Book reviews

Advanced Soil Mechanics by B. M. Das

McGraw-Hill. New York. 1983. 6/16 x 9/4" [mm. not available] 528 pp., 400 illustrations £30.25. ISBN 0-07-0154-16-3

From the title, one would expect this book to be similar in content to the material currently taught in MSc courses in soil mechanics at British universities. This is not the case. A preliminary glance indicates that while the analytical derivations are longer and more complex than would be found in a simple undergraduate text, they are not accompanied by the development of good conceptual models of soil behaviour. Further, there is little, if any, appreciation of the empirical and often intractable nature of the subject.

The book is divided into seven chapters. Chapter 1 deals primarily with the composition of soils, but also covers in passing, compaction and the swelling and shrinkage of soils. Just five pages are devoted to the concept of effective stress. Chapter 2 is concerned with permeability and seepage. In common with the rest of the text, considerable attention is given to detailed analytical derivations. Chapter 3 provides a summary of elastic stress distribution. The limitations of using elasticity to predict the stresses in a non-homogenous, anisotropic plastic material such as soil are not discussed. Chapter 5 considers the consolidation process; the explanation of the contribution of pore water pressure dissipation is misleading, and once again equations are refined beyond their usefulness. Chapters 6 and 7 cover, respectively, the evaluation of soil settlement and the shear strength of soils. Much of the fundamental material used here is more than 20 years old, and it is not presented in such a way as to be of use in practice.

From the viewpoint of a geotechnical engineer, Advanced Soil Mechanics contains a number of important omissions. Site investigation is not discussed and as a result it assumes, for example, that the reader will know the practice and limitations of dynamic and quasi-static penetration testing. The assessment of slope stability is nowhere mentioned. The importance of geology and geomorphology are never recognized.

This book presents old material in an old and rather unattractive way. It contains neither the author's prejudices nor the fruits of his experience. It is unlikely that Engineering Geologists will find the book useful, concentrating as it does on the analytical approach to the almost total exclusion of the real world.

C. R. I. Clayton

Geology for Geotechnical Engineers by J. C. Harvey

Cambridge University Press, Cambridge. 1982. pp. 136. £12.50 hb ISBN 0521246296. £5.25 pb ISBN 0521 288622.

The stated purpose of this book is to present civil engineers with sufficient information about geology to enable them to understand those aspects of the behaviour and properties of rock and soil that are relevant to the design of buildings, bridges, highways and dams.

The first four chapters describe the history of the Earth, mineralogy, weathering, erosion, rock types and geological structures. In these chapters the basic elements of geology are concisely presented and go a long way towards fulfilment of the stated purpose of the book. However, the author's descriptions of behaviour of soil and rock masses under the loading imposed by the foundations of buildings, bridges and dams are lacking in an understanding of the essential factors which govern foundation design.

Geotechnical engineers and engineering geologists when commencing to practice their chosen specialist career quickly learn that they are concerned, for the most part, with the upper 20 m or so of soil or rock. In the latter case the rock is likely to be wholly or partially weathered and jointed to a varying degree. If he is involved in foundation design, the geotechnical engineer will be required to advise on allowable bearing pressures. These are related to the compressibility of the rock mass which is, in turn, related to the elastic modulus of the intact rock and the frequency and width of discontinuities. The author does not provide us with any commentary on these factors. In fact the words ‘compressibility’ and ‘settlement’ appear to be missing from his vocabulary and the reader is left to conclude that the foundations of ‘large constructions’ must be taken down to unweathered rock even if this involves removing 20 m of weathered overburden to reach foundation level.

In a slim volume of this type, the difficulties of finding space for descriptions of the engineering characteristics of particular rock formations are appreciated, but it is regrettable that engineering problems associated with the Chalk and Keuper Marl which cover such large areas of Great Britain are not discussed. Glaciation also gives rise to many problems with foundations and earthworks, not only with construction within the glacial deposits, but also with the effects of glaciation on the stability and compressibility
of the underlying rocks. These problems are widespread in the British Isles but glaciation and its effects are discussed in a single page.

