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**No. 41.** THE PROPER MOTION AND THE DISTANCE OF THE PRAESEPE CLUSTER,
BY DR. W. J. KLEIN WASSINK, ASSISTANT OF THE KAPTEYN LABORATORY.

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# THE PROPER MOTION AND THE DISTANCE OF THE PRAESEPE CLUSTER.

**1. Introduction and Summary.**

Our knowledge of the structure of the Milky Way system is limited mainly on account of a lack of knowledge of the distances of the stars. This difficulty is caused by the position of the Sun within this system; it does not exist in an investigation of the local clusters: all objects are at the same distance from the Sun and it is thus possible to find out the relative frequencies of stars of determined absolute magnitude and spectral class etc., if we know which stars are members of the group.

This paper deals with the Praesepe-cluster ($\alpha = 8^h 34^m 39^s$, $\delta = + 20° 1'$). This is a stargroup of 4° to 5° in diameter, probably cosmically related to the Hyades. The brightness of the stars varies between the limit of naked-eye visibility to at least the eighteenth magnitude. The first attempt to distinguish the fainter members of the group from the backgroundstars by means of the proper motions was made by VAN RHIJN [1]), ten years ago. The result was negative. The investigation is repeated in this paper with more material.

The photographic plates have been furnished at the request of Prof. Dr. P. J VAN RHIJN by several observatories, summarised in the tables 1 and 2. The writer is greaty indebted to the Directors of these observatories for their kindness in repeating the early plates and sending them, together with the new ones, to the Kapteyn Laboratory for measurement.

The results in this paper may be summarised as follows:

The proper motions of about 600 stars have been derived with a probable error of 0".0015 to $m = 13$, but a magnitude error has weakened the result. 200 Stars belonging to the cluster have been found. Group stars occur to the limit of the plates ($m = 18{\cdot}0$). The brighter stars are more concentrated towards the centre and they cover a smaller area than the fainter ones. The brighter part of the cluster is elongated in a direction parallel to the Milky Way.

The proper motion of the group is 0".037 in the position angle 249°. The distance is found to be 137 parsecs ($\pi = 0''{\cdot}0073$).

The distribution of the absolute photographic magnitudes of the Praesepe stars has been compared with the distribution of the absolute photographic magnitudes in the neighbourhood of the Sun up to $M = m + 5 \log \pi = + 7$. The two curves are similar except that the number of bright stars is larger in the cluster. The spectral types A, F, G and K have also been treated separately up to $M = + 0{\cdot}5$.

Finally the velocity of the cluster through space appears to be nearly equal and parallel to that of the Hyades, only the position angles of the proper motions being somewhat discordant ($8° = 2\frac{1}{2} \times$ probable error).

1) *Groningen Publications* **26**, 1916.

# CHAPTER I.

**2. The material.** The material discussed in this paper has been summarised in table 1. The meaning of the columns will appear from their headings Both the new plates of pair VI have been measured; similarly the two early plates of pair VIII Table 2 gives a list of the plates which have been partly measured; they will be discussed in section 8.

TABLE 1. LIST OF THE COMPLETELY MEASURED PLATES.

| Pair | Observatory | Numb. of plate | Epoch | Mean. Sid. Time | Numb. of images | Exp Time | Lim. Ph. Magn. | Measured area. sq. degr. | 1 mm ∾ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | h m | | m | | | " |
| I | Pulkowo | F 3<br>C 78 | 11 Mar. 1894<br>11 Mar. 1923 | 7 37<br>7 23 | 1 | 25<br>28 | 14 | 2·8 | 60 |
| II | Greenwich | 1972<br>9266 | 10 Apr. 1894<br>23 Jan. 1923 | 9 52<br>9 26 | 1 | 40<br>40 | 14 | 2·8 | 60 |
| VI | Greenwich | 1973<br>9277<br>9280 | 10 Apr. 1894<br>8 Feb. 1923<br>17 Mar. 1923 | 10 20<br>8 41<br>8 44 | 2 | 6, 3<br>4¾, 2<br>6, 3 | 11·5 | 2·8 | 60 |
| VIII | Stockholm | 331<br>339<br>1915 | 13 Mar. 1899<br>23 Mar. 1900<br>9 Apr. 1923 | 9 8<br>11 37<br>12 15 | 1 | 24<br>30<br>15 | 12 | 2·2 | 87 |
| X | Helsingfors | 2<br>3 | 3 Feb. 1891<br>21 Feb. 1923 | | 1 | 20<br>20 | 12·5 | 2·8 | 60 |
| XII | Radcliffe | 235<br>920 | 26 Mar. 1909<br>12 Mar. 1924 | 9 44<br>9 45 | 2 | 20<br>15 | 14 | 1·5 | 29 |
| XIII | Radcliffe | 234<br>918 | 26 Mar. 1909<br>4 Mar. 1924 | 8 45<br>8 48 | 2 | 20<br>15 | 14 | 1·5 | 29 |
| XIV | Radcliffe | 231<br>886 | 19 Feb 1909<br>17 Mar 1923 | 7 38<br>7 37 | 2 | 20<br>15 | 13·5 | 1·5 | 29 |
| XV | Radcliffe | 68<br>923 | 31 Mar. 1905<br>1 Apr. 1924 | 9 49<br>9 52 | 3 | 5<br>4 | 13 | 1·5 | 29 |
| XVI | Radcliffe | 66<br>922 | 30 Mar. 1905<br>31 Mar. 1924 | 10 5<br>10 5 | 3 | 5<br>4 | 13 | 1·5 | 29 |
| XVII | Lick | 43<br>4300 | 15 Jan. 1902<br>13 Apr. 1923 | 8 9<br>10 46 | 1 | 123<br>90 | 18 | 0·5 | 39 |
| A | Potsdam | 55<br>690 | 17 Apr. 1893<br>10 Apr. 1915 | 11 20<br>11 23 | 1 | 60<br>60 | 14 | 2·8 | 60 |

The centre of the plates, Nr. XVII excepted, is $\alpha_{1900} = 8^h 34^m 39^s$, $\delta_{1900} = +20°1'·0$; the centre of Nr. XVII is $8^h 34^m 19^s$, $+20°15'·5$.

TABLE 2. LIST OF INCOMPLETELY MEASURED PLATES.

| Pair | Observatory | Number of plate. | Epoch | Mean Sid. Time | Exp. Time | 1 mm ∾ |
|---|---|---|---|---|---|---|
| | | | | h m | m | ″ |
| 1 | Radcliffe | 114<br>981 | 22 Mar. 1906<br>30 Mar. 1926 | 9 16<br>9 25 | 10<br>10 | 29 |
| 2 | Radcliffe | 119<br>986 | 29 Mar. 1906<br>12 Apr. 1926 | 9 29<br>9 34 | 5<br>3 | 29 |
| 3 | Radcliffe | 120<br>982 | 29 Mar. 1906<br>30 Mar. 1926 | 9 41<br>9 41 | 5<br>3 | 29 |
| 4 | Radcliffe | 121<br>983 | 29 Mar. 1906<br>30 Mar. 1926 | 9 56<br>9 56 | 5<br>3 | 29 |
| 5 | Radcliffe | 122<br>984 | 29 Mar. 1906<br>9 Apr. 1926 | 10 11<br>10 10 | 5<br>3 | 29 |
| 6 | Yerkes | 110<br>6381 | 30 Nov. 1909<br>1 Apr. 1924 | 8 40<br>8 40 | 60<br>60 | 11 |
| 7 | Allegheny | 1379<br>32302 | 1 Mar. 1915<br>15 Mar. 1924 | 8 42<br>8 50 | 4, 4<br>4½, 1½ | 15 |
| 8 | Dearborn | A 31<br>A 5553 | 5 Febr. 1913<br>16 Mar. 1923 | 0 50<br>0 48 | <br>12, 12 | 30 |

All the plates except the pair A have been measured by the writer on the Repsold measuring machine. This instrument has been described at length by VAN DE SANDE BAKHUYZEN; I therefore refer to his paper [1]) on the subject. **3. The measurements.**

The measurements of the pair A have been taken from *Groningen Publications* **26** pages T 1 to 11; they are rediscussed here.

If the plate of the new epoch has been exposed through the glass, the early and the new plate are put together, film against film, in the measuring machine. The distance between both images of the same star is then measured directly. This applies to the plates from the Radcliffe, Lick, Potsdam and Helsingfors observatories. In all other cases, the plate of the new epoch not being exposed through the glass, each plate has been measured separately with reference to the division lines of the scale.

The first method has been fully explained in *Gron. Publ.* **19** page 6, the second one in *Gron. Publ.* **25** page 7.

The plates are measured in two positions differing 90°. Only the plates X and A have been measured in four positions.

[1]) Bulletin de la *Carte du Ciel* **1**, 169, 1892.

The rectangular coordinates of the stars, $x$ and $y$, have been taken from *Gron. Publ.* **26**; they are expressed in minutes of arc; $x$ is the coordinate in the direction of increasing right ascension, $y$ in the direction of increasing declination. A new Durchmusterung has been prepared for plate XVII, because it contains stars fainter than the limiting magnitude of *Gron. Publ.* **26**.

(1) The maximum measured area is a circle with a diameter 110′ around the star BD + 20° 2166 = Boss 2310. The area of each plate separately has been given in table 1.

In the course of this investigation it appeared that the cluster covers a larger area than had been measured. The total area of the plates I and II has therefore been investigated after the regular measurements. The resulting proper motions are not printed in this paper; the group stars only have been picked out and are given in section 7.

The stability of the plate during the measurements has been tested by remeasuring two stars each morning. The differences in these measures can always be explained by a normal error of pointing.

The micrometer used has been described in *Gron. Publ* **19**, 10; the run of the screw is such that 1 revolution corresponds nearly to 0·1 mm on the plate.

**4. The Reductions.** The method of computing the annual proper motions from the measured quantities is well known. [1]) I need not repeat it here in detail. The following may suffice:

The plate constants have been determined from a certain number of suitably chosen stars. These reduction-stars are the faintest stars with good images and small proper motion, uniformly distributed over the plate and not belonging to the Praesepe-cluster. Their number is at least 80 to 100. Six plate-constants have always been computed in both coordinates. They are a constant term and the coefficients of the terms $x$, $y$, $x^2$, $xy$ and $y^2$. The reduction-stars have been chosen between the limits of magnitude and proper motion given in table 3.

I consider it necessary, if quadratic terms are taken into account, to have as large a number as 80 to 100 reduction-stars Moreover the stars ought to be uniformly distributed over the plate. If for instance, to take an extreme case, all the stars lie at the same distance from the centre, or lie on a diagonal of the plate, it is impossible to compute 6 constants; the normal equations are not independent of one another in these cases. [2])

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1) See *e. g. Groningen Publications* **26**, 1917.
2) *Cf.* JACKSON, *Monthly Notices* **84**, 1924.

TABLE 3. LIMITS OF MAGNITUDE AND PROPER MOTION OF THE REDUCTION-STARS.

| Plate. | Phot. magn. | $\mu_x$ and $\mu_y$. |
|---|---|---|
| I and II | 10·6 to 13·6 | ± 0″·020 |
| VI | 8·0 to 10·8 | group-stars |
| VIII and X | 10·6 to 12·8 | ± 0·025 |
| XII and XIV | 10·8 to 13·7 | ± 0·020 |
| XIII | 10·8 to 13·5 | ± 0·025 |
| XV and XVI | 10·6 to 13·3 | ± 0·020 |
| A | 10·6 to 13·5 | ± 0·025 |
| XVII | 15·0 to 17·5 | ± 0·020 |

In the case of plate VI the constants have been determined from the group-stars, the other stars being too small in number.

A certain number of stars certainly not belonging to the cluster have been picked out by means of a preliminary reduction of plate I. They have been used for the reduction of all plates except nr. VI and nr. XVII. This latter plate contains much fainter stars than the other ones; a preliminary reduction with linear terms has been sufficient to choose a set of reduction-stars.

**5. Spherical Coordinates.**

The right-ascension and declination of the stars, occurring in *Gron. Publ* **26** have been taken from that publication; for the other stars, the coordinates have been computed by means of the same formulae as have been used there. The equinox is that of the year 1900.

**6. The magnitudes.**

Photographic magnitudes derived from estimates of the diameters of the star images are given in *Gron. Publ.* **26**. The standard magnitudes were taken from an investigation by HERTZSPRUNG [1]).

Later on HERTZSPRUNG [2]) has published more accurate values, the differences with the first set being however very small. The later magnitudes have been adopted. They have been determined by means of the Halbgitter and Objectiv-gitter methods, the zero point being taken in accordance with the Göttinger Actinometrie. The scale is therefore identical with that of Mt. Wilson [3]).

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1) *Astronomische Nachrichten* **203**, 261. 1916.

2) *Astronomische Nachrichten* **205**, 71, 1917.

3) Seares (*Transactions of the International Astronomical Union*, Vol. 1, **78**, 1922) finds by a direct comparison of the Mt. Wilson and Göttingen magnitudes a possible zero-correction of $+^{m}05$ to the latter. An indirect comparison between the two scales by means of Harvard Circular 170 gives the value $-^{m}03$.

The probable error of a magnitude, derived from the diameters amounts to ± 0.12. SCHILT [1]) has developed a method, that gives a higher accuracy. The principle is as follows: the image of a small circular lens is formed on the photographic plate. The image of a star on the plate is brought to the centre of the circular bright spot projected on the plate by the illuminated lens; the darker the image of the star, the smaller will be the fraction of the light transmitted by the photographic plate. This fraction is measured by means of a thermocurrent. The reading of the galvanometer, which indicates the intensity of this current, is thus a measure of the photographic magnitude of the star.

SCHILT finds that the relation between the galvanometer values and the magnitudes is very nearly a linear one The curves for the Praesepe plates are less straight, they have the form:  . This means that the sensitiveness of the method increases from the brighter stars to a maximum and then decreases to practically zero for the very faintest stars.

I also find that there is a systematic correction depending on the distance from the centre of the plate. This is a serious difficulty, if the standard-magnitudes are not distributed over the whole plate. This is the reason why the magnitudes of the stars outside HERTZSPRUNG's field (distances 30′ to 55′) have less weight than the other stars (distance 0′ to 30′).

TABLE 4. PLATES MEASURED WITH THE MICRO-PHOTOMETER.

| Nr. of Plate. | Observatory. | Date. |
|---|---|---|
| C 78 | Pulkowo | 11 — 3 — 1923 |
| 9266 | Greenwich | 23 — 1 — 1923 |
| 4300 | Lick | 13 — 4 — 1923 |

The plates have been pressed against a thick plate-glass in order to eliminate the influence of the curvature of the plate on the galvanometer readings, which are very sensitive to changes in focus.

The plates have been measured in the following way. The image of a star is brought into the field of the microscope; the light-beam is admitted and the galvanometer is read. Then the film near the star image is brought into the field and the galvanometer is read again. The quotient of the two readings is the galvanometer value so called.

Before and after the regular measurements the galvanometer values of the

1) *Groningen Publications* **32**, 1924.

same eight stars have been determined to test the constancy of the measures. The galvanometer has been read also repeatedly for a definite point of the film.

It appeared that none of these quantities remained completely constant; especially if the measurements lasted more than one day. The variations of the reading of the film are of no consequence. From the galvanometer-values of the standard-stars corrections have been derived, by means of which the measurements of each day have been reduced to a common standard.

The corrected galvanometer-values have been plotted against HERTZSPRUNG's photographic magnitudes. Two curves have been derived in the case of plate C 78, one for the stars lying at distances 0′ to 15′, another for the stars at distances larger than 15′ from the centre of the plate. In the case of the plates 9266 and 4300 three groups of stars have been formed, corresponding to the distances 0′ to 10′, 10′ to 20′, > 20′ and 0′ — 15′, 15′ — 25′, > 25′ respectively.

The two curves of plate C 78 are identical for the fainter part (galvanometer-values ·600 to 1·000). The magnitudes of all stars, whatever their distance from the centre, have been read from this part of the curve. For the brighter stars a distance correction has been derived, amounting to $0^{m}\cdot35$ as maximum. This correction has been applied only to the stars inside a circle of 30′; the magnitudes of the stars outside HERTZSPRUNG's area have not been determined from this plate.

The three curves of plate 9266 are identical for all magnitudes. It has been assumed that the distance-correction is zero also for the stars at distances exceeding 30′; the magnitudes of all the stars on the plate have been determined.

In the case of plate 4300, there is some difference between the three curves, depending on the distance. As however no stars occur on this plate at distances exceeding 35′, no extrapolation is needed. The magnitudes of all stars are read from one of the curves.

The plates C 78 and 9266 cover the same magnitude interval. From the differences the probable error of one magnitude, derived from one plate, can therefore be computed. It is $0^{m}\cdot06$.

There is also a systematic difference between the two plates. For the inner stars it is zero, as might be expected a priori, but for the stars lying at distances 30′ to 55′ it is about $0^{m}\cdot23$; I therefore did not succeed in eliminating the distance-error for these larger distances.

The final magnitudes, printed in the catalogue are the mean of the magnitudes of *Gron. Publ.* **26**, if found there, and those derived here; the weights being 1 and 3 respectively.

**7a. Cluster-stars up to m = 14.**

The cluster-stars are distinguished from the background-stars by means of the proper motion. For this purpose the relative proper motions, as derived in section 4, are plotted in a diagram for each plate separately, three or more groups being formed according to the magnitude. The motion of the cluster is clearly shown in each diagram. It consists in a condensation of points in the third quadrant ($\mu_x$ and $\mu_y$ negative), more or less separated from the other points. The stars, forming this condensation will be called the group-stars. They have been selected from the diagrams of each plate separately. A comparison of the different plates shows that the mutual agreement is very good; there are only 3 stars left, out of the 162, of which it is doubtful whether they belong to the cluster.

On two plates, nrs. I and II, cluster-stars have been sought for outside the regularly measured area (1) between the limits: $\alpha = 8^h\,30^m\,7^s$ and $8^h\,39^m\,11^s$,
(2) $\delta = +\,18°\,52'{\cdot}5$ and $20°\,58'{\cdot}5$. The proper motions of this region have been treated in a similar way to the proper motions of the inner area. The results from both plates agree well. Twenty-six groupstars have been found up to the magnitude 13·0. Groupstars fainter than this limit could not to be distinguished from the backgroundstars. Seven stars of the twenty six are considered doubtful

Table 5 gives the cluster-stars; the doubtful cases are denoted by an asterisk. The numbers of the stars of the originally measured area, being always less than 532, are those of the catalogue, pages 42 to 47. The other 26 stars with numbers 532 to 557 are to be found in the catalogue on page 48.

The table is complete down to the photographic magnitude 13·0 within the limits (2). For the plenitude of the stars between 13·0 and 14·0, occurring within the area (1), see section 11.

A star, which really does not belong to Praesepe, may have nearly the same proper motion as the cluster-stars and may therefore have been inserted in table 5. The probability however, is very small. It is true that the angle between the direction towards the solar antapex and the direction of the groupmotion, amounts only to 40°, but the mean parallactic motion of the fainter stars ($m > 11$) is less than 25 % of the group motion and the brighter stars do not occur in any considerable number. The table by SEARES and VAN RHIJN[1]) gives 9 background-stars per 2·8 square degrees, brighter than the tenth magnitude, whereas I have found 8 such stars.

Moreover it will be seen from figure 2, which represents a diagram of the proper motions of the catalogue, that there is a clear gap between the groupstars and the other objects. This also shows that non-cluster stars probably do not occur between the cluster stars.

I have estimated that, apart from the doubtful cases, the probability of a star of table 5 being in reality a backgroundstar, is of the order $10^{-2}$.

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1) *Mt. Wilson Contributions* **301**, 1925.

