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DIVER'S INSTRUMENTED OBSERVATION BOARD: PAPER 1, SCIENTIFIC DIVING SERIES

Subproject No. SF 011 01 01 - Task No. 2612

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ABSTRACT

In the course of work involving diving by scientists, a number of specialized instruments and techniques for use by scientific divers were developed, one of these being the "Diver's Observation Board." A combination of basic diving instruments which are generally used separately, the diver's observation board has resulted in greatly increased efficiency of observation and recording of several types of underwater data of value to oceanography. It consists of a 6-inch by 8-inch writing board in and on which are mounted a compass, depth gauge, inclinometer, pull-out protractor, bubble levels, pencils; it has ruled edges, means for attaching other measurement tools, and means for attachment to the diver's belt. A functional description is given and some applications and their results are discussed.

Recommendations are made for a technique for using this device which enables divers to obtain quantitative measurements of the vertical oceanographic structure without need for shipboard electronics, sampling equipment, or laboratory analysis.

ADMINISTRATIVE INFORMATION

The instrument described in this report was conceived and built in 1956 under Project SEASITE. It has been used (and modified) on various projects as a general tool until the present time; it is felt that its usefulness and reliability, as borne out by experience over this period of time, combined with recent increase in interest under Projects OPSEARCH and SEA DEVIL, warrant its documentation at this time. This report is the first in a planned series of reports on the subject of scientific diving.

This report was produced under Subproject SF 011 01 01, Task 2612, Project FUST, Task 26.

APPROVED AND RELEASED 29 JULY 1963

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1. The purpose of this report is to properly document the development of the Diver's Observation Board inasmuch as sufficient experience has demonstrated its general usefulness. The work was originally done in 1956 to satisfy a need for more efficient scientific diving operations.

2. This report is forwarded for information and distribution to interested activities, and is the first in a planned series of reports on the subject of scientific diving.

R.T. Miller

R. T. MILLER

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INTRODUCTION

The recent rapidly increasing use of free diving techniques by marine scientists has, for a wide range of types of marine research problems, yielded data vastly improved over that obtainable otherwise. The personal use of self-contained underwater breathing apparatus (SCUBA) by scientists to obtain "first hand" information (thereby utilizing in the most direct way the professional training and observational capability of the scientist) has established the term "scientific diving" to describe such activity. The value, usefulness, and some of the results of scientific diving have been well documented (Reference 1). Results of previous work, combined with improvements in diving equipment, have clearly demonstrated that the future potential of scientific diving is limited by the diver-scientists' capability to observe, measure, sample, and record in situ phenomena of interest. The scientist's specialized training, experience, and observational powers are used under water to obtain direct, qualitative assessment of the significance of observable phenomena, and to ascertain what to measure, where, and when; further information of quantitative nature is obtained only by having available suitable measuring instruments. Additionally, both qualitative and quantitative information must be adequately recorded at the time and place of observation. The need has therefore arisen for specialized diver-held scientific instrumentation of various types. This is a field which should be vigorously explored in the future in order to exploit fully the potential of scientific diving.

Many research problems of near-shore oceanography can be attacked profitably by scientific divers using special instruments; in some instances adequate solutions can be obtained only by scientific diving. In particular, phenomena which involve either horizontal and vertical microstructure, or large gradients occurring over small distances, may be best understood by use of scientific diving in conjunction with conventional techniques. Examples of such problems are studies of slicks, thermoclines, current shear zones, bottom microtopography and composition, tide lines, turbulence, suspended material, underwater visibility, light transmission, and turbidity layers. Another objective for development of scientific diving is to provide suitable instrumentation and training such that naval divers can make rapid, detailed military oceanographic reconnaissance measurements from small craft operating in remote areas. The development of diver-held instrumentation for such research is being pursued at this Laboratory, and has resulted in the "Diver's Observation Board" described in this paper. The first of several diver-held instruments, it was developed as a fundamental tool to fill the need for a relatively simple, general data-collecting aid for use in conjunction with other more specialized instruments and techniques which are presently under development, some of which are: a hand-held current meter, a technique for measuring near-bottom current shear structure and turbulence, a hand-held hydrophotometer, a simple instrument to measure density directly, and a hand-held refractometer. These developments will be reported as subsequent papers in this series.

