REFERENCES

DEER (W. A.), HOWIE (R. A.), and ZUSSMAN (J.), 1962. *Rock forming minerals*, **5**, London (Longmans).
EADE (K. E.), 1952. *Geol. Surv. Canada, Paper* **52**–9.
NASH (C. R.), 1972. *Contr. Min. Petr.* **36**, 27–32 [M.A. 73–777].
PHILLIPS (E. A.), 1962. *Proc. Roy. Soc. Queensland*, **72**, 121–2.
SHIBATA (T.), 1972. *Journ. Japan. Assoc. Min. Petr. Econ. Geol.* **67**, 76–83.
STOCKWELL (C. H.), 1968. Tectonic map of Canada, *Geol. Surv. Canada Publication* 1251A.

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BOOK REVIEWS

AMSTUTZ (G. C.) and BERNARD (A. J.), Editors. *Ores in sediments*. VIII International Sedimentological Congress, Heidelberg, August 31–September 3, 1971. Intern. Union Geol. Sci., Ser. A, no. 3. Berlin, Heidelberg, & New York (Springer-Verlag), 1973. viii+350 pp., 184 figs. Price DM 48 ($15.30).

This well-produced volume contains the proceedings of a Symposium organized in connection with the 8th International Sedimentological Congress held in Heidelberg in 1971. It is the second symposium on the subject, and reveals appreciable progress since the previous one in 1963. A list of contents will be found in M.A. 73–2299.

As might be expected, there is a distinct gitological flavour about some of the material, by which I mean some of the authors go out of their way to attempt to show that the ore deposits were formed as normal sediments, with nothing introduced from far away, and particularly nothing brought in by hydrothermal fluids. It is a pity that the case is marred by some specious and pseudo-philosophical arguments. For example, Professor Bernard begins his introductory review of processes by saying 'A few years ago, eminent scientists still postulated seriously a deep-seated, magmatic origin of petroleum . . . This was a typical example of a dogmatic way of thinking or behaviour . . . it allowed the theorists to cling to their ideas, whereas the prospectors, the practical men, were expected to restrict their interest to oil reservoirs and traps . . . the concept of magmatism yields progressively to a concept which assigns more importance to synsedimentary traps . . . the accumulated oil is fossilised almost *in situ* together with its connate waters.' This travesty of the present state of hydrocarbon genetics is surprising; those who have advocated a plutonic origin for oil form a negligible proportion of workers in the field, almost as negligible as those who believe that oil and gas concentrations form almost without fluid migrations. The dogmatic thinking, it may be suggested, comes from the rigidly anti-epigenetic gitologists, rather than from a few plutonically inclined oil men.

The fact is that most lead, zinc, copper, and uranium concentrations in sediments, though admittedly influenced by the sedimentological history of the host rocks in so far as this has affected permeability conditions, are difficult or impossible to explain as normal sediments.

Thus Professor Bernard himself contributes a valuable paper on the control of mineralization by Karstic conditions, where epigenesis, not syngenesis, is clearly implied. Even here, however, he is quite unwilling to admit activity by warm solutions

other than those originating from within the limestones, or from the planated land surface. He deals with the evidence of fluid inclusions (which, for many investigators, provide the decisive evidence that hot solutions were involved) by maintaining that in the case of the Mississippi Valley deposits the highest recorded temperatures, up to 130 °C, represent the position reached at the maximum depth to which the deposits were buried after they accumulated. If an average thermal gradient of 30 °C per km is accepted, burial to depths of more than 4 km is implied—an unlikely depth for the Illinois–Kentucky deposits. Many deposits of comparable type show temperatures up to 200 °C in situations where it is most improbable that they ever suffered more than 1 km of burial.

In fairness to Professor Bernard, it must be admitted that he is quite prepared to accept an exhalative origin for some sulphide deposits, for example in tuffs; the symposium contains good descriptions of sea-bottom exhalative deposits at Vulcano in the Tyrrhenian Sea (in a paper from which the authors' names appear to have been accidentally omitted) and at Santorini. Surely these have been formed from hot waters introduced in connection with the volcanic activity? And if volcanic hydrothermal solutions are admitted, why not hypabyssal or even plutonic hydrothermal solutions? Or hydrothermal solutions from deeply circulating connate hypersalines?

The question of preconcentration of metals at the land surface is dealt with by Bernard and also by Samana. Uranium deposits like those of Texas can plausibly be explained by leaching of flood plains or tidal flats, but decisive evidence that this process really works for lead and zinc has not yet been produced. In the present state of knowledge it appears just as likely that trace metals are diluted and dissipated during continental weathering as that they are concentrated. It would seem preferable to rely on the far more effective solvent action of heated hypersaline brines at depth than the feeble action of oxygenated water at the surface.

It will be clear that some of the assumptions in this work will prove unacceptable to ore-geologists other than those with gitological leanings, and no amount of Cartesian philosophy will alter this. Nevertheless, there is much of value in the symposium, from the case made by Arnold *et al.* for a sedimentary origin for the famous Almadén mercury deposits to the excellent description of the comparatively recently discovered Texas uranium deposits and the very new finds around Merano in North Italy. There are sound papers on manganese and a record of goethite–montmorillonite ooliths from Lake Chad. All will agree with V. M. Popov that a high measure of structural anistropy is essential in the host rocks of ore deposits (especially epigenetic deposits); but it is appropriate to ask what is the meaning of the term 'subfluvial' as used by Y. V. Bogdanov and E. I. Kutyrev? What, for example, is subfluvial acid and basic dacite? There is a fine sedimentological study of the Katanga, Congo, sediments and copper ores; and there is a short paper that claims that dolomitization and lead-zinc mineralization are a simple matter of introducing sea-water into limestones. Finally, Zimmerman and Amstutz describe a sulphide-bearing mud volcano from Decaturville, formed by the introduction of unconsolidated sulphide-bearing sediment into higher, more consolidated strata.

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