TABLE 5. LIST OF 188 STARS BELONGING TO THE PRAESEPE-CLUSTER, BRIGHTER THAN THE FOURTEENTH MAGNITUDE.

| No. | Phot. Magn. | Spectrum. | No. | Phot. Magn. | Spectrum. | No. | Phot. Magn. | Spectrum. | No. | Phot. Magn. | Spectrum. | No. | Phot. Magn. | No. | Phot. Magn. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300 | 6·33 | A2 | 292 | 8·45 | A6 | 250 | 9·91 | F7 | 49 | 10·85 | | 368 | 11·73 | 514 | 12·60 |
| 265 | 6·46 | A0 | 143 | 8·51 | A2 | 472 | 9·91 | F3 | 508 | 10·87 | G | 336 | 11·81 | 52 | 12·62 |
| 204 | 6·70 | F0 | 340 | 8·56 | A4 | 31 | 9·92 | F8 | 288 | 10·90 | G0 | 304 | 11·84 | 474 | 12·64 |
| 284 | 6·76 | F0 | 318 | 8·60 | A3 | 268 | 9·92 | F9 | 196 | 10·92 | G | 476 | 11·86 | 313 | 12·65 |
| 328 | 7·08 | A5 | 350 | 8·67 | A5 | 454 | 9·96 | F8 | 392 | 10·92 | G5 | 309 | 11·89 | 448 | 12·66 |
| 283 | 7·10 | G5 | 124 | 8·76 | A8 | 293 | 9·97 | F8 | *555 | 10·99 | | 297 | 11·91 | 417 | 12·68 |
| 348 | 7·11 | A3 | 271 | 8·77 | A8 | 47 | 10·01 | F8 | 322 | 11·04 | G5 | 403 | 11·94 | *347 | 12·73 |
| 50 | 7·14 | A5 | 226 | 9·00 | F0 | *548 | 10·06 | G5 | 399 | 11·06 | G | 498 | 11·98 | 48 | 12·76 |
| 253 | 7·25 | K0 | 370 | 9·00 | A5 | 549 | 10·06 | F2 | 541 | 11·07 | G0 | 32 | 11·99 | *545 | 12·76 |
| 212 | 7·26 | K0 | 538 | 9·14 | A0 | 282 | 10·06 | F7 | 127 | 11·10 | G2 | 184 | 12·04 | 544 | 12·77 |
| 224 | 7·34 | A0 | 218 | 9·19 | F2 | 515 | 10·06 | G0 | 432 | 11·14 | G | 537 | 12·06 | 363 | 12·81 |
| 229 | 7·50 | A0 | 459 | 9·22 | F0 | 275 | 10·08 | G0 | 466 | 11·21 | G2 | 546 | 12·06 | *532 | 12·92 |
| 276 | 7·54 | A0 | 411 | 9·33 | A9 | 495 | 10·08 | G2 | 257 | 11·27 | G | 70 | 12·13 | 535 | 12·92 |
| 428 | 7·54 | K0 | 295 | 9·37 | A8 | 371 | 10·14 | F8 | 90 | 11·28 | | 213 | 12·16 | 256 | 12·96 |
| 150 | 7·65 | F0 | 16 | 9·38 | F8 | 421 | 10·29 | F9 | 335 | 11·28 | G5 | 533 | 12·18 | 172 | 12·97 |
| 279 | 7·72 | A0 | 232 | 9·38 | F2 | 222 | 10·30 | F8 | 554 | 11·29 | K | 542 | 12·18 | 141 | 13·00 |
| 286 | 7·81 | A0 | 146 | 9·45 | F2 | 238 | 10·36 | F9 | 334 | 11·31 | G3 | 263 | 12·30 | 183 | 13·16 |
| 207 | 7·85 | A3 | 142 | 9·46 | F8 | 258 | 10·39 | G0 | 301 | 11·35 | | *547 | 12·30 | 198 | 13·17 |
| 323 | 8·00 | A5 | 439 | 9·54 | F7 | 217 | 10·40 | F8 | 543 | 11·36 | | *530 | 12·32 | 209 | 13·22 |
| 385 | 8·01 | A3 | 155 | 9·55 | A7 | 244 | 10·42 | F8 | 540 | 11·40 | | 430 | 12·34 | 401 | 13·23 |
| 40 | 8·02 | A0 | 416 | 9·58 | F5 | 182 | 10·45 | F8 | 23 | 11·43 | | 460 | 12·40 | 272 | 13·31 |
| 203 | 8·02 | A3 | 227 | 9·60 | F5 | 557 | 10·46 | G3 | 58 | 11·43 | | 492 | 12·41 | 60 | 13·36 |
| 114 | 8·07 | A5 | 332 | 9·63 | F2 | 365 | 10·48 | G2 | 425 | 11·43 | | 471 | 12·43 | 390 | 13·38 |
| 445 | 8·10 | A3 | 34 | 9·65 | F6 | 341 | 10·49 | F8 | 30 | 11·46 | | *550 | 12·44 | 237 | 13·42 |
| 449 | 8·12 | A5 | 496 | 9·67 | F8 | 287 | 10·56 | F2 | 488 | 11·48 | | 236 | 12·44 | 415 | 13·58 |
| *534 | 8·22 | A2 | 536 | 9·68 | F5 | 418 | 10·59 | G4 | 164 | 11·53 | | 79 | 12·46 | 299 | 13·86 |
| 552 | 8·22 | A0 | 478 | 9·72 | F4 | 181 | 10·69 | G2 | 9 | 11·56 | | 353 | 12·46 | 267 | 13·90 |
| 45 | 8·23 | A2 | 239 | 9·76 | F5 | 100 | 10·71 | A0 | *539 | 11·58 | | 246 | 12·47 | * 93a | 14·00 |
| 375 | 8·24 | A3 | 458 | 9·80 | F7 | 208 | 10·80 | G6 | 326 | 11·63 | | 349 | 12·47 | | |
| 429 | 8·34 | F0 | 396 | 9·84 | F5 | 325 | 10·81 | G0 | 434 | 11·64 | | 344 | 12·48 | | |
| 154 | 8·36 | A0 | 553 | 9·87 | F6 | 162 | 10·82 | G2 | 27 | 11·66 | | 456 | 12·55 | | |
| 38 | 8·42 | A5 | 556 | 9·87 | G0 | 367 | 10·84 | G | 55 | 11·72 | | 551 | 12·59 | | |

* doubtful.

TABLE 6. TWENTY STARS, BELONGING TO THE CLUSTER, FAINTER THAN THE FOURTEENTH MAGNITUDE.

| Nr. | Phot. magn. | Nr. | Phot. magn. |
|---|---|---|---|
| 576 | 14·07 | 569 | 16·15 |
| 568 | 14·33 | 570 | 16·37 |
| 574 | 14·43 | 558 | 16·65 |
| 560 | 14·70 | 571 | 16·71 |
| 559 | 14·99 | 573 | 16·99 |
| 572 | 15·10 | 564 | 17·12 |
| 575 | 15·26 | 562 | 17·16 |
| 561 | 15·41 | 565 | 17·25 |
| 577 | 15·71 | 567 | 17·68 |
| 566 | 15·97 | 563 | 18·07 |

**7b. Cluster-stars $18 > m > 14$.** The proper motions of the stars fainter than the $14^{\text{th}}$ magnitude have been derived with a larger probable error. Moreover the measured area is one fifth of the maximum area of the other plates (table 1, plate XVII).

The proper motions are again plotted in a diagram for each magnitude separately. It is a little more difficult to distinguish the cluster-stars from the background-stars than in the case of section 7a but the presence of a group motion cannot well be doubted (figure 3). The 20 stars, lying within the dotted line of figure 3, are contained in table 6. The six cluster-stars in common with the other plates ($m = 13{\cdot}0$ to $14{\cdot}0$) have been found also on this plate.

The absolute proper motion of these faint Praesepe-stars, derived in section 9, is practically identical with that of the stars brighter than the magnitude 14.

**8. The Magnitude Error.** The accuracy of the proper motions, derived in this paper is high as far as the accidental errors are concerned. The probable error of the mean of the plates is $0''{\cdot}0015$ or less, up to the magnitude 12 or 13. It is therefore disappointing to find that a systematic error, of several times the value of this probable error, has vitiated the results. This error depends on the magnitude and will therefore be called magnitude error; this implies however no indication of its cause.

The value of this magnitude error can be determined by three different methods:

First method: the relative proper motions are compared with known meridian proper motions.

Second method: the differences are computed between the theoretical parallactic motion of the stars of determined magnitude and the mean relative proper motion of stars of the same magnitude.

Third method: the supposition is made that the mean proper motion of the cluster stars is independent of the magnitude.

The first method is useless in our case Absolute proper motions of non-group stars are unknown because they are too faint and the range in brightness of the group-stars with known meridian proper motion is too small for the derivation of the magnitude error.

The second method gives better results for the stars fainter than the tenth magnitude. Table 7 contains the quantities: $\Delta\mu_x$ and $\Delta\mu_y$ under the heading: background-stars.

$$\Delta\mu_x = \frac{h}{\varrho} \sin\lambda \sin\chi - \bar{\mu}_x$$

$$\Delta\mu_y = \frac{h}{\varrho} \sin\lambda \cos\chi - \bar{\mu}_y$$

$\bar{\mu}_x$ and $\bar{\mu}_y$ = mean relative proper motion of the background-stars of determined magnitude in the $x$ and $y$ direction respectively.

$\frac{h}{\varrho}$ = parallactic motion taken from table 26 of *Gron Publ.* **29.** [1])

$\lambda$ is the angular distance from the solar antapex

$\chi$ is the position angle of the direction towards the solar antapex.

TABLE 7. MAGNITUDE ERROR, DERIVED FROM CLUSTER-STARS AND BACKGROUND-STARS RESPECTIVELY.

| Plate-Group. | I, II | | | | | | VI | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group-stars | | | Background-stars | | | Group-stars | | | Background-stars | | |
| Phot. magn. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. |
| 6·0 — 7·0 | +0″·011 | +0″·006 | 4 | | | | —0″·034 | —0″·005 | 4 | | | |
| 7·0 — 8·0 | + ·007 | + ·008 | 14 | —0″·011 (6·0–10·0) | —0″·004 | 8 | — ·034 | — ·007 | 14 | —0″·041 (6·0–10·0) | —0″·022 | 9 |
| 8·0 — 9·0 | ·000 | + ·008 | 17 | | | | — ·034 | — ·012 | 19 | | | |
| 9·0 — 10·0 | ·000 | ·000 | 31 | | | | — ·034 | — ·014 | 30 | | | |
| 10·0 — 11·0 | + ·001 | — ·002 | 22 | — ·005 | — ·004 | 24 | — ·032 | — ·013 | 23 | — ·041 | — ·010 | 21 |
| 11·0 — 12·0 | ·000 | — ·004 | 27 | — ·003 | — ·004 | 60 | — ·032 | — ·014 | 10 | — ·049 | — ·020 | 13 |
| 12·0 — 13·0 | — ·001 | — ·006 | 25 | — ·004 | — ·004 | 100 | | | | | | |
| 13·0 — 14·0 | ·000 | — ·003 | 10 | — ·005 | — ·003 | 156 | | | | | | |

[1]) The parallactic motion used here, is changed very little by applying the correction $+0''\cdot006 \cos\delta$ to the $\mu_\delta$.

TABLE 7. (*Continued*).

| Plate-Group. | VIII | | | | | | X | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group-stars | | | Background-stars | | | Group-stars | | | Background-stars | | |
| Phot. magn. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. |
| 6·0 — 7·0 | + 0″·003 | + 0″·014 | 4 | | | | − 0″·002 | − 0″·010 | 4 | | | |
| 7·0 — 8·0 | + ·007 | + ·018 | 14 | − 0″·011 | − 0″·013 | 5 | + ·002 | − ·008 | 14 | − 0″·018 | − 0″·031 | 8 |
| 8·0 — 9·0 | + ·005 | + ·007 | 19 | | | | − ·002 | − ·012 | 19 | | | |
| 9·0 — 10·0 | ·000 | − ·008 | 30 | | | | − ·005 | − ·011 | 31 | | | |
| 10·0 — 11·0 | − ·001 | − ·008 | 24 | − ·004 | − ·002 | 20 | − ·002 | − ·009 | 23 | − ·004 | − ·005 | 24 |
| 11·0 — 12·0 | − ·002 | − ·003 | 25 | − ·001 | − ·007 | 52 | − ·004 | − ·005 | 27 | − ·006 | − ·005 | 57 |
| 12·0 — 13·0 | − ·003 | − ·007 | 18 | − ·007 | − ·003 | 55 | − ·003 | − ·008 | 16 | − ·006 | − ·005 | 59 |
| 13·0 — 14·0 | | | | | | | | | | | | |

TABLE 7. (*Continued*).

| Plate-Group. | XII, XIII, XIV | | | | | | XV, XVI | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group-stars | | | Background-stars | | | Group-stars | | | Background-stars | | |
| Phot. magn. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. |
| 6·0 — 7.0 | − 0″·018 | + 0″·021 | 4 | | | | − 0″·016 | + 0″·025 | 4 | | | |
| 7·0 — 8·0 | − ·023 | + ·024 | 13 | | | | − ·015 | + ·023 | 13 | | | |
| 8·0 — 9·0 | − ·017 | + ·022 | 14 | − 0″·018 | + 0″·009 | 12 | − ·014 | + ·012 | 14 | − 0″·010 | + 0″·005 | 11 |
| 9·0 — 10·0 | − ·011 | + ·012 | 21 | | | | − ·006 | + ·003 | 21 | | | |
| 10·0 — 11·0 | − ·006 | + ·004 | 16 | | | | − ·004 | − ·001 | 16 | | | |
| 11·0 — 12·0 | − ·004 | − ·002 | 15 | − ·004 | − ·004 | 30 | − ·005 | − ·003 | 16 | − ·004 | − ·005 | 28 |
| 12·0 — 13·0 | − ·003 | − ·004 | 14 | − ·004 | − ·005 | 42 | − ·002 | − ·006 | 13 | − ·003 | − ·001 | 43 |
| 13·0 — 14·0 | − ·002 | − ·006 | 10 | − ·003 | − ·008 | 64 | ·000 | − ·008 | 6 | − ·003 | − ·004 | 17 |

TABLE 7. (*Continued*).

| Plate-Group. | A | | | | | | All plates, VI excepted. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Group-stars | | | Background-stars | | | Group-stars | | Background-stars | |
| Phot. magn. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | Nr. | $\Delta\mu_x$ | $\Delta\mu_y$ | $\Delta\mu_x$ | $\Delta\mu_y$ |
| 6·0 — 7.0 | + 0″·036 | + 0″·007 | 4 | | | | − 0″·005 | + 0″·014 | | |
| 7·0 — 8·0 | + ·026 | + ·006 | 14 | + 0″·006 | − 0″·013 | 8 | − ·007 | + ·015 | − 0″·012 | − 0″·004 |
| 8·0 — 9·0 | + ·020 | + ·002 | 19 | | | | − ·007 | + ·010 | | |
| 9·0 — 10·0 | + ·011 | − ·002 | 29 | | | | − ·005 | + ·003 | | |
| 10·0 — 11·0 | + ·002 | − ·004 | 23 | + ·001 | − ·004 | 24 | − ·003 | − ·001 | − ·009 | − ·002 |
| 11·0 — 12·0 | ·000 | − ·006 | 27 | − ·002 | − ·007 | 59 | − ·002 | − ·003 | − ·004 | − ·004 |
| 12·0 — 13·0 | − ·004 | − ·005 | 25 | − ·007 | − ·003 | 107 | − ·002 | − ·006 | − ·004 | − ·003 |
| 13·0 — 14·0 | − ·009 | ·000 | 11 | − ·007 | − ·001 | 157 | − ·002 | − ·005 | − ·004 | − ·004 |

The result of the third method is given in table 7 under the heading: groupstars.

$$\Delta\mu_x = -\,0''\!\cdot\!034 - \bar{\mu}_x$$
$$\Delta\mu_y = -\,0''\!\cdot\!013 - \bar{\mu}_y.$$

$\bar{\mu}_x$ and $\bar{\mu}_y$ are the mean proper motion of the clusterstars in the $x$ and $y$ direction respectively. The adopted value of the group motion is $-\,0''\!\cdot\!034$ in the $x$ and $-\,0''\!\cdot\!013$ in the $y$ coordinate (section 9).

The agreement between the results of the second and third method is satisfactory except in the case of the stars brighter than the magnitude 10, the number of which is however very small. Some plates have a pretty large magnitude error both in $\mu_x$ and in $\mu_y$. The magnitude error in the $x$ coordinate practically disappears, if the mean of the different plates is taken. This is not the case in the $y$ coordinate; nearly all the plates have an error in the same direction; this is more clearly shown in table 8 containing the mean relative proper motion of the group stars. All the plates but Nr. X, indicate that the brighter stars move more rapidly to the south than the fainter ones.

TABLE 8. MEAN RELATIVE PROPER MOTION OF THE GROUP-STARS AS A FUNCTION OF THE MAGNITUDE.

| Plate / Phot. Magn. | I | | | II | | | VI | | | VIII | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{\mu}_x$ | $\bar{\mu}_y$ | Nr. | $\bar{\mu}_x$ | $\bar{\mu}_y$ | Nr. | $\bar{\mu}_x$ | $\bar{\mu}_y$ | Nr. | $\bar{\mu}_x$ | $\bar{\mu}_y$ | Nr. |
| 6 — 7 | — 0″·041 | — 0″·024 | 4 | — 0″·049 | — 0″·014 | 4 | 0″·000 | — 0″·008 | 4 | — 0″·036 | — 0″·027 | 4 |
| 7 — 8 | — ·039 | — ·023 | 14 | — ·043 | — ·020 | 14 | ·000 | — ·006 | 14 | — ·041 | — ·029 | 14 |
| 8 — 9 | — ·032 | — ·021 | 18 | — ·038 | — ·020 | 18 | ·000 | — ·001 | 19 | — ·038 | — ·020 | 19 |
| 9 — 9.5 | — ·028 | — ·014 | 12 | — ·038 | — ·013 | 12 | ·000 | + ·001 | 12 | — ·038 | — ·006 | 10 |
| 9.5 — 10 | — ·031 | — ·010 | 19 | — ·039 | — ·015 | 19 | ·000 | ·000 | 19 | — ·031 | — ·005 | 18 |
| 10 — 10·5 | — ·033 | — ·011 | 10 | — ·040 | — ·015 | 10 | — ·001 | ·000 | 10 | — ·032 | — ·005 | 9 |
| 10.5 — 11 | — ·032 | — ·008 | 12 | — ·037 | — ·010 | 12 | — ·002 | + ·001 | 12 | — ·033 | — ·005 | 12 |
| 11 — 11.5 | — ·032 | — ·008 | 17 | — ·037 | — ·010 | 17 | — ·000 | + ·002 | 11 | — ·033 | — ·009 | 15 |
| 11.5 — 12 | — ·035 | — ·009 | 10 | — ·032 | — ·007 | 10 | — | — | | — ·032 | — ·012 | 10 |
| 12 — 12.5 | — ·036 | — ·007 | 14 | — ·031 | — ·007 | 14 | — | — | | — ·029 | — ·005 | 17 |
| 12.5 — 13 | — ·035 | — ·008 | 11 | — ·031 | — ·006 | 11 | — | — | | — ·032 | — ·007 | 5 |
| 13 — 13.5 | — ·035 | — ·008 | 8 | — ·034 | — ·006 | 7 | — | — | | — | — | |
| > 13.5 | — ·033 | — ·008 | 2 | — ·034 | — ·018 | 3 | — | — | | — | — | |

