BOOK REVIEWS

PLATEAU UPLIFT: THE RHENISH SHIELD - A Case History

K. Fuchs, K. von Gehlen, H. Mälzer, H. Murawski and A. Semmel (eds).

Springer-Verlag, Berlin, Heidelberg, New York, Tokyo, 1983, 411p., \$49.50 (U.S.)

Seventy-nine workers collaborated on 42 papers in this book, which represents the results of a six year, generously funded, multidisciplinary research effort aimed at deciphering the complex uplift history of the Rhenish Shield. The research project, which is a West German contribution to the International Lithosphere Program, was conceived by the Deutsche Forschungsgemeinschaft to study epeirogenic processes in the continental lithosphere. The editors of the book were members of the committee chosen to support the late Prof. Henning Illies who, as the Coordinator, devoted much of the last six years of his life to guide this project to a successful conclusion. The volume is dedicated to his memory.

The Rhenish Shield is a rather small topographic feature when compared with the well-known plateaus of the world, but its origin poses many similar questions. With an area approximately 350 by 100 km and maximum elevations well below 1,000 m, the project area is comparable in size to one of the smaller Precambrian basement uplifts of southwestern U.S.A. It is a young uplift of Hercynian basement in the foreland of the Alpine collision front and lies astride the Rhine River. The Rhenish Shield acts as a hinge between a southern zone of shear rifting along the Rhine Graben in the south and an area of extensional rifting in the Lower Rhine embayment to the north. To elucidate the interaction between uplift, rifting and volcanism, the investigators studied the regional tectonic setting, changes in altitude (pre-Pleistocene, Pleistocene and Recent), volcanic activity, seismicity, in situ stresses and geothermal activity, the gravity field and geophysical properties of the crust and upper mantle, and the petrology of crustal and upper mantle xenoliths enclosed in the Tertiary and younger volcanic rocks of the area.

A long-range seismic refraction experiment and combined seismic reflection-refraction investigations established a marked lateral variability in the crust-mantle boundary structure beneath the topographically rather uniform shield. To the east of the Rhine, the upper mantle appears to be inactive, and the Moho forms a complex zone with a high-velocity layer at about 29 km overlying a low-velocity layer which gradually increases to upper mantle velocities at a depth of about 37 km. West of the Rhine the crust-mantle boundary and uppermost mantle region are occupied by an anomalous low-velocity zone, which is interpreted as containing up to 1% partial melt. This low-velocity body correlates with young volcanism and higher recent uplift rates. Surprisingly, this low-velocity zone was not detected by magneto-telluric sounding surveys; neither did these find significant differences in electrical conductivity between the upper mantle under the Rhenish Shield and that beneath neighbouring areas.

All papers of this volume are of high quality, clearly written, well illustrated and arranged in a logical sequence to give a truly comprehensive overview. Despite the large number of contributors, the editors have produced a book that reads uniformly and leads the reader smoothly through the large number of complex topics covered. In an epilogue, they give an objective summary and evaluation of the research program, summarizing major advances and outlining areas for future research. The editors point out that most uplift models proposed in the book concentrate on the anomalous body of low-velocity material under the western part of the Shield; these fail to provide a mechanism for the uplift of the eastern part. The crucial question of how this anomalous body was generated has also not been satisfactorily answered. Although a mantle diapir model appears to satisfy many of the observations, it is not yet clear whether this was generated by a random event or by shear heating as a result of stresses generated by an Alpine push from the south.

The book is an absolute must for all earth scientists involved in the sort of multidisciplinary research projects generated by the International Lithosphere Program. It is a type example of such a study and shows that it is possible for nearly eighty researchers to collaborate closely, with their findings presented in a well-organized and integrated fashion. All too often multi-authored books of similar scope tend to give the impression that the different researchers did "their thing" but lost sight of the other disciplines and/or the overall aim of the project. This book shows that good coordination of such projects is extremely important to maximize results. Sound planning and good coordination will become even more important when shortages of funds require that similar investigations have to be much longer term projects.

H. Helmstaedt
Kingston, Ontario

EXPLOSIVE VOLCANISM: Inception, Evolution, and Hazards

Geophysics Study Committee, National Research Council

Geophysics Series, vol. 14, 1984, National Academy Press, Washington, D.C., U.S.A., 176 p., \$24.50 (US).

