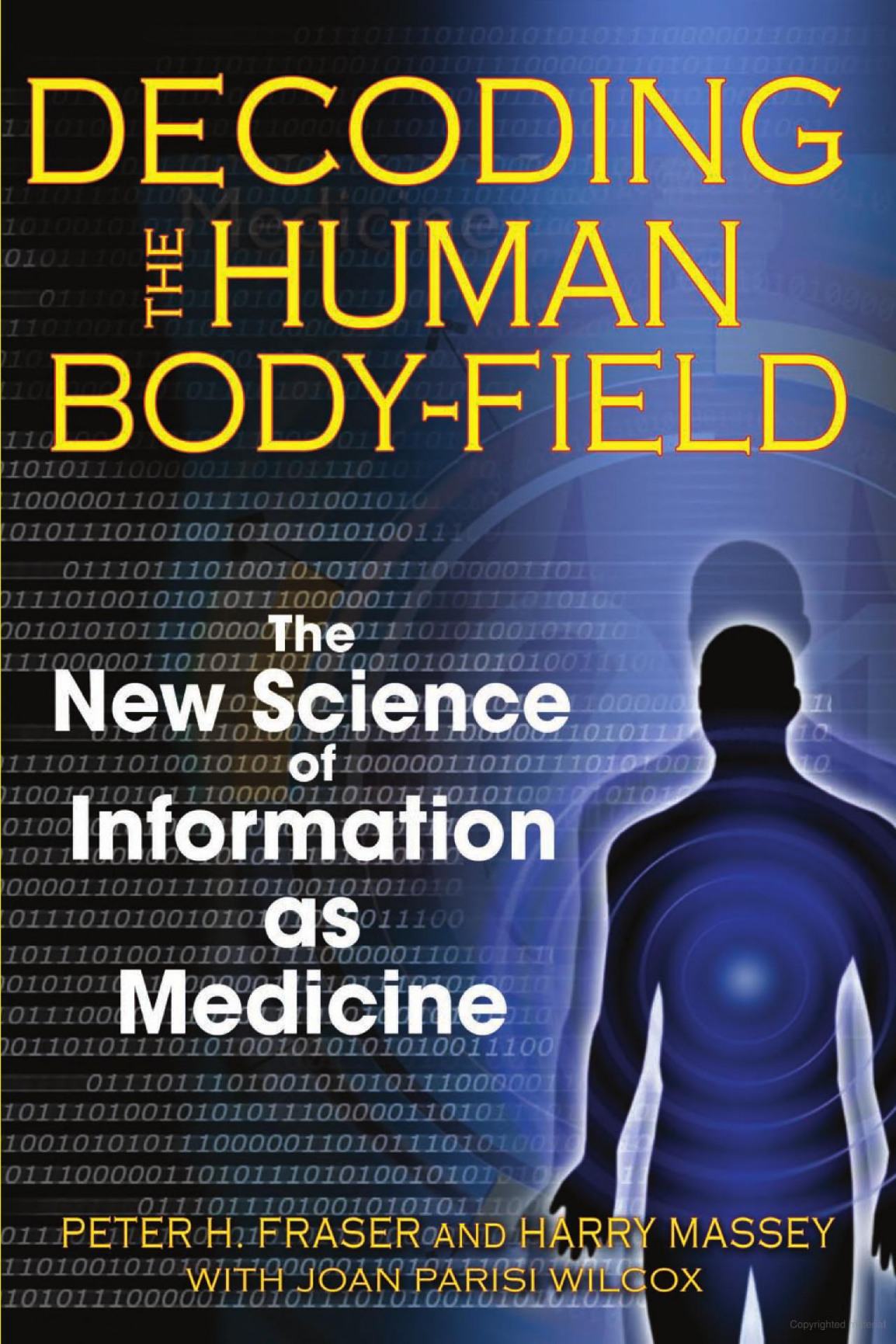
DECODING THE HUMAN BODY-FIELD

The New Science of Information as Medicine



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Healing Arts Press
One Park Street
Rochester, Vermont 05767
www.HealingArtsPress.com

Healing Arts Press is a division of Inner Traditions International

Note to the reader: *This book is intended as an informational guide. The remedies, approaches, and techniques described herein are meant to supplement, and not to be a substitute for, professional medical care or treatment. They should not be used to treat a serious ailment without prior consultation with a qualified health care professional.*

Library of Congress Cataloging-in-Publication Data
Fraser, Peter H.
Decoding the human body-field : the new science of information as medicine / Peter H. Fraser and Harry Massey with Joan Parisi Wilcox.
p. cm.
Includes bibliographical references and index.
Summary: "A revolutionary system that reestablishes the proper flow of information to the body's energetic fields to promote health"—Provided by publisher.
ISBN: 978-1-59477-225-2 (pbk.)
1. Energy medicine. I. Massey, Harry. II. Wilcox, Joan Parisi. III. Title.
RZ421.F73 2008
615.5'3—dc22

2007047745

Printed and bound in Canada by Transcontinental Printing

10 9 8 7 6 5 4 3 2 1

Text design and layout by Virginia Scott Bowman
This book was typeset in Garamond Premier Pro with Copperplate and Avant Garde as display typefaces.
All chapter 8 illustrations created by and used with the permission of Steven Lehar. His illustration of the Chladni figures in 8.2c is based on the work of Mary D. Waller.
Figure 13.5 is a reproduction of an image created by physicist Florian Marquardt and posted in color on *Wikipedia, The Free Encyclopedia,* at www.wikipedia.org/wiki/Interference.
All other illustrations created by Melissa James/MrsToast for NES (© Nutri-Energetics Systems, LTD).

