A NEW GRAVIMETER
AND MEASUREMENTS MADE AT THE BORNHOLM ISLAND

by

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(Translated from the French Text).

The Director of the Geodetic Institute of Danmark, Professor N.E. NÖRLUND, included in his projected geodetic measurements in Greenland some systematic gravimetric work. With this object in view, the Geodetic Institute Laboratory undertook wide experiments in order to produce a suitable contrivance. Hereafter we give a brief account of the results attained through this research work.

Endeavours were made to construct an extremely light instrument, free from any too complicated electric gear consuming large quantities of electric current so as to avoid using sensitive electrical instrument and an electrical thermostat with voltage batteries and storage cells.

More over, every effort was made to construct an apparatus allowing an accurate calculation of the force of gravity, without complicated calibrations or sensitivity valuations, because in Greenland there is no satisfactory gravity station allowing such calibration. The instruments must therefore be capable of working just as independently as ordinary pendulums.

These researches have shown that the most appropriate contrivance in a quartz torsion instrument. The instrument consists mainly of a horizontal quartz fibre K about 0.2 mm. thick and 12 cm. long (Fig. 1) from the middle of which a short quartz bracket A_1 starts almost horizontally. The quartz fibre is twisted until the moments of torsion and gravity counterbalance each other. A small concave mirror S_1 is placed at the end of the bracket. The mirror is cut directly into the quartz itself so as the avoid any inaccurate connexion.

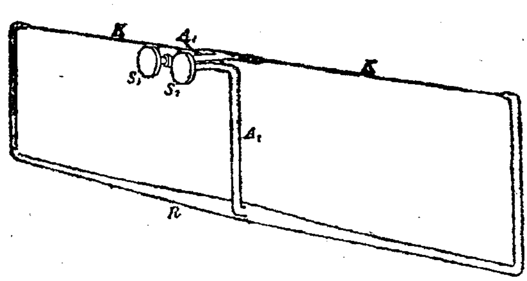

FIG. 1.

The quartz fibre is slightly strained within the quartz frame R on which is also fitted a quartz bracket A_2 supporting another small concave mirror S_2 (similar to S_1). Both

(1) See Hydrographic Review, Vol. XVII, N° 2, November 1940, pages 79-81.

mirrors are covered with a layer of platinum plated gold so as to ensure a great power of reflection.

The quartz apparatus is fitted in a chrome plated copper box, filled with a suitable liquid (generally monovalent and polyvalent alcohols, toluene or oils).

In order to obtain an adjustment of temperature, the quartz bracket A_1 is provided with a small platinum ring, so that the pressure on A_1 and on the platinum ring may be adequate.

The following method of measurement was used: the instrument is swung over until the moment of gravity be reduced, so that the mirrors S_1 and S_2 become parallel (which shows that the angle of torsion and consequently the moment of torsion for the quartz fibre will acquire a definite value).

If, by tilting the instrument, the angle of inclination i_1 in station 1 with the force of gravity g_1 is found together with i_2 in station 2 etc. the following expression is obtained :

$$g_1 \cos i_1 = g_2 \cos i_2 = g_3 \cos i_3 = \ldots$$

In consequence, once the force of gravity of a station is known, it is possible to infer the force of gravity of the others. So it becomes possible to determine the double angle of inclination 2 i by tilting the instrument first upwards, for instance, then downwards.

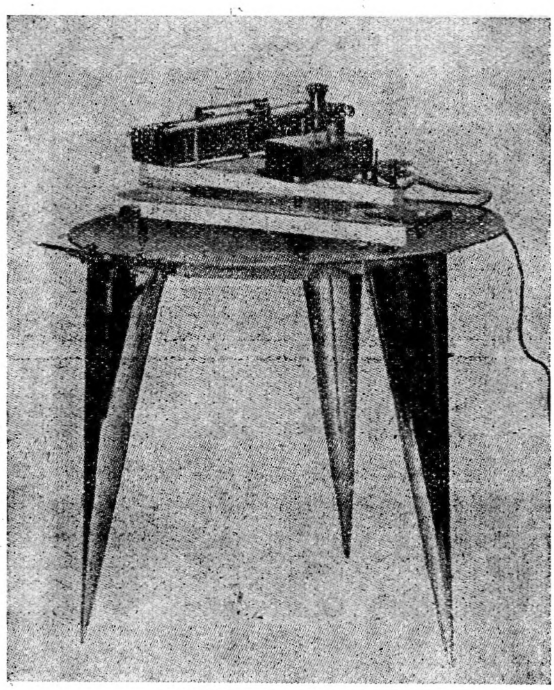

FIG. 2.

As regards practical results, it should be pointed out that we checked the instrument at the Bornholm Island under the most varied conditions, from the stand point of weather conditions as well as of transport and station conditions. Thus the instrument travelled in the following ways: it was carried over even and uneven roads, in motor cars, also in rowing boats, motor boats, air craft and on board ship: in all sorts of weathers: sunshine, rain, wind and fog, the conditions at the station were also of a very varied kind, as for instance, ordinary roads, fields, ploughed meadows, marshes, forests, dunes, beaches and rocks, in no case were any particular difficulties encountered.

On account of special care being taken in the inner making of the instrument the influence of temperature was adjusted to the extent that the instrument is capable of being worked in the open air. It never broke down.

The mean error was generally 0.2 mgal in a test made at the Bornholm Island in 1940.

Fig. 2 shows the instrument on its tripod.

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