

mineralogy. The balance is preserved and the new material has been skilfully incorporated so that the material is logically presented. This 21st edition is printed on whiter paper than formerly and this allows better reproduction of both line drawings and half tones. Taking up the aeronautical metaphor used at the outset, in my view this new edition has most successfully built on the high quality of its predecessor — it performs and handles very well. Finally, the plexicover edition at £22.95 for nearly 700 pages is very good value indeed.

A. C. BISHOP

von Raumer, J. F. and Neubauer, F. (Eds.) *Pre-Mesozoic Geology in the Alps*. Berlin, Heidelberg and New York (Springer-Verlag), 1993. Price DM 398.00 (ISBN 3-540-54757-6).

The Variscan and pre-Variscan elements in the Alpine orogenic belt comprised the central or major themes of discussion in meetings and workshops held at the University of Fribourg (Switzerland) in 1983, 1987 and 1990 and it is participants to the last of these that have contributed to the present hefty volume. The book contains 38 papers from 82 contributors all of whom are based in the five major countries (Austria, France, Germany, Italy and Switzerland) over which the Alps extend. The papers range from short (4 page) single author summaries to long (up to 33 page) multi (up to 17) -author data compilations but in all cases references are included such that each work can be read in isolation.

The book is subdivided into four very unequal parts. Part one (45 pages) deals with palinspastic reconstructions of the Pre-Mesozoic basement-cover relationships of the Western, Central and Eastern Alps with a short introductory overview. The authors have tried to piece together the features of the late Variscan orogenic collapse, extension and basin development during the opening of neo-Tethys and later Alpine nappe tectonics in order to reverse the sequence of events and thus obtain the original configuration. Correlation is made difficult by the fact that Alpine nappe deformation and emplacement involved not only coherent basement-cover sequences but also cover units detached from the basement as well as basement slivers devoid of cover sediments.

In part two (162 pages) overviews of various aspects of the pre-Mesozoic basement are preceded by an outline of the history of geological investigation by the book's editors. Interesting from these early studies was the opinion of the

Plutonist school that the Alpine uplift was driven by the intrusion of granites that were recognized to appear commonly in the core of central masses surrounded by successive envelopes of gneiss, schist and sedimentary rocks. Only later was it realized that a substantial part of the history of these crystalline units, especially the granite intrusion, was pre-Permian. The reviews encompass: Palaeozoic stratigraphy, biogeography and climate; the evolution of the continental crust from the geochronological and isotopic viewpoint; ultramafic rocks; ore deposits; palaeomagnetism and finally the early Mesozoic plate reconstruction and demise of the Variscan fold belt.

The geochronological studies (Gebauer), concentrating on zircon ages and age populations, imply that the Variscan crust was derived almost exclusively from recycled Gondwana crust as opposed to the other supercontinent of the time, Laurasia. The multiple, isotopically-distinguishable, events in the Palaeozoic are interpreted as the result of episodic closure of rift basins: a scenario consistent with the progressive cratonization deduced from ore mineralization and the distribution, age and character of magmatic rocks. The change from microplate collision giving a wide Variscan fold belt to destruction of the orogenic chain by dextral translations along conjugate fractures is interpreted (Ziegler) as due to a change in convergence direction between Gondwana and Laurasia because lithospheric thickening had reached its limit.

Part three, specific descriptions of the pre-Alpine basement, forms the bulk of the book (c. 380 pages) and is subdivided into four sub-sections covering the Helvetic (2 papers, 34 pages), Penninic (9, 134) and Austro-Alpine (9, 170) realms as well as the Southern Alps (4, 55). Each section begins with a list of contributions and an outline map showing the geographical region considered by each paper.

The pre-Permian basement of the External Massifs of the Helvetic Realm, although disrupted by Alpine thrust tectonics and overprinted by low-grade to greenschist-facies metamorphism, still preserves many characteristics typical for the Variscan basement outside the Alps. The overview by von Raumer and others describes the different lithological units in the polymetamorphic units corresponding to the 'monotonous' and 'varied' series in the polymetamorphic Moldanubian Zone in the Variscides. Units with a monometamorphic history, without a high pressure stage, are noted from the SW of the Belledonne Massif. In a study of the magmatic rocks in this realm Ménot and Paquette conclude that the mafic and bimodal magmatism was the

result of two major periods of lithospheric extension during Cambro-Ordovician and Devono-(lower) Carboniferous times. Rocks of the former event often appear as eclogites and granulites due to the intervening subduction-collision event.