With the impetus of the Mount St. Helens eruption, volcanology has become an explosive topic and the inevitable official panel joins the rush. Blessed with a catchy title and prestigious sponsors, this volume would seem to offer a comprehensive body of knowledge to substantiate its learned and practical recommendations. Thus, concerned geoscientists the world over would be anxious to part with their scarce dollars to purchase this modestly (for these days!) priced book. However, no attempt at thorough coverage is made, and the topics leap over a wide range within the most liberal definition of explosive volcanism. In a few cases, one can almost feel the strain as an article is spiced with some allusion to hazards in order to make it topical.

These comments are not, however, meant to denigrate the value of the individual papers in this volume. Many of the articles are excellent, some are unquestionably germane to the title, and all readers would find something worthwhile in the volume. The problem is that we are dealing here with a potpourri, common to many unstructured symposia. There is an unusual span of subjects which might be of concern, say, to an astrophysicist dealing with Io, or to a local government official charged during an eruption with directing and policing local and foreign geologists in their relationships to each other and the press. Some of the papers could have been more economically published in the appropriate journals.

Two points in the book's recommendations may escape the casual reader, though they would come to the fore during an eruption. The problem of centralized and concerted

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statements to the press goes to the very heart of free scientific inquiry and dissemination of knowledge. We geologists are always disagreeing, and a mechanism must be found to encourage a cosmetic homogenization of divergent views which could wreak havoc in government and among the general population.

Much of the book is concerned with the role of the U.S. Geological Survey. However, this is not the only organization in the U.S. capable of providing analyses of events during a dangerous volcanic eruption, as assumed in the recommendations. The U.S.G.S. certainly has the manpower, support and expertise, but it has no monopoly on knowledge or ability.

The book includes field, laboratory and experimental studies on topics such as magma formation processes, the relationship between tectonism and volcanism, volcanic periodicity - including the historical record, eruptive mechanics and events, and societal problems. A plea is made for emergency planning, and the recommendations include a call for more studies on the physical aspects of petrologic processes, and on the acquisition of precursory data to permit dependable predictions of eruptions and more communication between government agencies.

Samuel Bonis
Guatemala City, Guatemala

GEOLOGY OF INDIAN SUTURE ZONE OF LADAKH

V.C. Thakur and K.K. Sharma (eds.)

Wadia Institute of Himalayan Geology, Dehra Dun, 1983, 205p. No price listed.

D.N. Wadia, one of the fathers of Indian geology, wrote monumental volumes on the geology of the Himalaya and, in 1916, published his well-known book, the *Geology of India*. The latest edition was dated 1953, and reprints can still be purchased in New Delhi. It is appropriate that the major research institution in earth sciences in India outside the Geological Survey (GSI) is named after him.

This most recent publication of the Wadia Institute is subtitled, "Professor D.N. Wadia Birth Centenary Commemorative Volume," with 19 papers, several of which refer to the single paper on the Indus Suture Zone written by Wadia himself. That paper, published in the *Records of GSI* (v. 72, 1937, p.151), contains a description of the field relations of the various geologic units which can hardly be improved upon today. It is also accompanied by a geologic map which appears quite accurate compared with more recent maps. In one paper in the new volume, comparable to that of Wadia's, J.T. Gergan and P.C. Pant present the first geological map of the Eastern Karakorum, together with four cross sections whose location, unfortunately, is not indicated on the map. However, many years from now, references to this paper will still be made, as it presents the first map of this area.

The other papers are progress reports dealing with various aspects of the Indus-Tsangpo Suture Zone. It is remarkable that of the 24 contributing authors, all but six are from the

Wadia Institute, with most of the papers resulting from the Indus Suture Project of the Institute, headed by V.C. Thakur. There are no papers by foreign geologists. The book clearly shows what a powerful research organization the Wadia Institute is, but, for a more complete understanding of the Suture Zone, one should combine the reading of this volume with that of other publications, e.g. *Earth and Planetary Science Letters*, v. 60, 1982, p. 253, which present the results of the Swiss research group. Thakur's attempt in the final paper, after an all too brief summary of the main geological events, to relate the Ladakh and Southern Tibet areas is moderately successful, though the reader would benefit by a reading of the work of the Chinese-French Research Group on Tibet.

