

ment of vegetation types, stream segments and soil tones, and the possible relationship of these surface lineament patterns to subsurface structure.

The concluding section covers Photogeomorphology. Of the 16 papers, seven have been published since 1974 making this the most recent section of the volume. The main themes are regional landform analysis and the uses of aerial photographs in all aspects of geomorphological analysis, broadening in scope as far as use to planners, engineers and landscape architects in site development projects. Drainage pattern description and classification is a recurring topic within this section. Several papers evaluate the surface expression of deep hydrocarbon accumulations, perhaps the most thorough of these concluding that in the Central Rocky Mountains, surface expression of such deep structures are "subtle, inconclusive or absent". This general conclusion contrasts with specific examples from Nevada and the Anadarko Basin of good correspondence of surface features and subsurface hydrocarbon accumulations.

Taken as a whole, this set of papers provides a comprehensive overview of photogeological analytical techniques which will be of potentially high value to geologists faced with the future challenge of exploring onshore frontier basins in remote locations, where aerial photographs may form a key data set alongside satellite images and field-based studies. While there is little in this volume that many structural geologists will find gripping, there are numerous specific examples of the value of recognizing subtle geomorphological variations in flat-lying areas, which in the absence of seismic data, are frequently the only clue to predicting near-surface structure. Those papers dealing with fracture analysis and possible surface expression of deep structure in thrust systems largely predate recent developments in understanding the evolution of fault and fracture arrays, joint systems and three-dimensional thrust system geometry. As a result, many of the structural geological statements within these papers are a little oversimplified. These are minor points; the strength of the volume is in the detailed descriptions of photogeological methodology and analysis developed during the 1940s and 1950s. At \$25 *Photogeology and Photogeomorphology* is good value and should be consulted frequently by all geologists embarking on photogeological interpretation projects.

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Map projections: all you need to know

Maling, D. H. 1992. *Coordinate Systems and Map Projections* (2nd edn). Pergamon Press, Oxford, U.K. 476 pp. Price £72.50; \$145 (hardcover).

The geological map is the most concise method of conveying information in the geosciences. We spend much of our professional life working with such maps, but how much attention do we pay to the geographic base on which they are constructed? I suspect that many geoscientists compile carefully collected data on base maps using a photocopier to correct the scale. Whilst this might not create a problem for small areas, errors, distortion and incompatibilities can occur if the base map crosses national boundaries or has a large latitudinal extent. In certain branches of the science (e.g. geodetic surveys, marine geophysics, tectonics, remote sensing) an exact knowledge of the map projection used or the assumed geometry of the spheroid is essential. D. H. Maling's book, *Coordinate Systems and Map Projections* provides a comprehensive account of this field. This is a second edition of a work the publishers describe as "the definitive English work on map projection". I can certainly accept their claim. The book is comprehensive and all the relevant mathematical formulae for over 40 projections are given. The author has often deliberately omitted details of their derivations, simply confining himself to describing the underlying theory and presenting the result. I welcome this approach and find that it works well—all most people need is the basic equation. There is a comprehensive reference list for those who are interested in reading further. The problem of writing efficient algorithms for processing the necessary transformations is also discussed. The book is well illustrated, but as 1 page of text can refer to many diagrams readers will find themselves often having to turn several

pages to follow the arguments. However, the cross-referencing is good and the relevant page numbers of figures in other chapters are given.

Chapter 1 deals with the figure of the Earth and the reference systems used in surveying and mapping. This includes precise definitions of the spheroid and the geoid, tabulated estimates of the spheroid and discussion of errors in the spherical approximation. It is interesting to note that the divisions between national sectors in the North Sea are based on the spherical approximation. This could lead to errors in the order of hundreds of metres in the absolute positioning of these boundaries. Chapters 2 and 3 deal with coordinate reference systems on the plane and on the sphere. These give a concise review of Euclidean and non-Euclidean trigonometry. Chapter 4 discusses the geometry of the spheroid and deals with the important topic of accurate estimate of arc distance upon the spheroidal surface. A subject that is exciting considerable interest as long base-line GPS surveys are now being used to estimate inter- and intra-plate motions. Chapters 5–7 deal with the basic problems of projecting a spherical body onto a planar piece of paper. The various underlying assumptions that must be made, i.e. equal area, equal angular, equidistance, etc., and their relative strengths and weaknesses are discussed. Chapter 7 deals with the classification of families of projections (there are about 400 described!) and is really only of interest to the geographer doing research in this area. Chapters 8–10 describe how to construct, compute and derive map projections. Manual and automated methods are described. However, the present price of computing power means that manual methods are more of historic interest, or only apply in the preparation of large base maps without access to a suitable plotter. I found Chapters 11 and 12, which deal with the choice of suitable projections most interesting. Such problems as how to produce a base map for the Andes or the eastern seaboard of the Pacific with the minimum distortion of both area and angles are discussed. It may not be generally realized, but a Mercator projection of the Andes can lead to areal distortions in the order of 400% along the chain. Chapters 13–15 deal with deliberately distorted maps, navigation charts and surveying. Chapter 16 describes perhaps the most important projection, the equal area Transverse Mercator Projection of both the spherical and spheroidal earth in great detail. Chapters 17 and 18 deal with the distortions inherent in collecting remotely sensed images where a satellite in an oblique orbit scans a spheroidal surface. The problems of finding a suitable projection so that data derived from such images can be compared with that derived from other maps, or can be incorporated into GIS systems are also dealt with. This last point is discussed in more detail in Chapter 19. The appendices give the algebraic expressions for the coordinates and particular scales of most important map projections (Appendix I), projection coordinates for Briesemeister's projection for use with Chapter 9 (Appendix II) and the full equations to determine position, convergence and local scale factors on a Transverse Mercator projection of the spheroid (Appendix III).

