From Extraterrestrials to Animal Minds
Advance Praise

“An elegant and informative account of many popular mistakes about our evolutionary history, with fascinating details about creatures from surprisingly complex protists, through trilobites and almost-birds, all the way to our own peculiar species. Simon Conway Morris marshals his arguments and information to good effect, with an engaging openness to really peculiar theories and possible counterexamples.”

—Stephen R. L. Clark, DPhil, emeritus professor of philosophy, University of Liverpool

“If, somehow, the Christian visionary poet-artist William Blake were a world-class Cambridge paleontologist, evolutionary biologist, and astrobiologist, drank gin and tonics, and was very, very funny, you would have a human marvel approaching Simon Conway Morris. You would also have a world at once physical and mythical—a true cosmic story come alive, become real, that we are writing even as we are being written by it. You would have a ‘universe built on imagination,’ which is to say, ‘on consciousness.’ You would have what appears to be so.”

—Jeffrey J. Kripal, PhD, J. Newton Rayzor Professor of Religion, and associate dean of the School of Humanities, Rice University

“A classic Simon Conway Morris book. The point is not whether you agree with him (I rarely do) but whether you are intrigued, challenged, having fun with the play of ideas—as I always am. Equally, as always, I am deeply impressed by the profound understanding of evolutionary processes, as the author takes us on a dazzling tour through such topics as randomness and extinctions, to supposed missing links (Conway
Morris the paleontologist is very good here) and then on to animal minds and extraterrestrials. A worthy successor to Life’s Solution. Highly recommended.”

—**Michael Ruse**, PhD, professor emeritus at the University of Guelph, Canada, and author of *The Gaia Hypothesis*

“This book opens a fresh perspective on the evolutionary process, a very welcome change from the neo-Darwinian orthodoxy that has predominated for so long. Conway Morris shows convincingly that long term trends stretch over many millions of years, developmental patterns occur again and again in many kinds of convergent evolution, and all this take place in a universe built on imagination. Altogether surprising and liberating.”

—**Rupert Sheldrake**, PhD, author of *The Science Delusion*
From
EXTRATERRESTRIALS
to
ANIMAL MINDS
This is as strange a maze as e’er men trod
And there is in this business more than nature
Was ever conduct of: some oracle
Must rectify our knowledge

—William Shakespeare, The Tempest, Act 5, Scene 1

I have dipped into Darwin. It’s heavy going. The prose thick, grey and formidable, like porridge. . . . On the big question, the God question, he seems to have maintained—this one-time candidate for [holy] orders—a careful reticence, a curiously bland open-mindedness, an obtuse bewilderment. . . . There is a passage in [his autobiography] where the author laments the gradual loss of all taste for poetry, likewise, virtually, for music, painting, and fine scenery, and speculates (ever the man of science) on what has caused the atrophy of the relevant parts of the brain. Is he trying to tell us something?

—Graham Swift, Ever After (1992)
From EXTRATERRESTRIALS to ANIMAL MINDS

SIX MYTHS OF EVOLUTION

SIMON CONWAY MORRIS

TEMPLETON PRESS
For Felix, Nils, and Alexander
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The heat in Venice was insufferable, the narrow calle like ovens. Even as the boat pulled away from the Fondamente Nove, despite the breeze picking up the heat still followed us across the Lagoon. On arrival I ate alone, so far as that is ever possible in an Italian restaurant, and not long after I was rowed by Gianni’s son, Marco, across to San Francesco del Deserto. And there Mortimer was, standing at the same spot as we had said farewell so many years ago, grinning hugely, scarcely aged, among the lengthening shadows. Our meeting was characteristically English—understated, ironic, and amusing in turns. Later, after the evening meal, we walked around the cloisters.

