SUGGESTED REFERENCES

M. BORN, *Mechanics of the Atom.* Perturbation theory for classical mechanics wears somewhat different faces, depending on whether one's interest is in physics, celestial mechanics, the flight of space vehicles, or modern mathematics. Until recently physics textbooks tended to follow closely Born's treatment, itself the product of the development of the "old" quantum mechanics. Born's discussion, mainly of time-independent perturbation theory, is to be found principally in his Chapter 4, but there are various bits and pieces scattered through the book.

E. J. SALETAN AND A. H. CROMER, *Theoretical Mechanics.* This reference is cited as one of the better treatments along the line of Born. Only time-independent perturbation is described. Some examples, mainly referring to the harmonic oscillator, are considered in detail. There is also a short section on adiabatic invariants.

J. M. A. DANBY, *Fundamentals of Celestial Mechanics.* Once past the level of Kepler and most of Newton, celestial mechanics consists almost entirely of perturbation theory and the three-body problem. The literature on perturbation theory in celestial mechanics is therefore practically coextensive with that on celestial mechanics itself, and any citations must be highly selective. Danby's text is a relatively recent (1962) exposition of what might be called the classical version of perturbation theory, with up-to-date applications. It is unusually lucid for a field that generally runs to solid pages of formulas, and it has an extensive annotated bibliography. The von Zeipel method is not mentioned, nor are more modern developments such as the use of Lie series.

B. GARFINKEL, *Lagrange-Hamilton-Jacobi Mechanics*, in *Space Mechanics*, *Part 1*, ed. by J. B. Rosser. Ten concise and densely packed pages in this article describe perturbation theory as viewed by an expert in celestial mechanics. Assuming a background in canonical transformation theory and the Hamilton-Jacobi equation, it sweeps breathlessly from variation of constants to von Zeipel's method. It may be all you want.

Y. HAGIHARA, *Celestial Mechanics*, *Vol. 2*: *Perturbation Theory* (in two parts). In contrast, this reference covers the applications of perturbation theory to celestial mechanics in exhaustive detail, requiring some 900 pages. References to the current and historical literature appear to be nearly complete. If you want to find out what has actually been done in using perturbation techniques to solve the problems of celestial mechanics, this seems to be the place to look, although the text in words (what there is of it) is occasionally hard to follow. The Lie-series reformulation of the von Zeipel method is here, but the modern approach to stability theory is reserved for another volume.

R. DEUTSCH, *Orbital Dynamics of Space Vehicles.* It may be contested whether space technology provides an area of classical mechanics distinct from celestial mechanics. Perhaps the separation lies in the observation that "space mechanics" was born with a computer in its mouth. This reference for the most part reads like a textbook in celestial mechanics, and a good one at that. Various methods of perturbation theory are described in detail, including the specialized ones such as Hansen's method. The applications, however, mostly arise from space technology, as, for example, perturbation of artificial satellite orbits.

G. E. O. GIACAGLIA, *Perturbation Methods in Non-Linear Systems*. This is probably the best reference for a survey of modern developments in perturbation theory – from Poincaré and Lindstedt through Arnold and Moser – in a reasonably understandable form. The viewpoint appears basically to be that of an applied mathematician. The text, a grayish reproduction of typescript, is physically hard to read.

R. ABRAHAM AND E. MARSDEN, *Foundations of Mechanics*. There is a new language being used in the development and exposition of mechanics – that of differential topology. The physicist newcomer needs to take an intensive course in the language before its pronouncements become intelligible. It seems likely that in the area of global stability of perturbed motion the new language has scored notable successes not accessible by other means. However the expository advantages for the more conventional areas of mechanics appear highly doubtful. For those who wish to swim in these new waters, this newly revised text provides nearly encyclopedic coverage. Some 156 pages offer preliminaries on differential topology and the calculus on manifolds, but they require an orientation towards the methods of abstract mathematics. The applications in celestial mechanics form Part IV (pp. 619-740).

J. MOSER, *Stable and Random Motions in Dynamical Systems*. This short book reproduces the text of five lectures given in 1972. Moser has himself been responsible for many of the advances in the modern treatment of stability problems. He gives here a survey of the developments in this century with emphasis on celestial mechanics. Theorems are often stated without proof, and considerable mathematical sophistication is expected on the part of the reader. Nevertheless it succeeds better than Abraham and Marsden in conveying both the flavor and the successes of the newer techniques.

T. G. NORTHROP, *The Adiabatic Motion of Charged Particles*. Although developments since the early 1960s are naturally not to be found here, this brief monograph provides a good introduction to the complexities of calculations based on adiabatic invariants. The applications are to plasma "devices," e.g., mirror machines.

B. LEHNERT, *Dynamics of Charged Particles*. This reference is nearly contemporaneous with the preceding one and provides a somewhat more voluminous discussion of the same area. Some problems associated with plasma devices are discussed that do not bear on adiabatic invariants, e.g., radiation from the charged particles.