of the inner mountainous island; the lower wooded slopes; and, dominating all, the central, gray-white peak.

### *WORK OF THE COAST AND GEODETIC SURVEY*

THE report itself must be consulted for the details of the extensive cartographic work of the Bureau in the United States proper, Alaska, Porto Rico and the Philippines, as well as for the account of the progress of the primary triangulation and leveling of precision. In all these branches of the work great activity prevailed and notable results were achieved during the year.

Certain important work of the survey receives bare mention, as for instance the results of the investigation of the earth's figure based on geodetic operations in the United States. This is owing to the fact that these results were communicated to the International Geodetic Association in a preliminary report which has been published.

Appendix 1 gives the details of field operations, and Appendix 2, the details of office work. Five other appendixes form valuable discussions of interesting subjects.

Soon after the California earthquake of April 18, 1906, it became evident that the permanent horizontal displacements of large areas covered by triangulation in California had so changed the lengths and directions of the lines joining the triangulation stations as greatly to diminish the value of the triangulation for its primary purposes as a framework for future surveys. During the year, therefore, new triangulation extending from Point Arena to stations south of Monterey Bay was done, which serves to restore the value of the old triangulation by determining the new positions of 61 of the old triangulation stations. The triangulation included the Farallen Light House, 22 miles to the westward of the great fault accompanying the earthquake, and the stations Mocho and Mount Diablo, 33 miles to the eastward of the fault. The new triangulation serves to trace the permanent distortions and displacements of the earth's crust for many miles back from the fault in each direction and to show that they follow certain regular laws. This is the most extensive and accurate determination by triangulation of the effects of an earthquake which has yet been made anywhere in the world. Appendix 3 is a full report upon this investigation.

A full report on the measurement of six primary bases with steel and invar tapes in 1906 is printed as Appendix 4. The invar (nickel steel) tapes have a coefficient of expansion about one twenty-eighth that of steel tapes, hence it is much less difficult to keep the temperature errors within the required limit with invar tapes than with steel tapes. Invar tapes had not been used in the United States until 1906 in primary base measurements. The thorough tests of these tapes, made by using them on six bases in conjunction with the steel tapes formerly used, showed that measurements may be made more conveniently, accurately, and at smaller cost per mile than with the steel tapes, and that the invar tapes are sufficiently durable and stable for safe field use. This demonstration is believed to be a distinct step in advance in base measurement.

The steady progress in the magnetic survey of the United States and accumulation of magnetic observational data, as mentioned in Appendix 5 of the report, should be of special interest to the surveyor and the navigator, as well as to those pursuing the study of the science of terrestrial magnetism. Throughout the year the measurements of the earth's magnetism were made at places distributed over a majority of the states and territories of the United States and at numerous places at sea along the Atlantic and Pacific coasts of North and South America, and in Porto Rico and the Philippines. Important information was secured in the equatorial regions. Numerous "repeat" observations were made throughout the country in order to follow as closely as possible the secular change in the magnetic elements. Five magnetic observatories were maintained in continuous operation and important seismological data were also obtained. The facilities of the

observatories were afforded to all investigators who desired to make standardization comparisons of their instruments; and in response to numerous requests information, or observational data, was furnished for practical application or for use in special investigations of terrestrial magnetism and allied phenomena.

Appendix No. 6, constituting the concluding portion of a manual of tides, treats of the flow of water, of river tides, tidal currents, permanent currents, annual inequality, lake tides, seiches, and miscellaneous tidal matters.

Charts of concurrent lines are given for the principal marginal waters along the Atlantic Coast of the United States. The numbers upon these lines show the times of the maximum flood current.

The dependence of the permanent ocean currents and the annual height in equality upon the prevailing winds is briefly pointed out. Seiches are shown to exist in harbors and other tongues of water, as well as in lakes; but their character is fundamentally different in some respects.

The analyses of observations upon the tides of Lake Superior show that they follow closely the equilibrium theory although the range is only 1½ inches at Duluth and one third inch at Marquette.

In Appendix No. 7 is given a detailed description with appropriate illustrations of the Long Wire Drag, a device for detecting erratic obstructions of small extent in navigable waters. The method of operating can be understood from the simple statement that the drag is a wire varying in length from 480 to 1,400 feet, supported at suitable intervals and maintained at any desired depth below the surface of the water. This drag is towed over any given area by launches, and in the area so searched no elevation of the bottom above the depth at which the wire is suspended can escape detection. Buoys floating at regular intervals above the drag indicate to observers in the launches when and where an obstruction is touched, and the spot so indicated is then accurately determined.

This method of sweeping has proved a sure means of detecting pinnacle rocks and similar erratic obstructions which heretofore have eluded the hydrographic surveyor, since it is almost impossible to discover them by lines of soundings with the lead. Only the navigator in whose hands rest many lives and much property can realize the relief from mental strain that comes from knowing that the water in which he is sailing is absolutely free from hidden dangers or that every menace is charted. The device has proved very satisfactory under widely varying conditions and marks a decided advance in marine surveying.

This report, or any one of the Appendices, numbered 3 to 7, may be obtained by interested persons, free of charge, upon application to the Superintendent of the Coast and Geodetic Survey, Washington, D. C.

## *BERMUDA BIOLOGICAL STATION FOR RESEARCH*

By arrangement with the Bermuda Natural History Society, the Station for Research at Agar's Island will be open for about seven weeks this summer. There are accommodations for a limited number of instructors or research students in either zoology or botany.

Members of the expedition will sail from New York on the steamer *Bermudian* (Quebec Steamship Co.) at 11 A.M., on Tuesday, June 16, arriving in Bermuda, June 18, and will return on August 5, reaching New York August 7. Those who can not sail on June 16, may do so two weeks later, June 30.

The expense will be $110 for first-class passage from New York to Bermuda and return, and for board and lodging at the islands six weeks and six days. For the shorter time—four weeks and six days—the expense will be $90. Payments are to be made to the undersigned, fifty dollars on or before June 1, the balance on arriving in Bermuda.

For further information apply to

E. L. Mark

109 Irving Street,
Cambridge, Mass.

## *CONFERENCE ON THE CONSERVATION OF NATURAL RESOURCES*

In a sense the federal and state scientific work to date culminates in the Conference on