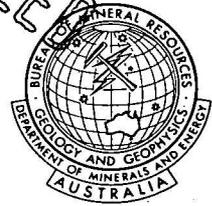


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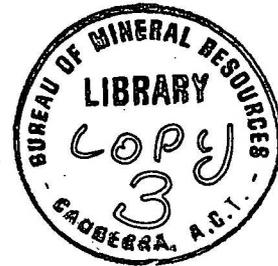
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RECORD 1975/81

INTRODUCTION

by

M.R. WALTER



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INTRODUCTION

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M.R. WALTER

Introduction

M.R. Walter*

It is 68 years since E. Kalkowsky coined and defined the word stromatolite, yet there is increasing controversy and confusion as to its use. Usage is not uniform in this book, nor have I attempted to make it so. The original definition is now of historical interest only. The only unifying feature of stromatolites is their genesis. The definition I find most useful is one modified from that presented in 1974 by S.M. Awramik and L. Margulis in the second Stromatolite Newsletter (unpublished):

Stromatolites are organosedimentary structures produced by sediment trapping, binding and/or precipitation as a result of the growth and metabolic activity of micro-organisms, principally cyanophytes. Non-genetic classifications are so broad as to include a wide range of nonbiogenic structures, so that the term would cease to be useful. The definition used here embraces the whole range of forms, including stratiform and unlaminated structures that some workers would exclude. It has generated the structure of this book.

For some time the belief that stromatolites are mainly a marine intertidal phenomenon dominated the literature. The distribution of stromatolites is not restricted in this way now, nor was it during the past, particularly during the Proterozoic. Stromatolites can form in almost any free-standing body of water, providing the following conditions are met:

1. the environment is suitable for the growth of appropriate micro-organisms;
2. the rate of growth of the constructing micro-organisms exceeds their rate of consumption by other organisms;

* Contributions by M.R. Walter in this book, except sections 3.3, 6.2 and 8.9, are published with the permission of the Acting Director, Bureau of Mineral Resources, Geology and Geophysics, Australia.

3. the rate of sedimentation is sufficient to produce a preservable structure but is not so great as to prevent colonization by micro-organisms;
4. the stromatolites accrete faster than they can be destroyed by boring and burrowing organisms and erosive and other mechanical and chemical forces.

These propositions may seem to be truisms yet they serve to explain the present and past distribution of stromatolites, as is discussed by many authors within this book. It is now generally accepted that stromatolites may form in a wide range of environments, but another simplistic notion is still prevalent. That is that all stromatolites are built by cyanophytes. This is not so now, nor was it necessarily the case in the past, many ancient stromatolites may have been built by bacteria or eucaryotic algae.

The study of stromatolites is essentially one of morphogenesis. There are several good studies of the morphogenesis of Holocene stromatolites and these provide the basis for the uniformitarian interpretation of ancient stromatolites. Such an approach is limited by the small range of stromatolite forms known from the Holocene, in contrast with the great variety described from the rock record, particularly the Proterozoic. Morphogenetic analysis has also been applied to ancient stromatolites with no Holocene homeomorphs. Both approaches will be found in this book. Neither approach is simple and the effort involved is worthwhile only because of the wealth of subtle palaeoenvironmental and palaeobiological information encoded in the shapes and microstructures of stromatolites. We are only just beginning to crack code. It is this basic role of morphology in the study of these structures, which are not true fossils but are more than sedimentary structures, that has produced the need for a taxonomy and has thus resulted in much debate. A fruitless part of the debate has concerned nomenclature; the fruit is to be found in discussions of classification,

for those who have the fortitude to wade through them. Suffice it to say that it is retrograde to force complex structures into a simple classification.

The study of stromatolites has burgeoned in recent years, and at the same time it has become more interdisciplinary. Microbiologists are making increasingly significant contributions to a field previously dominated by palaeontologists and sedimentologists. Now there are even geochemists, geophysicists and computer technologists hovering on the fringes of the field. The resultant abundance of new information and ideas made available over the past 5-10 years has not been assimilated by the geological profession at large and frequently there are false impressions, even among specialists, as to the attitudes of other specialists. These points apply particularly where research is published in languages other than that of the user. For all these reasons, I believe the publication of this book is timely. All contributions were invited by me in an attempt to provide a comprehensive coverage of studies of stromatolites. No attempt was made, however, to make the book geographically representative. The 41 authors have been remarkably co-operative and I have received all but 3 of the contributions originally invited. I have attempted to balance reviews of tried and tested work with reports of new methods and research, aiming both to reflect accurately the present state of knowledge and to produce a book useful to specialists and non-specialists alike. All authors were instructed to guide readers to the pertinent literature and the bibliography is, I believe, complete within its defined limits. This, I hope, will compensate for gaps in coverage that readers may detect within the text.

Gaps not covered by the text or the bibliography indicate those areas not yet studied. Some that can be perceived because research to fill them has just begun include the microbiology of Holocene stromatolites, the microfossil content of ancient stromatolites, the effects of diagenesis on

stromatolite microstructure, the interpretation of deep-sea manganese nodules as bacterial stromatolites, and the geochemistry of stromatolitic carbonates. Much research remains to be done on the most controversial of all subjects in this field, stromatolite biostratigraphy. This subject is thoroughly discussed in this book, from many points of view, but the reader will not learn here whether or not the method is valid. The available microbiological and micropalaeontological data suggest that stromatolite biostratigraphy should be possible, but more and more evidence is being uncovered which is inconsistent with the simple biostratigraphic scheme used 5 to 10 years ago. It may be that the main problem lies in the taxonomies presently in use. We should remember that the history of stromatolite biostratigraphy essentially spans only the last 17 years; compared to other fields of biostratigraphy, this one is in its infancy, so we should not be too quick to criticize. Even if stromatolite biostratigraphy eventually proves to be impossible, we will have accumulated abundant data for making much more precise palaeoenvironmental and palaeobiological interpretations than are presently possible.

Editing this publication has occupied a significant part of my time for two years and would not have been possible without the support and assistance of many people. I want to take this opportunity to thank four individuals whose contributions have been indirect yet vital: M.F. Glaessner as my teacher and mentor, Preston Cloud as a source of inspiration and confidence, Brian J. Skinner who by inviting me to Yale University gave me the opportunity to broaden my experience and eventually to meet most of my colleagues who were to contribute to this book, and Marilyn, my wife, who has shared this burden with me. The Bureau of Mineral Resources, Geology and Geophysics generously allowed me to take on this task while in their employ, and for that I am truly thankful. Almost every paper in this book was scrutinised by at least one referee and while the authors and I must

bear ultimate responsibility, the referees' contribution was indispensable. I shall not mention them all by name but several because of their skills and fortunate geographic location during the editing process bore more than their fair share of the work: they are W.V. Preiss, A.L. Donaldson and J.F. Truswell.