

REVIEWS

FORD, D. C., and WILLIAMS, P. W. *Karst geomorphology and hydrology*. London, Unwin Hyman. 1989. xv + 601 pp. Hardback ISBN 0 04 551105 5, price £75; paperback ISBN 0 04 551106 3, price £24.95.
(reviewed by M. M. Sweeting)

Both these authors began their caving and karst interests in the Mendips, so it is a pleasure to review this joint book for the U.B.S.S. The last 20 years has seen great developments in karst hydrology and geomorphology and much of the work discussed in this book has sprung from the ideas and experiments of Derek Ford and Paul Williams and their pupils. Throughout the book the authors convey to the reader their enthusiasm for karst and caves, enthusiasm generated by their early explorations in Swildon's and other Mendip caves.

The book develops an original and logical plan dealing first with karst limestones and geological controls followed by the chemical dissolution and kinetic behaviour of karst rocks and their rates of denudation. There are then two long sections which give an in-depth study of karst hydrology, the nature of karst aquifers and an analysis of karst drainage systems. The authors consider that surface karst landforms cannot evolve until the subterranean connections have been established between the input and output points, and thus the origins and patterns of caves and cave systems are next investigated. The section on caves is followed by those on surface karst landforms; since the availability of water is the key climatic factor in karst development, surface landform developments in humid regions are regarded as the characteristic forms of karst; karst landforms in non-humid environments are considered separately. This arrangement of chapters should be compared with a recent similar book by W. B. White on the *Geomorphology and Hydrology of Karst Terrains* (O.U.P. 1988), in which the consideration of the landforms and landscapes themselves precedes those on the chemistry of carbonate dissolution, karst hydrology and hydrogeochemistry.

Despite being written by two authors, the text is very well integrated. However, the text is dense, often using the minimum of explanation and it needs careful reading. This is partly because of the wide range of material that any modern book on karst has to cover and there are parts, even though it is over 600 pages, where one would like the book to be longer. The approach is also very analytical, for instance in the section on the solution of limestones, the basic equations and solution kinetics are fully discussed. All chapters give excellent reviews of recent work and bring the subject up to date as far as is possible; the bibliography will be much welcomed.

The sections which make the main contribution to our knowledge of karst and are the most outstanding are those dealing with karst hydrology and the analysis of karst drainage basins and their relationships to landforms; and those dealing with the origin and development of caves. These are the subjects which Paul Williams and Derek Ford have made their own over the last 25 years.

Their approach in the elucidation of the hydrological development of karst aquifers and the evolution of the landforms is from a systems perspective. Karst can be viewed as an open system of two clearly integrated hydrological and geochemical subsystems operating upon the karstic rocks; karst landforms are the products of the interplay of the processes in these linked subsystems. Thus a karst aquifer is envisaged as an open system with a boundary defined by the catchment limits and with input, throughput and output flows, mechanisms and controls. Flowtype (diffuse, conduit, etc.) is related to cave

type, from the work of White. The authors review the very important work by the French hydrogeologists, Casteny, Bakalowitz and Mangin. Casteny's work discusses techniques for the determination of hydraulic conductivity of karst, particularly in field settings; much of his work is published by U.N.E.S.C.O. Bakalowitz and Mangin show how the degree of organization of karst aquifers may be deduced from hydrograph and chemograph data. Though karst aquifers appear heterogeneous, the distribution of voids and drainage axes are ordered according to a certain hierarchy. Thus the aquifer in a karst basin can be considered structured with reference to the drainage and the water flows are increasingly organized as the structured aquifer develops. Bakalowitz and Mangin regard the karst system as being characterized by an impulse—response function, that transforms input phases from precipitation to the hydrograph responses at the springs. Hence analyses of the responses help to identify particular features of the aquifer and its degree of organization.

The sections of the book dealing with caves represent a big step forward in our understanding of the interpretation of cave development. As the authors say, caves are among the most complex of landforms and have been difficult to fit into a framework for genetic explanation. The vast majority of caves (over 80%) are formed by solution from meteoric waters in unconfined circulation in karstic rocks; these are referred to as common caves or hypogene caves. The chapter gives the most successful attempt so far to classify and analyse the development of common caves. This is done in terms of a systems model of single and multiple inputs, and which is compared with plans of well-known caves. A four-state model relates the sequence of passages to the progression of the phreatic zone and the water table; phreatic and water table caves are differentiated, but in reality there is much mixing of the types. Caves developed from meteoric waters but where the circulation is confined are also discussed. Hypogene caves are those caused by solution of deeply circulating waters, often associated with CO₂, or waters containing H₂S (like Carlsbad Cavern in New Mexico). Other aspects of caves dealt with include sea coast mixing-zone caves; erosional morphological features; and cave breakdown.

