Praise for *The Biology of Belief*

"Bruce Lipton's book is the definitive summary of the new biology and all it implies. It is magnificent, profound beyond words, and a delight to read. It synthesizes an encyclopedia of critical new information into a brilliant yet simple package. These pages contain a genuine revolution in thought and understanding, one so radical that it can change the world."

— Joseph Chilton Pearce, Ph.D.,
author of *Magical Child* and *Evolution's End*

"Bruce Lipton's delightfully written *The Biology of Belief* is a much needed antidote to the 'bottom-up' materialism of today's society. The idea that DNA encodes all of life's development is being successfully employed in genetic engineering. At the same time, the shortfall of this approach is becoming evident. *The Biology of Belief* is a review of a quarter-century of pioneering results in Epigenetics, heralded by *The Wall Street Science Journal* in mid-2004 as an important new field. Its personal style makes it eminently readable and enjoyable."

— Karl H. Pribram, M.D., Ph.D.,
(Hon. Multi), professor emeritus, Stanford University

"Dr. Lipton is a genius. His breakthrough discoveries give us tools for regaining the sovereignty over our lives. I recommend this book to anyone who is ready and willing to take full responsibility for themselves and the destiny of our planet."

— LeVar Burton, actor and director

"Bruce Lipton offers new insights and understanding into the interface between biological organisms, the environment—and the influence of thought, perception, and subconscious awareness—on the expression of one's body healing potential. Well-referenced explanations and examples make this book a refreshing 'must read' for the student of the biological, social, and health care sciences.

Yet the clarity of the author's presentation makes it an enjoyable read for a general audience."

— Carl Cleveland III, D.C.,
President, Cleveland Chiropractic College

"Dr. Lipton's revolutionary research has uncovered the missing connections between biology, psychology, and spirituality. If you want to understand the deepest mysteries of life, this is one of the most important books you will ever read."

—Dennis Perman, D.C., co-founder, The Master's Circle

"In this paradigm-busting book, Bruce Lipton delivers a TKO to Old Biology. With a left to Darwinian dogma and a right to allopathic medicine, he breaks out of the physicalist box into enlightenment on the mind/body (belief/biology) system. Must read, much fun."

— Ralph Abraham, Ph.D., professor of mathematics,
University of California; author of *Chaos, Gaia, Eros*

"Powerful! Elegant! Simple! In a style that is as accessible as it is meaningful, Dr. Bruce Lipton offers nothing less than the long sought-after 'missing link' between life and consciousness. In doing so, he answers the oldest questions and solves the deepest mysteries of our past. I have no doubt that *The Biology of Belief* will become a cornerstone for the science of the new millennium."

— Gregg Braden,
best-selling author of *The God Code* and *The Divine Matrix*

"I finished reading this book with the same sense of profound respect I have when I am with Bruce Lipton—that I have been touched by a revolutionary sense of the truth. He is both a scientist and a philosopher; a scientist in that he provides us with tools to alter cultural consciousness and a philosopher because he challenges our beliefs about the very nature of our perceived reality. He is helping us create our own futures."

— Guy F. Riekeman, D.C.,
President, Life University and College of Chiropractic

"*The Biology of Belief* is a milestone for evolving humanity. Dr. Bruce Lipton has provided, through his amazing research and in this inspiring book, a new, more awakened science of human growth and transformation. Instead of being limited by the genetic or biological constraints that humanity has been programmed to live by, humanity now has before it a way of unleashing its true spiritual potential with the help of simply transformed beliefs guided by 'the gentle and loving hand of God.' A definite must read for those dedicated to the mind/body movement and to the true essence of healing."

— Dr. John F. Demartini, best-selling author of *Count Your Blessings* and *The Breakthrough Experience*

"In a world of chaos, Dr. Lipton brings clarity to mankind. His work is thought-provoking, insightful, and will hopefully lead people to ask better quality questions in their lives and to make better decisions. One of the most exciting books I have read, this is a must read."

— Brian Kelly, D.C., President, New Zealand College of Chiropractic; President, Australian Spinal Research Foundation

"Finally, a compelling and easy-to-understand explanation of how your emotions regulate your genetic expression! You need to read this book to truly appreciate that you are not a victim of your genes but instead have unlimited capacity to live a life overflowing with peace, happiness, and love."

— Joseph Mercola, D.O., Founder of **www.mercola.com**, world's most visited natural-health site

"This book is an absolute must read if you want to know, from a scientific view point, that your lifestyle is in control of your health rather than your genetics. From a scientific viewpoint, Lipton demonstrates that the mind is more powerful than drugs to regain our health. The information reveals that your health is more your responsibility than just being a victim of your genes. When I started reading this book, I could not stop until it was finished."

— M. T. Morter, Jr., D.C.,
founder, Morter Health System;
developer of the B.E.S.T. Technique

"This is a courageous and visionary book that provides solid evidence from quantum biology to dispel the myth of genetic determinism—and implicitly, victimhood. Dr. Bruce Lipton brings a solid scientific mind to not only inform but to transform and empower the reader with the realization that our beliefs create every aspect of our personal reality. A provocative and inspiring read!"

— Lee Pulos, Ph.D., A.B.P.P.,
professor emeritus, University of British Columbia;
author of *Miracles and Other Realities* and *Beyond Hypnosis*

"History will record *The Biology of Belief* as one of the most important writings of our time. Bruce Lipton has delivered the missing link between the understandings of biomedicine of the past and the essentials of energetic healing of the future. His complex insights are expressed in a readily understandable fashion with a style that welcomes the scientist and the nonscientist on an equal footing. For anyone interested in health, the well-being of the species, and the future of human life, *The Biology of Belief* is a must read. The implications of the perspectives outlined have the potential to change the world as we know it. Bruce Lipton's understandings—and his concise expression of them—are sheer genius."

— Gerard W. Clum, D.C.,
President, Life Chiropractic College West

THE BIOLOGY OF BELIEF

Unleashing the Power of Consciousness, Matter & Miracles

Bruce H. Lipton, Ph.D.

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This book is dedicated to . . .

The Mother of Us All
May She forgive us our trespasses.

To my own mother, Gladys,
who has continually encouraged and supported me
while being patient for the twenty years
it took to get this book out.

To my daughters, Tanya and Jennifer,
beautiful women of the world who have always been there
for me . . . no matter how weird things had become.

And especially to my darling, Margaret Horton,
my best friend, my life partner, my love.
May we continue on our joyous quest
to live happily ever after!

Contents

Prologue

"If you could be *anybody*, who would you be?" I used to spend an inordinate amount of time pondering that question. I was obsessed with the fantasy of changing my identity because I wanted to be anybody *but* me. I had a good career as a cell biologist and medical school professor, but that didn't make up for the fact that my personal life was, at best, a shambles. The harder I tried to find happiness and satisfaction in my personal life, the more dissatisfied and unhappy I became. In my reflective moments, I resolved to surrender to my unhappy life. I decided that fate had dealt me a bad hand, and I should simply accept it. Que sera, sera.

In the fall of 1985, my depressed, fatalistic attitude changed in one transformational moment. I had resigned my tenured position at the University of Wisconsin's School of Medicine and was teaching at an offshore medical college in the Caribbean. Because the school was so far from the academic mainstream, I had the opportunity to think outside the rigid parameters of *belief* that prevail in conventional academia. Far from the ivory towers, isolated on an emerald island in the deep azure Caribbean Sea, I experienced a scientific epiphany that shattered my *beliefs* about the nature of life.

My life-changing moment occurred while I was reviewing my research on the mechanisms by which cells control their physiology and behavior. Suddenly I realized that a cell's life is controlled by the physical and energetic environment and *not* by its genes. Genes are simply molecular blueprints used in the construction of cells, tissues, and organs. The environment serves as a "contractor" who reads and engages those genetic blueprints and is ultimately responsible for the character of a cell's life. It is a single cell's "awareness" of the environment, not its genes, that sets into motion the mechanisms of life.