The author is on surer ground when dealing with problems of the stability of cutting slopes. Quite a full treatment is given to this subject, including the use of numerical methods for determining the stability of soil and rock slopes. In contrast the problems of rock tunnelling, for which an understanding of engineering geology is so essential, are dealt with in only five lines, mainly in the context of ground water flow.

Other examples of uneven treatment are the inclusion of a description of the relatively rare phenomenon of alkali-aggregate reaction, but omission of any reference to the more widespread problem of sulphate attack on concrete. Loess is described without any mention of its important engineering characteristic of loss of stability when saturated. A whole chapter is given to the engineering description of rocks, but there is no example of a borehole record and no mention of RQD and its empirical relationships with engineering parameters.

Perhaps the most useful chapter to the civil engineer is the one dealing with geological and geotechnical mapping. The student will find it helpful to an understanding of the portrayal of geological structures to follow the author’s guidance on the preparation of profiles from these maps.

M. J. Tomlinson

The Geology of Offshore Ireland and West Britain by D. Naylor and P. M. Shannon

Graham and Trotman, London. 1982. 195 x 255 mm, 161 + v - xii pp., 63 figs, 9 tables. £19.00 hardback, ISBN 0-86010-340-4. Paperback, ISBN 0-86010-247-5.

This book is a development from an earlier volume, co-authored by one of the present writers (D. Naylor), updating and expanding an earlier book. It is aimed at undergraduate geology students and the professional looking for background information with an appendix and glossary providing introductory material for the non-specialist. For the civil engineer, therefore, the book provides a general geological background to the environment in which he is working.

Both authors are petroleum geologists and the book sets out to review the offshore geology around Ireland and western Britain from an avowedly hydrocarbon viewpoint. The area is divided into eleven provinces and the chapter devoted to each summarizes the geology, systematically describes the geophysical data available and then the stratigraphic succession as defined largely from oil exploration boreholes. Each chapter ends with a discussion of the hydrocarbon potential of the area. The introduction (chapter 1) provides a brief review of plate tectonics and the opening of the north Atlantic. The following chapters (2-5) review the geology of the sedimentary basins of the English Channel, the southwest approaches, the Celtic Sea and the Fastnet Basin. The deepwater areas of the Goban Spur and the Porcupine Basin are reviewed in chapters 6 and 7 while chapter 8 deals with the poorly understood basins on the shelf and upper slope off northwest Ireland. Chapter 9 deals with the micro-continent of the Rockall plateau and trough and this is followed in chapter 10 with a review of the offshore geology off eastern Canada. The latter is intended to emphasize the continuity of the precontinental drift geology of northwestern Europe and eastern Canada and, while the inclusion of the chapter is of dubious value to the theme of the book, it does provide a useful geological summary. Chapters 11 and 12 deal with the basins to the west and north west of Scotland and chapter 13 with the Irish Sea. Chapter 14 summarizes the geological history and structural history of northwestern Europe with a series of Mesozoic palaeogeographic maps. The history of hydrocarbon exploration is recorded in chapter 15 and this is followed by two appendices describing hydrocarbon geological concepts and exploration and production technology with a short glossary of geological and technical terms. There is no index.

The distinct hydrocarbon bias of the book reflects the nature of data available offshore and results in an inevitably patchy cover. This is reflected in chapter headings alone (e.g. Channel Basin, Western Approaches Basin, Celtic Sea Basins) and little is said of the Palaeozoic and pre-Palaeozoic geology. Indeed the title of the book could well be the ‘Mesozoic geology of Ireland and west Britain’.

Given these constraints, however, the book does make a useful contribution. It draws together and summarizes a number of important papers, mostly published in the past few years, often in relatively inaccessible conference proceedings. It also presents data hitherto little known outside the confines of the confidential world of the oil industry. On the whole the references are adequate, giving a lead to a wider bibliography if it is required. The diagrams are clear, simple and well drawn though the necessity, in a generalized book of this nature, of extensive tables listing the wells drilled in each basin is questionable. They seem unnecessary and add little to the text.

