

brium theory or by application of narrow-sea methods, the other concerns the hydrodynamical theory of tidal motion in geometrically simple basins.

As regards the present state of the subject under review, it should be noted that the equilibrium theory, first used in the eighteenth century to account for actual tides in enclosed seas, provides a first approximation to these tides. In the case of certain geometrically simple basins hydrodynamical theory has progressed sufficiently within recent years to provide second approximations to the tidal motions in these basins; the results indicate, however, that the error of the first approximation, provided by the equilibrium theory, is small.

The publications are listed according to dates using the same classifications as that adopted for the *Tidal Bibliography* published by the ASSOCIATION OF PHYSICAL OCEANOGRAPHY (*Publication Scientifique* N° 2).

Part II. is compiled on similar lines to the preceding part. These basins may be treated as though they were non-elongated and closed, though the more recent explanations of the tides of these basins depend mainly on narrow-sea methods.

INVESTIGATIONS OF SUBMARINE VALLEYS.

by

F. P. SHEPARD.

(Extract from *Transactions of the American Geophysical Union* Fourteenth Annual Meeting, April 27, 28, 29, 1933, Washington, D.C., page 170).

Prior to 1930 there was almost no suspicion of the presence of submarine valleys off the New England coast. The old charts showed an essentially straight 100-fathom curve along this area, yet within the last three years 27 true canyons have been found cutting into the outer edge of the continental shelf all having depths of more than 1,000 feet below their marginal zones and attaining depths below sea-level of over a mile. Three of these canyons discovered last summer have walls rising from 2,500 to 4,000 feet above their floors. Where these canyons have been charted in the greatest detail it becomes evident that they have the characteristics of the great river-cut canyons of western United States. They are also comparable with many of the larger submarine canyons which have been charted off the Pacific coast.

The recent surveys have indicated that at least many of the valleys are the product of river-erosion evidently at a time when the present submerged continental margins were well above sea-level. We should certainly consider most carefully every other possible mode of origin of the canyons, and evidence should be sought which would either reject or more firmly entrench the idea of fluvial origin.

To obtain new evidence concerning the origin of the submarine valleys, something besides the routine charting methods employed by governmental surveys is necessary. Research vessels or private yachts could be used to attack the problem by a variety of methods.

Current-meters. — In order to see whether waves and currents are important in excavating or maintaining the valleys, current-meters could be used.

Study of the topography. — The surveys of submarine valleys by echo-soundings are highly practical, particularly in deep water, but they are subject to the error of giving the distance to the nearest reflecting surface of the bottom rather than the true depths. These inaccuracies are important where there are steep slopes, and even with the application of slope-corrections the result is somewhat in doubt.

Bottom-samples. — Very few samples from submarine valleys have been studied, although notations of the bottom-character have been made by survey officers from a large number of these valleys.

Evidence concerning submarine landslides. — The evidence which suggests that submarine landslides periodically reopen the submarine valleys also needs verification.

Investigation of changes through landsliding is highly practical work. If it is found that these changes are quite common after earthquakes, it will be necessary to rechart the sea-floor in the area adjoining the epicenters of all great submarine earthquakes.
