The weighted mean of the two levels gives a shift of the galactic north pole of $°\cdot37 \pm °\cdot92$ in the direction of $145°$ longitude and one of $°\cdot20 \pm 1°\cdot04$ in the direction of $235°$ longitude, these shifts to be counted from the pole used in *B.A.N.* No. 308, viz. $12^h 41^m\cdot3, +27° 21'$ (1900). The pole found from these star-counts is therefore $12^h 39^m\cdot5, +27°\cdot4$, with a mean error of $\pm 1°\cdot0$ in each co-ordinate.

The above calculations rest entirely on the *Mt Wilson Catalogue of Selected Areas*. It would not have been possible to obtain this valuable confirmation of the position of the galactic pole but for the extreme accuracy with which the magnitudes in the Selected Areas have been determined by SEARES and his collaborators; it may be noted in this connection that a mean error of $\pm \cdot015$ in the gradient of $\log A(m)$ corresponds to a mean error of $\pm \cdot06$ in m.

The gradients in the direction of the centre as found from the present solution are in accordance with those derived previously. The longitude of the centre which would follow from the above results, viz. $334°\cdot6 \pm 5°\cdot0$ (m.e.), deviates slightly from the standard value, $325°$, as well as from that derived in a somewhat different manner from the same material in *B.A.N.* No. 308 ($324° \pm 4°\cdot5$ m.e.).

Note on the distances and motions of some extremely remote Cepheids in Cygnus, by *J. H. Oort* and *P. Th. Oosterhoff.*

Among the δ Cephei variables for which radial velocities have been published by JOY [1]) there are two very faint stars, GL and V343 Cygni, discovered by BAADE [2]) in a region of the bright Cygnus cloud, at $43°$ longitude and $+3°$ latitude. The velocities of these stars, corrected for standard solar motion, are, respectively, -41 and -75 km/sec, thus deviating considerably from the usual differential galactic rotation, which is positive in this longitude. The peculiar velocities of δ Cephei variables, especially in low latitude, being usually quite small (from JOY's two groups of smallest distance — and therefore smallest influence of errors in the assumed distance — we find an average peculiar velocity of ± 9 km/sec) the presence of these two large residuals close together would appear to indicate a systematic motion deviating from the first-order effects of galactic rotation. According to theory deviations of the observed size would occur if the stars were situated at extremely large distances (between 5 and 10 kps).

In order to test this possibility, which for V343 Cygni had already been suggested by JOY, provisional estimates of the colour-excesses were made from plates taken by the second author with the Mount Wilson 60-inch reflector in 1934. The colour-indices found for these stars as well as for the two other known δ Cephei variables in this region (also discovered by BAADE) are given in the column "obs." of Table 1. The photographic and photovisual magnitudes from which the colour-indices were obtained have been derived by comparison with similar exposures on Selected Area 40, SEARES' photographic and photovisual magnitudes being used in the comparison; the latter had kindly been communicated to us by Dr SEARES in advance of their publication. For each variable only one good pair of plates was available, so that the colours given are only rough values with probable errors of $\pm {}^m\cdot1$; but they suffice to show that the colour-absorption for all 4 stars must be remarkably small. It may be noted that GL and V343 Cygni, which are only $7'$ apart, were measured on the same pair of plates, while QY and V336 Cygni were exposed in immediate succession, also on one pair of plates.

Table 1 gives some relevant data. The galactic co-ordinates were computed from OHLSSON's tables[1]), the absolute photographic magnitudes and spectra, which represent median values, have been taken from SHAPLEY[2]), the corresponding estimated intrinsic colour-indices were deduced from data given by Mrs PAYNE-GAPOSCHKIN[3]) reduced to the international scale and roughly extrapolated to the absolute magnitudes concerned; the median apparent magnitudes are BAADE's values. The observed colours were also tentatively reduced to median values. The colour-excesses so obtained are shown under E. They are quite small, averaging only $+ {}^m\cdot08$ for the 4 stars; this value is probably accidentally too small, for BAADE finds an average colour-excess of $+ {}^m\cdot25$ from 80 A-type stars between the 9th and 13th magnitude[4]). We may provisionally estimate that the true average colour-excess is at least $+ {}^m\cdot25$; we might expect it to come out still a little higher for these so much more distant variables, but in view of the direct observations it seems unlikely that it would exceed $+ {}^m\cdot50$. The average photographic absorption may accordingly be estimated to lie between 1^m

[1]) *Ap. J.* **86**, 363, 1937 and **89**, 356, 1939; *Mt Wilson Contr.* Nos. 578 and 607.
[2]) *Ap. J.* **79**, 481, 1934; *Mt Wilson Contr.* No. 493. Cf. also *A.N.* **232**, 65, 1927.

[1]) Had they been referred to the pole derived by Mr VAN TULDER in the first article of this Bulletin the latitudes would have been increased by $0°\cdot3$.
[2]) „Star Clusters", 135 and 137, 1930.
[3]) *H.A.* **89**, No. 6, 1935.
[4]) *L.c.*, p. 480.