My criticisms are therefore minor. The book certainly achieves its aim of providing a background for the professional and will I am sure be useful to the honours geology student. For the civil engineer—well he must know his geological jargon—but if he is willing to make the effort then the book is a valuable source for anyone working offshore.

M. J. Tomlinson
Ground and Air Survey for Field Scientists. Monographs on soil and resources survey by John Wright

Oxford University Press, Oxford. 1982. xi + 327 pp, £30 hardback, ISBN 0-19-857560-2. £15 paperback, ISBN 0-19-857601-3.

The author’s aim is three-fold: (a) to teach field scientists the elements of simple surveying of small areas and the field use of aerial photographs; (b) to explain to them the basis of more advanced surveying so that they can work with qualified surveyors and understand what they are doing; and (c) to compare methods of map-making so that scientists engaging contractors will have a better understanding of what to ask for when negotiating for work to be done. Any geologist should consider these objects to be laudable and every geologist should have some surveying ability, including tacheometric planetabling. In addition, as all geologists will use and presumably produce maps for the whole of their lives, it is only logical they should also know at least the principles on which their base maps are made. As an applied geologist, the reviewer will go even further and say that those geologists associated with mining and engineering spend so much of their lives close to projects related to precise surveying that they should have some formal training in the subject. In lieu of such training a book of this type should be part of the equipment of any geologist.

The book is divided into four parts. Part I describes simple field surveying in various terrains in three chapters. For a field geologist making a map at a moderate scale his methods appear to be somewhat slow and perhaps over-finchy although he himself has some useful comments about accuracy, pointing out that trying to fix the exact position of an approximate boundary (his example is between vegetation types) is time wasted. He describes spirit levelling, useful to any applied geologist, planetabling and ground photographic methods. He also briefly covers some special survey cases, such as simple hydrographic work, submarine surveys, cave and tunnel surveys.

Part II contains two chapters on more advanced field survey, beginning with a description of how to mark out the survey on the ground so that points will remain as permanent markers, followed by instructions on how to use a theodolite and on electromagnetic distance measurement (EDM). He continues by describing triangulation and heighting with these more sophisticated instruments. Illustrations of what a modern theodolite looks like would help. The only photograph (Fig. 6.3) is a very poor picture of what appears to be a very old vernier instrument. Surprisingly, he includes rangefinders under these more advanced techniques, an instrument he does not appear to approve of. A place for this simple and most useful instrument to field scientists should surely have been found in the earlier part of this book.

Part III consists of three chapters on surveying from aerial photographs. The first goes into considerable detail on what photographs represent with good plain instructions on radial line and slotted template methods of map construction but he ignores the simple preparation of the photos, such as baselining. The next chapter describes the use of stereoscopes and stereoscopic images and then goes into detail on the limitations of maps made from aerial photographs. His advice on photo scales needed for different purposes, including geology, tends to underestimate the applied geologist’s occasional need for large-scale photographs. His description of measuring heights from stereo-pairs could have been better explained and it would have been useful to have described how to measure dip from photographs with simplified implements such as the ‘dipometer’. The third chapter of this section is concerned with the preparation of maps from aerial photographs with generalized descriptions of how the various plotting instruments are used. Apart from its old-fashioned approach, this chapter never seems to quite convince, possibly because it assumes the reader can imagine complex instruments from the rather poor diagrams which support the text. Later, comments are given on orthophotographs and oddly at this stage, he includes some description of the construction and use of uncontrolled mosaics which surely, should have been introduced earlier, possibly even under simple surveying.

