another book in the series.) In particular, the author describes in detail the appropriate methods for correcting the "spectral signatures" of features for both atmospheric and system-dependent effects. A substantial amount of the author's own high-quality research is integrated into the book; however its greatest strength lies in the clarity with which Slater has explained, using little more than basic physics and simple mathematics, the relevant work of scientists in a great variety of fields, ranging from human optics to electromagnetic theory, from electronic circuitry to spectroradiometry, and from basic atmospherics to matter/energy interactions at the Earth's surface. Of particular value is his consistent use throughout the book of a powerful performance criterion, the "modulation transfer function".

Despite the prodigiousness of his undertaking, Slater is careful, for the most part, to cite references to the many principles with which his book deals. Thus it is all the more disconcerting when, on occasion, he makes flat assertions (without providing documentation) such as "the average eye can discriminate approximately 5 million colors but only 200 shades of gray". Actually there are almost as many (widely disparate) values quoted in the literature as there are experts who have addressed this highly important matter. An occasional citation is improperly listed in Slater's book but such errors will no doubt be corrected in future editions.

All told, Slater's book is highly authoritative, unusually up to date and comprehensive, clearly written, well fortified with relevant tables and neatly drawn figures, and eminently worth perusal by any serious remote-sensing scientist. □

Robert N. Colwell is a Professor at the University of California, Berkeley, and teaches courses in photo interpretation and remote sensing.

Beyond Wiener

Freeman Gilbert

Geophysical Signal Analysis. By E.A. Robinson and S. Treitel. Pp.466. (Prentice-Hall: 1980.) £23.40, $36.

GEOPHYSICAL signal analysis became a subject of research by the authors in the early 1950s, when they were graduate students at MIT. They were members of the Geophysical Analysis Group, sponsored by a consortium of petroleum and exploration companies, whose rather ill-defined goal was to use digital computers for the application of the ideas, techniques and methods of Norbert Wiener to the interpretation of reflection seismograms. In the intervening quarter-century the seismic exploration industry has "gone digital" in a big way. In a typical day the industry processes several thousand computer tapes (9 track, 1600 BPI, 2400 feet) of data on multiple mainframe computer systems. By contrast, in the early 1950s the authors used the Whirlwind II computer (now in the Smithsonian Museum). Input was on punched paper tape, output on electric typewriters and secondary storage on magnetic wire; instruction time was in milliseconds and memory was 1024 16-bit words. It was the premier computer of its day. The authors deserve a large part of the credit for developing many of the currently used computational procedures in geophysical signal analysis and their book provides the basis for understanding and using them. Their firsthand knowledge and experience are evident throughout.

The method of least squares pervades science and engineering; it is the central theme of the present volume. Basically the book is concerned with filtering, the process of removing or diminishing "noise" in order to reveal and enhance the "signal". With the reflection seismogram as a model, the authors develop least squares digital filtering from first principles in the first eight chapters. The subjects of minimum phase lag, minimum delay, causality and stability are presented in a thorough manner, and the concept of a prediction filter is introduced. The writing is well balanced between theory and application. This arises from the blending of the authors' talents — Robinson is a mathematician at home with geophysics and Treitel is a geophysicist at home with mathematics. They complement one another very well.

The second half of the book is devoted primarily to the subject of deconvolution, especially predictive deconvolution. The opening chapter is devoted to a discussion of stationary time series. The method of generalized harmonic analysis, attributed primarily to Kolmogorov and Wiener, is mentioned and briefly described, but the bulk of the chapter is devoted to Wold's predictive decomposition theorem, and deductions from it made by the authors. By using the innovational representation of a nondeterministic stationary time series (that is, the output of minimum delay filter whose input is a white noise process), the authors set the stage for the succeeding chapters on predictive deconvolution. Here, we learn how predictive deconvolution is used to remove multiple reflections and reverberations from seismic traces. The wave propagation theory is the familiar one-dimensional, plane wave theory. It does not conform to the usual common depth point stacking procedures and does not always give good results. The newer slant stacking procedures are better and give more nearly the plane wave stacks for which predictive deconvolution is designed.

The book ends with a chapter on spectral estimation. Both the ARMA (auto regressive, moving average) and ME (maximum entropy) methods are described.

Robinson and Treitel have produced a useful, carefully written book for students, teachers and prospectors. Many of the subjects that they consider are important beyond the realm of seismic prospecting for oil, and their book should find appeal among all scientists and engineers interested in digital signal processing. □

Freeman Gilbert is a Professor of Geophysics at the Institute of Geophysics and Planetary Physics, University of California, San Diego. In the early 1950s he was a graduate student at MIT and a member of the Geophysical Analysis Group.

GFD for all levels

D. Anderson

Geophysical Fluid Dynamics. By J. Pedlosky. Pp.624. (Springer-Verlag: 1979.) DM 83.50, $43.90. *Geophysical Fluid Dynamics for Oceanographers.* By J.J. von Schwind. Pp.307. (Prentice-Hall: 1980.) £19.45, $29.95.

THE science of physical oceanography is in the process of emerging from the dark ages, a process begun some 40 years ago and greatly accelerated in the past decade. The companion subject of dynamical meteorology has had a similar history but is slightly further advanced. Together they constitute geophysical fluid dynamics (GFD), an important new discipline which is attracting interest because of its relevance to improving weather forecasts and understanding climate.

With the expansion of the subject has come a demand for textbooks. The two reviewed here are intended for new graduate students or advanced undergraduates, but the levels of the courses for which the texts are suitable are totally different. To the novice student embarking on one of the rather compressed courses which tend to be offered at many institutions, Pedlosky would be rather daunting. Von Schwind, however, is sufficiently elementary that it could be picked up and read profitably by any new student. The subjects discussed in Chapters 3 and 5 are important — wind-driven ocean circulation, the explanation of western boundary currents and some aspects of large-scale wave dynamics — though the presentation could have been markedly improved if some indication of modern thinking had been included (only three of the references are post 1970). Much of the remainder of the book is in the nature of support material. Chapter 2, by far the largest (over half the length of the book), deals with various aspects of basic fluid mechanics and geophysical fluid mechanics. Since many students enter