

range. In five cases, where multiple sharp absorptions are poorly reproduced in this format, the relevant part of the spectra are also reproduced in an expanded wavenumber format. The spectra were measured in KBr pressed discs, a blank KBr disc being used in the automatically subtracted background measurements. The instrument was suitably purged and 50 'scans' were acquired for each spectrum, at a resolution of  $2\text{ cm}^{-1}$ . A 'peak-pick' program was used to produce (after editing) tables of absorption maxima.

The spectra suffer from the usual problem with FTIR spectra in that their wavenumber linearity and short format results in lateral compression of the 'fingerprint' region, even though the scale length is doubled from  $2000\text{--}225\text{ cm}^{-1}$ , and that they lack a fine grid. The tables of absorption maxima and the five expanded spectra help to make up for this. The reviewer feels that more expanded spectra would have been helpful, in particular those of the leadhillite polymorphs.

Each spectrum is accompanied by a 'windowed' text page with species and specimen details, including specimen and spectrum number, source, XRD number and compositional data, as well as 'peak' (absorption maxima) table, notes and references.

The spectrum of coalingite given is dominated by chrysotile absorptions from matrix contamination, the strong carbonate stretching absorption near  $1400\text{ cm}^{-1}$  showing only weakly. The authors do note that this spectrum differs from the literature version, which latter has to stand for the time being as standard. A different sample from the specimen must have been used for XRD.

The layer-lattice hydroxides with interlayer carbonate, such as the hydrotalcite and manasseite groups are notoriously difficult to study, being prone to variable interlayer population (due to their tendency to alter on keeping, and to ion-exchange), to preferred orientation effects, and a tendency to be intimately mixed with contaminants. The spectra given of the polymorphs manasseite and hydrotalcite are, as expected, closely related, but with differences, but those given of their iron analogues sjögrenite and pyroaurite are identical despite their different XRD patterns. A sampling mismatch is likely here, perhaps both minerals are present on one (or both) of the specimens sampled. The reviewer has run the spectra of a number of carefully sampled 'pyroaurites' over the years, some of which have been checked by XRD; these spectra vary considerably and the reviewer is still not certain what the 'correct' spectrum of pyroaurite looks like! The reviewer has no reliable sjögrenite and has to rely on the poor literature spectra.

In summary, this is an excellent and carefully compiled book, with few errors, filling a useful space in the vast gap in published spectra.

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C. Klein and C. S. Hurlbut Jr. *Manual of Mineralogy* (after James D. Dana) 21st Edition, 1993. John Wiley and Sons Inc., 681 pp. £22.95 plexicover, £62.00 cloth.

In writing this review I feel much as I imagine a test pilot might when called to evaluate a new version of an aircraft with an established and good reputation. There is little doubt that it handles well; the crucial question is how it compares with earlier marks of the type. There is hardly need to comment on the credentials of this book. James D. Dana's *Handbook of Mineralogy* first appeared in 1848 and, with his *System of Mineralogy*, became a firm favourite both with the student and the professional mineralogist. If authoritative information were needed, one could turn with confidence to 'Dana'.

The crucial question for the reviewer is how this 21st edition differs from and compares with the 20th edition published in 1985. The format and general arrangement of the book remain as before. The first nine chapters deal with the concepts, principles, and techniques of mineralogy and they are followed by three long chapters devoted to systematic and descriptive mineralogy. Chapter 14 deals with mineral assemblages and serves as an introduction to petrology, and the book concludes, as did the 20th edition, with a chapter on common gemstones. The new edition is nearly 100 pages longer than its predecessor; it contains much that is new and parts have been rewritten and rearranged.

The authors state in their Preface that they ".... have again striven to achieve a balance between concepts and principles on the one hand and the more systematic and descriptive treatment of mineralogy on the other". They have been most successful.

The first two chapters cover the history of mineralogy, literature sources, instrumentation, and the morphology of crystals. They are essentially similar to those of the earlier edition, though they have been updated and several new illustrations are included, reminding one that the appearance of scientific instruments seems now to date almost as rapidly as that of the motor car. The 32 classes of symmetry receive systematic treatment and the techniques for the stereographic projection of crystals are explained. I am pleased that this has been retained, for it is becoming a

matter of regret to many that this discipline seems increasingly to be squeezed out of mineralogy courses in the UK.