Finally, in Part IV, he describes the use and production of maps. Although informative, the three chapters are overlong and in the description of the preparation of fair copy maps one feels that the field geologist is, in his own particular field, better qualified than the author in deciding what should be shown and what omitted. More illustrations would have been welcome in this section, if only to interrupt the unbroken flow of text on a subject which would surely have benefited particularly by some examples. It is also astonishing that tracing linen (is it still available?) should be mentioned as one of the drawing materials suggested. In particular, in his description of reproduction methods, almost no mention is made of colour separation by photography from ‘author-coloured’ materials, a method surely now well established for producing geological maps. Presumably, other scientists use this method too.

The book is well produced and well bound and the reviewer found only one very minor misprint in the whole work plus a rather peculiar juxtaposition of sentences at the bottom of p. 292, which speaks well for the standard of editing. The price, however, is exorbitant. The main criticism is perhaps that the book is in places over-detailed and the text could have been shortened. It also suffers from poor illustration.
Schematic diagrams may explain the basics, but more factual diagrams or photos are needed to show the real thing. Many of the photos are quite inadequate. Figs 12.1 and 12.6 are examples: the first gives little idea of what scribing really consists of, the second hardly illustrates the process of ‘name sticking’. The book is supported by a short list of recommended further reading and a comprehensive glossary linked to page numbers but, alas, no proper index. Perhaps most irritating to a field scientist is his re-iterated comments throughout the book about taking work back to the ‘peace and comfort of the office’ away from the ‘tops of windy hills’ or ‘plagues of flies and small boys’. Unfortunately, windy hill tops and plagues of flies are the lot of geologists and other field scientists. They are conditions they have to live with and their base camps are frequently little better.

In general this book does cover the ground intended, but the author tries to cover too wide a field. Many methods of survey used in geology are omitted and probably the same may be said for other field sciences. Several books have been written on much the same subject in the past decade, but this, in itself, is no criticism; a new approach is always welcome. Unfortunately, one feels that this particular approach adds little to the literature.

J. W. Barnes

The Boundary Integral Equation for Porous Media Flow by J. A. Liggett and P. L.-F. Liu

George Allen & Unwin, Hemel Hempstead, 1983. 255 pp. £20 hardback, ISBN 0-04-620011-8.

Over the past decade, numerical modelling of subsurface flows has become an increasingly important tool in groundwater resource evaluation and management and in the treatment of seepage problems. Substantial developments have been made during that time in the range of numerical methods available for the analysis of porous media flow. Initial work concentrated exclusively on Finite Difference methods, but subsequent research has demonstrated the flexibility of Finite Element methods for representation of complex geometry and variable mesh generation and standard solution packages have made the method more accessible. A recent addition to the available techniques has been the Boundary Integral Equation Method (BIEM).

As the sophistication of the numerical method increases, lack of communication between research and practice can hinder application. A text has an important role in introducing the groundwater practitioner to an advance in numerical technique. In the case of the Finite Element method, Pinder & Gray (1977) provide an excellent example of successful communication. The BIEM has now been presented for application to porous media flow by Liggett and Liu.

Whereas a finite difference approximation to groundwater flow approximates piezometric head at discrete points in a region and finite element method approximates head over a discrete element within a region, the boundary integral equation method approximates piezometric head and its normal derivative at the boundary of a region, and satisfies the governing equation everywhere within the region. The method has the advantage that for a two-dimensional problem, integration over the line boundary only is required, and for a three-dimensional problem, the integration is over the bounding surface. Hence, the dimensions of the problem is reduced and improved computational efficiency can be achieved.

Following an introductory chapter in which the equations of groundwater flow are presented, in Chapter 2 the authors develop the BIEM for solution of the two-dimensional Laplace equation, illustrated with a simple worked example, and introduce the three-dimensional problem. In subsequent chapters additional refinements are discussed. The replacement of conventional linear interpolation of nodal boundary values by special functions where analytical solutions are of assistance is considered for examples which range from flow in corners to far-field solutions for infinite boundary problems. It is demonstrated that anisotropy can be treated by coordinate transformation, but heterogeneity must be represented by zones of different permeability.

