GRAVITY AND THE INTERNATIONAL GEOPHYSICAL YEAR

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One of the main purposes of the IGY is the increase of knowledge of the interior of the earth. Gravity is one of the means by which the non-homogeneous density of the interior, especially in the crust, can be studied. Therefore good information can be obtained from gravity anomalies for solving tectonic problems. But the shape of the earth can also be studied if the gravity values are sufficiently well distributed over the entire surface of the earth.

On land, gravity measurements can be made quite easily and with great accuracy with modern gravimeters, if certain conditions of observation and calibration are satisfied. Calibration of gravimeters is available with the needed accuracy only by comparison with pendulum measurements. But only very few pendulum equipments are today suitable for such purposes; the results must have a real accuracy of $\pm$ 0.5 mgals (1 mgal $= 10^{-5}$ cm/sec^{-2}), and to guarantee such a high accuracy many second-order effects must be taken into consideration. Pendulum gravity measurements remain one of the most difficult physical measurements.

Therefore, efforts have been concentrated over some selected *calibration lines :* two in North America, from Fairbanks, Alaska to Mexico City, the second from Ottawa to Washington; the third in Europe, from Hammerfest, Norway to Tripoli, Libya; and the last in the U.S.S.R., between Moscow and Poltava.

On these calibration lines, measurements have been made at a number of selected stations with different observers, using different pendulum equipments and different techniques to eliminate the systematic errors. The accuracy is now of the order of a few parts in 10^4, and has been controlled by transverse ties (with the exception of the Russian line).

These results are very important, as they provide control for practically all other gravimetric measurements on land. Therefore, a *first-order world gravity* net is almost completed, with a few selected first-order stations for every continent, with many connections obtained with different (both pendulum and gravimeter) equipments and observers.

All the *national reference stations* are connected to these first-order stations with the greatest accuracy; and from the national reference stations all the other gravity values in each individual nation have been derived mainly by gravimeter.

Most of the countries throughout the world are therefore covered, or are being covered, with a gravity net, with the exception of the polar cap.

The IGY has therefore concentrated its efforts in the Arctic and Antarctic, where all expeditions are now making gravity measurements.

To cover the earth with gravity measurements, it is obviously very important to make them also on the seas. Until a few years ago, only *Vening Meinesz's pendulum equipment* gave satisfactory results; and since 1923, more than 4 000 gravity measurements on sea have been made with Vening Meinesz's apparatus, all by submarine expeditions (Dutch, Italian, North-American, French, Russian, and many others).

For the past few years, measurements on the continental shelf have become possible with *remotely controlled gravimeters,* operated from shipboard but placed in a bathysphere on the ocean bottom; and many hundred thousands of gravity measurements have been made around the U.S.A., Italy, the Netherlands and in many parts of the Middle East (figs. 1 and 2).

Nevertheless, the major part of the ocean surface remained devoid of gravity values. Two methods have been followed to overcome this :

I) *Measurements on the bottom with Piccard's bathyscaph* (fig. 3) : very satisfactory results were obtained on 16 October 1957 at a depth of 820 m near Capri (Dr. Diceglie);

II) *Measurements on surface ships,* with gyro-stabilized platforms and recordings.

New equipment of this type is being developed by Germany (Graf), U.S.S.R. (Boulanger), Canada (Gilbert) and Japan (Tsuboi). Surveys have already been made by J. Lamar Worzal of the Lamont Geological Observatory, with Graf's sea gravimeter; and by Boulanger. Results seem to indicate that in a short time it will be possible to make gravity measurements simply and quickly anywhere at sea with an accuracy of $1/10^6$, similar to that obtainable on land up to 10 years ago.

This will be a very important contribution to the knowledge of the interior and shape of the earth, and to the determination of the gravity field in height, an essential item of information for the study of satellites.