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Note to Reader

Because of the biographical nature of parts of this book and the long time span involved in the retelling of certain aspects of Peter's research efforts, the passage of time has been compressed.

Client cases have been submitted by NES practitioners with the consent of their clients, although all client names have been changed to maintain their privacy.

Nutri-Energetics Systems does not diagnose, cure, prevent, or treat disease. If you have a medical condition or concern, please consult the appropriate health care professional. Also, NES and its claims have not been evaluated by any government agency or regulatory organization.

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Acknowledgments

Thanks to my dog, Pedro, for accompanying me on long walks to work on the puzzle; to Chetan for playing the didgeridoo for me on the beach; to Harry for his rescue mission; and to Joan for her detailed and time-consuming work on this book.

Peter H. Fraser

I am grateful to the numerous people over the past ten years who have supported making both NES and this book a reality. I especially want to acknowledge the following people: my family, especially my mother, who put up with me when I was ill and for initially funding NES; my various business partners, who helped keep NES going through those first difficult years; and Peter, who cured me. My thanks, too, to our NES practitioners and their clients, who put their faith in our system, and to Joan and Bruce, who took on the difficult task of making NES understandable.

Harry Massey

Special thanks to Joyce Cary for her tireless work in establishing and nurturing NES in the United States and to Bruce Robertson for all his work in sorting through NES research and making such good sense of it. To Peter and Harry, I extend my sincerest appreciation for their trust and friendship. To my soul partner, John, I offer my deepest gratitude for thirty years of love, support, and growth.

Joan Parisi Wilcox

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Introduction

WHEN YOU THINK OF YOUR BODY, you probably think of the heft and substance of it—flesh, muscles, bone. When you think of illness and disease, you ask, "What is the matter with me?"—speaking quite literally in physical terms about the real *matter* of your body. Your knee or elbow aches. Your throat is sore. Your stomach is upset. Your head is throbbing. It's counterintuitive to imagine your body at more discrete levels, such as at the levels of cells, molecules, or atoms. You are unlikely to hear a person with diabetes complain that "my beta cells are malfunctioning."

You get our point; it is almost impossible for us to view our bodies as vast networks of cells and molecules, much less as webs of interacting particles and waves. However, the beautiful mystery of nature is that at our most fundamental level, waves and particles are exactly what we are.

In grasping this reality, our problems are ones of perception and scale, for in the course of our everyday lives it appears that particles and waves have no relevance to us. However, as quantum physics reveals, everything is connected—the world is a vast web of interconnected relationships. We compartmentalize ourselves at our own risk. For example, where once we thought the body was machinelike, regulating itself independently of the mind, research now has proved that thoughts, beliefs, emotions, and attitudes profoundly influence the

functions of our cells, organs, and immune system—processes that are vital to our health and overall sense of wellness. Science has birthed a new mind-body medicine, and we can no longer deny that such immaterial aspects of ourselves as thoughts, beliefs, hopes, and desires can change the chemistry of our bodies. We can no longer afford to ignore the web of relationships that determine just about everything we are on a physical level.

With this new frame of reference, we can begin to seek an even deeper understanding of our bodies and our health. We are motivated to find the mechanisms, processes, rules, and relationships that define and determine our state of being. Through the work of innovators such as Peter Fraser,* we can begin to peel back the different aspects of the body like layers of an onion, moving from the macro to the micro scales, and then even deeper to the subatomic scale. What we find is a radically different body at each level. The deeper we go, the less substance there is to the body. Tissues and organs give way to molecules and atoms, which, when you probe deeply into their nature, give way to fuzzy clouds of subatomic particles, some real and some virtual, with those virtual particles popping out of nothingness and returning there after only a whiff of existence.

As we probe into the subatomic realm, we find that the brain, blood, and bone of the body give way to invisible forces, fields, and particles whose interactions underlie not only the human body but all of matter. Molecules give way to atoms that dissolve into subatomic particles, so that our bodies are governed not only by the laws of everyday chemistry but also by the paradoxical principles of quantum electrodynamics.

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*Coauthoring a book makes for some awkward narrative problems, such as using pronouns that will make it clear to readers which one of us is "speaking" at particular points in the text. This especially becomes a problem throughout part 2, in which we tell the stories of our individual journeys toward health and collaboration to create NES. Therefore, simply as a matter of narrative convenience, we have chosen to refer to ourselves in the text by first name.

When we probe to these levels of the body, our practical questions take on seemingly metaphysical overtones. How does a thinking, feeling, creative, intelligent human being arise from the fog of quantum particles? Where is the boundary at which the deterministic laws of chemistry give way to the quirky, probabilistic laws of quantum physics? At what level of being does illness first gain its foothold—at the quantum level of electrons and photons or only at the level of deoxyribonucleic acid (DNA) and cells? Is there such a thing as "quantum health," and if so, do we have any influence over it? Which mechanisms shift our bodies from health to illness and back toward health? These are among the myriad questions that are prompting researchers in biology and medicine to forge boldly forward, extending our understanding of how the body works and creating a new kind of health care in the process.