TABLE 8. *(Continued).*

| Phot. Magn. \ Plate | X $\bar{\mu}_x$ | X $\bar{\mu}_y$ | X Nr. | XII $\bar{\mu}_x$ | XII $\bar{\mu}_y$ | XII Nr. | XIII $\bar{\mu}_x$ | XIII $\bar{\mu}_y$ | XIII Nr. | XIV $\bar{\mu}_x$ | XIV $\bar{\mu}_y$ | XIV Nr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 — 7 | — 0″·031 | — 0″·003 | 4 | — 0″·020 | — 0″·024 | 4 | — 0″·008 | — 0″·032 | 4 | — 0″·020 | — 0″·047 | 4 |
| 7 — 8 | — ·036 | — ·005 | 14 | — ·011 | — ·027 | 13 | — ·007 | — ·037 | 13 | — ·015 | — ·051 | 13 |
| 8 — 9 | — ·032 | — ·001 | 19 | — ·018 | — ·027 | 14 | — ·010 | — ·039 | 14 | — ·023 | — ·040 | 14 |
| 9 — 9.5 | — 028 | — ·001 | 12 | — ·024 | — ·021 | 7 | — ·019 | — ·035 | 6 | — ·024 | — ·031 | 6 |
| 9.5 — 10 | — ·031 | — ·003 | 18 | — ·025 | — ·018 | 14 | — ·022 | — ·028 | 14 | — ·024 | — ·025 | 14 |
| 10 — 10.5 | — ·033 | — ·006 | 10 | — ·026 | — ·018 | 7 | — ·027 | — ·026 | 7 | — ·027 | — ·020 | 7 |
| 10.5 — 11 | — ·031 | — ·003 | 13 | — ·029 | — ·011 | 9 | — ·031 | — ·017 | 9 | — ·028 | — ·013 | 9 |
| 11 — 11.5 | — ·030 | — ·007 | 17 | — ·031 | — ·008 | 11 | — ·032 | — ·015 | 11 | — ·030 | — ·013 | 11 |
| 11.5 — 12 | — ·030 | — ·009 | 10 | — ·030 | — ·012 | 4 | — 033 | — ·010 | 4 | — ·029 | — ·014 | 4 |
| 12 — 12.5 | — 030 | — ·005 | 11 | — ·029 | — ·008 | 7 | — ·031 | — ·013 | 7 | — ·031 | — ·010 | 8 |
| 12.5 — 13 | — ·033 | — ·006 | 5 | — ·032 | — ·009 | 5 | — ·034 | — ·009 | 5 | — ·035 | — ·005 | 6 |
| 13 — 13.5 | — | — | | — ·033 | — ·006 | 8 | — ·034 | — ·006 | 8 | — ·028 | — ·007 | 6 |
| > 13.5 | — | — | | — ·030 | — ·011 | 2 | — ·030 | — ·004 | 2 | — | — | |

TABLE 8. *(Continued).*

| Phot. Magn. \ Plate | XV $\bar{\mu}_x$ | XV $\bar{\mu}_y$ | XV Nr. | XVI $\bar{\mu}_x$ | XVI $\bar{\mu}_y$ | XVI Nr. | A $\bar{\mu}_x$ | A $\bar{\mu}_y$ | A Nr. | Mean of all plates $\bar{\mu}_x$ | Mean of all plates $\bar{\mu}_y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 — 7 | — 0″·020 | — 0″·062 | 4 | — 0″·017 | — 0″·012 | 4 | — 0″·071 | — 0″·020 | 4 | — 0″·029 | — 0″·027 |
| 7 — 8 | — ·021 | — ·055 | 13 | — ·018 | — ·017 | 13 | — ·060 | — ·019 | 14 | — ·027 | — ·028 |
| 8 — 9 | — ·023 | — ·036 | 14 | — ·019 | — ·015 | 13 | — ·055 | — ·016 | 19 | — ·027 | — ·023 |
| 9 — 9.5 | — ·027 | — ·021 | 6 | — ·023 | — ·013 | 6 | — ·049 | — ·011 | 11 | — ·028 | — ·018 |
| 9.5 — 10 | — ·029 | — ·020 | 14 | — ·029 | — ·013 | 14 | — ·042 | — ·012 | 18 | — ·030 | — ·014 |
| 10 — 10.5 | — ·031 | — ·016 | 7 | — ·027 | — ·016 | 7 | — ·037 | — ·009 | 10 | — ·031 | — ·015 |
| 10.5 — 11 | — ·031 | — ·009 | 9 | — ·031 | — ·007 | 9 | — ·034 | — ·008 | 13 | — ·032 | — ·009 |
| 11 — 11.5 | — ·031 | — ·010 | 10 | — ·029 | — ·011 | 11 | — ·034 | — ·008 | 17 | — ·032 | — ·010 |
| 11.5 — 12 | — ·032 | — ·009 | 4 | — ·029 | — ·010 | 4 | — ·034 | — ·006 | 10 | — ·031$^5$ | — ·010 |
| 12 — 12.5 | — ·034 | — ·007 | 6 | — ·031 | — ·008 | 6 | — ·032 | — ·008 | 14 | — ·032 | — ·008 |
| 12.5 — 13 | — ·034 | — ·005 | 6 | — ·034 | — ·006 | 5 | — ·028 | — ·008 | 11 | — ·033 | — ·007$^5$ |
| 13 — 13.5 | — ·030 | — ·005 | 5 | — ·038 | — ·006 | 5 | — ·024 | — ·011 | 8 | — ·032 | — ·006$^5$ |
| > 13.5 | — | — | | — | — | | — ·027 | — ·015 | 3 | — ·026 31 | — ·011 |

Is this actually the case? I think not, for the following reasons:

1°. The magnitude effect is very different for different plates. Take for instance the magnitude 6—7. The mean $\mu_y$ varies from — 0″·003 to — 0″·062, whereas according to Boss' proper motions we should expect something like

— 0″·020. Part of the magnitude effect at least must therefore be a real error.

2⁰. Suppose the bright stars have a $\mu_\delta$ differing as much from that of the fainter ones as shown in table 8. The result will be that the cluster cannot exist at all. The fainter stars would have been outdistanced by the brighter ones at a rate of something like 5° in $10^6$ years, the proper motion in declination of the bright and faint stars being — 0″·028 and — 0″·008 respectively. I find on the contrary in table 17, section 11, that the centre of the cluster is independent of the magnitude.

3⁰. There are several binaries belonging to the cluster, whose components differ considerably in magnitude. Now let us assume that the sum of the masses of the components ≦ 10 ⊙, the parallax of the cluster = 0″·007 and the mean distance of the components = $d''$; then the relative proper motion of the two components cannot exceed 0″·016 . $d^{-1/2}$. The mean distance $d$ of the binaries of table 9 is about 30″. Therefore, their mean relative motion must be smaller than 0″·003.

The relative proper motions actually found are much larger than 0″·003, and agree almost exactly with the difference between the proper motions of the bright and faint cluster stars of the same brightness. I have investigated this point for each plate separately; in all cases the agreement is very good. See table 9.

TABLE 9. THE MEAN RELATIVE PROPER MOTION OF THE COMPONENTS OF A FEW BINARIES, BELONGING TO THE CLUSTER, COMPARED WITH THE MEAN GROUP MOTION AS DERIVED FROM THE SAME PLATE.

| Plate. | Binaries. | $\overline{m}_{phot.}$ | Binaries $\overline{\mu}_x$ | Binaries $\overline{\mu}_y$ | Group motion, table 8 $\overline{\mu}_x$ | Group motion, table 8 $\overline{\mu}_y$ |
|---|---|---|---|---|---|---|
| | | | ″ | ″ | ″ | ″ |
| I | *a, b, c, d, e* | 7·9 | — 0·039 | — 0·023 | — 0·036 | — 0·022 |
| | | 11·8 | — ·032 | — ·008 | — ·035 | — ·009 |
| II | *a, b, c, d, e* | 7·9 | — ·040 | — ·021 | — ·041 | — ·020 |
| | | 11·8 | — ·032 | — ·006 | — ·032 | — ·007 |
| X | *a, b, c, d, e* | 7·9 | — ·035 | — ·002 | — ·034 | — ·003 |
| | | 11·8 | — ·035 | — ·004 | — ·030 | — ·009 |
| XII | *a, c, d, e* | 7·7 | — ·015 | — ·025 | — ·012 | — ·027 |
| | | 11·6 | — ·032 | — ·009 | — ·030 | — ·011 |
| XIII | *a, c, d, e* | 7·7 | — ·004 | — ·044 | — ·008 | — ·037 |
| | | 11·6 | — ·028 | — ·015 | — ·033 | — ·012 |
| XIV | *a, b, c, d* | 8·0 | — ·019 | — ·048 | — ·019 | — ·045 |
| | | 11·7 | — ·028 | — ·016 | — ·029 | — ·014 |
| XV | *a, b, c* | 8·4 | — ·022 | — ·039 | — ·023 | — ·038 |
| | | 12·0 | — ·034 | — ·007 | — ·033 | — ·008 |
| XVI | *c, d* | 8·0 | — ·016 | — ·016 | — ·019 | — ·016 |
| | | 11·0 | — ·031 | — ·008 | — ·030 | — ·009 |
| A | *a, b, c, d, e* | 7·9 | — ·056 | — ·009 | — ·058 | — ·017 |
| | | 11·8 | — ·037 | — ·009 | — ·034 | — ·007 |

$a$ = 429,430; $b$ = 344,350; $c$ = 323,325; $d$ = 287,283; $e$ = 212,213.

The objection may be raised, that the binary character of these stars is not very well established, as the distances between the stars in a cluster are always small. The distances of the binaries of table 9, however, are only one tenth or less of the mean distance between the cluster stars.

$4^0$. The results of the second and third method, tabulated in table 7, agree pretty well as far as they overlap. For the fainter magnitudes the magnitude errors found here, are not at all exceptionnally large. See for instance table IX of *Gron. Publ.* **19**. The brighter stars on our plates show the larger deviations, but usually the number of these stars is too small for the determination of the magnitude error according to the second method [1]).

$5^0$. It will be shown below that the proper motion in declination of the cluster according to Boss' catalogue [2]) is — 0″·011. The mean of the plates of this paper gives — 0″·032 for the brightest stars, the correction to absolute proper motion being derived in accordance with the second method (see above)[3]). The difference between these two values cannot be explained by accidental errors. A systematic error in the corrected [2]) Boss' system of this amount, seems very improbable. It must, therefore, be a systematic error in the photographic plates.

These circumstances indicate, that the cause of the magnitude error is not a cosmical one but that the phenomenon is due to the photographic plates. In order to test this conclusion, I have partly measured some more plates. They are given in table 2. Three pairs of plates are from the Allegheny, Dearborn and Yerkes observatories respectively. The other five pairs of plates are another set taken with the Radcliffe refractor.

On each plate about ten bright and some fifteen faint cluster stars were measured. The following table 10 gives the result.

TABLE 10. MEASURES OF BRIGHT PRAESEPE STARS RELATIVE TO FAINT ONES. MEAN PROPER MOTION IN DECLINATION.

| Plates. | Brighter stars. | Magn. | Fainter stars. | Magn. |
|---|---|---|---|---|
| 1 | — 0″·018 | 8·3 | 0″·000 | 12·9 |
| 2 | — ·021 | 8·3 | ·000 | 12·2 |
| 3 | — ·027 | 7·4 | ·000 | 11·0 |
| 4 | — ·022 | 7·6 | ·000 | 11·0 |
| 5 | — ·022 | 7·9 | ·000 | 11·6 |
| 6 | ·000 | 7·2 | ·000 | 12·2 |
| 7 | — ·008 | 7·2 | ·000 | 11·0 |
| 8 | — ·013 | 7·7 | ·000 | 11·0 |

1) Kreiken has measured plates, containing the Pleiades (*Bulletin of the Astronomical Institutes of the Netherlands* Vol. II, 55, 1924); he also finds pretty large magnitude corrections.

2) A correction of — 0″·007 has been applied to the catalogue values.

3) See also section 9.

Seven of the eight plates once more indicate, that the brighter stars move faster to the south than the fainter ones! The plates taken with the Allegheny and Yerkes telescopes (6 and 7), having a large focal length show a small relative shift. On the Radcliffe plates the discrepancy is largest and again in the same direction as on the regularly measured plates. The values of this relative shift are almost identical on these five plates but they are, perhaps, not independent of one another as four of the five early plates have been taken in the same night with a time interval of a few minutes.

The error cannot be due to the method of measurement or to the computing devices. Mr. EBELS, observer at the KAPTEYN Laboratory has made revised measurements of some twenty bright stars, relative to the fainter ones. These revisions give exactly the same values as the original measurements. Moreover the measurements in the $x$ and $y$ direction have been performed in exactly the same way, and it is difficult to see why the $\bar{\mu}_y$ should be erroneous, whereas the $\bar{\mu}_x$ is free from magnitude error.

If a plate contains more than one image, the error is almost the same for each image.

The fainter cluster stars have a systematically later spectral type than the brighter ones (section 12). One might think therefore that it is due to atmospheric dispension. Table 1 shows however that the hour angles of the new and early epoch are almost the same in most cases. Moreover on this supposition the four bright giants of the type G — K should give the same values of the proper motions as the faint stars of this type. This is not the case. Their proper motion is equal to that of the A stars of the same brightness (table 11).

TABLE 11. RELATIVE, UNCORRECTED PROPER MOTIONS OF THE FOUR GIANT CLUSTER STARS OF TYPE G AND K, COMPARED WITH OTHER BRIGHT AND FAINT CLUSTERSTARS. MEAN OF ALL PLATES.

| Nr. | Phot. magn. | $\mu_x$ giant groupstars | $\mu_y$ giant groupstars | Phot. magn. | $\mu_x$ all groupstars; table 8 | $\mu_y$ all groupstars; table 8 |
|---|---|---|---|---|---|---|
| 212 | 7·3 | — 0″·027 | — 0″·026 | 7·3 (A) | — 0″·027 | — 0″·028 |
| 253 | 7·2 | — ·028 | — ·036 | 12· (G and K) | — ·032 | — ·009 |
| 283 | 7·1 | — ·030 | — ·034 | | | |
| 428 | 7·5 | — ·030 | — ·034 | | | |
| mean | 7·3 | — ·029 | — ·032 | | | |

It must be concluded that the error is due to the plates, but I have no explanation to offer of its real cause, unless it should be a guiding error, which seems highly improbable [1]).

The error might, perhaps, be due to either the early plates or the new plates exclusively. I have investigated this point in the case of the plates XIV, XV, 1, 3 and 4. For this purpose the distances in the $y$ direction of a few binaries have been measured, on the plates of the new and of the early epoch separately. The same binaries were measured on both plates of the pair X, which, according to table 8, yielded proper motions practically free from magnitude equation. I assumed therefore that the distances, derived from the latter pair of plates, were correct. The differences between these two measurements (fourth column of table 12) will be due to observational errors for the most part.

The result has been tabulated in the following table 12; the upper number for each binary in the first column represents the northern component. The last five columns contain the corrections to be applied to the measurements of the plates XV, XIV, 1, 3 and 4; the sign being positive, if the declination of the brighter component is too large.

TABLE 12. MEASUREMENTS OF THE DISTANCES IN THE $y$ DIRECTION OF 5 BINARIES. DIFFERENCES BETWEEN THE MEASUREMENTS OF DIFFERENT PLATES.

| Pair of Plates. | | | | X—XV | X—XIV | X—1 | X—3 | X—4 |
|---|---|---|---|---|---|---|---|---|
| Binary | Phot. magn. | Early plate and new plate | Distance in $y$ on X | | | | | |
| | | | ″ | ″ | ″ | ″ | ″ | ″ |
| 283 | 7·10 | E | 11·75 | +0·69 | +0·11 | +0·14 | −0·12 | +0·12 |
| 287 | 10·56 | N | 11·99 | −0·40 | −0·31 | +0·02 | −0·15 | −0·30 |
| 212 | 7·26 | E | 35·44 | +1·09 | +0·56 | +0·47 | +0·65 | +0·49 |
| 213 | 12·16 | N | 35·48 | +0·08 | −0·18 | +0·34 | +0·01 | +0·14 |
| 150 | 7·65 | E | 5·95 | +0·35 | +0·33 | +0·35 | +0·38 | +0·10 |
| 155 | 9·55 | N | 6·22 | −0·32 | +0·11 | +0·11 | +0·29 | +0·21 |
| 325 | 10·81 | E | 16·12 | +0·32 | +0·34 | +0·32 | +0·34 | — |
| 323 | 8·00 | N | 16·12 | −0·63 | −0·33 | +0·07 | −0·30 | — |
| 350 | 8·67 | E | 0·98 | +0·24 | +0·15 | +0·11 | +0·23 | −0·02 |
| 344 | 12·48 | N | 0·83 | −0·36 | −0·67 | −0·69 | −0·28 | −0·11 |
| Mean magn. bright: 7·7 | | | mean | +0·54 | +0·30 | +0·28 | +0·30 | +0·17 |
| faint: 11·1 | | | | −0·33 | −0·28 | −0·11 | −0·09 | −0·02 |
| | | | Diff. | +0·87 | +0·58 | +0·39 | +0·39 | +0·19 |
| Diff. between $\mu''_\delta$ (table 8 and 10) $m = 7·7$ and 11·1, multiplied by $\Delta$ Epoch. | | | | +0·79 | +0·50 | +0·30 | +0·38 | +0·44 |

1) In a recent letter to Prof. VAN RHIJN, Prof. KNOX-SHAW states that he has traced the cause of the error of the Radcliffe plates to the object-glass of the refractor. As however experiments are still going on, the definite result will be published later by the Radcliffe astronomer.

It will be seen from these figures, that the cause of the magnitude error of the proper motions cannot be ascribed either to the early plates, or to the new plates exclusively, although the latter plates need a smaller correction.

A value of the magnitude error of the annual proper motions can be derived from table 12, by dividing the difference between the corrections of the early and new plate by the epoch difference. This value is in good agreement with the magnitude error as derived above, as may be seen from the last two lines of the table. Thus the reality of this error is confirmed once more, but no more light is thrown on its cause.

I have applied corrections to the proper motions, which make the proper motions of the cluster stars independent of the magnitude. The corrected proper motions are printed in the catalogue. These corrections are the $\Delta\mu_x$ and $\Delta\mu_y$ of table 7 under the heading: group-stars. They have been read from a smooth curve for each star separately.

Even if it were not true that the bright and faint cluster stars have exactly the same proper motion, this procedure would have to be followed. It is quite impossible, with the data of this paper, to distinguish between a magnitude error and a real dependence on the brightness.

The proper motions of the stars fainter than the 14th magnitude have been derived from plate XVII. The number of group stars of each magnitude is very small. The magnitude error has therefore been derived according to the second method described on page 14. Table 13 contains the result.

TABLE 13. DIFFERENCE BETWEEN PARALLACTIC MOTION AND MEAN PROPER MOTION OF THE STARS OF PLATE XVII.

| Phot. magn. | $\bar{\mu}_x$ | $\bar{\mu}_y$ | $\left(\frac{h}{\varrho}\right)_x - \bar{\mu}_x$ | $\left(\frac{h}{\varrho}\right)_y - \bar{\mu}_y$ | Nr. |
|---|---|---|---|---|---|
| | ″ | ″ | ″ | ″ | |
| 13 — 14 | +0.012 | +0.010 | −0.014 | −0.013 | 47 |
| 14 — 15 | + .009 | + .003 | − .011 | − .005 | 63 |
| 15 — 16 | + .003 | − .005 | − .004 | + .003 | 99 |
| 16 — 17 | + .001 | − .002 | − .002 | .000 | 143 |
| 17 — 18 | − .002 | − 003 | + .001 | + .002 | 78 |

If these corrections are applied to the cluster stars, they yield proper motions which are practically independent of the magnitude (table 14).

TABLE 14. MEAN ABSOLUTE PROPER MOTIONS OF CLUSTER STARS, DERIVED FROM PLATE XVII.

| Phot. magn. | Numb. | $\bar{\mu}_x$ | $\bar{\mu}_y$ |
|---|---|---|---|
| 13·0 — 14·0 | 6 | — 0″034 | — 0″005 |
| 14·0 — 15·0 | 5 | — ·041 | — ·012 |
| 15·0 — 16·0 | 5 | — ·038 | — ·009 |
| 16·0 — 17·0 | 5 | — ·052 | — ·009 |
| 17·0 — 18·0 | 4 | — ·042 | — ·014 |
| mean | | — ·041 | — ·010 |

**9a. Reduction to absolute proper motions, m ∠ 14. Proper motion of the Cluster.**

The proper motions derived from photographic plates are relative to the faint stars of small motion. A correction must therefore be applied to reduce them to absolute proper motions. If the proper motions are absolute ones, the background stars ought to move towards the solar antapex, except for the peculiar motions. The correction is therefore equal to the parallactic motion minus the mean relative proper motion[1]). This quantity has already been computed for each magnitude separately in table 7, section 8, under the heading: $\Delta\mu_x$ and $\Delta\mu_y$, background stars.

The absolute proper motion of Praesepe can be found from the members of the cluster, which have the same magnitude as the reduction stars, by applying the correction which holds for the magnitude of the latter stars. Table 15 contains the result for different plates.