Mortimer did almost all the talking, not loquacious, but as ever weaving his webs of imagination. Here, I can only offer an inadequate paraphrase. "Well, yes, I heard the reports, and every time I learnt from one reliable source or another that you were going off the rails, I was enormously encouraged. Certainly you gave convergent evolution a good run for its money, but as ever you are spot on, becoming far too popular these days: plenty of capable hands to take that story forward. But evolutionary myths, tut! tut!, splendid opportunity to rattle the cage, stir those slumbering guardians of received wisdom. Wouldn’t be so bad if they were trying to slip by watchful dragons, but that’s another area where they show a distressing weakness. But, as you say, not fairy tales but areas of received wisdom that are long overdue for careful reexamination—or as I prefer to think, a really good kicking. Hardly surprising that your discipline is quietly drifting in circles, stranded in an intellectual Sargasso Sea. One almost envies the
physicists. Mislaying 90 percent of the visible universe is splendid; now they have the chance of making some real progress. Mind you, and I mean that literally, when they get the answer I don’t think they are going to like it one little bit.

But your myths! In one way or another they all point in much the same direction, don’t they? Obvious enough that evolution is strongly constrained. Convergence shows that well enough, and so too do those so-called missing links. No wonder those cladists get in such a tizz, caught in a web of their own making—or if you prefer, trapped in endless corridors made of mirrors. In the meantime evolution has better things to do. So it gets on with the straightforward business of combinatorics, shuffling and reshuffling the kaleidoscope of evolutionary possibilities. And the net result? Not only are the many permutations tested, but oddly enough the end result is pretty well guaranteed. It is the same story wherever you care to look. Just think of those squadrons of theropod dinosaurs taking to the air, those platoons of sarcopterygian fish marching in the same direction.

Helpful also, isn’t it, for those mass extinctions weighing in on the side of the angels rather than serving as the dark forces of destruction? Those groups that got it in the neck were doomed in any case; for them, the writing was on the wall long, long before the final chop. And what about their successors, the lucky few that by the merest fluke slipped under the wire? Come off it! There they are, already lined up under starters’ orders, indeed some already in the race. Now comes the day of doom: Kapow! No fun at all. But the dust soon settles, and who do we see emerging from the wreckage? The self-same groups that in the fullness of time would have taken over the world in any case. Mass extinctions accelerate the inevitable—far from the cliché of being destructive paradoxically, they are gratifyingly creative, giving evolution a 50 million year leg up, gratis.”

Silence fell, and then Mortimer glanced up at Venus, shining high above the colonnades. Pointing skyward at our shimmering companion, he continued, “Extraterrestrials? On Venus? Outside chance of life,
high up in the clouds, but pretty parlous place to be, I must say. Certainly wouldn’t put any money on aliens there, or anywhere else mind you. Most amusing—convergent evolution tells you what all those extraterrestrials are going to look like, but blow me down, nobody up there ready to take the call. But then our materialist chums never wanted to know what the universe is really like, nor how very odd it is that we can make sense of at least some of it. Music of the spheres, as that wise old bird Evelyn Cheesman said.”

As if on cue, a nightingale began to sing. Enraptured, we sat. “Glorious sound, but don’t tell me that those liquid notes have anything to do with our music.” Mortimer gestured again. “By the time Saint Francis stayed here in 1220, he had long been familiar with unseen but absolutely real worlds. So have many others, but, mind you, few with such playfulness. As I said when we parted all those years ago, the story doesn’t stop this side of the grave. Even I cannot see all the connections, but I am certain you are on the right track, just like old Teilhard, a much neglected figure. Evolution gets us to where we need to be, but our very uniqueness, the gulf that now separates us from all other animals, provides a splendid spectator sport. Watch all those forlorn attempts to paper over the cracks, to fool ourselves that the mental world of a chimpanzee is just a dilute version of our minds, or rather a Mind.

As I said, to open a door and to enter into a narrative not of our making, to become mythopoeic beings, able to intuit ever deeper meanings, Homo sapiens transforms into Homo narrans and fifty other species. So we discover meanings, and being granted access to orthogonal realities are now capable of infinite explorations. Maybe that’s where our extraterrestrials really are, but if so—as you yourself pointed out all those years ago—we’ll only be meeting ourselves. Now then what are your plans? Ah yes, I suspected as much. More unfinished business, but tell me when you return.” Mortimer laughed uproariously. “Keep up the good work! Only by going off the rails will you keep to the straight and narrow . . .”
From
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Once there were bacteria, now there is New York.”¹ No fish swam above the Archaean stromatolites, no rainforests swathed the tropics of the Cambrian, no cities lined the seaboards of the Cretaceous Tethyan ocean. Through time the biosphere reveals a story of ever-greater complexity. So too, as Darwin outlined, we are taught to see this as a step-by-step process. Undeniable, but things are not quite so simple, either literally or metaphorically. First, New York does indeed stand where once only microbial mats flourished, but the bacteria are still with us (which is just as well).² More importantly, however deep we choose to climb down the phylogenetic ladder, true simplicity is strangely elusive. Second, the implication of the unfolding tapestry of evolution is that it is effectively without limits or boundaries. A closer examination suggests that—with one crucial exception—this is not the case.

