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NOTE ON SOME SYSTEMATIC DIFFERENCES BETWEEN DIFFERENT SYSTEMS OF PROPER MOTIONS, WITH EMPHASIS ON THE INFLUENCE OF THE MAGNITUDE

G. VAN HERK

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The differences between the proper motions in right ascension of stars common to the FK4 and N30 show a strong correlation with the magnitudes of the stars for the declination zone between $-28°$ and $-81°$. The differences change, per magnitude, by -0.160 ± 0.026 (s.e.), in ″/100 y. For the region comprising the Hyades this change is -0.079 ± 0.014. The differences in proper motions in declination do not show any such relation. A possible source of this phenomenon is indicated.
A comparison of the motions in declination from the FK4 with those from the FK3 reveals differences which are correlated with $\cos \alpha$, more or less of the form $-0.14 \cos \alpha$, which has been ascribed to the neglect of the variation of latitude in observations with meridian circles prior to 1900. It turns out, however, that this α term varies from one region of the sky to another. This may be due either to the fact that the latitude correction is not applicable to the whole of the FK3, or that the FK4 is not yet free from this type of error.
The comparison of the proper motions from the FC, NFK, FK3 and FK4 shows that the motions in declination have changed least. The question remains open whether this indicates freedom from systematic errors in the declinations, or whether the declinations continue to have the same type of systematic errors.

1. Introduction

In this paper I intend to show the influence of the magnitudes of the stars on the proper motions derived from meridian circles. Work done by other investigators on proper motions will be partly rediscussed with the new FK4 material at hand.

KOPFF (1932) considered the influence of the omission of the variation of the latitude on meridian-circle observations prior to 1900 insignificant for the proper motions in declination, μ_δ. OORT (1950) rediscussed this question and found for the correction to the centennial μ_δ's of the FK3 (KOPFF, 1937) $-0.14 \cos \alpha$. In section 3 the differences between the μ_δ taken from the FK4 (FRICKE *et al.*, 1963) and those from the FK3, NFK (PETERS, 1907) and FC (AUWERS, 1879, 1883, 1897), respectively, are analysed with respect to a $\cos \alpha$ term.

Miss WILLIAMS (1947) discussed the differences between the proper motions from the General Catalogue (BOSS, 1937) and the Cape photographic zone motions (JONES and JACKSON, 1936, 1939). She found, on the assumption that only the latter were to be blamed for the differences in proper motions in right ascension, μ_α, a decidedly significant dependence upon apparent visual magnitude. This dependence was correlated with right ascension. In section 2 this problem is rediscussed and extended to other proper-motion systems. The attack of the problem differs from the customary one, used, e.g., by BROSCHE *et al.* (1964) in their discussion of the systematic differences FK4 − GC and FK4 − N30.

DELHAYE (1954) suggested an error in the proper motions of the General Catalogue which depends upon the magnitude. These errors show some dependence upon the right ascension. The source of this type of error was sought in the inhomogeneity of the material from which the General Catalogue is compiled.

In section 4 some general conclusions with respect to the differences between the FK4, the FK3, the NFK, and the FC systems of motions are given.

In general the stars were divided in groups according to right ascension and/or declination. On a few occasions I divided the stars according to three groups, depending on the difference in the observational history of the stars. When Auwers formed his FC, he published the results in three different papers. For each publication, a different set of catalogues was used to form this particular part of the fundamental catalogue. To maintain this difference in history, I decided to follow Auwers' division. Between $-80°$ and $+80°$ declination, the FK4, the FK3, the NFK, and the FC have the following numbers of stars in common (61 Cyg being omitted): 478 in the group, hereafter named N, with declinations from $-10°$ to $+80°$; 78 in the group, hereafter named M, with declinations from $-1°$ to

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$-31°$; and 271 in the group, hereafter named S, with declinations from $-21°$ to $-80°$.

