astronomical instruments. Thus the term "recalculation" is to be interpreted very broadly, including as it does, formulas, globes, instruments and so on. In any case, in order to compile a catalogue using ecliptical coordinates, the astronomer must know the position of the ecliptic and the position of the axis of the equinox OC in the epoch to which the catalogue is to be reduced (Fig. 113). This position is known with some error τ_1 (in the general case). The error in the calculation of the point C (along the ecliptic) induces the *systematic* rigid translation of the longitudes of all stars. Next, the astronomer may make a mistake τ_2 in the definition of the longitudes of the stars simultaneously. These two errors are summed to arrive at the systematic error in the longitude $\tau = \tau_1 + \tau_2$.

The next possible systematic error is induced by translation (shift) of the equinox point C along the meridian. In other words, it is the error in the latitude of the point C, since this point is translated from the equator. This error is denoted by β in Fig. 114. Instead of β, we can introduce a parameter φ, which is an angle between the real axis of the equinox and the line of intersection of the equatorial plane with the "catalogue's" ecliptical plane, see Fig. 114.

These two errors, β and τ (or φ and τ), totally describe all possible translations of the point C on the sphere: any error is some combination of β and τ (or φ and τ).

A third error, which we denote by γ, may appear in the calculation of the angle ε between the equator and the ecliptic (Fig. 113). In other words, γ is the error in the calculation of the position of the pole of the ecliptic on the celestial sphere.

All these errors were included in our calculation formulas and in the equations of the ecliptic motion. In addition, all possible pairs β, γ were tested in the calculation process. By varying β and γ, we can slightly shift (or swing) the ecliptical coordinate system. It is clear that any rotation of the celestial sphere can be decomposed into the product of three orthogonal rotations defined by the parameters τ, β, and γ. Thus, they include all other possible systematic errors (if they occur).

The possibility of systematic errors in the Almagest has been discussed by many authors, see [320], [321], and [13]. Let us summarize the results of these discussions.

The error τ can be induced by the observer's attempt to reduce a star catalogue to some date other than the actual date of observation. The catalogue of Tycho Brahe, for example, was reduced to the "perfect" calendar date of 1600 A.D. Or the astronomer may try to hide the real date of observation by reducing his catalogue to another epoch [321], [13]. Practically, such a translation (shift) of a catalogue is realized in a very simple way: it is sufficient to add some constant (corresponding to precession) to the longitudes of all the stars in the catalogue.

Sometimes the error τ is a consequence of a change in the starting point for the calculation of longitudes. Ancient astronomers did calculate longitudes starting from different initial points on the ecliptic—Copernicus, for example. This change required the addition of some constant to the longitudes of all the stars.

What about the errors β and γ? The equatorial latitudes of the stars can be determined from the observations in such a simple and exact way (see [321]) that we may assume that the error β (at the time of the actual observation, of course) must be practically zero. In other words, $\beta \approx 0$.

The error γ has quite a different character. Accurate determination of the ecliptic