get an indication of any systematic differences due to the instrument or to the locality. Unfortunately, not many Zusatzsterne have been observed at Munich, but the writer hopes that the northern Zusatzsterne have been observed by several northern observatories.

Regular observations of the planets Mars, Jupiter, Saturn, Uranus, Neptune, Ceres, Pallas, Juno and Vesta have been made at all available oppositions since 1941 and have been continued at Canberra. At a few oppositions the planets Pallas and Juno could not be observed owing to faint magnitude, very southern declination, or both.

The weather conditions at Mt Stromlo have been very favourable as compared with average conditions in Germany. Using even doubtful nights, the author was able to make observations on more than 20 nights each month. The seeing conditions seem to be slightly better than in Europe, although occasionally strong wind causes some trouble.

At the present time (July 1955) about 80% of the intended observations have been made and all these observations have been reduced. The complete confirmation of Rabe's result is already evident, i.e. that after the application of flexure correction as determined by observing stars reflected by mercury, there remain no *extreme* $\Delta\delta_\delta$-errors in the observed declinations. There are systematic and individual differences from the FK3 positions, but these are of a smaller amount, exceeding 0″.5 only in very few cases.

Detailed results cannot be given at the present time, as the exact value of the latitude can be derived only after a comprehensive discussion of all observations. It is intended to examine the observations for any possible corrections to refraction theory. The observations of planets will be used for deriving the equator point for the Munich observations as well as for those made at Canberra, following the suggestion made by Clemence (*A.J.* **54**, 10).

The writer will try to derive definite results as soon as possible after completion of the observational work; he hopes to have results ready for publication by the middle of 1956.

Prof. Witkowski made the following remark:

The original idea of eliminating systematical errors in a fundamental system of declinations by use of observations made in both hemispheres by the same observer and with the same instrument belongs to Prof. B. Zaleski, director of the Poznan Observatory. For this purpose he observed declinations of stars with a transportable Repsold meridian circle and intended to continue his observations in New Zealand. He published his Poznan declination catalogue in 1926 as well as a paper on his method.* His premature death in 1927 prevented him from carrying out the complete programme. The continuation of Zaleski's observations is included in the programme of the Poznan Observatory, but has not been realized till now for lack of financial resources.

8. PRELIMINARY RESULTS OF ABSOLUTE DETERMINATIONS FROM AZIMUTH OBSERVATIONS AT AN EQUATORIAL STATION

By G. van Herk

The method proposed by De Sitter and Oort (*B.A.N.* **81**, 1926) consists of a comparison between observed directions of a star when low above the horizon seen from an equatorial station with the computed azimuth. Knowledge of time of observation and geographic position is essential but not critical.

The observations compared with the computed azimuths will yield the zero point of the horizontal circle. The errors in the zero point originating from a systematic error in declination ($\Delta\delta_\delta$) in clock error and in latitude will be cancelled in the average when sufficient stars in each quadrant of the horizon are observed.

* B. Zaleski, 'Sur les déclinations fondamentales.' *Bulletin de l'Académie Polonaise des Sciences et des Lettres*, Sér. A, 1924. 'Declinations of 486 stars of the Berliner Jahrbuch for the equinox 1925.' *Id.* Sér. A, 1926.

From a (usually) straight line drawn through the zero-points as derived in 51 series of observations by the observers Blaauw, van Zadelhoff and van Herk the deviations for each star observed have been collected. These 51 series contain in the average 9 stars per quadrant.

From the repeated observations of a star by one observer in one azimuth direction (east or west) the mean errors for one determination are given in the second column (numbers between parentheses are number of residuals and number of stars used).

Blaauw	$\pm 0''.71$ (54, 27)	$\pm 1''.02$	$\pm 0''.70$
Van Zadelhoff	$\pm 0''.82$ (151, 72)	$\pm 1''.04$	$\pm 0''.70$
Van Herk	$\pm 0''.69$ (56, 28)	$\pm 0''.74$	$\pm 0''.63$

If the repeated observations of one star are combined for each azimuth direction irrespective of observer, assuming that no systematic deviations between the observers exist, the mean error for one determination turns out $\pm 0''.74$ (735, 322) in good agreement with the values from column 1.

Assuming further that no systematic deviations exist between the results for the stars derived from their eastern and western observations, the deviations collected can be compared irrespective of azimuth direction when only the signs of the deviations derived from the western observations are reversed.

In this case the mean error for one determination for the three observers combined comes out as $\pm 0''.67$ (482, 200), a little lower than the value $\pm 0''.74$ which difference at the moment can be justified by the mean error of the mean errors. It would indicate that no serious systematic differences in eastern and western observations do occur.

The mean errors as given in column 1 can be compared with those derived from the total of all contributing factors.

The mean error for one bisection (each star has had 6 bisections in the average) is given in column 2.

The mean error for one complete circle reading is rather high, of the order of $\pm 0''.50$.

