such as Jimi Hendrix and Eric Clapton, but nothing of Les Paul, whose seminal contributions to the development of the electric guitar and multitrack sound recording are more relevant to physics. Elsewhere in the book, a useful demonstration of the mathematical foundation of the basic diatonic and chromatic scales precedes a large section devoted to such topics as modes, chord sequences, and rhythm—but the section fails to connect those musical theories to physics. And the discussion of MIDI—and even iPods—reads more as product instruction than an explanation of their operative scientific principles. Several important instrument categories are omitted: There is no discussion of xylophones and marimbas; membrane-based drums; the first true musical synthesizer, the acoustic pipe organ; or the first electronic instrument, the theremin. In their absence, much potentially useful scientific discussion is lost.

Moreover, *Good Vibrations* contains editing errors and factual inaccuracies that may confuse readers outside the field's cognoscente. For example, in one sequence, the book erroneously uses the same diagram to describe both the first and second overtone patterns in a pipe; on the next page, the same topic is again covered in a slightly different diagram sequence that correctly shows the two different patterns. The frequency of the note "middle C" is expressed in different places in the book as 256 Hz, 261.6 Hz, or 262 Hz without any explanation as to why these values differ (256 Hz is "scientific" C, while 261.6 Hz is "musical" C in modern 12-tone equal temperament). The author also states that "the banjo and the mandolin have a bridge, but the ukulele does not." However, ukuleles *do* have bridges. Also, an open window has an acoustic absorption coefficient of 1, not 0, as stated. And the assertion that hearing loss above 5000 Hz "doesn't seriously affect your ability to appreciate music" would likely be challenged by musicians and audiologists who appreciate the subtle differences in sound timbre contributed by higher harmonics.

Other recent publications have more effectively bridged physics and music. The third edition of Ian Johnston's *Measured Tones: The Interplay of Physics and Music* (CRC Press, 2009) employs an informal conversational and storytelling style and blends the science, mathematics, and historic personalities. Its comprehensive coverage includes all major instrument types—acoustic and electric—as well as the basics of singing and the human ear. Covering similar ground is P. U. P. A. Gilbert and Willy Haeberli's *Physics in the Arts* (Academic Press, 2008; see the review in PHYSICS TODAY, March 2009, page 51), a more formal, textbook-type volume with example problems and work sets that is still accessible to the general reader.

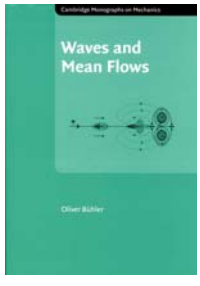
Although it misses the mark in places, *Good Vibrations* provides many interesting facts and connections between physics and music for the general reader. It falls short, though, of being a convincing tome for anyone who comes to the game with a detailed knowledge of either physics or music.

David Dolak
Columbia College Chicago
Chicago, Illinois

Waves and Mean Flows

Oliver Bühler
Cambridge U. Press, New York, 2009. $99.00 (341 pp.). ISBN 978-0-521-86636-1

Periodic propagating disturbances, or waves, and their underlying mean flows are ubiquitous in fluid dynamics. Most books that discuss the theory of waves and fluid flow tend to focus on water waves—although that observation may reflect my own bias toward the ocean. Three of the most accessible of those are Gerald Whitham's *Linear and Nonlinear Waves* (Wiley-Interscience, 1974), J. S. Turner's *Buoyancy Effects in Fluids* (Cambridge University Press, 1973), and James Lighthill's *Waves In Fluids* (Cambridge University Press, 1978). By contrast, Oliver Bühler's *Waves and Mean Flows* draws evenly from atmospheric and oceanic systems—for example, waves that actively drive flows as illustrated by surf on a beach and the quasi-biennial winds in the Pacific equatorial atmosphere.



Bühler's well-organized textbook is excellent in all the most important ways. It proceeds from a brief but clear summary of the basic concepts and equations of fluid dynamics to an introduction of linear waves and the effect of a mean flow, and finally to its meatiest topic: the generalized Lagrangian mean (GLM) formulation for handling—in theory, at least—finite-amplitude waves in arbitrarily complex mean flows. Whitham provides a more detailed discussion of nonlinear surface waves and several other interesting kinds of nonlinear waves, and Turner and Lighthill cover internal waves and related phenomena over a wider set of examples, contexts, and applications. But Bühler's text is unique in its clear and rigorous exposition of the inextricably linked coevolution of combined wave–current systems.

