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Discussion of photographic magnitudes of bright northern stars, together with new mean values in KING's photographic system, by *P. Th. Oosterhoff.*

The photographic catalogues of KING, HERTZSPRUNG and THÜRING have been intercompared. The photographic systems of KING and HERTZSPRUNG are very similar, whereas that of THÜRING deviates considerably in scale and colour equation. The magnitudes of HERTZSPRUNG are affected by a seasonal error, which has been determined from comparisons with several catalogues of photographic, photo-electric and visual magnitudes. The correction: $\Delta m = -{\cdot}039 \sin\alpha \cos\delta - {\cdot}066 \cos\alpha \cos\delta$ has been applied to all his magnitudes. Mean values have been formed of these three photographic series and of the photo-electric magnitudes of GÜSSOW after they had been reduced to KING's photometric system, the relative weights being 1 for the photographic and 10 for the photo-electric magnitudes. The new mean magnitudes have been collected in Table 1. They seem to be practically conform with the international system, at least for stars brighter than 5·5, when a zeropoint correction of about −·10 is applied.

A considerable number of investigations has been carried out during the last decennaries for the determination of photographic magnitudes of bright stars, especially in the northern hemisphere. As many of these catalogues overlap, it has been possible to reduce them to a uniform system with regard to zeropoint, scale and colour equation. In particular it has been SEARES who has derived the formulae by means of which they can be reduced to the international system. The brightest stars in the sky, say to magnitude 5, are usually not included in these catalogues and the relation between their magnitudes and the international system, which is difficult to establish at that on account of the very small number of bright stars in the North Polar Sequence, is consequently still rather uncertain.

In the present note a discussion is given of the photographic magnitudes by KING [1]), HERTZSPRUNG [2]), and THÜRING [3]) and of the photo-electric magnitudes by GÜSSOW [4]). The first step consisted in the intercomparison of the three photographic catalogues. The following relations were obtained:

$$\begin{array}{llll} m_H - m_T = -{\cdot}212 & -{\cdot}038\,(m_H + m_T - 7) & +{\cdot}276\,(c_2/T - 2) & \ldots\ldots 162 \\ & \pm\ 6 & \pm\ 12 \quad \text{(m.e.)} & \\ m_T - m_K = +{\cdot}167 & +{\cdot}026\,(m_T + m_K - 7) & -{\cdot}235\,(c_2/T - 2) & \ldots\ldots 106 \\ & \pm\ 6 & \pm\ 11 \quad \text{(m.e.)} & \\ m_K - m_H = +{\cdot}043 & +{\cdot}012\,(m_K + m_H - 7) & -{\cdot}034\,(c_2/T - 2) & \ldots\ldots 127 \\ & \pm\ 5 & \pm\ 10 \quad \text{(m.e.)} & \end{array}$$

The colour equivalents c_2/T have been taken from HERTZSPRUNG [1]) and stars which do not occur in his list have been excluded. The number of stars available has been indicated behind each formula. It is seen that the photographic systems of KING and HERTZSPRUNG are very similar. The difference in scale amounts to 2 percent and the colour equation is also small. The scale of THÜRING on the other hand is nearly 6 percent wider and the effective wavelength of his magnitudes considerably longer. As the accuracy obtained in these three catalogues is of the same order, the mean errors can be computed from the residuals of the formulae given above. The mean square residuals and the resulting mean errors are:

$$\begin{array}{llll} \Delta^2_{H-T} = {\cdot}0139 & \mu_K = \pm{\cdot}043 \\ \Delta^2_{T-K} = {\cdot}0085 & \mu_H = \pm{\cdot}085 \\ \Delta^2_{H-K} = {\cdot}0091 & \mu_T = \pm{\cdot}082 \end{array}$$

Although we will confirm later that the accuracy of KING's magnitudes is probably slightly better than that of the other two catalogues, the present determination is very uncertain for two reasons. In the first place the number of stars is small and therefore the mean square residuals are not well determined, their mean error being of the order of $\pm{\cdot}0013$ and secondly the residuals are not free from systematic effects, which are very marked in the relations between m_H and m_T and between m_K and m_H.

1) *B.A.N.* No. 329.

1) "Combined out-of-focus results from several instruments", *H.A.* **76**, No. 6.

2) "Photographic magnitudes of 658 stars from plates taken mainly by W. H. VAN DEN Bos with the 33 cm Leiden refractor", *B.A.N.* No. 35.

3) "Photographische Helligkeiten von 245 Sternen heller als vierter Grösze", *A.N.* **269**, 289.

4) "Lichtelektrische Helligkeiten und Farbenindizes von 94 ausgewählten Fixsternen", *Zs. f. Astrophys.* **20**, 25.

W. BECKER[1]) has found a systematic run with α in the colour indices HERTZSPRUNG phot. — Harvard vis. and HERTZSPRUNG himself found a similar effect in the colour equivalents which he derived from his magnitudes and the Potsdam visual magnitudes. The indications that HERTZSPRUNG's magnitudes are affected by systematic seasonal errors are therefore rather strong and in the following lines this question will be investigated further.

We have followed the procedure used by HERTZSPRUNG in *B.A.N.* No. 329 assuming the correction to be of the form: $A \sin\alpha \cos\delta + B \cos\alpha \cos\delta$. It is true that such a correction usually has a more complicated nature, and it has been noticed that some deviations from this simple formula are certainly real, but on the other hand it is advantageous to represent this correction by two constants only. The residuals from the three relations derived above can be represented by the following formulae, which have been determined by least squares:

$$\begin{array}{llll}
\text{residual (H—T)} = -{\cdot}005 & +{\cdot}043 \sin\alpha\cos\delta & +{\cdot}099 \cos\alpha\cos\delta & \\
 & \pm\ 14 & \pm\ 15 & \text{(m.e.)} \\
\text{residual (T—K)} = +{\cdot}002 & -{\cdot}000 \sin\alpha\cos\delta & -{\cdot}045 \cos\alpha\cos\delta & \\
 & \pm\ 14 & \pm\ 16 & \text{(m.e.)} \\
\text{residual (K—H)} = +{\cdot}005 & -{\cdot}067 \sin\alpha\cos\delta & -{\cdot}046 \cos\alpha\cos\delta & \\
 & \pm\ 13 & \pm\ 14 & \text{(m.e.)}
\end{array}$$

KDF. July 11, 1986
I bet it will be 30 years before anyone reads this.
Wear Hawaiian shirts

The residuals corrected for systematic errors enable us to determine anew the mean error for each catalogue. The mean square residuals and the resulting mean errors are now:

$$\begin{array}{llll}
\Delta^2_{\mathrm{H-T}} = {\cdot}0104 & & \mu_{\mathrm{K}} = \pm{\cdot}047 \\
\Delta^2_{\mathrm{T-K}} = {\cdot}0078 & & \mu_{\mathrm{H}} = \pm{\cdot}069 \\
\Delta^2_{\mathrm{K-H}} = {\cdot}0070 & & \mu_{\mathrm{T}} = \pm{\cdot}075
\end{array}$$