As with the Finite Element method, transient problems generally require finite difference approximation of temporal derivatives. This is introduced for transient two-dimensional free-surface problems, using a finite difference approximation of the free-surface boundary conditions. A linearized analysis is introduced to assess the performance of the finite difference approximation.

The formulation of the boundary integral necessitates identification of a ‘Kernel function’. The formulation of this function in axi-symmetric co-ordinates is more complex than for the previous examples, and is discussed in Chapter 6. An iterative scheme is presented for transient unconfined axi-symmetric analysis. In Chapters 7 and 8, three-dimensional problems are presented more fully, including single and multiple well solutions and multi-phase flow, as applied to the confined flow of two immiscible fluids, is discussed.

For problems of non-linear equations or non-constant coefficients, Finite Element methods are more powerful. Hence, in Chapter 9 the computational efficiency of the BIEM is combined with the flexibility of the Finite Element method for solution of problems involving both Darcy and non-linear flow.
Specific examples presented are the saturated–unsaturated analysis of drawdown at a well and non-Darcy flow under a cut-off wall.

In Chapter 10, the authors depart from the Laplace equation, but at the expense of increased complexity. For the solution of unsteady confined flow, the time derivative is treated by Laplace transform, generating a Kernel function involving a modified Bessel function. Solution in the transformed domain has then to be inverted. However, the BIEM is shown to be applicable to a range of complex problems including layered and unconfined leaky aquifers and complex multi-layer systems.

The final chapter presents three Fortran programs for introductory application of the method, with sample input and output data included. These are for confined flow with mixed boundary conditions, extension to include special elements with numerical integration, and an unsteady dam seepage analysis.

As is evident from the relatively sparse reference list, the BIEM has yet to be applied extensively to groundwater problems. However, while acknowledging the importance of field interpretation in comparison with model selection, the authors make a convincing case for further application of the method. The authors present a text which gives a clear introduction to the BIEM which will be of considerable value to all modellers interested in application of the method and although the method can be complex, the authors' claim in the penultimate chapter that many of the three-dimensional features of a complex aquifer system can be preserved in a one-dimensional solution will provide considerable incentive to generate a wider base of practical applications.

Reference

PINDER, G. F. & GRAY, W. G. (1977) Finite element simulation in surface and subsurface hydrology. Academic Press, New York.

H. S. Wheater

Handbook of Geology in Civil Engineering
by Robert F. Legget and Paul F. Karrow

McGraw-Hill, New York. 1982. £55.95. ISBN 0-07-037061-3.

In their Preface the authors explain that this Handbook '...is intended to be of assistance to all civil engineers by demonstrating the vital importance of geology in all civil engineering work, by illustrating this importance through selected case histories from around the world, and by providing useful references where in further and more detailed information may be obtained...' This the authors have done, and in so doing have produced a magnificent text that should be on the shelves of every engineer whose practice involves work with rock and soil. But it is not only the engineer who will benefit from this book. Geologists also will find in it a wealth of information that lies close to the heart of that subject called Engineering Geology.

Apart from its physical size (50 mm thick and weighing 1.9 kg) this book is one of the easiest to read. Each line bears witness to the immense pleasure and fascination both authors find in the subject. The script is written in a relaxed style and almost every page carries an excellent plate; indeed, the artwork has been extremely well selected and reproduced. Many of the figures hold your attention as they illustrate so well the case-histories that unfold in each chapter. This is very much a book about 'field observations', in particular about observing those features of pertinence, and the value of such an approach is strengthened by the complete absence of analyses. Not one formula is to be found in the script. The authors feel obliged to explain this as a deliberate policy, and as a policy it is effective, for it leaves the reader free to concentrate on the importance of geological observations to successful geotechnical engineering.

