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Isostatic Institute of the International Association of Geodesy.

by

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The study of the isostatic equilibrium of the earth's crust has been developed into one of the most important branches of the earth sciences — thanks to the pioneer researches of PRATT and AIRY in India in the middle of the 18th century and, later on, to the famous works of J. F. HAYFORD, F. R. HELMERT,, ILMARI BONSDORFF, WILLIAM BOWIE and F. A. VENING MEINESZ. Through BOWIE, who has been at first for a longer time President of the International Association of Geodesy and then President of the International Union of Geodesy and Geophysics, and also through VENING MEINESZ, the President, and General G. PERRIER, the Secretary of the International Association of Geodesy, isostatic study has become the focal point of the activity of the International Association of Geodesy, which fact has much advanced this branch of science.

Isostatic study is however rather troublesome and laborious. Every deflection of the vertical point and every gravity station must be reduced topographic-isostatically, so that one can use them for the study of the structure and figure of the earth. For the reduction of every station we must estimate the mean elevation or depth of the various zones and their compartments with the station as the common centre of these zones; these zones must cover the whole earth surface. All this demands much time.

In order to facilitate isostatic reduction work and to stimulate isostatic study there was founded, on the proposal of Prof. VENING MEINESZ at the Meeting of the Association of Geodesy in Edinburg in September, 1936, an »Isostatic Institute of the International Association of Geodesy»,

which is situated at Helsinki and the director of which I have had the honour to be.

The principal tasks of this Institute are:

1. The preparing of the isostatic world maps, giving the topographic-isostatic reduction of the gravity stations in the most distant HAUFORD zones.

2. The isostatic reduction of the gravity stations of such European countries, that will give their gravity measurements to this institute for reduction.

3. The isostatic reduction of the deflection of vertical stations in Europe and in Africa,

4. The study of the figure of the earth,

5. The study of the gravity formulas,

6. The study of the isostatic equilibrium and of the structure of the earth's crust, in first line by aid of the gravity anomalies.

The first commission of the Isostatic Institute was to send a circular to a number of geodesists and to the most important geodetic, topographic, mapping and military Institutions, in which the activity of the Institute was outlined for the near future and the Institutions were requested to send to the Institute, gratis, if possible, topographic and bathymetric maps on scales 1 : 200,000 to 1 : 10,000,000.

The Isostatic Institute has had the honour to receive necessary charts and maps from British India, Canada, Czechoslovakia, Denmark, Finland, France, Germany, Great Britain, Hungary, Italy, Japan, Lithuania, Monaco, the Netherlands, Norway, Poland, Sweden, Switzerland, United States of America and partly also from the U.S.S.R., all gratis.

Up till now the Isostatic Institute has published world maps for the topographic-isostatic effect of the outermost HAYFORD zones 10 to 1 to the gravity and world maps for the indirect effect of the undulations of the geoid on gravity anomalies. Besides this the topographic-isostatic effect of zones 11, 12 and 13 has been estimated for Europe, the Atlantic, India and the East Indies. These maps are only duplicated, not printed, and they can be sent to scientists, that may need them.

Two investigations have been published on the gravity formulas and one is just being printed. One publication gives the Tables for the topographic-isostatic reduction of the gravity, according to AIRY's hypothesis.

According to the resolution of the Association of Geodesy, adopted at its Meeting in Edinburgh, I have compiled the Catalogue of the isostatically reduced gravity stations of the world, 3758 in all.

In one publication Dr. NISKANEN has studied the mode of the upheaval of land in Fennoscandia and in another the deformation of the earth's crust under the weight of the glacial ice-load.

The remaining investigations are dealing with the isostatic structure of the earth's crust (in Ferghana and in the Carpathian countries).

As to the topographic-isostatic reduction of the gravity stations, altogether about 1000 stations have been reduced in the Isostatic Institute, namely 15 for Lithuania, about 100 stations at sea, 185 in the Ferghana basin, 310 in the Carpathian countries, about 300 in the East Alps and about 100 in Japan. For the study of the geoid and of the gravity formula the Institute has besides this reduced, with a smaller, accurary thousands of level land stations.

