This book uses modern biological knowledge to tackle the question: "What distinguishes living organisms from the non-living world?" In the first few chapters, the authors draw on recent advances in cell and molecular biology to develop an account of the "living state" that applies to all organisms, but only to organisms. Subsequent chapters use this account to explore questions about evolution, the origin of life and the possibility of extraterrestrial life. Towards the end of the book the authors consider human evolution, intelligence and the extent to which our species can be regarded as biologically unique. About Life is written as far as possible in non-technical language; all scientific terms are explained straightforwardly when they are introduced. It is aimed at the general, non-specialist reader, but the novel approach that it takes to general issues in biology will also interest students of the life sciences.
ABOUT LIFE
About Life

Concepts in Modern Biology

by

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Springer
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Thanks to the popular media, and to books by Dawkins, Fortey, Gould, Margulis and other writers, people are informed about many aspects of biology. Everyone seems to know a little about evolution, for example, and about DNA and the possibilities (good and bad) afforded by research in molecular genetics. Most people know some of the arguments for and against the likelihood of life on other planets. And so on. We are glad that these pieces of information have become so widely available. However, we do not assume any particular knowledge (other than the most basic) in this book. Our aim is to address general questions rather than specific issues. We want to enable our readers to join their disparate pieces of knowledge about biology together.

The most basic of these general questions – and perhaps the most difficult – can be expressed in beguilingly simple words: “What is life”? What does modern biology tell us about the essential differences between living organisms and the inanimate world? An attempt to answer this question takes us on a journey through almost the whole of contemporary cell and molecular biology, which occupies the first half of the book. The journey is worth the effort. The provisional answer we attain provides a coherent, unifying context in which we can discuss evolution, the origin of life, extraterrestrial life, the meaning of “intelligence”, the evolution of the human brain and the nature of mind. In other words, it enables us – as we said - to help our readers to join their disparate pieces of information together.

Although we assume virtually no knowledge of biology and use non-technical language as far as possible, we cannot avoid using some technical terms. These will be unfamiliar to many readers, so we have added a glossary and pronunciation guide after the final chapter.
We intend this book to be the first volume of a trilogy. In the second volume we plan to explore what science is, and why scientific thinking originated and flourished in western society. We want to investigate the ways in which biology resembles other sciences and the ways in which it differs from them. In the third book, we hope to explore the most controversial topics associated with biology today: patenting of human genes, cloning, genetic modification of crops, the obliteration of habitats, the extinction of species, and so on. This first volume is a prelude to these future projects.

We are grateful to many colleagues for discussions and advice during the several years of gestation of this book, and to the Carnegie Trust for a grant to support the project. All the illustrations were prepared by Dr Ruth Campbell, whose diligence in this work we gratefully acknowledge. Some of the illustrations are reproduced with permission from published sources: Fig. 2.1 from Goodsell (1991) “Inside the living cell,” Trends Biochem. Sci. 16, 206-210; Figs. 3.1(a) and 7.1 (b) from Mayer, Wheatley and Hoppert (2006) in Water and the Cell, chapter 12, Springer, Dordrecht; Figs. 5.3 and 13.5 from de Robertis and de Robertis (1980) Cell and Molecular Biology, 7th edition, Saunders, Philadelphia; Fig 6.5 from http://personalpages.umist.ac.uk/staff/goughlecture/the-cell/diffdev3/haemo.jpg; Fig. 8.3 from Wheatley (1982) The Centriole: a Central Enigma of Cell Biology, North Holland Biomedical Press; Fig. 10.2 from Hogben (1958) Science and the Citizen, George Allen and Unwin; Fig. 10.3 from <http://www.ug.edu.au/_school> science lessons/3.0; and Fig. 12.2 from <http://steve:gb.com/images/science/hydrothermal.jpg>.

While we have done our best to distil the basic concepts that guide biology today, informed readers are likely to consider parts of the text to be in need of revision or correction. We shall be glad of critical feedback. Science is a collective activity, and we are part of the collective.