TABLE 15. ABSOLUTE PROPER MOTION OF THE PRAESEPE CLUSTER AS DERIVED FROM DIFFERENT PLATES.

| Plates. | Mean magn. of reduction stars. | Relative prop. mot. groupstars | | From table 7 background-stars | | Absolute prop. mot. | |
|---|---|---|---|---|---|---|---|
| | | $\mu_x$ | $\mu_y$ | $\Delta\mu_x$ | $\Delta\mu_y$ | $\mu_x$ | $\mu_y$ |
| I, II | 12.5 | — 0″033 | — 0″008 | — 0″004$^5$ | — 0″004 | — 0″038 | — 0″012 |
| X | 11.7 | — 031 | — ·005$^5$ | — ·005$^5$ | — ·005$^5$ | — ·037 | — ·011 |
| XII, XIII, XIV | 12.4 | — ·030$^5$ | — ·009$^5$ | — ·004 | — ·006 | — ·034 | — ·016 |
| XV, XVI | 12.1 | — ·031 | — ·008 | — ·004 | — ·004 | — ·035 | — ·012 |
| (3) mean | | | | | | — ·036 | — ·013 |

1) *C. f. Groningen Publications*, **28**, 12—15, 1918.

The correction to absolute proper motions can be determined also by means of known absolute proper motions of Praesepe stars.

HECKMANN [1]) has determined the group motion from 9 Boss' stars and 6 unpublished stars investigated by KÜSTNER. He finds for the proper motion of the cluster, reduced to Boss' system: $\mu_\alpha \cos \delta = -0''{\cdot}031$, $\mu_\delta = -0''{\cdot}020$. The Boss' proper motions in declination however need a correction. KAPTEYN [2]) estimated this correction to be $+0''{\cdot}013 \cos \delta$. Other investigators [3]) find a value which is half this amount. Recently RAYMOND [4]) has derived corrections to the Boss' system by means of 34 catalogues not used by Boss. At the declination $+20°$ the correction to the $\mu_\delta$ is $+0''{\cdot}004$.

After having applied RAYMOND's corrections, VAN RHIJN has determined a residual correction of the form $G \cos \delta$, using the method described in B. A. N. 36. The preliminary result, not yet published, is $G = +0''{\cdot}0033$.

I have therefore applied a correction of $+0''{\cdot}007$ to the Boss' proper motions in declination and find the following result:

| | | | |
|---|---|---|---|
| Boss | (8 stars) | $\overline{\mu_\alpha \cos \delta} = -0''{\cdot}032$ | $\overline{\mu_\delta} = -0''{\cdot}011 \pm {\cdot}001^5$ |
| KÜSTNER | (6 stars) | $\overline{\mu_\alpha \cos \delta} = -\ {\cdot}033$ | $\overline{\mu_\delta} = -\ {\cdot}019 \pm {\cdot}002^5$ |
| mean | | $-\ {\cdot}032^5$ | $-\ {\cdot}013.$ (4) |

The agreement between the values (3) and (4) is good; their mean is

$$\mu_\alpha \cos \delta = -0''{\cdot}034 \qquad \mu_\delta = -0''{\cdot}013. \tag{5}$$

The reduction to absolute proper motion and the corrections for magnitude error have been applied simultaneously, so as to make the mean group motion of stars of each magnitude identical with the value (5).

**9b. Reduction to absolute proper motions, m > 14.**

Table 13 contains the corrections to absolute proper motions in the case of the stars of plate XVII. This correction is equal to the difference between the parallactic motion and the mean relative proper motion.

The corrected group motion of these fainter cluster stars becomes $-0''{\cdot}041$, $-0''{\cdot}010$ (table 14). A glance at figure 3 at the end of this paper shows, that this value has a relatively large probable error. The agreement with the value (5) is therefore quite satisfactory.

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1) *Astronomische Nachrichten* **225**, 49, 1925.
2) *Bull. Astron. Instit. Netherlands I*, 69, 1922.
3) VAN RHIJN and VAN DE KAMP, *Bull. Astron. Instit. Netherlands I*, 209, 1923.
ALDEN and VAN DE KAMP, *Astronomical Journal* XXXVI, 17, 1924.
OORT and MARSH, *Popular Astronomy* **32**, 559, 1924.
4) *Astronomical Journal* XXXVI, 129, 1926.

4

**10. Final Values of the Proper Motions and their Probable Errors.**

The proper motions as derived from different plates have been compared with one another, the corrections of sections 8 and 9 having been applied.

The probable error of one plate $\varrho$ is computed according to the formula

(6) $$\left(0{\cdot}845\,\frac{\text{sum differences}}{\text{number}}\right)^2 = \varrho_1^2 + \varrho_2^2.$$

I have compared plates for which the probable errors, according to the formula (6), are equal: $\varrho_1 = \varrho_2$.

The result is summarised in table 16. The second column contains the probable error computed according to the formula:

(7) $$\varrho = \frac{r}{\Delta T \sqrt{n}}$$

$\Delta T$ = epoch difference

$n$ = number of images of each star.

$r$ = prob. error of one distance of two single images.

I have adopted:

$r = 0''.18$ if 1 mm. $\sim 90''$

$= 0''.14$ ,, ,, ,, $\sim 60''$

$= 0''.11$ ,, ,, ,, $\sim 30''$.

TABLE 16. LIST OF PROBABLE ERRORS.

| Plate. | $\varrho$ (form. (7)) | Assumed weight. | Plates. | $\varrho$ (form. (6)) |
|---|---|---|---|---|
| I | 0''·0048 | 5½ | I, II | 0''·0033 |
| II | ·0048 | 5½ | I, II, X | ·0035 |
| VI | ·0034 | 6 | I, II, A | ·0047 |
| VIII | ·0068 | 2 | XII, XIII, XIV | ·0035 |
| X | ·0044 | 5 | XV, XVI | ·0034 |
| XII | ·0052 | 3²/₈ | | |
| XIII | ·0052 | 3²/₈ | | |
| XIV | ·0052 | 3²/₈ | | |
| XV | ·0034 | 7 | | |
| XVI | ·0034 | 7 | | |
| XVII | ·0060 | 3 | | |
| A | ·0064 | 2 | | |

It appears from the table that the probable errors computed according to the formula (6) are, in general, smaller than those of formula (7). It does not follow from this that the accuracy of measurement is higher than usual. The explanation is that all systematic differences depending on the magnitude, have been eliminated and that similar plates had practically the same reduction stars.

The weights in the third column of table 16 have been assumed nearly in accordance with the probable errors (7). The unit of weight corresponds with a probable error of 0″.010. The sum of the weights is given in the catalogue for each star. These weights refer of course to the accidental errors only. The mean weights are about 50—40 for magnitudes 6 to 11 and 40—20 for magn. 11 to 13.5.

It appears from a consideration of the cluster stars that the weights assumed are not too large. The cluster stars should all have exactly the same proper motion but for the accidental errors and the internal motion The latter probably is not negligible. The Hyades, for instance, the distance of which is about one fourth of that of Praesepe, have a mean internal motion of 0″.006 [1]).

The arithmetical mean of the differences $(\bar{\mu}_x - \mu_x)$ and $(\bar{\mu}_y - \mu_y)$ for the Praesepe stars is 0″.0021, whereas the average accidental error, according to the above is:

$$\frac{0''.010}{0.845 \sqrt{\text{mean weight}}} = 0''.0019.$$

These two values are practically identical. The cluster stars therefore even point to somewhat smaller accidental errors than those adopted in table 16. An independent value of the internal motion of the cluster stars cannot be found from the present material, the accidental errors being too large.

1) VAN RHIJN and KLEIN WASSINK, *Groningen Publications* **35**, 1924.

# CHAPTER II.

**11. The figure of the cluster, as projected on the sphere.** The centre of the cluster is independent of the magnitude. This appears from table 17, where the mean has been taken of the right-ascension and declination of the stars of table 5 and 6.

TABLE 17. MEAN POSITION OF THE GROUPSTARS.

| Phot. magn. | $\overline{\alpha_{1900}}$ | $\overline{\delta_{1900}}$ | Numb. |
|---|---|---|---|
| | $8^h$ | + | |
| 6·0 — 8·0 | $34^m$ $23^s$ | 19° 59′·3 | 18 |
| 8·0 — 10·0 | 34 38 | 20 2·1 | 52 |
| 10·0 — 12·0 | 34 24 | 19 59·7 | 64 |
| 12·0 — 14·0 | 34 47 | 19 58·7 | 55 |
| 14·0 — 16·0 | (34 20) | (20 14·6) | 10 |
| 16·0 — 18·0 | (33 52) | (20 13·6) | 10 |

The centre of the brighter stars ($m = 6$ to 14) lies very near the adopted
(8) centre $\alpha_{1900} = 8^h\,34^m\,39^s$, $\delta_{1900} = +\,20°1'·0$. The mean position of the fainter stars does not coincide with this centre. As these stars occur, however, only on plate XVII, this being a very small plate, they do not give the centre of the cluster at all, but they actually give the centre of this plate: $\alpha = 8^h\,34^m\,19^s$, $\delta = +\,20°15'·5$ (table 1). It seems safe to assume the same centre (8) for all magnitudes.

The figure of the cluster, as projected on the sphere, can be easily derived from the groupstars of table 5. The data of the following table were obtained by counting the stars in 12 sectors, each 30° wide; $\psi$ denotes the position angle with respect to the centre (8). Stars whose distance from the centre exceeds 60′ are not included in the counts.

TABLE 18. NUMBER OF GROUPSTARS IN DIFFERENT DIRECTIONS FROM THE CENTRE.

| Phot. Man. / ψ | 6·0 — 9·0 | 9·0 — 11·0 | 11·0 — 13·0 | Phot. Magn. / ψ | 6·0 — 9·0 | 9·0 — 11·0 | 11·0 — 13·0 |
|---|---|---|---|---|---|---|---|
| 0° — 30° | 3 | 3 | 5 | 180° — 210° | 3 | 7 | 2 |
| 30 — 60 | 4 | 6 | 10 | 210 — 240 | 4 | 3 | 7 |
| 60 — 90 | 0 | 4 | 4 | 240 — 270 | 3 | 5 | 4 |
| 90 — 120 | 0 | 4 | 5 | 270 — 300 | 3 | 2 | 5 |
| 120 — 150 | 3 | 4 | 9 | 300 — 330 | 4 | 4 | 6 |
| 150 — 180 | 4 | 6 | 4 | 330 — 360 | 6 | 9 | 2 |

The numbers of magnitudes 6·0 — 9·0 and 9·0 — 11·0 show two maxima at $\psi = 180°$ and $345°$ approximately and two minima at $\psi = 90°$ and $285°$. The figures in the fourth column of the table do not show these maxima and minima. This is due to the figure of the brighter part of the cluster being elongated in the directions $\psi = 180°$ and $345°$ and shortened in the other two directions. The general aspect resembles an ellipse with maior axis in the direction $\psi = 172°$, which is nearly parallel to the plane of the Milky Way: $\psi = 162°$. The same phenomenon has been observed in other clusters [1]). The fainter stars of the cluster seem to be distributed more equally in all directions.

The diameter of the group cannot be found directly from the data of tables 5 and 6, because the cluster extends beyond the limits of this paper. The counted numbers, however, may be extrapolated without introducing too much uncertainty.

In the first place it is necessary to investigate the limit of completeness of the observed stars. For this purpose I have compared the numbers of non-group stars with the numbers of SEARES and VAN RHIJN [2]) (table 19).

The Durchmusterung contains stars of the magnitude 14·1; the limit of completeness therefore is $\angle$ 14·1. In the case of plate XVII it is $\angle$ 18·7. It appears from the last column of table 19, that the plates are complete down to the magnitude 13·0, but that the logarithm of the numbers between 13·0 and 14·0 requires a correction of + 0·18. The last column shows that plate XVII is probably complete down to the magnitude 18·0.

The logarithm 0·18 corresponds with a factor 1·5. Actually I have multiplied the counted numbers of magnitude 13·0 to 14·0 by 1·3 for distances from the centre less than 30′ and by 2·0 for the distances 30′ to 56′.

The counts of the groupstars have been inserted in table 20. This table contains also the logarithm of the star-density, *i. e.* the number of stars per square minute.

1) RASMUSON, *Meddelanden Lund* II, 26, 1921.

2) *Proceedings Nat. Ac. Sciences Vol.* 11, 358, 1925.

TABLE 19. LOG. NUMBERS OF NON-GROUP STARS PER SQUARE DEGREE, COMPARED WITH THE CORRESPONDING NUMBERS OF SEARES AND VAN RHIJN.

| Phot. magn. | Log. numb. backgroundstars all plates | plate XVII | Log. numb. S. and V. R. | Difference. | |
|---|---|---|---|---|---|
| 10·0 | | | | | |
| | 0·45 | | 0·30 | +0·15 | |
| 10·5 | | | | | |
| | 0·70 | | 0·50 | +0·20 | |
| 11·0 | | | | | |
| | 0·81 | | 0·69 | +0·12 | |
| 11·5 | | | | | |
| | 1·13 | | 0·88 | +0·25 | |
| 12·0 | | | | | |
| | 1·29 | | 1·06 | +0·23 | |
| 12·5 | | | | | |
| | 1·41 | | 1·24 | +0·17 | |
| 13·0 | | | | | |
| | 1·50 } | | 1·41 | +0·09 } | |
| 13·5 | | 1·97 | | | +0·17 |
| | 1·48 } | | 1·58 | −0·10 } | |
| 14·0 | | | | | |
| | | 2·23 | 2·12 | | +0·11 |
| 15·0 | | | | | |
| | | 2·23 | 2·41 | | −0·18 |
| 16·0 | | | | | |
| | | 2·46 | 2·66 | | −0·20 |
| 17·0 | | | | | |
| | | 2·73 | 2·89 | | −0·16 |
| 18·0 | | | | | |

TABLE 20. NUMBER OF CLUSTER-STARS AND LOGARITHM OF STAR-DENSITY, ACCORDING TO PHOTOGRAPHIC MAGNITUDE AND DISTANCE FROM THE CENTRE.

| Distance \ Phot. Magn. | 6·0 — 9·0 | | 9·0 — 11·0 | | 11·0 — 13·0 | | 13·0 — 14·0 | |
|---|---|---|---|---|---|---|---|---|
| 0′ — 12′ | 11 | 8·39 | 8 | 8·25 | 10 | 8·34 | 4 | 7·94 |
| 12 — 24 | 9 | 7·82 | 15 | 8·04 | 11 | 7·91 | 5 | 7·57 |
| 24 — 36 | 10 | 7·64 | 14 | 7·79 | 10 | 7·64 | 4·5 | 7·30 |
| 36 — 48 | 6 | 7·28 | 11 | 7·54 | 17 | 7·73 | 4 | 7·10 |
| 48 — 60 | 1 | 6·36 | 9·1 | 7·34 | 14·3 | 7·54 | 3 | 6·87 |
| 60 — 72 | 1·6 | 6·50 | 6·9 | 7·15 | 7·6 | 7·18 | — | — |

The figures of the distances 48′ to 60′ and 60′ to 72′ need some more explanation. These distances partly fall outside the limits of the plates. The counted numbers have therefore been multiplied by the factors 1·03, 1·19 and 1·74 in the case of the distances 54′ to 60′, 60′ to 66′ and 66′ to 72′ respectively.

For the purpose of extrapolating the numbers of table 20, I assumed $1^0$ that the number of stars in each ring from the distance 12′ on outwards, falls off proportionately to the distance; $2^0$ that the logarithm of the surface-density is a linear function of the distance.

TABLE 21. NUMBER OF CLUSTERSTARS, ACCORDING TO PHOTOGRAPHIC MAGNITUDE AND DISTANCE FROM THE CENTRE. EXTRAPOLATED NUMBERS ARE IN ITALICS.

| Phot. magn. / Distance. | 6·0—7·0 | 7·0—8·0 | 8·0—9·0 | 9·0—10·0 | 10·0—11·0 | 11·0—12·0 | 12·0—13·0 | 13·0—14·0 | 13·0—14·0 | 14·0—15·0 | 15·0—16·0 | 16·0—17·0 | 17·0—18·0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′— 12′ | 2 | 9 | 0 | 4 | 4 | 4 | 6 | 4 | 3·2 | 2·6 | 2·2 | 3·1 | 4·4 |
| 12 — 24 | 2 | 3 | 4 | 7 | 8 | 6 | 5 | 5 | 5·8 | 4·6 | 3·9 | 5·5 | 7·8 |
| 24 — 36 | 0 | 1 | 9 | 9 | 5 | 7 | 3 | 4·5 | 5·8 | 4·6 | 3·9 | 5·5 | 7·8 |
| 36 — 48 | 0 | 1 | 5 | 3 | 8 | 8 | 9 | 4 | 5·0 | 4·0 | 3·4 | 4·8 | 6·7 |
| 48 — 60 | 0 | 0 | 1 | 4·8 | 4·3 | 6·5 | 7·8 | 3 | 3·9 | 3·1 | 2·6 | 3·7 | 5·2 |
| 60 — 72 | 0 | 0 | 1.6 | 4·7 | 2·2 | 2·5 | 5·1 | 2·3 | 3·0 | 2·3 | 2·0 | 2·8 | 4·0 |
| 72 — 84 | 0 | 0 | 0·2 | 2·6 | 2·5 | 3·1 | 3·2 | 1·8 | 2·1 | 1·7 | 1·4 | 2·0 | 2·8 |
| 84 — 96 | 0 | 0 | 0 | 1·7 | 1·6 | 2·3 | 2·3 | 1·3 | 1·4 | 1·2 | 1·0 | 1·4 | 1·9 |
| 96 —108 | 0 | 0 | 0 | 1·0 | 1·0 | 1·6 | 1·6 | 0·8 | 0·9 | 0·7 | 0·6 | 0·9 | 1·3 |
| 108 —120 | 0 | 0 | 0 | 0·5 | 0·5 | 1·0 | 1·0 | 0·4 | 0·6 | 0·4 | 0·4 | 0·5 | 0·8 |
| 120 —132 | 0 | 0 | 0 | 0·4 | 0·3 | 0·7 | 0·6 | 0·1 | 0·4 | 0·3 | 0·2 | 0·3 | 0·5 |
| 132 —144 | 0 | 0 | 0 | 0·3 | 0·2 | 0·4 | 0·5 | 0·0 | 0·1 | 0·1 | 0·1 | 0·2 | 0·3 |
| 144 —156 | 0 | 0 | 0 | 0·2 | 0·1 | 0·3 | 0·3 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·1 |
| 156 —168 | 0 | 0 | 0 | 0·1 | 0·0 | 0·2 | 0·2 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 |
| Total number | 4·0 | 14·0 | 20·8 | 39·3 | 37·7 | 43·6 | 45·6 | 27·2 | 32·2 | 25·6 | 21·7 | 30·7 | 43·6 |
| Extrapolated number | 0·0 | 0·0 | 0·2 | 6·8 | 6·2 | 9·6 | 9·7 | 6·7 | 23·2 | 18·4 | 15·6 | 22·1 | 31·4 |

The numbers, computed according to these hypotheses, have been averaged with weights 1 and 2; the result for magnitudes 6 to 14 is contained in table 21. The extrapolated numbers are printed in italics.

The counted numbers of stars fainter than magnitude 14·0 (table 6) have been treated in the way shown in table 22. The third column of the table contains a factor to allow for the missing stars, that could not be measured on account of bad images etc. The fifth column contains the logarithm of the number of stars per square minute.

TABLE 22. FAINTER CLUSTER-STARS, DERIVED FROM PLATE XVII.

| Phot. Magn. | Counted number | factor | product | Log. Density |
|---|---|---|---|---|
| 13·0 — 14·0 | 6 | 1·19 | 7·1 | 7·59 |
| 14·0 — 15·0 | 5 | 1·08 | 5·4 | 7·48 |
| 15·0 — 16·0 | 5 | 1·00 | 5·0 | 7·43 |
| 16·0 — 17·0 | 5 | 1·20 | 6·0 | 7·52 |
| 17·0 — 18·0 | 4 | 2·38 | 9·6 | 7·72 |

The centre of the cluster lies near the edge of plate XVII. The numbers of clusterstars could be counted for distances up to 30′ as maximum. In order to extrapolate the numbers to larger distances, I assumed, that $\frac{d \text{ log. dens.}}{d \text{ dist.}}$ has the same value as for the brighter magnitudes. An inspection of table 20 shows that this differential quotient is — 0·018 $m = 9 - 11$

— 0·016 $m = 11 - 13$

— 0·020 $m = 13 - 14$.

mean — 0·018

With this number and the data of table 22, the numbers of table 21 for magnitudes 13·0 — 18·0 have been computed. The agreement between the numbers, derived from plate XVII, and the data of the other plates may be judged from the overlapping magnitude 13·0 to 14·0.