2. Magnitude errors in proper motions

At the moment, these errors can only be detected through a comparison of motions from different, preferably independent, sources. Most sources are today —and this is particularly so for all systems depending on meridian-circle observations—not independent from each other, and failure to detect an error of a certain type by merely comparing the results from the different systems does not necessarily mean that such an error does not exist. If, on the other hand, a dependence of some sort can be traced, it is difficult to judge how large the error will be for each system.

It is to be hoped that at some time we shall have at our disposal a system of proper motions which is truly independent of the present-day meridian-circle observations, and free from magnitude equations. Perhaps long series of results from meridian circles working photographically (LAUSTSEN, 1967) or photo-electrically (HØG, 1960) will help us in this respect.

2.1. *The Cape photographic zone motions*

In her paper, Miss Williams offered sufficient details of the motions for the brighter stars—in which she was at that moment not interested—to draw some conclusions. From her table 3.I, one can obtain the differences

$$[\mu_\alpha(\mathrm{GC})-\mu_\alpha(\mathrm{Cape})]_{m\,=\,8.5} - [\mu_\alpha(\mathrm{GC})-\mu_\alpha(\mathrm{Cape})]_{m\,=\,8.5-x},$$

with $x = 1$ or 2, for every half hour in right ascension. These double differences are shown in figure 1. The smooth values of the first double differences, adopted by Miss Williams in her table 3.II, are indicated by crosses.

The following points should be recalled:

