Third Note on the number of Faint Stars with large Proper Motions. Zone $+27°$. By H. H. Turner, D.Sc., F.R.S., Savilian Professor.

1. In November 1908 the results of a comparison of ten pairs of plates in zone $+28°$, taken at intervals of 10 to 15 years, and in April 1909, the comparison of 30 plates in zone $+26°$, were communicated to the Society. The present note gives a similar comparison for 29 plates in zone $+27°$. A comparison for zone $+25°$ is about half done, and will complete the examination of material available at present. A sum of £100 has been kindly placed at the disposal of the University Observatory for this special investigation by the Government Grant Fund.

But when the straightforward computations for comparison of measures have been completed, there remains the careful examination and remeasurement of all exceptional cases which may be large proper motions. For this work I am in the present instance indebted to the volunteer help of Mr. W. H. Waterfield, B.A., of Christ Church.

Table I. which follows corresponds to Table I. in the previous papers. As a rule, cases have been specially examined where the differences exceeded $\pm 1''{\cdot}2$ in either coordinate, and the figures in column 4 give the number of cases where these differences were confirmed on remeasurement, and thus probably indicate a P.M., although no stress is laid on these records unless the P.M. exceeds $15''$ a century.

TABLE I.

Zone $+27°$. *Stars having probable large P.Ms.*

R.A. of Plate Centre.	Gal. Lat.	Total Stars compared.	Interval.	Total P.Ms.	Centennial P.Ms. $15''$–$20''$.	Centennial P.Ms. $> 20''$.
h m	°		y			
3 16	22	124	12·2	3	0	2
3 32	20	150	12·1	2	0	1
3 56	16	184	12·1	2	1	1
4 4	15	125	12·2	4	1	2
4 12	14	33	12·2	0	0	0
4 28	10	48	10·0	3	2	1
4 44	7	54	12·2	2	2	0
4 52	3	53	10·0	0	0	0
5 0	0	75	14·1	4	2	1
5 8	3	87	12·1	5	1	2
5 16	2	75	14·2	1	1	0
5 24	0	94	10·0	0	0	0
7 8	17	172	14·1	5	2	0
7 16	20	134	14·0	3	1	1
7 56	28	115	14·0	1	0	0

TABLE I.—*continued.*

R.A. of Plate Centre. h m	Gal. Lat. °	Total Stars compared.	Interval. y	Total P.Ms.	Centennial P.Ms. 15″–20″.	> 20″.
8 4	31	130	14·0	0	0	0
8 12	33	137	14·1	3	0	1
8 52	42	135	14·2	6	2	2
9 8	44	118	14·2	5	3	2
10 36	63	108	10·0	3	0	2
12 20	84	90	14·0	3	1	1
13 40	76	79	9·9	3	1	2
14 12	71	95	14·0	2	0	1
14 20	68	93	14·0	3	1	0
14 52	63	104	14·0	5	1	2
16 20	42	110	9·9	1	1	0
19 40	2	516	15·0	4	1	1
21 48	19	246	15·0	5	2	2
22 4	24	267	15·0	6	2	0
29 plates	...	3751	...	84	28	27
40 plates in +28° & +26°		9332	...	151	42	26
69 plates in all		13083	...	235	70	53

3. The fact brought out by former results (see vol. lxix. p. 492), that the crop of large P.Ms. is not much greater for a plate in the galaxy than for plates away from it, is confirmed by these independent results. Arranging the plates simply according to the number of stars shown we get—

TABLE II.

Plates in Order of Number of Stars.

No. Stars.	P.Ms. 15″–20″.	> 20″.	No. Stars	P.Ms. 15″–20″.	> 20″.	No. Stars.	P.Ms. 15″–20″.	> 20″.	No. Stars.	P.Ms. 15″–20″.	> 20.″
516	1	1	150	0	1	108	0	2	54	2	0
267	2	0	137	0	1	104	1	2	53	0	0
246	2	2	135	2	2	95	0	1	48	2	1
184	1	1	134	1	1	94	0	0	33	0	0
172	2	0	130	0	0	93	1	0			
			125	1	2	90	1	1			
Sums below multiplied by 2·0 for comparison.			124	0	2	87	1	2	Sums below multiplied by 2·5 for comparison.		
			118	3	2	79	1	2			
			115	0	0	75	2	1			
			110	1	0	75	1	0			
[2770]	[16]	[8]	1278	8	11	900	8	11	[470]	[10]	[3]

4. But it is perhaps more appropriate to arrange the plates in order of galactic latitude, and we may do this for all three zones together. The results are as follows:—

TABLE III.