Table 21 shows at once the diameter of the cluster. The distance, where the number of stars in a ring, 12′ wide, becomes less than ½, is given in table 23.

The area covered by the very brightest stars, is far less than the area of the stars of magnitude 9 and fainter, partly because the former are fewer in number and partly because they are more strongly concentrated towards the centre of the group. The higher concentration of the brighter stars has been found also in other clusters[1]) (*e. g.* the Pleiades, *h* Persei, Messier 11 and 13, and others).

[1]) TRÜMPLER, *Lick Bulletin* **361**, 1925. *Publ. Allegheny Obs.*, Vol. **6**, 45, 1922.
SHAPLEY, *Mt. Wilson Contributions* **116**, 69, 1915.

The diameter of the Praesepe group seems to lie between 4° and 5°.

TABLE 23. DISTANCE WHERE THE NUMBER OF STARS IN A RING OF 12′ BECOMES LESS THAN 0·5.

| Phot. Magn. | Radius. | Phot. Magn. | Radius |
|---|---|---|---|
| 6·5 | 25′ | 12·5 | 125′ |
| 7·5 | 45 | 13·5 | 110 |
| 8·5 | 70 | 14·5 | (110) |
| 9·5 | 110 | 15·5 | (110) |
| 10·5 | 110 | 16·5 | (110) |
| 11·5 | 125 | 17·5 | (110) |

In the preceding section the numbers of groupstars of each magnitude have been derived, as completely as can be done at present. They are found in table 21. The following table 24 contains the logarithms of these numbers (third column). For the sake of comparison I have added in the fourth column the frequencies of the stars in the neighbourhood of the Sun, as derived by VAN RHIJN [1]). The assumed parallax of the cluster is 0″0073. The table is illustrated by figure 1. **12. Frequency of the Luminosities.**

TABLE 24. FREQUENCY OF THE LUMINOSITIES OF THE PRAESEPE-STARS. COMPARISON WITH FREQUENCY OF NEAR-SUN STARS (*Gron. Publ* **38**, table 71).

| Phot. Magn. | Abs. magn. $m + 5 \log 0{\cdot}0073$ | Logarithm number | | Difference 4th and 3d col. |
|---|---|---|---|---|
| | | Clusterstars. | Near-Sun stars per 15140 cubic parsecs. | |
| < 6·0 | | — ∞ | 9·66 | |
| 6·0 — 7·0 | — 4·1 | 0·60 | 0·34 | — 0·26 |
| 7·0 — 8·0 | — 3·3 | 1·15 | 0·71 | — 0·44 |
| 8·0 — 9·0 | — 2·3 | 1·32 | 1·02 | — 0·30 |
| 9·0 — 10·0 | — 1·2 | 1·59 | 1·27 | — 0·32 |
| 10·0 — 11·0 | — 0·2 | 1·58 | 1·49 | — 0·09 |
| 11·0 — 12·0 | + 0·8 | 1·64 | 1·73 | + 0·09 |
| 12·0 — 13·0 | + 1·8 | 1·66 | 1·73 | + 0·07 |
| 13·0 — 14·0 | + 2·8 | 1·44 | 1·60 | + 0·16 |
| 14·0 — 15·0 | + 3·8 | 1·41 | 1·57 | + 0·16 |
| 15·0 — 16·0 | + 4·8 | 1·34 | 1·68 | + 0·34 |
| 16·0 — 17·0 | + 5 8 | 1·49 | 1·78 | + 0·29 |
| 17·0 — 18·0 | + 6·8 | 1·64 | 1·88 | + 0·24 |

[1]) *Groningen Publications* **38**, 1926.

It appears that the number of bright stars is relatively larger in the Praesepe-cluster than in the galactic system generally. The general features of both curves are, for the rest, very similar In both cases there is a maximum at the absolute magnitude + 2 and a minimum two or three magnitudes after the maximum. The slopes for the brighter and the fainter ends are practically identical.

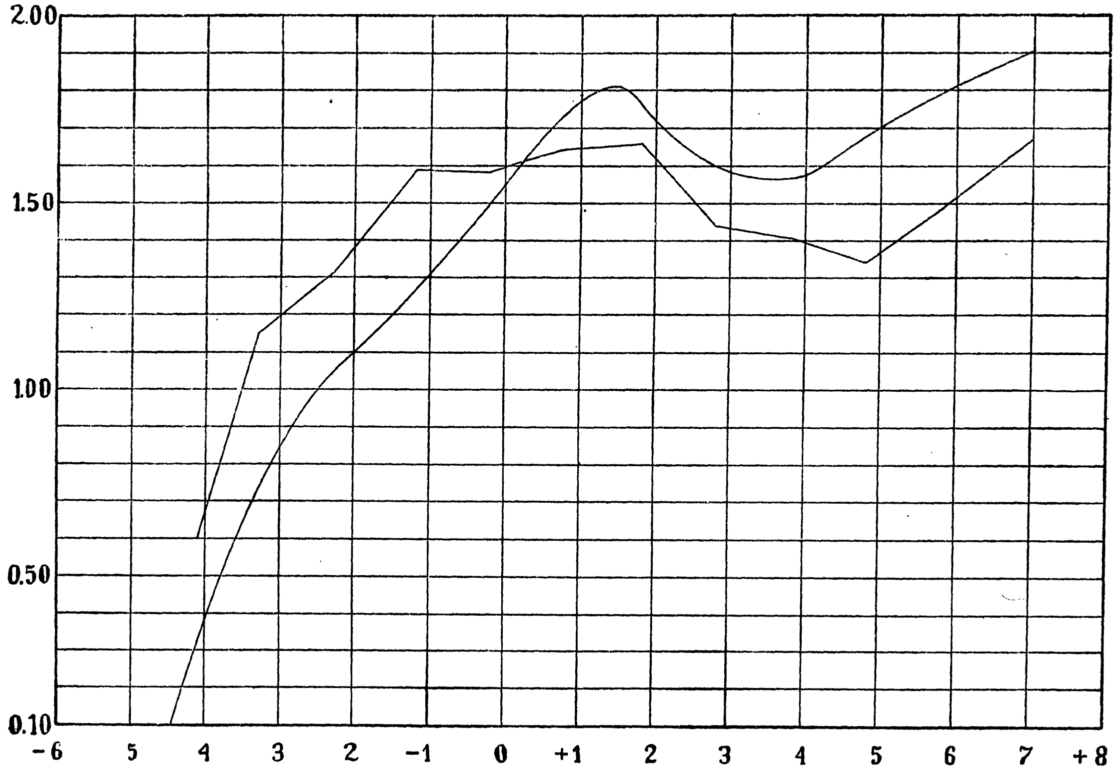


Figure 1. The abscissae are absolute photographic magnitudes; the ordinates represent the logarithms of the numbers of stars in the cluster and in the neighbourhood of the Sun; broken line = Praesepe stars, smooth curve = Near Sun stars per 15140 cubic parsecs.

It is true that the counted numbers, on which the frequencies of the faint Praesepe stars are based, are rather small and I think, that the agreement between the two curves is partly accidental; yet the general result will be near to the truth: the frequencies of the luminosities in the Praesepe-cluster do not differ very much from the frequencies of the stars in general.

The frequencies of the separate spectral types show clearly the well known form of Russel's diagram (see for instance: *Astron. Nachr.* **211**, 289, 1920; B. A. N. I, 79, 1922; *Astron. Journ.* **34**, 1, 1921).

Several giant stars exist of which four are of the type G—K. The dwarf stars change from the A class to the later types with decreasing brightness.

The available data are collected in table 25. The spectral types have been taken from the Henry Draper Catalogue up to $m = 8{\cdot}5$ and from unpublished data, kindly furnished by Prof. Dr. Schwaszmann from $m = 8{\cdot}5$ to $m = 11{\cdot}3$. The limit of completeness of the stars of table 25 is $M = +0{\cdot}6$.

Table 25. Number of Clusterstars and of Near-Sun stars, according to photographic magnitude and spectral type.

| Abs. Magn. $m + 5 \log 0{\cdot}0073$ | A type | | F type | | G type | | K type | |
|---|---|---|---|---|---|---|---|---|
| | Praesepe | Near-Sun | Praesepe | Near-Sun | Praesepe | Near-Sun | Praesepe | Near-Sun |
| $\leq -4{\cdot}4$ | 0 | 2·4 | 0 | 0·0 | 0 | 0·0 | 0 | 0·0 |
| $-4{\cdot}4 - -3{\cdot}4$ | 5 | 7·0 | 2 | 0·2 | 1 | 0·2 | 2 | 0·3 |
| $-3{\cdot}4 - -2{\cdot}4$ | 17 | 11·9 | 1 | 1·0 | 0 | 0·6 | 1 | 1·1 |
| $-2{\cdot}4 - -1{\cdot}4$ | 11 | 10·1 | 4 | 4·9 | 0 | 0·9 | 0 | 1·2 |
| $-1{\cdot}4 - -0{\cdot}4$ | 3 | 4·5 | 28 | 17·4 | 5 | 3·8 | 0 | 0·5 |
| $-0{\cdot}4 - +0{\cdot}6$ | 1 | — | 6 | 18·6 | 21 | 22·4 | 1 | 0·7 |

The number of near Sun stars has been derived from the frequencies given by Van Rhijn [1]), so as to make the total number of near-Sun stars equal to the number of cluster stars.

It will be seen that the agreement is not bad, except in the case of the F-stars.

The division into giants and dwarfs in clusters has been one of the grounds for assuming a similar division for the stars in general. Van Rhijn (l. c.) however has shown that the existence of the latter is not beyond doubt, for the missing stars, if they really exist, occur among objects of an apparent magnitude and proper motion, which have not yet been sufficiently investigated.

In the Praesepe cluster they certainly do not exist, but the frequency is perhaps not high enough to form a single star, as is indicated by the seventh and last column of table 25.

**13. On the Parallax of Praesepe.**

Schwarzschild and Hertzsprung [2]) have raised the hypothesis that the Hyades and the Praesepe cluster move together through space in the same direction with identical velocities. As the convergent and the radial velocity of the Hyades are known, the parallax of Praesepe can be computed by means of the proper motion. Schwarzschild finds $\pi = 0''{\cdot}0063$.

Kohlschütter [3]) assumes equal absolute magnitudes of stars of the same

1) loco citato, table 71.
2) *Astronomische Nachrichten* **196**, 9, 1913.
3) *Astronomische Nachrichten* **211**, 289, 1920.

spectral type in the two clusters and gets $\pi = 0''.0072$. VAN DEN BOS [1]) finds, by means of the same hypothesis for the giants $\pi = 0''.0078$. SITTERLY [2]) makes use of the magnitudes and spectral types of the HENRY DRAPER Catalogue and gets $\pi = 0''.0055$. HERTZSPRUNG [3]) applied the KAPTEYN correction to the proper motions in declination of Boss' catalogue; he computes a parallax $\pi = 0''.0060$ from the proper motion of Praesepe and the parallax, proper motion and convergent of the Hyades.

As however this correction of $+0''.013 \cos\delta$ is too large, I have computed
(16) the convergent etc. of the Hyades, assuming a correction of $+0''.007$ to Boss' proper motions in declination (see section 9). The result is:

| | | | |
|---|---|---|---|
| (9) | Centre of the Hyades | $\alpha = 65^\circ.5$ $\delta = +15^\circ.5$ | |
| (10) | Point of convergence (39 Boss' stars) | $\alpha = 92^\circ.0$ $\delta = +8^\circ.6$ | $\pm 1.8$ |
| (11) | Total proper motion in the centre | $\mu_2 = 0''.110$ | $\pm 0.0015$ |
| (12) | Position angle of the proper motion | $\psi_2 = 101^\circ.8$ | $\pm 3.8$ |
| (13) | Radial velocity (23 stars) | $R_2 = +39.0$ K.M. sec.$^{-1}$ | $\pm 0.5$ |
| (14) | Space-velocity from (10) and (13) | $V_2 = +43.7$ K.M. sec.$^{-1}$ | $\pm 0.7$ |
| (15) | Parallax from (4), (5), (6) and (9) | $\pi_2 = 0''.027$ | $\pm 0.0016$ |

The values (10) and (11) have been computed from the data given by Boss [4]) and the correction (16). The radial velocities have been taken from several authorities [5]). The formulae for the space-velocity and the parallax are:

(17) $$V = R \sec \lambda$$

(18) $$\pi = 4.74\, \mu\, (V \sin \lambda)^{-1}$$

$\lambda$ = angular distance from point of convergence.

If we assume, that the point of convergence and the space-velocity of the Praesepe-cluster are identical with those of the Hyades, the radial velocity of the former, according to formula (17), is found to be $\pm 34.8$ K.M. sec.$^{-1}$ $\pm 1.1$;
(19) the observed radial velocity is $+33.0$ K.M. sec.$^{-1}$ $\pm 0.6$ (24 stars [6])). The position
(20) angle of the proper motion should be $257^\circ.5 \pm 3$; the observed angle is $249^\circ \pm 2.5$.
(21) The centre of the cluster is $\alpha = 128^\circ.6$, $\delta = +20^\circ.1'$; the total proper
(22) motion is $\mu_1 = 0''.037 \pm 0.001_5$.

Applying formula (18) to the Hyades and to the Praesepe-group and eliminating the space velocity V, we get

(23) $$\pi_1 = \pi_2 \mu_1 \sin \lambda_2 \mu_2^{-1} \sin^{-1} \lambda_1 = 0''.0067 \pm 0.0007.$$

---

1) *Bull. Astron. Instit. Netherlands* I, 79, 1922.

2) *Astronomical Journal* XXXIV, 1, 1921.

3) *Bull. Astron. Instit. Netherlands* I, 150, 1922.

4) *Astronomical Journal* XXVI, 31, 1908.

5) The same as were used by VOÛTE in his catalogue of radial velocities and also from: *Mt. Wilson Contributions* **258** and *Publications of the Dominion Observatory* II, **1**.

6) Most of these radial velocities have been kindly furnished by Dr. W. ADAMS (see also: *Annual Report of the Director of the Mt. Wilson Observatory* 1923 page 200).

If V is eliminated between formulae (17) and (18), and the result is applied to the Praesepe-cluster, we get

$$\pi_1 = 4{\cdot}74\,\mu_1 \operatorname{cotg} \lambda_1 R_1^{-1} = 0''{\cdot}0070 \pm 0{\cdot}0006. \quad (24)$$

The values (23) and (24), which are not independent of one another, rest on the assumption of identity of space velocity only. This cosmical relation between the two clusters suggests the farther-reaching hypothesis of identical absolute magnitudes. The giant stars in both clusters differ $2^{m}{\cdot}69$ in brightness[1]; it follows that $\pi_1 = 0''{\cdot}0079$. The dwarf stars of A and F type differ $3^{m}{\cdot}19$ in apparent brightness[1]). The parallax becomes $\pi_1 = 0''{\cdot}0063$. (25) (26)

I have finally compared the maxima of the frequencies of each spectral class with the maxima of the corresponding frequencies of the stars near the Sun (c. f. table 25 page 35). The values of $M - m$ for the types G and K giants, F dwarfs and A stars are $-10{\cdot}3$, $-10{\cdot}0$ and $-11{\cdot}0$ respectively. The mean $-10{\cdot}4$ gives a parallax $\pi_1 = -0''{\cdot}0083$. (27)

The mean of the values (23), (24), (25), (26) and (27) is

$$\pi \text{ Praesepe} = 0''{\cdot}0073. \quad (28)$$

The distance is therefore, 137 parsecs (450 light-years).

Trigonometric parallaxes of Praesepe stars have not been published, as far as I know. Spectroscopic parallaxes occur in the lists of Mount Wilson[2]) and Victoria[3]). The mean parallax is

Mt. Wilson, 5 stars: $0''{\cdot}013$
Victoria, 4 stars: $0''{\cdot}009$.

If corrections are applied to the spectroscopic parallaxes to reduce them to mean parallaxes of VAN RHIJN[4]), these values become:

Mt. Wilson: $0''{\cdot}009$, Victoria $0''{\cdot}007$, mean $0''{\cdot}008$, agreeing very well with the value (28).

The convergent of Praesepe may be computed independently if the parallax is known. Adopting the values (19), (20), (22) and (28) I get:

Convergent Praesepe $\alpha = 95^{\circ}{\cdot}0$ $\delta = +4^{\circ}{\cdot}6$
Space velocity $+40{\cdot}8$ K.M.sec$^{-1}$

whereas the convergent of the Hyades is:

$\alpha = 92^{\circ}{\cdot}0$ $\delta = +8^{\circ}{\cdot}6$

and its space velocity $+43{\cdot}7$ K.M. sec$^{-1}$

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1) HERTZSPRUNG, *Astronomische Nachrichten* **209**, 115, 1919.
VAN DEN BOS, *Bull. Astron. Instit. Netherlands* I, 79, 1922.

2) *Contributions from the Mt. Wilson Observatory* **199** and **243**.

3) *Publications of the Dominion Observatory* III, **1**, 1925.

4) *Groningen Publications* **34** page 62, **37** page 18 and **38** page 37.

The uncertainty in the underlying data is large enough to explain the observed differences. The two clusters move along almost parallel lines through space; a real difference between the velocities at least cannot yet be shown. Neither can it be settled at present whether other star clusters, for instance Messier 67 [1]) and the Monoceros group [2]), share this motion.

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1) *Groningen Publications* **33.**

2) *Astronomical Journal* XXXIV, 1, 1921.

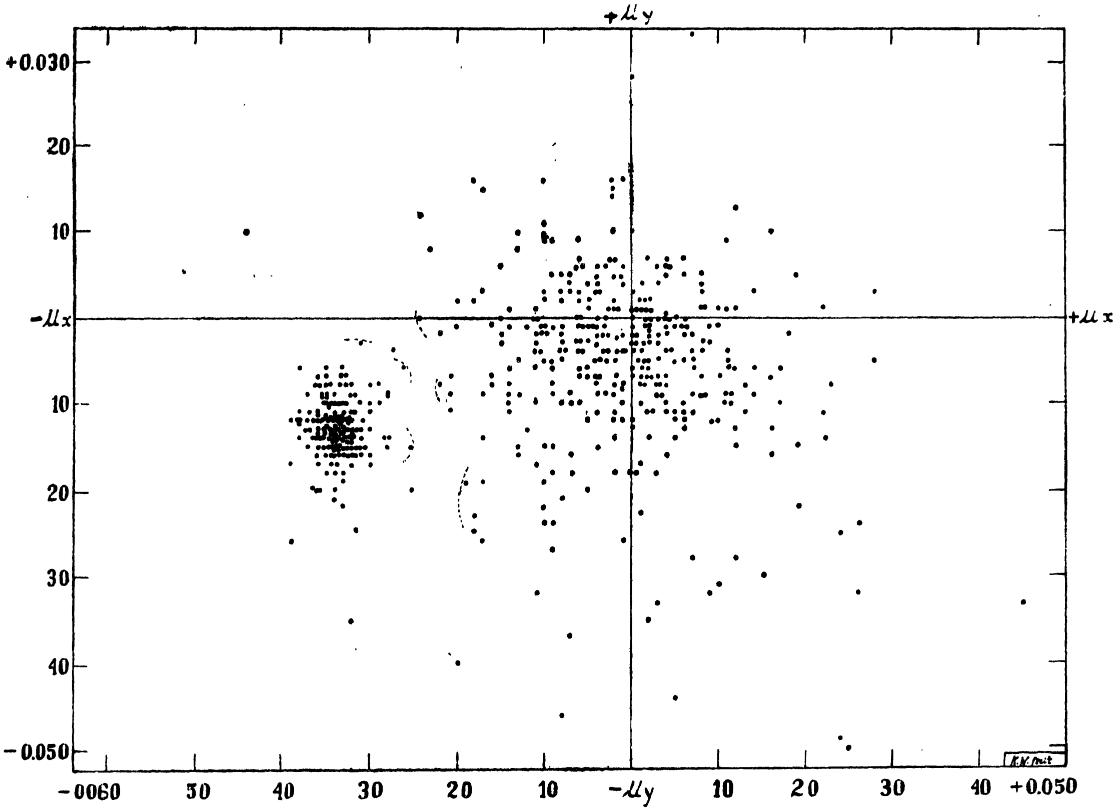


**Figure 2.** Diagram of the absolute proper motions of the Catalogue; photographic magnitude 6 to 14·0, numbers 1 to 531. The dotted lines separate the Praesepe stars from the backgroundstars.