The author is well known in the field for applications of the GLM formulation to real-world problems, and his book will likely become the authoritative resource on that subject. *Waves and Mean Flows* presents its readers with a clearly written text that is comfortable to read. For each progressively more advanced technique, it provides interesting examples that apply the lesson. As a logically laid-out, internally consistent, and self-contained work, it will be useful both as a textbook and as a handy reference for researchers. The first half is suitable for an introductory graduate course, whereas the last half—particularly the discussion of the intimidating task of applying GLM to practical problems—is more appropriate for advanced graduate classes and for researchers.

More than anything else, this book pays its way with its clear and complete exposition of the GLM methodology. The utility of the GLM lies in how it gives exact conservation laws for the wave-averaged quantities with the same generality, and even similar form, as the fundamental conservation laws for such unaveraged equations as Navier–Stokes, mass conservation, action conservation, Kelvin's circulation theorem, and potential vorticity. These have clear GLM-averaged analogues, though sometimes those include surprising modifications.

The price paid for such powerful formal rigor comes in the mathematical (and sometimes conceptual) overhead required by the GLM. For example, averaging and differentiation do not simply commute under the GLM, as they normally do. Thus, calculating the vorticity of the GLM-averaged flow requires subtracting the waves' "pseudomomentum" from the GLM mean flow before taking the curl. That is easily illustrated with surface waves, in which the pseudomomentum equals the Stokes drift. The Stokes drift, in turn, has vertical shear, but that property doesn't alter the fact that the waves, and hence the associated drift, are entirely irrotational. That kind of unexpected detail can lead to confusion in the application of GLM in practice, making this book all the more valuable for its clarity.

The author also clarifies the difference between the often confused quantities of pseudomomentum, Stokes drift, and the "bolus velocity" caused by a correlation between fluid density and wave orbital motion. For some waves (acoustic waves, for instance), all three quantities are indeed the same, but for many other waves, they are not; internal waves, for example, have pseudomomentum but no Stokes drift.

Waves and Mean Flows suffers slightly from a few typos and at least one case of an equation out of order: Equation 10.88 is referred to in the derivation of equation 10.69. However, those minor defects are not important and do not weaken the book's reader-friendly yet rigorous style. A class instructor, however, should be careful to augment the reference lists given at the end of each chapter, which seem rather focused on the cadre of Cambridge scientists. In particular, no reference is made to Alex Craik and Sidney Leibovich's foundational work in deriving what's commonly called the CL vortex force, which is due to the interaction of surface waves and currents; Leibovich's 1980 paper in the *Journal of Fluid Mechanics* even uses GLM! Although instructors and researchers alike should be aware of such omissions, Bühler's book still performs admirably as a self-contained reference.

For anyone wishing to work seriously with the GLM approach, *Waves and Mean Flows* is indispensable.

Jerome A. Smith
Scripps Institution of Oceanography
La Jolla, California

new books

acoustics

9th International Symposium on Therapeutic Ultrasound (ISTU 2009). K. Hynynen, J. Souquet, eds. *AIP Conference Proceedings 1215*. Proc. symp., Aix-en-Provence, France, Sept. 2009. AIP, Melville, NY, 2010. $224.00 *paper* (408 pp.). ISBN 978-0-7354-0758-9

