interpretation of metamorphic rocks and it has been clear for some time that a book was needed to enable the interested reader, with a background of some past exposure to physical chemistry and elementary calculus, to make use of these techniques. Edgar Froese's book can be recommended to accomplish this task. It would be possible to understand the book even without having once taken a course in physical chemistry, but one would not develop an overall understanding of the subject by this route.

The style of writing is, for the most part, clear and unambiguous, and easy to follow, and while Froese is careful to state matters rigorously there is little sign of rigor concealing the meaning of the sentences. I found only three minor typographical errors and the quality of printing and reproduction of figures is uniformly excellent. In many ways, the heart of the presentation lies in the profusion of figures, with 33 figures in 37 pages. Each figure serves to illustrate graphically one or more of the important equations around which the calculations are built, with the result that the reader need never feel lost in a maze of equations. There is always an illustration that shows graphically the meaning of each equation.

In addition to the extensive use of figures Froese has used detailed numeric examples to illustrate the application of the equations to problems of metamorphic petrology, some of which have been published elsewhere, and some of which are given for the first time in this paper. The examples are well-chosen so as to illustrate a variety of principles, ranging from simple calculation of univariant equilibrium, through ideal solution models applied to the displacement of equilibria, to consideration of non-ideal solid solutions and partial melting. This is an ambitious array of subjects for so short a book and it is inevitable that some parts of the subject of thermodynamics and some good examples have been omitted. However, there is at least one example of most kinds of equilibrium calculation and the reader who works his way through all of them will become sufficiently adept with the subject to progress the rest of the way on his own.

Attention should be drawn to some of the aspects this reviewer found most rewarding. Particularly good treatment is afforded to thermodynamic temperature scales, to the minimization of free energy at equilibrium, to the derivation and use of the equilibrium constant, and to the problems of standard states. Excellent illustrations will help the reader understand the different standard and reference states and the meanings of the different terms needed in finding the free energy of water at different pressures and temperatures. Clear but rather compact treatment is given to equilibria between suphides and silicates, and all chemical petrologists should become aware, via this approach, of the importance of 'opaques' in the understanding of metamorphic mineralogy.

It is always possible to find something to criticize in a short presentation of a large subject, particularly when similar problems can be treated by a variety of approaches even though the numerical results must finally all agree. For example, there is no derivation nor use made of the Gibbs phase rule, and no attention given to Schreinemakers' rules, presumably because these are a necessary though unstated consequence of the fundamental equations that are used. Similar reasoning must have excluded the representation of equilibria in CO_2-H_2O mixtures by means of diagrams plotting gas composition against temperature (T-x diagrams). The treatment of ideal site-mixing and the Temkin model of ideal site-substitution is rather short and essentially phenomenological, with no reference to the probabilistic nature of the entropy of ideal solution. This is not really a criticism but a reflection of different taste in development.

In summary this is a good book, and at the price of $3.00 an outstanding bargain. I recommend it to students of petrology at all levels, particularly undergraduates in their final year and graduate students in their first year. Readers who have been away from academic subjects for some years should also be able to read the book and use the results, although they need occasional reference to one of the standard texts of physical chemistry cited in the bibliography.

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Ice Ages: Ancient and Modern

Edited by A. E. Wright and F. Moseley
Geological Journal Special Issue No. 6, Seel House Press, Liverpool, 320 p., 1975
£ 12.00

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This volume containing 15 papers and two brief tributes to Leonard J. Wills on his 90th birthday and Frederick W. Shotton on his retirement after 24 years as Head of the Department of Geology, University of Birmingham, is an outgrowth of the 21st Inter-University Congress organized by the students of the Lapworth Society at Birmingham, U.K., in January, 1974. It deals with two groups of topics: the Quaternary and the pre-Quaternary glaciations - both of considerable interest to the Canadian earth scientists.

The first paper is F. W. Shotton's "Introduction to the Quaternary", discussing various lines of evidence that have been used to deduce and date the Quaternary climatic cycles, but also warning that not all of them are applicable to the earlier 'Ice Ages'. G. S. Boulton discusses processes and patterns of subglacial erosion, deformation and sedimentation by applying theoretical approach based upon direct observations at the present-day glaciers and the theories developed mainly by physicists, glaciologists and engineers. In conclusion he cautions, however, that his "predictions cannot be readily tested", as "there is as yet no consensus about the patterns of erosion and deposition produced by ancient ice sheets." E. A. Francis presents a review on glacial sedimentary deposits, their definitions and nomenclatures. He also proposes recommendations "in an attempt to simplify classification and to relate deposits to genesis and environment". While achieving this goal successfully re several terms, Francis unfortunately does not assist in solving the already existing confusion on the international usage in one of the basic terms - moraine -, by suggesting "that

the term moraine should be restricted to the material in glacial transport". P. H. Banham, with particular reference to Norfolk, discusses glaciotectonic structures and the models of glaciotectonic deformation. He also points out that some of the structures which have been interpreted as glaciotectonic, may have resulted from polygenetic multiple causes.