Nutri-Energetics Systems (NES*)—the system of health care that is the result of Peter Fraser's decades of research and his collaboration with Harry Massey—is pioneering this twenty-first-century health revolution. Their model of the human body-field integrates physics and biology to reveal a stunning new vision of how the body works. Peter's research over the past twenty-five years has expanded our understanding of how the body has two interdependent aspects: the biochemical (which is the basis of most modern Western medicine) and the bioenergetic (which has been the province of alternative and complementary medicine). The body and its physiology are stimulated by fields of energy, called Energetic Drivers in NES, that arise from the organs as a fetus develops. Meridian-like channels, called Energetic Integrators in NES, coordinate the information that drives millions of chemical processes, ensuring that the correct information gets to a specific place in the body at the precise time it is needed. Bioenergetic fields, called Energetic Terrains in NES, form environments in tissues to which

*The acronym NES is pronounced to rhyme with "Tess," although in the United States many early practitioners and clients pronounced each letter individually, "en ee ess."

pathogens and microbes, such as viruses and bacteria, are attracted if we are exposed to them. Energetic Stars form mini networks of information routes in the body-field that address distortions correlated to specific physiological issues. According to the NES model, everything that means anything in the physical body in terms of health has its energetic and informational counterparts. We can detect, monitor, and change the energetic environment of our body and so can directly influence the state of our health.

Throughout history, mystics and healers have claimed that we are "energy beings." The history of this belief is recounted in countless books and websites, so we will not review it here. Readers who are motivated to review this long history can start with traditional Chinese medicine and the Indian ayurvedic system. There are scores of individual pioneers and visionaries, both ancient and modern, who have devoted themselves to furthering our understanding of the underlying energies of the body. The modern physicians, scientists, and researchers include Edwin Babbitt, Harold Saxon Burr, Albert Szent-Györgyi, Ryke Geerd Hamer, Royal Rife, Samuel Hahnemann, Reinholdt Voll, Helmut Schimmel, Wilhelm Reich, Ida Rolf, Robert O. Becker, Freeman Cope, Herbert Fröhlich, James Oschman, Fritz-Albert Popp, Mae-Wan Ho, Walter Schempp, Peter Marcer, Edgar Mitchell, William Tiller, Candace Pert, and Bruce Lipton, to name only a few. Most of the research into biophysics has been more or less piecemeal, with researchers inquiring into one small aspect or another of the bioenergetics of the body. There have been few attempts to fashion an integrative model of our energetic physiology, which in NES we call the human body-field. The closest model is that of traditional Chinese medicine. However, for all its detail, even the Chinese system does not make clear connections to the modern biochemical understanding of the body. The NES model of the human body-field provides the first truly comprehensive and coherent link between biochemistry and bioenergetics.

NES is a system that is holistic in the best sense of that word. We don't reject the very real biochemical processes of the body. We don't

reject the value of allopathic medicine, which is built upon that biochemical framework. However, we are showing that there is more to the body than chemistry. There is a complex energy system that serves as a master control system for the biochemical body. To be truly healthy—to achieve long-lasting wellness—we need to correct distortions and blockages in the complex energy structure that is the human body-field.

The human body-field is a self-organizing, self-directed, intelligent system that directs the information flow of the body, information that is crucial to the genetic, chemical, and physiological processes of the body. To understand the NES model of the body-field you have to unlearn biology, in a sense. You have to put aside your focus on the diagnosis of disease based on symptomology. Symptoms are a consequence of the breakdown of biochemistry. However, chemistry is driven by the interaction of subatomic particles and waves. The root cause of disease, as most complementary practitioners will tell you, is at the level of the energy and information of your body.

NES research to date allows us to describe a model of the human body-field in detail and to determine how it is functioning—how well or poorly it is managing the energy and information that determine the biochemistry of your body. We have created a biotechnology, called the NES–Professional System, that detects problems in the body-field and determines both their severity and their priority for correction. We also have created a line of encoded liquid remedies, which we call Infoceuticals, that can directly influence the body-field, correcting how it processes the information vital to the physical body. The result is a novel system of healing that works in concert with the biochemical system of the body and that directly engages the body's own self-healing capabilities. Although a tremendous amount of research remains to be done, we believe that the NES model of the human body-field represents the dawning of a new era in health care, that our theory details the bioenergetic systems of the body more precisely than any other theory, and that our system for correcting body-field errors is more direct than any other modality, biotechnology, or remedy.

The Foundational Principles of NES

The NES model of the human body-field is based upon the following ten premises. You can use this as a general outline of the main aspects of NES. Please feel free to refer back to this list as you read through the book.

1. The universe is an interconnected network of information and energy. The human body is part of this web of relationships (via feedback loops), and our health is dependent upon the body's correct processing of this information and energy.
2. Although genetics and cellular chemistry are important facets of how the body works, there is a deeper reality to the body, one in which physics, especially the field of quantum electrodynamics, governs physiology. The interaction of quantum waves imparts energy and information that is encoded in what NES calls the human body-field, which serves as a holographic template for the physical body.
3. Information is directed in the body via many kinds of energy, including electromagnetic and vibrational (as phonons, the quantum aspect of sound) energies, and via frequency and phase relationships.
4. As an embryo develops, the organs create Energetic Driver fields, which impart constitutional energy and information to the body-field, and hence to the body.
5. There are at least twelve Energetic Integrator fields, which form a comprehensive communication network in the body-field that directs information to the right place in the body at the right time so that the body functions correctly.
6. Energetic Terrains are energetic disturbances in specific body tissues that create environments hospitable to microorganisms, such as viruses and bacteria, both real and virtual (the microorganism's energy field, rather than the actual microorganism). They can be highly disruptive to the body-field.
7. Symptoms of illness, whether physical or emotional, arise first not

in the physical body but as distortions or blocks in the underlying energy and information of the human body-field.

8. It is possible to analyze the holographic human body-field to determine if there are distortions in or blocks to the flow of energy and information that affect the state of our health.
9. Substances and liquids can be encoded or imprinted with information to influence the energetic state of the body-field, and hence of the physical body. The NES Infoceuticals are created according to this principle.
10. Correcting distortions in the human body-field can help return the body to homeostasis, which refers to the body's ability to maintain equilibrium, a process that is dependent on the body's own self-healing intelligence.

