

BORCHERT (Hermann) and MUIR (Richard O.). *Salt Deposits. The origin, metamorphism and deformation of evaporites*. London (D. van Nostrand Co. Ltd.), 1964. x+338 pp. Price: 80s.

This is not merely a translation of Professor Borchert's 'Ozeane Salzlagerstätten', published in 1959 by Gebrüder Borntraeger, Berlin; it has been revised and expanded by Dr. Muir, who has contributed about one-third of the book. The earlier part deals with mineralogy, distribution, depositional features, and tectonic environments. This is followed by accounts of the crystallization of salts during isothermal evaporation of sea-water, and 'dynamo-polythermal' evaporation involving temperature and concentration gradients. The carbonates are largely excluded. The next seven chapters (8-15) deal mainly with post-consolidation changes involving rise of temperature and pressure and the action of migrating solutions (progressive and retrograde metamorphism, &c.). Following sections include a brief chapter on non-marine evaporites, accounts of some marine deposits, and chapters on salt tectonics and the mechanical properties of evaporite minerals.

Professor Borchert's earlier monograph (Arch. f. Lagerstättenforsch., Heft. 67, 1940, Berlin) is a classic in the field of evaporite geology, particularly in its consideration of 'dynamo-thermal' systems and in its discussion of geothermal metamorphism. The present work contains much useful information on these topics, but places much more emphasis on metamorphism than on primary differentiation and early (penecontemporaneous) diagenesis. 'On one fundamental point, namely on the relative importance of metamorphic processes in the development of marine evaporites, we find ourselves opposed to some authors' (p. 3). This is very apparent; in fact a great many other evaporite geologists are freely castigated. Words such as 'undoubtedly', 'clearly', and 'certainly' are liberally used, often in situations that are by no means certain. For example: 'These porphyroblasts . . . provide a clear indication that gypsum survived diagenesis' (p. 129); all they indicate is that gypsum grew diagenetically, not that it survived diagenesis.

'The conversion of gypsum to anhydrite certainly results from true, geothermal, incongruent melting, and is thus really metamorphic, though O. Braitsch (1962, p. 120) does not agree' (p. 132). Nor do many other salt geologists. Incidentally, this important work of Braitsch ('Entstehung und Stoffbestand der Salzlagerstätten', Springer-Verlag, Berlin, 1962) cannot be found in the bibliography.

What does emerge clearly is that the authors are enthusiasts, and follow an hypothesis with great energy. It is a pity that this sometimes

leads them into errors of fact. For example, in their imaginative reconstruction of the Lower Evaporite succession of Yorkshire (I still prefer my own), they say on p. 228 that one of my reasons for suggesting pene-contemporaneous replacement of anhydrite by polyhalite is 'the relatively constant stratigraphic horizon of its development' and that 'the latter is incorrect'. I have searched my paper for this supposed statement of mine and have failed to find it there. Now, however, that this 'reason' has been mentioned by Borchert and Muir, I would say that it is broadly true, since the polyhalite is largely confined to the Middle cycle of the Lower Evaporites. Again, near the bottom of the same page: 'In places a little langbeinite has been preserved'—in fact none has ever been recorded here. On p. 229: 'The presence, in this replacement anhydrite, of the very rare mineral sulphoborite . . . is also very suggestive, for the only other record of this in Europe is in the carnallite of the Stassfurt Potash beds.' A third record, overlooked, is in the oolitic anhydrite-halite rock above Borchert and Muir's 'replacement anhydrite' at Fordon, a zone interpreted by them as an original carbonate zone. Of what is sulphoborite suggestive?

There are other questionable statements of which these are examples:

p. 28: '. . . the upper Devonian halite and potash deposits of the Donetz basin and Pripet Marshes', but, p. 31: 'Silurian, Devonian and Carboniferous potassium salts occur only in North America.'

p. 33: '. . . the Devonian evaporite belt, for example, follows an arc of a circle whose radius is greater than a great circle.'

p. 90: 'The start of the evaporite facies itself is usually marked by a dolomite precipitate' (see also top of p. 153). Surely a calcium carbonate precipitate.

p. 132: 'The youngest anhydritic rocks in the world (e.g. in the upper Miocene of Sicily) are 12–15 million years old.' There are modern ones in the Persian Gulf (Curtis *et al.*, 1963, *Nature*, vol. 197, pp. 679–680).

p. 49: referring to the Zechstein evaporites: 'On the whole, the position of the coastline varied remarkably little. Hence neither regional nor local contemporaneous subsidence can have achieved any real significance.'

This work, then, must be taken with some pinches of salt, but it is nevertheless a welcome addition to the literature on evaporite deposits in the English language, and it contains much stimulating information about the various processes that are of importance in the formation of these complex rocks. It also contains a large and valuable bibliography (44 pages), unfortunately rather carelessly compiled (for example, in the

section on British evaporites, pp. 224–231, five of the references given in the text cannot be found in the bibliography).

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TAYLOR (C. A.) and LIPSON (H.). *Optical Transforms; their preparation and application to X-ray diffraction problems*. London (G. Bell and Sons Ltd.), 1964. x+182 pp., 54 plates, many figs. Price: 45s.

This book is very appropriately dedicated to Sir Lawrence Bragg since it was he who first suggested the use of an optical diffraction apparatus to provide an analogue of the results obtained by the crystallographer in X-ray diffraction experiments. In the method of Taylor and Lipson, models of crystal structure projections are made by piercing holes in opaque cards, and their optical transforms (i.e. their diffraction patterns) are compared with the X-ray diffraction patterns from crystals. Correct and incorrect structure models can be recognized, and furthermore the effect of various structural changes can be readily seen, and the contribution of parts of the structure to the diffraction pattern can be determined. These and other relationships can, it is true, be dealt with either mathematically or physically, and which approach is taken is to some extent a matter of personal preference. Some crystallographers are content to do everything by calculation (with the aid of computers) while others prefer to see what they are doing by use of a physical experiment. For many the latter approach will give a greater insight into the processes of X-ray diffraction, and it is certainly of value in teaching X-ray diffraction in a physics course.

The theoretical principles of *Fourier transforms and their relation to X-ray diffraction* were dealt with in an earlier work by the same authors ('Fourier transforms and X-ray diffraction'), and they have assumed an understanding of these on the part of the reader of the present volume, which deals with the preparation of optical transforms and their application to X-ray diffraction problems.

Taylor and Lipson and their school at Manchester have developed this technique in all its aspects over a number of years. They have constructed a refined apparatus, simplified the procedure for its use, and gained extensive experience in the interpretation of results obtained from it. Any crystal structure worker who wishes to use this method (an apparatus can be bought or built) can now use this book to give him a flying start, benefiting not only by the lucid account of the principles and applications, but also by many of the 'tricks of the trade', which are passed on to the reader.