Fig. 1. — Gravimetric ship *Francesco Vercelli.*

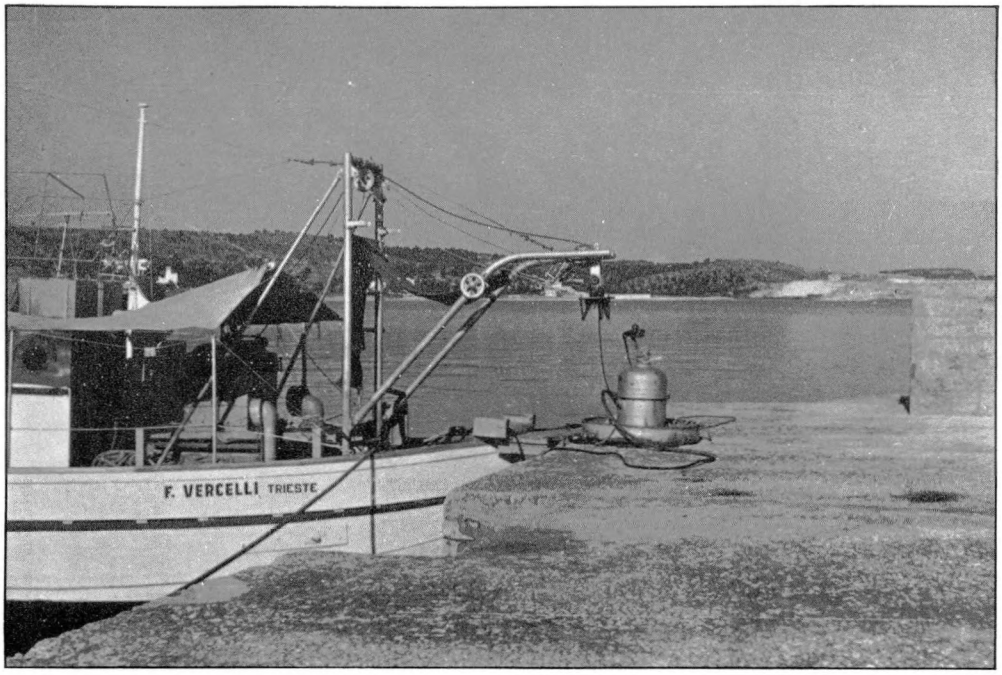

Fig. 2. — Shore Base.

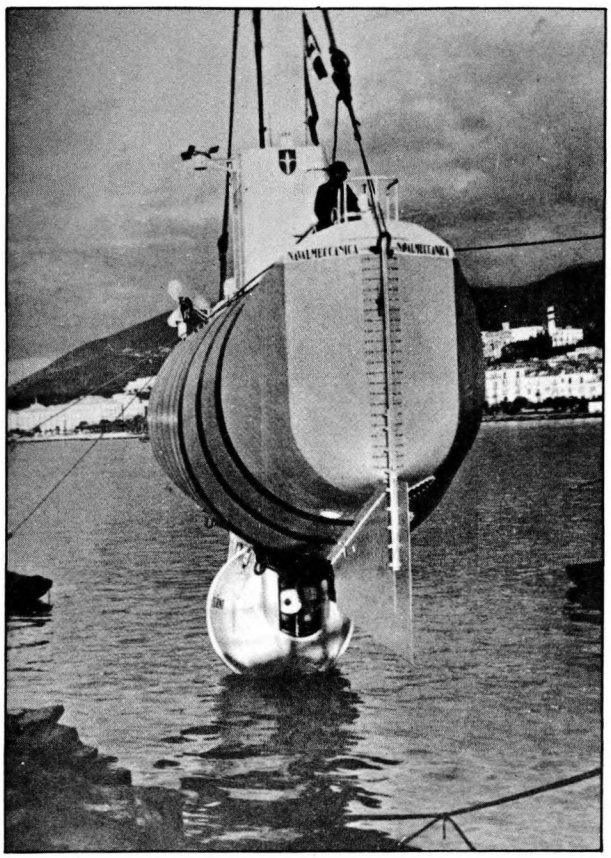

Fig. 3. — The bathyscaph *Trieste* equipped with the gravimeter for measurement at a depth of 820 m (16 Oct. 1957).