astronomy and astrophysics

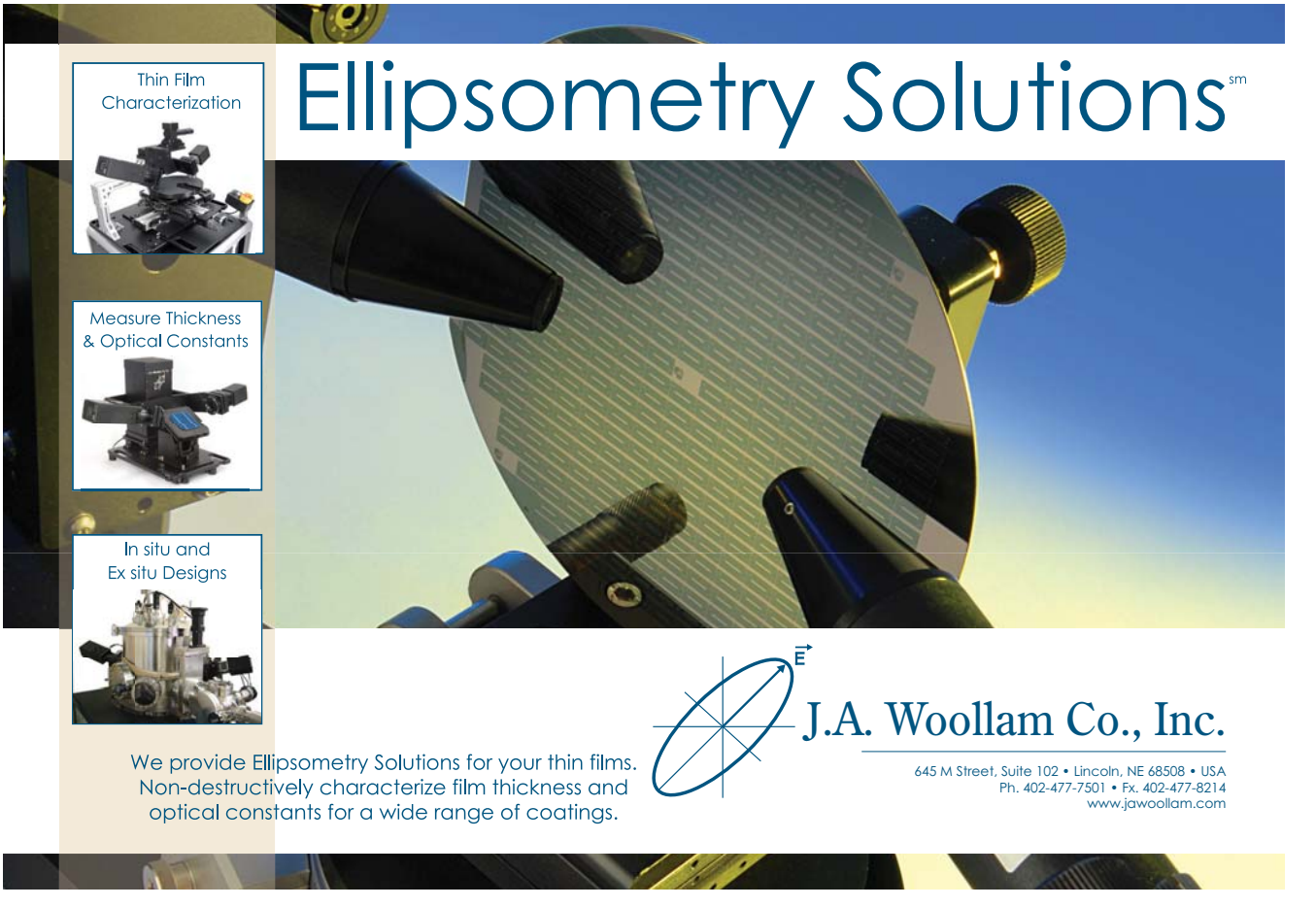
AKARI, a Light to Illuminate the Misty Universe. T. Onaka, G. J. White, T. Nakagawa, I. Yamamura, eds. *Astronomical Society of the Pacific Conference Series 418*. Proc. conf., Tokyo, Feb. 2009. Astronomical Society of the Pacific, San Francisco, 2009. $77.00 (546 pp.). ISBN 978-1-58381-716-2

Astrophysics and Cosmology After Gamow. S. K. Chakrabarti, G. S. Bisnovatyi-Kogan, A. I. Zhuk. *AIP Conference Proceedings 1206*. Proc. conf., Odessa, Ukraine, Aug. 2009. AIP, Melville, NY, 2009. $274.00 *paper* (488 pp.). ISBN 978-0-7354-0743-5

Bioastronomy 2007: Molecules, Microbes, and Extraterrestrial Life. K. J. Meech et al., eds. *Astronomical Society of the Pacific Conference Series 420*. Proc. wksp., San Juan, Puerto Rico, July 2007. Astronomical Society of the Pacific, San Francisco, 2009. $77.00 (531 pp.). ISBN 978-1-58381-720-9

The Earth as a Distant Planet: A Rosetta Stone for the Search of Earth-Like Worlds. M. Vázquez, E. Pallé, P. Montañés Rodríguez. *Astronomy and Astrophysics Library*. Springer, New York, 2010. $119.00 (422 pp.). ISBN 978-1-4419-1683-9

Fifth European Summer School on Experimental Nuclear Astrophysics. C. Spitaleri, C. Rolfs, R. G. Pizzone, eds. *AIP Conference Proceedings 1213*. Proc. sch., Santa Tecla, Sicily, Italy, Sept. 2009. AIP, Melville, NY, 2010. $154.00 *paper* (259 pp.). ISBN 978-0-7354-0756-5

Highlights of Spanish Astrophysics V. J. M. Diego et al., eds. *Astrophysics and Space Science Proceedings*. Proc. mtg., Santander, Spain, July 2008. Springer, Berlin, 2010. $249.00 (566 pp.). ISBN 978-3-642-11249-2

Protoplanetary Dust: Astrophysical and Cosmochemical Perspectives. D. Apai, D. S. Lauretta, eds. *Cambridge Planetary Science*. Cambridge U. Press, New York,