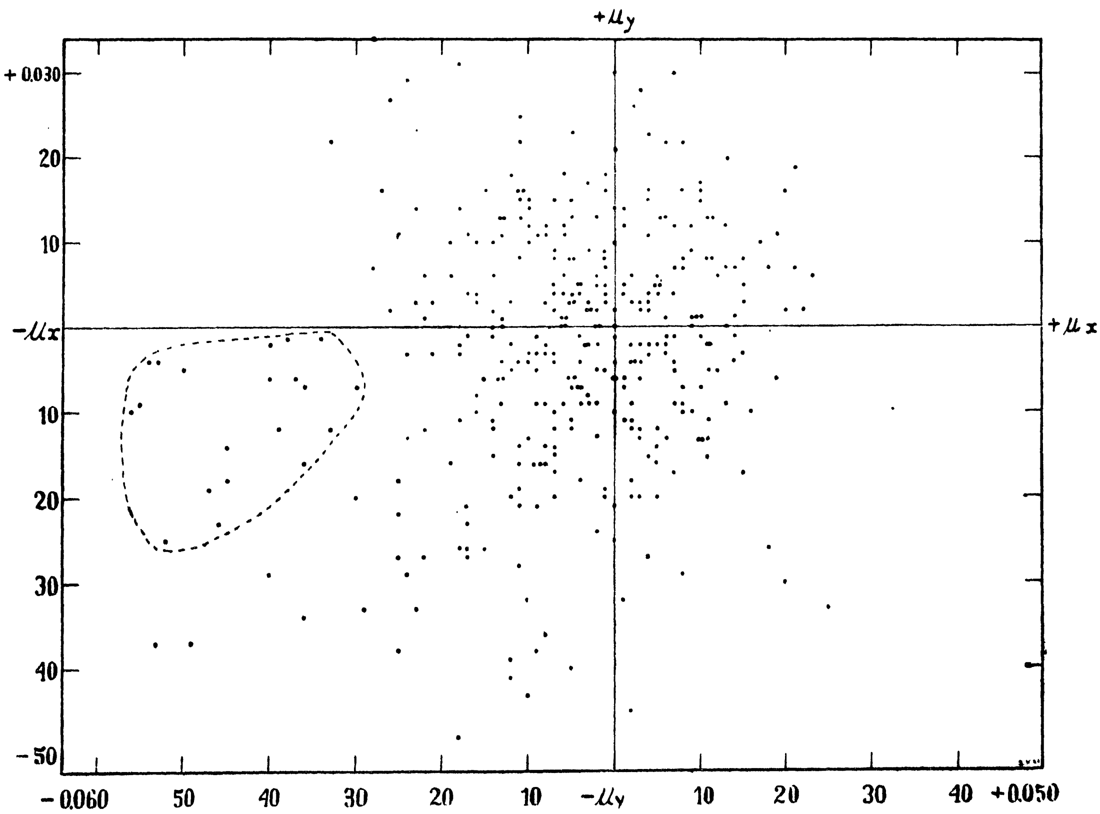


**Figure 3.** Diagram of the absolute proper motions derived from plate XVII. Phot. magn. 14·0 to 18·0. The stars within the dotted line are given in the Catalogue, nrs. 558 to 577.

# EXPLANATION OF THE CATALOGUE.

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The catalogue is divided into three parts: no. 1 to 531 containing all stars brighter than magnitude 13·0 and most stars between 13·0 and 14·0 inside a circle of 56′ radius (section 3); the second part (numbers 532 to 557) contains the groupstars brighter than the magnitude 14, outside the circle of 56′ radius; the third part contains the groupstars fainter than the magnitude 14·0 (section 7).

The *second column* contains the photographic magnitude on the scale of Hertzsprung (*Astr. Nachr.* Bd 205, 71, 1917) (section 6).

The *third and fourth column* contain the right-ascension and declination, derived from the measured coordinates.

The total absolute proper motion $\mu$ and its position angle $\psi$ are contained in the *fifth and sixth column*. The proper motion is the mean of all plates, corrected for magnitude error (sections 8 and 9).

The weight in the *last column* is the weight of $\mu_x$ or $\mu_y$; weight $= 1 \backsim$ probable error $= 0''\!\cdot\!010$.

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# THE CATALOGUE.

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 1 | 13·16 | 30m 49s | 19 56·6 | 0·013 | 219 | 6 |
| 2 | 13·23 | 30 49 | 19 59·6 | ·014 | 352 | 6 |
| 3 | 10·90 | 30 50 | 19 51·1 | ·012 | 138 | 18 |
| 4 | 12·01 | 30 50 | 20 6·9 | ·009 | 302 | 20 |
| 5 | 12·40 | 30 51 | 20 5·1 | ·013 | 203 | 18 |
| 6 | 12·38 | 30 54 | 19 53·2 | ·015 | 228 | 13 |
| 7 | 12·95 | 30 54 | 20 2·9 | ·017 | 177 | 13 |
| 8 | 12·77 | 30 57 | 20 12·5 | ·056 | 126 | 13 |
| 9 | 11·56 | 31 1 | 20 6·8 | ·040 | 236 | 18 |
| 10 | 12·83 | 31 2 | 19 45·1 | ·011 | 260 | 10 |
| 11 | 12·28 | 31 5 | 20 18·0 | ·018 | 276 | 18 |
| 12 | 12·79 | 31 9 | 20 14·2 | ·015 | 352 | 13 |
| 13 | 12·56 | 31 13 | 19 54·1 | ·011 | 218 | 13 |
| 14 | 11·66 | 31 14 | 19 48·0 | ·009 | 160 | 18 |
| 15 | 11·22 | 31 14 | 19 42·7 | ·005 | 259 | 18 |
| 16 | 9·38 | 31 17 | 19 57·1 | ·027 | 257 | 22 |
| 17 | 12·85 | 31 17 | 19 51·0 | ·004 | 14 | 13 |
| 18 | 12·22 | 31 18 | 20 25·8 | ·023 | 250 | 19 |
| 19 | 13·50 | 31 20 | 20 11·1 | ·011 | 85 | 8 |
| 20 | 11·40 | 31 23 | 20 30·9 | ·026 | 203 | 18 |
| 21 | 12·99 | 31 24 | 20 8·4 | ·011 | 131 | 11 |
| 22 | 12·06 | 31 24 | 19 41·2 | ·004 | 117 | 19 |
| 23 | 11·43 | 31 26 | 20 9·2 | ·033 | 249 | 19 |
| 24 | 13·19 | 31 26 | 19 38·8 | ·006 | 39 | 13 |
| 25 | 13·36 | 31 28 | 19 44·1 | ·008 | 50 | 11 |
| 26 | 12·24 | 31 30 | 19 54·9 | ·007 | 236 | 19 |
| 27 | 11·66 | 31 33 | 20 2·9 | ·035 | 255 | 19 |
| 28 | 12·58 | 31 35 | 20 32·9 | ·018 | 171 | 13 |
| 29 | 13·25 | 31 36 | 19 44·2 | ·028 | 198 | 11 |
| 30 | 11·46 | 31 36 | 20 31·7 | ·036 | 255 | 20 |
| 31 | 9·92 | 31 43 | 19 54·8 | ·033 | 256 | 26 |
| ★32 | 11·99 | 31 43 | 19 58·0 | ·036 | 258 | 20 |
| 33 | 12·86 | 31 44 | 20 4·8 | ·012 | 151 | 11 |
| 34 | 9·65 | 31 45 | 19 30·8 | ·030 | 254 | 26 |
| 35 | 12·29 | 31 45 | 20 29·8 | ·024 | 312 | 19 |
| 36 | 11·86 | 31 47 | 19 43·4 | ·007 | 164 | 22 |
| 37 | 12·70 | 31 47 | 20 24·2 | ·015 | 160 | 13 |
| 38 | 8·42 | 31 48 | 20 21·9 | ·038 | 256 | 23 |
| 39 | 12·32 | 31 49 | 19 27·5 | ·027 | 225 | 19 |
| 40 | 8·02 | 31 52 | 20 4·9 | ·031 | 243 | 26 |
| 41 | 13·29 | 31 53 | 20 20·0 | ·164 | 171 | 11 |
| 42 | 12·30 | 31 53 | 19 52·1 | ·020 | 207 | 16 |
| 43 | 10·76 | 31 55 | 20 6·2 | ·004 | 146 | 23 |
| 44 | 10·60 | 31 56 | 20 6·7 | ·002 | 90 | 26 |
| ★45 | 8·23 | 31 56 | 19 52·0 | ·033 | 247 | 26 |
| 46 | 13·52 | 31 58 | 20 40·2 | ·024 | 270 | 3 |
| 47 | 10·01 | 31 59 | 19 29·0 | ·033 | 261 | 24 |
| 48 | 12·76 | 32 2 | 19 56·9 | ·037 | 247 | 13 |
| 49 | 10·85 | 32 2 | 19 47·2 | ·033 | 254 | 26 |
| ★50 | 7·14 | 32 3 | 19 37·0 | ·029 | 252 | 26 |
| | | 8h | +° ′ | ″ | ° | |
| 51 | 12·53 | 32m 3s | 19 32·0 | 0·014 | 51 | 19 |
| ★52 | 12·62 | 32 4 | 19 27·4 | ·034 | 242 | 13 |
| 53 | 13·06 | 32 4 | 19 24·8 | ·016 | 308 | 13 |
| 54 | 10·98 | 32 5 | 20 39·2 | ·006 | 351 | 23 |
| 55 | 11·72 | 32 5 | 20 14·4 | ·035 | 243 | 20 |
| 56 | 11·95 | 32 6 | 20 0·0 | ·005 | 158 | 20 |
| 57 | 13·51 | 32 7 | 20 28·0 | ·008 | 300 | 8 |
| ★58 | 11·43 | 32 7 | 20 20·2 | ·039 | 249 | 20 |
| 59 | 13·82 | 32 8 | 20 10·1 | ·012 | 149 | 6 |
| 60 | 13·36 | 32 8 | 19 45·9 | ·022 | 251 | 11 |
| 61 | 12·67 | 32 8 | 19 18·1 | ·008 | 263 | 13 |
| 62 | 13·60 | 32 10 | 20 29·0 | ·020 | 75 | 11 |
| 63 | 11·94 | 32 10 | 19 37·9 | ·028 | 84 | 20 |
| 64 | 11·30 | 32 11 | 19 20·2 | ·009 | 108 | 23 |
| 65 | 13·08 | 32 12 | 20 30·5 | ·023 | 178 | 11 |
| 66 | 12·55: | 32 12 | 20 26·1 | ·008 | 225 | 18 |
| 67 | 13·73 | 32 12 | 20 8·9 | ·002 | 27 | 6 |
| 68 | 11·94 | 32 12 | 19 54·0 | ·045 | 283 | 20 |
| 69 | 12·47 | 32 13 | 20 16·3 | ·006 | 211 | 19 |
| ★70 | 12·13 | 32 13 | 19 35·1 | ·036 | 250 | 20 |
| 71 | 13·78 | 32 16 | 19 29·6 | ·022 | 208 | 6 |
| 72 | 13·52 | 32 17 | 19 52·2 | ·011 | 170 | 11 |
| 73 | 12·39: | 32 18 | 20 28·9 | ·098 | 167 | 11 |
| 74 | 12·85 | 32 18 | 20 15·2 | ·011 | 190 | 19 |
| 75 | 10·54 | 32 19 | 20 28·9 | ·010 | 204 | 23 |
| 76 | 11·74 | 32 20 | 20 43·8 | ·007 | 333 | 11 |
| 77 | 12·83 | 32 20 | 20 44·1 | ·006 | 108 | 13 |
| 78 | 12·57 | 32 21 | 19 32·0 | ·012 | 250 | 21 |
| ★79 | 12·46 | 32 22 | 20 20·2 | ·034 | 258 | 34 |
| 80 | 13·60 | 32 22 | 20 26·9 | ·006 | 309 | 15 |
| 81 | 12·64 | 32 26 | 19 44·1 | ·009 | 216 | 38 |
| 82 | 13·64 | 32 26 | 19 46·1 | ·005 | 292 | 15 |
| 83 | 11·71 | 32 28 | 20 7·5 | ·022 | 265 | 45 |
| 84 | 12·93 | 32 28 | 20 20·8 | ·009 | 193 | 38 |
| 85 | 12·34 | 32 28 | 20 24·9 | ·020 | 139 | 44 |
| 86 | 11·09 | 32 29 | 19 15·8 | ·009 | 111 | 23 |
| 87 | 13·34 | 32 29 | 19 37·0 | ·005 | 90 | 21 |
| 88 | 12·63 | 32 29 | 19 43·5 | ·018 | 243 | 44 |
| 89 | 11·25 | 32 30 | 19 54·1 | ·008 | 210 | 45 |
| ★90 | 11·28 | 32 31 | 19 42·9 | ·039 | 253 | 48 |
| 91 | 11·39 | 32 32 | 19 20·3 | ·014 | 172 | 23 |
| 92 | 13·28 | 32 33 | 19 33·9 | ·015 | 262 | 19 |
| 93 | 13·11 | 32 33 | 20 32·9 | ·018 | 223 | 17 |
| 93a | 14·00 | 32 36 | 19 45·2 | ·039 | 282 | 4 |
| ○94 | 8·48 | 32 37 | 20 33·5 | ·013 | 117 | 37 |
| 95 | 13·70 | 32 38 | 20 21·9 | ·024 | 128 | 11 |
| 96 | 12·24 | 32 38 | 20 40·1 | ·009 | 264 | 16 |
| 97 | 13·06 | 32 39 | 19 58·0 | ·001 | 0 | 38 |
| 98 | 12·58 | 32 39 | 19 59·2 | ·006 | 315 | 44 |
| 99 | 11·88 | 32 39 | 20 24·7 | ·010 | 287 | 42 |

25 prec. + 86 sec. — 5′·1

25 prec. + 86 sec. — 5′·1

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | + ° ′ | ″ | ° | |
| ☆100 | 10·71 | 32m 39s | 20 27·3 | 0·038 | 261 | 51 |
| 101 | 13·36 | 32 41 | 20 13·2 | ·015 | 113 | 22 |
| 102 | 12·41 | 32 45 | 20 24·6 | ·009 | 117 | 44 |
| 103 | 13·30 | 32 45 | 19 44·0 | ·009 | 207 | 22 |
| 104 | 11·50 | 32 45 | 19 27·4 | ·012 | 215 | 23 |
| 105 | 12·28 | 32 46 | 20 28·9 | ·020 | 120 | 44 |
| 106 | 12·44 | 32 47 | 20 1·3 | ·008 | 83 | 38 |
| 107 | 11·63 | 32 47 | 19 44·7 | ·002 | 63 | 48 |
| ○108 | 10·84 | 32 48 | 19 48·9 | ·012 | 228 | 48 |
| 109 | 10·02 | 32 49 | 20 12·8 | ·029 | 218 | 51 |
| 110 | 13·76 | 32 49 | 20 0·2 | ·012 | 160 | 19 |
| 111 | 12·95 | 32 50 | 20 4·2 | ·014 | 129 | 38 |
| 112 | 12·12 | 32 51 | 20 3·8 | ·004 | 194 | 44 |
| 113 | 13·57 | 32 52 | 20 36·1 | ·017 | 114 | 6 |
| ☆114 | 8·07 | 32 52 | 20 20·4 | ·035 | 246 | 51 |
| 115 | 13·79 | 32 52 | 20 15·0 | ·002 | 117 | 15 |
| 116 | 12·55 | 32 52 | 19 51·8 | ·029 | 139 | 43 |
| 117 | 10·77 | 32 53 | 19 59·9 | ·044 | 174 | 51 |
| 118 | 13·48 | 32 54 | 19 39·5 | ·007 | 326 | 19 |
| 119 | 13·44 | 32 54 | 19 29·0 | ·016 | 195 | 13 |
| 120 | 13·15 | 32 56 | 19 16·8 | ·006 | 135 | 13 |
| 121 | 11·38 | 32 59 | 20 23·1 | ·012 | 110 | 48 |
| 122 | 12·35 | 33 1 | 19 55·6 | ·016 | 140 | 42 |
| 123 | 13·01 | 33 2 | 20 46·8 | ·009 | 249 | 12 |
| ☆124 | 8·76 | 33 2 | 19 51·1 | ·036 | 254 | 51 |
| 125 | 13·83 | 33 3 | 20 17·2 | ·013 | 225 | 19 |
| 126 | 13·46 | 33 3 | 19 55·1 | ·017 | 237 | 19 |
| ☆127 | 11·10 | 33 4 | 20 25·1 | ·036 | 249 | 48 |
| 128 | 13·99 | 33 4 | 20 1·2 | ·011 | 326 | 11 |
| 128*a* | 13·74 | 33 6 | 19 38·1 | ·007 | 34 | 5 |
| 129 | 12·01 | 33 6 | 19 55·9 | ·024 | 289 | 45 |
| 130 | 11·46 | 33 7 | 20 22·2 | ·008 | 187 | 48 |
| 131 | 12·81 | 33 7 | 19 25·0 | ·026 | 200 | 13 |
| 132 | 13·63 | 33 8 | 19 32·4 | ·006 | 321 | 19 |
| 133 | 12·59 | 33 8 | 19 26·1 | ·002 | 90 | 13 |
| ○134 | 10·57 | 33 11 | 19 33·0 | ·010 | 259 | 47 |
| 135 | 11·87 | 33 13 | 20 3·0 | ·009 | 238 | 45 |
| 136 | 12·68 | 33 14 | 19 36·4 | ·009 | 243 | 19 |
| 137 | 13·16 | 33 15 | 19 23·2 | ·041 | 141 | 13 |
| ○138 | 11·07 | 33 15 | 19 46·5 | ·004 | 236 | 51 |
| 139 | 12·73 | 33 16 | 20 21·5 | ·056 | 153 | 11 |
| 140 | 13·10 | 33 17 | 20 8·8 | ·009 | 160 | 19 |
| 141 | 13·00 | 33 18 | 19 40·7 | ·036 | 254 | 24 |
| ☆142 | 9·46 | 33 18 | 20 4·6 | ·036 | 243 | 50 |
| ☆143 | 8·51 | 33 18 | 20 21·1 | ·036 | 245 | 51 |
| 144 | 13·86 | 33 20 | 19 44·8 | ·009 | 96 | 8 |
| 145 | 13·52 | 33 20 | 20 26·7 | ·017 | 123 | 8 |
| ☆146 | 9·45 | 33 20 | 20 28·2 | ·037 | 251 | 51 |
| 147 | 13·13 | 33 21 | 19 16·4 | ·011 | 270 | 13 |
| 148 | 11·49 | 33 21 | 19 23·8 | ·010 | 349 | 23 |