As a cell biologist I knew that my insights had powerful ramifications for my life and the lives of all human beings. I was acutely

aware that each of us is made up of approximately fifty trillion single cells. I had devoted my professional life to better understanding single cells because I knew then and know now that the better we understand single cells the better we can understand the community of cells that comprises each human body and that if single cells are controlled by their awareness of the environment so too are we trillion-celled human beings. Just like a single cell, the character of our lives is determined not by our genes but by our responses to the environmental signals that propel life.

On the one hand, my new understanding of the nature of life was a jolt. For close to two decades I had been programming biology's central dogma—the *belief* that life is controlled by genes—into the minds of medical students. On the other hand, my new understanding was not a complete surprise. I had always had niggling doubts about genetic determinism. Some of those doubts stemmed from my eighteen years of government-funded research on cloning stem cells. Though it took a sojourn outside of traditional academia for me to fully realize it, my research offered incontrovertible proof that biology's most cherished tenets regarding genetic determinism are fundamentally flawed.

My new understanding of the nature of life not only corroborated my stem cell research but also, I realized, contradicted another *belief* of mainstream science that I had been propounding to my students—the *belief* that allopathic medicine is the only kind of medicine that merits consideration in medical school. By finally giving the energy-based environment its due, it provided for a grand convergence uniting the science and practice of allopathic medicine, complementary medicine, and the spiritual wisdom of ancient and modern faiths.

On a personal level, I knew at the moment of insight that I had gotten myself stuck simply by *believing* that I was fated to have a spectacularly unsuccessful personal life. There is no doubt that human beings have a great capacity for sticking to false *beliefs* with great passion and tenacity, and hyper-rational scientists are not immune. Our well-developed nervous system, headed by our big brain, is testament that our awareness is far more complicated than that of a single cell. When our uniquely human minds get

involved, we can choose to perceive the environment in different ways, unlike a single cell whose awareness is more reflexive.

I was exhilarated by the new realization that I could change the character of my life by changing my *beliefs*. I was instantly energized because I realized that there was a science-based path that would take me from my job as a perennial "victim" to my new position as "co-creator" of my destiny.

It has been more than twenty years since that magical night in the Caribbean. Throughout the intervening years, biological research has continued to corroborate the knowledge I gained on that early morning. Today, two newly evolved fields of science representing the most important areas of biomedical research substantiate the conclusions offered in *The Biology of Belief*.

First, the science of *Signal Transduction* focuses upon the biochemical pathways by which cells respond to environmental cues. Environmental signals engage cytoplasmic processes that can alter gene expression and thereby control cell fate, influence cell movement, control cell survival, or even sentence a cell to death. Signal transduction science recognizes that the fate and behavior of an organism is directly linked to its perception of the environment. In simple terms, the character of our life is based upon how we perceive it.

Second, the new science of *Epigenetics*, which literally means "control above the genes," has completely upended our conventional understanding of genetic control. Epigenetics is the science of how environmental signals select, modify, and regulate gene activity. This new awareness reveals that our genes are constantly being remodeled in response to life experiences. Which again emphasizes that our perceptions of life shape our biology.

Months after this book was first published, an article in one of the most prestigious journals, *Nature*, revealed exciting new epigenetic insights on how the environment controls gene activity in stem cells, which coincidently is the same subject and conclusion I offer in Chapter 2. I must admit that I was amused by the fact that my chapter is entitled "It's the Environment, Stupid" while the more recent *Nature* article was titled "It's the Ecology, Stupid." (2005 *Nature* 435:268) Essentially, we are on the same page!

Some scientists in reviewing this book asked, "So what's new about this work?" Leading-edge scientists are familiar with the concepts proposed herein, and that's a good thing. The problem is related to the fact that over 99 percent of the rest of the population, the "lay audience," is still operating from antiquated and disempowering beliefs about being victims of their genes.

While research scientists might be familiar with this new and truly radical shift in awareness, these insights have yet to trickle down to the general public. The media worsens the situation by misleading the public with a never-ending onslaught of stories presumably identifying a gene that controls this cancer or that malady. Consequently, the intention behind this book is to translate the significance of this leading-edge science so that it is accessible to the lay audience. It is my sincerest hope that you will recognize that many of the *beliefs* propelling your life are false and self-limiting and you will be inspired to change those *beliefs*. Understanding on a scientific level how cells respond to your thoughts and perceptions illuminates the path to personal empowerment. The insights we gain through this new biology unleash the power of consciousness, matter, and miracles.

The Biology of Belief is not a self-help book; it is a *self-empowerment* book. The information offers knowledge of *self* and from that knowledge comes the power to control your life.

This information is powerful. I know it is. The life I have created using this awareness is so much richer and satisfying that I no longer ask myself: "If I could be *anybody*, who would I be?" For now, the answer is a no-brainer. I want to be *me!*

Introduction

The Magic of Cells

I was seven years old when I stepped up onto a small box in Mrs. Novak's second grade classroom, high enough to plop my eye right onto the lens and eyepiece of a microscope. Alas, I was too close to see anything but a blob of light. Finally I calmed down enough to listen to instructions to back off from the eyepiece. And then it happened, an event so dramatic that it would set the course for the rest of my life. A paramecium swam into the field. I was mesmerized. The raucous din of the other kids faded, as did the back-to-school smells of freshly sharpened pencils, new waxy crayons, and plastic Roy Rogers pencil cases. My whole being was transfixed by the alien world of this cell that, for me, was more exciting than today's computer-animated special-effects movies.

In the innocence of my child mind, I saw this organism not as a cell but as a microscopic person, a thinking, sentient being. Rather than aimlessly moving around, this microscopic, single-celled organism appeared to me to be on a mission, though what kind of mission I didn't know. I quietly watched over the paramecium's "shoulder" as it busily comported itself in and around the algal mat. While I was focusing on the paramecium, a large pseudopod of a gangly amoeba began to ooze into the field.

Just then my visit to this Lilliputian world ended abruptly when Glenn, the class bully, yanked me off the step and demanded his turn at the microscope. I tried to get Mrs. Novak's attention, hoping that Glenn's personal foul would get me another minute at the microscope free-throw line. But it was just minutes before lunch time and the other kids in line were clamoring for their turn. Immediately after school, I ran home and excitedly relayed my microscopic adventure to my mother. Using my best second-grade powers of persuasion, I asked, then begged, then cajoled my

mother into getting me a microscope, where I would spend hours mesmerized by this alien world that I could access via the miracle of optics.

Later, in graduate school, I advanced to an electron microscope. The advantage of an electron microscope over a conventional light microscope is that it is a thousand times more powerful. The difference between the two microscopes is analogous to the difference between the 25¢ observation telescopes used by tourists to observe scenic vistas and the orbiting Hubble telescope that transmits images of deep space. Entering the electron microscopy suite of a laboratory is a rite of passage for aspiring biologists. You enter through a black revolving door, similar to the ones separating photographic darkrooms from illuminated work areas.

I remember the first time I stepped into the revolving door and began to turn it. I was in darkness between two worlds, my life as a student and my future life as a research scientist. When the door completed its rotation, I was deposited into a large, dark chamber, dimly lit by several red photographic safelights. As my eyes adapted to the available light, I gradually became awed by what stood before me. The red lights were reflecting eerily off the mirrored surface of a massive, foot-thick chromium steel column of electromagnetic lenses that rose to the ceiling in the center of the room. Spreading out on either side at the base of the column was a large control console. The console resembled the instrument panels of a Boeing 747, filled with switches, illuminated gauges, and multicolored indicator lamps. Large tentacle-like arrays of thick power cords, water hoses, and vacuum lines radiated from the base of the microscope like tap roots at the base of an old oak tree. The sound of clanking vacuum pumps and the whir of refrigerated water recirculators filled the air. For all I knew, I had just emerged on to the command deck of the *U.S.S. Enterprise*. Apparently, it was Captain Kirk's day off, for sitting at the console was one of my professors, who was engaged in the elaborate procedure of introducing a tissue specimen into a high-vacuum chamber in the middle of the steel column.

