EDITORIAL NOTE.

The directors of the Observatories at Leiden and Utrecht, the Kapteyn Astronomical Laboratory at Groningen, the Heliophysical Observatory at Utrecht and the Astronomical Institute at Amsterdam, have decided jointly to publish the Bulletin of the Astronomical Institutes of the Netherlands, in which short communications from the institutes under their direction will be made public. The B. A. N. will appear at irregular intervals. Each number will contain one or more communications from one of the institutes. The separate numbers will be combined into volumes of about 200 pages, for which a title-page and index will be issued.

The B. A. N. will be distributed gratis to the principal observatories and to some other astronomical institutions. It will also be obtainable on subscription. The subscription for a volume (inclusive of postage) has been fixed at 12.50 Dutch currency, payable in advance. Orders to be sent in to the Director of the Observatory at Leiden.

COMMUNICATIONS FROM THE OBSERVATORY AT LEIDEN.

On a Method of Prof. Kapteyn for the determination of the collimation-error of a meridian instrument applicable in different zenith distances, by C. H. Hins, Observator at the Leiden observatory.

The common methods for the determination of the collimation-error of a meridian-instrument are the following:

a. with collimators,

b. by observations of two meridian-marks in combination with a reversal of the instrument,

c. with the mercury-basin (observation of the reflected middle-thread),

d. from transits of polar stars combined with a reversal of the instrument between the two groups of transits.

Since the possibility cannot be excluded, that the amount of the collimation-constant in meridian-observations may depend on the zenith distance, all these methods, with the exception of the fourth, are open to the objection, that they give the collimation-constant in positions of the instrument, which are not used in actual observations.

It would consequently be very desirable to have a method which made it possible to determine the collimation-constant in different zenith distances.

A suggestion from Prof. Kapteyn has led me to devise and carry out the following plan of observations with the meridian-circle of the Leiden Observatory.

1921 Sept. 28.
Instrument in position Clamp East.
1. Determination of the instrumental azimuth by the meridian-marks (twice, by two different observers).
2. Determination of level (twice, both with object-glass south and north, eight readings).
3. Clock-comparison (registrating and normal clock, by two observers).
4. Transits over 23 threads of 4 stars:
   (A. G. Leiden 9974, 9995, 10036, 10067) Group A.
5. Transits over 23 threads of 4 stars:
   (A. G. Leiden 10118, 10148, 10173, 10218) Group B.
   Instrument reversed, Clamp West.
6. Transits over 23 threads of 4 stars:
   (A. G. Leiden 87, 117, 148, 172) Group C.
7. Transits over 23 threads of 4 stars:
   (A. G. Leiden 204, 225, 244, 280) Group D.
8. Clock-comparison (see above)
9. Level-determination (see above)
10. Azimuth-determination (see above)
1921 Sept. 29
The same observations as on Sept. 28, but commencing with the instrument Clamp West, so that the groups A and B are observed with Clamp West, C and D with Clamp East.

On both nights the observations of the groups A and D were made by the observer H, those of the groups B and C by the observer G.

The 16 stars were so chosen, that the time taken by the observations was as short as possible, the declinations were nearly the same (range $30^\circ.5 - 34^\circ.9$) and the range of the magnitudes was within some tenths.

Personal equations, such as magnitude- or velocity-equation, can thus be neglected.

The simplest method of reduction would have been to compare the centres of gravity of the different groups, but the consideration that it was desirable to have a test on the accuracy of the method, has led me to reduce the eight pairs of stars separately. They were therefore combined symmetrically: number 1 of group A with number 4 of group D, etc.

First the transits, as given by the registering clock, were corrected for the instrumental level and azimuth. Since the level-constant may be different in both positions of the instrument (by a slight difference of the diameters of the two pivots) the eight stars before and the eight stars after the reversal of the instrument have each been corrected with the observed level-constant in the corresponding position. (On both nights the level-constant in the position clamp West is greater than for clamp East, and by nearly the same amount).

The azimuth-constant in both positions of the instrument being the same, the four determinations of azimuth on each night are combined two by two and the azimuth-constant for the different stars is found by interpolating between these results. (On both nights the amount of the azimuth-constant changes: $(t'_{16} - t'_i) - (t_{16} - t_i) = (\Delta T_{16} - \Delta T_i) + (\Delta' T_{16} - \Delta' T_i) - (\Delta T_{16} - \Delta T_i) + (\Delta' T_{16} - \Delta' T_i)$).

By combining star 2 with star 15, star 3 with star 14 etc., we find eight equations, which each separately give a result for $c$.

$(a'_{16} - a_{16})$ etc. are the differences in right ascension for the same star on both nights, which are given by a simple computation of the apparent places, totally independent of the knowledge of the exact place of the stars. The method is thus not restricted to the use of fundamental stars.

$(\Delta T_{16} - \Delta T_i)$ and $(\Delta' T_{16} - \Delta' T_i)$ etc. are the clock rates on both nights during the short time between the observations. Knowledge of the clock-correction itself is not required.

with the time, the change being nearly the same and in the same direction in both cases). These corrected times of transit, which are still expressed in time of the registering clock Knoblich, were then reduced to times of the normal clock Hohwü 17 by means of the interpolated difference Knoblich — H.17, as given by the clock-comparisons.

