LIFE

Life is a compelling addition to the Darwin College Lecture Series, in which eight distinguished authors each present an essay from their area of expertise devoted to the theme of 'life'. The book forges connections among art, science and the humanities in a vibrant and thought-provoking collection which exposes both conventional and unconventional views on the meaning of life, the enigmatic boundaries between the living and the dead, and what may or may not follow afterwards. This collection arises from the Darwin College Lecture Series of 2012 and includes contributions from eight scholars, all of whom are held in esteem not only for their research, but also for their ability to communicate their subject to popular audiences.

Contributors:
Michael Akam, Frances Ashcroft, Chris Bishop, Mark de Rond, Clive Gamble, Ron Laskey, Robert Macfarlane and Michael Scott.

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Life

Edited by *William Brown* and *Andrew Fabian*

Darwin College, Cambridge

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Frances Ashcroft FRS studied at Cambridge. She is currently a Royal Society Research Professor in the Department of Physiology, Anatomy and Genetics at the University of Oxford, and a Fellow of Trinity College, Oxford. Her research is on the process through which blood glucose concentration stimulates the release of insulin, and what goes wrong with this process in diabetes. She has published two popular science books, *Life at the Extremes* (2000) and *The Spark of Life* (2012).

Chris Bishop studied Physics at Oxford and Edinburgh and is now is a Distinguished Scientist at Microsoft Research, and a Fellow of Darwin College, Cambridge. He is also Vice President of the Royal Institution, and Professor of Computer Science at the University of Edinburgh. His research interests include probabilistic approaches to machine learning, as well as their application in a broad range of scientific and technological domains. His books include *Neural Networks for Pattern Recognition* (1995) and *Pattern Recognition and Machine Learning* (2006). In 2008 he gave the Royal Institution Christmas Lectures.

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Clive Gamble FBA studied at the University of Cambridge. He founded and directed the Centre for the Archaeology of Human Origins at the University of Southampton where he is now a professor. He has undertaken research into the evolution of human society concentrating in particular on the Palaeolithic. His recent books include *Origins and Revolutions: Human Identity in Earliest Prehistory* (Cambridge University Press, 2007), *Archaeology: The Basics* (2008) and the international-award-winning *The Palaeolithic Societies of Europe* (Cambridge University Press, 1999).

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Robert Macfarlane studied English at Cambridge and Oxford and is a Fellow of Emmanuel College and Senior Lecturer in the Faculty of English at Cambridge. He is the author of *Mountains of the Mind: A History of a Fascination* (2003), *Original Copy: Plagiarism and Originality in Nineteenth-Century Literature* (2007), *The Wild Places* (2007), *The Old Ways* (2012) and *Holloway* (2013). His books have won numerous national and international awards.

Michael Scott studied Classics at Cambridge and is now an Assistant Professor at Warwick University. He was formerly the Moses and Mary Finley Fellow in Ancient History at Darwin College. His publications include *From Democrats to Kings* (2009), *Delphi and Olympia* (Cambridge University Press, 2010) and *Space and Society in the Greek and Roman World* (Cambridge University Press, 2012). Committed to communicating about the ancient world to as wide an audience as possible, he has written and presented a number of television documentaries.

Preface and acknowledgements

The boundary between life and non-life has been the guiding principle for this interdisciplinary exploration of the notion of life. The chapters that follow start with cells, bio-electrical mechanisms, evolutionary processes and artificial intelligence. Then, in the social world, they consider work on the boundary of death, the way we have envisaged life in the distant past, the metaphor of ruined life, and how first humanity imagined going beyond life.

Cells are the minuscule bricks of life. Ron Laskey describes how living things are kept alive and healthy by the balancing of life and death among the trillions of cells of which they are made. Different functions require cells to have very different life expectations, from a few days to the whole life of the body. Each cell's birth and death is wholly altruistic. It is determined by what is needed for the best functioning of the body of which they are so tiny a part. The scale and complexity of what is required to keep a whole organism alive and healthy stretches our imagination. At the heart of every cell's birth is the process of division and thus replication of its DNA, an act of, in terms of man-made things, incomprehensible precision.

