



Having done all you can on your own, the next thing to do is to ask Grumpy. Most of us have a colleague whose chief talent lies in destructive criticism—ask him politely (it is usually a him) what he thinks of your experiment. (Do not despair at the response! Before you decide to drop science and take up knitting instead, have a stiff drink and a good night's sleep, after which his critique of your experiment will seem less devastating.) Naturally, such consultation is most effective at the planning stage of an experiment, as foreseen systematic effects can be countered by suitable design, or arranged to be monitored by suitable measurements.

The most vicious systematic errors are the ones you did not anticipate, such as an electronics component failing halfway through your experiment. You have two ways to defend yourself against this aspect of the basic hostility of things. The first is the use of consistency checks, if necessary repeatedly during the course of the experiment. The second is to randomise the order in which data are taken. Various nasty effects (electronics drifts, temperature drifts, and even psychological changes in the experimenter) are largely functions of time. If you take your data in an orderly sequence then this will become a systematic effect. Chopping and changing the order does not destroy these effects, but it renders them random rather than systematic.

The correct procedure depends on what you are trying to measure. This is very important in dealing with hysteresis effects in the apparatus (e.g. from adjustable controls with backlash). Measuring or setting the value of a quantity from below generally gives a different result than when approached from above. Thus, if the absolute values are important, such adjustments should be alternately done from above and from below, which will convert the systematic effect into a random one. On the other hand, if you are interested in a slope, i.e. the differences between two values is what matters, then the adjustments should all be made from the same side, as the systematic effects will cancel.

- aus R. J. Barlow **Statistics**

## 4. Fehler von Messungen

### 4.1 Was sind Fehler?

### 4.2 Zentraler Grenzwertsatz

### 4.3 Fehlerfortpflanzung

### 4.4 Systematische Unsicherheiten