Very important is the new adjustment of the national gravity base stations of the world, undertaken by Dr. R. A. HIRVONEN. Giving for the modern measurements weight 5 and for the stations measured before 1901 weight 1 and studying carefully the error sources and the constitution of the error equations, he used three methods that brought him practically to the same result. The corrections of the old BORRAS-values are in some cases remarkable ones. The greatest are the corrections for the base stations Karlsruhe (—11 mgal), Strasbourg (—11 mgal), Zürich (—9 mgal), Torino (—12 mgal), Kasan (—13 mgal), Tashkent (—7 mgal), Washington (+ 6 mgal) and Dehra Dun (+ 13 mgal). This adjustment is very interesting, especially as through it the gravity base values, and of course also the field values in America, become 6 mgal and in India 13 mgal greater and at many European stations about 10 mgal smaller. Therefore, the systematically negative anomalies in America and in India, and the systematically positive anomalies in Europe, decrease by 6, 13 and 10 mgal, but do not disappear wholly, s shown in a publication by HEISKANEN on the gravity formulas. Dr. HIRVONEN's investigation will before long appear in the Isostatic Institute's publications.

On the proposal of Prof. VENING MEINESZ, the President of the Association, the Assembly of the International Association of Geodesy in Washington decided to give the computation of the great waves of the geoid to the Isostatic Institute. We can divide the undulations of the geoid in two parts: into the local part N_1 and into the continental part tN_2, where N_1 is due to the gravity anomalies of the neighbourhood of he point to 300 or to 500 km from the point and N_2 is due to the gravity field beyond this boundary. Every country should itself compute the

part N_1, or the fine structure of the geoid, either by the aid of the deflections of the vertical or of the gravity anomalies, or by making use of both methods.

The continental part N_2 will however be computed in the Isostatic Institute. This very laborious work has been begun by Dr. L. TANNI. He is now drawing a map of the gravity anomaly field, by the aid of which it will be possible, by making use of the famous theorem of STOKES, to compute the continental undulations N_2 of the geoid. This will be computed for about 200 points. The work will appear in 1947.

Drs. L. TANNI and E. NISKANEN have been assistants of the Institute during the whole time and the following persons for a shorter while: L. REPO, student, PAAVO E. HOLOPAINEN, M. A., MAUNO D. KAJAMAA and V. EROLA, Eng. D. and NIILO LUOMA, E. S. HALONEN and I. S. HÄRMÄLÄ, engineers.

Up to 1941 the Isostatic Institute received 30,000 to 40,000 Finnish marks annually from the International Association of Geodesy and in 1941 sums of about 10,000 marks were got from Sweden, the Netherlands and Denmark. From 1942, because of the world war, foreign help completely stopped. Thanks to some Finnish authorities, that have helped the Isostatic Institute materially, the Institute has been able to continue its scientific work. Beginning from 1937 the Finnish Board of Education at first made an annual support of about 40,000 marks, but during the last years approx. 200,000 marks. The Finnish Technical University has given 30,000 to 150,000 marks annually during the whole time while the Finnish Academy of Sciences has undertaken to publish the scientific researches of the Institute in its *Annales* and the Institute has only paid for an overprint of 600 copies. Besides this the Finnish Culture Foundation, the JENNY and ANTTI WIHURI's Foundation and EMIL AALTONEN's Foundation have given subsidies to the assistants of the Isostatic Institute in all for about 300,000 marks. In 1946 the Institute has received from the International Union of Geodesy and Geophysies $ 1000 and from the Rockefeller Foundation $ 2500.

I take also this opportunity of thanking all these instances and authorities for their welcome help.

In my opinion the activity of the Isostatic Institute is a good example of the harmonious cooperation of the international and national work of culture.