This book explains the NES model of the human body-field and the body-field's influence on health in a nontechnical manner that we trust will be accessible to most readers. We have included a glossary of terms that might be unfamiliar, both NES-related and scientific, at the end of the book. Feel free to refer to the glossary as needed while you are reading. Although we strive in part 2 to preserve the personal narrative quality of how NES came into being, we understand that most readers will need the context and background information about physics and bioenergetics that is provided in part 1. After all, these are not subjects we think about during the course of a normal day, and if you are interested in the revolution in health care that is already upon us, you surely will want to know what all the excitement is about. Don't worry: you don't have to be a physicist or biologist to understand what your body is really like and how it functions at its deepest energetic level. You need only an open mind and a healthy curiosity. Although you could jump ahead to read parts 2 and 3 first, the perspective you will gain by reading part 1 is bound to alter your perception of yourself and your place in the world. Beyond providing the framework upon which

NES is built, we hope that the information in part 1 also will inspire you to see yourself as more than your body and foster a greater sense of the wonders of nature.

We understand that some readers may struggle to grasp what is really going on in their bodies at the subatomic level. Believe us when we say that we have shared that struggle! Peter especially wrestled with having to rethink his entire belief system. It was no small feat to grasp some of the strange, although tantalizing, results of his experiments. For most readers, the difficulties will come in believing that so much can take place in their bodies at so infinitesimal a scale. To help readers make the shift from the familiar to the unfamiliar as effortlessly as possible, we will begin our journey by taking you on a tour of your body, into the awe-inspiring interior spaces of yourself. You will see that when we say there is so much more to you than you may imagine, we are speaking quite literally. Then we will introduce you, in nontechnical terms, to the basics of quantum physics, because the human body-field appears to be governed by quantum processes. Finally, we will review some of the intriguing research into the energies of the body and the energetic aspects of health.

Our research—and research the world over—into the human body-field is still very much in its infancy, and yet it reveals a body that is awe-inspiring in its use of the energies of nature. Parts 2 and 3 are devoted exclusively to detailing the NES model of the human body-field and the NES system of health care. We hope that this information will educate you about what health truly is and how NES might help you maintain long-term wellness. We also hope that this new knowledge will help you cultivate a deeper appreciation for the grandeur of your body and body-field. Part 2 recounts how NES grew out of our own needs, for we both were seriously ill and unable to find lasting help from either allopathic or complementary medicine. We then recount Peter's long, and so often perplexing, journey toward understanding the true nature of the human body-field and its role in health. We end part 2 by relating how Harry's vision and Peter's research came together to

inspire the creation of Nutri-Energetics. In part 3, we detail the varied aspects of the NES model of bioenergetic health and recount the stories of many of the thousands of people worldwide who have been helped by NES.

We would like to close this introduction by reminding readers that no matter what beliefs they currently hold about what their bodies are made of and how healing works, nature always has the last word! Her truth will eventually be our truth. All that is required is that scientists, researchers, and healers be willing to follow where nature leads. However, as is so often the case in the history of science and medicine, just when scientists and researchers think they have it all figured out—when they think they are on the cusp of that coveted "theory of everything"—nature reveals that she has more secrets waiting to be unveiled. For all of the progress we have made in deciphering the intricacies of the human body-field, we know that we have only gleaned insight into the rudimentary aspects of it. We encourage other researchers to explore the implications of NES and of bioenergetics in general, and we urge health care practitioners and clients to put our system to the test, because we are confident that NES represents a true breakthrough in healing.

A classic hallmark that a theory has hit on a fundamental truth of nature is that it explains how a higher-level order emerges from apparently random and even seemingly chaotic lower-level processes. NES is such a theory. The bioenergetic logic that nature has revealed through Peter's experiments is more than beautiful, it is elegant. It is complex, but that complexity orders itself into a holistic, structured whole that reveals an overarching simplicity. Even though we have grasped only a small part of the larger picture, the implications for health care from what we have uncovered are staggering, and the opportunities for research are rich almost beyond measure.

Most important, however, is the fact that NES works, as thousands of clients can attest. It is not perfect. No health care or wellness system is. However, by using NES, you can directly engage your body's

self-healing intelligence in very specific ways. The NES approach to well-being is rooted not in the body but in the various energies and information networks of nature that are expressed in the body. It provides us a novel way to experience the interconnectedness of the cosmos through the medium of our own bodies. The universal energies flow through us. They are not metaphysical energies but appear to be the fields and forces of the real world, of nature. The NES–Professional System provides us the opportunity to quickly and accurately analyze the state of our own body-field and, by using the Infoceuticals, directly change the state of our energy to improve health if we are ill or bolster our ability to stay well if we already are healthy. Thousands of people have discovered NES and are benefiting from it, and we take this opportunity to offer them our gratitude, for without them our research would not have progressed so quickly and our model of the human body-field would not be as fully realized.

PART ONE

The Nature of the Body

1

The Universe of the Body

Hence this life of yours which you are living is not merely a piece of the entire existence, but is, in a certain sense, the whole; only this whole is not so constituted that it can be surveyed in one single glance.