Chapter 3 deals with the internal order and symmetry of crystals and explains the interrelations of morphology, structure, and space group notation. The section on phase diagrams in the earlier edition has been transferred to a new chapter in this book and the omission of the section on blowpipe chemical tests has made room for an expanded treatment of isostructuralism, polymorphism, polytypism, the metamict state and structural complexities and defects.

Crystal chemistry is tackled next in a thoroughly revised and expanded chapter which begins with the structure of the atom and the distribution of the elements in the Periodic Table and moves on to consider the ion and to review bonding mechanisms and the structures encountered in minerals. The structural changes that result from increasing pressure are discussed, and the chapter ends with a section on radioactivity in minerals.

Chapter 5 is new and is devoted to crystal chemistry. It begins by reviewing techniques for the chemical analysis of minerals and there follows a detailed discussion of the compositional variation in minerals, solid solution and exsolution. Examples are given of the recalculation of the chemical analyses of minerals and of the graphical presentation of chemical data.

The next three chapters, dealing with the physical properties of minerals, X-ray crystallography, and the optical properties of minerals, are similar to the corresponding chapters in the earlier edition. The sections dealing with colour and the magnetic properties of minerals have been rewritten so as to incorporate the concepts of crystal chemistry that were developed in Chapter 4. Barely a page, however, is devoted to the optical properties of opaque minerals: one feels that they warrant a fuller treatment.

Mineral stability diagrams are considered next in Chapter 9 which is new to this edition. It starts by introducing thermodynamics and then passes to a consideration of 1-, 2-, and 3-component diagrams with reference to those that are of mineralogical importance. A discussion of the representation of mineral reactions involving  $H_2O$  or  $CO_2$ , and of Eh-pH diagrams concludes the chapter.

The next 200 or so pages — about one third of the book — are devoted to systematic mineralogy. The chemical arrangement that is familiar to users of Dana is retained, so that reference is straightforward. Systematic descriptions are given of about 200 minerals together with their

petrological associations and topographical references. The descriptions are illustrated with clear diagrams — many new to this edition — with photographs of specimens and, where appropriate, with HRTEM photographs. It must be emphasised that this section is not a repetition of the mineral data in the earlier edition. Each species has been carefully checked and the data amended and brought up to date. The morphological data given in previous editions (interfacial angles and axial ratios) and blowpipe tests have been omitted from this volume. This section remains a most valuable compilation of essential and reliable information and data on the commoner minerals. It is invaluable to the student and a useful starting point for those requiring a succinct summary before pursuing further study.

The mineral descriptions each contain a section on occurrence and, of necessity, this has to be brief. Chapter 14 takes this further by explaining how it is that minerals occur in natural assemblages. The principles of the petrology of the igneous, sedimentary and metamorphic rocks are briefly discussed and their nomenclature and classification explained. Minerals and rocks are inseparably linked: although the emphasis here is obviously on minerals, the authors are at pains in this chapter to provide the conceptual link between them.

The book concludes, as previously, with a chapter on gemstones, illustrated by four pages of good quality colour plates. Like the preceding chapter on rocks, this account bridges a gap, this time between the academic discipline of mineralogy and the commercial world of the gem trade. Its retention is welcomed because most mineralogy courses stop short at this point and so, despite their training, some mineralogists know little of gemmology. One cannot expect to become an expert on gems by reading this chapter; that is not the intention. One should, however, become aware thereby of a fascinating area of applied mineralogy.

Each chapter in the book has a well chosen list of references to take the reader further. There is also an Appendix of determinative tables, usefully cross-referenced to the text, and of minerals listed in order of specific gravity and of refractive index. An alphabetical mineral index serves also as a concise listing of compositional data and salient properties, and there is a separate subject index. A Michel-Levy interference colour chart is a welcome addition to this edition.

The authors are to be congratulated on a thorough revision that brings up to date what was already a well established combination of explanatory text and authoritative descriptive

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