While the minutes passed, I experienced a feeling reminiscent of that day in second grade when I first saw a cell. Finally, a green fluorescent image appeared on the phosphor screen. The presence

of darkly stained cells could barely be discerned in the plastic sections, which were enlarged to about thirty times their original size. Then the magnification was increased, one step at a time. First 100X, then 1000X, and then 10,000X. When we finally hit warp drive, the cells were magnified to over 100,000 times their original size. It was indeed *Star Trek,* but rather than entering outer space, we were going deep into inner space where "no man has gone before." One moment I was observing a miniature cell, and seconds later I was flying deep into its molecular architecture.

My awe at being at the edge of this scientific frontier was palpable. So was my excitement when I was made honorary co-pilot. I put my hands on the controls so that I could "fly" over this alien cellular landscape. My professor was my tour guide, pointing out notable landmarks: "Here's a mitochondrion, there's the Golgi body, over there is a nuclear pore, this is a collagen molecule, that's a ribosome."

Most of the rush I experienced came from my vision of myself as a pioneer, traversing territory that had never been seen by human eyes. While the light microscope gave me an awareness of cells as sentient creatures, it was the electron microscope that brought me face to face with the molecules that were the very foundation of life itself. I knew that buried within the *cytoarchitecture* of the cell were clues that would provide insight into the mysteries of life.

For a brief moment, the microscope's portholes became a crystal ball; in the eerie green glow of its fluorescent screen I saw my future. I knew I was going to be a cellular biologist whose research would focus on scrutinizing every nuance of the cell's ultrastructure to gain insights into the secrets of cellular life. As I had learned early on in graduate school, the *structur*e and *function* of biological organisms are intimately intertwined. By correlating the cell's microscopic anatomy with its behavior, I was sure to gain insight into the nature of Nature. Throughout graduate school, postdoctoral research, and into my career as a medical school professor, my waking hours were consumed by explorations into the cell's molecular anatomy. For locked within the cell's structure were the secrets of its functions.

My exploration of the "secrets of life" led me into a research career studying the character of cloned human cells grown in tissue

culture. Ten years after my first close encounter with an electron microscope, I was a tenured faculty member at the prestigious University of Wisconsin School of Medicine, internationally recognized for my research on cloned stem cells, and honored for my teaching skills. I had graduated to more powerful electron microscopes that allowed me to take three-dimensional CAT scan–like rides through organisms where I came face to face with the molecules that are the very foundation of life itself. Though my tools were more sophisticated, my approach hadn't changed. I had never lost my seven-year-old conviction that the lives of the cells I studied had purpose.

Unfortunately, I had no such conviction that my own life had a purpose. I didn't believe in God, though I confess that on occasion I entertained the notion of a God who ruled with an extremely honed perverse sense of humor. I was after all a traditional biologist for whom God's existence is an unnecessary question: life is the consequence of blind chance, the flip of a friendly card, or, to be more precise, the random shake of genetic dice. The motto of our profession since the time of Charles Darwin, has been: "God? We don't need no steenking God!"

It's not that Darwin denied the existence of God. He simply implied that chance, not Divine intervention, was responsible for the character of life on Earth. In his 1859 book, *The Origin of Species,* Darwin said that individual traits are passed from parents to their children. He suggested that "hereditary factors" passed from parent to child *control* the characteristics of an individual's life. That bit of insight set scientists off on a frenzied attempt to dissect life down to its molecular nuts and bolts, for within the structure of the cell was to be found the heredity mechanism that controlled life.

The search came to a remarkable end fifty years ago when James Watson and Francis Crick described the structure and function of the DNA double helix, the material of which genes are made. Scientists finally figured out the nature of the "hereditary factors" that Darwin had written about in the 19th century. The tabloids heralded the brave new world of genetic engineering with its promise of designer babies and magic bullet medical treatments. I vividly remember the large block print headlines that filled the front page on that memorable day in 1953: "Secret of Life Discovered."

Like the tabloids, biologists jumped on the gene bandwagon. The mechanism by which DNA controls biological life became the Central Dogma of molecular biology, painstakingly spelled out in textbooks. In the long-running debate over nature vs. nurture, the pendulum swung decidedly to nature. At first DNA was thought to be responsible only for our physical characteristics, but then we started believing that our genes control our emotions and behaviors as well. So if you are born with a defective happiness gene, you can expect to have an unhappy life.

Unfortunately, I thought I was one of those people victimized by a missing or mutant happiness gene. I was reeling from a relentless barrage of debilitating emotional roundhouse punches. My father had just died after a long, pain-fraught battle with cancer. I was his principal caretaker and had spent the previous four months flying back and forth between my job in Wisconsin and his home in New York every three or four days. In between stays at his deathbed, I was trying to maintain a research program, teach, and write a major grant renewal for the National Institutes of Health.

To further compound my stress levels, I was in the midst of an emotionally draining and economically devastating divorce. My financial resources were rapidly depleted as I tried to feed and clothe my new dependents, the judicial system. Economically challenged and homeless, I found myself living pretty much out of a suitcase in a most abysmal "garden" apartment complex. Most of my neighbors were hoping to "upgrade" their living standards by seeking accommodations in trailer parks. I was particularly scared of my next-door neighbors. My apartment was broken into, and my new stereo system was stolen in my first week of residence. A week later, six-foot tall, three-foot wide Bubba knocked on my door. Holding a quart of beer in one hand and picking his teeth with a ten-penny nail held in the other, Bubba wanted to know if I had the directions for the tape deck.

The nadir was the day I threw the phone through the glass door of my office, shattering the "Bruce H. Lipton, Ph.D. Associate Professor of Anatomy, U.W. School of Medicine" sign, all the while screaming, *"Get me out of here!"* My meltdown was precipitated by a phone call from a banker, who politely but firmly told me he

couldn't approve my mortgage application. It was like the scene from *Terms of Endearment* when Debra Winger aptly responds to her husband's hopes for tenure: "We don't have enough money to pay the bills now. All tenure means is we won't have enough money forever!"

The Magic of Cells—Déjà Vu

Luckily, I found an escape in the form of a short-term sabbatical at a medical school in the Caribbean. I knew all my problems would not disappear there, but as the jet broke through the gray cloud cover above Chicago, it felt that way. I bit the inside of my cheek to prevent the smile on my face from evolving into audible laughter. I felt as joyful as my seven-year-old self, first discovering my life's passion, the magic of cells.

My mood lifted even more on the six-passenger commuter plane that took me to Montserrat, a mere four-by-twelve-mile dot in the Caribbean Sea. If there ever was a Garden of Eden, it probably would have resembled my new island home, erupting out of the sparkling aquamarine sea like a giant multifaceted emerald. When we landed, the gardenia-laced balmy breezes that swept the airport's tarmac were intoxicating.

The native custom was to dedicate the sunset period as a time of quiet contemplation, a custom I readily adopted. As each day wound down, I looked forward to the heavenly light show. My house, situated on a cliff fifty feet above the ocean, faced due west. A winding path through a tree-covered fern grotto led me down to the water. At the bottom of the grotto, an opening through a wall of jasmine bushes revealed a secluded beach, where I enhanced the sunset ritual by washing away the day with a few "laps" in the warm, gin-clear water. After my swim, I would mold the beach sand into a comfortable recliner, sit back, and watch the sun set slowly into the sea.

On that remote island, I was out of the rat race and free to see the world without the blinders of civilization's dogmatic beliefs. At first my mind was constantly reviewing and critiquing the debacle

that was my life. But soon my mental Siskel and Ebert ceased their thumbs up/thumbs down review of my forty years. I began to re-experience what it was like to live in the moment and for the moment. To became reacquainted with sensations last experienced as a carefree child. To again *feel* the pleasure of being alive.

I became more human and more humane while living in that island paradise. I also became a better cell biologist. Almost all of my formal scientific training was in sterile, lifeless classrooms, lecture halls, and laboratories. However, once I was immersed in the Caribbean's rich ecosystem, I began to appreciate biology as a living, breathing, integrated system rather than a collection of individual species sharing a piece of the earth's turf.

Sitting quietly within garden-like island jungles and snorkeling among the jeweled coral reefs gave me a window into the island's amazing integration of plant and animal species. All live in a delicate, dynamic balance, not only with other life forms but with the physical environment as well. It was life's harmony—not life's struggle—that sang out to me as I sat in the Caribbean Garden of Eden. I became convinced that contemporary biology pays too little attention to the important role of cooperation because its Darwinian roots emphasize life's competitive nature.

