BOOK REVIEWS

QUANTITATIVE STRATIGRAPHY

F.M. Gradstein, F.P. Agterberg, J.C. Brower, and W. Schwarzacher.

D. Reidel Publishing Company and Unesco/Paris, 1985, 598p., (C)\$77.00 (US).

In the Foreword, D.J. McLaren notes that this book on quantitative biostratigraphy and lithostratigraphy is "the first of its kind," and that the four authors "are foremost in this branch of science and have pioneered its application." On both accounts he is correct. This book, an outgrowth of the International Geological Correlation Programme (IGCP) Project 148, is the result of a decade of work by members of the Project and nicely pulls together many of its accomplishments.

As Gradstein states in his Preface, the "book introduces concepts and methods of quantitative stratigraphy and the impact of the results and interpretations on the geology of sedimentary basins". It provides a "practical, rather than theoretical approach to this interdisciplinary science" for users and offers a "pathway through the jungle of methods." The book is indeed complete, up-to-date and well organized, and the material is presented in a logical, easy-to-understand manner.

The history of IGCP Project 148 from its formulation in 1976 to its conclusion in 1985 is recalled in the introductory section by Agterberg, who was the project leader. This was one of the most successful of the many projects in the Program cosponsored by Unesco and IUGS. An outgrowth of the Project was the establishment of a permanent Committee on Quantitative Stratigraphy by the International Commission on Stratigraphy (ICS) in 1986. Gradstein then reviews some basics and background information on stratigraphy, paleontology, and methods to set the stage for the following material.

The subject is treated unevenly. Almost 70% of the book is devoted to biostratigraphy, with Biostratigraphic Zonation accounting for most of that space. The unevenness, however, reflects the amount of work done in each of these areas. In this part, which is mainly by Agterberg, Brower and Gradstein, such subjects as Relative Biostratigraphic Values (RBVs), multivariate analysis of assembly zones, seriation, ranking and scaling, normality testing, and unitary associations are discussed in detail with examples. The section concludes with a comparison of five zoning techniques on a common data set.

The third section is concerned with correlation and in particular the theory and application of a basin-analysis computer program CASC (Correlation And SCaling in time). The fourth section, concerned with quantitative lithostratigraphy, is the work of Schwarzacher. In his introduction to the subject, he notes "Although bio- and lithostratigraphy go hand in hand . . . the methods differ in a fundamental way . . . biostratigraphy is concerned with order, spacing and correlation of irreversible sequences of events in time, based on the evolution of living creatures, lithostratigraphy deals with recurring events, like the presence of shale in stratigraphic sections or cyclic sedimentation." From this then, he proceeds to develop the

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subject from the standpoint of analyzing a single section. He follows this with a discussion on lithostratigraphic correlation and sedimentation models - a subject in which he is well versed.

The last section on Time Scales and Burial History will perhaps be the most interesting to practicing geologists. Construction and interpretation of burial curves, paleobathymetry, and subsidence history have importance in the search for mineral resources. Also discussed are time scales and their resolution.

The book presents the new stratigraphy - exciting results and prospects of applying quantitative methods as a different approach to the subject. It reviews at a glance the results to date and gives assurances for the future. The book has an attractive format, is well illustrated, contains many references, is indexed, and readable. There is an appendix with nine databases and information on the computer programs used, and a glossary of geological, paleontological, statistical, and computer terms is also included. The book is highly recommended for "soft-rock" geologists, stratigraphers in particular.

D.F. Merriam
Kansas, U.S.A.

MANUAL OF CARBONATE SEDIMENTOLOGY: A LEXICOGRAPHICAL APPROACH

T.J.A. Reijers and K.J. Hsu

Academic Press Inc. Ltd., London, 302p., 1986, (H) \$85.00 (US), (P) \$50.50 (US).

