The theory of electron transport has been presented in the earlier chapters in all its complexity. The characteristics of important transport phenomena have also been described. We have not, however, considered any detailed experimental results or discussed how far the theory explains the available results. The total number of compound semiconductors is very large. There are about twelve important III-V compounds, six II-VI compounds, three IV-VI compounds and innumerable kinds of mixed and chalcopyrite compounds. It is impossible to discuss the transport properties of all these materials, nor would such coverage be meaningful at this stage, since reproducible data for well-characterised samples are generally not available. The data reported in the literature are mostly obtained by using available samples, which are not often in perfectly crystalline form and may be very impure, with unknown impurity concentration. The samples have been characterised by stating the electron concentration determined from the value of the Hall coefficient by assuming that the Hall factor is unity. This assumption may introduce an error of about 10-20% in the values of the electron concentration. Even if this error is ignored there remains a factor of greater uncertainty. The experimental samples are mostly compensated and the impurity concentration may be radically different from the electron concentration. We find on plotting the transport parameters against electron concentration that the data points are...
scattered within ranges differing by orders of magnitude. As an illustration, we have plotted in Fig.12.1 experimental results on electron mobility in gallium arsenide for a lattice temperature of 77 K. Agreement of theory with such data may be accepted only for a qualitative verification. In some cases even such verification may be important, for a confirmation of a scattering model of a material, the physical constants of which are completely unknown. However, transport theory with all its refinements as presented in this book should be useful for predicting the transport coefficients with greater significance. Encouragingly, in recent years, some experiments have been carried out in which the Hall coefficient of the samples was also studied at very low temperatures, where the impurity atoms are partially ionised. It is possible to obtain the acceptor as well as the donor concentration from the analysis of such data by assuming a single donor ionisation energy level as is usually the case. The samples for such experiments are characterised by stating both the donor and the acceptor concentration and the total impurity concentration for samples of such experiments are also known. A detailed comparison with theory is meaningful for such experiments only.

From the above considerations, we have chosen to present in this chapter results on the transport coefficients of compound semiconductors for which experiments were conducted with samples of known impurity content or of very pure form with negligible contribution from impurity scattering. Our discussion will be confined mostly to the Hall mobility and the low-field galvanomagnetic coefficients. We shall also present data on free-carrier absorption, as such data have been very useful in identifying the scattering mechanisms. The thermal transport coefficients are discussed for materials for which data are available. A discussion of the coefficients for quantising magnetic fields is omitted as it has been partially covered in Chap.10 and also because no elegant method has yet been developed for the accurate calculation of the coefficients for practical samples. Experimental results on hot-electron transport, wherever available, have already been presented and we shall not discuss these results any further.

We shall present calculated values of the coefficients along with the experimental results to indicate the applicability of the theory. The theoretical evaluation of the coefficients requires knowledge of a large number of physical constants, namely, mass density, lattice dispersion relations, dielectric constants, elastic constants, energy band diagrams, and deformation potentials. All the constants except the deformation potentials may be determined by physical measurements (see [12.1]). There is as yet no unambiguous method of determination of the deformation potentials. Some theoretical me-