random error cannot be predicted, the averaging of a number of readings can help to determine the magnitude of that error.

Composite errors

Faults, systematic (and semi-systematic) errors and random errors may exist in combination, in which case the error distribution may look like that shown in Fig. 16–4. The bell-shaped pattern of random errors is explained in the annex to this chapter.

Systematic errors shift the random distribution curve to the left or right of the correct value. A fault can be of any size, and therefore the distribution may be represented by a straight line, so adding a 'skirt' to the normal distribution.

In navigation, it is always possible for all these errors to exist in combination. Faults, systematic and semi-systematic errors can, however, be reduced, eliminated or allowed for, leaving in many cases only the random error to be dealt with. Random errors arc considered as being in one or two dimensions; these are discussed below.

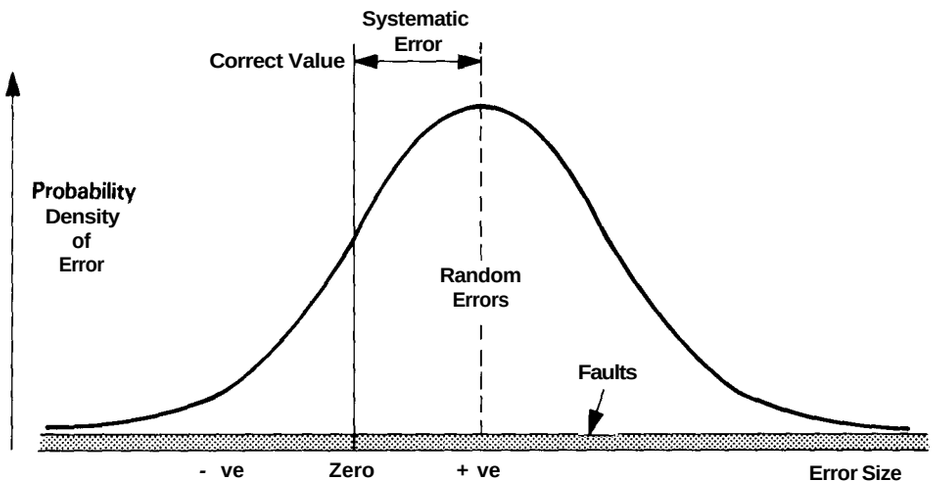

Fig. 16-4. Combined errors

In practice, the navigator may not have the time nor the information to analyse the nature of the errors experienced, nor to calculate them. If, however, he understands these concepts, he is better equipped to determine his Position Probability Area (PPA) and his Most Probable Position (MPP). For example, he should look upon his Estimated Position (EP) not so much as a position but rather as a 95% probability circle with a radius appropriate to the situation and expanding with time. If he considers his estimate of speed along the track to be less reliable than his estimate of the ground track itself, he may decide to change his Position Probability Area from a circle to an ellipse, the longer axis being along the track.

Random errors in one dimension

Consider a ship making good an actual ground track of 090° (Fig. 16–3). Her position is fixed at various times by some navigational aid. Each fix includes random errors which cause it to fall either north or south of the actual track.