In essence this is the published version of an in-house Shell Oil Company manual prepared for non-specialist petroleum geologists and students of petroleum geology. It aims to present the first "concise overview of the entire field of carbonate sedimentology with special emphasis on trends and porosity development." The book is also a multilingual lexicon to aid geologists with literature in other languages as well as to provide linguistically satisfying foreign equivalents of terms first invented in English.

The book is divided into four sections, which deal with carbonate sedimentary particles, depositional structures, environments, diagenesis and reservoirs. The format is simple, consisting of entries and their definitions or explanations in English, followed by equivalent terms in Dutch, German, Spanish and French, plus an abbreviation, handy computer code and a graphic symbol for use in lithologic logs. Many entries are illustrated with line drawings, most of which have been taken from previously published works. This conciseness does not, however, come cheaply, and the excellence one would expect at this price is not to be found.

The lexicon is the core of the book. The entries are grouped, and each section is introduced by a couple of explanatory pages. These introductions are good summaries, though sometimes uneven. However, some of the terms that

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are defined are obsolete or represent uncommon or unsophisticated usages, and a few of the definitions are even erroneous. For example, "spongiostrome stromatolite" does not consist of calcified filaments but rather of clotted or structureless micrite; porostromate stromatolites preserve filaments. Some of the foreign equivalents are not equivalent at all, and there are strange omissions. For instance, the common English term "peloid," coined by McKee and Gutschick in 1969, nowhere appears in this manual. Instead the authors use the almost obsolete "pelletoid," even though the non-English equivalents presented here seem closer to "peloid."

A large number of the foreign words are simple linguistic modifications of the original English, as one would expect in a discipline dominated by English-speakers and English-language publications. In fact, anyone with a smattering of these foreign languages would have no trouble recognizing almost all the equivalents; presumably the reverse is true as well. I fail to see the justification for forcing cumbersome foreign equivalents for scientific jargon that is already linguistically artificial.

Only in the rarest of occasions have I found it necessary to read geological publications in the Dutch language. A casual perusal of journals like *Geologie en Mijnbouw* and *Leidse Geologische Mededelingen* shows that Dutch geologists have been publishing in English for years. On the other hand, there is certainly more carbonate literature in, say, Italian or Serbo-Croatian, and there are many petroleum geologists with these mother tongues who do not work for the major English-speaking companies.

Information is portrayed visually as well, and the text is liberally illustrated with line drawings. Many of these are familiar, for they have been reproduced from other publications, and credits are given in most cases. One could always quibble about the choices, but I do wonder about the 17 pages taken up by reproductions of teeming benthic environments originally published in McKerrow's 1978 book *The Ecology of Fossils*. One of these appears to have already undergone multiple photocopying before being printed here. It might be added that paleontologists found numerous small inaccuracies in these three-dimensional drawings. Many other diagrams have been redrawn or invented for use in the book, but a few seem redundant, ineffective or even pointless. Overall, most are adequate, but could have been chosen or designed more judiciously.

The promised special emphasis on porosity turns out to be just a handful (24) of definitions and a reproduction of Choquette and Pray's familiar chart. The high number of typographical errors in this volume is staggering, and neither language (except possibly Dutch) nor the diagrams are spared.

It would not be fair to dismiss this book or the idea behind it. As a lexicon it falls short, but company geologists and geophysicists knowing little or nothing about carbonate rocks could conceivably use it for reference, if they were working in isolation. More likely, though, they would seek advice from their resident carbonate expert. Undergraduate students would probably find it a useful summary for last-minute exam preparation if they could afford it. At the price, you could buy two of the excellent full-length textbooks available on the subject.

B. R. Pratt
Toronto, Canada

PLATE TECTONICS: HOW IT WORKS

Allan Cox and Robert B. Hart

Blackwell Scientific Publications, Inc., 1986, 392p., (P) \$29.95 (US)

PERSPECTIVES ON A DYNAMIC EARTH

T.R. Paton

Allen & Unwin, Inc., London, Boston, Sydney, 1986, 142 pages, (C) \$29.95 (US); (P) \$11.95 (US).

