

stars, say 35 per cent. Excluding these, the number of stars down to 9.4 magnitude would thus be some 400,000.

The adopted values of the numbers for the different groups of magnitudes, and the percentage values within certain limits of proper motion, are given in the following table :—

Percentage of Stars within Certain Limits of Centennial Proper Motions in Order of Magnitude, with Estimated Number of Stars.

Mag.	0" - 5"	5" - 10"	10" - 20"	> 20"	Estimated No. of Stars in Thousands.
1 -4.9	43	22	18	17	1
5.0-5.9	55	23	15	7	3
6.0-6.9	60	25	10	5	12
7.0-7.9	75	17	6	2	35
8.0-9.4	79	14	6	1	350

Estimated Number of Stars within Certain Limits of Centennial Proper Motions in Order of Magnitude.

1 -4.9	430	220	180	170	1
5.0-5.9	1,650	690	450	210	3
6.0-6.9	7,200	3,000	1,200	600	12
7.0-7.9	26,250	5,950	2,100	700	35
8.0-9.4	276,500	49,000	21,000	3,500	350
	312,030	58,860	24,930	5,180	401

From a comparison of the Groombridge and Carrington proper motions, for the purpose of estimating the effect of accidental error, the probable error of a centennial proper motion in N.P.D. is $\pm 0''.8$ and in R.A. $\pm 0''.9$; thus the probable error of a resultant centennial proper motion is $\pm 1''.2$. It would, therefore, be reasonable to infer that the numbers corresponding to these limits of proper motion would not be liable to any serious alteration for the effect of accidental error of observation.

If the group 0" - 5" is further broken up it will be found that for all magnitudes the stars tend to accumulate somewhere round 2".5 as a resultant centennial proper motion, and this seems too large a quantity to be due to systematic or accidental error.

Notes on some Proper Motions derived from a Comparison of Carrington's Catalogue with the Greenwich Places for 1900.
By W. G. Thackeray.

In the Greenwich Catalogue for 1900, which is now in course of construction, there are 1185 stars to be found in Carrington's Circumpolar Catalogue for 1855. Of these stars, 94 common to the Groombridge-Greenwich system have been used to discuss the

systematic corrections applicable to Carrington's places to bring them into line with the Groombridge-Greenwich system, and the results have been published in *Monthly Notices*, lxvi. pp. 320-323.

After applying these corrections to the Carrington Catalogue places, proper motions for these 1187 stars have been derived by a simple comparison of the Greenwich observed places for 1900 with the corrected Carrington places brought up to 1900 by Struve-Peters precession constants.

Taking those stars which are common to Groombridge and Carrington, and forming the differences of proper motion derived from the Groombridge and Carrington Catalogue places respectively in the sense of correction to Groombridge for every three hours of right ascension, we get corrections which can be compared with the tables of corrections given by Boss in his paper, "The New Reduction of the Meridian Observations of Groombridge" (*Monthly Notices*, lxvi. p. 513).

The tables are given in the form of corrections to proper motion in arc in both elements. Boss's corrections in N.P.D. are not given, as being practically insensible.

Boss's corrections in R.A. are found by multiplying by $\frac{3}{16}$ the quantities given in Table II., Zone IV., *Monthly Notices*, lxvi. p. 563.

Corrections to Groombridge's Proper Motions in Order of R.A.

R.A.	Right Ascension.		N.P.D. Carrington-Greenwich.
	Boss.	Carrington-Greenwich.	
0h	"000		
1 $\frac{1}{2}$		+ "003	- "003
2	+ '009		
4	- '006		
4 $\frac{1}{2}$		- '003	- '010
6	- '010		
7 $\frac{1}{2}$		- '010	- '005
8	- '016		
10	- '001		
10 $\frac{1}{2}$		+ '003	- '005
12	+ '017		
13 $\frac{1}{2}$		+ '020	- '003
14	+ '016		
16	+ '014		
16 $\frac{1}{2}$		+ '013	- '002
18	'000		
19 $\frac{1}{2}$		- '004	- '004
20	+ '002		
22	- '006		
22 $\frac{1}{2}$		+ '002	- '001

The agreement between Boss and Carrington is notable, and shows the excellence of Carrington's observations. The small

mean difference in N.P.D. represents but a small systematic discordance.