Considering the internal Penninic Realm are papers discussing: the Ligurian Alps; the Briançon Zone (2 papers); the Dora Maira Massif; the Lepontine area; and the Venediger nappe of the Tauern window (3 papers). In addition the complex inter-folded Penninic (Monte Rosa, Arcesa-Bruson and Gran Paradiso nappes) and Austro-Alpine (Dent Blanche and Sesia Lanzo nappes) units along with the intervening (post-Variscan ophiolite and calc-schist-bearing) Piedmont Zone rocks are dealt with by Dal Piaz. The fact that these latter three units have all been subjected to Alpine high pressure, low to moderate temperature, eclogite-facies metamorphism but still retain abundant evidence for pre-Alpine high-temperature events is quite important when considering much older orogenic belts where time differences between the various stages may be less obvious. Spectacular Alpine metamorphic rocks from the Dora Maira Massif within this realm, apart from the well known pyrope-coesite rocks, are jadeite-bearing (and, on textural grounds, probably also formerly coesite-bearing) undeformed metagranites formed from Variscan protoliths.

Themes covered in the section on the Austro-Alpine Realm in the Eastern Alps are: the fossiliferous Palaeozoic; Palaeozoic volcanism; Palaeozoic quartzphyllites; late- and post-Variscan sediments; metamorphic basement east of the Tauern Window; metamorphic basement south of the Tauern Window; the Bernina Massif; the Silvretta Nappe; and the Ötztal-Stubai, Scarl-Campo and Ulten basement units. Exceptional rocks in the last-named unit are small bodies of exceedingly fresh garnet and spinel-bearing peridotites set within kyanite-bearing migmatites. The preservation of these rocks is attributed to a lack of fluid during exhumation. Within this section there is some discussion as to the use of 'Caledonian': a term warranting 13 lines in the index and often used for any pre-Variscan, presumed Lower Palaeozoic, metamorphic or even magmatic event. The sedimentary record certainly appears to rule out an orogenic event of 'Caledonian' age and many authors here favour a late Precambrian (Cadomian/PanAfrican) orogenic event and a Lower Palaeozoic thermal event related to rifting.

The section on the Southern Alps, i.e. those units south of the Peri-Adriatic Lineament,

assesses the medium to high-grade rocks of the Ivrea Zone and Orobic Alps and also low-grade Palaeozoic volcanosedimentary sequences in the Eastern Alps north and south of Bolzano and in the Alpi Apuane tectonic window (Northern Apennines, Tuscany).

In the fourth and final part the editors (von Raumer and Neubauer) have tried to draw together the many threads from the preceding chapters to summarize the late Precambrian and Palaeozoic evolution of the Alpine Basement. Using the palinspastic reconstruction developed in part one by Ratschbacher and Frisch, the spatial distribution of regions undergoing sedimentation, magmatism, metamorphism, ophiolite formation or granite intrusion are indicated for a series of six time periods. The last paper, by the same authors, attempts a much larger-scale reconstruction of the sequence of events in the Variscan and East-Mediterranean realm.

This book has tried to summarize the present extent of our knowledge of the Pre-Alpine history of the Alps reached from more than 200 years of active investigation. Both detailed descriptions as well as correlations and interpretations are given and the text is richly illustrated throughout, including fold-out maps where necessary, so that one can locate oneself when entering the less familiar regions. As someone working in the Variscan basement outside the Alps it is remarkable to see how much of the Variscan development is still recoverable in these reworked thrust units. I can see that in the study of Variscan processes the disadvantage of having had the Alpine deformation and/or metamorphism and the fieldwork difficulties mentioned in the preface are outweighed, when compared to the units of the same age outside the Alps, by the advantage of greater relief and exposure. Thus I imagine that everyone seriously involved in research in the Variscides will be reserving their own copy of this book. For those working in the Alps and frustrated by the fact that the basic literature is often in obscure journals in foreign languages the reviews here and reference lists will serve as a valuable source of data. Also, the variation in coverage for different areas shows where basic research still needs to be done. As a final comment I think the editors should be congratulated on putting together a coherent, compact, and at the same time readable volume which precedes any equivalent volume on the Variscan basement outside the Alps!

P. J. O'BRIEN