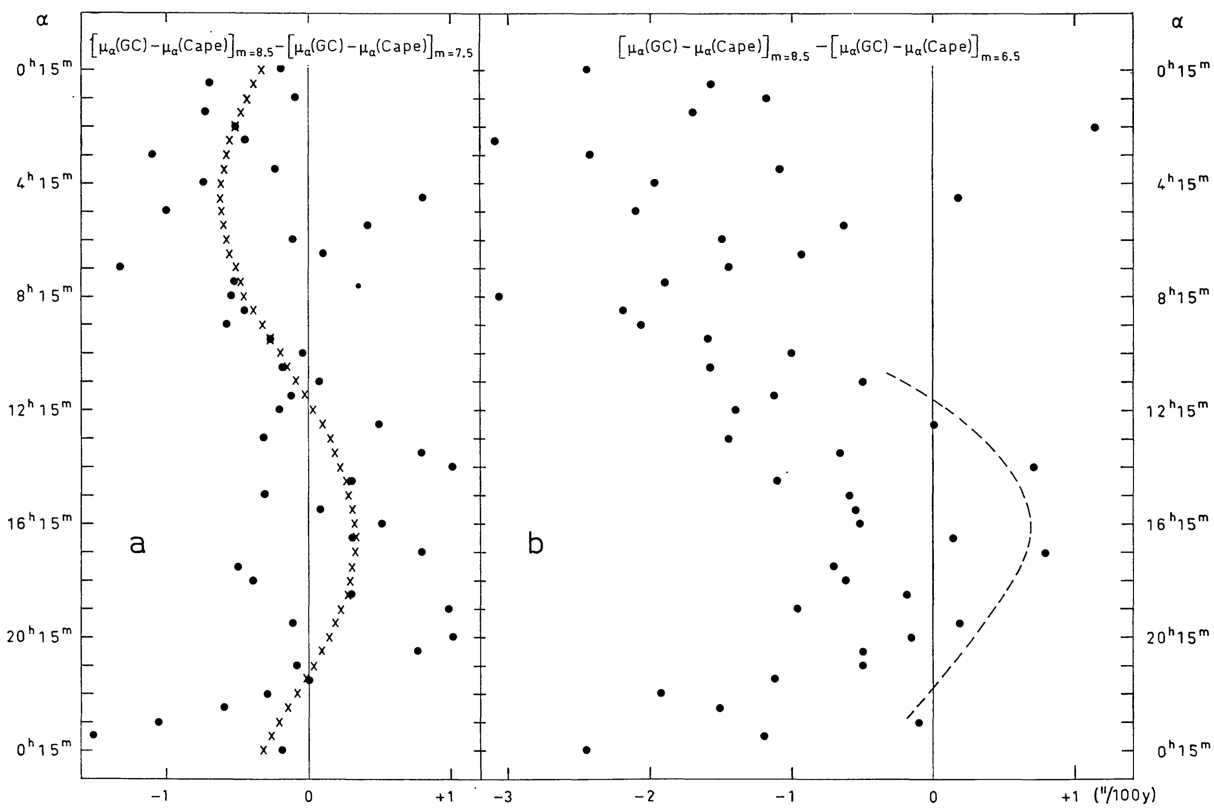

Figure 1. Double differences between proper motions taken from the General Catalogue and the Cape photographic zone motions, with respect to two different magnitude intervals: a) differences with respect to $m = 7.5$, and b) differences with respect to $m = 6.5$, compared with the difference in motions for $m = 8.5$.

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a) A magnitude error affects the positions of all the stars on a photographic plate in the same sense, acts as a systematic error.

b) For different plates, one usually hopes that these magnitude errors will be independent.

c) The Cape motions depend for each epoch upon positions from two overlapping plates for the marginal zones of one degree in declination, for all the other declinations upon three plates.

It is surprising that in an average of close to three plate pairs such large magnitude errors should have remained. The dependence of this error upon right ascension seems to me a serious problem, but may, perhaps, find its explanation in the following suggestion. If the driving mechanism of the Cape refractor has had different temperature dependence (change of lubricating oil?) at the two epochs, a temperature term could have been introduced in the proper motions in right ascension, which, via season, could to some extent show itself as a dependence on right ascension.

We expect the effect of a magnitude error to increase somewhat with decreasing magnitudes. In figure 1 (b) this seems to be true for the right ascension from 0^h till 12^h. From then on we notice that the magnitude error found by Miss Williams for the stars of $m = 7.5$ is not reproduced for the stars of $m = 6.5$ in the direction we should expect from remark a. The differences should have run according to the dashed line. The conclusion is that Miss Williams' tacitly made assumption of no magnitude error in the motions from the General Catalogue has to be reconsidered.

2.2. *Comparison of motions from FK4 and GC*

The stars between declinations $-28°$ and $-81°$ common to the FK4 and the GC have been used to obtain differences in μ_α and μ_δ for every hour of right ascen-

TABLE 1

Rates of differences of proper motions from various systems in seconds of arc per century per magnitude; stars arranged according to right ascension

