A maximum distance of 38 miles was reached in one case last season with sono-radio-buoys. As this was in the relatively shoal water of the Gulf of Mexico, it is expected that much better performance will be found in deeper and colder water. The buoys used for the Atlantic coastal work were built from ordinary commercial oil drums and are quite inexpensive. The audio and radio units are shown in the photograph.

Another party on the Pacific coast for experimental purposes has built a similar unit but much smaller and lighter. This buoy has not yet been used in actual service to any great extent, but it is shown here to illustrate the variation in ideas which are obtained from a group of engineers who have been trained in the same work for many years. The Pacific coast buoy, complete with antenna, batteries, and equipment, can be lifted by one man. This is a decided advantage in handling. It appears quite rugged, and if it satisfies the other conditions of stability and reliable operation, it may be more desirable than a heavier unit. The total weight of the large buoy is approximately 750 pounds, without anchor gear.

III. *RADIO ACOUSTIC RANGING.*

The decrease in cost of offshore hydrography in the United States has been due not alone to echo sounding and Radio Acoustic Ranging development. It is also largely due to the taut wire apparatus for areas such as the coastal shelves, which are found on the Atlantic coast of the United States of America and other continents of the world. This device was brought to my attention at the last Conference by Admiral Edgell and it has been used in conjunction with radio acoustic ranging methods very successfully. It may be conservatively stated that the two purchased for $ 1000 each have saved us $ 200,000 in the five years and in addition has increased the accuracy of our offshore control.

An extract from the report of the Commanding Officer of the Ship *Oceanographer* will serve to indicate the increase in economy largely due to development in these methods.

Cost of hydrography per mile of sounding line :

Year	Cost per mile
1933	$ 20.03
1934	16.20
1935	12.20
1936	8.62

These costs per mile are based on the operating expenses of the ship and are thought to be the best criterion for estimates or other comparison of costs.

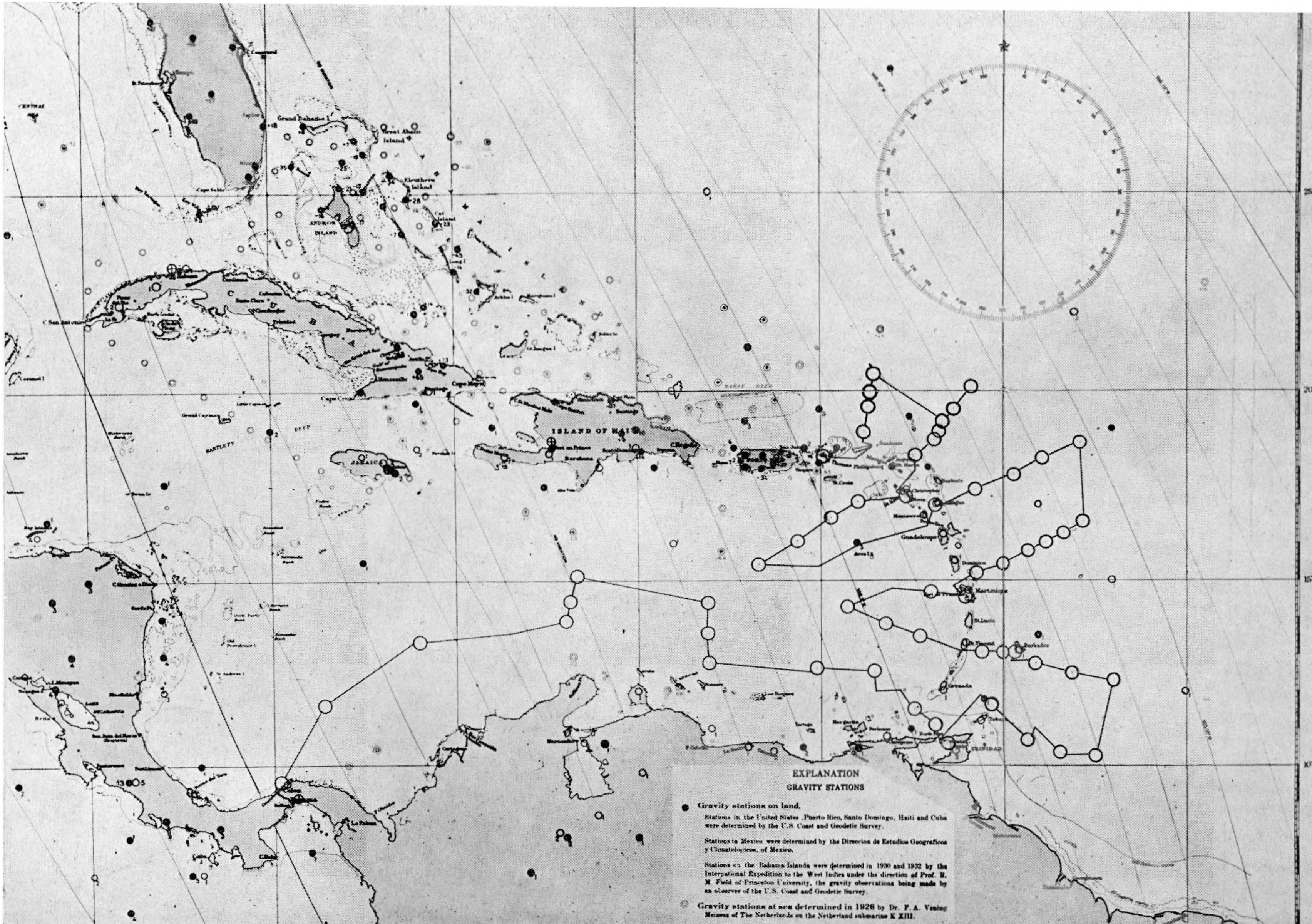
Several plates showing the work which was accomplished during the past summer (1936) by the U. S. Coast and Geodetic Survey using these methods are shown here.

