INTRODUCTION

We are in the midst of a revolution. It is a scientific revolution built upon our understanding of DNA, the hereditary material of life. Using the tools of molecular biology, we probe and prod the world around us in ways unimaginable a few decades ago. Big or small, past or present, no organism is immune. Need to identify and track a bacterium at the root of a hospital outbreak? No problem: the offending germ's complete genetic profile can be obtained in 24 hours. Curious about how we humans differ from our closest relatives, the now-extinct Neanderthals? Anthropologists are tackling this very question with DNA extracted from fossilized bone. With a simple cheek swab and a hundred dollars you can delve into your family history in ways that traditional genealogy cannot, and the same technology can reveal susceptibility to Alzheimer's disease and certain cancers. It can even solve a crime. We insert human DNA into *E. coli* bacteria to produce our insulin; we isolate spider silk protein from the milk of transgenic goats; we dream of solving the energy crisis with microbes engineered to produce alternative biofuels; we can clone our pets.

Precisely when and how this revolution began is debatable, but it is safe to say that it would not have happened without the advent of DNA 'sequencing'. The iconic DNA double helix is a ladder-like molecule whose rungs are comprised of four chemical 'bases'. In the 1970s scientists did a remarkable thing: they figured out how to take a piece of DNA and determine the precise order of these bases from one end of the molecule to the other. The microbiologist Carl Woese referred to it as 'biology's ultimate technique', and for good reason. Buried within the four-letter chemical read out—within the DNA sequence—are an organism's genes, collectively the set of 'instructions' it uses to synthesize the proteins needed to sustain life at the cellular level. The genetic alphabet is simple but the information it stores is complex and powerful. As we learned the language of life we learned to manipulate it with increasing ease, transforming countless areas of basic and applied research. Science would never be the same again.

It is natural to look at biotechnology in the twenty-first century with an uneasy mix of wonder and fear. Biotechnology is, however, not as 'unnatural' as one might think. Indeed, biotechnology would be utterly impossible if not for the following indisputable fact: all life on Earth is related. All living organisms use the same fundamental molecular processes to maintain and replicate their genetic material; all organisms use the same basic genetic code to 'read' their genes. From wombats to whales, yaks to yeasts, barnacles to bacteria, the similarities are written in their DNA. And here's the astonishing thing: evolution has been 'plugging-and-playing' with the molecular components of life from the very beginning, generating new organisms with novel biochemical capabilities. It continues to do so today. The evidence is there for all to see. In fact we *are* the evidence; we need look no further than the inner workings of our own cells.

Molecular biology has allowed us to gaze back more than three billion years to the ancient roots of unicellular life. It has revealed how, from simple precursors, complex life forms came into existence. This book tells the story of how we have come to realize that our cells are natural chimaeras, and the importance it holds for us as human beings. It is some of the most exciting and important scientific detective work most people have never heard of.