Preface to the Second Edition

Some errors and misprints that were found in the first edition of this work have been corrected. Although the impetus of the work is on the geometrical properties of charged-particle optics, we have included sections on the propagation of electron waves in macroscopic fields and on the Aharanov–Bohm effect in Chap. 2. The incorporation of wave-optical considerations has been necessary for deriving the resolution limit of electron microscopes and for understanding diffraction and interference phenomena utilized in electron holography.

Chapter 3 has been extended by a section on the calculation of static electromagnetic fields by means of the charge-simulation method. To elucidate the imaging properties of electron lenses in more detail, we have added in Chaps. 4 and 8 the imaging properties of the Glaser model field for a magnetic round lens because this field yields analytical expressions for the paraxial rays and the primary aberrations. Moreover, we have incorporated in Chap. 6 a section on the formation and classification of caustics because they are nowadays widely used for determining the state of alignment of aberration-corrected electron microscopes. Owing to its importance for the performance of systems corrected for primary chromatic and geometrical aberrations, we have added in Chap. 8 a section on fifth-order aberrations of multipole systems with straight axis.

We have added extensive new material to Chap. 12 and rewritten Chap. 14 on relativistic electron motion eliminating several inaccuracies. In particular, we have included aspects of the Stern–Gerlach effect and depicted Lorentz transformations within the frame of relativistic electron motion in Minkowski space. The last chapter is entirely new and discusses the effect of velocity and acceleration on the electromagnetic field of a moving charged particle. We treat this difficult problem by introducing the self-action of the particle in a covariant form. An appendix is added containing a list of symbols used frequently.

I am grateful to several readers who drew my attention to errors and misprints in the first edition and to Mrs. Anna Zilch for skilful drawing of many new figures.

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