TABLE I.
δ Cephei variables in the Cygnus cloud

star	l	b	P	m_{pg}	M_{pg}	Sp.	colour-index obs.	intr.	E	r_1	r_2	ϖ_1	ϖ_2	Θ_1 Θ_2	v_{obs}	v_1	v_2
	°	°	d	m	m		m	m	m	ps	ps	ps	ps	km/sec		km/sec	
GL Cygni	42.9	+3.4	3.4	14.6	−1.1	F9	+1.19	+ .9	+.29	8700	5500	10500	8700	238 246	−41	− 67	− 23
V343 "	42.9	+3.3	11.9	14.8	−2.0	G5	+1.33	+1.1	+.23	14500	9100	15000	10800	215 236	−75	−132	− 73
QY "	41.2	+3.3	3.9	15.4	−1.2	G0	+ .89	+ .9	−.01	13200	8300	13700	10100	222 240		−117	− 58
V336 "	42.2	+3.8	15.8	15.8	−2.3	G6	+ .93	+1.1	−.17	26300	16600	25800	16800	161 206		−195	−148

and 2^m. The columns r_1 and r_2 give the distances computed upon the assumption that the absorption is 1^m·0 or 2^m·0 respectively. The distances ϖ to the centre of the galactic system and the circular velocities were computed with the following constants[1]: longitude of the centre 325°, distance from the sun to the centre ϖ_0 = 8000 ps, circular velocity near the sun Θ_0 = 250 km/sec, $\partial\Theta/\partial\varpi$ = −·005 km/sec.ps. The circular velocities were calculated from the linear formula $\Theta = \Theta_0 + (\varpi-\varpi_0)\, \partial\Theta/\partial\varpi$, which is likely to hold approximately for the range of distance of the first three stars. At the distance of V336 Cygni the decrease in the circular velocity will probably be greater than that given by the linear formula, as at this large distance the variation of the force with ϖ may more nearly approach Newton's law. If we assume the inverse-square law instead of the above formula we obtain Θ_1 = 139, Θ_2 = 172 km/sec for this star; for v_1 and v_2 we would find − 202 and −164 km/sec respectively; the deviations from the values computed from the linear formula thus appear to be unimportant.

Comparing the observed median velocities v_{obs} (all values have been corrected for standard solar motion) with the computed differential motions v_1 and v_2 we see that the observed velocities are in good accord with the galactic rotation effects at these distances. They would indicate that the correct absorption is somewhere between 1^m·0 and 2^m·0.

The results for these stars indicate that even in these regions, farther away than the galactic centre, the simple model of galactic rotation in circular orbits fits the observations [2].

The Cygnus stars are quite exceptional, for they are probably more than three times as distant as the furthest other stars near the galactic plane known in the region observable from northern observatories[3]; the only comparable stars may be the faint Cepheids in the η Carinae region. As will be seen from the column z in Table 2 the five other very distant Cepheids included by Joy in his group V are probably all at large distances from the galactic plane. Individually these are of no great interest for a discussion of galactic rotation, in as much as they must be expected to have peculiar velocities of the same order as the rotation effects. Though most δ Cephei variables have low velocities, in accordance with the average peculiar radial velocity of about

TABLE 2.
Distant δ Cephei variables observed for radial velocity

Star	l	b	r	z	v_{obs}	colour-excess
	°	°	ps	ps	km/sec	m
BH Oph	7.5	+11.9	6900	+1400	+52.2	−.3
MZ Cyg	51.3	− 9.5	7100	−1200	−37.0	
RX Lib	316.3	+25.6	9600	+4100	−48.1	
V377 Sgr	342.2	− 9.8	13200	−2200	+ 8.0	
V410 Sgr	345.7	−12.9	8500	−1900	+18.2	.0

± 9 km/sec mentioned above, there is a small admixture of high-velocity objects, illustrated by κ Pav, BB Her, W Vir and AL Vir, which, after removal of the ordinary galactic rotation terms, show residuals of, respectively + 37, + 86, − 44 and + 46 km/sec. The latter two stars are situated at distances of 2700 and 1400 ps from the galactic plane, and illustrate the fact that, in order to penetrate to such distances, stars must belong to the high-velocity sort; for example, a star near the galactic plane would need a velocity perpendicular to this plane of at least 60 km/sec to reach out to a height of 1500 ps above or below this plane. It is probable that nearly all objects found at such heights, and thus also those included in Table 2, belong to this high-velocity class. The stars in the Cygnus cloud may on the other hand be considered as belonging to the much more frequent small-velocity type.

The distances in Table 2 were computed with the values for absorption coefficient and thickness of absorbing layer as assumed by Joy (absorption coefficient ^{m}·85 per kps, half-thickness absorbing layer 200 ps). The values of the absorption are, of course, quite uncertain. Colour determinations are available for BH Ophiuchi and V410 Sagittarii. The median colour-excesses, each derived from three pairs of plates, are shown in the table; they confirm

[1] M.N. 99, 374, 375, 1939.
[2] According to a private communication Mr Joy has obtained an approximate velocity of −100 km/sec for QY Cygni. Correction for solar motion reduces this to −80 km/sec, which fits in very well between the computed velocities v_1 and v_2 for this star.
[3] These great distances coupled with low galactic latitude might make it worth while to search for interstellar lines; if the intensities of interstellar lines would increase linearly up to these distances the equivalent widths of interstellar K- and D-lines would be of the order of 30 A.