No. of Plates.	Mean Gal. Lat.	Mean Number of P.Ms. per Plate.			Mean No. of Stars on Plate.
		In all.	15″–20″.	> 20″.	
13	4°	2·9	1·1	0·7	293
11	15	4·4	1·5	0·8	268
13	23	2·9	0·9	0·8	209
11	32	2·0	0·6	0·6	170
11	53	2·8	1·0	1·1	106
10	78	3·7	0·9	0·6	68

5. It seems clear that stars with P.Ms. greater than 15″ per century (and probably the limit can be reduced) are scattered with no sensible reference to the galaxy, and the inference is that whatever causes the galaxy lies beyond them.

6. There are on the average 1·0 stars per plate (about 2° × 2°) with P.M. between 15″ and 20″ per century, and 0·8 stars per plate with P.M. > 20″. So that on the whole sphere we may expect about 10,000 stars with P.M. between 15″ and 20″, and 8000 > 20″, among the stars of magnitude (say) 10·5 and brighter. The limiting magnitude is a little indefinite, since the comparison deals with plates which were admittedly less rich in stars than they should have been; but we may put the whole number at about 2 or 3 million.

7. The following is a list of stars having P.M. greater than 15″ per century on these 29 plates in zone +27°. It may not have been noticed that the Oxford numbers in the second column give the means of obtaining the equatorial coordinates of the star in the sky when the reductions indicated in the volumes of the *Oxford Astrographic Catalogue* are carried out. The measured coordinates are first to be corrected by the constants given at the head of each plate, and then reduced to equatorial coordinates by the tables given in the introduction to each volume.

[TABLE.

TABLE IV.

List of Large P.Ms. in Zone +27°.

R.A. of Plate Centre. h m	Oxford Number.	Cent. P.M. in Arc.	Δx.	Δy.	Interval. yr	Mag.
8 52	23081*	39·2	+ 4·5	−18	14·2	7·0
8 12	31703*	35·1	+ 0·5	−16·5	14·1	5·7
14 52	32902*	32·3	− 8·5	−12·5	14·0	9·5
5 0	10504	30·6	+ 6	−13	14·1	11·3
9 8	24000	29·9	−12·5	− 7	14·2	10·2
14 52	33053	29·1	−13·5	- 2	14·0	10·1
3 56	8844	27·8	+11	+ 2	12·1	11·3
13 40	31117	27·3	− 9	0	9·9	[12·0]
5 8	10665*	26·8	+10	− 4	12·1	7·3
19 40	52491*	25·2	− 1·5	+12·5	15·0	7·1
21 48	64737*	25·2	−10·5	− 7·5	15·0	6·8
9 8	24044	24·8	+ 9·5	− 7	14·2	9·6
5 8	10670*	24·8	+10	− 1	12·1	8·9
10 36	26534*	24·3	+ 8	− 1·5	10·0	8·4
3 32	7890	24·0	+ 5·5	− 8	12·1	11·0
7 16	17930	23·9	+ 2·5	+11	14·0	10·0
12 20	29343*	23·9	+ 4	−10·5	14·1	8·0†
8 52	23050*	23·5	− 5	−10	14·2	9·1
3 16	7175	23·0	+ 8	− 5	12·2	11·0
3 16	7228	23·0	+ 8	− 5	12·2	10·0
4 28	9707*	21·9	+ 7	− 2	10·0	8·6
21 48	64113*	21·4	+10·5	+ 2	15·0	8·8
14 12	32030	20·5	− 1·5	− 9·5	14·0	9·7
4 4	9148	20·4	+ 2	− 8	12·2	10·9
4 4	9149	20·4	+ 2	− 8	12·2	10·9
10 36	26431*	20·1	− 4·5	+ 5	10·0	8·9
13 40	31102	20·0	− 6·5	− 1	9·9	10·4
16 20	35320	20·0	− 1	+ 6·5	9·9	11·2
21 48	64188	19·4	− 9·5	− 2	15·0	10·8
5 8	10614*	19·4	− 5	− 6	12·1	7·0
3 56	8968	19·3	+ 7·5	− 2	12·1	10·6
7 16	18449*	19·2	+ 7·5	− 5	14·0	8·1
13 40	31145	19·1	− 2	− 6	9·9	11·7
14 20	32211	18·2	− 8	+ 3	14·0	[12·0]
22 4	65954	18·0	+ 9	0	15·0	10·3

† A double star ; mags. 8·0 and 8·2, distance 4″, measured as one mass on the Oxford plates.

