



PREFACE

Alien Dreams

It has been a long time, but I distinctly recall the sounds and sights of my alien friends. I was only about 8 or 9 when they first visited me. I frequently heard their voices calling to me, as small sounds in the night, like whispers into my ear. I'd listen hard, trying to make out a few words. Sometimes I even saw them. They signaled with little flashes as the dawn light entered my room, or in daytime with dancing lights in rays of sunshine. They must have been quite tiny, these friends from other worlds. At night, I'd look for signs of their spaceships in the sky. I knew that someday they would invite me to take a trip with them, carrying me far from adolescent troubles to wondrous places of beauty, adventure, and joy. Out there, pain and suffering were unknown. They would show me the galaxy, they would choose me as their ambassador to Earth, and I would bring the news of our great new future to all of humanity. It was only a matter of time, and of my ability to decipher their whispers in the night.

I'm now in my fifth decade of life, and I have not seen or heard from my friends since I was a teenager. I still believe they are out there, somewhere, but I am no longer convinced that they really visited me in my bedroom. Growing up can change your perspective in remarkable ways. The tooth fairy and Santa Claus don't seem quite the same now as they did when I was a child. My little stuffed bear, whom I'd affectionately named Wilshire Boulevard, never did grow back the hair I clipped off him one day, even though I was sure he would. My alien visitors seemed so very real, but now it seems more likely that I saw reflections from dust suspended in the air, and that the whispers in the night were just the sounds that I still hear but now interpret quite differently.

Still, I have not given up hope of someday meeting my friends again. I am more convinced than ever that wondrous worlds really do await us, if only we can put aside our human hatreds and wars and survive long enough to meet those who have inhabited this universe for millions or billions of years before us. Yes, growing up can change your perspective in remarkable ways. I no longer believe in the voices in the night, in the dancing

lights in rays of sunshine, or in the world of magic. Instead, I now *know* that my imagination was far too limited, for the real world holds wonders far more mystifying and incredible than anything my young mind could ever have conjured up.

My personal journey from wide-eyed child to wide-eyed scientist was inspired not only by my alien friends but also by two real events of the late 1960s. The most important by far occurred on July 20, 1969, when Neil Armstrong and Buzz Aldrin became the first human beings to set foot on another world. The fact that the Apollo Moon landings occurred during a time of great turbulence, with both the Vietnam War and the Cold War in full swing, only amplified their message of hope. For myself and other young children of the era, Apollo told us that the troubles of the present would eventually give way to a future that held new worlds. The other event was the release of the movie *2001: A Space Odyssey*. This movie, which opened a year before Apollo reached the Moon, was my first exposure to the idea that the universe might have beings so advanced that they would seem incomprehensible to us. I became a science fiction aficionado, which allowed me to continue journeying into space even as the Apollo program wound down. It's been over 35 years since the last real people walked on the Moon in December 1972, but at night my dreams routinely allow me to travel far beyond.

Between the movie, the Apollo reality, and my own alien friends, it's no accident that I decided to pursue a career as a space scientist. Still, it was hardly a straight-line path. I started college as an engineering major, thinking I might build spacecraft, but soon decided I was more interested in the places that spacecraft might visit than in the rockets themselves. By the time I graduated (from the University of California at San Diego) I had become more pragmatic, majoring in biophysics because it seemed to offer more direct benefits to society than studying distant stars and galaxies. Luckily for me, Carl Sagan's *Cosmos* series aired just in time to show me the error of my ways.

Sagan's series is still remarkably fresh despite being more than two decades old, and it beautifully illustrates the reason I altered my own career path: It shows us that knowledge of the cosmos is not just idle knowledge but rather is at the core of everything that makes us human. I took the message to heart and sent letters turning down the schools that had offered me graduate study in biophysics. I had already been very interested in teaching, having worked through college as an elementary school teaching aide (grades 2–3), and decided that my calling would be to try to follow Sagan's footsteps as a popularizer of astronomy. I ended up at the Univer-

sity of Colorado in Boulder, because their program was flexible enough to allow me to pursue my interest in teaching while still obtaining a doctoral degree in astrophysics. Thanks to my ever-patient thesis advisor, Tom Ayres, I was even allowed to spend time nearly equivalent to what I spent on my thesis in pursuing an educational project that involved building a scale model of the solar system (discussed in chapter 3).

