

suggests that China may have provided a link between Australia and Euramerica. The relationship between the changing Carboniferous geographies and the dispersal of early tetrapods is discussed by Johnson.

Two other papers deal with Palaeozoic botany. Dianne Edwards considers the appearance, habits and affinities of early vascular plants, but concludes sadly that little progress has been made in reconstructing the details of terrestrial plant communities of Devonian times, while Scott reviews the ecology of Late Palaeozoic floras, emphasizing the innovative effects of the evolution of arborescence and seed production. The only other non-vertebrate contribution is that by Rolfe, who describes the early invertebrate terrestrial faunas; these were dominated by arthropods, the larger of which, together with the amphibious eurypterids and scorpions, must have provided a food source for the earliest amphibians.

In one of the most interesting of the vertebrate papers, Thomson points out that there is little evidence that any of the Devonian lobe-finned fishes were primarily freshwater in habitat; he believes that the amphibians may have evolved from fish that still spent at least part of their lives in coastal lowland estuaries. But to which lobe-finned group did this fish belong? Opinions seem to be becoming more, not less, diverse. Though Rackoff's study of the fins of one osteolepid rhipidistian shows a number of close resemblances to the tetrapod limb, Janvier believes that the osteolepid pectoral girdle, though variable, could not have evolved into that of tetrapods. But an even more heretical phylogenetic idea also appeared at the symposium. Both Patterson, in an historical review of the problem of tetrapod origins, and Gardiner in a reappraisal of current evidence, suggest that the lungfish are the closest relatives of the tetrapods. The debate on this central issue promises to be interesting and fruitful.

In another morphological paper, Carroll notes the similarity between the hyomandibular of rhipidistians and that of early amphibians, and suggests that the bone retained a cheek-support function well into the Amphibia, only a few lines having independently transformed it into a sound-transmitting stapes.

Two early tetrapod faunas are reviewed. The new basal Late Carboniferous Scottish Cowdenbeath fauna is described by Smithson; it includes aquatic fish-eating and possibly herbivorous forms, as well as one genus that may have eaten terrestrial invertebrates, but provides few antecedents for later faunas. Andrew Milner makes a detailed analysis of the well-known, very diverse, later Carboniferous fauna of Nýřany, Czechoslovakia, and distinguishes its different components — open-water, shallow swamp-lake and

terrestrial-marginal endemics, as well as rarer elements from neighbouring environments.

Finally, a number of authors discuss the origin and classification of particular taxa — the anthracosaurian amphibians (Panchen), the Nectridea (Angela Milner), the Cotylosauria (Heaton), the Pelycosauria (Reisz) and the major amniote groups (Gaffney).

The contributions maintain a high

standard of interest and readability, and the volume is attractively produced; there are few typographical errors, and there is both an author and a subject index. It should serve for many years as both a benchmark of our knowledge, opinions and attitudes today, and as a source of references to the earlier literature. □

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Electron microscopy at the limits

David J. Smith

Experimental High-resolution Electron Microscopy. By J.C.H. Spence. Pp.420. ISBN 0-19-851365-8. (Clarendon/Oxford University Press: 1981.) £35, \$74.

THE technological revolution of the past decade has resulted in a concomitant improvement in the flexibility and usage of the commercially available electron microscope, not least in the direction of improved performance. Lattice and point resolutions in the region of 1Å and 3Å, respectively, have become standard. Hence, instead of high-resolution electron microscopy remaining an esoteric art, it is, in principle at least, now available to all those who can afford the admittedly considerable price of the latest instruments. That more scientists have not yet taken advantage of the opportunity to resolve physical details almost at the atomic level probably reflects the fact that recording a high-resolution micrograph, even with these advanced microscopes, is still difficult; moreover, the literature does not provide much guidance to the newcomer. This readable account of high-resolution methodology thus represents a sorely needed addition to the field.

The book can be considered to consist of two parts. The first, comprised of Chapters 3 and 4, the first half of Chapter 5 and most of Chapter 6, provides a useful introduction to dynamical electron diffraction theory, setting out clearly most of the underlying concepts and in particular emphasizing the possible pitfalls of micrograph interpretation. Copious references have been included, making these chapters useful even to experienced workers. These sections are also carefully cross-referenced to the remainder of the book.

On the experimental side, there are separate chapters on lenses and electron sources; much of the information here is tangential to the major theme of the book, and could well be omitted in a first reading. Nevertheless, these chapters represent valuable compilations of background material and, again, are well-referenced.

The remaining chapters deal with the practical problems involved in realizing

high-resolution micrographs, pointing out the requirements for knowledge of relevant electron-optical parameters, describing possible sources of interference and instability, and discussing operating techniques. These details will be of greatest value to the novice but many experienced workers will undoubtedly also find information of relevance to their research.

Despite the obvious attractions of the book, it is not free of some misleading or incorrect statements, and there are certainly strong arguments for re-ordering the subject matter. For example, the second half of Chapter 5, which briefly describes some applications, could well follow Chapter 10 on methods, and Chapters 1 and 2, which primarily deal with experimental details, would be better placed after the theoretical discussions of Chapter 6. The worst of the factual errors, presumably due to the publisher rather than the author, is located on the dust jacket where it is claimed that "Applications . . . are all described in full practical detail . . ." — this was manifestly not one of the author's objectives. It would also appear unlikely that any manufacturer of lanthanum hexaboride cathodes would readily acquiesce to operation in vacuum levels of only "better than 10^{-5} T" (p.262), and most users of field-emission sources would expect tip lifetimes of the order of several months, irrespective of operating voltage, rather than "about 80 hours" (p.263).

Such criticisms are obviously minor, and overall the author has produced a text which is far more than a "recipe book" for the beginner. He has evidently drawn on the wealth of knowledge of his many friends and colleagues in Oxford, Melbourne and Tempe, three of the leading centres in the field, as well as his own practical experience, and his book should become a valued guide and source of information for the practising microscopist. □

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