41. Supplementary Notes on the Most Suitable Formula for the Japanese Gravity Values.

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In a former paper of his[1], one of the present authors showed by an approximate calculation that the most suitable formula for the Japanese gravity values was

$$\gamma = 977{\cdot}981\ (1 + 0{\cdot}005\,562 \sin^2\varphi)$$

using as data g_0'' at the Japanese gravity stations which are 122 in number. The ellipticity of the geoid corresponding to this gravity formula is 1/322 which is much smaller than the normal value. Although the above calculation was an approximate one, the large departures of the numerical constants in this formula from the corresponding ones in other ordinary formulas cannot be overlooked. This seems to indicate that an abnormal subterranean structure exists in the neighbourhood of Japan noted for the seismic and volcanic activities.

Seeing, however, that there was some incompleteness in the former calculation, the authors intend here to determine the most suitable formula for the Japanese gravity values g_0', not for g_0''. The present calculation, therefore, is based on the Helmert's method of condensation reduction.

The determination of the formula was made by the method of successive approximation. First of all, tentative values were assigned to g_ε and β in the formula

$$\gamma = g_\varepsilon\ (1 + \beta \sin^2\varphi)$$

and from a set of 122 observation equations of the form

$$g_0' - \gamma = \frac{\partial \gamma}{\partial g_\varepsilon} \Delta g_\varepsilon + \frac{\partial \gamma}{\partial \beta} \Delta\beta = (1 + \beta \sin^2\varphi)\ \Delta g_\varepsilon + g_\varepsilon \sin^2\varphi \Delta\beta,$$

Δg_ε and $\Delta\beta$ are determined by the method of least square, the solution being the cerrections to be applied to the constants in the initial ten-

1) C. TSUBOI, *Bull. Earthq. Res. Inst.*, **11** (1934), 632.

tative formula. Repeating this process until we have $\Delta g_e=0$ and $\Delta\beta=0$, we get the final formula.

In the present case, we started from the formula,

$$\gamma=977{\cdot}968\ (1+0{\cdot}005\,640\sin^2\varphi)$$

and obtained

$$\Delta g_e=+0{\cdot}030,\qquad \Delta\beta=-0{\cdot}000\,10.$$

Then as the next approximation, we started from

$$\gamma=977{\cdot}998\ (1+0{\cdot}005\,540\sin^2\varphi)$$

and obtained

$$\Delta g_e=0{\cdot}000,\qquad \Delta\beta=-0{\cdot}000\,002.$$

Thus we get as the final formula

$$\gamma=977{\cdot}998\ (1+0{\cdot}005\,538\sin^2\varphi).$$

The departure of each of the observed g_0' from γ ranges from $+0{\cdot}161$ to $-0{\cdot}111$, the mean without sign being $0{\cdot}035$. This large departure makes the probable error of each of the constants in the formula also large, thus

$$g_e=977{\cdot}998\pm0{\cdot}019,\qquad \beta=0{\cdot}005\,538\pm0{\cdot}000\,053.$$

The reciprocal of the ellipticity of the geoid that corresponds to this gravity formula is $319{\cdot}5\pm5{\cdot}4$.

In Fig. 1 are plotted g_0' at the gravity stations against the corresponding $\sin^2\varphi$. The broken line in the figure which corresponds to the Helmert's formula

$$\gamma=978{\cdot}030\ (1+0{\cdot}005\,302\sin^2\varphi)$$

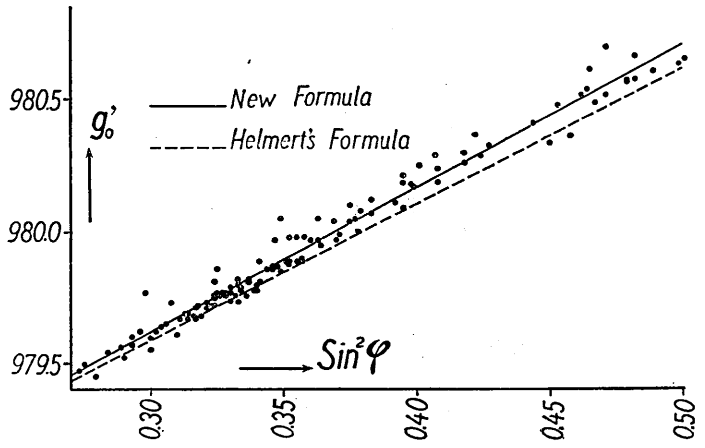

Fig. 1. Relation between g_0' and $\sin^2\varphi$.

does not agree well with the gravity values observed in Japan.

Although some further gravity reductions, such as the isostatic or "geological", may considerably reduce the gravity anomalies and the formula based on the gravity values thus reduced may indicate the normal ellipticity of the geoid, it is a noteworthy fact that the ellipticity of the actual geoid in Japan is considerably smaller than the normal one determined from the world wide gravity determination.

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41. 日本の重力に最もよく適合する式

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日本に於ける重力の値 g_0' を材料とし，これに最もよく適合する式を求めて

$$\gamma = 977{\cdot}998\,(1 + 0{\cdot}005\,538 \sin^2\varphi)$$

を得た．此の式に相當するゼオイドの扁平度の逆數は 319·5±5·4 である．之等の常數が世界の重力の値から定めたものと著しい差があるのは注意す可き事である．