To the chagrin of my U.S. faculty colleagues, I returned to Wisconsin a screaming radical bent on challenging the sacred foundational beliefs of biology. I even began to openly criticize Charles Darwin and the wisdom of his theory of evolution. In the eyes of most other biologists, my behavior was tantamount to a priest bursting into the Vatican and claiming the Pope was a fraud.

My colleagues could be forgiven for thinking a coconut had hit me on the head when I quit my tenured position and, fulfilling my life's dream to be in a rock 'n' roll band, took off on a music tour. I discovered Yanni, who eventually became a big celebrity, and produced a laser show with him. But it soon became clear that I had a lot more aptitude for teaching and research than I did for producing rock 'n' roll shows. I wound down my midlife crisis, which I'll describe in more agonizing detail in a later chapter, by giving up the music business and returning to the Caribbean to teach cell biology again.

My final stop in conventional academia was at Stanford University's School of Medicine. By that time I was an unabashed proponent of a "new" biology. I had come to question not only Darwin's dog-eat-dog version of evolution but also biology's Central Dogma, the premise that genes control life. That scientific premise has one major flaw—genes cannot turn themselves on or off. In more scientific terms, genes are not "self-emergent." Something in the environment has to trigger gene activity. Though that fact had already been established by frontier science, conventional scientists blinded by genetic dogma had simply ignored it. My outspoken challenge of the Central Dogma turned me into even more of a scientific heretic. Not only was I a candidate for excommunication, I was now suitable for burning at the stake!

In a lecture during my interview at Stanford, I found myself accusing the gathered faculty, many of them internationally recognized geneticists, of being no better than religious fundamentalists for adhering to the Central Dogma despite evidence to the contrary. After my sacrilegious comments, the lecture room erupted into shouts of outrage that I thought meant the end of my job application. Instead, my insights concerning the mechanics of a new biology proved to be provocative enough to get me hired. With the support of some eminent scientists at Stanford, especially from the Pathology Department's chairman, Dr. Klaus Bensch, I was encouraged to pursue my ideas and apply them to research on cloned human cells. To the surprise of those around me, the experiments fully supported the alternative view of biology that I was postulating. I published two papers based on this research and left academia, this time for good. (Lipton, et al, 1991, 1992)

I left because, despite the support I got at Stanford, I felt that my message was falling on deaf ears. Since my departure, new research has consistently validated my skepticism about the Central Dogma and the primacy of DNA in controlling life. In fact, *epigenetics*, the study of the molecular mechanisms by which environment controls gene activity, is today one of the most active areas of scientific research. The newly emphasized role of the environment in regulating gene activity was the focus of my cell research twenty-five years ago, long before the field of epigenetics was even established.

(Lipton 1977a, 1977b) While that is gratifying for me intellectually, I know that if I were teaching and researching in a medical school, my colleagues would still be wondering about those coconuts because in the last decade I have become even more of a radical by academia's standards. My preoccupation with a new biology has become more than an intellectual exercise. I believe that cells teach us not only about the mechanisms of life, but also teach us how to live rich, full lives.

In ivory tower science, that kind of thinking would no doubt win me the wacky Dr. Dolittle award for anthropomorphism or more precisely cytopomorphism—thinking like a cell, but for me it is Biology 101. You may consider yourself an individual, but as a cell biologist, I can tell you that you are in truth a cooperative community of approximately fifty trillion single-celled citizens. Almost all of the cells that make up your body are amoeba-like, individual organisms that have evolved a cooperative strategy for their mutual survival. Reduced to basic terms, human beings are simply the consequence of "collective amoebic consciousness." As a nation reflects the traits of its citizens, our human-ness must reflect the basic nature of our cellular communities.

Living the Lessons of Cells

Using these cell communities as role models, I came to the conclusion that we are not victims of our genes, but masters of our fates, able to create lives overflowing with peace, happiness, and love. I tested my hypothesis in my own life after a nudge from my audiences, who asked me why my insights hadn't made me any happier. They were right: I needed to integrate my new biological awareness into my daily life. I knew I had succeeded when, on a bright Sunday morning in the Big Easy, a coffee-shop waitress asked me: "Honey, you are the happiest person I ever did see. Tell me child, why are you so happy?" I was taken aback by her question, but nevertheless I blurted out, "I'm in Heaven!" The waitress shook her head from side to side mumbling, "My, my," and then proceeded to take my breakfast order. Well, it was true. I was happy, happier than I had ever been in my life.

A number of you critical readers may rightly be skeptical of my claim that Earth is Heaven. For by definition, Heaven is also the abode of the Deity and the blessed dead. Did I really think that New Orleans, or any other major city, could be part of Heaven? Ragged homeless women and children living in alleys; air so thick that one would never know if stars really existed; rivers and lakes so polluted that only unimaginable "scary" life forms could exist in them. This Earth is Heaven? The Deity lives here? He *knows* the Deity?

The answers to those questions are: yes, yes, and I believe I do. Well, to be completely honest, I must admit that I don't know all of the Deity personally, for I don't know all of you. For God's sake there are over six billion of YOU. And to be more fully honest, I don't really know all of the members of the plant and animal kingdom either, though I believe they also comprise God.

In the immortal words of Tool Time's Tim Taylor: "Baaaaack the truck up! Is he saying that *humans* are God?"

Well . . . yes I am. Of course I am not the first to have said that. It is written in Genesis that we are made in the image of God. Yes, this card-carrying rationalist is now quoting Jesus, Buddha, and Rumi. I have come full circle from a reductionist, scientific take on life to a spiritual one. We are made in the image of God, and we need to put Spirit back into the equation when we want to improve our physical and our mental health.

Because we are not powerless biochemical machines, popping a pill every time we are mentally or physically out of tune is not the answer. Drugs and surgery are powerful tools when they are not overused, but the notion of simple drug fixes is fundamentally flawed. Every time a drug is introduced into the body to correct function A, it inevitably throws off function B, C, or D. It is not gene-directed hormones and neurotransmitters that control our bodies and our minds; our beliefs control our bodies, our minds, and thus our lives . . . Oh ye of little belief!

The Light Outside of the Box

In this book I will draw the proverbial line in the sand. On one side of the line is a world defined by neo-Darwinism, which casts life as an unending war among battling, biochemical robots. On the other side of the line is the "New Biology," which casts life as a cooperative journey among powerful individuals who can program themselves to create joy-filled lives. When we cross that line and truly understand the New Biology, we will no longer fractiously debate the role of nurture and nature because we will realize that the fully conscious mind trumps both nature and nurture. And I believe we will also experience as profound a paradigmatic change to humanity as when a round-world reality was introduced to a flat-world civilization.

Humanities' majors, who may be worried that this book offers an incomprehensible science lecture, have no fear. When I was an academic, I chafed at the three-piece, itchy suit, the constricting tie, the wing-tip shoes, and the interminable meetings, but I loved to teach. And in my post-academia life, I've gotten plenty of teaching practice; I have presented the principles of the New Biology to thousands of people all around the world. Through those lectures, I have honed my presentation of the science into easy-to-understand English illustrated by colorful charts, many of which are replicated in this book.

In Chapter 1, I discuss "smart" cells and why and how they can teach us so much about our own minds and bodies. In Chapter 2, I lay out the scientific evidence to show you that genes do not control biology. I also introduce you to the exciting discoveries of epigenetics, a new field of biology that is unraveling the mysteries of how the environment (nature) influences the behavior of cells without changing the genetic code. It is a field that is uncovering new complexities in the nature of disease, including cancer and schizophrenia.

Chapter 3 is about the cell's membrane, the "skin" of the cell. You no doubt have heard more about the DNA-containing nucleus of the cell than you have about its membrane. But frontier science is revealing in ever greater detail what I concluded over twenty years ago, that the membrane is the true brain of the cellular operation. In Chapter 4, I talk about the mind-bending discoveries of quantum physics. Those discoveries have profound implications for understanding and treating disease. However, the conventional medical establishment has not yet incorporated quantum physics into its research or medical school training, with tragic results.

