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Preface

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PREFACE

It is hard to imagine a more multidisciplinary topic than the subject of this symposium. Investigating the fossil remains of biomolecules requires expertise from several major branches of science: physical, chemical, biological and geological. The specializations of the scientists contributing to this volume almost reads as an A–Z of science, ranging from archaeologists to zoologists, with biochemists, chemists, geneticists, geologists, immunologists, molecular biologists, palaeontologists and other, more difficult to classify, experts in between.

This breadth of expertise is both a blessing and a curse. It is not always easy for geologists or chemists to become fully aware of the intricacies of the polymerase chain reaction (PCR), yet the significance of the recent exciting results on fossil DNA sequences can only be assessed when this technology is understood. Similarly the details of organic chemistry, geology, immunology and a host of other disciplines are very difficult for non-specialists to comprehend. The speed of technical development in biomolecular research is a further complication, because techniques are changing very rapidly indeed. Spare a thought for all scientists, of whatever discipline, who make the considerable effort to master complex techniques and procedures, only to find that these hard-won skills become almost obsolete overnight as they are overtaken by new developments. PCR was virtually unheard of only 2 years ago, and yet it is now universally available, regularly used in all branches of molecular biology, and is crucial for the investigation of fossil DNA!

With such developments, and more in the pipeline, it is not surprising that it is difficult even for those involved in research on fossil molecules to keep fully in touch with all the relevant developments in this field. It is all the more difficult because it is imperative that investigations of fossil molecules are based on comprehensive understanding of the related biomolecules in living organisms. We need to know the *in vivo* structure and function of the biomolecules that act as a source for important groups of fossil molecules. In many cases this information is not available, and must be specially determined.

Contamination by biomolecules from ubiquitous organisms such as bacteria remains the biggest problem for the study of fossil molecules, and comprehensive information on the breakdown pathways of biomolecules in geological situations remains the best protection against misleading results. Acquiring such information is a major task in its own right.

Despite the spectacular successes of recent years, there is still little known about the extent to which biomolecules are preserved in the fossil record. The geological conditions that are conducive to good biomolecular preservation are something of a mystery: indeed, we simply do not know yet whether such preservation is exceptional rather than commonplace. Further research may well reveal many more examples of excellent preservation; there will surely be spectacular discoveries in the next few decades, as new techniques are applied more widely and as we begin to build up a better understanding of the processes in geological environments.

Advances will be made in a number of ways, not only in more sequences from fossil organisms. The primary sequence of biomolecules such as DNA may represent the highest, and most sought after, level of information in biological systems, but this is not necessarily the case for fossil molecules. The individual building blocks of complex macromolecules (i.e. amino acids, lipids, etc.) are information-rich in their own right, and can throw considerable light on a wide range of topics from environments through to food sources and diets. This symposium documents significant advances in the investigation of the fossil occurrences of a number of these small biomolecules, and many more will undoubtedly appear in the future. New techniques, such as isotopic determinations, will be more widely applied. It is important that small and relatively simple biomolecules are not overlooked in the stampede for fossil sequences: no matter how many conjoined pieces of DNA are found in the geological record, there is no doubt that small biomolecules such as amino acids and lipids will always be much more abundant and widely distributed.

This topic is very complex both to investigate and understand. However, it would be scientifically indefensible to abandon a comprehensive multidisciplinary approach in favour of a narrower more focused approach. All chapters are concise, well-referenced, and designed to address an audience of non-

specialists. Further, it represents the most up-to-date and comprehensive survey available on the state of research on fossil molecules: because of the rapid publication schedule of the Royal Society this symposium contains the latest information as of March 1991, with additional developments incorporated during the subsequent review process.

This volume should contain something of interest to most scientists. For evolutionary biologists there is the tantalizing prospect of being able to investigate the processes of molecular evolution at first hand, for geologists there is the possibility of coming to terms with the enormous range of organic compounds in rocks and exploring the many ways in which their presence may influence, change or determine the progress and nature of geological processes, whereas for environmental research there is the considerable information stored in fossil molecules about climates and conditions in the past.

Extensive discussion has been included after every chapter and this captures some of the excitement, controversy and enlightened interest which characterized the discussion meeting itself. We invite you to experience this, and hope you enjoy this as much as we did.

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