Jurassic environments

Jurassic Environment. (Cambridge Earth Sciences Series.) By A. Hallam. Pp. ix+269. (Cambridge University: Cambridge and London, August 1975.) £11.00.

THE Jurassic System has a special place in geological history as it provided the touchstone for early concepts in stratigraphy and biostratigraphy. Just before he died in 1956, W. J. Arkell, in his *Jurassic Geology of the World*, reviewed the global status of these studies in the final of several of his works which are already, in the best sense, classics of geological literature. The subsequent two decades have been revolutionary ones for the geological sciences, with quite new approaches possible through palaeomagnetism and the concept of seafloor spreading: for the Jurassic, too, substantial work has been done in formerly little known areas. The time may be ripe for a dynamic synthesis on the geography, biogeography and ecology of the period, collating and the interpreting of the changing Jurassic environments.

Over the past two decades Dr Hallam has enlivened Jurassic specialists with a range of novel contributions on various aspects of Jurassic environments, contributions which often emphasised the inadequacies of currently held hypotheses rather more than they provided acceptable explanations of their underlying problems. The stimulating role of these in Jurassic studies, especially to a younger generation, has been considerable. It is therefore particularly welcome to have a summary which brings together his views on the sediments, tectonism, sealevel movements, climate, and biogeography of the period.

The most satisfactory parts of the book are where he attempts a rigorous analysis of Jurassic tectonism, sealevel changes and ammonite provincialism, even if length does not permit an exhaustive treatment. These are marked advances over anything which could have been written twenty years ago. Less satisfactory are the instances, especially in the several chapters on various sediment types, which raise problems common to most geological periods. Here, quixotic tilting at various hypotheses when space is not available to deal thoroughly with any of them is not helpful.

Nonetheless this is a refreshing and valuable contribution for those with any interest at all in the Mesozoic Era. For Jurassic specialists the attempt at updating Arkels work, and the long bibliography of more recent work, will be welcome. Students (if any can afford to buy it) will appreciate the breadth of view presented in a work which will add some sparkle to their labours.

How vividly a comparison of this work with Arkell's 1956 volume brings out contrasts in the scientific approach: Hallam delighting in controversy and speculation, Arkell cautious and scholarly. The one giving a stimulating attack on problems, the other working most to ensure a sound foundation for advance. The writing of the one often repetitive and with printer's errors, that of the other always of systematic and elegant prose. Science uses both, but what would Joscelyn Arkell have thought on the fulsome dedication of a volume to him which spells his name incorrectly even on the dedication page?

M. R. House

Cosmic rays

The Origin of Cosmic Rays. (Nato Advanced Study Institutes Series, Series C.) Edited by J. L. Osborne and A. W. Wolfendale. Pp. x+466. (Reidel: Dordrecht and Boston, Massachusetts, April 1975.) Dfl. 105; £39.50.

Composition of Cosmic Radiation. (Topics in Astrophysics and Space Physics, Vol. 11. By Krishna M. V. Apparao. Pp. x+86. (Gordon and Breach: London, New York and Paris, March 1975.) £5.40.

SPECULATION about the origin of cosmic rays has gone on ever since the discovery of the radiation itself, but in the early stages that speculation was inevitably somewhat wild and unproductive. A quite demoralising lack of hard facts about physical conditions in possible source regions and ignorance about the processes which could occur there gave to the discussions a metaphysical flavour, a tinge of the glamour of the occult, that they have never wholly lost.

But times have changed. Fermi's suggestion, that the particles are accelerated by collisions with moving gas clouds during their zig-zag motion through the magnetic fields of interstellar space, brought the cosmic ray question firmly into the forefront of contemporary astrophysics, and there it has remained. Yet the debate on origins is not over. The Fermi model has given way to others in which supernova explosions, supernova remnants (pulsars) and explosive events in the nuclei of our own and other galaxies have been suggested as cosmic ray sources. The experimental data on which these rival models will be judged is accumulating steadily. There have been spectacular improvements in our knowledge of the chemical composition of cosmic rays, their energy spectra, and their directional properties. Optical and radio astronomy—and, more recently, X-ray and γ-ray astronomy—have provided much relevant information about the physical conditions in regions where acceleration and propagation of cosmic rays must take place.

The meeting organised in Durham last year by Professor Wolfendale and his colleagues, with the financial support of NATO, was planned to consider the origin of cosmic rays in this broad astrophysical context, and it is the proceedings of that meeting which are now available in book form. That publication has taken place in so short a time (less than twelve months) is something of an achievement in itself, and although at first sight the price (verging on £20) must seem high, the book is in truth a veritable bargain. The contributors are authoritative, they have written with the needs of students in mind and not solely for their fellow experts, and the material is as near up-to-date as one could hope for. The known facts about the particle radiations are summarised by Watson (Leeds), Thambyahpillai (London), Rasmussen (Lyngby), and Meyer (Chicago), whereas the related γ radiation is considered by Pinkau (Munich) and Stecker (NASA). Relevant features of galactic structure are described by Osborne (Durham) and Thielheim (Kiel), and the link between the chemical composition of cosmic rays and nuclear processes within stars is discussed by Reeves (Saclay). The arguments in favour of the three major models for cosmic ray acceleration are put forward by their best-known advocates: Burbidge (San Diego), Pacini (Frascati) and Colgate (New Mexico). With such a galaxy of authors, the book will surely become a *vade mecum* for every postgraduate student concerned with astrophysics, and a valued source of reference for others.

The second book under review, on the chemical composition of the cosmic radiation, is a much slimmer volume. The author is, once again, an authority in his field and writes to interest students as well as specialists. In principle, he succeeds. Unfortunately, he has been ill-served by the leisurely pace of book production. Important developments, duly noted in the Durham proceedings, are missing in Dr Apparao's book, which carries as its most up-to-date reference "1971—in the press". Although the book is still of interest and has its uses, the potential purchaser must reflect that the price per page is substantially greater than for the Durham proceedings, and that the information it gives him is three years behind the times.

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