In Chapter 5, I explain why I named this book *The Biology of Belief*. Positive thoughts have a profound effect on behavior and genes but *only* when they are in harmony with subconscious programming. And negative thoughts have an equally powerful effect. When we recognize how these positive and negative beliefs control our biology, we can use this knowledge to create lives filled with health and happiness. Chapter 6 reveals why cells and people need to grow and how fear shuts down that growth.

Chapter 7 focuses upon conscious parenting. As parents we need to understand the role we play in programming our children's beliefs and the impact those beliefs have on our children's lives. This chapter is important whether you are a parent or not for, as a "former" child, the insight into our programming and its impact upon our lives is quite revealing. In the Epilogue, I review how my understanding of the New Biology led me to realize the importance of integrating the realms of Spirit and Science, which was a radical shift from my background as an agnostic scientist.

Are you ready to use your conscious mind to create a life overflowing with health, happiness, and love without the aid of genetic engineers and without addicting yourself to drugs? Are you ready to consider an alternate reality to that provided by the medical model of the human body as a biochemical machine? There is nothing to buy, and there are no policies to take out. It is just a matter of temporarily suspending the archaic beliefs you have acquired from the scientific and media establishments so that you can consider the exciting new awareness offered by leading-edge science.

Chapter 1

LESSONS FROM THE PETRI DISH:
In Praise of Smart Cells and Smart Students

On my second day in the Caribbean, as I stood in front of more than a hundred visibly on-edge medical students, I suddenly realized that not everyone viewed the island as a laid-back refuge. For these nervous students, Montserrat was not a peaceful escape but a last-ditch chance to realize their dreams of becoming doctors.

My class was geographically homogeneous, mostly American students from the East Coast, but there were all races and ages, including a sixty-seven-year-old retiree who was anxious to do more with his life. Their backgrounds were equally varied—former elementary school teachers, accountants, musicians, a nun, and even a drug smuggler.

Despite all the differences, the students shared two characteristics: One, they had failed to succeed in the highly competitive selection process that filled the limited number of positions in American medical schools. Two, they were "strivers" intent on becoming doctors—they were not about to be denied the opportunity to prove their qualifications. Most had spent their life savings or indentured themselves to cover the tuition and extra costs of living out of the country. Many found themselves completely alone for the first time in their lives, having left their families, friends, and loved ones behind. They put up with the most intolerable living conditions on that campus. Yet with all the drawbacks and

the odds stacked against them, they were never deterred from their quest for a medical degree.

Well, at least that was true up to the time of our first class together. Prior to my arrival, the students had had three different histology/cell biology professors. The first lecturer left the students in the lurch when he responded to some personal issue by bolting from the island three weeks into the semester. In short order, the school found a suitable replacement who tried to pick up the pieces; unfortunately he bailed three weeks later because he got sick. For the preceding two weeks, a faculty member, responsible for another field of study, had been reading chapters out of a textbook to the class. This obviously bored the students to death, but the school was fulfilling a directive to provide a specified number of lecture hours for the course. Academic prerequisites set by American medical examiners have to be met in order for the school's graduates to practice in the States.

For the fourth time that semester, the weary students listened to a new professor. I briefed them on my background and my expectations for the course. I made it clear that even though we were in a foreign country, I was not going to expect any less from them than what was expected from my Wisconsin students. Nor should they want me to because to be certified all doctors have to pass the same Medical Boards, no matter where they go to medical school. Then I pulled a sheaf of exams out of my briefcase and told the students that I was giving them a self-assessment quiz. The middle of the semester had just passed, and I expected them to be familiar with half of the required course material. The test I handed out on that first day of the course consisted of twenty questions taken directly from the University of Wisconsin histology midterm exam.

The classroom was deadly silent for the first ten minutes of the testing period. Then nervous fidgeting felled the students one by one, faster than the spread of the deadly Ebola virus. By the time the twenty minutes allotted for the quiz were over, wide-eyed panic had gripped the class. When I said, "Stop," the pent-up nervous anxiety erupted into the din of a hundred excited conversations. I quieted the class down and began to read them the answers.

The first five or six answers were met with subdued sighs. After I reached the tenth question, each subsequent answer was followed by agonizing groans. The highest score in the class was ten correct answers, followed by several students who answered seven correctly; with guesswork, most of the rest scored at least one or two correct answers.

When I looked up at the class, I was greeted with frozen, shell-shocked faces. The "strivers" found themselves behind the big eight ball. With more than half a semester behind them, they had to start the course all over again. A dark gloom overcame the students, most of whom were already treading water in their other, very demanding medical school courses. Within moments, their gloom had turned into quiet despair. In profound silence, I looked out over the students and they looked back at me. I experienced an internal ache—the class collectively resembled one of those Greenpeace pictures of wide-eyed baby seals just before heartless fur traders club them to death.

My heart welled. Perhaps the salt air and sweet scents had already made me more magnanimous. In any case, unexpectedly, I found myself announcing that I would make it my personal commitment to see that every student was fully prepared for the final exam, if they would commit to providing matching efforts. When they realized I was truly committed to their success, I could see the lights flash on in their previously panicked eyes.

Feeling like an embattled coach revving up the team for the Big Game, I told them I thought they were every bit as intelligent as the students I taught in the States. I told them I believed their State-side peers were simply more proficient at rote memorization, the quality that enabled them to score better in the medical college admissions tests. I also tried very hard to convince them that histology and cell biology are not intellectually difficult courses. I explained that in all of its elegance, nature employs very simple operating principles. Rather than just memorizing facts and figures, I promised they were going to gain an understanding of cells because I would present simple principles on top of simple principles. I offered to provide additional night lectures, which would tax their stamina

after their already long lecture- and lab-packed days. The students were pumped up after my ten-minute pep talk. When the period ended, they bolted from that classroom snorting fire, determined they would not be beaten by the system.

After the students left, the enormity of the commitment I had made sank in. I started having doubts. I knew that a significant number of the students were truly unqualified to be attending medical school. Many others were capable students whose backgrounds had not prepared them for the challenge. I was afraid that my island idyll would degenerate into a frenetic, time-consuming academic scrimmage that would end in failure for my students and for me as their teacher. I started thinking about my job at Wisconsin, and suddenly it was beginning to look easy. At Wisconsin, I gave only eight lectures out of the approximately fifty that made up the histology/cell biology course. There were five members of the anatomy department who shared the lecturing load. Of course I was responsible for the material in all of the lectures because I was involved in their accompanying laboratory sessions. I was supposed to be available to answer all course-related questions asked by the students. But knowing the material and presenting lectures on the material are not the same thing!

I had a three-day weekend to wrestle with the situation I had created for myself. Had I faced a crisis such as this back home, my type A personality would have had me swinging from the proverbial chandeliers. Interestingly, as I sat by the pool, watching the sun set into the Caribbean, the potential angst simply morphed into an exciting adventure. I began to get excited about the fact that for the first time in my teaching career, I was solely responsible for this major course and free from having to conform to the style and content restrictions of team-taught programs.

Cells as Miniature Humans

As it turned out, that histology course was the most exhilarating and intellectually profound period of my academic career. Free to teach the course the way I wanted to teach it, I ventured into a

new way of covering the material, an approach that had been roiling in my brain for several years. I had been fascinated by the idea that considering cells as "miniature humans" would make it easier to understand their physiology and behavior. As I contemplated a new structure for the course, I got excited. The idea of overlapping cell and human biology rekindled the inspiration for science I had felt as a child. I still experienced that enthusiasm in my research laboratory, though not when I was mired in the administrative details of being a tenured faculty member, including endless meetings and what, for me, were tortuous faculty parties.

I was prone to thinking of cells as human-like because, after years behind a microscope, I had become humbled by the complexity and power of what at first appear to be anatomically simple, moving blobs in a Petri dish. In school you may have learned the basic components of a cell: the nucleus that contains genetic material, the energy-producing mitochondria, the protective membrane at the outside rim, and the cytoplasm in between. But within these anatomically simple-looking cells is a complex world; these smart cells employ technologies that scientists have yet to fully fathom.

