists having an immediate need for the data.

SUBMARINE GEOLOGY AND GEOPHYSICS

Deep Sea Seismic Reflection Studies (Dr. Hays, Mr. Caulfield, Dr. Hersey).

The use of the "Sparker" and "Boomer" continued during the CHAIN Cruise 21 in November and December, 1961. In the Mediterranean special attention was given to the areas southwest of Naples and south of Cyprus. This work was done in conjunction with sound transmission studies in those areas. Here the "Sparker" and "Boomer" were used as sources for the direct path sound transmission but both direct and bottom returns were recorded. In one of these runs sub-bottom (hundreds of fathoms deep) energy was detected when the source to receiver range was over fifteen miles.

Dr. Harold Edgerton of MIT joined the CHAIN in Monaco for the return trip across the Atlantic with a new style of transducer to use with the 13,000 joule capacitor bank. The new transducer design extended the life of the transducer plates as compared with the previous design. Continuous seismic profiles were recorded across several abyssal plain areas between Gibraltar and Woods Hole.

A paper discussing the two sources ("Sparker" and "Boomer") and some of the scientific results of recent continuous seismic profiling has been accepted for presentation at a July meeting of the British Institute of Radio Engineers (A Symposium on Sonar Systems).

Seismic Refraction Studies in the Gulf of Maine (Mr. Fahlquist).

Preliminary results show a crustal thickness of about 37 kilometers in the coastal region of Maine. More significantly, the technique of using fixed geophone arrays and a moving shot point has yielded data especially suited for refraction amplitude studies. Further study of the data may yield more direct information pertaining to the existence of velocity gradients within the crust. Two papers were delivered at the recent AGU meeting on various aspects of the analysis. The abstracts for the two papers were published in the program for the 43rd Annual Meeting, American Geophysical Union, April 25 - 28, 1962, as follows:

"Cooperative Maine Experiment in Crustal Seismology: Methods and Application of Fixed Linear Recording Arrays to Crustal Measurements" by R. P. Meyer, J. S. Steinhart, B. F. Howell, Jr., W. E. Bonini, D. A. Fahlquist, and L. T. Aldrich.

"Maine Seismic Experiment; General Crustal Results" by J. S. Steinhart, R. P. Meyer, B. F. Howell, Jr., D. A. Fahlquist, W. E. Bonini, and T. Asada.

Seismic Refraction Studies in the Western Mediterranean (Mr. Fahlquist).

Analysis of seismic refraction data from ATLANTIS Cruise 242 and CHAIN Cruise 7 is complete. The final report interpreting and summarizing the geophysical results is in preparation.

Studies of Cores from the Central Mediterranean Sea (Mr. Workum and Mr. Ryan).

On CHAIN Cruise 21 three 30-foot piston cores were taken in the abyssal plain of the Tyrrhenian Sea in an area where echo-sounding records during this and other cruises are quite numerous. A detailed investigation of these cores was made to determine the relationship between the sequence of presumed subbottom echoes seen on the echo-sounding records and the layering in the cores. Velocity and strength measurements were made at the MIT Department of Soils Engineering. Calcium carbonate, water content, and particle size analyses were made at Woods Hole as well as mineralogical and fossil identifications. A preliminary investigation of the data suggest that the

echoes correspond to layers of coarse sediment (sand and silt) interspersed in thicker layers of clay. The complexity of the layering in the cores is not revealed in greater detail on the echo sounding records.

Puerto Rico Trench Rocks (Mr. Nalwalk and Dr. Bowin).

Three successful dredge hauls taken on the north wall of the Puerto Rico Trench (CHAIN Cruise 19) collected sedimentary and igneous rocks. The sedimentary rocks are: limestones, shales, porcellanites, chert nodules, and poorly consolidated sediments. The igneous rocks are: serpentinites and basalt (one sample only).

About 120 thin-sections have been made and are being analyzed. Specific gravity measurements have been made on selected samples and are being compared with the minerals identified under the petrographic microscope. Several of the sedimentary rocks were found to contain foraminifera and radiolarians; these rocks have been sent to various persons for microfossil identification. Samples of the serpentinites have been sent out for chemical analysis and radioactive dating.