The mean error for the reading of the level is about $\pm 0''.10$; the contributing mean error for change in collimation is estimated of the same order, $\pm 0''.10$, but this is only a guess. As mean error for one star declination is taken $\pm 0''.15$ and for the influence of the error in the deducted time of observation $\pm 0''.15$. Combining all these, we expect the mean error for one determination to be as given in column 3.

The method described by De Sitter and Oort is based on two assumptions: (1) no personal equations exist, which cannot be traced from the observations at this moment; (2) no systematic lateral refraction does exist.

About the latter we may remark the following. To reach some conclusions the findings of the Greenwich observers in their latitude work with the Cookson floating zenith telescope have been applied to the azimuth observations performed at the equatorial station. It would mean that the direction of the wind has some influence on the inclination of the air layers. This deviation from the normal would result in an error in the observed direction of the form

$$+0''.22 \sin(a-20^\circ),$$

where the 20° phase shift is connected with the prevailing wind direction N.E.E. During 291 series of observations, the observers have noted

10 × a direction of the wind almost W.
117 × a direction of the wind almost N.E.E., strength 0–3
164 × a direction of the wind almost N.E.E., strength 3, or more.

It cannot be decided upon at this stage whether systematic differences in E. and W. observations will be traced in the final results. They would amount to roughly

$0''.13$ for stars of declinations 60°
$0''.10$ for stars of declinations 40°
$0''.05$ for stars of declinations 20°
$0''.00$ for stars of declinations 0°

If an insufficient number of stars in each quadrant is observed, the star observations can be combined into pairs, preferably one star observed in the East, the other in the West. These pairs will give rise to equations of conditions with the $\Delta\delta_\delta$ and $\Delta\phi$ as unknowns neglecting the errors depending on α. The influence of the neglected refraction correction to the observed directions has been computed in the case of Blaauw's observations (about 600 star observations in all, or 300 pairs).

It turns out that this neglect would cause systematic differences in the correction $\Delta\delta_\delta$ as follows: for zone of declinations $+60^\circ$ to $+50^\circ$, $+50^\circ$ to 40° and so on till -40° to -50°, the values: $-0.''13$, $-0.''15$, $-0.''17$, $-0.''17$, $-0.''19$, $-0.''19$, $-0.''22$, $-0.''18$, $-0.''20$, $-0.''17$, $-0.''15$. The error made in the correction to the adopted latitude $d\phi$ is insignificant, $-0.''02$.

In the discussion following this paper Dr Blaauw inquired about the influence of changing errors in the graduation of the circle, and Prof. Heckmann about the importance of collimation error. Dr van Herk emphasized that a change in collimation error would not affect the results. As to the importance of the first source of error, Dr van Herk stated that the division errors had been determined before the first expedition but not since then. As the circle had been changed very often during observations, the effect would at most mean slightly increased accidental errors.

9. A FUNDAMENTAL SYSTEM OF DECLINATIONS AS DERIVED BY SHAPOSHNIKOV'S METHOD

By D. D. Polozhentsev

In compiling fundamental catalogues it is common practice to derive the means from the results of the observations made at different observatories. This method, however, is far from satisfactory when the elimination of systematic errors is intended.

In 1939 V. G. Shaposhnikov (1) suggested an original method of constructing a fundamental system of declinations based upon the principle of zenith symmetry of errors in meridian observations. In accordance with this principle, the arcs of the meridian, spaced symmetrically with respect to the zenith, and equal in the declination system of the catalogue i, are also equal in reality. This equality can be expressed by the following formula:

$$\delta^i_{\phi_i+z} - \delta^i_{\phi_i} = \delta^i_{\phi_i} - \delta^i_{\phi_i-z}, \tag{1}$$

where $\delta^i_{\phi_i}$ is the declination of the zenith in latitude ϕ_i and $\delta^i_{\phi_i+z}$, $\delta^i_{\phi_i-z}$ are the declinations of the points having zenith distance north and south of the zenith at the upper culmination.

For corrections to the system of declinations, Shaposhnikov's principal formula is:

$$\Delta\delta^i_{\phi_i+z} - 2\Delta\delta_{\phi_i} + \Delta\delta^i_{\phi_i-z} = 0. \tag{2}$$

Applying the systematic differences between the declinations of catalogue i and those of the fundamental catalogue, one can deduce the corrections to the fundamental catalogue. Equation (2) in this case will have the form:

$$\Delta\delta_{\phi_i+z} - 2\Delta\delta_{\phi_i} + \Delta\delta_{\phi_i-z} = \Delta\delta^i_{\phi_i+z} - 2\Delta\delta^i_{\phi_i} + \Delta^i_{\phi_i-z} \tag{3}$$

where $\Delta\delta_\delta$ are corrections to the system of the fundamental catalogue, and $\Delta\delta^i{}_\delta$, the systematic differences between catalogue i and the fundamental one. The system derived from equations (3) has a definite solution, provided only that the corrections $\Delta\delta_\delta$ at the boundaries of the zone are known.

The construction of a fundamental system based on the zenith symmetry involves the derivation of equations (3), the assignment to these of weights according to their systematic quality, and the solution of the system thus obtained by the method of least squares. The weights are assigned, the extent to which the conditions of zenith symmetry