There is a useful review of cave interior deposits (not entrance deposits) and a good section on the dating and palaeo-environmental analysis of calcite speleothems and other interior deposits. This is a section of the book where the reader might wish the authors had more space to expand.

The standpoint taken throughout by the authors is that the essence of karst is subterranean. Hence the long sections on karst hydrology and cave development come before the discussion on the surface landforms. The initiation of the 'karst plumbing' is regarded as an essential pre-condition for the early development of medium to large scale landforms. The landforms result from processes operating in coupled hydrological and geochemical systems which operate over a wide variety of environments provided there is water.

The section on surface karst landforms in humid regions occupies less than 100 pages of the book. It is particularly good on dolines and karst morphometric analysis. There are many telling observations which probably for lack of space are not enlarged upon, such as the statement on page 423, that 'karstification does not *disorganize* the stream pattern . . . It *reorganizes* it'.

Modifications in the patterns of karst development caused by different climatic and environmental conditions (aridity, glacial, permafrost, changes in sea-level), are discussed in relation to some interesting examples. There is also a review of relict and palaeokarst, a subject of much recent research.

The final chapter gives a useful account of the uses of karst resources, and their exploitation and management; because of the experience of the authors, the examples are well-chosen and world-wide.

The book is a significant contribution to our knowledge of karst hydrology and the development of caves, particularly in relationship to the development of certain karst landforms. There are other factors affecting karst, which the authors are not able to develop, and problems which for lack of space they do not try to answer. However, it is not the point of a review to discuss what a book does not contain but rather to evaluate what it tries to do. Within the viewpoint and aims of the authors the book fulfills its objective very successfully. The integration of the text, diagrams and photographs is also excellent.

BASTIN, B. (ed.) *Colloque international de sédimentologie karstique (Han-sur-Lesse, Belgique, 18-22 mai 1987)*. Liège, 1988, iv, 199 pp. (Annales de la Société Géologique de Belgique 111(1)). ISSN 0037-9395. Price BF 700. (reviewed by S. N. Collcutt)

If Belgium is a small country, with less than ten thousand square kilometres of limestone terrain in its southeastern provinces, it is by no means 'small' in its contribution to speleology. Not only are its own caves and karst of considerable interest but it is rapidly becoming both a forum for international discussion and a major exporter of ideas and expertise. The proceedings of the symposium on karst sedimentology held at Han-sur-Lesse in 1987 are a testimony to this growing influence.

It is customary for a reviewer to report the vital statistics of the subject volume. The book is soft-bound, with its two hundred or so pages printed on glossy paper. It is copiously illustrated but the reproduction is poor, the photographs being particularly disappointing. There are forty-four authors from a variety of countries: Belgium (8), Britain (8), Canada (3), China (3), Czechoslovakia (1), France (11), Italy (4), Spain (5) and Yugoslavia (1). Study material from all these countries is presented and Bulgaria gets a mention too. In all, there are twenty articles, in French (14) or English (6), each with useful abstracts in both these languages save for one French text with French and German abstracts; there is even one article with bilingual figure/plate captions. When authors are native speakers of neither French nor English the prose may become somewhat idiosyncratic but the arguments are rarely unintelligible. Articles are numbered in the discussion below in order of their appearance in the book to facilitate multiple references.

The first impression, then, is that the book is rather short. Individual articles are of extremely varied quality, although readers would probably disagree on the range and ranking. The true and remarkable value of the work only becomes apparent when it has been read from cover to cover and the whole is considered in its own right. What excited and even disturbed this reviewer is the fact of the book's almost painful currency. All that is good, bad or indifferent (depending upon one's point of view) in temperate karst sedimentology today can be found in these pages, and in such close juxtaposition that the reader is forced to re-examine his or her own preconceptions. It seems unlikely that this effect was planned, since there is no overt theme to link the contributions. It follows that it is a difficult book to review in an objective manner—but here goes anyway, with apologies for the violence that may be done to the authors' conceptions of the original point of their articles.