

tionship and deduce the history from it". The final chapter of comparisons strongly favours a 'Late Heavy Bombardment' phase at ~ 3.8 to 4.0 gy in the inner planets. This is controversial. Deposition of basaltic plains (maria) succeeded this phase on Mercury, Moon and Mars in the authors' view. Climate cycles and changes on planets with atmospheres are considered; the treatment of causes of glaciations is trite.

The book is very well illustrated with good quality reproductions of satellite images, mosaics and air photographs, plus appropriate original or reproduced line diagrams.

Much of my criticism follows from the authors' intent to write a book without equations, formulae or analytic exposition, for the general interest reader and as a supplementary in undergraduate planetology courses. We have no main text for undergraduate, geological planetology courses! Here, the lack of formal exposition severely limits the treatment of most important matters (models of origin, cratering flux rates, etc.), induces repetition and some rather dogmatic statements.

A second weakness is inescapable. The book is out of date as a consequence of the recent pace of satellite exploration, although it cites references from 1979. The exciting Galilean satellites of Jupiter can be covered in only a few appended pictures. The orbiter radar map of Venus, constituting almost all that is known of that surface at present, is too recent for analysis here. The halt in U.S., planetary explorations for the next few years gives Western specialists the chance to catch up and write major analytical texts in comparative planetology, rather than hasty supplementaries. That being said, this book is the best overview currently on the market and is very reasonably priced.

MS received July 7, 1981.

Moraines and Varves

Edited by C. Schluchter
A.A. Balkema, Rotterdam 441 p., 1979
(99 Main Street, Salem NH 03079, U.S.A.)
\$45.00 U.S.

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Moraines and Varves is a collection of papers presented at the 1978 meeting of "INQUA Commission on Genesis and Lithology of Quaternary Deposits" which was held in Switzerland. It consists of approximately 40 contributions varying from 4 to 33 (average about 10) pages which cover subjects as diverse as till provenance investigations in areas of alpine glaciation, rock glacier deposits, dispersal of debris by modern glaciers, till stratigraphy, laminated Holocene lacustrine sediments and sedimentology of a tidal lake. The editor is to be commended for using a two word title for a package this diverse.

The book is truly an international collection of papers with authors from 17 countries. Most papers are in English (4 are in German and 1 in French). In one or two the writing is a little difficult to follow but when one considers that English is the first language of less than 1/3 of the authors, the writers have handled the language very well. There is some inconsistency in type face and illustration style from paper to paper because author prepared materials have been extensively used. However the overall quality of the book is good and the editor and his reviewers have obviously put a lot of effort into preparing this book.

The volume is divided into three parts. The first part, *Geology and Genesis of Moraines*, covers aspects of sedimentation and sedimentology of glacial deposits (mainly till), formation and recognition of till landforms, provenance of till, transportation of material by ice and genetic interpretations of till stratigraphy. One criticism is that many papers do not provide textural data or adequately describe the glacial sediments which are discussed. The second part, *Varves and Glaciolacustrine Sedimentation*, contained only four papers which were germane to varves (classical sense) or glaciolacustrine sedimentation. The others were concerned with rhythmical laminations in Holocene lake sediments which are considered to be annual in cycle and sedimentation in nonglacial water bodies such as the Black Sea and Lake Biwa.

The third section, *Contributions Related to the Field Excursion*, includes a summary paper on the Quaternary History of Switzerland, a discussion on formation of Alpine moraine complexes in Switzerland and two papers on deformation structures in glaciolacustrine sediments.

There is considerable variation in subject, detail of treatment, use of data and overall quality from paper to paper. Several papers, such as, "Weichselian till stratigraphy in central South-Norway" by K. Garnes and "Sedimentology of a tidal lake, Pitt Lake, British Columbia" by G.M. Ashley are comprehensive reports which probably should have been published as separate monographs. Others, such as "Analysis of pre-pleistocene glacial rocks: aims and problems" by M.J. Hambrey and W.B. Harland and "Paleogeography of Lake Biwa, Japan - and deep drilling site investigations in ancient lakes" by S. Horie are little more than descriptions of projects and hence should not have been included in this volume of scientific papers. Some such as "Origin and composition of clastic varves" by M. Sturm, consider sedimentation from a broad theoretical point of view whereas others such as "Moraines on the northern slopes and foothills of the Macgillycuddy's Reeks, south-west Ireland" by W.P. Warren, consist mainly of qualitative descriptive information for a very small area.

