RELATIVE DISTANCES OF THE COMPONENTS *C* FROM THE PAIR *AB* IN THE VISUAL TRIPLE SYSTEMS

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Summary: The centre of accumulation of the relative distances of the components *C* from the pairs *AB* in the visual triple systems has approximately been determined. From the distribution of the logarithm of the ratio of relative distances: $\log(\rho_{AB\text{-}C}/\rho_{AB})$, it is inferred that the grouping of these distances is centered around the value $\rho_{AB-C}/\rho_{AB} \approx 7$.

It is a well known fact that „......., as a rule, triple systems, whether visual or spectroscopic, consist of a close binary pair and a companion relatively distant.", (Aitken, R., 1963). But about what relative distances is the matter is not specified by R. Aitken, nor has this been done, to my knowledge, in other, later, papers.

With A. N. Deutsch (Deutsch, A. N., 1963) we find a more definite indication: „Among triple and multiple pairs a great majority represent the systems, ..., in which pairs are separated from other pairs or single stars by distances, considerably exceeding the scale of orbits of the binary components".

The object of this paper is to determine more definite „relative distances of the companions" in Aitken's words, i.e. „distances considerable exceeding the scale of orbits of the binaries in the systems" (Deutsch).

The number of systems with *certain* evidence that all three components are forming a system is statistically unsuficient, still less that of systems whith known inclinations of the orbits of component *C* relative to the orbite of the close pair *AB*.

For these reasons, approaching the solution statistically, we are compelled to assume the complanarity of the components in the system, as well as the fact that the results will, to some extent, be burdened by the effect of the optical components *C*.

The present study is based upon the triple systems listed in the *ADS* Catalogue (Aitken, R., 1932), designating the multiples by *AB* — *C* or *A* — *C*, which means that *C* is a „companion" of the close pair *AB*. The combination *A* — *BC* is not considered here. It appears less frequently, but a considerable distance of the close pair BC from the component A is evident there too. The study comprises 946 systems, divided into three groups:

a) 448 systems with $\rho_{AB} < 1''$
b) 268 systems with $1'' \leqslant \rho_{AB} < 2''$
c) 230 systems with $2'' \leqslant \rho_{AB} < 3''$

For all three groups the distribution of $\log(\rho_{AB-C}/\rho_{AB})$ is found, using the interval 0.1 of the logarithme. The results are shown in Table 1 and Fig. 1. The Table presents the numerical (N) and percentage (%) distribution.

Table 1

Numerical (N) and percentage (%) distribution of relative distances C (ρ_{AB-C}/ρ_{AB}) according to ADS Catalogue

Intervals ρ_{AB-C}/ρ_{AB}	Intervals $\log(\rho_{AB-C}/\rho_{AB})$	$\rho<1''$ N_1	%	$1''\leq\rho<2''$ N_2	%	$2''\leq\rho<3''$ N_3	%
— 1.3	— 0.10	0	0.00	2	0.74	1	0.43
1.3 — 1.6	0.10 — 0.20	1	0.22	0	0.00	1	0.43
1.6 — 2.0	0.20 — 0.30	1	0.22	1	0.37	5	2.17
2.0 — 2.5	0.30 — 0.40	1	0.22	2	0.74	6	2.61
2.5 — 3.2	0.40 — 0.50	1	0.22	7	2.61	9	3.91
3.2 — 4.0	0.50 — 0.60	2	0.45	3	1.12	13	5.65
4.0 — 5.0	0.60 — 0.70	3	0.67	10	3.73	14	6.09
5.0 — 6.3	0.70 — 0.80	12	2.68	16	5.97	21	9.13
6.3 — 8.0	0.80 — 0.90	17	3.79	23	8.58	18	7.83
8.0 — 10.0	0.90 — 1.00	15	3.35	18	6.72	15	6.52
10.0 — 12.6	1.00 — 1.10	9	2.01	17	6.34	21	9.13
12.6 — 15.8	1.10 — 1.20	24	5.36	23	8.58	21	9.13
15.8 — 20.0	1.20 — 1.30	27	6.03	29	10.82	13	5.65
20.0 — 25.1	1.30 — 1.40	29	6.47	26	9.70	21	9.13
25.1 — 31.6	1.40 — 1.50	40	8.93	21	7.84	13	5.65
31.6 — 39.8	1.50 — 1.60	42	9.38	19	7.09	11	4.78
39.8 — 50.1	1.60 — 1.70	29	6.47	16	5.97	9	3.91
50.1 — 63.1	1.70 — 1.80	43	9.60	10	3.73	10	4.34
63.1 — 79.4	1.80 — 1.90	22	4.91	10	3.73	7	3.04
79.4 — 100.0	1.90 — 2.00	25	5.58	6	1.63	1	0.43
100.0 — 125.9	2.00 — 2.10	34	7.59	6	1.63	0	0.00
125.9 — 158.5	2.10 — 2.20	18	4.02	1	0.37	0	0.00
158.5 — 199.6	2.20 — 2.30	15	3.35	1	0.37	0	0.00
199.6 — 251.2	2.30 — 2.40	17	3.79	1	0.37	0	0.00
251.2 — 316.4	2.40 — 2.50	9	2.01	0	0.00	0	0.00
over 316.4	2.50 —	12	2.68	0	0.00	0	0.00
		448		268		230	

As already stated, this distribution is a combination of two independent distributions: one originating from the triple systems in which the component C is physically bound to the pair AB and the other originating from the triple systems with the optical component C.