Mid-Atlantic Ridge Rocks and Topography (Mr. Nalwalk and Dr. Pratt).

About 150 pounds of basaltic (pillow lavas) and serpentinitic rocks were collected from the mid-Atlantic Ridge on CHAIN Cruise 21. Many of the samples have been thin-sectioned; these are being analyzed under the petrographic microscope. Several samples have been sent out of the Institution for chemical analysis.

The serpentinites contain the following minerals: antigorite, veinlets of chrysotile, and varying amounts of olivine and augite. The basalts consist of volcanic glass, plagioclase, metallic oxides, olivine and an unidentified semi-opaque cloudy material. The results of the analysis of the rocks are being prepared for publication.

Sounding data taken over the mid-Atlantic Ridge on recent cruises has been analyzed and studied with special emphasis on the median rift valley. A topographic model is being constructed of the area near 29°N and 42°W.

OCEANOGRAPHIC AND ACOUSTIC INSTRUMENTATION

Precision Graphic Recorder Instrumentation (messrs. Knott, Witzell, and Hess).

A programming system was devised earlier in the year for the PGR's to replace the commutator counting system with electronic counters which establish as before the timing of pulses, the number of pulses transmitted, the delay between pulsing and recording, and the selection of recorded sweeps. The construction of this system was given to out-of-house contractors. Near the end of this quarter a partially finished model was delivered for evaluation. Delivery of the final unit is scheduled in late February, 1963.

We have continued to investigate the use of solid state design in the various components of the PGR's to reduce the size of units and the heat dissipated. Presently emphasis is upon obtaining solid state power amplifiers to replace the conventional tube-type power amplifiers which provide the precision time base power for the synchronous drive motors. Five of these units have been ordered to our specifications for spring delivery.

Preliminary designs for a solid state version of the PGR signal amplifiers and for the gating circuits to be used with the electronic programmer above are being tested.

Two new PGR's have been received from Alden Electronics which are scheduled to be transferred in February to the Tudor Hill Laboratory in Bermuda. Difficulties which have been experienced in earlier commercially made units were not completely corrected in these two PGR's. However, their mechanical performance surpassed that of our units constructed in-house in the past. We have concluded the work of correcting these problems by writing a new list of specifications for the two-channel PGR. The results of these specification changes will be first evaluated when we receive, in June, two Alden 419 PGR's constructed to the new specifications and ordered, in this case, under a BuShips' contract (NObsr-72521).

Spark Sound Source (Mr. Caulfield).

The 25,000 joule source was in full operation from the first of November to the end of January. Only minor maintenance was necessary. Minor modifications were added to improve reproducibility of the pulse shape. This machine was fired over half a million times without a major breakdown. The primary use of the sparker during this time was for continuous seismic profiling.

Work in the early spring was concerned with means of packaging the source in a trailer body to facilitate its use on different ships.

Inverted Echo-Sounder (Mr. Dow).

The inverted echo-sounder (WHOI Contr. No. 1222, Inverted Echo Sounder by Willard Dow and Stephen L. Stillman, Marine Sciences Instrumentation, Vol. 1 (1962), Plenum Press, Inc. pp. 263-272.) has been modified to correct defects experienced in using the instrument during sound velocimeter lowerings at sea last summer. Steps have been taken to eliminate corrosion of certain aluminum components which became exposed to sea water due to failure of their protective coatings. More rugged water-tight electrical connectors have been installed and the external wiring simplified. The operation of the instrument has also been made easier.

A high precision electronic timer for controlling the repetition rate of the transmitted pulse has been installed, and a new high-frequency power converter which has been developed at WHOI has been incorporated into the transmitter to eliminate the audio-background noise previously generated by this unit. The acoustic output power of the transmitter is being increased for improved operation of the system in deep water experiments.

Acoustic Telemetering Buoys (Mr. Dow and Mr. Carter).

