

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.

The first two papers, by Ek & Quinif on clastic cave sediments (No. 1) and by Gewalt & Ek on speleothems (No. 2), are short overviews of the literature published during the last twenty years. These nonjudgmental syntheses are competent but, by definition, contribute little to the overall tension generated by the rest of the book. Nevertheless, certain important motifs can be isolated. In the case of clastics, some subjects are couched in terms of climatic determinism whilst others are discussed from the point of view of proximal and complex mechanisms whereby sediments can be seen not only as effect but also as cause. In the case of speleothems, the authors take their brief of synthesis quite liberally and combine 875 published Uranium-series dates on stalagmite from northern latitudes to examine the frequency relationship with Oxygen-isotope stages. However, they also plot in the same way 51 dates from Belgium alone and thus, whether or not deliberately, contrast the global with the particular.

An almost pure climatic determinism is apparent in the articles by Kervazo & Laville (No. 5) on the Grotte Vaufrey (France) and by Burhenne (No. 12) on the Trou Jadot (Belgium). Research based upon such an approach always seems to involve entrance facies sediments with archaeological material. Great importance is attached to the laboratory derivation of values for simple textural and compositional attributes; the changing values are then interpreted directly as changing climate. By no means all exponents are francophones; Burhenne cites the work of J. B. Campbell in British Upper Palaeolithic caves. These researchers are interested in the unique aspect of history—time's arrow. Readers must decide for themselves whether or not they find the crucial sediment/climate equations plausible.

In complete contrast, the article by Bini, Cremaschi, Forit & Perna (No. 16) on the karst of Iglesiente (Italy) is concerned with Tertiary cave fills, the instability of which threatens the local mining industry. Although they demonstrate the general antiquity of the fills, these authors are not interested in unified history. The source of the materials is important because of the associated mechanical properties. The emplacement mechanisms are discussed, in terms both of facies models (for instance, for braided streams) and of motifs/cyclothem (sequences involving erosion, aggradation, cementation, etc.). It is the recursive aspect which is stressed here—time's cycle.

Having isolated these two viewpoints, it becomes interesting to see how much the climatic/historic and processual/ahistoric associations hold in other papers. The article by Musil (No. 4), which is unfortunately represented by an abstract alone, considers the proper approach to vertebrate biostatigraphy in caves. The conclusion is that population phenotypic change, responding to environmental change, yields a relative age for any assemblage and, when calibrated, even an absolute age. On the other hand, Choppy (No. 15) describes plastic deposits in caves (muds of various types including carbonate forms). The mechanisms listed (flooding, sheet flow, dripping, gravitational collapse, drying, carbonate build-up, the imprint of tracks) and the resulting sedimentary structures would provide an excellent basis for facies models reflecting decreasing water circulation and 'fossilization'.

A considerable proportion of the papers discuss the evolution of particular karst geomorphologies. Some studies are extensive, applying relatively simple observations to material spread over long time intervals and wide areas. Delannoy, Guendon & Quinif (No. 3) discuss karst in the French Alps, integrating morphological data with observations of interior and exterior deposits; they note increased incision and other downward trends during periods of cold climate. Lin, Zhang & Huang (No. 20) provide a synthetic report on the karst of eastern China, stressing the lateral (regional) patterning

produced by successive shifts in climatic belts. Rohou, Barbanson & Perthuisot (No. 17), whilst addressing some historical questions, note a radical change in the geometry of the sub-surface drainage between fossil and more recent cave systems in Cantabria, a change resulting more from rock structure and tectonics than from direct climatic influence. Papers covering more restricted areas tend to include the results of more intensive study. Ferrier (No. 8) reports on a single catchment (including the cave of Temnata) in northern Bulgaria. Bastin, Quinif, Dupuis & Gascoyne (No. 6) discuss the alluvial-speleothem cycles in the Grotte de Bohon (Belgium). Maire & Quinif (No. 7) bring a complex battery of techniques to bear upon the sedimentary sequences in the Galerie Aranzadi of the Gouffre de la Pierre Saint Martin (French Pyrenees). Rowe, Austin, & Atkinson (No. 10) use speleothem ages alone from two caves in the Manifold Valley (Britain) to derive an average regional incision rate covering the last two million years. All the above authors strive to integrate the morphological and sedimentary aspects of karst, no matter what scale is employed. The same may be said of Gonzales, Isturitz, Lopez de Ascona, Sanchez Goñi & Ugarte (No. 19), although the minimal sequences filling the exokarst in the Spanish Basque Country present intractable problems.