Again arranging these Carrington proper motions in order of magnitudes and in octants of R.A., in the same manner as was adopted in the case of the Groombridge Catalogue, we get the following tables of numbers and percentages:—

Numbers of Stars—Centennial Proper Motions in Order of Stars' Magnitude.

Magnitude.	Total Number of Stars.	0"-5"	5"-10"	10"-20"	>20"
m m					
5.0-5.9	19	5	8	6	0
6.0-6.9	46	28	12	4	2
7.0-7.9	114	73	25	14	2
8.0-8.4	179	121	35	16	7
8.5-8.9	442	338	82	17	5
9.0-	378	302	56	17	3
Total .	1178	867	218	74	19

Percentage of Stars—Centennial Proper Motions in Order of Stars' Magnitude.

m m					
5.0-5.9	19	26	42	32	0
6.0-6.9	46	61	26	9	4
7.0-7.9	114	64	22	12	2
8.0-8.4	179	69	19	9	4
8.5-8.9	442	77	18	4	1
9.0-	378	80	15	5	1

Percentage of Stars—Centennial Proper Motions in Order of R.A.

Limits of R.A.	Total Number of Stars.	0"-5"	5"-10"	10"-20"	>20"
h h					
0- 3	149	67	28	5	1
3- 6	127	77	16	7	0
6- 9	137	80	12	7	2
9-12	170	70	22	5	3
12-15	172	71	20	8	1
15-18	140	75	19	4	2
18-21	147	82	15	2	1
21- 0	136	74	11	13	2

The mean discordance of a determination of proper motion from Groombridge and Carrington is $\pm''\cdot010$ in N.P.D. and $\pm''\cdot011$ in R.A., using those stars only which have little or no systematic error which would give a probable error for a resultant centennial proper motion of $1 \pm''\cdot2$ as the effect of accidental error.

On the Accidental Production of Temporary Errors of Division on a Graduated Circle. By W. M. Witchell.*(Communicated by the Astronomer Royal.)*

During an examination, undertaken recently, of the micrometer screws of the Greenwich Meridian Circle reading microscopes, a suggestive discovery was made.

Six observations of "runs" had been taken over each of three consecutive intervals of 5', and these agreed among themselves quite normally so long as the same interval was under consideration; but when the results from the different intervals were compared a discordance much beyond the probable accidental error of observation appeared between the values obtained at pointer reading $89^{\circ} 35'-40'$, and those at $89^{\circ} 40'-45'$.

As will be seen from the following figures, the discordance amounted to $0''.014$ or $0''.84$, and an attempt to trace its origin was necessary.

Value of 5' of Circle in "Mean Micrometer."

	Pointer $89^{\circ} 35'$ to $89^{\circ} 40'$.	Pointer $89^{\circ} 40'$ to $89^{\circ} 45'$.
	\bar{r}	\bar{r}
Set 1 . . .	4.903	4.893
„ 2 . . .	.912	.892
„ 3 . . .	.908	.897
„ 4 . . .	.907	.894
„ 5 . . .	.904	.893
„ 6 . . .	.908	.891
	<hr/>	<hr/>
	4.907	4.893
	<hr/>	<hr/>
	Difference : $0''.014$	

An accidentally large deviation from the mean division error at this part of the circle was at first suspected. A search for others of like magnitude in the neighbourhood, however, produced negative results. But when these observations (which consisted of three sets of runs over each 5' interval from pointer reading $88^{\circ} 20'$ to $89^{\circ} 20'$) were arranged so as to exhibit the values from the six micrometers individually, and were compared with the former series similarly arranged, it was at once seen that the discordance took its origin in a large apparent error of the particular graduation viewed by microscope D when the pointer reads $89^{\circ} 40'$. The figures follow. They were considered to give strong evidence of an error amounting to $0''.03$ of micrometer, or $1''.8$ in this graduation, inasmuch as the mean screw measurements of the two adjacent intervals appeared to be too large and too small respectively by approximately this quantity.