Due to the small number of observations these values should be accepted with some care. Although the existence of systematic errors in HERTZSPRUNG's magnitudes is confirmed by the relations with KING and THÜRING, the exact value of the two coefficients is still ill determined and for this reason we have compared his magnitudes with some other photometric series. The first of these are the photo-electric measures at wavelengths 420 and 449 mμ by GÜSSOW. The following relation has been derived by least squares:

$$\begin{array}{lll}
m_{\mathrm{H}} = +{\cdot}035 + {\cdot}493\,(m_{420} + m_{449}) & + {\cdot}15\,(m_{420} - m_{449}) & \quad 70 \\
\qquad\qquad\quad \pm\ 6 & \pm\ 6 \quad \text{(m.e.)} &
\end{array}$$

The residuals from this formula have then been investigated for a systematic run with α, which is found to be:

$$\begin{array}{lll}
\text{residual} = -{\cdot}022 + {\cdot}050 \sin\alpha\cos\delta & + {\cdot}123 \cos\alpha\cos\delta & \\
\qquad\qquad\qquad \pm\ 19 & \pm\ 24 & \text{(m.e.)}
\end{array}$$

This correction reduces the mean error of one equation from $\pm{\cdot}101$ to $\pm{\cdot}083$.

It is difficult to understand that BECKER could derive a variation with α in the colour indices HERTZSPRUNG phot. — Harvard vis. The zeropoint of HERTZSPRUNG's magnitudes has after all been fixed for each plate separately by means of the Harvard magnitudes for stars of mean photographic magnitude 5. For this reason we have again compared HERTZSPRUNG's magnitudes for stars between $4^{\mathrm{m}}{\cdot}50$ and $5^{\mathrm{m}}{\cdot}50$ with the revised Harvard photometry and also with the Potsdam visual magnitudes. The resulting equations, which were derived for the white and yellow stars separately, c_2/T being $<$ or $>$ $3{\cdot}00$, are:

$$\text{Potsdam}\left\{\begin{array}{lllll}
\text{white:} & m_{\mathrm{vis}} - 5 = -{\cdot}022 + {\cdot}944\,(m_{\mathrm{H}} - 5) & - {\cdot}685\,(c_2/T - 2) & & 197 \\
 & \qquad\qquad\qquad\quad \pm\ 27 & \pm\ 17 & \text{(m.e.)} & \\
\text{yellow:} & m_{\mathrm{vis}} - 5 = -{\cdot}052 + {\cdot}943\,(m_{\mathrm{H}} - 5) & - {\cdot}683\,(c_2/T - 2) & & 69 \\
 & \qquad\qquad\qquad\quad \pm\ 33 & \pm\ 23 & \text{(m.e.)} &
\end{array}\right.$$

$$\text{Harvard}\left\{\begin{array}{lllll}
\text{white:} & m_{\mathrm{vis}} - 5 = -{\cdot}208 + {\cdot}864\,(m_{\mathrm{H}} - 5) & - {\cdot}542\,(c_2/T - 2) & & 198 \\
 & \qquad\qquad\qquad\quad \pm\ 24 & \pm\ 15 & \text{(m.e.)} & \\
\text{yellow:} & m_{\mathrm{vis}} - 5 = -{\cdot}161 + {\cdot}979\,(m_{\mathrm{H}} - 5) & - {\cdot}638\,(c_2/T - 2) & & 70 \\
 & \qquad\qquad\qquad\quad \pm\ 31 & \pm\ 21 & \text{(m.e.)} &
\end{array}\right.$$

Before we shall investigate the residuals from these equations, attention may be drawn to the differences between the scale and colour coefficients for white and yellow stars in the case of the Harvard photometry. It is one more proof that the Harvard catalogues are less homogeneous than the Potsdam photometry, as has now generally been accepted[1]). The residuals of white and yellow stars have been used together in a solution of the variation with α. The following equations have been derived:

[1]) *Zs. f. Astrophys.* **9**, 82.

[1]) E.g. PAYNE GAPOSCHKIN, *Transactions I.A.U.* **6**, 218.

$$\text{residual (Potsdam)} = +\cdot010 \underset{\pm\ 8}{-\cdot028} \sin\alpha\cos\delta \underset{\pm\ 9}{-\cdot056} \cos\alpha\cos\delta \quad \text{(m.e.)}$$

$$\text{residual (Harvard)} = +\cdot006 \underset{\pm\ 8}{-\cdot018} \sin\alpha\cos\delta \underset{\pm\ 9}{-\cdot033} \cos\alpha\cos\delta \quad \text{(m.e.)}$$

The coefficients for Potsdam are slightly smaller than those formerly derived, but the comparison with Harvard yields still smaller values. The amplitude of ·038 for the latter is however in good agreement with BECKER's result and the conclusion seems therefore permitted that a small systematic variation with α in the Harvard catalogue has been increased in HERTZSPRUNG's work.

In order to obtain further information HERTZSPRUNG's magnitudes have been compared with the *Göttingen Aktinometrie*. The residuals from the relation:

$$m_H - m_S = \underset{\pm\ 9}{+\cdot066} +\cdot012\ (m_H + m_S - 10) \underset{\pm\ 12}{+\cdot012}\ (c_2/T - 2) \quad \text{(m.e.)} \qquad 112$$

in which s stands for SCHWARZSCHILD, show some systematic variations with α, but in this case they do not come to light in the equation:

$$\text{residual (H—S)} = +\cdot001 \underset{\pm\ 11}{-\cdot025} \sin\alpha\cos\delta \underset{\pm\ 13}{+\cdot009} \cos\alpha\cos\delta \quad \text{(m.e.)}$$

as they may be represented by a sine term with the double argument. The absence in the difference HERTZSPRUNG minus Göttingen of the systematic error in α, which is evident in all the comparisons discussed so far, is difficult to explain. The stars which could be used here are fainter in the mean than those occurring in the other comparisons, which may suggest that the amplitude of the α-error decreases with increasing magnitude. A subsequent investigation of HERTZSPRUNG's faintest stars with regard to the Potsdam photometry gives a weak confirmation of this suggestion, but it seems probable that the Göttingen magnitudes themselves are also subject to a similar seasonal error. The stars under consideration are the brightest stars of the *Aktinometrie* and a generalization of this remark over the entire catalogue is certainly inadmissible, although the systematic corrections relative to the Harvard photographic system derived by PAYNE GAPOSCHKIN [1]) and BERTAUD [2]) may be remembered in this connection.

