Few readers who have gone this far would care to follow details of the circuits as it would be rather technical reading. Attention is invited to one item, however, so that credit may accrue to the Coast and Geodetic Survey. In the lower left of Plate IV, labelled *Radio Receiver*, is shown a variable crystal oscillator. I used this method of radio reception on the *Oceanographer* during the summer of 1930 and it has been used continuously at radio station WSP since that time. The idea is to introduce a small amount of radio frequency voltage of nearly the same frequency as that being received, instead of using the beat frequency oscillator. Thus the crystal oscillator is much more constant, and varying the amount of radio frequency voltage introduced helps to keep down the effect of static and makes reception from the RAR stations and sono-radio buoys easier. The ships *Hydrographer*, *Lydonia* and *Oceanographer* have been using this system successfully during the past season. Like anything good, this has also been discovered by others and it is now on the market in some receivers. Its use will probably be extended to more of our equipment.

SONO RADIO BUOY

(Extract from an article by LIEUTENANT-COMMANDER JACK SENIOR,

Commanding officer, U.S. Coast and Geodetic Survey Ship *Lydonia*).

Information concerning the new Sono Radio Buoy which has been used during recent years by the U.S. Coast and Geodetic Survey for radioacoustic ranging in surveys out of sight of land, was given in *Hydrographic Review*, Vol. XIV, N° 2, November 1937, pp. 66, 258, 261.

In N° 11 of the *Field Engineers Bulletin* published by this Service in December 1937, Lieutenant-Commander Jack SENIOR, Commanding officer of the Surveying Vessel *Lydonia*, gives a number of additional details, from which the following have been extracted.

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Sono-radio buoys were used successfully in shallow water, i.e., in depths less than twenty fathoms. In shallow water over the irregular bottom encountered this season, the *Lydonia's* sono-radio buoys were effective for distances up to nineteen seconds (*) (approximately fifteen nautical miles). Over regular bottom, signals from greater distances were easily received and recorded; in the shallower areas, with intervening shoals, sound reception was more or less uncertain with a corresponding decrease in effectiveness of radio acoustic hydrography. Offlying shoals were sounded and developed using radio acoustic methods of control with an accuracy of position closely approximating that obtained by visual fixes.

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The party on the *Lydonia* also made the deep water survey of the continental slope and of the extension of the Delaware Submarine Valley. This survey was made on the scale of 1:120,000. Four sono-radio buoys, one of which was borrowed from the ship *Oceanographer*, anchored near the edge of the continental shelf, were used simultaneously during this survey. The positions of these four sono-radio buoys were determined by the party on the *Oceanographer* by taut-wire measurements and sun azimuths. Hydrography was accomplished offshore by the *Lydonia* out to the 1000 fathom curve, and in the vicinity of the Delaware Submarine Valley the survey was extended 40 nautical miles beyond the 1000-fathom curve into depths of 1,600 fathoms. This afforded a most critical test and at the seaward limits of the work radio-acoustic ranging was only moderately successful. Bomb returns were received successfully for distances up to about 60 seconds (approximately 50 nautical miles). The maximum distance signals were recorded from the sono-radio buoys was 72 seconds.

The apparent horizontal velocity of sound in sea water still remains a somewhat uncertain factor. In the shallow water over the "lumpy" bottom of the continental shelf and in the deep water of the continental slope with the many steep submarine gorges and extensive valleys, the true travel path of the primary sound wave is not known. Seasonal temperature changes

(*) It is customary in radio-acoustic surveying to speak of distances in travel time, sound in sea water traveling approximately 8/10 of a nautical mile a second.

(EDITOR).

are large and unpredictable. A careful study indicates that theoretical bottom velocities are not applicable. Experimental velocities were used in smooth plotting the season's radio-acoustic work, and, for the inshore and intermediate areas on the continental shelf where there were sufficient positions determined by returns from three buoys, the final results are accurate. At this point it is desired to emphasize the important advantage in the use of *three* instead of two radio-acoustic ranging stations. The use of at least three sono-radio buoys simultaneously makes for efficiency and increased accuracy. It certainly decreases the uncertainties in the velocities of sound. It "fixes" the probable velocity to be used for the area for the time of the survey. That the correct locations of the buoys are of primary importance, of course, is self evident. Theoretical velocities are corrected and used where applicable. Serial temperature and salinity observations are needed for correcting echo soundings and should not be omitted.

The successful use of sono-radio buoys to replace station ships on the Atlantic coast has been tested and proven. That this is indeed a great advance in our hydrographic methods, from the standpoint of economy and efficiency, is very evident. The release of our tenders from dangerous station ship duty is an important consideration.

Sono-radio buoys are entirely automatic, and like all things mechanical do require adjustment and attention. It is logically assumed that certain minor electrical defects and limitations will be overcome and the automatic features of these buoys progressively improved by Dr. DORSEY and his efficient assistants. Some of the improvements made in the proper functioning of the sono-radio buoys during the 1937 season may be mentioned briefly. During the 1936 season, bomb returns were complicated by an unpredictable apparent lag, which was roughly an inverse function of bomb size, and distance to buoy and which could be traced definitely to the electrical circuit of the sono-radio buoy. This keying circuit lag has been reduced to a constant of 0.02 second and is not affected by the size of the bomb used. There was an improved technique in the tuning and adjusting of the sono-radio buoys prior to placing them on station.

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SPECIAL ASPIRATING THERMOMETER FOR MEASURING THE TEMPERATURE OF THE AIR AT SEA

by

ALBERTO SOMMA

(Extract from the *Annali del R. Istituto Superiore Navale*, Naples, Vol. VI, Part 1-II, 1937-XVI, page 235).
(Translated from the Italian).

1. The problem of the determination of temperature at sea should be examined from two view-points as follows :– a) *a measurement of the temperature of the air* and b) *a measurement of the temperature of the water.*

The importance of such determinations is very great owing to the fact that a knowledge of the superficial thermal distribution, in conjugation with that of the air in immediate contact with the sea water, is of considerable interest to a large number of scientists.

In fact, the relations which exist between the two oceans, aerial and marine, are subsidiary to the sciences of meteorology, oceanography (physical and biological), of fisheries and navigation. But while, on the one hand, the sciences of meteorology and oceanography find in thermal exploration a solid basis of support for the solution of their fundamental problems, the arts of fishing and navigation may extract from a study of thermometric data some elements of great utility which contribute not a little to the realisation of well-defined objectives.

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2. On board ship the use of the sling thermometer for the measurement of air has been proposed by a large number of investigators. It should be stated, however, that with the results obtained from the measurement of the air at sea, it has not been possible up to the present to arrive at very satisfactory conclusions. Dr. RUSSELTVEDT in an interesting monograph recently published by him (1) shows in fact that Dr. LUTGENS, à propos the meteorological observations made on board the vessel PANGANI, revealed errors greater than 7° C.