Physicist Erwin Schrödinger

THE ANNALS OF MEDICINE are filled with anomalies, those cases that defy rational explanation and baffle even the most brilliant medical minds. For the most part, medical professionals ignore anomalies such as spontaneous remissions, relegating them, if they report on them at all, to the footnotes of journal articles. However, we do ourselves a grave disservice by dismissing such anomalies as inexplicable, for they demonstrate in the most visceral way that hidden deep in the dim recesses of the body are clues about the mind-body's ability to heal itself. Consider the following examples of medical anomalies:

- A woman suffering from the debilitating effects of decades of multiple sclerosis (MS) is confined to a wheelchair, her legs structurally deformed so that she can stand upright or walk a few steps

only while in full leg braces. Her pain worsens until her doctors are forced to sever the tendons to her kneecaps. Over time, some of the tissues and nerves of her legs become irretrievably impaired, her right kneecap slips off center, and her ankles and feet become paralyzed. She suffers with dignity for years, until one night, inexplicably, she hears a voice telling her she can be healed. The next day her legs begin to feel prickly and warm. She is astonished to find she can wiggle her toes. As she examines her legs, she notices that her right knee is no longer deformed. She throws off her braces and stands. In astonishment, she runs through the house, shouting in excitement, and even bounds up a flight of stairs. Her various doctors conduct examinations and tests, which reveal that her brain no longer shows the telltale lesions indicative of MS. Her legs have normal reflexes even though tendons have been severed. Her doctors for the most part are ecstatic at her startling recovery, but they are completely mystified, saying there simply is no medical explanation for it. One of her longtime physicians, however, is so upset, even frightened—because medical science says that MS cannot be reversed or cured—that he dismisses her from his office, calling her a fraud.[1]

- A young honors mathematics university student undergoes a brain scan. The doctor is shocked when the scan reveals that the young man has almost no brain! His cortex—the part of the brain that is the seat of intellect, perceptual awareness, and memory—is barely a millimeter thick, having been squashed to almost nothing because of undiagnosed hydrocephalus. However, even without this crucial brain matter, the young man has always functioned normally, with an above-average IQ.[2]
- A young girl with lupus, which has no cure and can be controlled only partially by using drugs that have numerous side effects, is conditioned to take her medication while smelling roses and tasting cod-liver oil. Over time, as the conditioning is strengthened, her medications are reduced. Finally, after several years, she is

able to stop taking her medications entirely, but she receives all the benefits of those drugs simply by being exposed to the scent of roses or the taste of cod-liver oil.[3]

These stories and others like them are well documented in medical journals and books, and although they are different in detail they share a subtle commonality: the body was able to act to change its physical state. How the body was able to accomplish this is open to question, although this book offers one possible explanation. In the first example, you might be tempted to explain away the remission of MS by citing the mind-body connection, but if the woman's belief system or mind-set was the mechanism for healing, then the healing occurred without any conscious effort on her part. Also, just what do we mean by a mind-body connection? Thoughts, beliefs, hopes, and dreams are intangibles, and to explain how the mind can affect the body we are forced to ask what consciousness is. The most current research tells us that consciousness is a field, perhaps a quantum field. What does such a field do? It conveys energy and information.

In the second example, the young man, by Western medical standards, shouldn't even have a normal, functioning mind, but it is possible to explain his lack of intellectual and behavioral deficits by surmising that other parts of his brain took over the functions normally processed in the cortex. Still, even this explanation leaves us wondering about the plasticity of the brain, about how parts of the brain that may not normally control intellect and awareness can, if necessary, take over these functions. Such plasticity pushes the boundaries of what current biological theory tells us is possible or likely.

The third example can be accounted for as the mind's effect on the biochemistry of the body or by the placebo effect, which involves realizing a deeply held intention or expectation. However, again we are back to asking what the mind is. If it is so powerful that it can change the state of our body and mimic the effects of pharmaceuticals, then why has medicine ignored this natural healing capability for so

long, dismissing it derisively as the placebo effect, and why isn't there a Manhattan Project of health care to explore and harness it?

At heart, each of these cases highlights how things as immaterial as mind and thoughts or fields of information play a role in health. The fact that these seemingly miraculous stories are real—and there are hundreds of other such stories in the world's medical literature—assures us that healing is not dependent only on the physical matter of the body. They hint that we should not, as we so often do, relegate to the realm of the metaphysical the mechanisms for interfacing with what appears to be the organizing, quantum-level information fields of nature. At the level of the quantum universe, everything is connected or correlated and so can affect or be affected by everything else, although the robustness of such connections is open to debate. It appears that information fields order the physical world. Because we are part of that physical world, it is not a huge leap to think that our bodies, over the millions of years of our evolutionary development, have inherent links to these underlying energy and information fields. Some scientists have finally taken notice and are marshaling the will and the funding to explore these mysteries.

THE POWER OF INFORMATION

Although we tend to think of information as abstract and insubstantial—not a material *thing* at all—scientists are beginning to view information as something as real as fields, forces, and energy. As science reporter Mark Buchanan wrote in *New Scientist* magazine, an increasing number of physicists and other kinds of scientists "believe that information is a kind of subtle substance that lies behind and beneath physical stuff."[4] The study of information has spawned many new scientific disciplines, starting with cybernetics and advancing through systems theory, complexity theory, chaos theory, fractal geometry, and game theory, to name only a few. Information theory is being applied to create new technologies, from fully realized machines such as those that perform

functional magnetic resonance imaging (fMRI) to still theoretical ones such as quantum computers. Information theory has invigorated other disciplines, including ecology, economics, biology, and sociology.

As physicist Jacob D. Bekenstein reminds us, "Ask anybody what the physical world is made of, and you are likely told matter and energy. Yet, if we have learned anything from engineering, biology, and physics, information is just as crucial an ingredient."[5] In the opinion of physicist Anton Zeilinger, information may have a deeper reality than anything else in the universe, so that physics itself might be thought of not as the theory of energy and matter but as the theory of information.[6]

Frontier theorists view information as a guiding and organizing force in nature, a force that creates "systems." In its most general scientific sense, a system is something that organizes and processes information. However, information both drives systems and emerges from them (in effect, information can be either cause or effect). Scale matters in systems theory, with coherent patterns emerging from what might first appear to be chaos or randomness. As one moves down the scale of a system, probing ever deeper into it, one finds patterns within patterns within patterns. A system seems to imprint information about those patterns into itself, so that it can be considered to have "memory."