As stated above HERTZSPRUNG's magnitudes larger than 5·49 have been compared with the Potsdam visual magnitudes. The following relation was derived by least squares:

$$(m_P - 5) = -\cdot016 \underset{\pm\ 23}{+\cdot960}\ (m_H - 5) \underset{\pm\ 13}{-\cdot720}\ (c_2/T - 2) \quad \text{(m.e.)} \qquad 139$$

The residuals from this formula are represented by the equation:

$$\text{residual} = +\cdot005 \underset{\pm\ 12}{-\cdot016} \sin\alpha\cos\delta \underset{\pm\ 12}{-\cdot044} \cos\alpha\cos\delta \quad \text{(m.e.)}$$

In the following table we give a summary of the results obtained. A and B are the coefficients of $\sin\alpha\cos\delta$ and $\cos\alpha\cos\delta$ respectively as they have been derived from the different comparisons. Column n gives the number of stars involved and column $\overline{m}$ the mean photographic magnitude of these stars.

compared with	A	B	n	$\overline{m}$
KING	— ·067 ± ·013	— ·046 ± ·014	127	3·58
GÜSSOW	— ·050 ± ·019	— ·123 ± ·024	70	3·74
THÜRING	— ·043 ± ·014	— ·099 ± ·015	162	3·84
Potsdam 4·5 to 5·5	— ·028 ± ·008	— ·056 ± ·009	266	4·94
Harvard 4·5 to 5·5	— ·018 ± ·008	— ·033 ± ·009	268	4·94
Göttingen Akt.	+ ·025 ± ·011	— ·009 ± ·013	112	5·16
Potsdam > 5·5	— ·016 ± ·012	— ·044 ± ·012	139	6·09

If we omit the values derived from the comparison with Harvard, on which HERTZSPRUNG's magnitudes have been based with regard to zeropoint, and also the values obtained by means of the *Göttingen Aktinometrie*, because the brightest stars in this catalogue are probably not very reliable, the remaining values indicate a slight decrease of the coefficients with increasing magnitudes, but in view of the uncertainty of this result, it has not been taken into account and the following correction to HERTZSPRUNG's catalogue has been adopted:

$$\text{correction} = -\cdot039 \sin\alpha\cos\delta - \cdot066 \cos\alpha\cos\delta$$
$$\text{or correction} = +\cdot077 \sin(\alpha - 120^\circ)\cos\delta$$

It is believed that this correction, which has been applied to all stars of the catalogue, nullifies the main effects of the systematic errors depending on the right ascension.

As the investigations of KING, HERTZSPRUNG and THÜRING have many stars in common, it was thought worthwhile to form mean values. To these three catalogues have been added the photo-electric magnitudes of GÜSSOW. Although the photographic material for the brightest stars is not exhausted herewith, it

[1]) *Harvard Mimeogr.* Ser. I, No. 3.
[2]) *A.N.* **263**, 6.
Annales de Paris Tome VIII, Fasc. III.

seemed better not to include investigations on small numbers of stars, as the formulae necessary to reduce them to a uniform system are then rather indefinite. The Draper catalogue has not been used on account of its low weight. The main reason why the photographic system of KING has been chosen as standard system is the fact that it is the oldest precision catalogue for the bright stars which also covers the southern hemisphere. We have indeed no certainty that this scale is conform to the international system, but as will be seen later it is fully confirmed by the independent scale determinations of HERTZSPRUNG and GÜSSOW.

According to some formulae already given the relations between KING and the magnitudes of HERTZSPRUNG and THÜRING are:

$$m_K = +{\cdot}027 + 1{\cdot}024\, m_H - {\cdot}034\, c_2/T$$
$$m_K = -{\cdot}446 + \;\;{\cdot}950\, m_T + {\cdot}229\, c_2/T$$

From the discussion of the seasonal error in HERTZSPRUNG's magnitudes it is seen that a similar though smaller effect exists between KING and THÜRING. As this effect is differential and as we do not know which of the two catalogues should be held responsible, we have neglected it altogether.

The relation between KING and the photo-electric magnitudes of GÜSSOW is found to be:

$$m_K = -{\cdot}024 \underset{\pm 5}{+{\cdot}505} (m_{420} + m_{449}) \underset{\pm 44}{+{\cdot}002} (m_{420} - m_{449}) \quad \text{(m.e.)}$$

The photographic and photo-electric scales appear to be in full accord.

After all series had been reduced to KING's photographic system mean values have been formed with the relative weights 1, 1, 1 and 10 for KING, HERTZSPRUNG, THÜRING and GÜSSOW respectively. The resulting magnitudes are given in Table 1. The star number from the revised Harvard photometry is given in the first column. If a star is known to be variable, a *v* has been added to this number. Components of double stars have been connected by parentheses. If the magnitude in the second column is marked by a colon, it means that the combined light of a double star has been given. In the last column the deviations of the reduced catalogues from the mean value are given in detail. If the magnitude occurs in one catalogue only, the residual zero has been replaced by a dash.

Some remarks should be added about the relative weights. From the intercomparison between the catalogues of KING, HERTZSPRUNG and THÜRING the mean errors ± ·05, ± ·07 and ± ·07 respectively were derived above. These values are free from the influence of seasonal errors. As KING and THÜRING have measured the brighter stars only, the mean error derived for HERTZSPRUNG's magnitudes should apply therefore to stars brighter than about 4·5. These stars represent a small fraction of the total material. For the fainter stars some information can be gained from the comparisons with the Harvard and Potsdam visual catalogues, which have been made in connection with the seasonal errors. The relation between m_{vis} and m_H was derived in the form: $m_{vis} = A + Bm_H + C\, c_2/T$, which is no doubt good enough for the determination of seasonal errors. But as m_{vis} and m_H have practically the same accuracy, it does not represent the best relation between the two catalogues. The mean error of these equations was found to be:

Potsdam:	±·077	405
Harvard:	±·073	268

As these mean errors are due as well to the errors in the visual catalogue as to those of m_H, we may conclude that the mean error of HERTZSPRUNG's magnitudes for the fainter stars can not be much larger than ±·05. This value is in full accordance with the mean error given by HERTZSPRUNG himself. The smaller accuracy of the brighter stars is further confirmed by the comparison with the photo-electric magnitudes of GÜSSOW, which has already been discussed. The mean error, including the errors of both series, is found to be ±·08, which makes a mean error of HERTZSPRUNG's magnitudes for the bright stars smaller than ±·07 rather improbable. Equal weights for the three photographic catalogues seemed therefore well justified. The weight assigned to the combined magnitudes of GÜSSOW is very uncertain, as it is not known in how far these measures have been affected by systematic errors. Finally the mean errors have been computed from the residuals in Table 1 with the following result:

KING:	±·063	151
HERTZSPRUNG:	±·074	222
THÜRING:	±·070	185
GÜSSOW:	±·026	73

The last value has no practical significance as it depends largely on the assigned weight.

There remains the important question whether the new mean magnitudes, which will be designated by m', are conform to the international system. The effective wavelength of KING's photographic system can be derived from the relation between his magnitudes and those of GÜSSOW. The result is 434 mμ and this value remains unchanged, if the effective wavelengths for the blue and yellow filter magnitudes, as corrected by HERTZSPRUNG [1]), are used. The new magnitudes m' have also been directly compared with the magnitudes of KIENLE, STRASZL and WEMPE [2]) at reciprocal wavelengths 2·236 and 2·384. The relation obtained by least squares with omission of γ Cas is:

[1]) *B.A.N.* No. 349, 282.
[2]) *Zs. f. Astrophys.* **16**, 265.

$$m' = +2{\cdot}053 + {\cdot}504\,(m_{2{\cdot}236} + m_{2{\cdot}384}) + {\cdot}057\,(m_{2{\cdot}236} - m_{2{\cdot}384}) \qquad 33$$
$$\pm\ 7 \qquad\qquad \pm\ 37 \quad \text{(m.e.)}$$

The effective wavelength of m' is therefore 434 $m\mu$. Finally the relation between m' and the ultraviolet and blue magnitudes of COLLMANN [1]) has been derived. The effective wavelength of m' computed from the equation

$$m' = +2{\cdot}655 + {\cdot}484\,(m_{\rm uv} + m_{\rm bl}) - {\cdot}148\,(m_{\rm uv} - m_{\rm bl}) \qquad 37$$
$$\pm\ 11 \qquad\qquad \pm\ 21 \quad \text{(m.e.)}$$

is 428 $m\mu$. The values derived indicate that the effective wavelength of m' may be slightly longer than that of the international system, but also that the relative colour equation must be very small [2]).

