7.4. Error values in the Almagest star catalogue. Computer calculations resulted in the following values of minimal mean-square errors (they practically do not depend on t):

$$\delta_A^{\min} = 16.5'; \qquad \delta_B^{\min} = 19.2';$$
$$\delta_{\mathrm{Zod}\,A}^{\min} = 12.8'; \qquad \delta_{\mathrm{Zod}\,B}^{\min} = 19.3';$$
$$\delta_C^{\min} = 22.5'; \qquad \delta_D^{\min} = 24.4';$$
$$\delta_M^{\min} = 20.5'.$$

It follows that the region Zod A is the most well-measured one in the star atlas. One can see the curve $\hat{\gamma}_{\mathrm{Zod}\,A}(t)$ (which, in fact is a line) in Fig. 116. This curve is contained in the tolerance set corresponding to a confidence level $\epsilon = 0.05$. Similar curves were obtained for all the other regions. We also calculated all functions $\hat{\varphi}_R(t)$. An example can be seen in Fig. 116.

These calculations confirmed that the corresponding values $\hat{\beta}_R$ (which can be obtained from $\hat{\gamma}_R$ and $\hat{\varphi}_R$) are rather small ($|\hat{\beta}_R| < 5'$), i.e., $\beta \ll \gamma$.

But the tolerance sets for the curves φ are very wide (about 40°). This fact indicates the "nonsystematic" nature of the parameter φ. Indeed, the calculated value $\hat{\varphi}_{\mathrm{Zod}\,A}$ is only the average of the individual values φ_G for six zodiacal constellations (from G_1 = Gemini to G_6 = Scorpius). This fact can be considered as an indirect confirmation of the hypothesis that measurements were made by some instrument fixing an angle between the ecliptic and the equator (of course, with some error in the value of this angle). It is also probable that the axis of the rotation was fixed each time a measurement occurred. One such ancient instrument is the well-known "astrolabe" or "armillary sphere" described by Ptolemy.

Now let us turn to the procedure of testing the hypothesis that the value $\hat{\gamma}_{\mathrm{Zod}\,A}$ determined by our calculations is common for all constellations in Zod A, i.e., this value really represents the group error. For each constellation G in Zod A, we calculate and compare the corresponding "initial" error $\delta_G^{\min} = \delta_G(t, 0, 0)$, "minimal" error $\delta_G^{\min}(t)$ and an error δ_G^{gr}, which results after rotation over the angles $\hat{\gamma}_{\mathrm{Zod}\,A}(t)$ and $\hat{\varphi}_{\mathrm{Zod}\,A}(t)$, i.e.,

$$\delta_G^{\mathrm{gr}} = \delta_G\big(t, \hat{\gamma}_{\mathrm{Zod}\,A}(t), \hat{\varphi}_{\mathrm{Zod}\,A}(t)\big).$$

The result is shown in Fig. 117 for $t = 100$ A.D. Similar calculations were made for all t. We can see from Fig. 117 that the resulting effect induced by the "optimal" individual rotation for each individual constellation practically coincides with the effect induced by the "common" rotation calculated for the total Zod A. We can also see the additional confirmation of the nature of the group error $\hat{\gamma}_{\mathrm{Zod}\,A}(t)$ in Fig. 118 where we demonstrate graphs of the percentages of the stars with latitude deviations not exceeding 10′ after a corresponding "optimal" rotation (see $p_G^{\min}$) and without rotation (initial percentage p_G^{in}).

We also investigated the neighbourhoods of eight named stars: Antares, Arcturus, Aselli, Lyra, Capella, Regulus, Spica. Two of these stars (Arcturus and Procyon) have a large velocity of proper motion.

It turned out that the group errors for all these stars are the same (or very close) as those for the stars in Zod A. Numerical data contained in the star catalogue