thrust propulsion and periodic orbits in the Earth–Moon system. Additionally, there is an appendix on the treatment of the canonical equations of celestial mechanics.

The text is structured for both reference and teaching. It places emphasis on the fundamentals of astrodynamics and perturbation theory, while effectively communicating the subject in a manner not found in other texts. Since the material in the book is comprehensive, the book can be used in the same domain as the second edition of *Fundamentals of Celestial Mechanics* by J. M. A. Danby, published by Willmann-Bell (1988). I will definitely use this book as a reference. There is a sprinkling of minor text errata that does not detract significantly; I trust that they will be eliminated in a subsequent printing. I encourage anyone interested in a clear understanding of the history and theory of astrodynamics to read this book.

David Folta
NASA Goddard Space Flight Center
Greenbelt, Maryland

The Fusion Quest

T. Kenneth Fowler
The Johns Hopkins U. P., Baltimore, Md., 1997. 250 pp. $29.95 hc ISBN 0-8018-5456-3

Central to this graceful book are the images of farsighted Prometheus (thinker about the future) and his shortsighted brother, Epimetheus (thinker about the present), whose muddled failure to provide people with fur, claws or other natural endowments for survival moved Prometheus to compensate by stealing fire from heaven. In revenge, Zeus chained kindly Prometheus to a mountain to have his liver daily devoured by an eagle—an apt metaphor for the fusion community, which has coped with serious erosion of its budget in recent years.

Ken Fowler, the author of *The Fusion Quest*, is one of the Promethean heroes of the epic struggle to make controlled fusion a reality. He gives ample credit, with warm personal anecdotes, to many colleagues. He tells of the origins of the dream, from the 1929 paper by Robert d'E. Atkinson and Fritz G. Houtermans, who first pointed out that fusing light elements would release enormous amounts of energy, to the premature announcement by Argentine President Juan Peron that controlled fusion had been achieved in the laboratory, to the establishment in the US and elsewhere of national programs systematically to develop controlled fusion, first by magnetic confinement in stellarators, tokamaks,

tandem mirrors and the like and soon thereafter by inertial confinement with laser and particle beam drivers.

Although Fowler's book is written with admirable attention to the basic physics, it contains not a single equation, except for some simple algebraic formulas in a mathematical appendix. It is fascinating to follow an accurate but literary description of the Vlasov equation. Similarly, there are fine prose descriptions of the energy principle, for judging gross magnetohydrodynamic stability, and of the free-energy principle, for judging the readiness with which plasma can create turbulence and microscopic instabilities. Alvin Weinberg, a wise, early director of the Oak Ridge National Laboratory, admonished fusion scientists to strive for the "dullest of plasmas," and these principles point the way.

The book contains eight color figures, nicely balanced between reality and hope. Included are a detailed engineering drawing of a neutral-beam injector, a photograph of the interior of the Tokamak Fusion Test Reactor, laser-heated hot zones on the wall of a target for inertial confinement fusion, and also artful, airbrushed renderings of the International Thermonuclear Experimental Reactor and the National Ignition Facility. In the chapter on inertial confinement fusion, the book contains a crisp explanation of what only a few years ago were called "classified targets." With characteristic clarity, Fowler outlines the problems connected with Rayleigh–Taylor instabilities and laser–plasma interactions in laser fusion targets.

Although intended for nonspecialists, *The Fusion Quest* is not appropriate for drowsy, bedtime reading, since some concentration is required to follow the careful review of most of the key technologies, from neutral beam injectors to lasers to nonlinear crystals for laser frequency multiplication. Fowler uses apt similes to clarify physical ideas. For example: "When a laser beam is passed through the KDP [potassium dihydrogen phosphate] crystal, the electrons in the crystal oscillate at the frequency of the laser beam. At low intensity, the electron motion is oscillatory at the pure frequency characteristic of the color of the laser light. However, as the laser intensity is increased, this pure oscillation becomes perturbed and develops a second-harmonic component that in turn generates a laser beam at the second harmonic, in the same way that a bugle player can jump an octave from low C to high C."

Toward the end of the book there is a remarkably sober analysis of the political history of controlled fusion in the United States, of the way fusion policy was set at the Department of Energy in the heady days of strong national support, in response to the oil embargoes of the 1970s, and of the painful reversal of fortune that started in the 1980s—and continues to this day in spite of truly remarkable scientific and technical progress.

Having read the book, I found it hard not to feel profound sympathy and admiration for those who have devoted their lives to realizing controlled fusion. Let us hope that the Greek poet Cavafy, steeped in the tradition of the hero Prometheus, speaks prophetically to the controlled fusion community:

"As you set out for Ithaka
hope the voyage is a long one,
full of adventure, full of
discovery . . .
Keep Ithaka always in your
mind.
Arriving there is what you are
destined for.
But do not hurry the journey
at all.
Better it last for years,
so you are old by the time
you reach the island,
wealthy with all you have
gained on the way,
not expecting Ithaka to
make you rich."

WILLIAM HAPPER
Princeton University
Princeton, New Jersey

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