The relations between m' and the magnitudes of KIENLE and COLLMANN provide an additional check on the scale of m'. Taking all evidence together we conclude that this scale is correct within 2 percent at least for the stars brighter than 4·5.

The present list has two stars in common with the North Polar Sequence. Their magnitudes are:

	HR	m'	IPg	Δm
1s	424	2·68	2·56	+·12
1	6789	4·42	4·39	+·03

The revised international magnitudes have been taken from SEARES [3]). Although these data are insufficient for the determination of the zeropoint, it seems likely that the zeropoint of m' does not differ more than about one tenth of a magnitude from the international system.

An indirect comparison with the international system has been made by means of the photo-electric magnitudes of HASSENSTEIN [4]) and the photographic catalogues of PAYNE GAPOSCHKIN and SHAPLEY [5]). Most of the stars in HASSENSTEIN's list are of the sixth magnitude and only a few brighter stars have been observed. Ten of these are also found in Table 1. In the following table their photographic and photo-electric magnitudes m' and $m_{\rm Ha}$ have been tabulated together with the difference Δm.

HR	m'	$m_{\rm Ha}$	Δm
424	2·68	2·65	+·03
2527	6·26	5·974	+·29
3751	6·21	5·796	+·41
5321	6·48	6·223	+·26
5430	5·99	5·693	+·30
5903	4·44	4·295	+·14
6789	4·42	4·352	+·07
7750	4·42	4·304	+·12
8819	5·38	5·189	+·19
8974	4·51	4·294	+·22

1) *Zs. f. Astrophys.* **9**, 194.
2) This is in accordance with SEARES' formula (4) in *Mt W. Contr.* No. 288.
3) *Mt W. Contr.* No. 587, 3.
4) *A.N.* **269**, 188.
5) *Harvard Mimeogr.* Series I, Nos 1 and 2.

The values in the last column seem to indicate a difference in scale. A solution by least squares shows that it amounts to five percent, the resulting relation being:

$$m' = -{\cdot}220 + 1{\cdot}052\, m_{\rm Ha} + {\cdot}056\, c_2/T \quad . \quad . \qquad 10$$
$$\pm\ 21 \qquad \pm\ 22 \quad \text{(m.e.)}$$

As it can hardly be assumed that the photo-electric scale is so much in error, it was thought at first that the scale of m' for the faint stars deviates from that derived for the brighter stars. This explanation did not seem unreasonable as the faint stars in Table 1 were nearly all observed by HERTZSPRUNG only and his plates have been measured in a Hartmann photometer which does not yield two fixed points at both ends of the reduction curve, which in its turn may cause some uncertainty in the scale for the brightest and faintest stars measured. The discrepancy can however be explained in a different way, which probably is the correct one. The scale factor derived above depends strongly on the magnitudes of Polaris (HR 424). With the omission of Polaris we obtain the modified relation:

$$m' = -{\cdot}057 + 1{\cdot}004\, m_{\rm Ha} + {\cdot}084\, c_2/T \quad . \quad . \qquad 9$$
$$\pm\ 38 \qquad \pm\ {\cdot}27 \quad \text{(m.e.)}$$

Although the mean error is considerable, there is now full accordance between the photo-electric and photographic scales. The colour equation is somewhat larger, but in view of its mean error its value is not excessive. The mean error of one equation is found to be $\pm\,{\cdot}047$, which corresponds closely with what one could expect. According to this relation $m' = 5{\cdot}50$ corresponds with $m_{\rm Ha} = 5{\cdot}37$ for stars with the colour equivalent $c_2/T = 2{\cdot}0$ and the difference $\Delta m = +{\cdot}13$ should be compared with the difference of $+{\cdot}08$ derived for the two brightest stars of the North Polar Sequence between m' and the international magnitudes. The evidence is therefore rather convincing that the magnitudes of Table 1 need a negative correction of about ·1 in order to reduce them to the international system. As the exact amount of the correction is still uncertain the writer preferred to give the new mean magnitudes in KING's photographic system, especially because a zeropoint correction is readily applied if necessary.

There are two good reasons why the photo-electric magnitude of Polaris as given by HASSENSTEIN should be rejected. In the first place HASSENSTEIN himself remarks that his value is very uncertain and secondly it is not consistent with the international system. The relation between HASSENSTEIN's magnitudes and the standard catalogue of SEARES [1]), which is supposed

1) "Magnitudes and colors of stars north of + 80°", *Mt W. Obs.* 1935.

TABLE I.

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
	m					
15	1·98	3	+9	−5	−4	
21	2·72	13	+10	+7	−1	−1
39	2·58	3	+9	+2	−11	
45	6·70	1		—		
63	4·75	2	+4	−4		
68	4·61	1		—		
123	4·72	1		—		
130	4·39	1		—		
144	5·06	1		—		
153	3·49	13	−7	+1	−7	+1
154	4·18	1		—		
163	5·34	1		—		
165	4·78	2		−3	+4	
168 v	3·59	13	−8	+7	+8	−1
179	4·69	1		—		
193	4·58	1		—		
215 v	5·37	1		—		
219	4·10	13	+3	+8	0	−1
224	6·19	1		—		
226	4·35	1		—		
244	5·55	1		—		
253	6·33	1		—		
264 v	2·03	13	−4	+4	−4	+1
265	5·85	1		—		
269	3·96	2		−2	+3	
271	5·50	1		—		
294	5·36	1		—		
335	4·12	1		—		
337	3·94	3	0	−4	+3	
343	4·59	1		—		
351	5·88	1		—		
352	5·80	1		—		
360	5·90	1		—		
383	4·72	1		—		
390	6·10	1		—		
399	6·05	1		—		
403	2·87	13	+7	+2	+3	−1
417	5·29	1		—		
424 v	2·68	2	+1		−2	
437	4·80	3	−3	−6	+10	
442	5·94	1		—		
458	4·71	1		—		
464	5·15	2		−4	+4	
477	4·88	1		—		
489	6·02	1		—		
496	4·10	1		—		
510	5·33	1		—		
542	3·24	13	−2	+12	−6	0
544	4·00	3	−1	−2	+4	
549	5·71	1		—		
553	2·86	3	−1	0	0	
569	5·12	1		—		
575	4·84	1		—		
580	4·14	1		—		
590	4·95	11		+3		0
{603	3·84	1		—		
{604	3·43:	12	+10		+13	−2
617	3·35	3	−1	−5	+6	
620	4·96	11		−3		0
622	3·19	13	+3	−2	−1	0

