INTERIORS OF THE PLANETS, by A. H. Cook (Cambridge Planetary Sciences Series). University Press, Cambridge, 1980. xi + 348 pp. (£25.00) (ISBN 0 521 23214 7).

The number of scientists devoted to the problems of planetary interiors (especially for planets other than the Earth) is small, appropriately so in view of the limited data base. However, the recent results from deep space missions together with recent rapid advances in high pressure physics are providing planetary modelers with well-constrained problems and solutions of limited ambiguity. These advances are important and interesting for a wide community of planetary and other scientists and need to be communicated to them in appropriate form.

This book by A. H. Cook, Jacksonian Professor of Natural Philosophy in the University of Cambridge, England, is unlike any other text currently available and partially fulfills an important need. The only other comparable up-to-date text is the 1978 version of "Physics of Planetary Interiors" by Zharkov and Trubitsyn (translated, edited and with additional material by Hubbard). However, these two texts are very different in intent. Whereas Zharkov and Trubitsyn provide details (extensive tabulations of material properties and planetary models), Cook concentrates more on establishing basic physical principles and techniques. Unlike Zharkov and Trubitsyn, Cook is not an active researcher in planetary interiors but this is not necessarily a disadvantage since it provides a broader perspective. Cook's style is lucid and the text makes easy reading for the most part.

About one third of the text concentrates on the interpretation of planetary data (with an emphasis on gravity field interpretation but including a brief discussion of planetary magnetism), another third on the behavior of materials at high pressure and most of the remainder is concerned with specific models of planets (including a long chapter on the Moon). The Earth's interior is also discussed (35 pages), primarily as a basis for discussion of other planets. One topic noticeably missing from the text is a quantitative discussion of convection. Cook provides a brief qualitative discussion of subsolidus convection but omits any mention of recent advances in this area.

The even-handed treatment of all the planets is a strong feature of the text. Almost fifty pages are devoted to the giant planets and there is a lengthy section on the most abundant metal in our planetary system (metallic hydrogen). Unfortunately, the discussion of the giant planet models does not fully reflect the advances made in the last five years (despite references as recent as 1980). This particular section is marred by the claim (also mentioned in the foreword) that the infrared excess heat output of Jupiter may actually be caused by UV or solar wind energy from the Sun. These *upper atmosphere* heating mechanisms do not provide enough energy to explain the bolometric infrared measurements of energy that is emitted from much deeper levels. (This can be shown from the numbers given in the Von Zahn and Fricke paper quoted from Cook: the solar wind energy flux at Jupiter is 0.02 erg/cm^2-s. Even if all of the energy flux impinging the magnetosphere were transferred with 100% efficiency to the atmosphere, a flux of $\lesssim$ 800 erg/cm^2-s would result—one order of magnitude less than the measured infrared excess of 7000 erg/cm^2-s. Actually, the value of 800 erg/cm^2-s is probably an overestimate by about three orders of magnitude. For example, the heating efficiency by this mechanism for the Earth's upper atmosphere is 5×10^{-4}, as Von Zahn and Fricke discuss. The UV heating is also negligible for the *total* energy budget. It is not negligible in the thermosphere.) The excess heat outputs of Jupiter and Saturn are securely established (although the precise values are in doubt).

Another erroneous claim which is made in several places concerns the high pressure behavior of α, the coefficient of thermal expansion. On page 8 it is asserted that α is negligible at high pressures. In fact, α is (to a first approximation) inversely proportional to K (the bulk modulus) and αT is *not* negligible in accurate planetary models. For example, $\alpha=10^{-5}$ in the Earth's core (*not* less than 10^{-6}, as Cook claims on page 93). These difficulties could have been avoided by a treatment which emphasizes the thermodynamic Gruneïsen γ as the most important parameter (an appealing choice since γ is dimensionless and is not strongly dependent on anything). Once an estimate of γ is made, an estimate of α can be obtained from the thermodynamic identity $\gamma=\alpha K_s/\rho C_p$ (not encountered until page 102).

Despite the clarity of exposition and good organization of material, I would not personally use this book as a text in a course because of the number of irritating inaccuracies and mis-statements throughout. The following list (not exhaustive) illustrates my point: the density of Uranus is incorrect (page 3 and later), boiling points are not relevant in the condensation of solids from a primordial solar nebula (page 5), radiation pressure does not dominate in all stars—only in massive stars (page 7), the discussion on page 25 appears to exclude the existence of SKS waves beyond the shadow zone, the outer core is almost certainly colder than the melting point of pure iron (page 39), thermodynamic theories of melting are possible and do not require any understanding of the precise mechanics of the transition (page 130), separate accretion of the lunar crust after mantle formation is geochemically inconceivable (page 159), the *T*-Tauri phase does not determine the solar nebula conditions for equilibrium condensation (page 174), the molecular-metallic transition pressure in hydrogen is generally considered to be known to better than an order of magnitude (page 200), the quoted values of the Fermi temperature and typical actual temperature for the metallic core of Jupiter are too low by a factor of ten (page 204), the geometric flattening of Jupiter is consistent with J_2 and J_4 (page 244), the probability that Jupiter's interior is superconducting or superfluid is as vanishingly small as the probability that the Earth's core exhibits these quantum effects (p. 267), the "typical" models of Jupiter (page 267) and Saturn (page 268) are not typical because they omit the rock core that is common to all recent models, Uranus and Neptune are not predominantly methane (page 271), the notion that the thickness of the Earth's oceanic crust is determined by the presence of the overlying water is highly unorthodox (page 275), Hide's recent work on determining the size of a planetary core from time variations of the magnetic field is misinterpreted on page 289, recent work on the dynamic aspects of the magnetic dynamo problem are ignored on page 294, and the discussion of Earth core dynamics (p. 300) does not adequately represent recent work (including that done at Cambridge!).

Nevertheless, the wary reader can derive some benefit from this book. The discussion of the lunar interior is clear and logical (leading to the conclusion that the Moon probably has a small iron core), the general philosophy presented for planetary modeling is sensible, the discussion of metallic and molecular hydrogen is satisfactory (although more discussion of the shock wave data is desirable), and the lengthy discussion of gravity fields has good features. I would recommend parts of this book to students as supplementary reading. Researchers interested in the specifics of planetary interiors would be better advised to consult Zharkov and Trubitsyn.

D. J. STEVENSON

DYNAMICS OF THE UPPER ATMOSPHERE, by Susumu Kato. Center for Academic Publications Japan/D. Reidel Publishing Company, 1980. xiii + 233 pp. (£15.95) (ISBN 90 277 1132 1).

This book is the first in a series of monographs entitled "Developments in Earth and Planetary Sciences" which will review recent advances in geosciences, particularly stressing Japanese work. The author's intention, as stated in the Preface, is to provide "a mathematically oriented introduction to the dynamics of the earth's upper atmosphere, with special emphasis on acoustic-gravity and tidal waves and their ionospheric effects."

The first chapter introduces basic concepts and the equations of fluid