fortunately, the price is rather high, and this may put it beyond the reach of research students who would find it especially useful. JOHN STRINGER

Sedimentology

Origin of Sedimentary Rocks. By H. Blatt, G. Middleton and R. Murray. Pp. xix+634. (Prentice Hall: Englewood Cliffs, New Jersey, July 1972.) $16.

SOMEONE had to try to summarize and evaluate the many advances in sedimentology—in data, techniques and ideas—that lie buried in the post-Pettijohn[1] plethora of literature. I think the authors have succeeded—though one reviewer can hardly hope to be so informed he can assess adequately that which has taken three authors to put together.

The book consists of twenty chapters divided between six parts. Part 1 (one chapter) outlines the aims and methods of study of sediments. Part 2 (five chapters) discusses the physics of sedimentary processes and deals with the geologic cycle, sedimentary textures, sediment movement by fluid flow, sedimentary structures and facies models. Parts 3, 4 and 5 (thirteen chapters) cover the mineral and chemical composition, classification, origin and diagenesis of the common (*sic*) sedimentary rocks. The final chapter (Part 6) outlines current thinking on the major external controls of sedimentation.

The material (inevitably uneven and with the occasional factual error) is in the main treated in an informative and enjoyable manner, with insight, conviction and, on occasion, humour. Most important, the authors are not afraid to make value judgments and they are particularly generous with their suggestions for future lines of research.

My main criticism concerns what has been left out—perhaps because these are the rocks with which I am most familiar! Surely one would expect sections on coal, lignite and oil-shale? Sedimentary rocks containing metals are also virtually ignored. There is nothing, for example, on the Colorado Plateau uranium-copper-vanadium province, or on metalliferous black shales. No mention is made of manganese ores in chapter 19, in spite of its title—and so I could go on. Why do geologists (not just sedimentologists) write petrological texts that ignore so many rocks coming within their terms of reference apparently solely because they are of economic value? It is scientifically unsound and potentially dangerous. Future geologists must be made to realize that a study of "economic" rocks is no different from a study of rocks of "academic" interest, otherwise there is little hope of our finding new sources of supply of the materials necessary to maintain our civilization.

In spite of this criticism I have no doubt that the book will stimulate the next generation of sedimentologists and take its place as the obligatory text in most university courses. To the practising geologist intent on catching up with many aspects of sedimentology he has fallen behind with, there is no rival. It is beautifully produced (with the occasional exception of some photographs) and free from misprints (though I suspect the inclusion of references in bold type in the title of Section 4.7 is an editorial lapse).

P. McL. D. DUFF

[1]Pettijohn, F. J., *Sedimentary Rocks* (Harper and Row, New York, 1957).

Needle and Haystack

Atomic Safeguards: A Study in International Verification. By Allan McKnight. Pp. xxii+301. (United Nations Institute for Training and Research, New York, 1971.) $6.50.

THE nuclear fuels which fire up modern electric plants are schizophrenic materials. In dilute form they suffice to sustain a controlled chain reaction as an essential source of energy for peacetime. In concentrated form they may be adapted for use in nuclear explosives. The "atoms for peace" made famous by President Eisenhower's 1953 speech to the United Nations have a dual identity and it becomes the task of modern society to keep nuclear material confined to the fuel cycle of peacetime industry.

An amount of concentrated or fairly pure nuclear material about the size of a baseball is adequate for a low-power nuclear explosive. But as nuclear power grows from its present infancy to more maturity the world's power plants will consume huge quantities of nuclear fuel. As a result more than a thousand tons of potential bomb-stuff will be circulating in the nuclear fuel cycle before the end of the century. Keeping track of this precious and precocious stuff is increasingly a needle-in-the-haystack proposition with the haystack getting bigger every year.

The problem of this nuclear needle-hunting forms the basis of *Atomic Safeguards*, written by Allan McKnight, the first Inspector General of the International Atomic Energy Agency (IAEA). No agreement such as the Non-Proliferation Treaty will be worth much if there is no inspection system devised and constantly implemented to keep account of the nuclear material as it goes into nuclear power plants, comes out as spent fuel, enters storage tanks, undergoes reprocessing to recover unburned nuclear fuel and is refabricated as fuel elements. In some parts of the fuel cycle, radioactivity becomes a protective device since diversion of it becomes unwieldy due to the sheer weight of shielding required to handle it safely. Slightly enriched nuclear fuel, while not such a hazard, is not a candidate for basement bomb-making. The point of greatest vulnerability in the fuel cycle is the plutonium recovery and, in the future, in the power-breeder fuel which will be 15 or more per cent plutonium oxide.

Atomic Safeguards is a comprehensive and competent examination of this troublesome nuclear issue with emphasis on (Part I) the political development of IAEA safeguards and (Part II) the executive administration of these safeguards. Half of the book consists of a series of nine annexes which back up the text and provide details of pertinent treaties and technologies.

Given the escalation of fanatical extremism in the world it becomes necessary to worry about the siphoning off of nuclear material to groups which might convert it into a nuclear weapon. It requires little imagination to glimpse the potential mischief in store for society when some vulnerable part of the social anatomy is threatened with a blackmail or retaliatory coup. The UNITAR's (UN Institute for Training and Research) rather viscous prose tends to obscure the contemplation of the consequences as it focuses on administrative and inspection mechanisms. But the magnitude and intensiveness of the study testify to the significance which UN officials attach to the nuclear safeguards problem.

The shape of the future of nuclear power is still hard to discern. To be sure, we know approximately how many and what size power plants will come on stream decade by decade. The world's rapidly depleting premium fossil fuels guarantee a world rush to heavy metal energy. About the only event capable of arresting the momentum of this juggernaut would be a serious accident, but even this would not stop nuclear power but would mean an interruption. But where these plants will be sited and how they will be clustered and what pattern the fuel network will assume is still uncertain. One possibility which offers hope for increased safeguards against illicit acquisition of nuclear material is the evolution of self-contained reprocessing centres where the input is spent fuel and the output is fresh fuel. Such a development could serve to concentrate the circulation of high grade plutonium within tightly controlled security boundaries.

The UNITAR study, a solid contribution to the nuclear safeguards problem, is essentially an administrative introduc-