FUNCTIONAL DESCRIPTION

Fundamental to any type of scientific diving is the need for the diver to ascertain depth, direction, and be able to record results of observations and measurements. The basic instruments commonly used for these purposes are the compass, depth gauge, watch, ruler, and some sort of writing board. Normally these are attached to the diver by straps or short lines attached to a belt, or are carried in hand. Quite often, if other equipment (e.g., underwater camera, sampler, etc.) has to be carried, the diver becomes so festooned with dangling and projecting equipment that he is encumbered in getting in and out of the water, and hampered in action in the water. An obvious solution to this problem is to combine several of the necessary equipment items into one unit which would be easy to carry and more efficient to use. Shumway (Reference 2) used this approach to provide a compass-inclinometer-writing board combination for geologic use. The device described herein and illustrated in Figures 1 and 2 carries this idea further by combining in one instrument the following functions:

a. Writing board

b. Depth gauge

c. Compass

d. Inclinometer

e. Pull-out protractor (with bubble level on one edge)

f. Ruled edges for measurement

g. Bubble levels on two edges

h. Holder for two pencils

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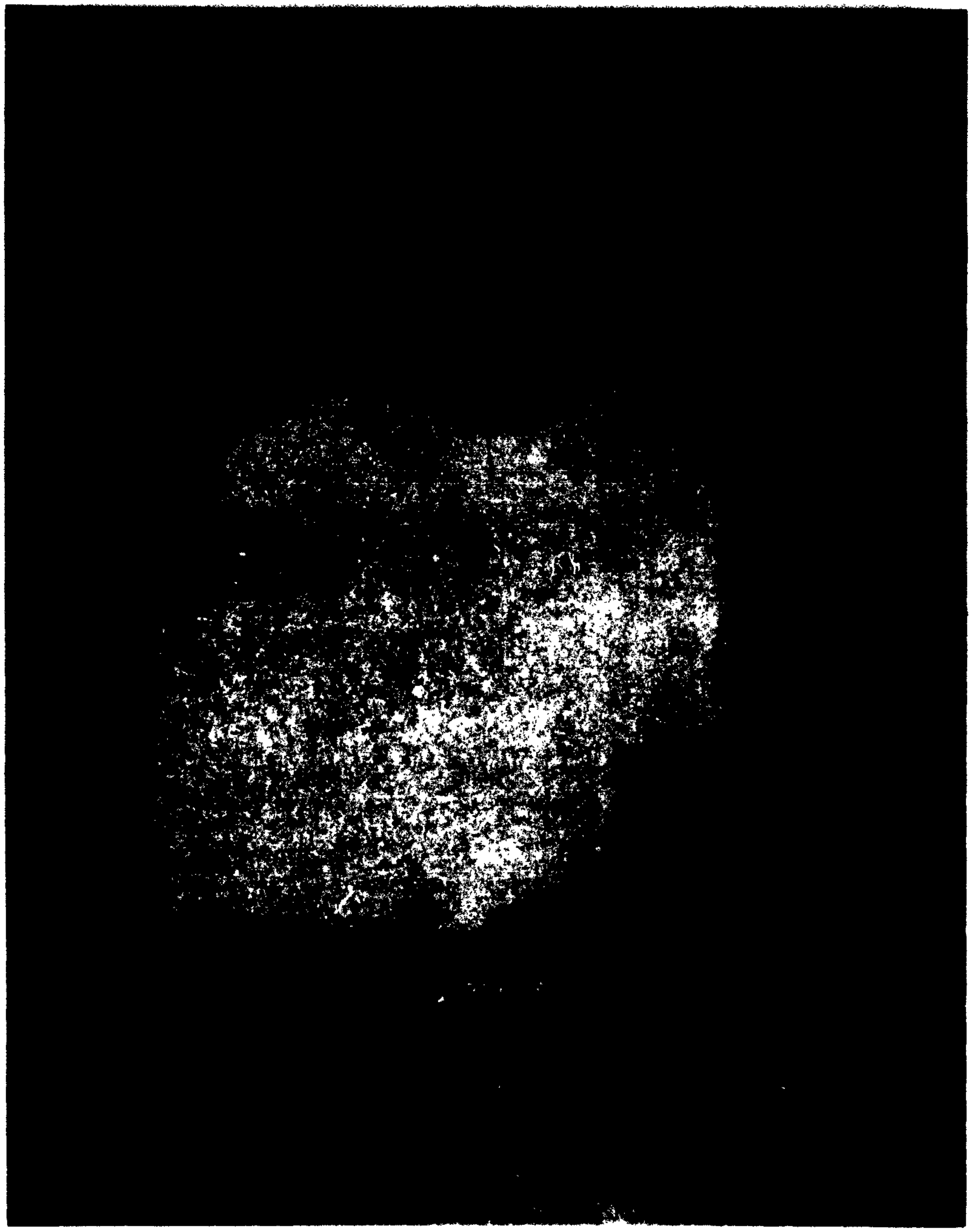