Gary Schwartz, professor of psychology and medicine, and Linda Russek, assistant professor of medicine, both of the Human Energy Systems Laboratory at the University of Arizona, have outlined the differences between systems concepts and nonsystems concepts. These distinctions, in effect, explain how conventional, reductionist, Newtonian-based science differs from the newest integrative, information-based, and quantum-based sciences.[7]

Nonsystems Concepts: Independent, static, closed, disconnected, linear, random, state-independent, parts, fixed

Systems Concepts: Interdependent, dynamic, open, interactive, nonlinear, emergent, state-dependent, whole, flexible, creative

Those who study the new scientific discipline called "sync," for example, explore the physics of coherent oscillations, which occur when two or more systems resonate together, imparting information to each other.[8] Coherent oscillations explain how individual members of a certain species of firefly synchronize themselves to flash in perfect unison, how a bridge can collapse as the result of the synchronized footfalls of people crossing it, or how electrons can pair up and move in unison to create a phenomenon called superconductivity (the complete loss of electrical resistance).

The systems view of information—as a forcelike entity in its own right that can direct energy and affect matter—is changing the face of biology and medicine. Biology is moving beyond the study of the matter of life and beginning to consider how fields, energies, and information shape and direct life itself. One of the most public debates in medicine currently is the use of embryonic stem cells, which are special because they are precursor cells that can be coaxed into becoming almost any kind of differentiated cell. Scientists don't understand how a stem cell *knows* how to turn itself into a specific kind of cell—a liver, heart, muscle, or nerve cell. From where does it get its information? Biochemistry and DNA cannot provide the full answers, for the processes they either initiate or direct are themselves dependent on information.

Throughout your body, there are trillions of chemical processes that form a tangled web of interconnections to make the enzymes, proteins, hormones, and other substances that your body needs to work properly. All of these processes must be exquisitely timed, and these substances must be produced in specific quantities and delivered with precision to the correct cells. It seems only reasonable to assume that this intricate biological dance must be choreographed by something. That something is information.

One way to gain an appreciation for how crucial information is to the reality of our very lives is to delve into the workings of our own bodies. It is no surprise that most of us are as unfamiliar with the landscapes of our physical selves as we are with the terrain of Mars. So, let

us gain an appreciation for how crucial information is by examining the way our own bodies work. Cells are the smallest measure of living things, so that is where we will shift our focus. Because every fiber of our material being is made from cells, our health, or lack of it, depends on how well they function.

EXPLORING THE BIOLOGICAL BODY

No one knows exactly how many cells make up the human body, but the numbers are beyond imagining. At birth, your body has about ten thousand trillion cells. However, because that number decreases radically as you develop, by the time you are an adult your body contains between 50 trillion and 100 trillion cells, which can be grouped into about two hundred different types.[9] It's impossible to make sense of such huge numbers. To get a handle on it, imagine you have a metronome that makes an audible click with each swing of the arm. As the arm swings to the left—click. Back to the right—click. If you heard a click every second, it would take more than 31,546 years to tick off one trillion seconds. If you heard a click once a second for every cell in your body, using the conservative estimate of 50 trillion cells, you would be listening for more than 1.5 million years![10]

However, only about 10 percent of these cells make up the solid aspects of your body, such as your bones and tissues. Approximately 40 percent make up the nonsolid parts of you, such as your blood and lymphatic fluids. You have about 30 trillion red blood cells and 500 million white blood cells circulating through your body. Your lymph system is crowded as well, as it contains roughly one trillion lymphocytes and other immune cells. The other half of the cells in your body are bacterial cells, most of which are beneficial and inhabit your digestive system. To get a true count, you will need to decide if you want to include the cells of the 100 trillion microorganisms that call your eyeballs, mouth, nose, ears, skin, and other areas of your body home. Our bodies are actually vast ecosystems for these organisms, many of

which we could not live without because they contribute to the vital functioning of our bodies.[11]

It only makes sense that with so many trillions of cells in our bodies, cells are indeed tiny things. How tiny? About twenty microns wide, on average. To appreciate just how small the average human cell is, imagine marking off one inch on a piece of paper. If you laid average-size cells side by side, you would be able to fit 1,270 into that inch.[12] If you are like most people, you can hardly conceive of anything so small. So it comes as a shock to think that a cell, which seems so incredibly tiny as to be almost nothing, is intricately structured and massively crowded. At the scale of chemistry, it is actually huge: it houses more than a dozen structures inside of itself and more on its surface, and it is host to uncountable numbers of molecules that zip in and out of it every second.

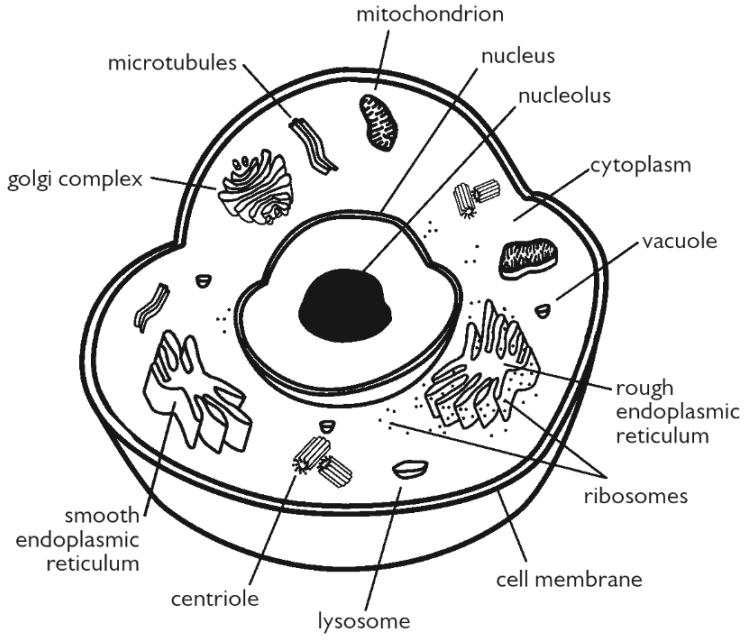

Figure 1.1. Although cells are incredibly tiny, they are intricately constructed, containing dozens of smaller, functioning structures within them that coordinate thousands of processes.