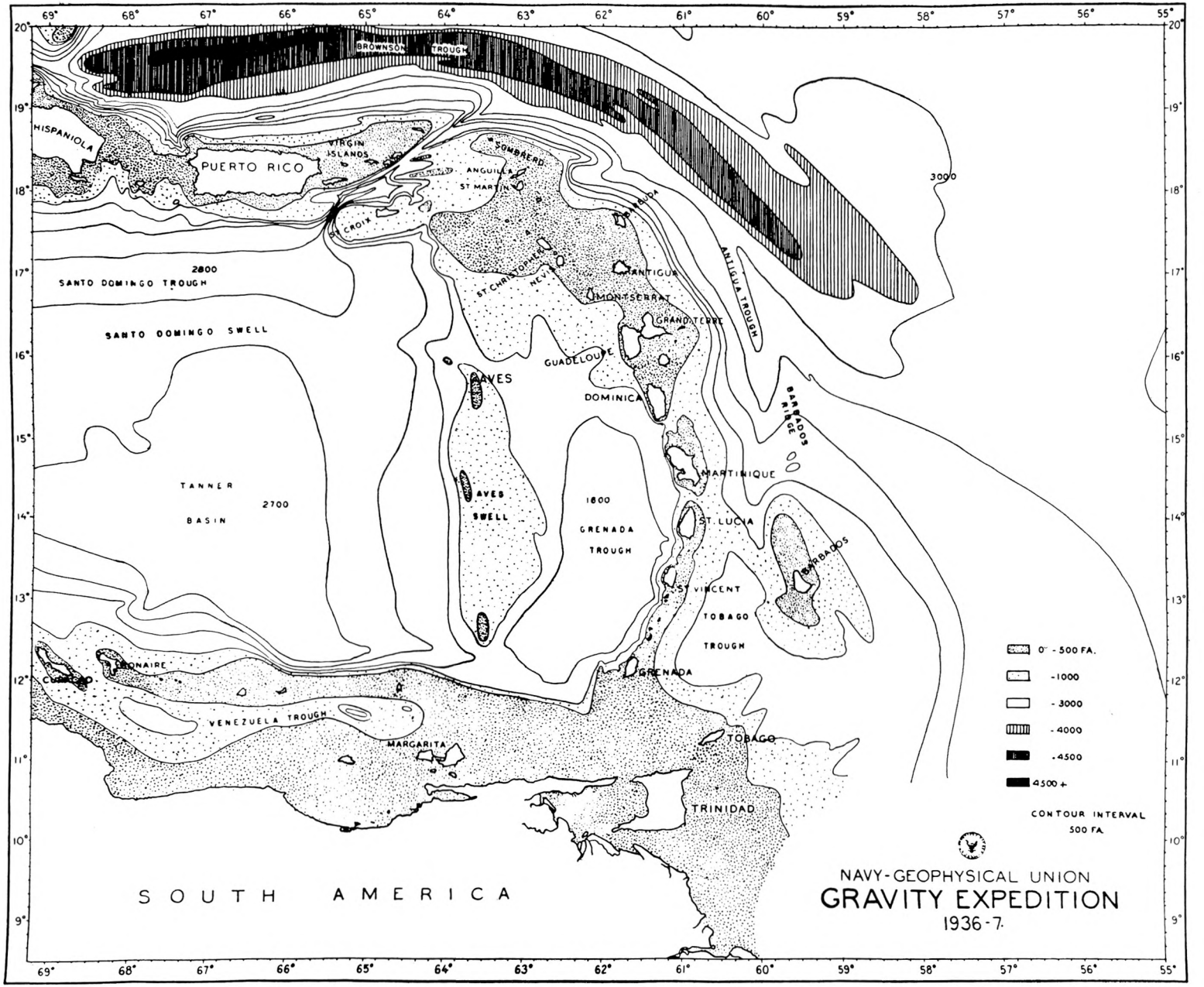
The results of the experiments on the velocity of sound in sea water which were carried out by the ships PIONEER and GUIDE, in January, 1935,