"Plate Tectonics: How It Works" deserves to succeed. It is refreshingly written in simple language. It talks to the reader directly and takes him or her gently and amusingly through the complexities of the geometry of plate tectonics. By the use of chalk-board diagrams, anecdotes, exercises and suggested readings it provides a very accessible introduction to the "hands-on" of plate reconstruction.

PLATE TECTONICS How It Works

Allan Cox
Robert Brian Hart

The "How It Works" of the title is the "how" of plate motions. The concepts of sea floor spreading, subduction zones, paleomagnetism, and hot-spots are briefly covered and well presented, but the heart of the text attempts to give the reader direct experience and understanding of how to reconstruct the past position of plates, how to find their poles of rotation and how to calculate their vector interactions - even how to be able to predict the future of triple junctions.

The authors describe their intended reader as "a college undergraduate whose appetite for plate tectonics was whetted by an introductory course in geology." Despite their assurance that the mathematical background required to understand the exercises is minimal (elementary calculus and familiarity with vectors), this college undergraduate will need to be mathematically and analytically inclined and motivated. Nevertheless it is impossible to disagree with the authors' underlying contention that to play the plate tectonic "game", players need to be able to understand the niceties of Euler poles, stage poles, angular velocity vectors, finite rotations, the three plate problem and related topics.

In a last chapter entitled "Putting it All Together", the book nudges the reader ever so gently into the deep end of global tectonics and the enigmas of plate driving forces, absolute motions, polar wander and the life cycle of a plate. By maintaining their conversational style (e.g. "when a continent arrives at a trench, the plate screeches to a halt") the authors very successfully involve the reader in their speculations without intimidating with jargon or sounding patronising.

For any geoscientist involved in regional tectonics or marine geophysics, this book is highly recommended as a learning and teaching tool and a source-book that provides an insight into the "how" of the increasingly complex plate reconstruction schemes that proliferate in the literature. For any

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student of the tectonics of the western margin of North America and the plate tectonics of the Pacific Ocean, it should be required reading.

In contrast, Paton's is a flawed, but intriguing and personal mixture of a textbook and a history of geoscience. It begins with quotations asserting that to understand and appreciate science, one must know its history. The book then sets out to tell the story of man's understanding of the earth, how it works and how its surface is created.

Very properly, the author begins at the beginning with a very readable account of how the shape, size and mass of the earth were measured and discussed from 450 BC to the 19th century. Discussion of Wegener's and Du Toit's drifting continents and their almost total rejection right up to the mid-20th century, is followed by an assessment of the technological advances that led to modern geology.

For these, the author picks three applications of physics to geology: radiometric dating, rock magnetism and seismology, though not all scientists are going to agree that these were the germinal technologies that forged the way. In describing them Paton produces three essays which include some basic concepts, formulae, and simple, clear figures.

Then follows a chapter on the ocean basins and the discovery that their geology was totally different from the continents. This leads to a description of paleomagnetism and the plate tectonic "revolution".

Every scientist who has worked over the last 20 years has his or her own version of what were the key discoveries, who made them and how and when they fitted together. The author's version concentrates on marine magnetic anomalies, sea-floor spreading and JOIDES drilling. It has a few minor errors but probably falls in the mainstream of such historical accounts.

The last chapter, and the weakest, attempts to show how plate tectonics is beginning to explain major tectonic features such as the western North American Cordillera and the Himalayas. Whereas throughout the book the author has been at pains to illustrate (with good self-explanatory diagrams) each scientific concept, here the discussion becomes too broad and open-ended. Understanding of these regions is changing so rapidly that many ideas referred to by the author as being current have already been shown to be wrong. It provides an unfortunate, but probably unavoidable, finish.

The book is titled "a perspective". Its readers and market are difficult to predict. For the reviewer it cleared up some misunderstandings, filled in some gaps, provoked some questions and made a two hour bus journey pass quite agreeably.

R. Riddihough
Ottawa, Canada

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