PROGRESSI E TENDENZE NEI PROCEDIMENTI PER DETERMINAZIONI DI GRAVITA RELATIVA.

(PROGRESS AND TENDENCIES IN THE METHODS OF DETERMINING RELATIVE GRAVITY)

by PROF. G. CASSINIS

Professor G. CASSINIS has written a very interesting article in Nos 5 and 6 of the *Bolletino del Comitato Nazionale Italiano per la Geodesia e la Geofisica,* which are appended to Nos 5 and 6 of *Universo.* This deals with the various appliances which, within recent years, have caused the determination of gravity to make great progress.
The following is a summary of this article :-

1) Improvements introduced into the method of R. V. STERNECK by investigating the influence of the elasticity of the support, to which the Italians A. VENTURI, G. LORENZONI, G. SILVA and V. REINA have contributed; the employment of appliances in rarefied air and the employment of invar or of non-magnetic bronze.

2) Determination of the duration of the oscillations. The method consisting of appreciating the coincidences by eye and ear has been replaced by various self-registering systems which greatly increase the accuracy : by photography (VENING-MEINESZ, CONYNGHAM, O. MEISSER and H. MARTIN), by photo-electric cells and by hertzian waves. One of the most interesting of these appliances, which may also be used for measuring other time intervals, is that which was invented by Father LEJAY and investigated by H. MAHNKOPF and H. SCHMEHL. It consists of a triode valve connected as reaction, followed by a low frequency amplifier. The aerial consists of a horizontal wire, about one metre long, the free end of which is immediately under the pendulum when at rest. The pendulum has, at its lowest part, a short horizontal filament which is parallel to the aerial and very close to it in the position of rest. The valve is so constructed that a very small variation in the capacity of the grid circuit starts oscillation. The signals thus produced by the pendulum at each oscillation are very sharp and can be recorded in the usual way.

3) Minimum pendulums, *i. e.* pendulums the dimensions of which are so combined that the variation in the duration of oscillation, due to irregular variations in distances between the knife edge and the centre of gravity of the pendulum, are made as small as possible. The rule laid down by J. WILSING has been applied to pendulums of cylindrical form by KOHLSCHÜTTER. Various metals and alloys have also been tested.

4) The precautions taken by MEISSER to introduce great accuracy in the new Jena apparatus, measurement of temperature and pressure, and differential observations.

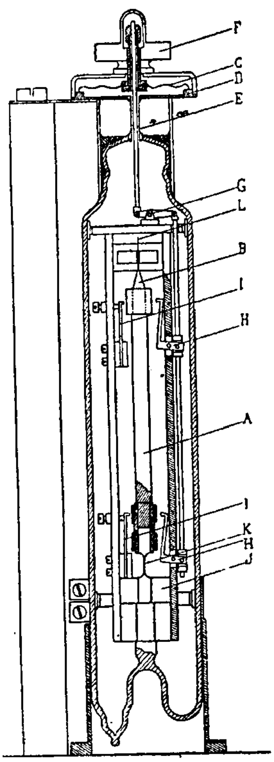
5) Short description of the VENING-MEINESZ apparatus intended for gravimetrical measurements at sea. It consists of three pendulums oscillating in the same plane, together with a fourth pendulum which is free to move in a plane at right-angles to the other. MEINESZ carried out experiments with his apparatus in submarines which were submerged to such depth that the movement of the sea was no longer appreciable. He has obtained several hundred determinations in the Atlantic, the Pacific and the seas of the East Indian Archipelago. It is to be hoped that observations will shortly be taken in the Mediterranean, where comparison with the results obtained on land will be particularly easy and instructive. The investigation of gravity at sea, which this instrument has made possible, is quite new and may lead to the corroboration or to the modification of our ideas on the subject of the constitution and equilibrium of the terrestrial crust, on isostasy, on earthquakes etc.

6) Investigation of elastic pendulums with which the Swedes, ISING and URELIUS have carried out experiments. These two have adopted a torsion pendulum in which the small quartz bar (about 25 millimetres long) is in an upright position. It sets itself into a position of equilibrium which is determined by the equality of the contrary moments

exerted by gravity and the torsion of a horizontal quartz thread. By this method the sensitiveness of small variations of g may be practically increased enormously.

This *static* method, which is intended for the measurement of the variation of g from one point to another, has the advantage of being quite independent of time measurement.

7) A system which has the same object and which is not dissimilar to the preceding one, but which is *dynamic*, has been used with great success by Father LEJAY. His pendulum consists of a shaft of quartz AB, about 10 centimetres long, which stands vertically and which is connected to its support J by a blade of elinvar K, the elastic force of which very nearly counterbalances the weight of the shaft. The pendulum thus has a very long period and is very sensitive to variations in g.



A recent communication by Father LEJAY, which appeared later than Professor CASSINIS' article and was included in the *Comptes Rendus de l'Académie des Sciences*, Paris, of 4th May, 1931, page 1116, contains a description of the latest model (*see* figure) and the results obtained in France and Switzerland. Time is measured by an auxiliary free pendulum of quartz, the duration of the oscillation of which (about ½ second) is compared by direct stroboscopic observation with that of the gravity pendulum. For this purpose the free pendulum causes a spark at each passage through the vertical and this illuminates the filament L which is attached to the upper end of the gravity pendulum. To obtain g with an error less than a unit of the second place of decimals, an observation lasting 15 minutes is required. The apparatus stands transportation very well.

8) H. HAALCK has constructed and carried out experiments, during 1930, with a *static measurer of gravity* for deducing the variations in gravity between two stations from the variation in the height of a column of mercury which is held in equilibrium by the pressure of a gaseous mass enclosed in a suitable receptacle.

P. V.

The bibliography appended to his investigation by Professor CASSINIS is given below. This will allow full information on these questions to be obtained.

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