The existence of a combined distribution is most noticeable in the group *b*. Secondary maxima in all three groups take place for the same value of $\log(\rho_{AB-C}/\rho_{AB})$ while absolute maxima are shifted from the greater (Group *a*) to the lesser values of $\log(\rho_{AB-C}/\rho_{AB})$ (Group *c*).

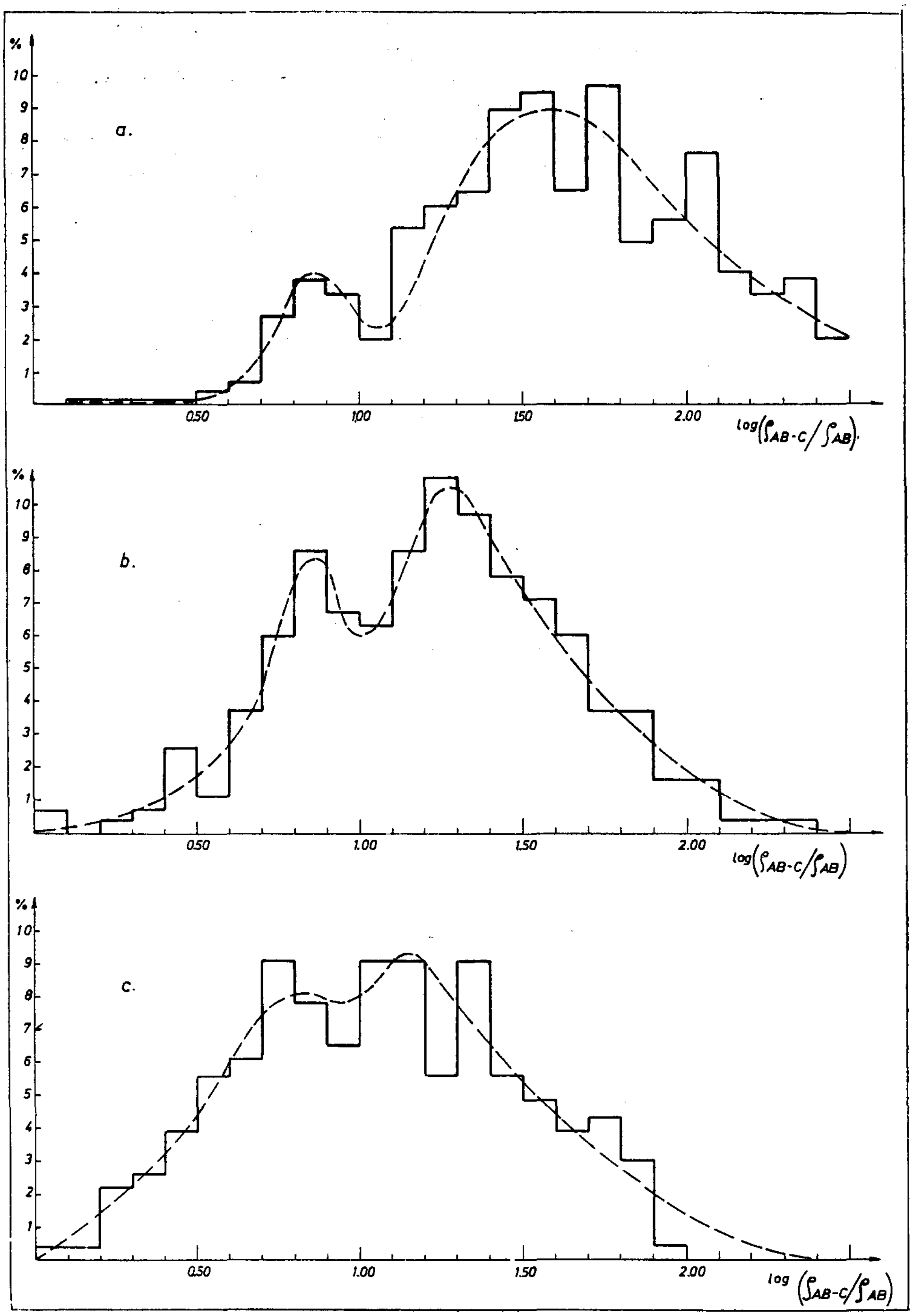

Fig. 1

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The distance of the optical component C from the pair AB, ρ_{AB-C}, is a random and from ρ_{AB} independent quantity, but the distribution of $\log(\rho_{AB-C}/\rho_{AB})$ depends upon the interval within which ρ_{AB} lies. This dependence finds its expression in the shifting of the absolute maxima.

The distribution of relative distances of the components C, physcally bound to the system, reaches its maximum for the same value of $\log(\rho_{AB-C}/\rho_{AB})$, the independent quantity being now the ratio ρ_{AB-C}/ρ_{AB}, consequently no change is brought about in the distribution by passing from one group to another.

From Table 1 and Fig. 1 we may conclude that the centre of the distance concentration of the physical components C from the pairs AB in the visual triple systems is placed in the interval 0.80—0.90 of $\log(\rho_{AB-C}/\rho_{AB})$, i.e. at the value 6.3—8.0 of the ratio ρ_{AB-C}/ρ_{AB}. Thus we are led to accept the average, statistically deduced, relationship:

$$\overline{\rho_{AB-C}} \approx 7\,\bar{\rho}_{AB}.$$

REFERENCES

Aitken R., 1932: New General Catalogue of Double Stars, Vol. I, II, Washington, 1932.

Aitken R., 1963: The Binary Stars, New York, 1963.

Deutsch A. N., 1962: Kurs astrofiziki i zvezdnoj astronomii II, Moskva, 1962.