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## INTRODUCTION: WELCOME HOME

A noise wakes you up. Leaves rustling outside your window? You keep your eyes closed for a few seconds, pull the blanket tighter around your shoulders and savoring the sensation that you're safe, warm, at home in your bed.

But then your brain registers that something is wrong. The rustling you heard is not the sound of leaves, but of voices. And this is not the edge of a blanket in your hand, but the collar of a coat. Beneath you are hard wooden slats.

You sit up and open your eyes. Now you discover, to your horror, that you are not at home at all, not in bed, but sitting on a bench, at the edge of a park, in an alien city.

*Alien.* Everything single thing your senses reveal to you is unknown, from the floating buildings and the five-eyed people to the three reddish moons in a grass-green sky.

You have a choice now. You can shut your eyes again and hope that this strange, frightening vision will melt away like a dream. Or you can accept that it's real, accept that this is where you are, and start exploring.

Might as well get up. Whether you like it or not, somewhere utterly alien and unexpected *is* where you are, right now. To find out just how alien and unexpected, you only have to open your eyes and let science guide you around the world you thought you knew. Science fiction may impress or amuse us with its inventions, but science reveals an actual world that is, as Arthur C. Clarke once observed, far stranger.

What science tells about our alien world belongs to all of us, and it can be imagined and grasped and understood. One motive I had for writing this book is the sheer irritation I feel when people say lazily that this or that thing is “just too big (or small, or complicated, or weird) to imagine”—as if that’s a good excuse for what they have done, which is not bother to try. Maybe some things are impossible to imagine, but let’s not give up so easily. Let’s see if we can *find* ways to imagine them. Because science tells us things about where we live that are, in the most literal sense of that overused word, *wonderful*.

This book is a tourist guide to your universe. A hit-the-highlights introduction to *everything*, it aims to give you a sense of what our world’s furniture is, and how it’s bolted together. The journey goes in steps, like rungs on a ladder:

upwards, to the very large scales of geography and astronomy, and at the same time downwards or inwards to that other great space, the limitless province of the microscope. **At each step you are ten, a hundred, ten trillion times removed from the human scale—in both directions at once. So it will be apparent at a glance that bacteria are to you as you are to a continent. Or that you are to Mount Everest as Mount Everest is to Saturn.**

In science, being a nut for accuracy is usually a good thing. The cesium fountain / ytterbium atomic clocks at the US National Institute of Standards and Technology and the UK's National Physical Laboratory are among the best timekeepers ever made, accurate to better than a second every 100 million years. This kind of accuracy isn't just for nerdy bragging rights—it has also made possible the most precise length measurements ever. By clocking laser pulses as they bounce back from three reflectors left on the lunar surface by the Apollo astronauts, we can tell the distance to the Moon within a centimeter. Because of that, we're in a position to test ideas about gravity, seismology, and other subjects. That umpteenth decimal place can make a difference