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DEDICATION

To Janeane, who is my inspiration and my model of modern parenthood. Thank you the trust you have put in me to share in the task of preparing Crystal for her future. What greater gift and what greater trust could any person bestow on another? I love you always.

-Jack.

It takes an entire village to raise a child.

Old African saying

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A book never springs fully formed from the mind of a writer. Instead, it is the cumulative sum of a lifetime of influences, all of which have their origins outside of the author. In the case of this book, it is impossible to recount all of the people and experiences that have built the complete message. However, some individuals stand out in my mind, and I could not conceive of putting thoughts on subsequent pages without acknowledging their contributions right at the outset.

Siviram Arepalli of the Johnson Space Center was my guide into the world of carbon nanotubes. Siviram also shares my faith in today's youth, and serves with me on the board of the Science National Honor Society. Maurice Smith of *Micscape Magazine* in the United Kingdom helped to shape my thoughts on nanotechnology and on micro electro-mechanical systems. Valin Thorn of the Johnson Space Center has provided the seeds of many parts of my thinking on education, culture, and the pace of technology. Brian Dyer has added particularly insightful views on technology and society. Mehrdad (Mark) Ehsani, Sébastien Gay, and Mark Hotzapple of Texas A&M University have completely reshaped my perspectives on transportation and energy. My thanks to Dr. Mark Westhusin—also of Texas A&M—for his patient explanations of genetics and cloning, and to Dr. Steven K. Feiner of Columbia University for his guidance in augmented reality.

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Finally, every word of this book and every joy in my life has its origins in the positive foundation that my parents, Ben and Diddie Bacon, have built for me and for my siblings for over fifty years. If I can be anywhere close to being as good a role model and parent to my stepdaughter as they have been to me, then the world will be a better place. I hope that this book brings joy, optimism, and pride to them, just as their love has brought these things to me.

-Jack Bacon

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PREFACE

We just left my stepdaughter in New York. She is fifteen years old and on her own, ready to tackle the world of modeling. Her five roommates have flown in from as far away as Brazil, all eager to make their mark in the fashion world.

What do you tell such a child? The city is such a scary place, and the world is so different than it was when I was her age. The big city has so little to do with it...it is more the ever-rolling stream of *change* that makes her future such a mystery. Nothing is the same as it was when I was a child.

Her mother and I spend the day exploring the Explorers Club in midtown Manhattan. Aging photographs of astronauts and wizened adventurers from ages past decorate the walls beside faded flags and memorabilia of times when there were still unexplored corners of the world. My stepdaughter has already been in eleven countries, with prospects for many more. She's even had the V.I.P. tour of the Antarctic support center "Operation Deep Freeze" in Christchurch. At age fifteen she has seen as much of the world as many of the explorers honored on the walls saw in their lifetimes.

She has her cell phone, and can reach anyone on the planet in seconds—notably *us*. She has her prepaid magnetic cards—better than cash—for long-distance calling and for the subway and bus systems. She'll have a credit card soon, and cash-in-hand will cease to be important.

The changes in modern society constitute far more than the changing tastes in fashion, art, and music that have separated previous generations. The landscape ahead of Crystal is as astounding as the breathtaking discoveries of the great explorers of the past, and the forecasts of the great visionaries of today.

Crystal is facing a future of unparalleled opportunity and of unparalleled challenges. Her great-grandmother made history

in a small way as one of the first women in government professional service at the NACA. Now professional service is expected of her. Somehow, she must balance the demands of professional life with the demands of being a woman. Being a woman has never been easy. It may be about to be more difficult.

Her professional life will require her to consider timing the moment that she begins to raise children to a point that may be dangerously close to the limits of what is statistically healthy for her. The demands on her career may require her to travel many times farther than any previous generation has gone. She will face jet lag and must accommodate worldwide commerce that continues 24 hours per day. She'll need to work in the metric system. Her world will be increasingly complex and she will be asked to digest and react to more information (and possibly misinformation) than anyone who has gone before her.

She carries with her the burden of prejudices that have scarred our male-dominated society for centuries. Perhaps in her lifetime she will see equal pay for equal work. Perhaps in her lifetime humankind's new focus on information will take away the boundary between male and female, and as Martin Luther King dreamed, will create a time when all men and women will be judged not by the color of their skin (or by their gender) but by the content of their character.

So, here's what a technologist tells his daughter as she enters the world. You're welcome to listen in, because it's *your* future too. There are some *great* changes coming, and I know that the benefits will outweigh the new problems. Life always gets better, but it pays to know where you're going, and how long it may take!

FOREWORD

FOREWORD

In my previous book, *My Grandfathers' Clock*, I examined the changes my twenty-seven male ancestors and I had seen in our lifetimes. Of course, it is easy to chart the trajectory of humankind while looking backwards— hindsight is always 20/20. Throughout my career at the cutting edge of technology I have been witness to some miraculous glimpses of the future, yet for any mason laying the foundation of a great building, it is often difficult to fully imagine the heights to which the structure will rise. So too it is hard to tell from today's foundation where the pinnacles will reach in a few short years.

In my research for the previous book I was struck by the realization that none of my ancestors could have foreseen the amazing advances each son would see in his lifetime. In particular, I was struck by how such a task is becoming more difficult for each generation, because of the increasing pace of modern society and of technology.

Although I have had a challenging career in a variety of complex technical and social areas, my most challenging job is to be the best father I can be to my stepdaughter— that amazing young lady who has brightened my life each day since her mother and I met. The greatest challenge that a man can face is to prepare his children to face a world that will be more complicated and more challenging than the one that he inherited.

For the longest time I have altruistically thought of my work as being for “our” children. Now this one, sparkling chance at posterity has focused and intensified my visions of the future.

Therefore, on top of all of my other occupations, I have become a futurist out of necessity. I spend my days trying to recognize the course ahead, and to sketch what wonders and risks are there. I try not to dwell too much on what *might* be, for

there are infinite possibilities. To be a good mapmaker, I must make every effort to map what *will* be there. This book is my best present map. Like the ancient cartographers, there are regions at which I can only guess. Unlike the ancients, however, in modern society we have enough hindsight and history to be assured that there are *never* dragons at the edge of the known world, and that generally, wonderful things lie out beyond the edges.

Soon I must hand the tiller over to Crystal, so that she can steer her own course. Her watch at the helm is coming. I hope that the map that I have laid out for her will help her to navigate and to enjoy her journey as much as I have enjoyed mine. My stepdaughter's watch is coming, as she and her generation sail to new lands beyond the edges of the map. Welcome aboard, as dawn rises on the changing of the watch.