$\langle\alpha\rangle$	FK4−GC ($-81° < \delta < -28°$)		FK4−N30 ($-81° < \delta < -28°$)				FK4−FK3 ($+28° < \delta < +80°$)			
	$\Delta\mu_\alpha/m$	$\Delta\mu_\delta/m$	$\Delta\mu_\alpha/m$		$\Delta\mu_\delta/m$		$\Delta\mu_\alpha/m$		$\Delta\mu_\delta/m$	
$0^h.5$	−0.24	+0.01	−0.07 ±	6	−0.10 ±	9	−0.02 ±	3	−0.05 ±	4
1.5	−0.18	−0.04	−0.21	6	+0.12	9	+0.08	5	−0.02	2
2.5	−0.28	+0.19	−0.32	14	−0.07	22	+0.18	6	+0.02	2
3.5	−0.12	−0.11	−0.11	8	+0.04	10	+0.15	4	+0.02	4
4.5	−0.10	+0.06	−0.01	23	+0.24	10	+0.14	5	+0.02	3
5.5	−0.24	+0.15	−0.21	8	−0.02	9	+0.10	2	−0.03	3
6.5	−0.11	−0.06	−0.24	10	−0.04	3	−0.08	7	−0.00	9
7.5	+0.16	+0.11	−0.21	10	−0.13	14	+0.00	7	−0.00	4
8.5	+0.09	+0.06	−0.08	24	+0.12	10	+0.17	7	−0.20	9
9.5	−0.13	−0.15	+0.08	13	+0.02	16	+0.10	6	+0.03	3
10.5	−0.01	+0.06	+0.09	10	+0.00	22	+0.01	5	+0.04	3
11.5	+0.22	−0.13	−0.22	8	−0.06	6	−0.00	4	+0.03	3
12.5	+0.07	−0.01	−0.08	3	−0.07	2	+0.05	4	+0.03	3
13.5	+0.09	+0.20	−0.20	3	−0.14	4	+0.12	6	−0.03	3
14.5	+0.05	+0.04	−0.25	7	−0.04	4	+0.04	2	+0.04	3
15.5	+0.18	+0.06	−0.32	10	−0.14	30	+0.01	6	−0.05	5
16.5	+0.12	−0.11	−0.09	13	−0.10	11	+0.07	9	+0.03	4
17.5	−0.18	+0.02	−0.27	16	+0.18	9	+0.06	5	+0.01	2
18.5	+0.02	−0.02	−0.46	6	+0.11	6	+0.06	9	−0.01	2
19.5	+0.30	+0.05	−0.18	18	+0.15	9	+0.09	7	−0.07	4
20.5	−0.23	−0.10	+0.09	6	−0.01	4	−0.03	2	+0.01	3
21.5	+0.18	+0.40	−0.00	12	+0.18	26	−0.03	3	−0.03	3
22.5	−0.28	+0.02	−0.17	8	−0.03	9	+0.01	4	−0.09	6
23.5	−0.20	+0.16	−0.83	42	+0.07	4	+0.03	6	+0.02	7

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sion. This southern zone was chosen, since one expects a minimum of smoothing where a minimum of telescopes is involved. With respect to the averages obtained for every hour of right ascension, a linear dependence upon visual magnitude was computed. These rates, $\Delta\mu_\alpha/m$ and $\Delta\mu_\delta/m$, are entered in table 1. The average standard deviation of such a rate is ± 0.09. The unit is, as everywhere, ″/100 y. There is evidence for a dependence of the rates $\Delta\mu_\alpha/m$ on the right ascension. This is certainly not the case for the rates $\Delta\mu_\delta/m$.

2.3. *Comparison of motions from FK4 and N30*

Table 1 gives the rates $\Delta\mu_\alpha/m$ and $\Delta\mu_\delta/m$ obtained from the hourly groups of differences of the motions in common to the FK4 and N30 (MORGAN, 1951). These rates were obtained in the same manner as indicated in section 2.2, except that the visual magnitudes were taken from the Catalogue of Bright Stars (HOFFLEIT, 1964). These magnitudes are more modern, and are likely to be more accurate than the magnitudes always reprinted in meridian-circle catalogues. One will notice that the rates $\Delta\mu_\delta/m$ do not show anything significant. The rates $\Delta\mu_\alpha/m$ have now 21 negative, and only 3 positive values. As the manner of sampling can have profound influence on computed correlations, and as the subdivision according to right ascension does not seem to have any physical meaning in this respect, the material was divided into 24 groups, practically equal in number of stars, but this time in sequence of decreasing declination. The resultant rates are given in table 2. The rates $\Delta\mu_\delta/m$ show again nothing particular. Of the rates in $\Delta\mu_\alpha$, 21 are again negative. I believe it is very difficult to escape from the suggestion that the proper motions in at least two of the three systems mentioned suffer from a magnitude error in μ_α. The frequency distribution of the ratios of the rate to its

TABLE 2

Rates of differences of proper motions from various systems in seconds of arc per century per magnitude; stars arranged according to declination