On the other hand, some of the results presented in this volume nicely complement those from Tibet. For example, anomalous high heat flow in Tibet (*Nature*, v. 307, 1984, p. 32) is thought to result from the emplacement of shallow plutonic bodies, assuming that the radiogenic heat contribution is normal. K.K. Sharma, O.P. Sharma, and K.K. Nagpaul actually measured the U and Th concentrations in the Ladakh Batholith north of the Indus Suture, and found that the radiogenic heat contribution cannot explain the anomalously high heat flow in this area. They, too, assume recent plutonic intrusion as the most likely cause.

The Ladakh Batholith was studied by K.K. Sharma and coworkers in detail; major and trace element analyses of 38 samples are the basis for a comparison with the Peruvian Coastal Batholith. Intrusion, apparently the result of northward subduction in the suture zone, began in the Middle or Late Cretaceous and culminated in the Early Eocene. Uplift and erosion must have followed quickly, as R.N. Lakhanpal and S.C.D. Sah describe a new fossil palm species (named after Wadia) of Eocene-Oligocene age that occurs in the Hemis Conglomerate. This conglomerate is part of the Indus Molasse, which post-dates subduction, obduction and also intrusion. But this molasse precedes the major tectonic phase of the Himalaya and is thus pre-orogenic, in contrast to the post-orogenic Kargil-Kailash molasse of Late Miocene to Pliocene age, also known locally as the Indus Molasse. This rather confusing issue is not very well clarified in the present volume, although there is a good descriptive paper by N.S. Mathur on the Kargil Molasse.

Hakim Rai argues that the batholith intruded an ophiolite-andesite-volcanics-flysch sequence, which is preserved in the north in the Shyok Suture Zone, and in the South into the Indus Suture Zone. According to him, then, the Shyok Zone is not a subduction zone, or even a suture, but rather a compressed back-arc basin. This interesting proposition is at variance with other recent interpretations. Subduction in the Indus Suture Zone is no longer questioned, apparently because of the concurrence of ophiolitic mélanges and glaucophane schists (V.C. Thakur and D.K. Misra). It is shown in the same paper that subsequent to subduction, major Himalayan telescoping superimposed in the Indus Valley ophiolitic mélanges of strikingly different tectonic fabric. One of the thrust slices contains the so-called Indus Formation, with sedimentation continuing from Cretaceous through Oligocene time. A detailed petrographic analysis of sandstone (V.C. Thakur and T.N. Bagati) shows that most of the detritus was derived from the Ladakh Island arc and deposited as arc-trench sediments.

No book on Himalayan geology would be complete without some paleobotany, for after all, it was the study of paleoflora that led to the concept of Gondwana versus Eurasia and eventually to that of collision between the two continents. There is no study of *Glossopteris* here, but rather one of Jurassic flora from north of the Ladakh arc (M.N. Bose and others); this flora cannot be compared to coeval flora in

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Nepal or Bhutan, but is similar to that of the Karakorum. A tentative conclusion is that the NeoTethys must have been a fairly wide ocean through the Late Jurassic.

Overall, this is a fine volume, notwithstanding the numerous typographic errors, although not in the paleontological papers, poor quality of the half-tones, and, in my copy, mixed-up binding of pages 144-177. More than anything else it shows that Indian geologists of the present generation are worthy successors to Wadia and, also, that sophisticated isotope machines or paleomagnetic equipment are not necessary to produce interesting results.

Kees A. DeJong
Cincinnati, Ohio,

THE DAWN OF ANIMAL LIFE - A BIOHISTORICAL STUDY

Martin F. Glaessner

Cambridge University Press, Cambridge, London, New York, 1984, 244p., \$49.50 (US).

The title of this book immediately recalls a synthesis published in 1875 by Sir J. William Dawson of Montreal as "The Dawn of Life," in which the controversial *Eozoon* (the "dawn-animal," a supposed giant foraminiferan) from marbles in the Canadian Shield figured so prominently. Precambrian paleontology has progressed immensely since then, particularly during the past 30 years, and Glaessner has been in the forefront of research on Late Precambrian mega-fossils. *Eozoon* is not even mentioned in this book, having been laid to rest as nonbiologic long ago. Instead, the book is primarily a synthesis of Glaessner's many years of experience, observations and views on the assemblages of extraordinary soft-bodied animals known as the Ediacara fauna, now recognized in more than 20 regions. Based on all available fossil evidence, he presents an overview of the early diversity of marine invertebrate animals in Late Precambrian time, and the transition to shell-bearing Cambrian fossils. The book is intended for graduate students and researchers in evolutionary and marine biology, paleontology, and historical geology.