Every cell is the center of a whirlwind of activity, doing everything that is necessary to keep you alive. Science writer Bill Bryson eloquently makes our point:

> If you could visit a cell you wouldn't like it. Blown up to the scale at which atoms were about the size of peas, a cell itself would be a sphere roughly half a mile across, and supported by a complex framework of girders called the cytoskeleton. Within it, millions upon millions of objects—some the size of basketballs, others the size of cars—would whiz around like bullets. There wouldn't be a place you could stand without being pummeled and ripped thousands of times every second from every direction.[13]

What is a cell so busy doing? It depends on what type of cell it is, of course. However, to say that our cells are workhorses is an understatement. Cell biologist Franklin M. Harold calls each cell an "intricate and sophisticated chemical factory." He says, "Even in the simplest cells, this calls for collaborative interactions of many thousands of molecules, large and small, and requires hundreds of concurrent chemical reactions. These break down foodstuffs, extract energy, manufacture precursors, assemble constituents, note and execute genetic instructions and keep all this frantic activity coordinated. The term 'metabolism' designates the sum total of all these chemical processes, derived from the Greek word for 'change.'"[14] Harold's is an elegant way to characterize cells: they manage change. However, the rates of change that a single cell must coordinate are barely fathomable. Which brings us to the subject of the speed of life.

Activities in our body occur at speeds that have no counterpart in our normal, macroscopic world. Every second millions of cells die. They have to be identified and then dismantled and swept from the body, even as new cells are being born to replace them. Take the red blood cells in your body. Every second almost three million red blood cells die, and every second new blood cells are made to replace them.

That's only one type of cell and one set of related activities that takes place in one second. There are millions of other activities taking place in your body during time frames that make seconds feel like forever. In your kidneys, specialized cells are monitoring your salt and water levels, secreting hormones, and removing wastes. Amino acids are arranging themselves into strings that are making up the particular proteins that the body needs at specific times and in exact quantities. The proteins then fold themselves into the intricate three-dimensional structures that determine their function. Each configuration gives a protein a different identity, but somehow proteins know which shape to assume. Ribonucleic acid (RNA) is zipping apart the double helix of DNA, copying the millions of "letters" of the genetic code, proofreading the replication and correcting any mistakes before zipping the new strand of DNA back together again. Messenger RNA is receiving messages from DNA and shuttling those messages around to direct the production of enzymes and other molecules. Your heart is pumping more than a liter of blood a minute. T-cells and other immune cells are tagging, attacking, and destroying foreign organisms such as bacteria and viruses, while leaving harmless microorganisms alone. Adenosine triphosphate (ATP), arguably the busiest molecule in the body, is being broken down to provide energy to power your cells. In fact, every minute millions of cells in your body will each deplete about 500 million ATP molecules, and an equal number of new ATP molecules will be created to rush into those cells to replace them. Neurons are firing, releasing cascades of neurotransmitters, which are fitting like keys into the receptor locks on the surface of cells. Many of the different types of receptors that pepper the surface of cells are themselves active, changing their shape over time and according to different states of the body's internal environment to accept only particular molecular keys, while rejecting others. Thousands upon thousands of other activities and millions upon millions of chemical reactions that are absolutely crucial to your health—and to your life—are going on below the level of your awareness every minute of every day.

Yet this frenzy of activity that is occurring at staggering speeds in spaces too small to imagine is nothing compared with what is going on at the submolecular level of your body. At the quantum level, activity is taking place at speeds that make chemical reactions seem lethargic and in spaces that make cells feel cavernous. Here is where chemistry gives way to physics. Physics is the study of the very small (as in smaller than atoms and therefore "subatomic") and the very fast (as in almost the speed of light, which is slightly more than 186,000 miles per second). As molecular biologist P. W. Atkins wrote of chemistry, "On the one hand it deals with biology and provides explanations for the processes of life. On the other hand it mingles with physics and finds explanations for chemical phenomena in the fundamental processes and particles of the universe."[15] He marveled at the precise nature of the interactions that must take place for chemistry to work at all: "One or two atoms can convert a fuel to a poison, change a color, render an inedible substance edible, or replace a pungent odor with a fragrant one. That changing a single atom can have such consequences is the wonder of the chemical world."[16]

An obvious question is what causes that transformation, that selection of one atom rather than another? What is directing the choice or the need? To answer this kind of question, you have to shift your attention from chemistry to physics. Yet few biologists, or even biochemists, concern themselves much with physics. For all intents and purposes, in the life sciences today, chemistry rules. Even genetics is based on the chemistry of DNA. However, if scientists are not following chemistry down to the level of physics, how can they be sure they are not missing important and fundamental aspects of what is going on in the body? It was not until relatively recently that scientists began to look at the quantum aspects of the body. The young disciplines of quantum biology and biophysics now sanction the study of the quantum processes—the energies and information—that underlie chemistry. Even so, they are still decidedly fringe elements of the conventional scientific world.