It is their role as electrical machines in the process of life that is the crucial aspect of cells for Frances Ashcroft. Electricity is the literal spark of life which informs and powers the muscles that allow an organism to function. Her account of physiologists' growing understanding of this mechanism focuses on the proteins, known as ion channels, which permit electrical charges to be released or inhibited in the interaction of cells and nerve circuits. These are fundamental not only to how life proceeds, but also to how a vast variety of toxins are created in nature both to

attack and defend it. A deepening understanding of the many roles of ion channels is proving to be of great importance to medical science.

Moving from the bricks and control systems of life to whole organisms, the extraordinary achievement whereby organisms are evolved becomes apparent. Michael Akam discusses what the analysis of genomes is telling us about this process. It reveals how misleading the appearance of a plant or animal might be as an indicator of its forebears. The power of natural selection can create superficially similar life-forms from ones with profoundly different histories. The evolution of life has not been one towards ever-increasing complexity. The underlying genetic toolkit has not changed much over the whole period in which all living organisms have been evolving from a common ancestor. Co-operative interaction is key to this toolkit. Some relatively simple types of cell appear to have evolved from more complex cells, finding benefit in the division of their specific labour. There appears to be a logic embodied in the interaction of genes themselves which controls the evolution of life.

Despite the extreme complexity of life, the potential for simulating or even creating aspects of it has been an increasingly attainable ambition with rapid advances in computer science. Chris Bishop explores the scope for artificial intelligence around three seminal ideas of Alan Turing. He starts with the insights that mathematics has provided of the capacity of interactive systems to explain the development of structure in living systems. He then sketches the quest to create artificial intelligence, with its progression from expert learning to machine learning, and on to the construction of neural networks, exploiting the immensity of contemporary computing power. He ends with the emerging field of synthetic biology utilizing understanding of genetic codes to manipulate the fact that life is 'a system which manages information'.

The extraordinary experience of six weeks in a busy military field hospital in Afghanistan provided Mark de Rond with the opportunity to see how people work at a raw interface between life and death. He takes us into the worlds of the soldiers coping with killing, of the medics struggling to avert death, and of the photographers seeking to catch the images that will hold the world's attention. Success in these roles depends upon managing, as an individual, shocking contradictions, and

upon seeing them as such, and not to be glossed over. Paradoxically, he suggests that this may best be done if team-working focuses less on maintaining inter-personal harmony and more on protecting a sharp awareness of the cruel contradictions inherent in the work.

In answering the question of what life was like in the ancient world, Michael Scott tells a vivid story of the uses and abuses of history. It is a story of how successive generations have chosen to portray a place and past where gems of insight and knowledge have gradually emerged from a mud of ignorance. Interpretations of life in ancient Greece have always been responsive to the attitudes and needs of subsequent worlds. He shows how the classical world has, over the subsequent centuries, been described, re-described, contested and idealized to fit whatever the current debates might have been. It was all so very long ago, and yet the remaining written and artistic evidence is so exceptionally rich. As a result, the process of debate over the nature of the ancient Greek civilization continues to be a powerful part of the intellectual life of our modern world.

A potent artistic device for the understanding of human life has been the imaginary exploration of its ruination. The fragile order of life and its structures degrades into weeds and jungle. An account of the gentle demise of an unpeopled city of Cambridge opens Robert Macfarlane's discussion of the way this literary tradition has evolved. Early 'ruinists', who celebrated the imagined triumph of nature over the works of man, gave way to a more melancholic or romantic approach. More recently, exemplified by the poet and naturalist Edward Thomas, the use of the metaphor has shifted to be neither hateful nor nostalgic. The challenge for our age is an accommodation with nature, rather than wishing either its eradication or its triumph.

The after-life discussed by the archaeologist Clive Gamble was not the physical one of graves and tombs. It was the more profound one of when the human mind started to go beyond the here and now. When did our forebears begin to imagine absent others, whether alive or dead? Such 'going beyond' involves not just living people but the material things in which we are enmeshed and which shape us as social beings. It implies that another person has a different perspective than you do; that they have a mind. He argues that the notion of an after-life emerged as a

feature of mobile people, who lived at low population densities, fishing, gathering and hunting, but equipped with the means to think ahead. They did this materially through the metaphors of containers and instruments, and linguistically through signs and symbols. They created their own after-lives, as do we.

This collection of essays would not be complete without an acknowledgement to the many Members of Darwin College who facilitated the lecture series, and, in particular, to Richard and Ann King for their generous financial support, and to Janet Gibson, who brought order both to the contributors and to their manuscripts.

William Brown and Andrew Fabian