⟨δ⟩	FK4−N30 (−81° < δ < −28°) $\Delta\mu_\alpha/m$		FK4−N30 $\Delta\mu_\delta/m$		⟨δ⟩	FK4−FK3 (+28° < δ < +80°) $\Delta\mu_\alpha/m$		FK4−FK3 $\Delta\mu_\delta/m$	
−28°.7	−0.13 ±	5	−0.01 ±	5	+78°.2	−0.08 ±	7	+0.07 ±	6
−30.5	−0.18	7	+0.01	12	+75.3	+0.17	7	−0.01	4
−32.3	−0.41	14	−0.11	17	+72.3	+0.07	8	−0.00	4
−33.6	−0.07	10	+0.17	11	+69.1	+0.17	8	+0.02	3
−35.3	−0.15	10	+0.13	10	+66.4	+0.22	7	+0.03	5
−36.6	−0.10	6	+0.03	10	+63.3	−0.06	5	+0.01	3
−38.2	−0.24	8	+0.19	8	+60.5	−0.03	7	+0.02	3
−40.6	−0.41	12	−0.10	10	+58.0	+0.05	5	−0.01	4
−42.2	−0.11	12	+0.10	12	+56.0	+0.01	6	+0.05	2
−43.3	−0.12	8	+0.01	8	+53.6	+0.05	5	+0.04	3
−45.4	+0.16	12	−0.03	8	+50.9	+0.08	6	+0.02	3
−47.0	+0.01	11	−0.00	6	+48.8	+0.04	4	−0.02	4
−49.1	−0.09	12	+0.22	11	+46.9	+0.05	7	+0.04	5
−51.6	−0.20	11	−0.16	12	+45.4	+0.09	3	−0.00	2
−53.4	−0.24	13	−0.12	5	+43.6	+0.02	5	−0.03	4
−55.8	−0.30	9	−0.12	10	+41.6	+0.07	5	+0.06	4
−58.0	−0.08	9	−0.09	9	+40.4	+0.03	5	−0.01	4
−60.4	−0.10	8	−0.01	5	+38.8	+0.02	2	+0.00	2
−62.6	−0.13	13	−0.04	10	+37.4	+0.06	7	−0.03	8
−65.6	−0.11	13	+0.20	15	+35.7	+0.07	6	−0.20	6
−68.7	−0.26	10	−0.06	11	+34.0	+0.02	5	+0.06	3
−71.4	+0.06	13	+0.09	10	+32.6	+0.12	7	−0.00	6
−75.7	−0.28	27	−0.11	12	+30.9	−0.02	5	−0.08	5
−79.0	−0.47	19	−0.03	9	+29.0	+0.09	7	+0.02	2

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standard error is also significant in the sense that it is hard to accept the result as purely accidental. The total average rate for $\Delta\mu_\alpha/m$ in the differences for FK4 and N30 is -0.160 ± 0.026 (s.e.).

2.4. *Comparison of motions from FK4 and from FK3 and NFK*

After the results given in tables 1 and 2 were found, it was deemed interesting to go further back in time, and look for possible influences of the magnitudes on motions taken from the FK3 and the NFK compared with those from the FK4. The large uncertainty of the individual motions in the NFK is certainly responsible for standard errors in the computed rates from 3 to 6 times those found above. Nothing significant was therefore found. The differences $\Delta\mu_\alpha$ between FK4 and FK3 for the zone $-81° < \delta < -28°$ show some trace of the same effect, but not as convincing as for the previously mentioned set of differences.

Of the complete northern equivalent zone, with $+28° < \delta < +80°$, only the comparison of FK4 and FK3 gave a significant result for a correlation of the differences in μ_α with magnitude, irrespective of the grouping according to right ascension or declination.

2.5. *Comparison of motions from FK4 and N30 within the boundaries $2^h10^m < \alpha < 5^h10^m$ and $0° < \delta < +45°$*

Within the limits indicated, Wayman *et al.* (1965) have made a search for new members of the Hyades cluster. The catalogues FK4 and N30 have here 75 stars in common. The following table gives the averages of the (new) magnitudes, and of the differences of μ_α and μ_δ for five groups, each of 15 stars, arranged according to magnitude.