The volume is divided into 5 chapters of which the first is a clear general review of Precambrian life and its development. Here, due attention is given to theories of the origin of life, the subdivisions of the Precambrian, the preservation and recognition of biologic remains in rocks, cell organization and life processes, biologic classification, and Proterozoic fossils and environments. There is also a discussion of the early differentiation of the Metazoa, the earliest of which are thought to be small detritus feeders living about 900-1,000 Ma ago. This review is based on the hypothetical phylogenetic sequence and radiation postulated by A.V. Ivanov and R.B. Clark, and these topics serve as a background for later chapters.

The second, longest and best illustrated chapter, about a third of the book, treats the Ediacaran ("Ediacarian"

according to Glaessner) faunal assemblages as documented in the fossil record. As such it is the most paleontologically oriented part of the book. We learn how R.C. Sprigg made the initial discovery in the Pound Quartzite in the Ediacara Hills of South Australia, and of subsequent finds, about the nearshore paleoenvironment and the remarkable mode of preservation in quartzite. This is followed by an analysis of the fauna. Thirty-one named species in 22 genera are recognized and tabulated, comprising 21 species of coelenterates, 7 species of annelids, 2 of arthropods, and one of unknown systematic position. About a third of them are illustrated. Other occurrences of the fauna in Australia, Africa, South America, Eurasia and North America are described, and some are illustrated, the most diverse now known being that from the White Sea coast (see Sokolov and Fedonkin, Episodes, March 1984). A final section in the chapter summarizes the data and discusses the concept of the Ediacaran fauna as a global phenomenon of the Late Precambrian.

Chapter 3, on Precambrian diversification of the Metazoa, has a paleozoological orientation and is chiefly theoretical, treating the significance of the fauna for metazoan phylogeny. The taxa discussed in Chapter 2 are placed in an evolutionary context, and conclusions are drawn about the physical environments of the Late Precambrian Metazoa, animal diversification, and the high rates of evolution at the end of the Precambrian.

A fourth, lengthy chapter considers the Precambrian-Cambrian transition and touches on principles of stratigraphic classification, problems of terminology, and on competing candidates for global stratotype sections for this interval of the geologic record. Other topics include the disappearance of the Late Precambrian faunas and the introduction of the first shelly fossils during a critical, but somewhat indefinite 10-20 Ma span of time, the diversification of the Early Cambrian fauna, the problem of biomineralization and its significance, the increase in diversity of trace fossils, and the consequences and causes of evolutionary diversification. The term 'Holozoic' is proposed for the 'post-Precambrian' eon - although 'Phanerozoic' is used in the same sense elsewhere in the book - highlighting the problems caused by the formalization and continued use of the word 'Precambrian'.

In the final chapter, Glaessner integrates the earlier ones into a general biohistorical synthesis, insisting on the close interaction between lithosphere, hydrosphere, atmosphere and biosphere. Envisaged is a three-stage metazoan expansion in the marine biosphere: slow development during a long lead time from inception to the mid-Vendian, rapid increase through the Cambrian to the Late Ordovician, followed by a steady plateau throughout the rest of Phanerozoic time. A final section gives a concise recapitulation of animal life - past, present and future.

A brief appendix provides an explanation of how certain problems of language, and geographic, stratigraphic, and biologic terminology were resolved. The reference list is extensive (18 pages) and up to date through early 1983. Separate author and subject indexes are provided. The number of illustrations (50) is adequate, but the quality of several figures (reproductions from other publications, overly contrasty photographs, and dirt spots on some) leaves something to be desired. The book is remarkably free of typographical errors. The binding is durable; the cover bears a reconstruction of some elements of the Ediacara fauna, and has the striking lime colour of other volumes in the Cambridge Earth Science Series.

This is a timely and authoritative volume, providing a valuable, up-to-date view of the appearance and diversification of Metazoa based on worldwide data documented by the author and others during the past 25

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years. Readers may disagree with certain of Glaessner's views, conclusions and proposals, but they cannot disregard them. This is not a text, but it is essential reading for all who are interested in the evolution of the biosphere, particularly paleontologists and evolutionary biologists, and those who work with stratigraphic problems in the interval encompassing the Precambrian-Cambrian transition.

H.J. Hofmann
Montreal, Canada

GROUND WATER IN WATER RESOURCES PLANNING

IAHS Publication 142 (No editor listed)

International Association of Hydrological Sciences,
2 volumes, 1983, 1214p, \$22 (U.S.)