The site- or region-specific studies in this volume all mention, to a greater or lesser degree, the varying contribution of interior and exterior sediments and processes. The recognition of alluvial-speleothem (-entrance facies) motifs (in articles Nos. 3, 6, 7 or 8, for example), plastic forms (article No. 15) or diagenetic iron nodules (article No. 17) stresses the reorganization occurring in the cave environment. However, most authors note that the majority of karst sediments have exterior origins. Soil derivatives (cf. article No. 16), volcanic ash (cf. articles Nos. 8, 16 and No. 14 by Juvigné dedicated to Belgian examples) and glaciogenic material (cf. article No. 7) provide examples. Schroeder & Desmarais (No. 18) describe the Caverne Laffèche (Canada) which appears to have acted as a trap for substantial glacial and fluvio-glacial sediments and which even contains a notch referable to an incursion of the Champlain Sea.

A number of perennial topics in cave sedimentology receive attention, sometimes with a new and interesting bent.

The textural characteristics of clastic sediments are noted and subjected to 'indexing' in several papers. Modes, spread, skewness and peakedness in distributions are recognized and 'Passega' (C/M) diagrams are constructed (article No. 7). One article (No. 11), by Fielder, Gilbertson, Briggs, Griffin & Jenkinson, is dedicated to log skew Laplace distributions. In some articles the link between textural attributes and real-world processes is clear, in a few (notably the last-mentioned) it is somewhat elusive.

The enormous potential of speleothems is well attested. A surprisingly large number of papers include Uranium-series or radiocarbon dates, although few Oxygen-isotope studies are mentioned. Highly plausible palaeomagnetic results are reported (article No. 10), pollen is extracted (article No. 6) and the survival of the vulnerable vitrified portion of volcanic ash is noted (article No. 14). The most promising side is that speleothems are often seen as relatively stable and complex sedimentary microsequences in their own right—and the depressing side is that sometimes they are not.

No volume on karst sediments in northern latitudes would be complete without some consideration of ice in caves. Cryoclastic scree must be present in most caves because most authors say it is. Gospodarič (No. 9) reports ice wedge and cryoturbation effects within the Postojna system (Yugoslavia) and the Grotte Vaufrey has stone nests at its entrance (article No. 5). This

reviewer's favourite paper is by Pissart, Van Vliet-Lanoë, Ek & Juvigné (No. 13) and concerns aspects of sediments in the Grotte de Remouchamps (Belgium). The crux of this most lucid and concise article is the recognition in fine sediments of micromorphological features indicative of former segregation ice. This observation is carefully placed within a framework of chronology, cave meteorology and sedimentary history. It is concluded that, since superficial permafrost degrades from the surface downwards, the persistence of frozen sediment and ice masses in lower parts of the Remouchamps system as a thaw set in would explain the observed reactivation of higher passages. Finally, the authors make a plea for the publication of direct observations of segregation ice in modern caves.

It cannot be claimed that the proceedings of the Han symposium constitute a 'seminal' work (although one or two of the individual papers might qualify). Nevertheless, this reviewer has a feeling that the book will make its own special place in the history of karst sedimentology because it has been written at one of those moments when international communication is improving, when new techniques are being applied and when researchers are asking a much wider variety of questions of their study material and are experimenting with different conceptual frameworks to organize their observations. One could think of many adjectives to characterize all or part of the book, but just plain 'enjoyable' will probably do.'

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(reviewed by S. L. Hobbs)

The 21st IAH (International Association of Hydrogeologists) conference concerning karst hydrogeology and karst environment protection was held in Guilin City, China. It was attended by 380 delegates from 34 countries, a combination that ensured a diverse range of karst research from many different environments was presented. The two-part conference proceedings contain 156 papers and 107 abstracts, all except one of which are written in English. Over 100 papers/abstracts are by Chinese authors, which illustrates the range of work that is currently being carried out in China on karst hydrogeology.

The papers in the proceedings are divided into the following fourteen sub-groups (numbers in brackets refer to the number of papers/abstracts): Part 1: keynote papers (11); strategy of comprehensive planning and development of karst areas (24); general karstology (27); regional distribution pattern and systematic analysis of karst groundwater (58); Part 2: parameters and modelling of karst groundwater (37); geophysical and remote sensing techniques (11); isotopic approach (9); karst geochemistry, groundwater tracing and thermal mineral water in karst areas (32); water pollution problems (16); mine dewatering in karst areas (9); leakage from reservoirs in karst areas (10); surface collapse problems (12); karst hydrogeological maps (5); hydrogeological problems in non-karst areas (2). Because of the number and range of papers no detailed critique of individual work is given. However a generalized summary is presented below.

Part 1 of the proceedings contains most of the more descriptive papers. These range from overviews of karst hydrogeology in India (K. S. Murty), Thailand (S. Wongsawat—abstract) and China (Zhuang Shouue *et al.*) to detailed catchment area studies in countries as far apart as Canada (F. A. Michel *et al.*) and South Africa (M. Marker). Some of the papers concentrate