$\langle m \rangle$	$\langle \Delta\mu_\alpha \rangle$	$\langle \Delta\mu_\delta \rangle$
2.99	+0.026	+0.007
3.88	−0.067	+0.034
4.52	−0.043	+0.002
5.18	−0.137	−0.061
5.76	−0.174	+0.023

While the differences in motions in declination show no correlation, some correlation with magnitude can be suspected for the motions in right ascension. Figure 2 shows the relation between average magnitude and average difference in proper motion in right ascension, with the double standard error for each point. The computed rate $\Delta\mu_\alpha/m$ turns out to be -0.079 ± 0.014 (s.e.).

2.6. *Tentative explanation of the magnitude error in μ_α*

In the days of a fixed reticule the wires were always placed symmetrically with respect to the central wire, and the latter was kept as close as possible to the collimation axis. The introduction of the traveling-wire micrometer can have changed the habit of observing strictly symmetrically relative to the collimation axis. I have noted, for example, that with the Leiden meridian circle this symmetry was not maintained.

With asymmetrical observations it is not certain that aberrations remained small enough to be disregarded completely. Coma terms, and, perhaps, first-order spectral aberrations may depend on magnitude, and the possibility of the existence of a number of catalogues comprising these small systematic errors cannot be

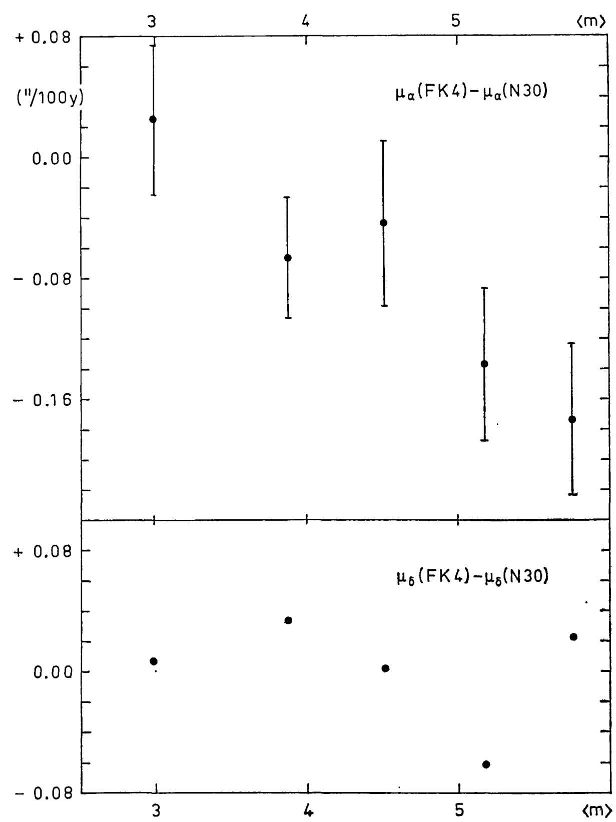

Figure 2. Dependence on the visual magnitude of the differences in μ_α and μ_δ from the FK4 and the N30 for the area $2^h10^m < \alpha < 5^h10^m$, and $0° < \delta < +45°$.

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excluded a priori. This might explain the absence of a correlation term of the form $\Delta\mu_\delta/m$, as declinations are always observed on a horizontal diameter in the field, or very near to it. Aberrations are considered to be radially symmetric, so no term of this kind will arise in the observations of declinations.

In deriving the correlation between μ_α and m use has been made of the nominal values for the magnitudes. In reality, in the majority of cases, some kind of attenuator is used to diminish the apparent brightness of the brightest stars. The observational effect will, therefore, be more pronounced in reality than has been found in this article. It is highly to be recommended that astronomers publish the average apparent brightness of the stars during their observations. Without the knowledge of this parameter, the study of magnitude effects remains almost impossible.