FIGURE 1. THE DIVER'S OBSERVATION BOARD (FRONT)

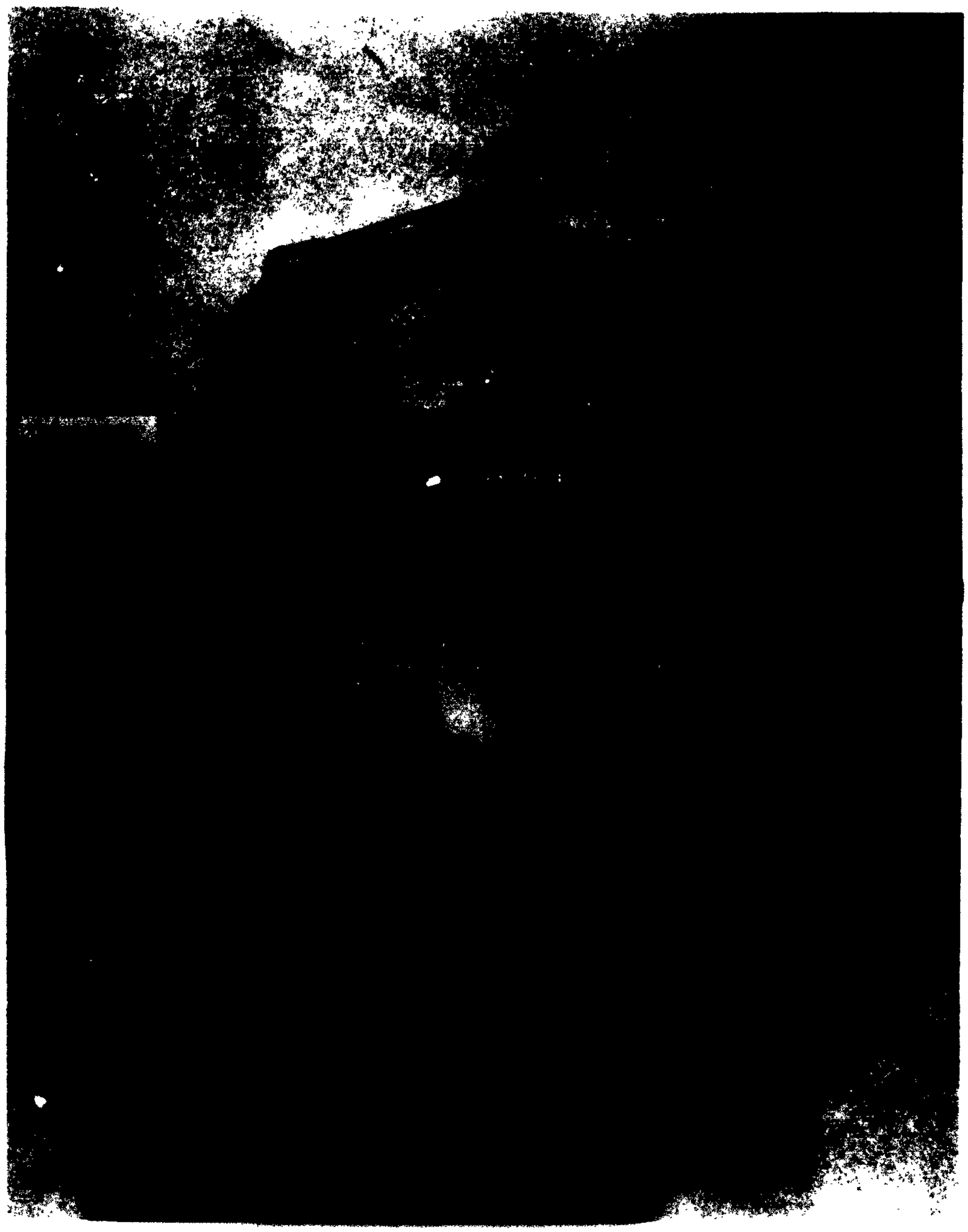

FIGURE 2. THE DIVER'S OBSERVATION BOARD (BACK)

i. Rubber straps on back for attaching folding aluminum rule, thermometer, etc.

j. A special clip which allows it to be carried out of the way on the belt when not in use

A brief description of these functions and their uses will be given.

The writing board (6 inches by 8 inches) which forms the body of the device, is made of plexiglas and is approximately 1 inch thick in order to contain the protractor and inclinometer, provide recess for pencils, allow flush mountings of the depth gauge, and provide sturdiness. The usable writing area is covered with opaque white plastic 1/16 inch thick which has been slightly roughened to provide a good writing surface. The white plastic is not absolutely necessary, as the plexiglas surface when roughened will allow writing; however, the white surface is more efficient, especially in dim light. Two adjacent perpendicular edges are ruled in inches and fractions to 1/8 inch. One bubble level is recessed in one edge. The other bubble level is recessed in the pull-out protractor, which is a quarter circle of 1/2-inch plexiglas hinged at the corner of the board and marked at 1-degree intervals. It can be pulled out to measure any angle which can be identified by aligning one edge of the board and the edge of the protractor with the lines being observed, or an angle with respect to the vertical. Also, it can be set at a predetermined angle before entering the water in order to adjust underwater equipment. More convenient for measuring angles with respect to the vertical is the inclinometer, which is a weighted pointer hanging in a hollow 90-degree sector in the body, with an engraved scale (1-degree intervals). In the center of the body, under the writing surface, is a recessed hollow for two pencils, with a spring to hold them in place (otherwise they float to the surface; a pencil is as vital to a diving scientist as to any other). At the