BOOKS: ENERGY RESOURCES

Locating the Summit of the Oil Peak

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From 1956 to 1982, geophysicist M. King Hubbert published a series of papers about the trends of oil discovery and production in the United States (*1*). Through his work with Shell Oil and later with the U.S. Geological Survey (USGS), he was one of the first to provide a quantitative basis for understanding oil production in the United States and for estimating how production trends might change in the future.

In *Hubbert's Peak*, Kenneth S. Deffeyes, an emeritus professor of geology at Princeton University and a former colleague of Hubbert's from the Shell Oil research laboratory, writes about oil, how it is discovered and produced, and what the future may hold for its production. Using Hubbert's methods, Deffeyes projects that world oil production will peak sometime around 2004 to 2008, too quickly for world economies to escape disaster as supply is unable to keep up with increasing demand.

The first half of Deffeyes's book is a primer on oil occurrence and exploration. He explains, in a folksy manner, the origin of oil deposits and methods of exploration. Spiced with many personal anecdotes, his account concentrates on contributions from himself and his colleagues at Shell and Princeton. The remainder of the book presents Hubbert's methods, some of the calculations Deffeyes has derived from them, and an outlook for the future of fossil fuels. The focus throughout the book is on oil, with relatively little discussion of natural gas.

Hubbert's Peak
The Impending World Oil Shortage
by Kenneth S. Deffeyes
Princeton University Press, Princeton, NJ, 2001. 220 pp. $24.95, £17.95. ISBN 0-691-09086-6.

Deffeyes's projection of an imminent drop in world oil production is based, however, on a questionable methodology. Proponents of Hubbert's methods are always quick to point out his success in predicting that U.S. oil production would peak in the early 1970s. Deffeyes does so and, like other advocates of Hubbert's approach, he does not discuss the failures of the methodology in other cases. Hubbert's unsuccessful prediction curves for natural gas in the United States and for oil on a global scale go unmentioned. Colin Campbell, currently the best-known user of the Hubbert methodology, has had to repeatedly revise his predictions because the forecast date of the peak has passed (*2*).

There are good reasons why Hubbert's methods worked for oil in the United States but have failed elsewhere. Trends in petroleum discovery and production are affected by much more than just resource depletion. They are also shaped by a large variety of economic, technologic, and political factors. Hubbert's method is best suited to circumstances of rapidly increasing consumption and relatively little restriction on exploration and production. That situation is more closely approximated by onshore oil production in the United States than by natural gas or by oil in the rest of the world. Since Hubbert's time, a considerable body of work has developed more sophisticated assessment methods, but of these Deffeyes seems to be unaware.

Hubbert's method retains some popularity for two reasons. First, it requires only modest data and human resources. This endears it to those practitioners who are retired from academia, the petroleum industry, or (like Deffeyes) both. Geological analyses at a more detailed level can have very large data and staff requirements. For example, the 1995 USGS national assessment (*3*) and the 2000 USGS world assessment (*4*) each involved about 100 person-years of effort. Second, the Hubbert method is popular with some because it tends to suggest relatively low limits on resources and production. Just as high estimates can be used to promote certain social and political agendas, so can low predictions. One would instead hope for a public that is open to the assessments supported by the best possible science, regardless of preconceptions.

Many smart and experienced people have tackled the difficult problem of estimating the extent of still-undiscovered petroleum resources, with quite different results. Future oil (and natural gas) production capabilities will have an immense impact. For many consumers, the price of a gallon of gas at the filling station is the only effect that they consider. Deffeyes is correct in pointing out the serious connection between oil production and economies of the world. His subject affects all our futures. The public, though, could use a far more balanced treatment than the one he offers in *Hubbert's Peak*.

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References and Notes

1. Many of these papers are difficult to find, but a relatively easily accessible example is M. K. Hubbert, *Am. Assoc. Pet. Geol. Bull.* **31**, 2207 (1967).
2. For example, a 1989 peak was used in C. J. Campbell, *Noroil* **17**, 35 (1989).
3. D. L. Gautier, G. L. Dolton, K. I. Takahashi, K. L. Varnes, *U.S. Geol. Surv. Digital Data Series* **30** [CD-ROM] (1995).
4. U.S. Geological Survey World Energy Assessment Team, *U.S. Geol. Surv. Digital Data Series* **60** [4 CD-ROMs] (2000); also available at http://greenwood.cr.usgs.gov/energy/WorldEnergy/DDS-60/.

BROWSINGS

Mechanics of Motor Proteins and the Cytoskeleton. *Jonathon Howard.* Sinauer, Sunderland, MA, 2001. 384 pp. $59.95. ISBN 0-87893-334-4.

Understanding how proteins use energy from adenosine triphosphate hydrolysis to move cells requires concepts such as force, elasticity, damping, and work. In this physics text for cell biologists, Howard develops the connections among mechanical, thermal, and chemical forces and uses this framework to explore the structures and functions of cytoskeletal filaments and motor proteins.

Histories of the Electron. The Birth of Microphysics. *Jed Z. Buchwald and Andrew Warwick, Eds.* MIT Press, Cambridge, MA, 2001. 526 pp. $55, £37.95. ISBN 0-262-02494-2.

J. J. Thomson is widely credited with having discovered the electron, the first subatomic particle to be identified, through his experiments with cathode rays in the late 1890s. However, others had previously claimed cathode rays were composed of particles smaller than hydrogen atoms, and into the 1920s Thomson maintained a distinction between the "corpuscles" he had produced and the "electron" posited by theorists. The first of this volume's four sections offers a variety of perspectives on Thomson's role in establishing the existence of electrons. Other essays examine how physicists and chemists first used electrons in experiments and discuss applications to nuclear structure, chemical bonding, and the engineering of electrical devices. The last section considers what the history of the electron suggests about issues in the philosophy of science.

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