The notion of cells as miniature humans that I was mulling over would be considered heresy by most biologists. Trying to explain the nature of anything not human by relating it to human behavior is called anthropomorphism. "True" scientists consider anthropomorphism to be something of a mortal sin and ostracize scientists who knowingly employ it in their work.

However, I believed that I was breaking out of orthodoxy for a good reason. Biologists try to gain scientific understanding by observing nature and conjuring up a hypothesis of how things work. Then they design experiments to test their ideas. By necessity, deriving the hypothesis and designing the experiments require the scientist to "think" how a cell or another living organism carries out its life. Applying these "human" solutions, i.e. a human view of resolving biology's mysteries, automatically makes these scientists guilty of anthropomorphizing. No matter how you cut it, biological science is based to some degree on humanizing the subject matter.

Actually, I believe that the unwritten ban on anthropomorphism is an outmoded remnant of the Dark Ages when religious authorities denied any direct relationship existed between humans and any of God's other creations. While I can see the value of the concept when people try to anthropomorphize a light bulb, a radio, or a pocketknife, I do not see it as a valid criticism when it is applied to living organisms. Human beings are multicellular organisms—we must inherently share basic behavioral patterns with our own cells.

However, I know that it takes a shift in perception to acknowledge that parallel. Historically, our Judeo-Christian beliefs have led us to think that *we* are the intelligent creatures who were created in a separate and distinct process from all other plants and animals. This view has us looking down our noses at lesser creatures as nonintelligent life forms, especially those organisms on the lower evolutionary rungs of life.

Nothing could be further from the truth. When we observe other humans as individual entities or see ourselves in the mirror as an individual organism, in one sense, we are correct, at least from the perspective of our level of observation. However, if I brought you down to the size of an individual cell so you could see your body from that perspective, it would offer a whole new view of the world. When you looked back at yourself from that perspective you would not see yourself as a single entity. You would see yourself as a bustling community of more than fifty trillion individual cells.

As I toyed with these ideas for my histology class, the picture that kept recurring in my mind was a chart from an encyclopedia I had used as a child. Under the section on humans, there was an illustration with seven transparent plastic pages, each printed with an identical, overlapping outline of the human body. On the first page the outline was filled in with an image of a naked man. Turning the first page was like peeling off his skin and revealing his musculature, the image within the outline on the second page. When I turned the second page, the overlapping images of the remaining pages revealed a vivid dissection of the body. Flipping through the pages I could see in turn, the skeleton, the brain and nerves, blood vessels, and organ systems.

For my Caribbean course, I mentally updated those transparencies with several additional, overlapping pages, each illustrated with cellular structures. Most of the cell's structures are referred to as organelles, which are its "miniature organs" suspended within a jellylike cytoplasm. Organelles are the functional equivalents of the tissues and organs of our own bodies. They include the nucleus, which is the largest organelle, the mitochondria, the Golgi body, and vacuoles. The traditional way of teaching the course is to deal first with these cellular structures, then move on to the tissues and organs of the human body. Instead, I integrated the two parts of the course to reflect the overlapping nature of humans and cells.

I taught my students that the biochemical mechanisms employed by cellular organelle systems are essentially the same mechanisms employed by our human organ systems. Even though humans are made up of trillions of cells, I stressed that there is not one "new" function in our bodies that is not already expressed in the single cell. Each eukaryote (nucleus-containing cell) possesses the functional equivalent of our nervous system, digestive system, respiratory system, excretory system, endocrine system, muscle and skeletal systems, circulatory system, integument (skin), reproductive system, and even a primitive immune system, which utilizes a family of antibody-like "ubiquitin" proteins.

I also made it clear to my students that each cell is an intelligent being that can survive on its own, as scientists demonstrate when they remove individual cells from the body and grow them in a culture. As I knew intuitively when I was a child, these smart cells are imbued with intent and purpose; they actively seek environments that support their survival while simultaneously avoiding toxic or hostile ones. Like humans, single cells analyze thousands of stimuli from the microenvironment they inhabit. Through the analysis of this data, cells select appropriate behavioral responses to ensure their survival.

Single cells are also capable of learning through these environmental experiences and are able to create cellular memories, which they pass on to their offspring. For example, when a measles virus infects a child, an immature immune cell is called in to create a

protective protein antibody against that virus. In the process, the cell must create a new gene to serve as a blueprint in manufacturing the measles antibody protein.

The first step in generating a specific measles antibody gene occurs in the nuclei of immature immune cells. Among their genes are a very large number of DNA segments that encode uniquely shaped snippets of proteins. By randomly assembling and recombining these DNA segments, immune cells create a vast array of different genes, each one providing for a uniquely shaped antibody protein. When an immature immune cell produces an antibody protein that is a "close" physical complement to the invading measles virus, that cell will be activated.

Activated cells employ an amazing mechanism called *affinity maturation* that enables the cell to perfectly "adjust" the final shape of its antibody protein, so that it will become a perfect complement to the invading measles virus. (Li, et al, 2003; Adams, et al, 2003) Using a process called *somatic hypermutation,* activated immune cells make hundreds of copies of their original antibody gene. However, each new version of the gene is slightly mutated so that it will encode a slightly different shaped antibody protein. The cell selects the variant gene that makes the best fitting antibody. This selected version of the gene also goes through repeated rounds of somatic hypermutation to further sculpt the shape of the antibody to become a "perfect" physical complement of the measles virus. (Wu, et al, 2003; Blanden and Steele 1998; Diaz and Casali 2002; Gearhart 2002)

When the sculptured antibody locks on to the virus, it inactivates the invader and marks it for destruction, thus protecting the child from the ravages of measles. The cells retain the genetic "memory" of this antibody, so that in the future if the individual is again exposed to measles, the cells can immediately launch a protective immune response. The new antibody gene can also be passed on to all the cell's progeny when it divides. In this process, not only did the cell "learn" about the measles virus, it also created a "memory" that will be inherited and propagated by its daughter cells. This amazing feat of genetic engineering is profoundly important because it represents an inherent "intelligence" mechanism by which cells evolve. (Steele, et al, 1998)

The Origins of Life: Smart Cells Get Smarter

It shouldn't be surprising that cells are so smart. Single-celled organisms were the first life forms on this planet. Fossil evidence reveals they were here within 600 million years after the Earth was first formed. For the next 2.75 billion years of the Earth's history, only free-living, single-celled organisms—bacteria, algae, and amoeba-like protozoans—populated the world.

Around 750 million years ago, these smart cells figured out how to get smarter when the first multicellular organisms (plants and animals) appeared. Multicellular life forms were initially loose communities or "colonies" of single-celled organisms. At first, cellular communities consisted of tens and hundreds of cells. But the evolutionary advantage of living in a community soon led to organizations comprised of millions, billions, and even trillions of socially interactive single cells. Though each individual cell is of microscopic dimensions, the size of multicellular communities may range from the barely visible to the monolithic. Biologists have classified these organized communities based on their structure as observed by the human eye. While the cellular communities appear as single entities to the naked eye—a mouse, a dog, a human—they are, in fact, highly organized associations of millions and trillions of cells.

The evolutionary push for ever-bigger communities is simply a reflection of the biological imperative to survive. The more awareness an organism has of its environment, the better its chances for survival. When cells band together they increase their awareness exponentially. If each cell were to be arbitrarily assigned an awareness value of X, then each colonial organism would collectively have a potential awareness value of at least X times the number of cells in the colony.

In order to survive at such high densities, the cells created structured environments. These sophisticated communities subdivided the workload with more precision and effectiveness than the ever-changing organizational charts that are a fact of life in big corporations. It proved more efficient for the community to have individual cells assigned to specialized tasks. In the development

of animals and plants, cells begin to acquire these specialized functions in the embryo. A process of cytological specialization enables the cells to form the specific tissues and organs of the body. Over time, this pattern of *differentiation*, i.e., the distribution of the workload among the members of the community, became embedded in the genes of every cell in the community, significantly increasing the organism's efficiency and its ability to survive.

In larger organisms, for example, only a small percentage of cells are concerned with reading and responding to environmental stimuli. That is the role of groups of specialized cells that form the tissues and organs of the nervous system. The function of the nervous system is to perceive the environment and coordinate the behavior of all the other cells in the vast cellular community.