top of the body are two holes for depth gauge and compass. The requirement to provide the compass makes the use of all nonmagnetic materials desirable. Across the back are two rubber straps, under which can be conveniently carried a folding aluminum (or brass) rule, thermometer, or any other small object. This has proved to be a very useful feature. In order that the diver have his hands free, and not have the board dangling at the end of a line while entering and leaving the water, there is a belt clip to which the board may be attached by placing a special slot in the back of the board over the clip and turning the board 90 degrees. An alternative to this is to place the board in the sample collection bag which is often used. At the top of the board is a hole for attaching a line if necessary, and a space designed for winding on a light line for measuring or signalling purposes.

The size of such a board is not critical; several sizes have been tried, and 6 inches by 8 inches appears to offer the best compromise between usefully large writing space and small size for convenient handling.

RESULTS AND USES

The diver's observation board has proved quite useful and convenient in a variety of problems and environments. It has been used in Arctic diving (Reference 3) in 29 degrees Fahrenheit water and can be handled and used effectively even with heavy gloves. In an oceanographic and seismic survey at Eniwetok Lagoon, it was useful for installing and checking three-component geophones which had to be oriented directionally and vertically. Divers engaged in a bottom microtopography study in the Panama City area, which established the offshore distance to which ripple fields extend as related to the meteorology of the area (Reference 4), found that this device greatly facilitated data gathering. For work involving the use of underwater vehicles such as minisubs and towed sleds, where the presence of wrist-mounted or dangling bulky instruments are undesirable, this device with its belt clip has proved very useful.