The book is divided in 5 parts, each containing a number of chapters. Some such division is essential for a text of this size, but must be executed with care if the resulting structure of the script is to be of use. I felt that the divisions were excellent, for in spite of the size of the book, the 5 parts place the reader in control of the text. This is a considerable feat on behalf of the authors, for the script records the practical experience of a lifetime gained by two senior and eminent geotechnical engineers and this is not the easiest of subjects to present as one volume. Each part groups together related subjects in such a way that the natural reaction to browse back and forth, ahead and beyond the page of interest becomes a fruitful pastime, as much information relevant to the original enquiry is revealed. The division into parts also provides the reader with rapid access to the subjects of interest.

Part 1 is devoted to Geology. The subject is introduced, the nature and origin of rocks and soils is reviewed, and the influence of this nature and origin upon the mechanics of rocks and soils is described. The part concludes by considering the characters of groundwater and by briefly introducing the effects of climate upon site conditions.

Part 2 concerns Preliminary Studies and is essentially devoted to site investigation: it is approximately the same size as Part 1. Most of the 'nitty-gritty' that can be read on the subject in various standards, manuals and working party reports has been avoided, leaving the text free to impart the 'flavour' of the subject, thus
conveying some sense of the investigation philosophy that should be present in the minds of investigators prior to field activities. The chapters describe various investigations, including those for construction materials, and also describe geological maps and the geology beneath cities (the book includes material previously published in Cities and Geology).

Part 3 is the largest portion of the book and is entitled Civil Engineering Works. It is larger than Parts 1 and 2 combined but remains manageable by reason of careful division into chapters that are grouped so as to cover related subjects. The Part commences with a chapter on Drainage, which is so important to many engineering works, and moves on to consider excavations, (Open Excavation; Tunnels; Underground Space). The next four chapters deal with foundations (Buildings; Powerhouses; Bridges; Dams). Reservoirs and Catchment Areas are the subject of the chapter to follow that on Dams, with subsequent chapters on the subjects of Grouting and Water Supply. A further batch of four chapters considers Canals, Roads, Railways, and Airfields. The part concludes with chapters devoted to River Training, Marine Works, Land Reclamation and the Problems of Cold Regions. There is a certain amount of duplication within Part 3, but on the whole I found this providing a welcome link between topics rather than an irritating repetition of them.

Part 4 is devoted to Special Problems and is about the same size as Part 1. By ‘Special problems’ the authors mean Subsidence, Sinkholes, Landslides, Rockfalls, Erosion and Sedimentation, Problem Soils and Rocks, Faults and Joints, Volcanoes and Earthquakes and Floods, each of which is the subject of a chapter. This grouping is the only character of the book where mild criticism came to mind—not of the treatment, which is excellent, but to the definition of all these subjects as ‘special problems’. Landslides, rockfalls, erosion, sedimentation, and floods are very normal processes of erosion and deposition: faults and joints are to be expected rather than considered as something special. It might have been better if some of the material had been included into Parts 1 and 2. That said, it must be noted that the authors were also aware of this problem and focus the script accordingly.

Part 5 reviews Geology and the Environment and is very much a section for readers to recommend to administrators in planning authorities. It is the shortest of all the parts and contains four chapters, as follows: Geology and Planning; Man-made Geological Problems; Conserving the Environment; and Geology and the Civil Engineer. Amongst the various subjects treated are Terrain Analysis, Pollution, Waste Disposal, Problems with Methane, Waste from Mines, Sand and Gravel Pits, Mining and the Environment, Stabilization of Sand Dunes, and Archeology.

There are 5 appendices, which include a Glossary of Geological Terms, the name and address of Geological Surveys of the World and of Geological Societies of the World, and lists of useful journals. Two powerful indices are also provided.

The Frontise of the book is a portrait of William Smith and Members of the Society will know that in 1977 Robert Legget became the first recipient of the Society’s William Smith Medal. There is thus a fine and fitting link between this text and the Society, and it is with great pleasure that I can warmly recommend the Handbook to Fellows and other readers. The cost of purchase may seem painful at first, and to those in pain I put these thoughts . . . there are 50 chapters in the book (51 if you include the valuable appendices) and at just over £1.00 a chapter you could not possibly make a better investment.

M. H. de Freitas