Division of labor among the cells in the community offered an additional survival advantage. The efficiency it offered enabled more cells to live on less. Consider the old adage: "Two can live as cheaply as one." Or consider the construction costs of building a two-bedroom single home versus the cost of building a two-bedroom apartment in a hundred-apartment complex. To survive, each cell is required to expend a certain amount of energy. The amount of energy conserved by individuals living in a community contributes to both an increased survival advantage and a better quality of life.

In American capitalism, Henry Ford saw the tactical advantage in the differentiated form of communal effort and employed it in creating his assembly line system of manufacturing cars. Before Ford, a small team of multiskilled workers would require a week or two to build a single automobile. Ford organized his shop so that every worker was responsible for only one specialized job. He stationed a large number of these differentiated workers along a single row, the assembly line, and passed the developing car from one specialist to the next. The efficiency of job specialization enabled Ford to produce a new automobile in ninety minutes rather than weeks.

Unfortunately, we conveniently "forgot" about the cooperation necessary for evolution when Charles Darwin emphasized a radically different theory about the emergence of life. He concluded 150 years ago that living organisms are perpetually embroiled

in a "struggle for existence." For Darwin, struggle and violence are not only a part of animal (human) nature but the principal "forces" behind evolutionary advancement. In the final chapter of *The Origin of Species: By Means of Natural Selection, Or, The Preservation Of Favoured Races In The Struggle For Life,* Darwin wrote of an inevitable "struggle for life" and that evolution was driven by "the war of nature, from famine and death." Couple that with Darwin's notion that evolution is random and you have a world, as poetically described by Tennyson, that can be characterized as "red in tooth and claw," a series of meaningless, bloody battles for survival.

Evolution Without the Bloody Claws

Though Darwin is by far the most famous evolutionist, the first scientist to establish evolution as a scientific fact was the distinguished French biologist Jean-Baptiste de Lamarck. (Lamarck 1809, 1914, 1963) Even Ernst Mayr, the leading architect of "neo-Darwinism," a modernization of Darwin's theory that incorporates twentieth-century molecular genetics, concedes that Lamarck was the pioneer. In his classic 1970 book, *Evolution and the Diversity of Life,* (Mayr 1976, page 227) Mayr wrote: "It seems to me Lamarck has a much better claim to be designated the 'founder of the theory of evolution,' as indeed he has by several French historians . . . he was the first author to devote an entire book primarily to the presentation of a theory of organic evolution. He was the first to present the entire system of animals as a product of evolution."

Not only did Lamarck present his theory fifty years before Darwin, he offered a much less harsh theory of the mechanisms of evolution. Lamarck's theory suggested that evolution was based on an "instructive," cooperative interaction among organisms and their environment that enables life forms to survive and evolve in a dynamic world. His notion was that organisms acquire and pass on adaptations necessary for their survival in a changing environment. Interestingly, Lamarck's hypothesis about the mechanisms of evolution conform to modern cell biologists' understanding of how immune systems adapt to their environment as described above.

Lamarck's theory was an early target of the Church. The notion that humans evolved from lower life forms was denounced as heresy. Lamarck was also scorned by his fellow scientists who, as creationists, ridiculed his theories. A German developmental biologist, August Weismann, helped propel Lamarck into obscurity when he tried to test Lamarck's theory that organisms pass on survival-oriented traits acquired through their interaction with the environment. In one of Weismann's experiments, he cut off the tails of male and female mice and mated them. Weismann argued that if Lamarck's theory were correct, the parents should pass on their tail-less state to future generations. The first generation of mice was born with tails. Weismann repeated the experiment for 21 more generations, but not one tail-less mouse was born, leading Weismann to conclude that Lamarck's notion of inheritance was wrong.

But Weismann's experiment was not a true test of Lamarck's theory. Lamarck suggested that such evolutionary changes could take "immense periods of time," according to biographer L. J. Jordanova. In 1984, Jordanova wrote that Lamarck's theory "rested on" a number of "propositions" including "the laws governing living things have produced increasingly complex forms over immense periods of time." (Jordanova 1984, page 71) Weismann's five-year experiment was clearly not long enough to test the theory. An even more fundamental flaw in his experiment is that Lamarck never argued that every change an organism experienced would take hold. Lamarck said organisms hang on to traits (like tails) when they need them to survive. Although Weismann didn't think the mice needed their tails, no one asked the mice if they thought their tails were necessary for survival!

Despite its obvious flaws, the study of the tail-less mice helped destroy Lamarck's reputation. In fact, Lamarck has been mostly ignored or vilified. Cornell University evolutionist C.H. Waddington wrote in *The Evolution of An Evolutionist* (Waddington 1975, page 38): "Lamarck is the only major figure in the history of biology whose name has become to all intents and purposes, a term of abuse. Most scientists' contributions are fated to be outgrown, but very few authors have written works, which, two centuries later, are still rejected with indignation so intense that the skeptic may

suspect something akin to an uneasy conscience. In point of fact, Lamarck has, I think, been somewhat unfairly judged."

Waddington wrote those prescient words thirty years ago. Today Lamarck's theories are being reevaluated under the weight of a body of new science that suggests that the oft-denounced biologist was not entirely wrong and the oft-lauded Darwin not entirely correct. The title of an article in the prestigious journal *Science* in 2000 was one sign of glasnost: "Was Lamarck Just a Little Bit Right?" (Balter 2000)

One reason some scientists are taking another look at Lamarck is that evolutionists are reminding us of the invaluable role cooperation plays in sustaining life in the biosphere. Scientists have long noted symbiotic relationships in nature. In *Darwin's Blind Spot* (Ryan 2002, page 16), British physician Frank Ryan chronicles a number of such relationships, including a yellow shrimp that gathers food while its partner gobi fish protects it from predators and a species of hermit crab that carries a pink anemone on top of its shell. "Fish and octopuses like to feed on hermit crabs, but when they approach this species, the anemone shoots out its brilliantly colored tentacles, with their microscopic batteries of poisoned darts, and stings the potential predator, encouraging it to look elsewhere for its meal." The warrior anemone gets something out of the relationship as well because it eats the crab's leftover food.

But today's understanding of cooperation in nature goes much deeper than the easily observable relationships. "Biologists are becoming increasingly aware that animals have coevolved and continue to coexist, with diverse assemblages of microorganisms that are required for normal health and development," according to a recent article in *Science* called "We Get By With A Little Help from Our (Little) Friends." (Ruby, et al, 2004) The study of these relationships is now a rapidly growing field called "Systems Biology."

Ironically, in recent decades, we have been taught to wage war against microorganisms with everything from antibacterial soap to antibiotics. But that simplistic message ignores the fact that many bacteria are essential to our health. The classic example of how humans get help from microorganisms is the bacteria in our digestive system, which are essential to our survival. The bacteria

in our stomach and intestinal tract help digest food and also enable the absorption of life-sustaining vitamins. This microbe-human cooperation is the reason that the rampant use of antibiotics is detrimental to our survival. Antibiotics are indiscriminate killers; they kill bacteria that are required for our survival as efficiently as they kill harmful bacteria.