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
	m					
649	5·29	1		—		
664	4·04	12	+7	−2		0
670	5·34	10				—
699	6·61	1		—		
707	4·76	1		—		
718	4·22	1		—		
779	3·91	2	−1	+1		
788	5·59	1		—		
799	4·69	1		—		
801	4·52	1		—		
804	3·58	2		−6	+5	
813	4·61	1		—		
824	5·79	1		—		
834	5·68	2		+10	−9	
838	3·55	3	−1	−3	+4	
840	4·59	11		0		0
843	6·43	1		—		
854	4·78	1		—		
879	4·74	11		0		0
882	6·40	1		—		
{887 {888	4·69:	1		—		
896	4·67	1		—		
911	4·41	3	+6	+7	−14	
915	3·77	3	−2	0	+3	
932	5·03	1		—		
937	4·68	12	+12	+2		−2
941	4·86	11		+4		0
947	5·95	1		—		
951	5·56	1		—		
972	4·90	1		—		
985	4·75	1		—		
991	6·67	1		—		
996	5·63	1		—		
999	6·29	1		—		
1002	5·07	1		—		
1017	2·35	13	+11	−1	+13	−2
1030	4·68	2		−5	+4	
1034	4·92	1		—		
1035	4·66	2	0	+1		
1038	3·71	3	0	+4	−5	
1040	5·17	2	+4	−4		
1044	4·68	1		—		
1046	5·16	1		—		
1052	6·03	1		—		
1066	5·40	1		—		
1087	4·28	1		—		
1122	2·89	13	+8	+4	−2	−1
1129	5·74	1		—		
1131	3·91	2		+4	−4	
1135	4·36	2		−2	+1	
1140	5·55	1		—		
1142	3·69	1		—		
1145	4·28	1		—		
1148	4·78	1		—		
1149	3·85	1		—		
1155	6·68	1		—		
1156	4·21	1		—		
1165	2·86	2	+2	−1		
1178	3·66	1		—		

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
	m					
1180	5·09	1		—		
1203	3·07	3	0	−1	+1	
1204	4·99	1		—		
1220	2·69	12	+3	+9		−1
1228	4·06	12	+2	+14		−2
1251	3·96	1			—	
1256	5·73	1		—		
1261	4·44	1		—		
1273	4·20	2		0	+1	
1303	5·30	1		—		
1306	5·89	1		—		
1311	5·80	1		—		
1320	4·29	1		—		
1324	4·72	1		—		
1329	5·30	1		—		
1346	4·83	2		−1	+1	
1350	4·90	1		—		
1373	4·98	2		−3	+4	
1380	5·06	1		—		
1387	4·47	2	+1	−1		
1389	4·38	1		—		
1392	4·61	11		0		0
1394	4·81	1		—		
1396	5·87	1		—		
1409	4·78	2		−8	+8	
1411	4·99	1		—		
1412	3·67	1		—		
1427	4·98	1		—		
1444	5·03	1		—		
1454	5·79	1		—		
1457	2·71	13	−5	+15	+6	−1
1458	4·48	1		—		
1473	4·44	1		—		
1479	4·95	1		—		
1497	4·21	1		—		
1542	4·32	1		—		
1543	3·78	2	0		−1	
1544	4·46	1		—		
1547	5·40	10				—
1552	3·47	2	+5		−5	
1567 v	3·42	1			—	
1568	4·52	1		—		
1570	4·75	1		—		
1577	4·49	3	−3	+4	−1	
1580	5·47	1		—		
1592	5·09	1		—		
1603	5·05	1		—		
1605 v	3·82	1		—		
1620	4·87	11		−3		0
1637	5·48	1		—		
1638	4·72	1		—		
1641	3·04	3	−12	+7	+5	
1659	5·61	10				—
1666	3·04	2	+10		−10	
1676	5·23	1		—		
1689	5·11	1		—		
1708	·99	2	+4	−4		
1726	6·04	1		—		
1729	5·42	1		—		
1788	3·10	2	+4	−4		

TABLE 1 (*continued*).

