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John Postgate, FRS, is Emeritus Professor of Microbiology at the University of Sussex, where he was also Director of the Unit of Nitrogen Fixation. He was educated at Kingsbury County School, among others, and Balliol College, Oxford, where he took a first degree in chemistry before turning to chemical microbiology. He then spent fifteen years in government research establishments – studying mainly the sulphur bacteria and bacterial death – before moving to the Unit at Sussex, where he spent the next twenty-two years. He has held visiting professorships at the University of Illinois and Oregon State University and has been President of the Institute of Biology and of the Society for General Microbiology.

He is the third Professor John Postgate: the first his great-grandfather taught medicine at Birmingham University, the second his grandfather taught classics at Liverpool University. His other grandfather was George Lansbury, the Socialist leader, and his father was Raymond Postgate, the historian and gourmet. Long ago John Postgate led the Oxford University Dixieland Bandits (on cornet), and he is known as a jazz writer. He and his wife, who read English at St Hilda’s College, Oxford, have three grown-up daughters.

Since the dawn of life on Earth, the world has been gradually transformed by living things into a comfortable home for plants, animals and ourselves. But many harsh and seemingly inhospitable places remain, and it is the inhabitants of such places, mainly invisible microbes, that reveal the remarkable potential and resilience of life itself. How do microbes survive, even flourish, in superheated water or supercooled brine; at enormous pressures; without air; amid poisons? And what part do, and did, they play in making the Earth hospitable?

In this fascinating account, for lay readers, John Postgate, one of Britain’s leading microbiologists, tells of the diverse adjustments microbes have made to apparently impossible habitats. Modern understanding provides new clues to the origin and evolution of terrestrial life, offers glimpses of how life might have established itself elsewhere in the universe, and raises profound questions about death, sensation and individuality – as well as illustrating the often muddled pathways of scientific progress.
Related title

*Microbes and Man, 3rd edition*

JOHN POSTGATE FRS
JOHN POSTGATE FRS

The Outer Reaches of Life
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Preface

Almost a quarter of a century ago I wrote a book, *Microbes and Man*, in which I gave an account of the world of microbes – bacteria, viruses, protozoa and the like – and described their impact on our lives, our economy and our society. It was written primarily for non-scientist readers and has been a success, I am happy to say: translated into half a dozen languages and now into its third edition.

A dozen years after it came out my late aunt came across it. She was Dame Margaret Cole, classicist, writer, educationalist and Fabian socialist. Surprised that her nephew had written a paperback, she dutifully read it.

My aunt belonged to the generation of educated people which took it for granted that scientists were essentially uneducated, as well as barely literate. (I would not deny that a brief scan of professional scientific journals is likely to confirm her view, but how did she know?) Having read my book, she was moved to write to me – a thing she rarely did – expressing, with disarming frankness, her pleased surprise that she understood and even enjoyed considerable portions of it. She added that it would have been even better if I had left out the chemistry: those formulae and equations, with their lines, arrows and rows of capital letters – they put her off.

I felt humbly complimented. But I have worried ever since, on and off, about her response to equations and formulae. It is widely shared. Yet equations (mathematical or chemical) and formulae, like diagrams and graphs, are more than scientific shorthand; they can be beautiful when you understand the picture they reveal. Nevertheless, they can also be a deterrent for those who are not
tuned in to such things. How, then, without formulae and diagrams, does one explain the glorious inwardness of biology, when so much of it is rooted in chemistry, particularly when the biological entities are microbes?

Should one shrug one’s shoulders? Shed a tear, perhaps, for that huge Other Culture in our society, comprised of all those who were never told, or have forgotten, the basics of chemistry, physics and biology? Of course not; there is not time. For it is they who are daily obliged to make decisions on problems where scientific understanding is essential, decisions on matters which range from the merits of nuclear energy to the choice of baby food.

‘Scientific understanding’, I said, not ‘scientific knowledge’. The distinction is important. Science has grown so big that no brain can encompass even a moderate fraction of the vast mass of knowledge which is preserved in print and on disk. Of course, good scientists have to have good memories, but the era of the polymath is over. Most scientists specialise in subdivisions of their main subject, and have little real knowledge of other areas, let alone of other disciplines. But scientific understanding is another matter. Reading or hearing about science, one allows oneself to forget, in self-defence, most of the detail on offer, but experiences new insights, recognises new relationships among things, and learns new patterns of thought and logic. Our perception of the world we live in is for ever changed, and our awareness of our place in it is enhanced.

Scientific understanding changes lives. It is – or can be – quite as valuable, formative and enjoyable a cultural experience as absorbing a great work of art or literature.

The day will come when the elements of science, and its logic, are as much a part of human culture as reading, writing and arithmetic. But that day is still a generation or two away, and meanwhile science races on, spawning new technologies and raising new ethical problems the while. And as it advances, it also illuminates ever wider vistas of our cosmos, from its tiniest components to the whole universe. Must the cultural delight in the understanding that science brings be closed to over half the populace?
Preface

I do not think so, and in this book I have tried to convey, to non-scientist readers, something of the way in which our understanding of the largely invisible world of microbes is giving us new slants on life itself. Avoiding formulae, maths, technical terms and graphs as much as I could, I have tried to display the glimpses microbes offer of exotic ways of life, some of which were probably dominant at various stages of this planet’s infancy, and some of which may well have become the norm among creatures elsewhere in the universe.

John Postgate
Lewes, 1993

Some readers will find it helpful to read Chapter 1 first, because it includes a brief introduction to microbes in general. Thereafter there is no need to take chapters consecutively – even though there is a logic in their order.
Acknowledgements

The hobyahs, whose visual comments on the chapters so much enhance my book, are imp-like creatures, in no way resembling microbes, visualised by John D. Batten for one of the classic nineteenth-century collections of traditional fairy stories assembled by Joseph Jacobs. I thank Sue Shields for the vignettes and congratulate her on the way in which her adaptations retain the manic vivacity of Batten’s original beasties.

I am also grateful to the Editors of the following publications for permission to include portions of previously published writings: The Student Book 1988/89 et seq. (Macmillan) for part of Chapter 1; New Scientist for parts of Chapters 3, 7, 10, 16 and 17; Times Higher Education Supplement for parts of Chapters 11, 12 and 14.

Finally, I thank my wife, Mary Postgate, for reading, criticising and improving every chapter.