who tend to define several terranes when in doubt about the relationship between tectonostratigraphical units, and those who prefer to lump them all together in case they are related. Dallmeyer covers the terranes of the southern Appalachians, the Atlantic–Gulf coastal plane and their correlatives in west Africa. That the definition of terranes in the southern Appalachians is far from resolved can be clearly detected by comparing the terrane maps of Dallmeyer and Horton *et al.* Neuman and Max examine the possible correlation of early Paleozoic orogenic events around the north Atlantic.

An expanded and more unifying preface by the editor would have been useful; for example this would have been a perfect opportunity to advertise other publications and achievements of the IGCP 233 project. Particularly deserving of a mention here is the 'Tectonic map of Pre-Mesozoic Terranes in the circum-Atlantic Phanerozoic Orogens' (1:5,000.000, Oblique Mercator projection) of the North Atlantic region also published in 1989 by Keppie and Dallmeyer ($25). This map, the first in a series of three, is a superb and comprehensive synthesis of stratigraphical and tectonic data from around the North Atlantic and in my view, could have been constructively linked to this publication.

Overall, this book is a useful collection of high quality papers produced to a high standard with good quality print and clear diagrams. The book benefits greatly from an effective index. It is certainly good value by today's standards and will, I expect, be particularly attractive to North American geologists.

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Geological maps

Boulter, C. A. 1989. *Four Dimensional Analysis of Geological Maps: Techniques and Interpretation.* John Wiley & Sons, Chichester, U.K. 296 pp. Price £14.95 ($41.95 in U.S.) (paperback).

During the first reading of *Four Dimensional Analysis of Geological Maps* I found the book most irritating. This I eventually attributed to the title which I will never like. On reading the book a second time I found the text both enjoyable and informative and suggest that future readers ignore the title.

Typographical and factual errors are rare and the presentation and style of text is clear and visually appealing (keywords are displayed in bold characters). Most of the diagrams are clear and do not suffer from the absence of colour. I felt that a few of the diagrams are rather too complicated (e.g. Fig. 9.34, p. 176) or cluttered (Fig. 9.40, p. 182) for an introductory text.

Chapters 2–5 cover the basics of map interpretation (rule of "V"s, etc.) and they are particularly clear and concise. Chapter 2 is a useful introduction to base maps, a topic often ignored in undergraduate courses. The description of remote sensing methods in map construction and interpretation (Chapter 5) is very useful and one of the most appealing features of the book.

Chapter 6 entitled "The Fourth Dimension—chronology" describes the various chronological frameworks used in the interpretation of geological maps and conveys accurately many of the problems in correlation. This chapter is well suited to undergraduate studies.

In the preface the author emphasizes that the text is introductory and admits in the acknowledgements his own bias towards structural geology. Unfortunately, Chapters 7–9 suffer from this bias. While an understanding of geological processes will always improve map interpretation these chapters go beyond that which may be considered introductory (e.g. Fig. 9.24, p. 166 and Fig. 9.29, p. 171). This may result in students believing that the interpretation of geological maps is structural geology and not a basic skill. From the tone of the preface I doubt that this is the wish of the author. The contribution of these chapters to map interpretation can be assessed very easily; Chapters 7, 8 and 9 contain, respectively, one, four and four real examples of geological maps when these chapters contain five, 39 and 45 figures, respectively. This is in marked contrast to Chapters 10 and 11 within which 50% of the diagrams constitute actual examples. The small number of examples is the main deficiency of this book but this could be rectified in future editions.

In many respects this is an excellent book for first year undergraduate classes. In particular, it conveys an impression that the interpretation of geological maps can be enjoyable; this is its main advantage over other texts on the subject.

The interpretation of geological maps is a skill that we are losing from the geological community as a whole; this book is one of only a few that goes some way to reversing that trend.

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Problem maps

Bennison, G. M. 1990. *An Introduction to Geological Structures and Maps (5th edn).* Edward Arnold, London. 69 pp. Price £4.95 (paperback).

This book, now appearing in its fifth edition, is one of the "problem-map" genre, of which several are published in the U.K. The maps, rarely based on real situations, depend largely on the construction of straight, parallel and equidistant structure-contours to define the geometry of formations which are uniformly dipping or folded into non-plunging planar-limbed folds; unconformities and faults are also commonly planar. The unreal nature of the maps is furthered by the fact that usually neither the stratigraphic order of formations nor their dip direction is given, and the artificiality persists to the extent that the strike of formations is commonly N–S (sometimes E–W), that the structure contours for different formations neatly coincide, and that dip and thickness values are nice round numbers.

I consider that such maps, far from helping students to interpret real geological maps, do positive harm. Because these maps focus on 'solving' a map (fitting a series of straight lines between the dots, making one dip calculation and establishing the stratigraphic order), the student simply does not *think* about the relationship between the boundary and the topography, but grabs a ruler. In spite of the exhortations of the author of this book to draw stratum-contours freehand because they are "seldom strictly parallel in nature" and to try to deduce the basic structure from outcrop patterns, these unreal maps do not encourage this behaviour.

Of course, real maps state the stratigraphic order, if known, and give us all the dip information available. Having said that, I think one reason these unreal maps became popular in the U.K. is the very variable, but often shameful, presentation of information on our Geological Survey maps in the past. Contours on our 1" to 1 mile and 1:50,000 maps are rarely visible through the murky colours and confusion of rocks and buildings, while dip arrows, if present at all, often have no values at their heads. Compare with the excellent U.S.G.S. maps of the same scale!

No doubt, defenders of such books (and there must be many recommending them to their students) would argue the need for such simple maps and solutions before confronting the complexity of nature. I accept that one or two such maps have a place to introduce some basic principles, but all experience of interpretation should be based on real maps with boundaries, faults and folds portrayed as the more or less complex surfaces they are.

The real enemies here, I suspect, are the examination boards in the U.K. who persist in the examination of such maps and thus influence their use in schools. I quote for instance, from the requirements for the practical examination in "A" level Geology of the Joint Matriculation Board: "The determination of the geometry of geological boundaries . . . (from) . . . the construction of stratum contours (strike lines) (*exercises will not be set involving curved stratum contours*)" (my italics). At University, students who have taken this examination find it very difficult to kick the straight structure contour and problem map habit and they have a very poor appreciation of the meaning of outcrop patterns on real maps.

The attraction of this book to University students, apart from its easy solutions, is the price. However, I would urge my students to go for the recently published, reasonably-priced, book by Lisle or even to consider those by Butler and Bell and by Boulter, all of which emphasize the use of real situations.

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