

FIFTY YEARS AGO...

The question of reference spheroids used for mapping purposes had been under active discussion in the 1930s. This is borne out by an interesting paper which appeared in the *Hydrographic Review*, Vol. X, No. 2, of November 1933 from which we reproduce the following extracts.

"DEFLECTION OF THE PLUMB-LINE
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Geoid and the Reference Spheroid

The visible land surface of the earth is very irregular on account of its mountains and valleys. The ocean surface, however, if it be freed from the disturbing effects of the winds and tides, is very regular, so much so that the mean sea level lends itself to accurate determination along the sea shore and forms the standard zero reference datum for all land surface heights. This ocean surface is held in equilibrium by the force of gravity attracting it towards the earth, and the rotational or centrifugal forces acting outwards; it is therefore an equipotential surface and is truly level. By which is meant that at every point the actual pull of gravity is in a direction perpendicular to the surface.

If this mean sea-level surface be supposed to be extended under the land surface by narrow sea-level canals, then this whole equipotential water surface would give a shape that is called the "geoid".

The direction of the pull exerted by the earth at any point is called the *Plumb-line direction*. The geoid has the characteristic property that it is everywhere perpendicular to the Plumb-line. Owing to this characteristic, this surface plays a very important role in all geodetic operations; for example, it is the datum surface from which heights of all points on the surface of the earth are reckoned.

In a geodetic survey, the first step is to measure a base on the ground, and then start a series of triangulation from it. To compute this triangulation, a knowledge of the form of the geoid is required, but this is not known at the time of survey. Even if we knew the local form of the geoid, it would be a very inconvenient surface for mathematical computations, as the irregularities produced in it by the attraction of irregular features of the earth, visible and invisible, would make the mathematical formulae very complicated.

Geodetic measurements show that the form of the geoid is approximately that of a spheroid of revolution about its minor axis, and so it has become customary now to base all the triangulation computations on an oblate spheroid of reference.

The geoid surface is elevated under the continents and depressed under the oceans.

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Summary

To put the matter briefly :

a) The geoid is the true or equipotential surface of the earth, and the direction of the Plumb-line, or true vertical, is always perpendicular to this surface.

b) For computation purposes a spheroid of reference has to be assumed for the figure of the earth, and the departure of the geoid from the spheroid can be calculated by the deviation of the Plumb-line, or vertical. This is obtained from astronomical observations combined with triangulation data.

c) The shape of the geoid is largely influenced by the topographical irregularities of the earth's surface, but still more by the variations of density in the outer crust. Various theories of isostasy have been put forward to account for the undulations of the geoid, and the irregular deviations of the Plumb-line."

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Also the following item is worth mentioning :

"MERCATOR'S WORLD ATLAS
"AD USUM NAVIGANTIUM"

In Vol. IX, No. 2 of the *Hydrographic Review*, Nov. 1932, there appeared an announcement that the International Hydrographic Bureau had issued a full-sized reproduction of the original *Chart of the World* by Gerhard Mercator published in 1569. The original of this reproduction is the chart in the possession of the Municipal Library of Breslau.

Dr. J.W. VAN NOUHUYS, Director of the "Prins Hendrik" Museum, Rotterdam, informs the Bureau that the museum has recently acquired an original copy of a *World Atlas for Navigation* compiled by Mercator from his world chart in the same year. The atlas was discovered in 1932 at an auction at Lucerne, where it evidently failed to attract the attention it deserved, and was afterwards purchased by private treaty on behalf of the Museum".