TABLE IV.—*continued.*

R.A. of Plate Centre. h m	Oxford Number.	Cent. P.M. in Arc.	Δx.	Δy.	Interval. yr	Mag.
4 44	10214	17″·8	+ 1·5	− 7	12·2	10·3
4 4	9109*	17·7	− 4	− 6	12·2	7·6
8 52	23037	17·2	− 8	− 1	14·2	11·8
4 28	9751	17·1	+ 5·5	− 1·5	10·0	10·4
5 0	10517*	17·0	+ 8	0	14·1	7·3
7 8	17408	17·0	+ 8	0	14·1	11·2
12 20	29299	16·6	− 6	+ 5	14·1	11·3
4 44	10103*	16·5	+ 5	− 4·5	12·2	9·2
4 28	9758	16·5	0	− 5·5	10·0	11·2
21 48	64622*	16·2	+ 8	− 1	15·0	9·0
5 16	10848	16·0	+ 7	− 3	14·2	10·0
22 4	65836*	16·0	0	− 8	15·0	8·0
5 0	10523*	15·5	+ 7	− 2	14·1	8·9
19 40	51969*	15·4	− 1·5	− 7·5	15·0	9·2
14 52	33072	15·4	− 7	+ 1·5	14·0	11·2
7 8	17662*	15·3	+ 6	− 4	14·1	8·1
8 52	23380	15·1	+ 1	− 7	14·2	11·8
9 8	23785	15·0	− 7	+ 2	14·2	11·6
9 8	23786*	15·0	− 7	+ 2	14·2	9·1
9 8	23811	15·0	− 7	+ 2	14·2	9·9

The stars marked with an asterisk are in the Cambridge Catalogue, and are therefore comparatively bright stars; it will be seen that there are 24 out of 55. [In the last note the numbers were 24 out of 50.] The magnitudes for these stars are simply those of the Cambridge Catalogue. For the other stars the magnitudes are inferred from the formulæ in the printed volume for $+27°$, but are to be taken as provisional only.

8. If, now, we group these stars according to magnitude, we get results as follows, N denoting the *total* number as bright as, or brighter than, the reading.

TABLE V.

Showing P.Ms. for successive Magnitudes.

Mag.	To 7·9.	8·9.	9·9.	10·9.	12·0.
N over 20″	5	11	15	22	28
N 15″–20″	3	7	12	18	27
N over 15″	8	18	27	40	55
log N over 15″	0·90	1·26	1·43	1·60	1·74
Diff.		0·36	0·17	0·17	0·14
From last paper		0·36	0·22	0·16	0·19

Summary.

On 69 plates in zones $+26°$, $+27°$, and $+28°$, containing altogether 13,000 stars, there are 123 stars with P.M. exceeding 15″ per century, of which 53 have P.M. exceeding 20″ per century. There are also 112 other stars with P.Ms. which are smaller, but fairly discernible with the rather rough methods here adopted. The large P.Ms. are scattered uniformly in R.A., with no condensation towards the Milky Way, and thus probably indicate stars belonging to our Solar Cluster.

The motion of Jupiter's Eighth Satellite from 1910 *to* 1916.

By A. C. D. Crommelin, D.Sc. (Plate 3.)

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This paper is in continuation of that by Mr. Cowell, Mr. Davidson, and the writer in *Monthly Notices*, vol. lxix., No. 5. The motion has been carried on by the same method and in the same orbit as that used previously. It is evident that the orbit needs some small adjustment; but as it is still too soon to reach an absolutely final orbit, this adjustment has been postponed till the satellite has been observed over several revolutions. The various tables given are similar to those in the former paper. The equator and equinox of 1910·0 are used throughout. The coordinates of Jupiter for 1913–1914 are taken from the *Annuario Astronomico pel* 1910, *pubblicato dal R. Osservatorio di Torino.* Those for 1915 have been carried on by an approximate method, great accuracy being unnecessary for this purpose, since the solar perturbing action is small compared to Jupiter's action.

The geocentric places are true places for Paris mean noon, the equation of light not having been applied.

The axis of x turns to the First Point of Aries, that of y to R.A. 6^h, Dec. $0°$, that of z to the North Pole of the Equator.

An examination has been made of these coordinates to ascertain the values of sidereal period, eccentricity, inclination, node, etc. The results below are computed in most cases with four-figure logarithms; they are therefore much less accurate than the coordinates themselves, and these latter should be used in all cases where accuracy is required.

The Sidereal Period.

This has been determined by the interval between the passages through the planes $x = 0$, $y = 0$, $x = \pm y$.