Several of the papers are excellent and many are good. The ten papers mentioned below are what I considered to be the best but a reader with different biases and interests would have little difficulty choosing other papers for this list.

"Sedimentation by valley glaciers; a model and genetic classification" by G.S. Boulton and N. Eyles, is easy to read, presents a logical classification and provides fairly comprehensive interpretations of complex glacial stratigraphy. It does however suffer from a lack of concrete data. "Composition and dispersal of debris by modern glaciers, Bylot Island, Canada" by R.N.W. DiLabio and W.W. Shiels, presents plenty of data on the composition and variation of tills and shows how compositional data can be used in interpreting the history of ice movement and the nature of glacial processes. "The problems of waterlain tills" by A. Dreimanis, is a good and concise review. It clearly outlines the problems in determining the precise origin of glacial sediments and provides concrete suggestions on further research. "The origin of preconsolidated and normally consolidated tills in eastern Wisconsin, U.S.A." by D.M. Mickelson, L.J. Acomb and T.B. Edil, contains a detailed presentation of the data on which hypotheses are based

(this is lacking in many other papers) and arrives at intriguing conclusions. "La genèse des drumlins" by G. Seret, makes good use of pebble orientation and till structure data to back up the hypothesis that drumlins are developed by movement of basal ice from synclinal to anticlinal axes within a glacier. "Weichselian till stratigraphy in central South-Norway" by K. Garnes, is an excellent example of thorough fieldwork and careful use of data. A picture of shifting ice flow patterns and centres is presented and used to explain till stratigraphy, till distribution, and the pattern of ice flow indicators. "Origin and composition of clastic varves" by M. Sturm, discusses the main sedimentation parameters present in lake basins and describes the different structures which result from the interaction of these. It is an excellent reference for anyone attempting to explain depositional lake sediment features. "Sedimentology of a tidal lake, Pitt Lake, British Columbia, Canada" by G.M. Ashley, presents a complete description of a unique depositional system. It is an excellent paper but most of it is not pertinent to varves or glaciolacustrine sedimentation. Also because of the comprehensive scope of the paper it probably should not be in the middle of a book but be published where it is certain to be referenced on its own. "Deglaciation and glaciolacustrine sedimentation conditions, Okanagan Valley, British Columbia, Canada" by J. Shaw and J. Archer, is short, to the point and contains explanations of glaciolacustrine textures and structures. I disagree with their conclusions on glacier dynamics during deglaciation because of personal observations and interpretations made in the area discussed, but still view it as a very good discussion of glacial lake sedimentation. "Genesis of lateral moraine complexes, demonstrated by fossil soils and trunks; indicators of post-glacial climatic fluctuations" by F. Roethlisberger and W. Schneebeli, is a rather lengthy (33 pages) but well illustrated paper which uses fossil soils in alpine moraine sequences to both date climatic change and to develop models for construction of complex lateral moraine ridges.

My conclusion is that even though the quality of the papers is not uniform (the editor admits to this in his introduction) and not all papers are related to moraines and varves, this volume contains enough good papers and stimulating ideas to make it a worthwhile addition to the library of any one interested in glacial and glaciolacustrine deposits and processes.

MS received August 19, 1981.

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Western and Arctic Canadian Biostratigraphy

Percival Sydney Warren Memorial Volume

Edited by C.R. Stelck and B.D.E. Chatterton
Geological Association of Canada
Special Paper 18

This book, which includes 16 papers from a symposium of the same name, contains papers of biostratigraphic interest ranging in age from the Ordovician through to the Tertiary.

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Late Silurian and Early Devonian Graptolite, Brachiopod and Coral Faunas From Northwestern and Arctic Canada

by D.E. Jackson, A.C. Lenz, and A.E.H. Pedder
Geological Association of Canada
Special Paper 17

The work integrates the author's separate and on-going studies of graptolites, brachiopods and corals from northern and Arctic Canada. Much of the importance of the rich faunas from these regions is due to interbedding of graptolite-bearing shales with limestones carrying shelly fossils and conodonts. This and paleoecological aspects of the faunas are stressed by the authors. The volume is 160 pages in length, with four graptolite, ten brachiopod and thirty coral plates. (August, 1978)

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