3. Differences in μ_δ of the form H cos α between FK4, and FC, NFK and FK3

It seemed worth while, in view of Oort's suggested correction of -0.14 cos α to the centennial μ_δ's from the FK3, to investigate the differences in μ_δ from the FK4 on the one hand, and the FC, NFK and FK3 on the other. The solutions for C and H from equations of condition of the form μ_δ(FK4)$-\mu_\delta$(older catalogue) $= C+H$ cos α were found for each of the three groups of stars, N, M and S, defined in section 1. The following table gives the results for H, again with standard errors.

	N		M		S	
FK4–FC	+0.039 ±	0.08	+0.126 ±	0.18	+0.001 ±	0.11
FK4–NFK	+0.039	0.025	−0.006	0.071	+0.121	0.081
FK4–FK3	−0.058	0.012	−0.085	0.025	−0.115	0.022

TABLE 3

Average differences d of proper motions in α and δ for the three groups of stars N, M, S defined in section 1 and for four magnitude intervals; m_1 means $m \leq 2.50$, m_2: $2.51 \leq m \leq 3.50$, m_3: $3.51 \leq m \leq 4.50$, m_4: $m \geq 4.51$; σ = r.m.s. deviation/$n^{\frac{1}{2}}$; unit: ″/100 y. The numbers of stars are given in parentheses

	N				M				S			
	m_1 (39)	m_2 (76)	m_3 (177)	m_4 (186)	m_1 (9)	m_2 (21)	m_3 (30)	m_4 (18)	m_1 (24)	m_2 (52)	m_3 (87)	m_4 (108)
					μ_α(NFK)$-\mu_\alpha$(FC)							
$\langle d\rangle$	+0.95	+0.99	+1.07	+0.76	+1.19	+1.42	+1.79	+1.80	+0.58	+0.95	+1.02	+1.23
σ	0.121	0.107	0.107	0.160	0.133	0.204	0.183	0.376	0.165	0.104	0.120	0.150
$\langle \lvert d\rvert\rangle$	1.05	1.15	1.45	1.71	1.19	1.52	1.82	2.05	0.82	1.02	1.21	1.54
					μ_α(FK3)$-\mu_\alpha$(NFK)							
$\langle d\rangle$	−0.33	−0.36	−0.31	−0.34	+0.51	+0.33	+0.26	+0.21	+0.84	+0.73	+0.90	+0.96
σ	0.047	0.040	0.029	0.038	0.158	0.085	0.095	0.177	0.133	0.108	0.104	0.117
$\langle \lvert d\rvert\rangle$	0.34	0.41	0.40	0.47	0.56	0.42	0.47	0.52	0.88	0.88	1.08	1.22
					μ_α(FK4)$-\mu_\alpha$(FK3)							
$\lvert d\rvert$	−0.07	+0.06	+0.07	+0.18	−0.34	−0.37	−0.30	−0.02	+0.01	+0.01	+0.12	+0.13
σ	0.042	0.029	0.017	0.019	0.098	0.072	0.063	0.051	0.081	0.043	0.043	0.058
$\langle \lvert d\rvert\rangle$	0.22	0.20	0.19	0.26	0.37	0.39	0.34	0.17	0.31	0.25	0.34	0.44
					μ_δ(NFK)$-\mu_\delta$(FC)							
$\langle d\rangle$	−0.54	−0.64	−0.51	+0.10	−0.48	−0.50	−0.75	−0.85	+0.12	−0.25	+0.10	+0.19
σ	0.165	0.107	0.072	0.105	0.226	0.213	0.157	0.228	0.160	0.109	0.106	0.126
$\langle \lvert d\rvert\rangle$	0.91	0.96	0.87	1.04	0.58	0.91	0.97	1.06	0.64	0.63	0.77	1.03
					μ_δ(FK3)$-\mu_\delta$(NFK)							
$\langle d\rangle$	+0.14	+0.26	+0.31	+0.17	+0.12	+0.24	+0.00	+0.18	+1.04	+0.94	+0.95	+0.82
σ	0.077	0.034	0.030	0.034	0.124	0.077	0.072	0.167	0.174	0.101	0.094	0.106
$\langle \lvert d\rvert\rangle$	0.33	0.90	0.42	0.39	0.25	0.31	0.34	0.46	1.11	0.98	1.11	1.09
					μ_δ(FK4)$-\mu_\delta$(FK3)							
$\langle d\rangle$	+0.01	+0.02	−0.02	+0.03	−0.08	−0.02	−0.13	−0.08	−0.22	−0.21	−0.17	−0.25
σ	0.018	0.016	0.011	0.013	0.045	0.030	0.037	0.044	0.042	0.023	0.026	0.038
$\langle \lvert d\rvert\rangle$	0.09	0.11	0.12	0.15	0.12	0.11	0.18	0.16	0.26	0.23	0.24	0.35