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
	m					
1790	1·32	2	+5	−4		
1791	1·53	13	+2	+3	+2	−1
1810	4·76	1		—		
1843	5·10	1		—		
1845	6·84	1		—		
1851 1852 v	1·93:	2	+3		−3	
1876	4·28	1		—		
1879 1880	3·16:	2	−1		+2	
1899	2·43	2	+3		−3	
1903	1·48	2	+6		−5	
1907	5·19	1		—		
1910	2·78	13	+4	+2	−2	
1931	3·30	1			—	
1946	4·78	1		—		
1948 1949	1·48:	2	+7		−6	
1995	5·51	1		—		
2004	1·79	2	+11		−11	
2010	4·87	1		—		
2011	6·66	1		—		
2012	5·33	1		—		
2029	5·08	1		—		
2034	4·66	1		—		
2047	5·16	11		−5		0
2061 v	2·46	2	+19		−19	
2077	5·00	2		−5	+4	
2084	4·79	1		—		
2088 v	2·03	3	−2	−3	+5	
2091	6·42	1		—		
2095	2·63	2	−3	+3		
2124	4·39	1		—		
2134	5·20	1		—		
2135	4·99	1		—		
2159	4·32	1		—		
2198	4·84	1		—		
2199	4·33	1		—		
2209	4·76	1		—		
2219	5·49	1		—		
2238	4·45	1		—		
2286	4·84	13	0	+1	−16	+2
2343	3·98	2		+5	−4	
2421	1·99	3	+3	−1	−1	
2456	4·42	2	−4	+3		
2470	4·97	1		—		
2473	4·69	13	+1	0	−3	0
2478	5·93	1		—		
2484	3·90	3	+1	−5	+4	
2527	6·26	1		—		
2529	5·43	10				—
2540	3·78	2		−5	+4	
2560	5·36	1		—		
2564	5·10	1		—		
2585	5·00	1		—		
2697	5·96	1		—		
2714	4·20	1			—	
2751	5·18	1		—		
2763	3·72	2		+2	−2	
2777	4·01	13	−14	−13	−7	+3
2818	4·65	1		—		
2821	5·06	12		−9	−4	+1
2845	2·79	3	+1	+2	−3	
2852	4·64	12	+11	−8		0
2854	5·98	1		—		
2864	6·01	1		—		
2890 2891	1·69:	2	−1		+1	
2905	5·87	1		—		
2930	5·34	1		—		
2943	·85	1	—			
2946	5·08	1		—		
2973	5·45	1		—		
2985	4·76	13	−3	−15	+2	+2
2990	2·37	13	−1	−15	+7	+1
3067	5·09	1		—		
3173	4·81	1		—		
3249	5·30	2		−1	0	
3262	5·80	10				—
3275	6·02	1		—		
3314	3·94	2	+3		−4	
3323	4·39	3	+7	−13	+6	
3403	6·04	1		—		
3449	4·65	1		—		
3461	5·21	1		—		
3474 3475	5·17	1		—		
3482	4·26	2	−3		+2	
3532	6·74	10				—
3547	4·42	1			—	
3569	3·52	13	−12	−12	0	+2
3572	4·52	1		—		
3576	6·75	1		—		
3579	4·59	11		−16		+2
3594	3·66	2		+5	−4	
3612	5·88	11		+1		0
3616	5·46	1		—		
3619	4·94	11		−10		+1
3624	5·17	1		—		
3662	5·09	1		—		
3665	3·89	1			—	
3690	4·06	2		−4	+5	
3705	5·05	3	−1	+2	−2	
3731	6·00	1		—		
3751	6·21	1		—		
3757	4·16	12		−10	−4	+2
3771	5·56	1		—		
3773	6·27	1		—		
3775	3·83	13	−7	−1	−2	+1
3787	4·76	1				
3799	4·60	1		—		
3800	5·73	1		—		
3809	6·13	1		—		
3834	6·29	1		—		
3852	4·22	2		+7	−8	
3873	4·02	2		+3	−3	
3888	4·26	12		−5	−7	+1
3894	4·68	1		—		
3905	5·45	1		—		
3950	6·69	1		—		
3974	4·78	1		—		
3975	3·64	2		+5	−5	
3980	6·24	1		—		
3982	1·38	3	−8	+3	+4	
4031	3·91	3	−4	−1	+5	
4033	3·62	2		0	+1	
4054	5·41	1		—		
4057 4058	3·32:	1	—			
4069	4·95	3	−7	+9	−2	
4072	5·03	1		—		
4090	5·12	1		—		
4100	5·30	1		—		
4112	5·54	11		+1		0
4132	5·07	1		—		
4133	3·80	2		−2	+1	
4166	5·65	1		—		
4247	5·12	2		−8	+9	
4248	4·70	1		—		
4295	2·47	13	−7	−4	+5	+1
4300	4·50	1		—		
4301	3·10	13	−1	+3	+3	0
4310	5·09	1		—		
4335	4·42	2		−4	+3	
4357	2·78	3	−9	+8	+1	
4359	3·47	3	−8	+4	+3	
4362	6·62	1		—		
4374 4375	4·42:	1	—			
4377	5·20	2		+6	−7	
4380	4·90	2	+3	−2		
4399	4·48	2		−5	+6	
4434	5·78	2		+7	−7	
4517	5·90	1		—		
4518	5·14	2		−2	+1	
4527	5·17	1		—		
4534	2·33	3	−4	−2	+5	
4540	4·28	2	0		+1	
4554	2·53	13	−10	+3	+4	0
4589	4·82	2	−3	+2		
4608	5·36	1		—		
4660	3·48	13	+2	+3	+3	−1
4697	6·02	1		—		
4707	5·42	1		—		
4716	5·89	1		—		
4737	5·73	1		—		
4785	4·98	2	+6	−6		
4787	3·80	2		−3	+4	
4789	4·92	1		—		
4825 4826	3·14:	1	—			
4828	5·10	1		—		
4905	1·82	12	+2	+4		0
4910	5·16	2	+7		−8	
4914	2·71:	1	—			
4915	2·93	1		—		
4920	6·72	1		—		
4931	5·44	1		—		
4932	3·98	3	−5	+7	−1	
4954	6·67	1		—		

TABLE I (*continued*).

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
4968, 4969	4·98:	1		—		
4983	4·97	2	0	0		
5017	5·11	1		—		
5054, 5055	2·39	1		—		
	2·16:	12	+4		+1	−1
5062	4·32	1		—		
5107	3·56	2	+1		0	
5110	5·51	1		—		
5112	4·97	1		—		
5127	5·19	1		—		
5154	6·65	1		—		
5185	5·10	2	+2	−3		
5191	1·73	13	0	+4	−15	+1
5200	5·96	1		—		
5219	6·72	1		—		
5226	6·48	1		—		
5235	3·37	3	−2	−3	+4	
5238	5·78	10				—
5291	3·67	12		−5	−3	+1
5304	5·47	1		—		
5321	6·48	1		—		
5328, 5329	4·85	1		—		
5340	1·37	3	+1	−7	+6	
5350	5·06	1		—		
5351	4·34	2	−3	+2		
5361	6·16	1		—		
5370	6·40	1		—		
5404	4·64	1		—		
5429	5·08	2		+3	−3	
5430	5·99	1		—		
5435	3·29	3	−4	−9	+12	
5447	4·87	1		—		
5477, 5478	3·97:	1		—		
5490	6·78	1		—		
5502	5·76	1		—		
5505, 5506	3·43:	1	—			
5511	3·78	1			—	
5544	5·54	1		—		
5563	3·77	13	−3	+5	−8	+1
5589	6·46	1		—		
5600	6·66	1		—		
5602	4·61	3	+3	−5	+3	
5616	6·04	1		—		
5618 v	5·57	1		—		
5681	4·53	2		+1	−1	
5733, 5734	4·73	1		—		
5735	3·15	13	+6	+1	−4	0
5744	4·68	2		0	+1	
5747	4·04	2		−7	+6	
5774	5·13	1		—		
5778	4·04	1		—		
5793 v	2·23	3	0	−2	+2	
5842	4·56	1		—		
5849	3·82	2		+2	−3	
5854	3·99	3	−4	+4	0	
5867	3·84	2		−8	+8	
5868	5·16	1		—		
5879	6·11	1		—		
5881	3·53	1			—	
5886	5·33	10				—
5889	5·55	1		—		
5892	4·00	1			—	
5899	6·49	1		—		
5901	6·06	1		—		
5903	4·44	1		—		
5914	5·27	1		—		
5933	4·44	2		−5	+4	
5947	5·62	1		—		
5960	5·31	1		—		
5971	4·94	1		—		
5972	4·81	1		—		
5982	4·72	2	+2	−2		
5986	4·66	12	0	+14		−1
6018	5·96	1		—		
6023	4·20	1		—		
6056	4·46	2	+9		−9	
6075	4·38	1			—	
6092	3·74	2		−2	+3	
6093	5·24	1		—		
6095	4·06	2		−5	+6	
6103	6·04	1		—		
6117	4·65	1		—		
6132[1])	3·80	13	+4	+2	+5	−1
6148	3·88	3	0	0	0	
6149	3·93	1			—	
6159	6·72	1		—		
6161	5·01	1		—		
6168	4·24	1		—		
6212	3·59	3	−5	−5	+11	
6220	4·58	3	+3	−1	−1	
6223	6·29	1		—		
6237	5·32	1		—		
6254	5·02	1		—		
6281	4·34	1		—		
6299	4·60	2		+8	−7	
6315	5·48	11		+2		0
6324	3·90	2		+8	−8	
6355	5·19	1		—		
6396	3·09	13	−7	−2	+3	0
6406 v, 6407	4·67:	1	—			
6410	3·21	3	+5	−6	+1	
6418	4·79	3	+6	+1	−6	
6421	5·84	10				—
6436	4·57	1		—		
6526	5·99	1		—		
6536	3·88	13	−2	−10	+6	+1
6554	5·21	1		—		
6556	2·32	3	−1	−4	+5	
6588	3·63	2		−4	+4	
6596	5·29	1		—		
6603	4·09	2	−7		+7	
6623	4·31	3	+3	−13	+9	
6629	3·87	1			—	
6636, 6637	5·09	1		—		
6688	5·18	2		+1	0	
6695	5·37	2		−9	+9	
6703	4·79	2		−7	+7	
6705	4·02	13	0	+9	−4	−1
6707	4·79	1		—		
6713	6·10	1		—		
6714	3·96	1			—	
6752	5·13	1	—			
6770	5·87	1		—		
6771	4·02	2		+1	−2	
6779 v	3·84	2		−4	+5	
6787	4·15	1		—		
6789	4·42	1			—	
6845	5·50	10				—
6868	6·78	1		—		
6869	4·29	1			—	
6872	5·68	1		—		
6895	5·26	2		−5	+6	
6903	5·22	10				—
6920	4·27	1		—		
6923	5·18	1		—		
6927	4·17	3	−8	+5	+3	
6945	6·30	1		—		
6978	5·54	1		—		
7001	·08	12	+1	−16		+2
7051, 7052	4·95:	1		—		
7053, 7054	4·84:	1		—		
7056, 7057	4·67	1		—		
7061	4·72	2	+3	−4		
7064	6·24	1		—		
7069	4·54	2	+11	−10		
7125	6·12	1		—		
7131	5·49	1		—		
7133	5·40	1		—		
7137	5·98	1		—		
7139	6·21	1		—		
7157	5·88	1		—		
7176	5·20	1		—		
7178	3·26	13	−6	−5	−5	+1
7180	6·15	1		—		
7235	3·01	3	−1	−6	+8	
7236	3·32	1			—	
7262	5·22	10				—
7298	4·31	11		−25		+2
7306	4·68	1		—		
7310	4·23	2		−5	+5	
7314	5·77	1		—		
7328	4·91	2		−3	+3	
7352	5·94	1		—		
7358	4·97	1		—		
7371	4·73	1		—		
7372	4·83	1		—		
7377	3·80	2	+4		−4	
7405	6·15	1		—		
7417	4·37	1	—			
7420	4·02	2		−3	+2	
7426	4·53	1		—		