I don't believe in fate, but with hindsight it's rather striking how my detours set me up perfectly to be writing about aliens today. Largely because I was one of the few people who actually volunteered to teach freshmen courses, I ended up teaching several courses each year throughout my graduate student career. My love of teaching and my work on the scale model solar system caused my name to come up in a faculty committee charged with helping to revise the university's core requirements, and the timing worked out just right for me to become the director and lead teacher for a new mathematics program for liberal arts students, a program that we based on the idea that the ability to think critically about numbers and mathematical ideas—what we call “quantitative reasoning”—is for most students much more important than the equation-solving skills taught in traditional mathematics courses such as college algebra. The lack of existing material for the new course caused me to start writing my own, which soon led me to a publishing contract for a college mathematics textbook. When the publisher found out that I was actually an astronomer rather than a mathematician, I was offered my next contract, this time for a college astronomy textbook. Both books proved fairly successful, setting me up for the fateful day when my astronomy editor, Adam Black, asked me if I'd consider writing a textbook about the search for life in the universe.

I said no, of course, because I didn't feel I knew enough about the subject. Unlike the subjects of my prior textbooks, this was a course I'd never taken and never taught. However, Adam promised to team me up with some bona fide experts in the field, and with a little study I realized that my undergraduate background in biology would actually come in useful. The idea that my past detours would suddenly be of value was too much to let go of. I agreed to the project and Adam arm-twisted two of the world's foremost astrobiologists into working with me (Bruce Jakosky from Boulder, who left the project after the first edition, and Seth Shostak of the SETI Institute, who continues to work with me). I often felt like I was an undergraduate student again as they patiently tried to explain the science to me. I'm not always quick to grasp new things, and I probably asked more “stupid questions” of them than all my students combined have ever asked of me. Nevertheless, I eventually learned enough so that we could successfully

complete the textbook, called *Life in the Universe*, which is now in its second edition and has become the leading college textbook for introductory-level courses in the young field that NASA calls “astrobiology.”

And you know what I was thinking about the whole time I worked on that project? Every time I saw rays of sunlight shining in through my window, I thought about my long lost alien friends. I realized that with my new understanding, I could finally start to think about them again, but this time with an eye toward real science instead of just dreams. I also realized that the questions raised by the search for life in the universe go far deeper than I had naively expected. They touch on issues of the origin of life, the origin of intelligence, the nature of the human mind, and the survivability of our civilization. Most relevant to the task at hand, I decided that these issues cut so deeply that both individuals and cultures might change for the better if all were aware of them. I decided that I should take what I’d learned in writing a college textbook and present the crucial lessons in a format that could be read by anyone, in hopes of sharing my newfound understanding with as many people as possible. If you are reading these words, then I know I’ve succeeded at least in getting you through the first few pages.

If you are willing to continue on, this book will take you on a short journey through the world of science and what it has to say about the possibility of life beyond Earth. I will explain why life elsewhere seems ever more likely, why many scientists suspect that civilizations are also common, and the surprising things that we can say about alien visitors to Earth, even while I am personally skeptical of claims that they are here. I’ll describe how the search for life on other worlds is helping us understand life on Earth, illuminating the remarkable circumstances of our planet and showing us how we may be unwittingly threatening our own existence. I’ll discuss the search for life elsewhere, both within our own solar system and beyond. Most important, I’ll tell you why I believe that the quest to find life beyond Earth may help us overcome the ailment that I call *center of the universe syndrome*—the syndrome that makes too many people behave as though the universe really does revolve around them. So with that introduction, let’s leave our alien dreams behind, and look into what science really has to say about the search for extraterrestrial life and its astonishing implications for our future.