25 prec. + 86 sec. — 5′·1

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | + ° ′ | ″ | ° | |
| ○149 | 12·28 | 33m 21s | 19 39·3 | 0·008 | 130 | 42 |
| ☆150 | 7·65 | 33 21 | 20 1 8 | ·032 | 250 | 50 |
| 151 | 12·77 | 33 22 | 20 19·9 | ·001 | 45 | 38 |
| 152 | 14·12 | 33 23 | 19 41·5 | ·038 | 171 | 6 |
| 153 | 13·28 | 33 24 | 20 27·0 | ·013 | 315 | 24 |
| ☆154 | 8·36 | 33 25 | 19 56·6 | ·036 | 255 | 51 |
| ☆155 | 9·55 | 33 25 | 20 1·9 | ·036 | 248 | 50 |
| 156 | 8·98 | 33 26 | 19 18·1 | ·027 | 297 | 26 |
| 157 | 11·84 | 33 27 | 19 16·9 | ·012 | 211 | 20 |
| 158 | 13·67 | 33 28 | 19 51·9 | ·010 | 264 | 19 |
| 159 | 12·28 | 33 28 | 20 41·9 | ·009 | 69 | 19 |
| 160 | 13·74 | 33 28 | 20 45·5 | ·014 | 249 | 3 |
| 161 | 11·78 | 33 29 | 19 17·2 | ·085 | 246 | 20 |
| ☆162 | 10·82 | 33 29 | 19 28·0 | ·037 | 251 | 26 |
| 163 | 13·64 | 33 29 | 19 54·4 | ·010 | 259 | 19 |
| 164 | 11·53 | 33 29 | 20 33·9 | ·035 | 240 | 20 |
| 165 | 13·48 | 33 31 | 19 24·4 | ·018 | 180 | 13 |
| 166 | 13·13 | 33 32 | 19 32·4 | ·007 | 180 | 21 |
| 167 | 9·90 | 33 34 | 20 24·3 | ·035 | 136 | 51 |
| 168 | 13·05 | 33 35 | 20 44·2 | ·007 | 297 | 13 |
| 169 | 12·51 | 33 35 | 19 41·3 | ·006 | 239 | 38 |
| 170 | 12·89 | 33 35 | 19 25·2 | ·017 | 128 | 13 |
| 171 | 13·09 | 33 37 | 20 48·4 | ·011 | 326 | 10 |
| 172 | 12·97 | 33 37 | 20 12·8 | ·035 | 250 | 38 |
| 173 | 12·83 | 33 37 | 19 28·7 | ·012 | 115 | 11 |
| 174 | 11·54 | 33 37 | 19 20·3 | ·003 | 180 | 23 |
| 175 | 12·96 | 33 38 | 19 23·2 | ·008 | 194 | 11 |
| 176 | 13·21 | 33 39 | 20 25·8 | ·012 | 185 | 28 |
| 177 | 13·55 | 33 40 | 19 30·9 | ·004 | 180 | 21 |
| 178 | 13·49 | 33 41 | 20 45·4 | ·003 | 45 | 10 |
| 179 | 12·23 | 33 41 | 20 26·2 | ·007 | 164 | 45 |
| 180 | 13·86 | 33 41 | 20 21·0 | ·004 | 90 | 15 |
| 181 | 10·69 | 33 41 | 19 48·8 | ·037 | 247 | 51 |
| 182 | 10·45 | 33 45 | 20 25·2 | ·035 | 253 | 50 |
| 183 | 13·16 | 33 45 | 20 8·2 | ·036 | 245 | 38 |
| 184 | 12·04 | 33 45 | 19 49·5 | ·037 | 246 | 44 |
| 185 | 12·78 | 33 46 | 20 33·9 | ·007 | 236 | 18 |
| 186 | 13·60 | 33 47 | 20 18·3 | ·006 | 270 | 22 |
| 187 | 12·36 | 33 47 | 20 00·0 | ·005 | 281 | 44 |
| 188 | 13·28 | 33 48 | 20 47·9 | ·033 | 164 | 10 |
| 189 | 13·69 | 33 48 | 20 43·0 | ·023 | 247 | 8 |
| ○190 | 10·05 | 33 48 | 20 31·4 | ·017 | 280 | 51 |
| 191 | 13·04 | 33 48 | 19 36·1 | ·033 | 162 | 38 |
| ○192 | 10·78 | 33 49 | 19 38.9 | ·004 | 236 | 51 |
| 192*a* | 13·68 | 33 50 | 19 15·9 | ·016 | 353 | 5 |
| 193 | 12·96 | 33 50 | 20 21·7 | ·004 | 90 | 22 |
| 194 | 12 88 | 33 50 | 20 21·6 | ·011 | 170 | 24 |
| 195 | 12 79 | 33 51 | 19 51·8 | ·015 | 302 | 44 |
| 196 | 10·92 | 33 52 | 19 13·8 | ·034 | 256 | 23 |
| 197 | 13·19 | 33 53 | 19 56·9 | ·018 | 180 | 31 |

25 prec. + 86 sec. — 5′·1

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 198 | 13·17 | 33m 54s | 19 47·6 | 0·037 | 257 | 26 |
| 199 | 13·48 | 33 55 | 20 17·9 | ·008 | 315 | 19 |
| 200 | 13·35 | 33 55 | 19 15·4 | ·024 | 242 | 13 |
| 201 | 12·95: | 33 57 | 20 0·2 | ·045 | 207 | 18 |
| 202 | 13·86 | 33 58 | 20 30·9 | ·008 | 30 | 12 |
| 203 | 8·02 | 33 58 | 20 26·2 | ·038 | 243 | 51 |
| 204 | 6·70 | 33 58 | 20 7·8 | ·037 | 246 | 51 |
| 205 | 13·45 | 33 58 | 19 25·1 | ·002 | 297 | 11 |
| 206 | 12·41 | 33 59 | 19 46·7 | ·174 | 195 | 39 |
| 207 | 7·85 | 34 1 | 19 37·9 | ·034 | 251 | 51 |
| 208 | 10·80 | 34 2 | 19 43·2 | ·036 | 247 | 44 |
| 209 | 13·22 | 34 2 | 20 10·9 | ·037 | 246 | 38 |
| 210 | 13·70 | 34 5 | 20 13·5 | ·031 | 213 | 19 |
| 211 | 13·90 | 34 7 | 19 40·2 | ·036 | 133 | 6 |
| 212 | 7·26 | 34 7 | 19 53·9 | ·035 | 250 | 51 |
| 213 | 12·16 | 34 7 | 19 54·2 | ·039 | 249 | 44 |
| 214 | 13·64 | 34 7 | 19 55·0 | ·007 | 34 | 22 |
| 215 | 11·34 | 34 7 | 20 18·1 | ·015 | 143 | 48 |
| 216 | 10·22 | 34 7 | 20 53·6 | ·018 | 232 | 21 |
| 217 | 10·40 | 34 8 | 19 40·0 | ·037 | 251 | 51 |
| 218 | 9·19 | 34 8 | 20 54·9 | ·037 | 249 | 22 |
| 219 | 12·65 | 34 9 | 19 16·5 | ·008 | 315 | 13 |
| 220 | 13·94 | 34 9 | 19 30·8 | ·006 | 90 | 19 |
| 221 | Var.1) | 34 10 | 20 10·5 | ·011 | 275 | 36 |
| 222 | 10·30 | 34 10 | 20 25·1 | ·036 | 250 | 51 |
| 223 | 13·37 | 34 12 | 19 46·9 | ·004 | 124 | 22 |
| 224 | 7·34 | 34 12 | 19 54·6 | ·038 | 251 | 51 |
| 225 | 13·34 | 34 13 | 19 17·3 | ·007 | 16 | 11 |
| 226 | 9·00 | 34 13 | 20 30·9 | ·036 | 243 | 51 |
| 227 | 9·60 | 34 14 | 19 33·2 | ·036 | 250 | 51 |
| 228 | 13·62 | 34 14 | 19 42·1 | ·021 | 129 | 19 |
| 229 | 7·50 | 34 14 | 19 53·9 | ·037 | 247 | 48 |
| 230 | 9·74 | 34 14 | 20 1·3 | ·006 | 100 | 51 |
| 231 | 12·10 | 34 14 | 20 8·9 | ·003 | 315 | 45 |
| 232 | 9·38 | 34 14 | 20 23·2 | ·037 | 244 | 51 |
| 233 | 13·81 | 34 15 | 19 30·6 | ·014 | 155 | 15 |
| 233a | 14·19 | 34 15 | 19 41·9 | ·030 | 100 | 5 |
| 234 | 9·94 | 34 16 | 19 17·9 | ·020 | 267 | 26 |
| 235 | 12·59 | 34 16 | 19 41·3 | ·033 | 175 | 44 |
| 236 | 12·44 | 34 16 | 19 55·2 | ·035 | 248 | 44 |
| 237 | 13·42 | 34 16 | 19 55·9 | ·034 | 248 | 38 |
| 238 | 10·36 | 34 16 | 20 9·7 | ·036 | 250 | 51 |
| 239 | 9·76 | 34 16 | 20 29·4 | ·035 | 248 | 51 |
| 239a | 13·81 | 34 17 | 19 17·5 | ·048 | 222 | 6 |
| 239b | 14·08 | 34 17 | 19 40·7 | ·012 | 9 | 6 |
| 240 | 13·06 | 34 17 | 20 8·4 | ·011 | 270 | 38 |
| 241 | 12·82 | 34 17 | 20 16·1 | ·017 | 234 | 44 |
| 242 | 12·70 | 34 18 | 19 14·2 | ·020 | 213 | 13 |
| 243 | 12·63 | 34 18 | 20 52·1 | ·016 | 166 | 10 |
| 244 | 10·42 | 34 19 | 19 21·2 | ·036 | 254 | 26 |

25 prec. + 86 sec. — 5′·1

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 245 | 13·06 | 34m 19s | 19 21·6 | 0·017 | 246 | 13 |
| 246 | 12·47 | 34 19 | 20 8·2 | ·035 | 246 | 44 |
| 247 | 12·88 | 34 19 | 20 32·3 | ·055 | 154 | 13 |
| 248 | 11·53 | 34 19 | 20 32·8 | ·022 | 231 | 36 |
| 249 | 13·90 | 34 20 | 19 20·5 | ·009 | 40 | 11 |
| 250 | 9·91 | 34 20 | 20 5·0 | ·034 | 244 | 51 |
| 251 | 13·98 | 34 21 | 19 56·2 | ·006 | 270 | 8 |
| 252 | 13·12 | 34 21 | 20 0·6 | ·014 | 266 | 31 |
| 253 | 7·25 | 34 21 | 20 21·9 | ·040 | 238 | 51 |
| 254 | 13·80 | 34 21 | 20 27·9 | ·009 | 162 | 19 |
| 255 | 11·61 | 34 21 | 20 44·0 | ·005 | 169 | 20 |
| 256 | 12·96 | 34 22 | 19 22·8 | ·031 | 251 | 13 |
| 257 | 11·27 | 34 22 | 19 39·8 | ·039 | 247 | 48 |
| 258 | 10·39 | 34 22 | 19 48·6 | ·047 | 236 | 51 |
| 259 | 12·80 | 34 22 | 20 43·7 | ·023 | 135 | 10 |
| 260 | 13·42 | 34 23 | 20 43·8 | ·022 | 87 | 3 |
| 261 | 13·90 | 34 25 | 19 23·2 | ·005 | 37 | 8 |
| 262 | 13·67 | 34 25 | 19 53·1 | ·021 | 219 | 11 |
| 263 | 12·30 | 34 25 | 19 58·5 | ·035 | 245 | 45 |
| 264 | 12·59 | 34 26 | 20 49·7 | ·016 | 235 | 18 |
| 265 | 6·46 | 34 26 | 20 19·8 | ·037 | 250 | 51 |
| 266 | 11·68 | 34 26 | 19 47·8 | ·009 | 153 | 45 |
| 267 | 13·90 | 34 28 | 20 7·9 | ·040 | 239 | 14 |
| 268 | 9·92 | 34 28 | 19 59·7 | ·038 | 245 | 51 |
| 269 | 12·90 | 34 28 | 19 31·1 | ·009 | 305 | 35 |
| 270 | 11·74 | 34 30 | 20 55·2 | ·003 | 135 | 18 |
| 271 | 8·77 | 34 30 | 20 20·9 | ·035 | 245 | 51 |
| 272 | 13·31 | 34 30 | 20 16·1 | ·035 | 246 | 31 |
| 273 | 12·06 | 34 32 | 20 25·9 | ·004 | 258 | 44 |
| 274 | 11·56 | 34 32 | 20 17·5 | ·004 | 258 | 51 |
| 275 | 10·08 | 34 33 | 20 8·6 | ·036 | 242 | 51 |
| 276 | 7·54 | 34 33 | 19 53·2 | ·034 | 253 | 51 |
| 277 | 12·72 | 34 33 | 19 38·8 | ·010 | 281 | 44 |
| 278 | 13·24 | 34 33 | 19 5·9 | ·008 | 293 | 8 |
| 279 | 7·72 | 34 36 | 20 2·7 | ·034 | 249 | 51 |
| 280 | 13·86 | 34 36 | 19 53·3 | ·019 | 328 | 6 |
| 281 | 12·53 | 34 36 | 19 23·2 | ·018 | 204 | 19 |
| 282 | 10·06 | 34 37 | 20 27·8 | ·036 | 255 | 51 |
| 283 | 7·10 | 34 37 | 20 1·6 | ·041 | 241 | 51 |
| 284 | 6·76 | 34 37 | 19 42·2 | ·033 | 252 | 51 |
| 285 | 13·14 | 34 38 | 20 46·0 | ·005 | 307 | 51 |
| 286 | 7·81 | 34 39 | 20 11·5 | ·038 | 247 | 51 |
| 287 | 10·56 | 34 39 | 20 1·8 | ·036 | 243 | 48 |
| 288 | 10·90 | 34 39 | 19 49·1 | ·037 | 246 | 48 |
| 290 | 12·79 | 34 41 | 20 53·4 | ·069 | 203 | 13 |
| 291 | 10·38 | 34 41 | 20 44·4 | ·093 | 180 | 26 |
| 292 | 8·45 | 34 41 | 20 32·2 | ·039 | 242 | 51 |
| 293 | 9·97 | 34 41 | 19 49·9 | ·036 | 250 | 50 |
| 294 | 13·48 | 34 41 | 19 23·1 | ·004 | 346 | 13 |
| 295 | 9·37 | 34 42 | 20 2·5 | ·036 | 247 | 51 |

25 prec. + 86 sec. — 5′·2

1) HERTZSPRUNG, *Astronomische Nachrichten* **205**, 33, 1917.

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | $8^h$ | $+$° ′ | ″ | ° | |
| 296 | 13·85 | $34^m 43^s$ | 20 41·3 | 0·011 | 158 | 3 |
| 297 | 11·91 | 34 43 | 20 40·0 | ·037 | 247 | 20 |
| 298 | 14·00 | 34 43 | 20 31·8 | ·008 | 263 | 6 |
| 299 | 13·86 | 34 43 | 20 0·7 | ·041 | 241 | 16 |
| 300 | 6·33 | 34 43 | 19 54·1 | ·040 | 252 | 51 |
| 301 | 11·35 | 34 44 | 19 38·0 | ·036 | 254 | 48 |
| 302 | 11·89 | 34 44 | 19 5·9 | ·021 | 194 | 18 |
| 303 | 12·43 | 34 45 | 19 24·3 | ·031 | 216 | 20 |
| 304 | 11·84 | 34 46 | 20 33·3 | ·038 | 240 | 35 |
| 305 | 12·06 | 34 46 | 20 16·4 | ·010 | 264 | 44 |
| 306 | 13·75 | 34 46 | 19 45·8 | ·003 | 270 | 19 |
| 307 | 13·37 | 34 46 | 19 22·9 | ·008 | 284 | 13 |
| 308 | 13·26 | 34 46 | 19 21·9 | ·057 | 176 | 11 |
| 309 | 11·89 | 34 47 | 20 12·2 | ·035 | 245 | 45 |
| 310 | 12·98 | 34 47 | 19 42·6 | ·012 | 138 | 38 |
| 311 | 10·71 | 34 47 | 19 18·5 | ·007 | 172 | 23 |
| 312 | 13·01 | 34 47 | 19 16·2 | ·026 | 123 | 8 |
| 313 | 12·65 | 34 49 | 19 59·2 | ·040 | 248 | 44 |
| 314 | 13·17 | 34 49 | 19 9·9 | ·002 | 180 | 13 |
| 315 | 12·22 | 34 50 | 20 43·2 | ·012 | 156 | 19 |
| 316 | 13·43 | 34 50 | 20 7·7 | ·005 | 169 | 22 |
| 317 | 13·08 | 34 50 | 19 53·2 | ·010 | 174 | 38 |
| 318 | 8·60 | 34 50 | 19 33·0 | ·037 | 259 | 45 |
| 319 | 14·04 | 34 50 | 19 30·0 | ·011 | 49 | 11 |
| 320 | 12·48 | 34 52 | 19 32·4 | ·000 | — | 44 |
| 321 | 11·48 | 34 53 | 20 15·4 | ·003 | 0 | 48 |
| 322 | 11·04 | 34 55 | 20 1·3 | ·037 | 250 | 48 |
| 323 | 8·00 | 34 56 | 19 34·9 | ·036 | 252 | 48 |
| 324 | 10·80 | 34 57 | 20 55·4 | ·026 | 182 | 20 |
| 325 | 10·81 | 34 58 | 19 34·8 | ·037 | 257 | 51 |
| 326 | 11·63 | 34 58 | 19 55·2 | ·039 | 245 | 45 |
| 327 | 11·84 | 34 58 | 20 22·1 | ·034 | 199 | 38 |
| 328 | 7·08 | 34 59 | 20 4·3 | ·038 | 251 | 51 |
| 329 | 13·62 | 34 59 | 20 19·2 | ·002 | 117 | 19 |
| 330 | 13·55 | 34 59 | 20 52·1 | ·010 | 0 | 8 |
| 331 | 13·76 | 35 1 | 20 8·0 | ·003 | 90 | 19 |
| 332 | 9·63 | 35 2 | 19 39·9 | ·037 | 247 | 51 |
| 333 | 10·86 | 35 3 | 19 53·9 | ·002 | 207 | 51 |
| 334 | 11·31 | 35 3 | 20 0·9 | ·038 | 245 | 48 |
| 335 | 11·28 | 35 3 | 20 16·6 | ·034 | 251 | 48 |
| 336 | 11·81 | 35 4 | 19 15·4 | ·037 | 247 | 20 |
| 337 | 12·73 | 35 6 | 19 11·0 | ·007 | 236 | 13 |
| 338 | 11·56 | 35 6 | 19 29·0 | ·018 | 96 | 20 |
| 339 | 13·76 | 35 6 | 20 10·9 | ·003 | 225 | 19 |
| 340 | 8·56 | 35 7 | 20 37·1 | ·032 | 242 | 26 |
| 341 | 10·49 | 35 8 | 19 50·2 | ·038 | 247 | 51 |
| 342 | 13·02 | 35 9 | 20 13·8 | ·008 | 120 | 42 |
| 343 | 13·43 | 35 10 | 19 32·2 | ·007 | 344 | 11 |
| 344 | 12·48 | 35 10 | 20 17·3 | ·037 | 246 | 35 |
| 345 | 13·58 | 35 11 | 19 50·0 | ·014 | 188 | 18 |

25 prec. + 86 sec. — 5′·2

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | $8^h$ | $+$° ′ | ″ | ° | |
| 346 | 13·25 | $35^m 11^s$ | 19 59·4 | 0·004 | 104 | 38 |
| 347 | 12·73 | 35 11 | 20 13·1 | ·027 | 261 | 44 |
| 348 | 7·11 | 35 12 | 19 56·0 | ·036 | 247 | 50 |
| 349 | 12·47 | 35 12 | 20 5·2 | ·038 | 251 | 44 |
| 350 | 8·67 | 35 12 | 20 17·2 | ·039 | 246 | 51 |
| 351 | 13·78 | 35 14 | 19 50·1 | ·006 | 135 | 16 |
| 352 | 13·30 | 35 16 | 20 13·9 | ·013 | 153 | 22 |
| 353 | 12·46 | 35 16 | 20 48·8 | ·041 | 253 | 13 |
| 354 | 13·27 | 35 20 | 20 31·3 | ·002 | 27 | 16 |
| 355 | 13·66 | 35 20 | 20 6·0 | ·034 | 12 | 14 |
| 356 | 11·43 | 35 20 | 19 52·7 | ·009 | 291 | 45 |
| 357 | 12·73 | 35 20 | 19 38·4 | ·016 | 266 | 44 |
| 358 | 12·72 | 35 22 | 19 52·0 | ·002 | 27 | 44 |
| 359 | 13·78 | 35 23 | 19 57·7 | ·007 | 27 | 16 |
| 360 | 11·76 | 35 23 | 19 43·5 | ·029 | 166 | 45 |
| 361 | 11·91 | 35 24 | 20 15·7 | ·023 | 311 | 45 |
| 362 | 13·93 | 35 24 | 20 13·7 | ·018 | 137 | 18 |
| 363 | 12·81 | 35 24 | 19 48·0 | ·039 | 251 | 38 |
| 364 | 13·42 | 35 24 | 19 32·8 | ·025 | 117 | 15 |
| 365 | 10·48 | 35 24 | 19 25·6 | ·037 | 250 | 26 |
| 366 | 13·48 | 35 25 | 20 25·9 | ·006 | 162 | 19 |
| 367 | 10·84 | 35 25 | 20 12·6 | ·037 | 247 | 51 |
| 368 | 11·73 | 35 25 | 20 10·3 | ·036 | 248 | 45 |
| 369 | 14·01 | 35 26 | 20 22·9 | ·004 | 225 | 11 |
| 370 | 9·00 | 35 26 | 20 11·0 | ·038 | 248 | 51 |
| 371 | 10·14 | 35 26 | 19 51·8 | ·036 | 249 | 51 |
| 372 | 13·03 | 35 27 | 20 28·3 | ·009 | 243 | 31 |
| 373 | 12·56 | 35 27 | 19 21·5 | ·010 | 186 | 19 |
| 374 | 13·74 | 35 28 | 20 29·9 | ·014 | 78 | 19 |
| 375 | 8·24 | 35 28 | 20 16·6 | ·038 | 251 | 51 |
| 376 | 12·97 | 35 28 | 19 49·9 | ·013 | 148 | 38 |
| 377 | 7·19 | 35 29 | 20 49·9 | ·004 | 166 | 21 |
| 378 | 13·85 | 35 30 | 19 16·3 | ·010 | 96 | 11 |
| 379 | 11·88 | 35 30 | 19 9·9 | ·012 | 265 | 12 |
| 380 | 13·66 | 35 32 | 19 57·0 | ·004 | 194 | 12 |
| 381 | 13·76 | 35 32 | 19 49·9 | ·023 | 239 | 19 |
| 382 | 13·27 | 35 32 | 19 29·8 | ·006 | 288 | 17 |
| 383 | 13·78 | 35 32 | 19 22·8 | ·028 | 0 | 6 |
| 384 | 13·03 | 35 32 | 19 10·0 | ·007 | 106 | 13 |
| 385 | 8·01 | 35 35 | 19 36·9 | ·037 | 247 | 50 |
| 386 | 11·54 | 35 35 | 19 9·3 | ·002 | 180 | 18 |
| 387 | 11·88 | 35 37 | 20 20·1 | ·005 | 217 | 45 |
| 388 | 13·12 | 35 38 | 19 21·8 | ·012 | 119 | 13 |
| 389 | 13·64 | 35 39 | 20 37·2 | ·013 | 157 | 11 |
| 390 | 13·38 | 35 40 | 19 17·2 | ·040 | 254 | 8 |
| 391 | 13·28 | 35 41 | 20 45·9 | ·010 | 84 | 11 |
| 392 | 10·92 | 35 41 | 20 17·9 | ·035 | 250 | 51 |
| 393 | 14·06 | 35 41 | 19 55·2 | ·005 | 90 | 10 |
| 394 | 12·91 | 35 41 | 19 10·8 | ·105 | 199 | 13 |
| 395 | 13·58 | 35 42 | 20 35·9 | ·009 | 220 | 6 |