Swimming a compass course is easier with the board than with a wrist compass because the board can be held level and provides a "sight" along the edge. The inclinometer is very useful for measuring wire angles, angles of slope of bottom and bottomed objects, dip of outcrops, and slopes of bottom ripples and mounds. The ruled edges, in conjunction with a folding rule, provide excellent measurements of ripple height and wavelength. The combination of compass and depth gauge allows measurement of current direction as a function of depth; current speed can be estimated quite accurately by observing the time (by use of comercially available diving wrist chronometer) required for a piece of omni-present suspended detrital matter to traverse the long edge of the observation board, or, for higher current speeds, a convenient distance along the folding rule. Thus, by means of this device and a descending line, a diver can obtain a quite complete picture of the vertical water mass structure by measuring and recording the depth at which observable changes occur, estimating visibility, measuring temperature with a good thermometer, and measuring current speed and direction as previously described. Many other possible uses will probably occur to the reader; e.g., the back side of the device could be painted and used as a standard target for horizontal visibility measurements.

SUMMARY AND CONCLUSIONS

There is an urgent need for specialized instruments for use by scientific divers concerned with near-shore oceanographic problems. In a program to provide such instrumentation, the diver's observation board was developed as a tool fundamental to the scientific diving program. A combination of basic diving instruments and tools which are generally used separately (often with disadvantage and inconvenience to the diver), it has resulted in greatly increased efficiency in collecting and recording of many types of underwater data of value to oceanographic investigations. Although it is not indispensable, its usefulness has made it an accepted standard tool, fundamental to scientific diving done for oceanographic purposes at this Laboratory. The advantages that have accrued from experience with this relatively simple device force the conclusion and recommendation that further development of this and similar devices, and the techniques for their use, should be pursued with vigor. In particular, since it is possible by use of this device to obtain all of the essential elements of a shallow water vertical oceanographic profile except for density and salinity, it is recommended that techniques be developed for in situ measurements of these additional parameters by divers. This would then allow scientific divers to rapidly determine, on the spot, most of the basic oceanographic measurements required for naval purposes (e.g., electrical conductivity of the sea water, sound velocity structure, currents, bottom type, etc.), without requiring expensive time and space consuming special shipborne electronic equipment, sampling equipment, or laboratory analysis of sea water. The advantages of such a procedure for performing "assault oceanography" from small craft operating in remote regions are obvious. Development of simple and reliable tools and techniques would give EOD and UDT divers, after a small amount of special training, the ability to acquire a major part of the elementary environmental information needed to plan assault and mine countermeasures operations.

Certain research studies would be aided by utilizing properly trained and equipped scientific divers to obtain measurements of underwater parameters and their spatial variations, some of which would be practicably unobservable by other methods. An example of this is the direct measurement of the amplitude of wave-induced oscillatory motion of water near the bottom. Another example of this is illustrated in Figure 3, which shows a scientific diver measuring population density and orientation of small sand dollars (Mellita quinquiesperforata), using an in situ application of standard microscope counting technique (Reference 5).

In conclusion, the diver's observation board is but one step in the direction of increased diver efficiency. It provides the diver with a useful, time-saving, multi-purpose tool with which he can measure and record various environmental phenomena. The development and improvement of such tools and techniques for their use is necessary to exploit fully the potential of not only scientific diving but also that of military swimmers.

FIGURE 3. DIVER'S OBSERVATION BOARD BEING USED AT THE SEA BOTTOM

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ACKNOWLEDGMENTS

The detailed engineering design and specification work necessary to reduce the author's concepts to construction drawings was done by R. S. Ward; W. E. Brewer deserves credit for his patience, perseverance, and mechanical ingenuity in constructing the prototype and several modified versions.

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