This is a useful reference book for workers in the Earth Sciences. It is too comprehensive and too slanted towards the needs of cartographers to be suitable for recommendation to students. However, if your work involves preparing synoptic small-scale maps of large areas and you wish to select the optimum projection, geodetic surveying or the integration of several different projections into a GIS system, then this is the book for you.

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Visiting England and Wales

Duff, P. McL. and Smith, A. J. (editors). 1992. *Geology of England and Wales*. The Geological Society, London. 651 pp. Price £75 (hardback); £34 (softback).

How many of us have been acutely embarrassed when asked by overseas visitors for a text covering the geology of the British Isles? We have been able to suggest that there is an excellent book describing the geology of Scotland (Craig 1991), but that the best that can be offered for England and Wales are rather generalized student texts (e.g. Anderton *et al.* 1979) or the 13 British Regional Geology series (BRG) books. Excellent though many of the latter may be, they fail to give a

co-ordinated account and are often sadly out of date. And so, the appearance of the *Geology of England and Wales* published under the auspices of the Geological Society, is welcomed as long overdue.

At first sight the book produces two contrasting impressions. The first is of a comprehensive (651 pp.) treatment, containing 13 chapters, each written by an acknowledged expert, covering Precambrian to Quaternary Stratigraphy, plus chapters on Offshore Geology, Igneous Rocks, Structure, Deep Geology, and Economic Geology. The second is a strong sense of *déjà vu*, produced by the inclusion of many diagrams copied directly from the BRG series and from previous publications with little or no attempt to synthesize across the regions. The style adopted is also that of the BRG series—one that is well known from survey memoirs—and one that pays little attention to more modern approaches to geology. For example, in the 450 pages describing stratigraphy, the tectonics of basin development are only seriously considered in Leeder's treatment of the Dinantian rocks and by Smith's discussion of offshore geology. In many chapters the subject is not even mentioned. Indeed the almost complete separation of structure from stratigraphy throughout most of the book makes an overall understanding of the geology very difficult.

Of most interest to readers of this journal will be the chapter on Structure by F. W. Dunning. Sadly this proved to be one of the least satisfactory in the book. It is set out in six sections: Precambrian Basement; the Caledonides; the Hercynides (Variscides); the Older Cover; the Younger Cover; and Post-Alpine Cover. Such a grouping has proved successful in several previous publications and lends itself to tectonic analysis, but this is precisely what the author fails to achieve. Instead, the account is bogged down with minutiae, listing divergent interpretations of individual structures more or less in publication order—the chapter in places reads more like the traditional historical review section of many Ph.D. theses. Unlike most Ph.D. theses, however, it is almost impossible, unless one is particularly familiar with local geography, to follow the detailed arguments, as the named structures and associated localities are rarely accom-

panied by locality maps. Unfortunately, too, these accounts do not include the latest work (within the last 2–3 years) which in many cases synthesize the structure with innovative ideas, on which the chapter in my opinion should have been based. Indeed, in some instances even the detail that is provided is inadequate. For example, the discussion of the important Caledonian fault structures running through the Welsh Borderlands gives a series of fault names and localities, but with no reference map and with no indication of their sinistral sense or of their plate tectonic significance. I would anticipate that many British geologists familiar with local geography will find this account difficult to follow and frustratingly irrelevant, whereas those less familiar with the region, including overseas visitors, will be almost completely lost.

Fortunately, the other chapters, despite the general criticisms previously mentioned, do not suffer from the same problems. Most of the chapters give excellent factual accounts of the relevant sections of English and Welsh geology; they will serve as extremely useful introductory overviews, with the reference lists at the end of each chapter providing a route into the more important literature. Most of the chapters are well written and admirably illustrated, although sadly the photographs are not in colour. Unfortunately, too, there are some errors in fact scattered throughout the book which must be corrected in future editions. For example, we are told that the major Hercynian anticline in North Devon runs NNW through Lynton (instead of WNW), and that the 11 coal seams extracted from the major opencast pit at Ffoslas, in the South Wales coalfield are of Westphalian A, rather than Westphalian B, age. We are also informed that an Aulacogen is “a graben of quasi-geosynclinal character” which is a definition that is symptomatic of the tenor of much of the book.

In summary, this is a book that fills a major gap in British geological literature and one which, despite its drawbacks, will find its place as a standard student text, particularly useful to those visiting the U.K.

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