sexual behavior in Darwin's private notebooks dating from 1837–39. Brent cannot resist the observation:

> The sexual instinct, its manifestations and attendant organs interested him more than they had before, and it need not be a prurient point to see in this a sublimated reflection of his own sharpened sexuality [p. 298].

And Brent also speculates on the Darwins' sex life as husband and wife:

> Unspoken in the humility and gratitude with which he [Charles] received her [Emma] accepting him as husband, implied in the recurring description of himself as "brute," one senses the sexual "demand," that physical transaction in which the wife gives in, as graciously as she can and the husband, almost despite himself, struggles briefly for his own satisfaction. Convulsed by guilt, he afterwards thanks her for permitting such a violation, and lives out his sexual life in a mixture of resentment and contrition [p. 320].

But the most revealing of all concerns the Health Diary that Darwin kept from 1849 to 1855.

> In 1850, too, there appear occasional little ticks in the record, four or five a month, and it is possible that these marked the occasions of sexual intercourse. It seems unlikely that he would have neglected this factor, yet impossible that he would have mentioned it directly. There is no indication, however, that such a conclusion is correct, rather than based on the wishful prurience of a biographer [p. 384].

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Vibrations of the Earth

Free Oscillations of the Earth. E. R. LAPWOOD and T. USAMI. Cambridge University Press, New York, 1981. xii, 244 pp., illus. $49.95. Cambridge Monographs on Mechanics and Applied Mathematics.

It is more than 20 years since the free oscillations of the earth were first observed. Yet the book under review is the first one devoted exclusively to the subject. Lapwood and Usami have written a thorough monograph emphasizing the mathematical and theoretical aspects of this active subject of research.

The book begins with a survey of work from the second half of the 19th century and the first half of the 20th. Both observational and theoretical studies are presented. Without good instrumentation and recording systems, and without computers, progress during this period was modest. Nevertheless, considerable insight into the subject was achieved.

In 1960 perhaps the largest earthquake in a century occurred in Chile. By then, theoretical and computational developments were well advanced and data acquisition systems were improved. The Fourier spectra of the seismograms clearly showed the resonance peaks of the free oscillations of the earth, and a new branch of observational geophysics was firmly established, albeit without the benefit of the fast Fourier transform algorithm.

The authors approach the formulation of free oscillation theory pedagogically, making their book well suited as a basis for a series of lectures. Chapters 2, 3, and 4 are devoted to the oscillations of a homogeneous sphere, a shell, and a two-layered sphere. These are two-point boundary value problems, and the authors discuss in detail the interpretation of the eigenvalues (squared frequencies of oscillation) and eigenfunctions. The authors, as is usual, treat the outer core as a fluid, but they also include a discussion of small, finite rigidity of the outer core. As the rigidity vanishes the spheroidal equations drop from sixth to fourth order and the toroidal from second to zero. This is an example of a singular perturbation problem where one class of eigenvalues collapses onto the origin. A discussion of singular perturbation theory (such as is found, for example, in *Perturbation Methods in Applied Mathematics* by J. D. Cole) could have been included without loss of clarity or style.

The effects of self-gravitation and methods of computation for stratified models are treated in chapters 5 and 6. Experience has shown that the most stable and efficient numerical methods for computing eigenfrequencies and eigenfunctions are the Rayleigh-Ritz method and the finite difference method. The former is made more tractable by using Hermite cubic splines as the basis, as has been done by both Buland and Wiggens. The latter is rendered numerically very stable by using the method of minors in the formulation of the equations, as has been done by Woodhouse.

After a brief discussion of rotational splitting in chapter 7, chapter 8 is devoted to the solotone effect. The usual theory of the asymptotic distribution of eigenvalues in a Sturm-Liouville problem requires that the relevant parameters be twice differentiable. When they are not there are internal resonances and the simple asymptotic distribution breaks down, leading to the solotone effect. Sturm-Liouville theory has made numerous contributions to geophysics in the past. In the matter of the solotone effect geophysics has returned the favor.

The formulation of the excitation of free oscillations in terms of the source moment tensor is presented in chapter 9. This is followed by a discussion of array processing techniques for identifying spectral peaks and measuring their frequencies. The use of free oscillation spectra to determine source mechanisms is a subject of current research and is an approach that can be applied to all events of magnitude 6.5 or larger.

A survey of current research concludes the book. The book provides a firm foundation for anyone who would engage in research in the free oscillations of the earth. In fact, in this reviewer's opinion, astronomers could benefit from reading it. It is a fitting companion to the recent volume *Nonradial Oscillations of Stars* (W. Unno, Y. Osaki, H. Ando, and H. Shibahashi, University of Tokyo Press, 1979).

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Flatworms

The Biology of the Turbellaria. Proceedings of a symposium, Diepenbeek, Belgium, Aug. 1980. ERNEST R. SCHOCKAERT and IAN R. BALL, Eds. Junk, The Hague, 1981 (U.S. distributor, Kluwer Boston, Hingham, Mass.). xiv, 302 pp., illus. $69.50. Reprinted from *Hydrobiologia*, vol. 84. Developments in Hydrobiology 6.

This book consists of papers presented at the Third International Symposium on the Biology of the Turbellaria. The first two symposia of this series convened under different names: the Libbie H. Hyman Memorial Symposium (Chicago, 1970), and the Alex Luther Centennial Symposium on Turbellaria (Tvärminne, Finland, 1977).

The 36 papers included in the book are grouped in five sections. In the first section, Systematics and Zoogeography, I. R. Ball discusses the phyletic status of the Paludicola and points out that this taxon may not be monophyletic and may have evolved from two marine ancestors. Several papers deal with the karyology of polyclads and triclads. W. Teshirogi and S. Ishida study the electrophoretic band patterns of proteins of a species of *Polycelis*, and R. Biersma and H. G. W. Wijsman analyze enzyme variations in two closely related species.

The section Ecology and Faunistics contains papers on various aspects of the ecology of freshwater and marine Turbellaria. P. M. Martens and E. R. Schockaert discuss sand-dwelling micro-