The project has employed a commercial oceanographic data type radio buoy converted for acoustic telemetering until this year. As previously reported (WHOI Ref. No. 62-14, p. 19), this buoy proved to have inherent physical and electrical characteristics which considerably impaired its efficiency for acoustic work. Therefore, a new radio buoy has been developed

at WHOI that is designed particularly for acoustic telemetering, salvaging meanwhile as much as possible from the old oceanographic unit so as to save construction costs.

Although the new buoy is less than two-thirds the length and approximately half the weight of the older type, the R. F. power output has been increased and the effective battery life for continuous operation considerably extended. The low frequency response of the new hydrophone preamplifier has been improved for seismic work and a new type of hydrophone of our construction is now employed. Preliminary sea trials with the prototype indicated good performance and stability.

Effective R. F. coverage in the two megacycle band out to at least forty miles under average weather conditions has been achieved in ranging tests. Longer runs will be made as soon as a second buoy, tentatively operating in the seven-megacycle region, can be completed.

Ceramic Hydrophone (Mr. Dow, Mr. Hoskins, and Mr. Wilde).

Two lead zirconate hydrophones constructed somewhat along the principles outlined in Hudson Laboratories Technical Report No. 70 have been developed principally for use with transistorized preamplifiers. If successful they will be used with the new acoustic telemetering buoys described above for seismic work, and with the telemetering hydrophone for transmission studies in deep water.

Precision Time Source for Remote Control (Mr. Breslau).

The Miniaturized Precision Time Source mentioned in a previous progress report (WHOI Ref. No. 62-14, p. 20) has been installed in a standard E. G. & G., SP-8 Sonar Pinger and has successfully completed a sea trial in fifteen hundred fathoms of water. A section of annotated Precision Graphic Recorder record obtained during this pinger lowering is presented in Figure 2. It has been found possible to track an instrument in the sea by employing a Precisely Timed Submersible Pinger and a Precision Graphic Recorder. A manuscript reporting this development has been accepted for publication by "Deep-Sea Research".

FIGURE 2 - SECTION OF PRECISION GRAPHIC RECORDER RECORD OBTAINED
DURING THE DESCENT OF THE INSTRUMENT.

An engineering study concerning an improved version of this precision time source has been completed. An engineering proposal has been written that is directed toward the installation of a precision time base in the remaining standard SP-8 Pingers on hand at WHOI. It has been found feasible to utilize a commercially available packaged oscillator, employing a crystal oven contained in a Dewar flask, in conjunction with our frequency dividing circuitry. The improved version, when used with a standard SP-8 Pinger, is designed to possess the following features: a frequency stability of one part in ten million per day, a capacity of more than ten hours of continuous operation, provision for the inclusion of a missed ping every tenth ping when the pinger is operated by itself, provision for the inclusion of a missed ping every time a photograph is taken when used in association with a standard E. G. & G. CA-8 Deep Sea Camera.

This work involves a joint effort with the Massachusetts Institute of Technology inasmuch as Mr. Breslau is being supported under their contract Nonr-1841 with the Office of Naval Research.

Tape Recording System for Scuba Divers (Mr. Breslau, Dr. Zeigler, and Mr. Owen).

The tape recording system for scuba divers, which was described in the previous progress report (WHOI Ref. No. 62-14, p. 23), has been field tested during a study of beach erosion by scientists using scuba. The instrument performed satisfactorily and therefore no further development work is anticipated.

This system has been described in a manuscript submitted for publication to the "Bulletin de L'Institut Oceanographique".

This work was accomplished under the following contracts: Nonr-1841 with MIT, Nonr-1367(00) with WHOI, and Nonr-2196(00) with WHOI.

Processing of Ocean Bottom Photographs (Miss Broughton and Mrs. Gallagher).

Index catalogues are completed showing individual photo contents, for the following cruises: CHAIN 7, 9, 11, 13, and 19; ATLANTIS 242 and 260. Catalogues for CHAIN 17, 21, and ATLANTIS 251 are in progress.