PSA
DNW
Chapter 1

INTRODUCTION

On a fine day in late spring or early summer, preferably around sunrise or sunset, go to a patch of uncultivated or wooded land as far as possible from people and traffic. Find a comfortable place where you can remain quiet and still for half an hour. Wait, watch and listen. For a while you hear only the sounds of insects, the alarm calls of small birds and the breeze among foliage; nothing moves except leaves and clouds. But after ten or fifteen minutes there is a transformation. Birds settle and feed. Shiny beetles sidle down tree trunks and over the ground. Furry bodies dart to and fro. The world around you has come alive.

Such experiences bring us into contact with other species and seem to satisfy a deep human hunger. "Communing with Nature" is sometimes said to refresh the spirit. The sights and sounds and smells of non-human life in its natural setting arouse our curiosity. They fascinate and enchant. They are the source of much poetry, music and visual art - and of science.

Science - in this case the science of life, biology – has its roots in curiosity. What we see raises questions. These might be simple questions, such as the names of the trees and the shiny beetles and the owners of the furry bodies. Or they might be more complicated ones, such as how birds and flowers are made, how they do the things they do, why they do them; and why they exist at all. Science is a way of framing such questions and trying to answer them. It is not the only way, but it is a very informative and productive one. It works by considering things in themselves, taking no account of whether they are beautiful or ugly or good or bad. The nature and origins of science and its effects on the world are topics for a different book. For present purposes a simple definition will suffice: science is a way of satisfying our curiosity by formulating questions about what we observe and answering them dispassionately – that is, without making value judgements.
You might ask how "communing with Nature" can still enchant a person - a scientist - who devotes his or her working life to dispassionate analytical inquiry. Surely, when curiosity is satisfied, wonder is lost? In fact, for most scientists, the opposite holds. Understanding the techniques of counterpoint and sonata form can enhance our appreciation of Bach fugues and Beethoven symphonies. Analysis of literary styles can help us to relish the subtle ways in which Henry James or Charles Dickens convey character and tension and a sense of place. In much the same way, the fruits of scientific inquiry increase both our understanding of the natural world and our wonder at its workings. Framing and answering questions does not destroy our pleasure in what we see around us; quite the contrary. Knowledge (especially the acquisition of knowledge) is pleasurable in itself, and it augments other pleasures.

However, research scientists ask different kinds of questions from other people. Two individuals who witness the same burgeoning of life during a spring sunrise might experience similar feelings of wonder and excitement. But if one of them is a practising biologist and the other is not, their curiosity will take different forms. The non-specialist might ask why certain insects visit primroses but not wood anemones, or how the shiny beetle manages to feed on the unappetising trunk of the oak tree; or how swallows, swooping from the bright sunlit air into the windowless barn, adapt so quickly to the sudden darkness that they unerringly find their nestlings and never collide with beams or walls. The specialist, the scientist, might be able to answer such questions; if not, then answers will surely be found among the wealth of available wildlife documentaries, books and magazine articles. But personally, he or she will be interested in different matters: the exact mechanism, say, whereby the primrose flower synthesises its chemoattractant, and why insects of one species but not others respond to it; or precisely what place the shiny beetle has in the ecology of mixed woodland. For both individuals, the pleasure of questioning and answering enhances the immediate sensory experience. But the biologist's pleasure in knowledge is difficult to share, except with those who have the same specialist background. There is a comprehension barrier, which we need to try to cross so that scientific knowledge becomes more generally accessible.

Popular science books, television and radio documentaries, science articles in newspapers – all these have gone a long way towards overcoming this barrier. Nevertheless scientists still tend to feel, and to be, misunderstood. This is apparent in their reactions to the most general, basic-seeming questions, the sorts of questions that a child might ask. Scientists tend to consider such questions unanswerable: too vague, too resistant to accepted technical vocabulary, too remote from the rigorous demands of ongoing research; in a word, too hard. For instance, when after a quarter of