Recent advances in genome science have revealed an additional mechanism of cooperation among species. Living organisms, it turns out, actually integrate their cellular communities by sharing their genes. It had been thought that genes are passed on only to the progeny of an individual organism through reproduction. Now scientists realize that genes are shared not only among the individual members of a species but also among members of different species. The sharing of genetic information via *gene transfer* speeds up evolution since organisms can acquire "learned" experiences from other organisms. (Nitz, et al, 2004; Pennisi 2004; Boucher, et al, 2003; Dutta and Pan 2002; Gogarten 2003) Given this sharing of genes, organisms can no longer be seen as disconnected entities; there is no wall between species. Daniel Drell, manager of the Department of Energy's microbial genome program told *Science* (2001 294:1634) "we can no longer comfortably say what is a species anymore." (Pennisi 2001)

This sharing of information is not an accident. It is nature's method of enhancing the survival of the biosphere. As discussed earlier, genes are physical memories of an organism's learned experiences. The recently recognized exchange of genes among individuals disperses those memories, thereby influencing the survival of all organisms that make up the community of life. Now that we are aware of this inter- and intra-species gene transfer mechanism, the dangers of genetic engineering become apparent. For example, tinkering with the genes of a tomato may not stop at that tomato but could alter the entire biosphere in ways that we cannot foresee. Already there is a study that shows that when humans digest genetically modified foods, the artificially created genes transfer into and alter the character of the beneficial bacteria in the intestine. (Heritage 2004; Netherwood, et al, 2004) Similarly, gene transfer

among genetically engineered agricultural crops and surrounding native species has given rise to highly resistant species deemed superweeds. (Milius 2003; Haygood, et al, 2003; Desplanque, et al, 2002; Spencer and Snow 2001) Genetic engineers have never taken the reality of gene transfer into consideration when they have introduced genetically modified organisms into the environment. We are now beginning to experience the dire consequences of this oversight as their engineered genes are spreading among and altering other organisms in the environment. (Watrud, et al, 2004)

Genetic evolutionists warn that if we fail to apply the lessons of our shared genetic destiny, which should be teaching us the importance of cooperation among all species, we threaten human existence. We need to move beyond Darwinian Theory, which stresses the importance of *individuals*, to one that stresses the importance of the *community.* British scientist Timothy Lenton provides evidence that evolution is more dependent on the interaction among species than it is on the interaction of individuals within a species. Evolution becomes a matter of the survival of the fittest *groups* rather than the survival of the fittest individuals. In a 1998 article in *Nature,* Lenton wrote that rather than focusing on individuals and their role in evolution "we must consider the totality of organisms and their material environment to fully understand which traits come to persist and dominate." (Lenton 1998)

Lenton subscribes to James Lovelock's Gaia hypothesis that holds that the Earth and all of its species constitute one interactive, living organism. Those who endorse this hypothesis argue that tampering with the balance of the superorganism called Gaia, whether it be by destroying the rainforest, depleting the ozone layer, or altering organisms through genetic engineering, can threaten its survival and consequently ours.

Recent studies funded by Britain's Natural Environment Research Council provide support for those concerns. (Thomas, et al, 2004; Stevens, et al, 2004) While there have been five mass extinctions in the history of our planet, they are all presumed to have been caused by extraterrestrial events, such as a comet smashing to earth. One of the new studies concludes that the "natural world is experiencing the

sixth, major extinction event in its history." (Lovell 2004) This time though, the cause of the extinction is not extraterrestrial. According to one of the study's authors, Jeremy Thomas, "As far as we can tell this one is caused by one animal organism—man."

Walking the Talk of Cells

In my years of teaching in medical school, I had come to realize that medical students in an academic setting are more competitive and backbiting than a truckload of lawyers. They live out the Darwinian struggle in their quest to be one of the "fittest" who stagger to graduation after four grueling years in medical school. The single-minded pursuit of stellar medical school grades, without regard for the students surrounding you, no doubt follows a Darwinian model, but it always seemed to me an ironic pursuit for those who are striving to become compassionate healers.

But my stereotypes about medical students toppled during my stay on the island. After my call to arms, my class of misfits stopped acting like conventional medical students; they dropped their survival of the fittest mentality and amalgamated into a single force, a team that helped them survive the semester. The stronger students helped the weaker and, in so doing, all became stronger. Their harmony was both surprising and beautiful to observe.

In the end, there was a bonus: a happy Hollywood ending. For their final exam, I gave my students exactly the same test the students in Wisconsin had to pass. There was virtually no difference in the performance of these "rejects" and their "elitist" counterparts in the States. Many students later reported that when they went home and met with their peers who attended American medical schools, they proudly found themselves more proficient in their understanding of the principles governing the life of cells and organisms.

I was of course thrilled that my students had pulled off an academic miracle. But it was years before I understood *how* they were able to do it. At the time, I thought the format of the course

was key, and I still believe that overlapping human and cell biology is a better way to present the course material. But now that I've ventured into what I told you would be considered by some as wacky Dr. Dolittle territory, I think a good part of the reason for my students' success was that they eschewed the behavior of their counterparts in the United States. Instead of mirroring smart American medical students, they mirrored the behavior of smart cells, banding together to become even smarter. I didn't tell my students to pattern their lives after the lives of the cells, because I was still steeped in traditional, scientific training. But I like to think that they went in that direction intuitively after listening to my praise of cells' ability to group together cooperatively to form more complex and highly successful organisms.

I didn't know it at the time but I now believe that another reason for my students' success was that I did not stop at praising cells. I praised the students as well. They needed to hear they were first-rate students in order to believe that they could perform as first-rate students. As I will detail in future chapters, so many of us are leading limited lives not because we have to but because we *think* we have to. But I'm getting ahead of myself. Suffice it to say that after four months in paradise, teaching in a way that clarified my thinking about cells and the lessons they provide to humans, I was well on my way to an understanding of the New Biology, which leaves in the dust the defeatism of genetic and parental programming as well as survival-of-the-fittest Darwinism.

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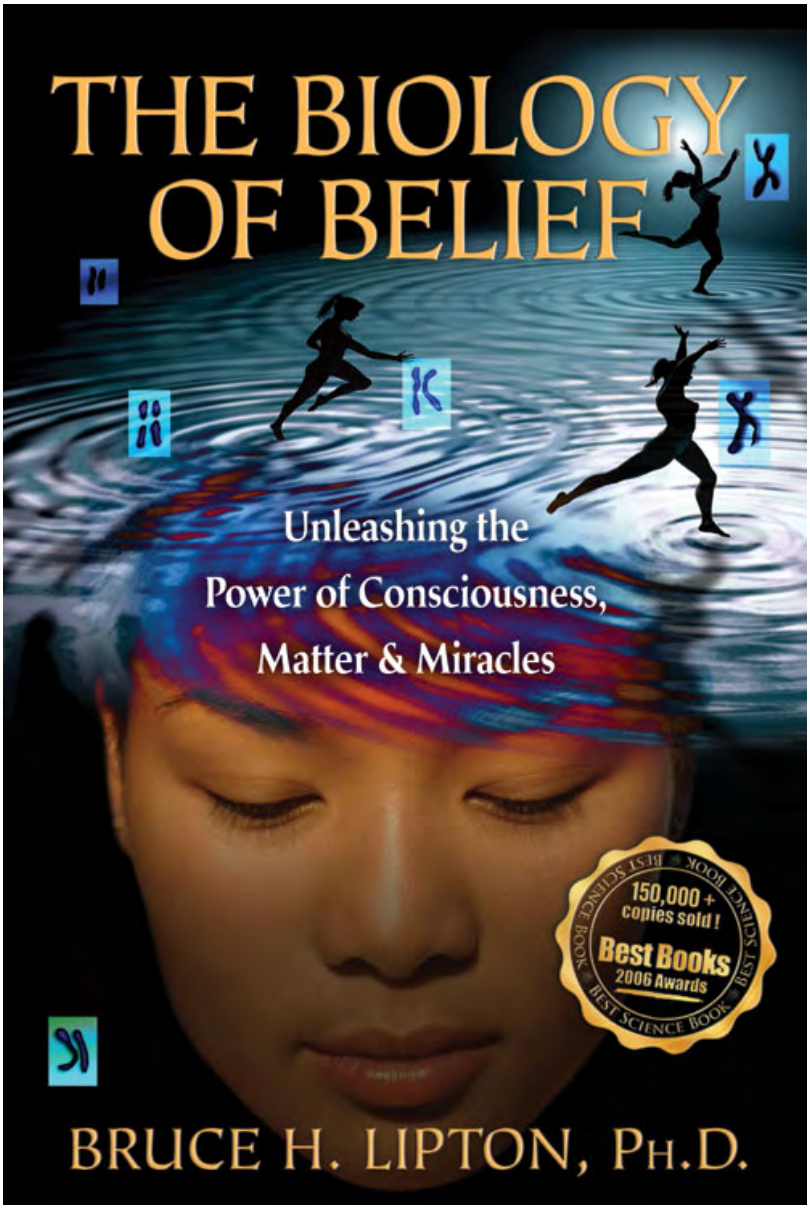

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