Four authors deal with the Pleistocene climate from various points of view - H. H. Lamb's paper begins with the recent meteorological and climatological data, followed up by the past climatic regimes, and concludes with drawing attention to the short-time periods of rapid climatic change. R. B. G. Williams discusses "the British climate during the Last Glaciation; an interpretation based on periglacial phenomena", while G. R. Coope attacks the same problem by studying fossil assemblages of Coleoptera which appear to be more sensitive climatic indicators than plants. Therefore "the pattern of climatic changes indicated by Coleoptera deviates considerably at times from the traditional picture". W. H. Zagwijn follows the more traditional way and discusses the "variations in climate as shown by pollen analysis, especially in the Lower Pleistocene of Europe", and points out that the translation of vegetational changes into terms of climatic changes also offers many problems.

R. F. Flint's paper on "Features other than diamicts as evidence of ancient glaciation", though placed among the papers dealing with climate, actually ties together the criteria used for deciphering the Quaternary glaciations with those of the more ancient ones.

The pre-Quaternary glaciations are dealt with by five papers. W. B. Harland and K. N. Herod present a general review for the time span ranging from Precambrian to Late Cenozoic, also pointing out the different opinions of various authors and the possible varieties of the causes of ice ages. A. M. Spencer discusses the "Late Precambrian glaciation of the North Atlantic region", P. Allen, the "Ordovician glacials of the central Sahara" where even some landforms have survived the hundreds of millions of years and are exposed in the desert terrain. R. J. Adie deals with the "long-known Permo-Carboniferous deposits throughout the Southern Hemisphere", reviewing also the different opinions on their sequence and paleogeography. L. J. G. Schermerhorn reviews quite critically the supposed Precambrian glacials in a setting of tectonic framework and concludes that "the great majority of Late Precambrian mixtites are essentially the product of crustal instability".

The concluding paper, by both editors, is a summary of inter-disciplinary discussions on all topics and several related problems.

The book is a valuable contribution to a better understanding of glacigenic sediments and structures, and the climates which have been favourable for their wide-spread formation.

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Beach and Nearshore Sedimentation

Edité par Richard A. Davis, Jr. et R. L. Ethington
S.E.P.M. Publication speciale No. 24, 187 pages, 1976.
CSPG membres $11.00, autres $13.00

Critique par Bernard F. Long
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Cet ouvrage constitue une sythèse des différents sujets abordés au cours du colloque de DALLAS, organisé par la SEPM en 1975 sur le thème: Sedimentation des plages et infralittoraux (Aspects physiques et biologiques). Il résume les tendances actuelles de la recherche en sedimentologie marine qui furent preconisées lors du colloque de Toronto, en 1964, sur les relations entre les structures morphosédimentaires et les paramètres hydrodynamiques et biologiques.

Ce livre contient 10 articles, neuf sur les aspects physiques due problème et un seul sur l'influence de la biologie sur la sedimentation. Il démontre, d'une part le haut degré de symbiose existant actuellement entre la sédimentologie classique et l'océanographie physique et d'autre part les relations modestes liant la biologie marine aux sciences de la terre.

Le premier article, "Weather Patterns and Coastal Processes" de W. T. Fox et R. A. Davis présente les relations entre les conditions météorologiques et l'evolution littorale en divers points du continent Nord-Americain en insistant sur l'influence de la pression atmosphérique sur la stabilité du littoral.

L'article de V. Goldsmith ("Wave Climate Models for the Continental Shelf: Critical Links between Shelf Hydrolic and Shoreline Processes") propose un modèle mathématique très poussé de la propagation des houles de différentes périodes dans la mer de Virginie. Il en détermine leurs orientations, leurs énergies et leurs actions à la côte ainsi que les relations entre cette action et la nature granulométrique des sédiments. Cet article complète l'approche théorique de J. F. Collin ("Approches to wave modeling") qui constitue une synthèse des travaux sur la dynamique des houles.

Quatre auteurs: P. D. Komar ("Evaluation of Longshore Current Velocities and Sand Transport Rates on Beaches"), B. N. Benninkmeyer ("Sand Fountain in the Surf Zone"), R. L. Miller ("Roles of Vortices in Surf Zone Prediction: Sedimentation and Wave Forces") et E. Waddell ("Swash-Groundwater-Beach Profile Interactions") précisent de manière théorique et expérimentale l'influence des différents paramètres hydrodynamiques sur les mouvements sedimentaires au niveau des estrans. Komar insiste sur l'importance de l'angle d'attaque des houles par rapport à la côte et sur le role majeur des brisants dans le transport littoral; ce dernier point fait l'objet d'une excellente étude "in situ" de la part de Benninkmeyer à l'aide de systèmes optiques. Miller démontre le role des vortex dans l'érosion des figures sédimentaires durant la période des brisants et du déferlement. Les interactions de phénomènes hydrodynamiques au niveau de jet de rive sont définies par Waddell. Ainsi, toutes les étapes des actions mécaniques des houles sur les littoraux sont analysées.

Les aspects morphosédimentaires font l'objet de deux articles: "Wave Formed Sedimentary Structures"