are treated in detail are the theory of the coherence properties of light, laser modes and cavity design, semiconductor and phonon lasers, and non-linear optics. The rest of the papers are grouped in the sections on optical pumping and magnetometers, molecular beam masers, gas lasers, the spectroscopy of solid-state materials, solid-state masers and solid-state lasers. It is clear that the laser is responsible, directly or indirectly, for about half the papers.

From such a wealth of material it is scarcely possible to choose a few papers for special mention. It is adequate to say that the papers in each of the ten sections make each an invaluable survey of its particular field. The conference attracted leading experts, many of whom gave survey papers covering their own subjects, among them E. Wolf, J. Brossel, N. F. Ramsey, W. R. Bennett, jun., C. G. B. Garret and P. A. Franken. Particularly valuable is a record of the discussion which followed each paper, and the editors are to be congratulated on their success in persuading the authors to present their published papers in full, and not merely in skeleton form. A useful luxury is appended to a few of the papers in the form of a summary, sometimes in the language of the paper and sometimes in the second language of the conference. The value of the *Proceedings* would have been considerably enhanced if short summaries of all the papers could have been given in both English and French, but one can appreciate the magnitude of the editors' task in achieving this ideal. Inevitably the price of the two volumes is formidable, but entirely commensurate with their value.

J. H. Sanders

DEEP-SEA SANDS, GREYWACKES AND FLYSCH

Turbidites

Edited by A. H. Bouma and A. Brouwer. (Developments in Sedimentology, Vol. 3.) Pp. 264. (Amsterdam, London and New York: Elsevier Publishing Company, 1964.) 90*s*.

With an ever-increasing number of sedimentologists working in flysch and greywacke sequences, a book on turbidites will inevitably arouse interest. This volume consists of fourteen articles together with an introduction and a final summary. In the first article, Prof. Kuenen, who introduced the term 'turbidite' into geological literature and who is largely responsible for the present popularity of the turbidity-current hypothesis, considers the evidence for the origin of deep-sea sands and their possible ancient equivalents. Two further articles are concerned with modern sands in the Adriatic and the Mediterranean; another two pay some attention to methodology. Regional accounts of geosynclinal successions with flysch and greywackes are given from the Apennines, Britain, the Central Carpathians, Germany, the Maritime Alps and the United States. Points of sedimentary detail are described in another two articles and a comprehensive bibliography of turbidite literature has been compiled.

Kuenen presents a powerful restatement of the turbidity-current hypothesis as applied to the interpretation of deep-sea sands, flysch sandstones and greywackes. He also includes some penetrating criticism of alternative suggestions which have been made for the origin of these sediments.

Stanley and Bouma advocate the systematic examination of sedimentary features and the recording of data graphically and on punch cards preparatory to analysis using the digital computer. They go on to give an account of a palæogeographical reconstruction using the 'multiple parameter' method which they have described. The reconstruction, however, differs in no obvious ways from others prepared over the past decade (for example, the excellent palæogeographical atlas of the Polish Carpathians) which do not claim to involve anything more than traditional methods. Or is it that sedimentologists have been using the 'multiple parameter' method all this time without realizing it?

The regional accounts vary from detailed analyses to short articles which are little more than bibliographical lists. The palæogeographical reconstructions from the Maritime Alps (Stanley and Bouma) and the Central Carpathians (Marschalko) are very valuable examples. Meischner presents a detailed investigation of calcareous turbidites (called 'allodapic limestones') in which the sedimentary features are interpreted in terms of a model of sedimentation similar to schemes already suggested. Among other data from Britain, Kelling makes special mention of the frequent divergence in the current directions of sole markings and, a little higher in each bed, transverse ripples. In addition to recognizing the possibility of the reworking of turbidite deposits by bottom currents Kelling suggests that surge waves resulting from the passage of the turbidity current may have been responsible for the transverse ripples. With gradually accumulating evidence for the operation of bottom currents in present-day deep-waters, this problem of ripple-mark versus sole mark direction is likely to provide the basis for much future discussion. Spotts and Weser find that there may also be a discrepancy between grain-orientation and sole markings. Is this an aspect of the same problem —an interaction of turbidity-current flow and bottom currents or the effect of reflected surge waves?

Granted the operation of both types of current, how are the turbidites to be distinguished from those sands deposited from bottom currents? Massive graded beds without large-scale current bedding would appear to be typical of turbidites especially if, as Meischner points out in his investigation of the allodapic limestones, current sole markings, bed thickness and grain-size show some intercorrelation. But the distinction is very difficult when laminated and rippled fine-grained sandstones are considered. Van Straaten, following Bouma, maintains that the lamination sequence, parallel—ripple and convolute—parallel, is diagnostic of turbidites, but this would be regarded with some scepticism by other workers. Rizzini and Passega contend that grain size analyses using the CM method developed by Passega can be used to separate turbidite from traction deposits. This method has, however, the disadvantage that it can only be applied to sequences of sandstones.

The foregoing remarks will show that there is much of value in *Turbidites* and the specialist will find a number of papers well worth reading. There are, unfortunately, a number of features to be deprecated. The quality of some of the plates is deplorable and typographical errors can be found throughout the volume. Many readers will welcome the fact that some of the foreign authors have presented their work in English. It is clear, however, that some of these writers needed to rely heavily on editorial help in clarifying and correcting their work; this help was apparently not provided and some of the text is ambiguous or obscure.

There is, too, a vast unevenness of treatment. Does, for example, a paper describing an outcrop of one bedding plane, 10 square yards in extent and describing one small feature of sedimentation, merit 30 pages when the turbidites from the rest of the United States are treated in 12? Again, ten Haaf's provocative little paper on the Apennines raises a number of complex questions which I at least would have liked to have seen developed.

Perhaps the clue to the unevenness lies in the fact that the papers were initially gathered together to form a special issue of *Sedimentology*. The collection remains a series of papers for a journal and, however valuable some of them are individually, they do not form a satisfactory book—not at the price of £4 10*s*.

E. K. Walton