This two-volume work is the proceedings of an international symposium organized by Unesco and the West German Committee for the IHP in Koblenz, F.R.G., September 1983. The meeting dealt comprehensively with all aspects of the place of groundwater in water resources planning. Much of the developing world lies in semi-arid and arid regions, where groundwater is the sole supply of an essential commodity. Sub-surface water is also of increasing importance in the developed world, where high-quality resources are limited in relation to demand. The importance of the subject is indicated by the large number of international scientific and technical organizations dealing with water that supported the Koblenz meeting (Unesco, WHO, IAH, IASH, UNDT, FAO, UNICEF, ICID and IWRA).

The first of six sections in this work deals with the importance of groundwater in different regions: developing regions, based on United Nations projects; Federal Republic of Germany; the arid zone; Brazil; and submarine groundwater discharge in Australia. This section also includes general papers on Zaire, India, Sudan, Botswana, Argentina, Iraq, Algeria, Brazil and Guatemala, all emphasizing the importance of groundwater in the national economy. The more complex and much investigated problems of groundwater in more developed economies, such as Belgium (Louvain-la-Neuve), Spain, (Guadalquivir) and France, (Lorraine) is considered. The latter includes multiple uses of aquifers, for groundwater storage, as a source of energy from thermal waters, and for stocking of liquid effluents.

The economic, social and institutional aspects of groundwater and the practicability of planning concepts are reviewed in other papers that stress two fundamentals. First, the amount of high-quality groundwater is decreasing while demand is growing, and second, pollution, contamination and depletion are endangering many groundwater resources. There is a need to treat all water resources together, but there are also many obstacles to this approach. Pollution is producing groundwater quality deterioration due to urban development in the U.K.; the mass-transfer of surface water to and from underground also implies the mass-transfer of pollution. The requirements of users are also stressed in an entirely social-economic paper on the phreatic waters of Alsace. The

overall position of groundwater in the Soviet Union is exemplified by the statement that "in the U.S.S.R., water is an exclusive state property and is made available only for use. It is neither characterized by a commodity price, nor can it be bought or sold and, thus, water cannot be separated from state property." UN work in developing countries demonstrates that "an awareness has to be developed in the public and decision-makers of the possibilities and limitations of groundwater."

A series of papers deal with the technical base for planning groundwater development. This includes a most interesting account of the planning and management of groundwater resources in a vast region of China, other papers review maps and data manipulation, with examples from Rhenish-Westphalia and Lower Saxony, groundwater recharge, hydrochemistry (F.R.G., India and Brazil), and the control of infiltration, pumping and groundwater levels in Cairo following the construction of the Aswan Dam.

Basic concepts concerning the conflicts arising from multiple demand on groundwater are reviewed in ten papers. The emphasis for the actual planning and management of groundwater is on the use of models to enable efficient planning and management. This is appropriate because today the large number of input variables, both technical and economic, the need to integrate these in different ways, and the need to get results on which planning and management decisions may be made with confidence, all demand mathematical models.

The final group of contributions to this work discuss hazards related to the pollution and contamination of groundwater, and various measures for its protection. Many of these papers deal with contamination of groundwater through agricultural activities (mainly nitrates), hydrocarbons, chemicals, organic and nuclear wastes. Several review, at a basic level, medical and organic aspects of pollution problems and self-purification processes in aquifers. The 103 papers in these two volumes are of a high standard, and should be read by all dealing with the scientific, economic, social or political aspects of groundwater.

David Burdon
Co Cork, Ireland

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Eds. E. Seibold and J.D. Meulenkamp

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IUGS New Publication Series No. 14.

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ARCHEAN AND EARLY PROTEROZOIC GEOLOGIC EVOLUTION AND METALLOGENESIS

International Symposium held in Salvador, Bahia, Brazil – September, 1982

Revista Brasileira de Geociências, 12(1-3), 1982

This 544 page issue of the *Revista Brasileira de Geociências* constitutes the proceedings of the international symposium that brought together in Salvador, Brazil, some of the topmost specialists in the study of ancient regions all over the world. Grouped into four main subjects, the papers represent the most complete work ever made of the first half of the Earth's history.

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volume 12 números 1, 2 e 3 março-junho - setembro 1982

ANEXO DO IBGP
International Symposium on Archaean and Early Proterozoic Geologic Evolution and Metallogenesis
Salvador, Bahia, Brazil - 3 a 11 setembro, 1982
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