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COMMUNICATION FROM THE OBSERVATORY AT LEIDEN.

Results of the Observations for the variation of latitude made with the Zenith-Telescope of the Leiden Observatory, by the late Dr. H. J. Zwiets. *)

The observations cover the period from June 13, 1899 to October 11, 1906 and are made by Dr. J. Stein S. J. from June 13, 1899 to July 10, 1900 and by Dr. H. J. Zwiets from July 11, 1900 to Oct. 11, 1906.

The observations made in the first interval have already been reduced and published by STEIN in Vol. IX, Part 1 of the Annals of the Observatory, where also the description can be found of the instrument and the observing-hut used and the method of observation employed.

The new reduction of the whole period is based, as regards the stars observed, on the places and proper-motions, derived by Zwiets in Vol X, Part 3 of the Annals: "Untersuchungen über die Declinationen und Eigenbewegungen von 163 Sternen, welche 1899-1906 am Zenith-Teleskop in Leiden beobachtet worden sind".

Until the end of 1902 the value of a revolution of the screw is assumed as 51°,714, derived by STEIN; from 1903 a value of 51°,727 is used, derived by Zwiets after an extensive investigation.

The periodic and progressive errors of the screw are determined and applied separately for every year.

To the results from the individual groups of stars corrections have been applied for the perturbation of the vertical by the Sun and Moon and the influence on the aberration by the Moon, Jupiter and Saturn, computed for the mean time of observation of the group.

From the nights, on which all pairs of stars belonging to a same group have been observed, corrections are derived to reduce the different pairs to the mean of their group; these corrections are applied to the individual pairs, when a group was not observed completely.

By means of a cyclical adjustment of the mean differences in the resulting latitude, obtained from consecutive groups of stars observed in the same night, the corrections have been determined, which must be applied to every group to reduce it to the mean system of declinations.

The final results of the groups are combined to normal places, depending on about 40 observed pairs each, represented in the diagram by the circled dots. The curve is drawn as nearly as possible through these normal-places and then read off for every tenth of a year.

For the intervals 1899.9—1905.9 and 1906.0—1907.0 the quantities $x$, $y$ and $z$ have been taken from Parts III and V respectively of the "Resultate des Internationalen Breitendiensten", which have been transformed into the latitude-variation for Leiden by the formulas:

$$
\Delta \phi = x \cos \lambda + y \sin \lambda \\
\Delta ' \phi = x \cos \lambda + y \sin \lambda + z
$$

with $\lambda = -17^\circ 56.1' 15"$.

The values $\phi$ for the latitude of Leiden, read off from the curve, diminished by $\Delta \phi$ or $\Delta ' \phi$ give for every tenth of a year a value of the mean latitude of Leiden.

The following table gives the results from year to year:

*) The reduction and discussion of the observations with the Zenith-Telescope from 1899 to 1906 were found amongst the papers of Dr. Zwiets after his death. All discussions were complete in every detail, and testify to the painstaking care and thoroughness that were characteristic of all Zwiets' work. It may be expected that the Netherlands Geodetic Committee, under whose auspices the observations were made, will publish the observations and discussions in full detail. As some time must anyhow elapse before this publication can be ready, the results only are succinctly communicated here. The diagram is reproduced as found amongst Zwiets' papers. The explanatory text has been prepared by Mr. Hins.
Variation of latitude at Leiden, 1899.5—1906.7

- Leiden observations, normal places of about 40 pairs.
- International stations, without $s$-term.
- International stations, with $s$-term.

Mean latitude of Leiden.

<table>
<thead>
<tr>
<th>Year</th>
<th>$\varphi_0$</th>
<th>$\varphi'_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>52° 19' 802 ± 0.18</td>
<td>19° 811 ± 0.009(m.e.)</td>
</tr>
<tr>
<td>01</td>
<td>815</td>
<td>809</td>
</tr>
<tr>
<td>02</td>
<td>780</td>
<td>811</td>
</tr>
<tr>
<td>03</td>
<td>780</td>
<td>774</td>
</tr>
<tr>
<td>04</td>
<td>804</td>
<td>786</td>
</tr>
<tr>
<td>05</td>
<td>798</td>
<td>807</td>
</tr>
</tbody>
</table>

Mean: 52° 19' 801 ± 0.007 19° 800 ± 0.006

Adding to this value of the mean latitude of Leiden the quantities $\Delta \varphi$ and $\Delta \varphi'$, the international polar curve without and with $s$-term has been constructed.

The first is the curve joining the open circles, the second is only represented by the dots, not joined by a curve.

Diminishing the readings from the Leiden curve $\varphi$ by $\Delta \varphi$, we can consider the residuals $(\varphi - \Delta \varphi) - \varphi'_0$ as forming a Leiden $s$-term, which is then represented by the formula:

$$s = + 0^\circ.001 - 0^\circ.057 \sin \tau + 0^\circ.021 \cos \tau$$

or

$$s = + 0^\circ.001 + 0^\circ.0607 \sin (\tau + 159^\circ.8)$$

where $\tau = 2\pi \times$ the fraction of the year.

The international $s$ for the same years, derived from Part III of the "Resultate" gives:

$$s_{\text{int}} = + 0^\circ.001 - 0^\circ.0106 \sin \tau + 0^\circ.0426 \cos \tau$$

or

$$s_{\text{int}} = + 0^\circ.001 + 0^\circ.0439 \sin (\tau + 104^\circ.0)$$

The international polar curve in $x$ and $y$, combined with the Leiden $s$-term, represents the readings from the Leiden curve with a mean error of $0^\circ.028$.

It is interesting to compare the resulting mean latitude of Leiden with that derived from the reduction of 84 stars near the North Pole, published in Vol. XIII, Part 3 of the Annals.

The resulting latitude found there is 19°.72, but as mentioned on page 60, E. F. V. D. SANDE BAKHUZEN already suggested a correction to the adopted constant of refraction, which would make the resulting latitude 19°.81 ± 0°.010, in close agreement with the value obtained here.