in the Santa Barbara Basin, off the southern coast of California, have yielded valuable data on the travel of sound in water. The complete report of the Commanding Officer of the ship PIONEER, was printed in the Field Engineers' Bulletin of the U. S. Coast and Geodetic Survey for December, 1936. The following is a summary of the most important findings of the analysis :

It was definitely established that the sound travels in a series of reflections and refractions, with some diffraction for short distances, and that the path is materially affected by the even or uneven character of the bottom or steep slopes near the receiving hydrophone. It was found that the sound of a one-pound TNT bomb will travel in a direct line from bomb to hydrophone for a distance of only 9 to 12 km., although it will travel by refraction and reflection to about 75 km. and that a 7-pound bomb will carry to over 300 km. (by refraction and reflection). These experiments were performed in deep water (about 1025 fathoms) with bombs fired at various depths down to 800 fathoms and hydrophones located at different depths, the deepest being also about 800 fathoms. The positions of the exploded bomb and the receiving hydrophones were accurately located so that the intervening distances were well determined and the sound-wave train was closely observed on the receiving hydrophones by means of oscillograph-records from which it was comparatively easy to identify the various waves.

From these experiments it was found that the apparent horizontal velocity of sound in the open sea is a discontinuous function of the distance, the magnitude of the discontinuities depending on the bottom profile, depth and size of the bombs, and sensitivity of the hydrophone. With decreasing depth of bottom, or increasing bomb-size, the magnitude of the discontinuities decreases and may become negligible under certain conditions. Many other interesting and valuable facts were disclosed by these experiments, a study of which is now being made and which it is believed will materially add to the accuracy and efficiency of radio-acoustic ranging methods.


EXPLANATION
GRAVITY STATIONS
Gravity stations on land.
Stations in the United States ,Puerto Rico, Santo Domingo, Haiti and Cuba were determined by the U.S. Coast and Geodetic Survey.
Stations in Mexico were determined by the Direccion de Estudios Geograficos y Climatologicos, of Mexico.
Stations on the Bahama Islands were determined in 1930 and 1932 by the International Expedition to the West Indies under the direction of Prof. R. M. Field of Princeton University, the gravity observations being made by an observer of the U.S. Coast and Geodetic Survey.
Gravity stations at sea determined in 1926 by Dr. F.A. Vening Meinesz of The Netherlands on the Netherland submarine K XIII.
ISLAND OF HAITI
ANDROS ISLAND
Great Abaco Island
Eleuthera Island
Cape Cruz
Cape Maysi
Guadeloupe
Martinique
St. Lucia
Dominica
Grenada
Barbados
TRINIDAD
25°
20°
15°
10°


BROWNSON TROUGH
HISPANIOLA
PUERTO RICO
VIRGIN ISLANDS
SOMBRERO
ANGUILLA
ST MARTIN
BARBUDA
ANTIGUA
ST CROIX
ST CHRISTOPHER
NEVIS
MONTSERRAT
GRAND TERRE
GUADELOUPE
DOMINICA
MARTINIQUE
ST LUCIA
BARBADOS
ST VINCENT
TOBAGO
GRENADA
TOBAGO
TRINIDAD
ANTIGUA TROUGH
BARBADOS RIDGE
3000
2800
SANTO DOMINGO TROUGH
SANTO DOMINGO SWELL
TANNER BASIN
2700
AVES
AVES SWELL
1800
GRENADA TROUGH
TOBAGO TROUGH
BONAIRE
CURACAO
VENEZUELA TROUGH
MARGARITA
0 - 500 FA.
-1000
- 3000
- 4000
-4500
4500 +
CONTOUR INTERVAL 500 FA.
SOUTH AMERICA
NAVY-GEOPHYSICAL UNION
GRAVITY EXPEDITION
1936-7