TABLE 1 (*continued*).

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
	m					
7437	4·88	1		—		
7462	5·62	1		—		
7469	4·99	12	−3	−13		+2
7478	5·78	1		—		
7479	5·18	1		—		
7483	5·44	10				—
7488	5·52	1		—		
7525	4·36	3	+4	+5	−8	
7528	2·92	13	−1	−13	−2	+1
7536	5·37	3	+10	−11	0	
7546	5·09	1		—		
7557	1·03	2	+9	−9		
7565	4·75	1		—		
7582	4·97	2		+3	−3	
7592	4·50	1		—		
7595	5·95	1		—		
7602	4·70	1			—	
7613	4·75	1		—		
7615	4·90	1		—		
7619	5·06	1		—		
7628	5·47	10				—
7635	5·28	2		+7	−6	
7653	4·84	1		—		
7685	6·18	1		—		
7708	4·87	1		—		
7710	3·26	2	+1		0	
7724	5·07	1		—		
7730	4·97	1		—		
7735	5·22	2		+4	−5	
7736	5·23	1		—		
7739	4·71	1		—		
7740	4·53	2	+3	−3		
7744	6·05	1		—		
7750	4·42	1		—		
7751	5·90	1		—		
7763	5·43	1		—		
7796	3·05	13	+3	+6	+1	−1
7806	6·10	1		—		
7834	4·53	1		—		
7844	4·95	1		—		
7850	4·55	1		—		
7852	4·00	2		+6	−5	
7866	6·55	1		—		
7871	4·90	1		—		
7882	4·19	3	−13	+7	+5	
7891	4·88	1		—		
7906	3·88	2		−7	+8	
7924	1·44	13	−2	−11	−5	+2
7928	4·86	1		—		
7929	5·43	10				—
7942	5·51	1		—		
7949	3·67	3	−1	+4	−3	
7955	5·22	11		+1		0
7957	4·56	13	+2	+6	+4	−1
7963	4·50	1		—		
7977	5·40	1		—		
7995	5·59	1		—		
8001	4·76	1		—		
8028	4·06	2	−2	+2		
8047	5·04	1		—		

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
	m					
8079	5·66	2		+17	−16	
8085	6·75	1		—		
8086	7·80	1		—		
8089	6·50	1		—		
8097	5·17	1		—		
8115	4·40	2		+8	−8	
8123	5·20	1		—		
8130	4·24	3	+3	−5	+2	
8143	4·42	1		—		
8146	4·38	1		—		
8154	5·04	1	—			
8162	2·81	13	−4	+5	−5	0
8173	5·44	1		—		
8225	6·54	1		—		
8232	3·84	2	+2		−1	
8238 v	3·03	3	−1	+10	−8	
8252	5·09	2	+6	−6		
8255	6·25	1		—		
8279	5·17	11		+9		−1
8301	4·70	1		—		
8308	4·15	3	+1	+8	−10	
8309, 8310	5·06:	1		—		
8313	5·67	1		—		
8315	4·64	1		—		
8317	5·93	1		—		
8334	4·98	1		—		
8335	4·14	1		—		
8343	5·09	1		—		
8402	4·62	1		—		
8406	5·68	10				—
8413	6·53	1		—		
8414	4·02	2		+3	−2	
8417	4·83	1		—		
8430	4·24	2		0	0	
8450	3·68	2		+4	−5	
8454	4·80	1		—		
8465	5·17	2		+8	−8	
8468	5·93	1		—		
8469	5·42	1		—		
8485	6·12	1		—		
8494	4·54	12	+7	+1		−1
8498	5·84	1		—		
8518	3·82	2		−2	+1	
8520	4·88	1		—		
8522	4·84	1		—		
8523	4·47	1		—		
8528	6·34	1		—		
8538	5·61	1		—		
8539	4·54	1		—		
8541	4·71	12	−2	−1		0
8551	5·96	1		—		
8558, 8559	4·18:	1		—		
8572	6·30	1		—		
8574	5·69	10				—
8579	4·46	11		−1		0
8585	3·84	2		+1	−1	
8597	3·97	1		—		
8606	6·31	1		—		

