

- chapán Area, Western El Salvador, Central America: unpub. M. A. Thesis, The University of Texas, Austin, Texas.
- MEYER-ABICH, H., 1960, El Salvador: Lexique Stratigraphique International, Vol. V, Fasc. 2a, *Amerique Centrale*, 99-128, Paris 1960.
- SEGER, D., 1960, Geología de la Región de Ahuachapán: Energía Geotérmica, Informe No. 1, Serv. Geol. Nac. San Salvador.
- ROSS, C. S. and R. L. SMITH, 1960, Ashflow Tuffs: their Origin, Geologic Relations, and Identification: U. S. Geol. Survey, Prof. Paper 366.
- SMITH, R. L., 1960, Zones and Zonal Variations in Welded Ash Flows: U. S. Geol. Survey, Prof. Paper 354-F.
- WEYL, R., 1954, Beiträge zur Geologie El Salvadors, V. Die Schmelztuffe der Balsamkette: *Neues Jb. Geol. Paläontol.*, Abh. 99, 1-32.
- WEYL, R., 1957, Las Tobas Fundidas de la Cadena Costera: *Com. ITIC* 6, No. 1, 1-20 San Salvador.
- WEYL, R., 1960, Las Ignimbritas Centroamericanas: *Inst. Geog. Costa Rica*, Informe Semestral, Enero a Junio 1960, 39-60.
- WEYL, R., 1961, Mittelamerikanische Ignimbrite: *Neues Jb. Geol. Paläontol.*, Abh. 113, 13-45.

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REVIEWS

TURBIDITES; THE MOVEMENT OF BEACH SAND THE HISTORY OF THE STUDY OF LANDFORMS OR THE DEVELOPMENT OF GEOMORPHOLOGY; THE DEEP AND THE PAST

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TURBIDITES, edited by A. H. Bouma and A. Brouwer. Published by Elsevier Publishing Company, Amsterdam, London, and New York, 1964, v + 264 pp., illus., \$12.50

This volume, the third in the *Developments in Sedimentology* series, was produced on behalf of the International Association of Sedimentologists who assembled the papers. It is the first book devoted to turbidites, a relatively new term in sedimentology, but nevertheless of such wide interest that more than seven hundred articles on this subject have appeared in technical journals.

The fifteen articles included in the book are drawn from many parts of the world illustrating the universal interest in turbidite studies and presenting varied views on the importance and interpretation of turbidity currents and turbidite deposits. Eleven papers are in English, two are in French, and two are in German.

Much of the recent work on turbidites is reviewed and the most significant aspects of these puzzling and fascinating rocks are treated in this book. It should help to stimulate additional research and discussion leading to more definitive answers to some of the remaining problems. The extensive and comprehensive bibliography containing more than six hundred and fifty entries is most important and useful.

THE MOVEMENT OF BEACH SAND, by James C. Ingle Jr. Published by Elsevier Publishing Company, Amsterdam, London, and New York, 1966, x + 221 pp., illus., \$14.50

This is the fifth volume in the series, *Developments in Sedimentology*, published by the Elsevier press. It presents the results of a large scale study of beach sand transport using a new technique, tracing the movement of fluorescent-dyed sand grains along the beaches of southern California over the period of two years. For the first time the paths of individual grains can be related to dynamic parameters such as current velocity and direction of movement.

The general patterns of foreshore-inshore tracer transport, sand movement seaward of the breaker zone, sand movement around man-made structures, and analysis of tracer dispersion are treated in separate chapters. The field and laboratory procedures are described fully, including the ingenious techniques required to retrieve adequate samples from controlled stations in the rigor of the heavy surf zone. The techniques used to mark sediment grains with fluorescent dyes are summarized in an appendix. This novel approach to the study of sedimentary environments ultimately will aid greatly in understanding the dynamics of sediment transport and deposition.

THE HISTORY OF THE STUDY OF LANDFORMS OR THE DEVELOPMENT OF GEOMORPHOLOGY, Volume I, Geomorphology before Davis, by Richard J. Chorley, Antony J. Dunn, and Robert P. Beckinsale. Published by Methuen & Co. Ltd, London, and John Wiley & Sons Inc., New York, 1964, xvi + 678 pp., 131 figs., \$13.95

This is the first of a series of volumes designed to review the history of study of landforms from both geographical and geological viewpoints, especially emphasizing fluvial geomorphology. Volume I deals with the early development of this subject, terminating with the first significant statement of the Cycle of Erosion by William Morris Davis in 1889.

This book is a treasury of historical data treated in a definitive and detailed analysis of the development of geomorphic thought. In fact, it is far more a history of *geology* than is indicated by the title. The scope of landform study as interpreted by the authors includes most of physical and historical geology. Thus, it will be of direct interest to all geologists and not to geomorphologists alone.

Part one, "worlds without end," deals first with early ideas on the process of erosion and the recognition of rock strata from the brief comments of Aristotle in the fourth century B. C. to the greatly enlightened observations of Leonardo da Vinci in the later fifteenth century A. D., Agricola in the mid-sixteenth, and Steno in the late seventeenth centuries. Next Werner's theory, then Hurton's *Theory of the Earth* and Playfair's elucidations and modifications are discussed in detail with consideration of the Neptunist-Plutonist controversy which lasted until 1820.

Part two, "the age of Lyell," 1820-1845, begins with Buckland and the Diluvialists followed by thorough discussion of Lyell's *Principles of Geology* and his uniformitarianism, Agassiz and the glacial controversy and its eventual general acceptance; it concludes with the beginnings of American geomorphology and "early quantitative geomorphology."

Part three, "marine versus subaerial erosionists," 1846-1875, includes the "advent of marine planation," Lyell's marine dissection theory, Lyell's iceberg theory, the cata-

strophic and stratigraphic structuralists, and the fluvialistic survival in various areas.

Part four, "the western explorations," treats the work of the pioneer students of the American west, including John Wesley Powell, G. K. Gilbert, C. E. Dutton, and others; the effect of the western explorations on geomorphic thought, and concludes with discussion of "the geographical cycle."

This large, handsome, well illustrated, and comprehensive volume is an indispensable resource for historical reference on the development of geomorphic thought and the general history of geology.

THE DEEP AND THE PAST, by David B. Ericson and Goesta Wollin. Published by Alfred A. Knopf, New York, 1964, xiv + 292 + xi pp., illus., \$6.95

The Deep and the Past is a popular but scholarly account of the studies of cores of deep-sea sediment by the authors and the results of their work at the Lamont Geological Observatory, Palisades, New York. They have examined numerous deep-sea cores collected by more than forty deep-sea expeditions.

The greatest benefit derived from this work is the precise dating and subdivision of the sediments deposited during the Pleistocene Epoch into the four major glacial advances and three interglacial stages. This has been accomplished through the discovery that the direction of coiling (dextral or sinistral) of certain planktonic foraminifera is related to climate or ecological parameters. The most revealing of these species proved to be *Globorotalia truncatulinoides*, in which the dextral forms in the upper few centimeters were suddenly replaced by sinistral forms at a level within the cores later determined to correspond to approximately 11,000 years ago. The obvious conclusion is that the colder late Pleistocene waters contained living sinistral forms and the post-Pleistocene waters contained dextral forms. Further refinement of the coiling relationships led to the distinction of various portions of the Pleistocene as recorded in the cores, providing a time scale for evolutionary studies. Later study of *Globorotalia menardii* led to delineation of the Pliocene-Pleistocene boundary. The authors have presented their story in a most pleasing and readable literary style.