We put:

$t_i$ the time of transit of the star $i$ expressed in time of the normal clock on Sept. 28,

$\Delta T_i$ the clock-correction of the normal clock at the time of the transit of the star,

$\alpha_i$ the apparent right ascension,

$\delta_i$ the apparent declination,

$c$ the collimation-constant (which is supposed to be equal but of opposite sign in the two positions).

$i$ has the values from 1 to 16.

The same expressions for Sept. 29 are represented by the same symbols with accents. Then we find the following equations.

Sept. 28 Clamp east

$t_i = \alpha_i + \Delta T_i - c \sec \delta_i \quad (i = 1, \ldots, 8)$

Clamp West

$t_i = \alpha_i + \Delta T_i + c \sec \delta_i \quad (i = 9, \ldots, 16)$

Sept. 29 Clamp West

$t'_i = \alpha'_i + \Delta' T_i + c \sec \delta'_i \quad (i = 1, \ldots, 8)$

Clamp East

$t'_i = \alpha'_i + \Delta' T_i - c \sec \delta'_i \quad (i = 1, \ldots, 16)$

The observed difference of time between star 1 and star 16 on Sept. 28 is:

$t_{16} - t_i = (\alpha_{16} - \alpha_i) + (\Delta T_{16} - \Delta T_i) + (\Delta' T_{16} - \Delta' T_i)$

The same difference on Sept. 29 is:

$t'_{16} - t'_i = (\alpha'_{16} - \alpha'_i) + (\Delta' T_{16} - \Delta' T_i) - (\Delta T_{16} - \Delta T_i)$

The combination of the two equations gives:

$(\Delta T_{16} - \Delta T_i) = (\Delta T_{16} - \Delta T_i) + (\Delta' T_{16} - \Delta' T_i) - (\Delta T_{16} - \Delta T_i) + (\Delta' T_{16} - \Delta' T_i)$

The computed daily rates of the normal clock on Sept. 28 and 29 at the mean time of the transits were $0.274$ and $0.236$ respectively. Only the difference of these rates viz: $0.038$ enters into the determination of $c$. For the stars 1 and 16 (one and a half hour difference of time) this difference of rate can only have an influence of about $0.002$, and for the other pairs this influence becomes wholly imperceptible.

But also in the case of a greater difference in the clock-rates, the required correction offers no difficulty.

The eight resulting equations for $c$ derived in this way, and their solutions are:
Mean: $c = + 0.239 \pm 0.005$ (m. e.), mean error of one determination $\pm 0.013$.

This result for the mean error of one determination has led me to examine the mean error to be expected a priori.

The m. e. of the time of transit of a star at 23 threads is $\pm 0.014$. Since the right-hand term of the equations for $c$ consists of the difference of two differences, this term has a m. e. of $\pm 0.028$. The m. e. of one determination of $c$ due to the errors of the observed transits alone thus is $\pm 0.028$ (coeff. of $c^{-1}$), which at the declination here used, would be $\pm 0.006$.

The m. e. as found from the observations must be much larger, since it also contains the uncertainties in the applied constants of level and azimuth and the possible inequalities of the rate of the chronograph.

In conclusion, the method, as exposed here, seems very useful for the intended purpose viz: a control of the collimation-constant as found by the methods commonly used and the investigation of an eventual change of this constant depending on the zenith distance.

Since two pairs of stars chosen in the way explained above, already give a result with a m. e. of $\pm 0.009$ (when sufficient attention is paid to the other instrumental constants) the following scheme of observations seems to me to give entirely sufficient accuracy and to be very convenient in execution:

Two transits of stars at the zenith distance $0^\circ$, decl. $+ 50^\circ$

- $20\,^\circ\, + 30$
- $40\,^\circ\, + 10$
- $60\,^\circ\, - 10$

Observation of the South meridian mark
- North

Reversal of the instrument

Observation of the North meridian mark
- South

Two transits at the zenith distance $60^\circ$, decl. $- 10^\circ$

- $40\,^\circ\, + 10$
- $20\,^\circ\, + 30$
- $10\,^\circ\, + 50$

At the beginning and at the end determinations of the level and azimuth.

The pointings on the meridian-marks directly before and after the reversal can also be combined so as to give a supplementary determination of azimuth.

The next day the same observations must be made in reversed order.

In the interval from Jan. 1 to July 1 1921, we have found for the collimation-constant by the mercury-collimator $+0.284$ from the meridian-marks $+0.262$.

The material after July 1 gives as the result for the collimation-constant exclusively from observations with the mercury-collimator $+0.254$.

These results are all reduced to $10^\circ$ C. The result found above still requires a correction of $0.004$ (mean temperature $11^\circ.4$), giving the definitive result: $+0.243$.

There is thus as yet no reason to assume a real difference.

I am greatly indebted to Prof. Kapteyn for his interesting suggestion, and to the computer-observer D. Gaykema of the Leiden Observatory for his help in the observations and the reductions.

October 10, 1921.