25 prec. + 86 sec. — 5′·2

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 396 | 9·84 | 35m 43s | 19 53·9 | 0·038 | 248 | 51 |
| 397 | 11·70 | 35 44 | 19 43·6 | ·019 | 242 | 42 |
| 398 | 11·77 | 35 44 | 20 32·6 | ·002 | 297 | 38 |
| 399 | 11.06 | 35 45 | 20 6·1 | ·041 | 250 | 46 |
| 400 | 11·50 | 35 47 | 19 52·9 | ·012 | 241 | 48 |
| 401 | 13·23 | 35 48 | 19 13·6 | ·038 | 241 | 13 |
| 402 | 13·28 | 35 48 | 19 21·9 | ·003 | 180 | 13 |
| 403 | 11·94 | 35 49 | 20 19·4 | ·039 | 251 | 45 |
| 404 | 12·64 | 35 50 | 20 5·2 | ·006 | 180 | 44 |
| 405 | 12·21 | 35 51 | 19 17·4 | ·008 | 173 | 20 |
| 406 | 12·90 | 35 51 | 19 53·5 | ·006 | 171 | 38 |
| 407 | 9·26 | 35 51 | 20 1·0 | ·025 | 222 | 51 |
| 408 | 11·94 | 35 51 | 20 3·4 | ·011 | 142 | 44 |
| 409 | 13·07 | 35 51 | 20 39·4 | ·006 | 219 | 13 |
| 410 | 12·46 | 35 51 | 20 47·0 | ·003 | 135 | 19 |
| 411 | 9·33 | 35 53 | 19 29·9 | ·040 | 252 | 40 |
| 412 | 12·08 | 35 53 | 20 45·8 | ·015 | 222 | 20 |
| 413 | 12·52 | 35 54 | 19 24·3 | ·015 | 132 | 19 |
| 414 | 13·05 | 35 54 | 20 33·8 | ·012 | 189 | 13 |
| 415 | 13·58 | 35 55 | 19 37·2 | ·036 | 260 | 18 |
| 416 | 9·58 | 35 58 | 20 0·9 | 039 | 249 | 51 |
| 417 | 12·68 | 35 58 | 20 19·0 | ·037 | 257 | 44 |
| 418 | 10·59 | 35 58 | 20 34·9 | ·038 | 243 | 26 |
| 419 | 13·04 | 36 0 | 19 37·6 | ·016 | 356 | 38 |
| 420 | 12·80 | 36 0 | 20 1·9 | ·012 | 180 | 43 |
| 421 | 10·29 | 36 2 | 19 37·4 | ·038 | 253 | 51 |
| 422 | 13·76 | 36 2 | 19 55·7 | ·005 | 202 | 14 |
| 423 | 11·36 | 36 3 | 19 29·2 | ·018 | 186 | 23 |
| 424 | 12·08 | 36 4 | 19 42·1 | ·008 | 210 | 45 |
| 425 | 11·43 | 36 4 | 19 46·0 | ·029 | 252 | 48 |
| 426 | 13·19 | 36 5 | 19 12·5 | ·009 | 125 | 13 |
| 427 | 11·94 | 36 5 | 19 39·9 | ·015 | 270 | 44 |
| 428 | 7·54 | 36 6 | 20 13·8 | ·041 | 241 | 50 |
| 429 | 8·34 | 36 7 | 20 30·9 | ·036 | 259 | 48 |
| 430 | 12·34 | 36 7 | 20 31·3 | ·036 | 258 | 40 |
| 431 | 13·09 | 36 10 | 19 37·1 | ·007 | 135 | 31 |
| 432 | 11·14 | 36 11 | 20 2·8 | ·036 | 250 | 51 |
| 433 | 10·99 | 36 11 | 19 59·4 | ·008 | 187 | 48 |
| 434 | 11·64 | 36 11 | 19 36·8 | ·036 | 254 | 45 |
| 435 | 11·98 | 36 11 | 19 35·2 | ·011 | 236 | 44 |
| 436 | 12·93 | 36 14 | 20 42·9 | ·010 | 241 | 11 |
| 437 | 14·06 | 36 14 | 20 21·6 | ·014 | 295 | 6 |
| 438 | 12·66 | 36 15 | 20 16·2 | ·016 | 292 | 35 |
| 439 | 9·54 | 36 15 | 19 16·0 | ·034 | 256 | 26 |
| 440 | 12·32 | 36 17 | 19 47·0 | ·003 | 162 | 45 |
| 441 | 13·98 | 36 18 | 20 9·2 | ·005 | 217 | 6 |
| 442 | 14·09 | 36 19 | 19 51·2 | ·018 | 311 | 8 |
| 443 | 11·13 | 36 21 | 19 57·4 | ·038 | 191 | 51 |
| 444 | 13·13 | 36 22 | 19 35·3 | ·004 | 135 | 38 |
| 445 | 8·10 | 36 23 | 19 46·0 | ·040 | 245 | 48 |

+ 25 prec. + 86 sec — 5′·2

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 446 | 12·26 | 36m 26s | 20 30·1 | 0·015 | 259 | 44 |
| 447 | 12·44 | 36 27 | 20 30·9 | ·022 | 201 | 44 |
| 448 | 12·66 | 36 28 | 19 38·0 | ·040 | 252 | 44 |
| 449 | 8·12 | 36 28 | 19 17·5 | ·031 | 255 | 24 |
| 450 | 12·43 | 36 31 | 20 31·7 | ·028 | 100 | 44 |
| 451 | 13·82 | 36 31 | 20 24·5 | ·005 | 259 | 19 |
| 452 | 12·41 | 36 31 | 20 5·2 | ·024 | 109 | 44 |
| 453 | 13·72 | 36 31 | 20 4·0 | ·011 | 255 | 11 |
| 454 | 9·96 | 36 31 | 20 2·7 | ·039 | 252 | 51 |
| 455 | 13·17 | 36 32 | 19 58·4 | ·016 | 240 | 31 |
| 456 | 12·55 | 36 33 | 20 46·1 | ·033 | 250 | 19 |
| 457 | 11·26 | 36 33 | 20 4·9 | ·015 | 247 | 48 |
| 458 | 9·80 | 36 35 | 20 23·7 | ·036 | 255 | 50 |
| 459 | 9·22 | 36 36 | 20 32·2 | ·035 | 254 | 38 |
| 460 | 12·40 | 36 37 | 20 28·5 | ·029 | 239 | 35 |
| 461 | 11·43 | 36 37 | 20 38·6 | ·009 | 198 | 20 |
| 462 | 11·09 | 36 40 | 19 56·8 | ·047 | 190 | 46 |
| 463 | 12·06 | 36 42 | 20 37·8 | ·003 | 252 | 19 |
| 464 | 13·62 | 36 47 | 19 21·0 | ·009 | 58 | 11 |
| 465 | 14·20 | 36 47 | 20 6·8 | ·014 | 231 | 1 |
| 466 | 11·21 | 36 49 | 19 45·2 | ·043 | 246 | 40 |
| 467 | 13·13 | 36 49 | 20 16·8 | 015 | 122 | 19 |
| 468 | 13·16 | 36 50 | 19 52·2 | ·013 | 312 | 6 |
| 469 | 12·61 | 36 52 | 19 20·0 | ·009 | 167 | 13 |
| 470 | 12·50 | 36 54 | 19 32·0 | ·002 | 297 | 19 |
| 471 | 12·43 | 36 57 | 19 29·3 | ·036 | 248 | 19 |
| 472 | 9·91 | 36 57 | 19 54·0 | ·038 | 250 | 26 |
| 473 | 13·63 | 36 58 | 19 57·2 | ·014 | 274 | 11 |
| 474 | 12·64 | 36 59 | 19 58·9 | ·038 | 245 | 19 |
| 475 | 12·98 | 36 59 | 20 3·2 | ·006 | 219 | 13 |
| 476 | 11·86 | 36 59 | 19 27·4 | ·039 | 243 | 20 |
| 477 | 12·22 | 37 1 | 20 21·5 | ·024 | 204 | 20 |
| 478 | 9·72 | 37 1 | 19 56·2 | ·036 | 249 | 26 |
| 479 | 13·17 | 37 1 | 19 40·7 | ·034 | 153 | 13 |
| 480 | 11·58 | 37 1 | 19 24·2 | ·012 | 125 | 17 |
| 481 | 13·57 | 37 2 | 19 59·9 | ·007 | 344 | 11 |
| 482 | 12·32 | 37 3 | 20 42·8 | ·001 | 180 | 13 |
| 483 | 13·84 | 37 4 | 19 58·1 | ·019 | 141 | 6 |
| 484 | 11·98 | 37 4 | 19 49·5 | ·004 | 194 | 20 |
| 485 | 12·22 | 37 6 | 19 41·9 | ·011 | 243 | 19 |
| 486 | 13·52 | 37 10 | 20 12·6 | ·013 | 312 | 11 |
| 487 | 13·72 | 37 13 | 20 2·3 | ·008 | 256 | 11 |
| 488 | 11·48 | 37 15 | 20 41·8 | ·034 | 260 | 17 |
| 489 | 11·86 | 37 17 | 20 1·2 | ·031 | 157 | 19 |
| 490 | 13·07 | 37 17 | 19 53·6 | ·010 | 299 | 13 |
| 491 | 12·46 | 37 19 | 19 48·7 | ·004 | 90 | 19 |
| 492 | 12·41 | 37 19 | 19 31·6 | ·034 | 246 | 14 |
| 493 | 10·94 | 37 21 | 19 57·2 | ·001 | 0 | 26 |
| 494 | 12·12 | 37 21 | 19 39·0 | ·020 | 276 | 20 |
| 495 | 10·08 | 37 22 | 19 47·8 | ·035 | 251 | 20 |

25 prec. + 86 sec. — 5′·3

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 496 | 9·67 | 37m 24s | 19 25·7 | 0·036 | 250 | 26 |
| 497 | 13·50 | 37 27 | 19 29·2 | ·008 | 150 | 6 |
| 498 | 11·98 | 37 27 | 19 53·1 | ·031 | 243 | 20 |
| 499 | 11·07 | 37 27 | 20 35·7 | ·004 | 243 | 18 |
| 500 | 12·22 | 37 28 | 19 31·9 | ·019 | 201 | 20 |
| 501 | 13·36 | 37 28 | 20 1·0 | ·018 | 43 | 11 |
| 502 | 12·12 | 37 28 | 20 35·4 | ·004 | 270 | 16 |
| 503 | 13·28 | 37 31 | 19 23·8 | ·005 | 349 | 8 |
| 504 | 13·34 | 37 32 | 19 29·2 | ·008 | 173 | 13 |
| 505 | 12·86 | 37 32 | 20 37·7 | ·009 | 63 | 8 |
| 506 | 13·64: | 37 34 | 19 43·7 | ·005 | 307 | 11 |
| 507 | 13·00 | 37 34 | 20 11·2 | ·005 | 101 | 13 |
| 508 | 10·87 | 37 36 | 20 7·8 | ·033 | 254 | 25 |
| 509 | 13·07 | 37 39 | 19 34·4 | ·014 | 129 | 13 |
| 510 | 12·76 | 37 41 | 20 11·2 | ·009 | 131 | 14 |
| 511 | 13·58 | 37 42 | 19 53·9 | ·007 | 196 | 11 |
| 512 | 12·26 | 37 43 | 19 26·9 | ·018 | 211 | 13 |
| 513 | 11·74 | 37 46 | 19 35·8 | ·006 | 149 | 20 |
| 514 | 12·60 | 37 48 | 20 6·2 | ·035 | 244 | 14 |
| 515 | 10·06 | 37 50 | 20 33·0 | ·031 | 264 | 23 |

25 prec. + 86 sec. — 5′·3

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 516 | 12·38 | 37m 52s | 20 8·2 | 0·018 | 109 | 19 |
| 517 | 12·30 | 37 53 | 20 15·2 | ·015 | 132 | 19 |
| 518 | 12·86 | 37 54 | 19 49·1 | ·006 | 260 | 11 |
| 519 | 13·00 | 37 59 | 20 15·1 | ·008 | 83 | 13 |
| 520 | 12·62 | 38 3 | 19 46·0 | ·013 | 180 | 11 |
| 521 | 12·26 | 38 4 | 19 33·5 | ·005 | 233 | 13 |
| 522 | 12·77 | 38 8 | 19 38·2 | ·008 | 220 | 13 |
| 523 | 12·85 | 38 9 | 20 18·1 | ·012 | 200 | 10 |
| 524 | 10·50 | 38 9 | 20 3·8 | 035 | 177 | 26 |
| 525 | 12·76 | 38 14 | 19 54·8 | ·005 | 338 | 10 |
| 526 | 12·36 | 38 15 | 20 14·7 | ·012 | 85 | 13 |
| 527 | 13·27 | 38 16 | 19 55·0 | ·012 | 250 | 13 |
| 528 | 12·18 | 38 17 | 20 1·3 | ·018 | 214 | 19 |
| 529 | 13·32 | 38 19 | 20 10·5 | ·006 | 100 | 5 |
| 530 | 12·32 | 38 22 | 19 40·6 | ·032 | 231 | 14 |
| 531 | 12·26 | 38 27 | 20 5·2 | ·007 | 243 | 7 |

25 prec. + 86 sec — 5′·3

| No. | Phot Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 532 | 12·92 | 30m 27s | 19 58·3 | 0·062 | 254 | 3 |
| 533 | 12·18 | 30 29 | 19 53·4 | ·034 | 244 | 3 |
| 534 | 8·22 | 30 30 | 20 41·7 | ·034: | 251 | 3 |
| 535 | 12·92 | 30 41 | 20 35·0 | ·045 | 258 | 5 |
| 536 | 9·68 | 30 45 | 19 18·5 | ·048 | 248 | 5 |
| 537 | 12·06 | 30 58 | 20 28·5 | ·035 | 248 | 5 |
| 538 | 9·14 | 31 3 | 19 13·6 | ·040 | 238 | 5 |
| 539 | 11·58 | 31 3 | 19 36·3 | ·041: | 238 | 5 |
| 540 | 11·40 | 31 25 | 20 38·4 | ·043 | 246 | 5 |
| 541 | 11·07 | 31 49 | 18 59·9 | ·029 | 252 | 5 |
| 542 | 12·18 | 32 21 | 20 47·6 | ·036 | 248 | 5 |
| 543 | 11·36 | 32 30 | 20 55·5 | ·038 | 249 | 5 |
| 544 | 12·77 | 32 59 | 20 56·2 | ·033 | 270 | 5 |
| 545 | 12·76 | 34 35 | 18 54·1 | ·023 | 267 | 3 |
| 546 | 12·06 | 34 51 | 19 1·4 | ·036 | 247 | 5 |
| 547 | 12·30 | 34 55 | 19 2·7 | ·033: | 252 | 3 |
| 548 | 10·06 | 37 29 | 20 41·5 | ·041 | 281 | 5 |
| 549 | 10·06 | 38 7 | 19 9·4 | ·038 | 240 | 5 |
| 550 | 12·44 | 38 7 | 20 31·5 | ·039 | 222 | 5 |
| 551 | 12·59 | 38 14 | 19 15·1 | ·041 | 248 | 5 |
| 552 | 8·22 | 38 15 | 19 23·5 | ·028 | 268 | 5 |
| 553 | 9·87 | 38 24 | 20 26·5 | ·031 | 243 | 5 |
| 554 | 11·29 | 38 45 | 20 40·6 | ·034 | 227 | 5 |
| 555 | 10·99 | 38 48 | 19 49·7 | ·026: | 252 | 5 |
| 556 | 9·87 | 38 55 | 20 4·5 | ·038 | 251 | 5 |
| 557 | 10·46 | 39 4 | 20 3·7 | ·049 | 270 | 5 |

| No. | Phot. Magn. | $\alpha_{1900}$ | $\delta_{1900}$ | Abs. Prop. Mot. $\mu$ | $\psi$ | Weight |
|---|---|---|---|---|---|---|
| | | 8h | +° ′ | ″ | ° | |
| 558 | 16·65 | 32m 42s | 20 11·1 | 0·057 | 260 | 3 |
| 559 | 14·99 | 32 44 | 20 12·7 | ·035 | 255 | 4 |
| 560 | 14·70 | 33 11 | 20 32·0 | ·050 | 247 | 4 |
| 561 | 15·41 | 33 17 | 20 23·6 | ·037 | 259 | 4 |
| 562 | 17·16 | 33 21 | 20 33·3 | ·031 | 257 | 3 |
| 563 | 18·07 | 33 25 | 20 8·1 | ·058 | 244 | 3 |
| 564 | 17·12 | 33 29 | 20 22·4 | ·054 | 266 | 3 |
| 565 | 17·25 | 33 30 | 20 26·7 | ·037 | 261 | 3 |
| 566 | 15·97 | 33 30 | 20 25·3 | ·047 | 253 | 4 |
| 567 | 17·68 | 33 31 | 20 32·1 | ·039 | 246 | 3 |
| 568 | 14·33 | 33 43 | 19 53·0 | ·051 | 243 | 4 |
| 569 | 16·15 | 33 52 | 20 10·1 | ·050 | 264 | 4 |
| 570 | 16·37 | 33 56 | 20 20·7 | ·053 | 266 | 4 |
| 571 | 16·71 | 33 56 | 20 22·9 | ·050 | 248 | 4 |
| 572 | 15·10 | 34 20 | 20 6·7 | ·035 | 250 | 4 |
| 573 | 16·99 | 34 29 | 20 6·2 | ·056 | 261 | 3 |
| 574 | 14·43 | 35 25 | 20 17·4 | ·040 | 267 | 4 |
| 575 | 15·26 | 35 30 | 20 23·6 | ·041 | 253 | 4 |
| 576 | 14·07 | 35 31 | 20 6·2 | ·040 | 261 | 4 |
| 577 | 15·71 | 35 38 | 20 36·3 | ·038 | 268 | 4 |

25 prec. + 87 sec. — 5′·2

– member measured photo-electrically: Johnson ApJ 116, 640
o non-member " " "