The table below shows the number and general location of mounted and cataloged pictures in our files to April 30, 1962.

<u>Cruise No.</u>	<u>General Area of Cruise</u>	<u>Reference giving geographic locations</u>	<u>Stereo Pairs</u>	<u>Single Exposures</u>
A-242	Indian Ocean, Red Sea, Mediterranean, Atlantic	WHOI Ref. No. 62-28 (in preparation)	1738	567
A-251*	Blake Plateau	WHOI Tech. Memo. #3-60	409	5
A-260	N. E. Seamounts	WHOI Ref. No. 62-19	2629	465
C-7	Atlantic & Mediterranean Sea		411	235
C-9	Bermuda Area		2419	1098
C-11	Atlantic, Caribbean Sea, Puerto Rico Trench	WHOI Ref. No. 62-7	1577	618
C-13	Atlantic, North Sea	WHOI Ref. No. 62-8	1092	503
C-17*	Romanche Trench, Bermuda Area	WHOI Ref. No. 62-9	72	33
C-19	Puerto Rico Trench, Bermuda Area	WHOI Ref. No. 62-10	825	66
C-21*	Atlantic, Mediterranean Sea	WHOI Ref. No. 62-11	313	0
TOTAL			10,485	3,090

*Mounting of photographs in progress

CHAIN 11 has four lowerings in which the cameras were swung 90° out of phase and are therefore out of stereo. These are not mounted, but are on file. There are microfilm copies (1 positive and 1 negative), of mounted pictures taken on the following cruises: A242 and 260; CHAIN 7 and 9 and partial copies for CHAIN 11, 13, and 19. It is planned to continue the program of microfilming each lowering as mounting progresses.

Index catalogues have increased the ease and speed of finding specific pictures or types of pictures. All camera lowerings, including those made by Mr. David Owen under Nonr-2196 are being plotted on master charts filed at WHOI. These are used in conjunction with charts showing track plots, cores taken, and dredge hauls. There are also small charts available in house for quick reference. A large display book is now available which shows the types of photographs that can be found in the bulk of the collection. These photographs are labeled with the geographic area and ocean depth at which they were taken.

Locations of the camera stations taken on those cruises tabulated above can be found on the track plots within the listed reports.

APPENDIX

Use of Vessels

Operation of R/V CHAIN during this period was as follows:

<u>Cruise No.</u>	<u>Departure Return</u>	<u>Work Area</u>	<u>Principal Investigations</u>	<u>Scientist in Charge</u>
21	16 Aug. 1961 18 Dec. 1961	Atlantic Ocean - Mediterranean Sea	Seismic profiling, bathymetry, coring, dredging, rock samp- ling, bottom photography, geothermal heat flow measure- ments, thermistor chain studies, sound transmission studies, deep scattering layer studies, sound velocity measurements.	J. B. Hersey E. E. Hays

Operation of R/V CRAWFORD during this period was as follows:

<u>Cruise No.</u>	<u>Departure Return</u>	<u>Work Area</u>	<u>Principal Investigations</u>	<u>Scientist in Charge</u>
73	20 Feb. 1962 23 Feb. 1962	At Sea	Testing cameras and precision time source pinger	L. Breslau A. Johnston

Visitors's List

Dr. A. B. Wood	Admiralty Research Laboratory
Mr. John M. Alden	Alden Electronics
Mr. F. W. Simpkins	" "
Mr. J. Hushman	Alpine Geophysical Company
Dr. R. H. Nichols	Bell Telephone Laboratories
Mr. Julian Craig	Bendix Corp. - Pacific Division
Mr. R. Holms	Bendix Corp.
Mr. T. J. Maggio	" "
Mr. R. M. Walls	" "
Dr. J. M. Moulton	Bowdoin College
Mr. B. Bromfield	Bromfield Corp.
Dr. R. Phinney	California Institute of Technology
Dr. J. Belshe	Cambridge, England
Mr. Sidney Cornell	Centroid
Mr. E. St. George	"

Visitors's List

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