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It turns out that the first two comparisons yield no significant answers. From the last line in the table one might infer that either the FK4 is not yet free from an error of the type indicated by Oort, or the derived value of -0.14 was not applicable to the whole of the FK3. As the value of H depends on the distribution in longitude of the participating observatories, it seems not unlikely that H would vary for different groups of stars.

4. Miscellaneous results derived from comparisons of motions from FK4, FK3, NFK and FC

When one writes down the motions of the 827 stars between the declinations $-80°$ and $+80°$ common to the four systems, that is, all the stars except 61 Cyg, divided according to four magnitude groups and type of early history of the observations (defined by N, M and S), a few conclusions can be drawn from the averages such as given in table 3. The greatest change occurred from the FC to the NFK. Changes brought about by adopting the FK4 instead of the FK3 are small. One may wonder how much the change will be if at some time an FK5 is introduced. It looks as if we are oscillating already around values which change little. The southern stars are not yet at this point, and this proves again that another set of continuous observations in the South belongs to the work most needed in the next forty years.

To probe this a little further, a count was made of the stars showing considerable agreement amongst the motions in all four catalogues, in the last three, and, finally, in the last two. The limits for rejection were different for the different counts, depending somewhat on the accuracy of the least accurate catalogue involved. Thus, table 4 gives the number of stars whose proper motions in none of the four catalogues differ more than 0.35 from the straight average of the four values. In counting the number of stars which the FK4, FK3 and NFK have in common, this limit was diminished to 0.30, and in the counting of stars common to the FK4 and FK3, the limit was put at 0.15. The last two counts contained 25 extra stars, which had been added to the NFK (in group M) and were retained in the two later catalogues. Table 4 gives the total numbers of stars, n, and the percentages for the three groups N, M and S. The number of motions which underwent

TABLE 4

Similarity of motions taken from a number of combinations of the catalogues FK4, FK3, NFK and FC for the stars in the groups N, M and S defined in section 1; the number of stars in a group considered is in parentheses

μ_α N	μ_α M	μ_α S	μ_δ N	μ_δ M	μ_δ S
Percentage of stars common to the FK4, FK3, NFK and FC with proper motions not deviating more than 0.35 (″/100 y) from the mean of the four motions					
11 (478)	3 (78)	3 (271)	21 (478)	22 (78)	8 (271)
Percentage of stars common to the FK4, FK3 and NFK with proper motions not deviating more than 0.30 (″/100 y) from the mean of the three motions					
56 (478)	43 (103)	16 (271)	66 (478)	65 (103)	22 (271)
Percentage of stars common to the FK4 and FK3 with proper motions not deviating more than 0.15 (″/100 y) from the mean of the two motions					
74 (478)	62 (103)	55 (271)	92 (478)	79 (103)	64 (271)

a minimum of change, from one system to another, is decidedly lower for μ_α than for μ_δ. If we believe that the proper motions in declination are inferior to those in right ascension (a thought often advocated in the past), we must come to the conclusion that our observations of declinations need to be carefully scrutinized. For if this view is correct, it appears from table 4 that our observations continue to be influenced by the same type of systematic errors.

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