HR	m	p	Δm Ki	Δm He	Δm Th	Δm Gü
	m					
8613	4·92	1		—		
8622	4·71	12	−5	−5		+1
8632	6·03	1		—		
8634	3·36	3	+4	0	−3	
8641	4·75	1		—		
8650	3·96	13	−4	−3	+1	+1
8665	4·82	2	0	0		
8667	5·21	1		—		
8684	4·54	2		+2	−1	
8694	4·74	2		−2	+2	
8717	5·00	1		—		
8762 v	3·50	3	+6	+9	−15	
8766	5·26	10				—
8773	4·44	1		—		
8775	4·40	3	0	+3	−3	
8780	5·94	1		—		
8781	2·46	3	+4	−1	−4	
8795	6·45	1		—		
8796	6·36	1		—		
8797	4·86	1		—		
8819	5·38	1		—		
8830	4·91	11		−2		0
8852	4·67	2		−1	+1	
8860	6·83	1		—		
8872	5·81	1		—		
8880	4·86	1		—		
8905	5·15	1		—		
8911	5·02	1		—		
8916	5·53	1		—		
8923	5·55	1		—		
8926	4·80	1		—		
8961	4·87	2		+3	−3	
8965	4·22	1		—		
8967	5·36	10				—
8969	4·78	2	+6	−6		
8974	4·51	2	+4	−4		
8976	4·08	1		—		
8984	4·71	1		—		
8997	6·02	1		—		
9045 v	6·00	1		—		
9052	6·33	1		—		
9064	6·54	1		—		
9071	4·86	11		+6		−1
9072	4·52	1		—		

[1]) This star is η Draconis of spectral type G5. The photographic magnitude given by FAIRLEY in the *Yerkes Actinometry*, Second Series, is 4·66, which value is based on three plates, and that given in *Harvard Mimeogram* Series I, No. 1 is 4·46. The visual catalogues agree with the value of the present paper, as they all give visual magnitudes near 2·9 and 3·0. As variability is highly improbable, the magnitude given by FAIRLEY is most likely a misprint for 3·66. This may also explain the deviating value of the Harvard Catalogue in which the Yerkes magnitudes have been used. Half the number of errata given by FAIRLEY in *Ap. J.* **75**, 427 are of this type, the magnitude being in error by one magnitude.

to be on the international system, is given by the former author as:

$$m_{Ha} = m_S + {}^{\cdot}006 + {}^{\cdot}019\,(m_S - 6{}^{\cdot}00) + {}^{\cdot}002\,\mathrm{I} \qquad 39$$
$$\pm\ 9 \pm\ 14 \qquad \pm\ 13 \quad \text{(m.e.)}$$

From this equation, in which Polaris has not been used, the two systems appear to be practically identical, although the scale of HASSENSTEIN is about 2 percent wider [1]). The difference in zeropoint at the sixth magnitude is neglectable. According to this equation the magnitude of Polaris in HASSENSTEIN's system should be 2·50, if we accept the international value 2·56. The value given by HASSENSTEIN is 2·65, which must therefore be considered incorrect, unless we assume that the international magnitude of Polaris is considerably in error, which seems improbable.

Lastly a comparison has been made between the magnitudes of Table 1 and those given by PAYNE GAPOSCHKIN and SHAPLEY. The stars in the last catalogues which are marked with a colon have been omitted. Altogether 128 stars are in common with Table 1. When the differences $m'-m_{\mathrm{Harv.}}$ are arranged according to m', the following result is obtained:

m'	Δm
3·00—3·99	+·02
4·00—4·99	+·04
5·00—5·99	+·29
> 5·99	+·40

For stars brighter than the fifth magnitude the agreement is satisfactory, but for the fainter stars the differences are considerable. They should however be diminished by about ·10, which is the zeropoint correction to be applied to m'. The remaining values may be due to a difference in scale and to some extent to a colour equation. The rather small number of stars common to both catalogues and the large dispersion of the differences $m'-m_{\mathrm{Harv.}}$ only permit tentative conclusions. If we assume that the increasing values of Δm for the fainter stars are due to a difference in scale, the dispersion of $m'-m_{\mathrm{Harv.}}$ is found to be:

m'	dispersion	n
3·00—3·99	±·27	15
4·00—4·99	±·20	48
5·00—5·99	±·22	51
> 5·99	±·17	14

In order to investigate the influence of a colour equation the observations have been divided into 21 groups of 6 stars each according to the values of m' and c_2/T. The group means are given in Table 2. A least squares solution yields the relation:

$$m_{\mathrm{Harv.}} = +{}^{\cdot}552 + {}^{\cdot}872\,m' - {}^{\cdot}037\,c_2/T$$
$$\pm\ 41 \qquad \pm\ 37 \text{ (m.e.)}$$

It is seen that the colour coefficient is of no importance. The mean error of one equation is ±·108, which corresponds with a mean error of ±·26 for a single star confirming the large values derived above.

TABLE 2.

$m_{\mathrm{Harv.}}$	m'	c_2/T	n	O—C
3·00	3·16	1·63	6	— ·25
3·87	3·80	1·63	6	+ 6
4·28	4·27	1·63	6	+ 6
4·54	4·49	1·71	6	+ 14
4·74	4·73	1·60	6	+ 12
4·77	4·83	1·73	6	+ 7
4·88	5·00	1·74	6	+ 3
4·94	5·34	1·64	6	— 21
4·11	4·20	2·40	6	— 1
4·74	4·90	2·18	6	0
4·89	5·17	2·50	6	— 8
5·16	5·32	2·36	5	+ 6
5·25	5·52	2·62	5	— 2
4·46	4·45	3·57	6	+ 16
4·64	4·90	3·45	6	— 6
4·89	5·20	3·61	6	— 6
5·34	5·57	3·32	6	+ 5
5·49	5·89	3·33	6	— 7
5·71	6·00	3·69	6	+ 6
5·79	6·18	4·04	6	0
5·93	6·40	3·77	5	— 6

As the mean error of m' is not larger than ±·07, these dispersions are practically due to the Harvard catalogues. The large difference in scale can not be determined accurately from this material, but the information gathered from the many relations which connect m' with other photometric series seems to indicate that the scale of m' is substantially correct.

The large mean error of the Harvard catalogues derived here seems to be in conflict with a result obtained by SEARES [1]). He compared the Harvard magnitudes with a working list of mean magnitudes which are based on six catalogues and the average deviation was found to vary between ±·05 and ±·02. SEARES' comparison is limited to the region north of 80° and covers the magnitude interval from 5·0 to 8·25. In this part of the sky the Harvard magnitudes are mean values of own observations and of the magnitudes from four catalogues, which were also used by SEARES in forming his working list. Although the reduction formulae for these catalogues were

1) HASSENSTEIN considers the difference $(m_{Ha}-m_S)$ as a function of m_S and of I. This procedure is incorrect as the left and right hand sides of the equation are thus not independent. A new solution by the writer yields:

$$(m_S - 6{}^{\cdot}00) = -{}^{\cdot}006 + {}^{\cdot}976\,(m_{Ha} - 6{}^{\cdot}00) + {}^{\cdot}008\,\mathrm{I}$$
$$\pm\ 14 \qquad \pm\ 13 \text{ (m.e.)}$$

the scale difference being 2·4 instead of 1·9 percent.
SEARES (*Mt W. Contr.* No. 647) is of the opinion that the scale difference of nearly two percent between his mean magnitudes in the Polar Catalogue and those of HASSENSTEIN is not real, but that it is a consequence of an irregular correction which should be applied to HASSENSTEIN's zeropoint. There remains however a discrepancy in the photo-electric magnitudes of Polaris as determined by HASSENSTEIN and by STEBBINS and WHITFORD.

1) *Mt W. Contr.* No. 489, 2, 1934; *Ap. J.* 79, 204, 1934.