**INVENTING THE EUKARYOTE:**
**FIRST SIMPLE, THEN . . . ?**

What circumscribes life is an oddly neglected topic, but perhaps this is less surprising when there is so much to try to understand in the grand narrative of evolution. Central to this task is the identification
of major transitions in the history of life,\textsuperscript{3} epochal rearrangements that may build on existing diversity but usher in new worlds. Language, or perhaps more generally the human mind, is one such example; the evolution of multicellularity is perhaps another. But assuredly neither of these breakthroughs would have happened without the evolution of the eukaryotes, which were originally single-celled organisms, as we still see in the living *Amoeba* (figure 1.1). The subsequent diversifications of the eukaryotes have been staggering, populating the planet with mushrooms, sequoias, sperm whales, and for good measure giant kelp. If the starting point was a single cell then so too surely it was gratifyingly simple? Correspondingly we can then sit back to enjoy a story of unfolding complexity? Such would be the intuitive assumption. Given a rudimentary fossil record that scarcely preserves any cellular details
and involves events that were probably underway more than two billion years ago, one might enquire how we would ever know one way or the other. The answer is relatively straightforward inasmuch as every living organism has an evolutionary footprint that will betray its origins.

Not that tracing these various spoor is a simple exercise. Form may be altered almost beyond recognition, and evolutionary convergence can fool even the seasoned observer (chapter 2). Genomes may be scrambled, bloated, or stripped down, and foreign genes can be parachuted into the cell in the process known as horizontal gene transfer. Neither, despite enormous advances in the technologies of evolutionary analysis, is it possible (or even necessary) to analyze every species. So we take representatives to serve as proxies for each of the major groups of eukaryotes. These, by general consensus, number five or six. Should you wish to know, you are a unikont, which among other things explains why my sperm have a single flagellum. To be slightly more specific we are opisthokonts (the flagellum is located at the posterior end of the sperm), thus placing us humans relatively close to the toadstools. These very major groups are, of course, further subdivided so that in turn we are also animals (metazoans), vertebrates, primates, and a very peculiar sort of ape (chapter 5).

In any event, all these groups, including the unikonts, stem from the ancestral eukaryote. We can then infer the relative complexity of this ur-eukaryote on the reasonable premise that if all the major groups share particular genes, molecules, or cellular structures, then we can be pretty confident that so too did the ancestral cell—which usually shelters under the acronym LECA, for “last eukaryotic common ancestor.” It is now clear, for example, that LECA came equipped with mitochondria and these were essential for its (and ours) respiration. Mitochondria also serve as a canonical example of so-called endosymbiosis. That is, these tiny organelles were once free-living bacteria (specifically α-proteobacteria) that surrendered their freedom (or brokered some other agreement) to become permanently associated
with the eukaryotes. Mitochondria are almost universal among eukaryotes. However, parasitic forms, such as that little parasitic horror *Giardia* (figure 1.2), lack mitochondria. In the heady earlier days of these studies, when the outlines of eukaryotic phylogeny were emerging, such forms were thought to give a glimpse of the very first stages of their evolution. But this is not so: the mitochondria are not so much lost as converted into a rudiment labeled the mitosome (consistent with *Giardia*’s effectively anaerobic existence).

Yet even if mitochondria were in place at the very earliest steps in eukaryotic history (or perhaps were even a pre-eukaryotic acquisition), we should still expect to see stories of unfolding complexity as each of the major groups elaborated in their different ways the elementary scaffolding provided by LECA. The exact reverse turns out to be the case: far from being simple, this common ancestor was astonishingly complex. To explain just how complex is almost as challenging as understanding the innumerable intricacies of the eukaryotic cell itself.