Of course, alternative and complementary medicine and sci-

ence have a rich, and ancient, history of viewing the body in terms of energy, which is fundamentally what physics is about. Traditional Chinese medicine and Indian ayurvedic medicine have long explored the energies of the body. Acupuncture and homeopathy are practiced widely in Asia and Europe (Britain, for example, has at least four exclusively homeopathic hospitals) and are slowly gaining acceptance in the United States and elsewhere. Today, there is growing interest in these unconventional techniques and theories because science is beginning to discover that although chemistry has been wildly successful at explaining many of the mechanisms of the body, it is not adequate by itself to the task of explaining the *integrative* workings of the body. As Deepak Chopra, a physician and prolific writer and speaker, so artfully argues, the body is simply too complex to be ruled by chemistry alone; there is some deeper process involved that keeps everything running at the level of precision the body demands:

> The healing mechanism resides somewhere in this overall complexity, but it is elusive. There is no one organ of healing. How does the body know what to do when it is damaged, then? Medicine has no simple answer. Any one of the processes involved in healing a superficial cut—the clotting of the blood for example—is incredibly complex, so much so that if the mechanism fails, as it does with hemophiliacs, advanced scientific medicine is at a loss to duplicate the impaired function. A doctor can prescribe drugs to replace the missing clotting factor in the blood, but these are temporary, artificial and have numerous side effects. The body's perfect timing will be absent, as well as the superb coordination of a dozen related processes. By comparison, a man-made drug is a stranger in a land where everyone else is blood kin. It can never share the knowledge that everyone else was born with.[17]

Dr. Chopra's assessment of the limits of chemistry is one that is finding grudging acceptance among many biologists. One of the

difficulties that confronts scientists in moving from chemistry to physics when analyzing the body is not their intellectual capacities or any inadequacies with their instrumentation, but their method of questioning. To paraphrase Albert Einstein, we can only find answers to the questions we choose to ask. Our questions are limited by our worldview, our paradigm. If scientists believe that chemistry and genetics are all there is to the body, then that is all they will examine. As they shift their perspective from the stuff of life (matter) to the processes of life (energies and information), they are finding a whole new world within the body.

The current trend in mainstream medicine is genetics. Modern research findings about the genetic components of disease have been incredibly enlightening and certainly have improved health care over the last few decades. However, there appears to be a fundamental limit to how much science and, by extension, medicine can achieve by treating the body only as a chemical factory or as being dependent solely, or mostly, on its genetic "blueprint." Eric Landers, who was at the forefront of the Human Genome Project, has called the genome a parts list. Having a parts list alone does not tell you what the pieces are for and how to combine them into something useful.[18] You need an information template for that.

DNA is an alphabet of only four letters, the chemicals (called bases) adenine, thymine, cystosine, and guanine, yet combinations of those four bases, we are told, determine many, if not most, of our core characteristics, from the color of our eyes to our propensity for developing certain diseases. However, for all the progress made in decoding our DNA, scientists still consider 95 percent of it as "junk" DNA because it has no known function. A large portion of this noncoding DNA, as it is called, was at first thought to be a vestige of evolution—bits and pieces of the DNA of other organisms that are our evolutionary ancestors. Recently, however, scientists have begun to glean clues that this "molecular garbage" may have important regulatory functions in the body. In fact, the discovery that junk DNA may have purpose was

initially made by scientists who applied linguist theory to analyze the DNA! They found "messages"—a biological grammar and syntax—in the noncoding DNA that may influence how genes function and affect cellular processes.[19] So for all intents and purposes, science still has a long, long way to go even to make sense of how much of our DNA is useful, never mind to tease out its functions in the body.

In terms of current allopathic medicine and biology, manipulating DNA is considered the most promising route to cure disease. However, as genetic research roars ahead, scientists are becoming more sober in their predictions and expectations, for they are finding that there is probably not a one-to-one correspondence between genetics and most of the diseases that kill the majority of people, such as heart disease and cancer. For a few diseases, such as cystic fibrosis and sickle cell anemia, there is an undeniable genetic correlation, but for others the link is tenuous. Most genetic defects occur because you are missing a gene. Others occur because you have a faulty copy of one or more genes. In the latter case, all that genetics can tell you is that you may be *predisposed* toward a particular disease. For the disease to manifest, the associated defective gene or genes have to be "expressed." For example, colon cancer is linked to five different defective genes. Yet, of the 145,000 new cases of colon cancer reported each year in the United States, only 5 percent of the people affected have one of the defective genes. In this case—as confusing as it may seem—having the defective gene gives you a very high probability of getting the disease, yet very few people with the disease actually have the gene.[20] Obviously, something other than mutated genes is causing the cancer in the majority of people with colon cancers.

What is causing the vast majority of cancers and other diseases? One clue comes from the National Institutes of Health. On their Human Genome Project website, they report that environmental factors may be the single most important trigger in whether a genetic mutation is expressed or not: "Scientists estimate that each of us carries between 5 and 50 [gene] mutations that carry some risk for disease or

disability. Some of us may not experience negative consequences from the mutations we carry, either because we do not live long enough for it to happen or because we may not be exposed to the relevant environmental triggers."[21]

An intriguing study on twins also revealed a strong correlation between cancer and environmental factors. Identical twins are a unique population for studying the correlation between genes and disease risk because these twins share the same DNA. Yet after taking into account all known risk factors, the researchers for this study found that the single best predictor for why one twin got cancer and the other did not was exposure to environmental toxins and lifestyle choices, such as cigarette smoking.[22] As you will see in part 3, the NES system of health care takes environmental factors—from geomagnetic fields and electromagnetic pollution to chemical toxins and dietary factors—into consideration in the analysis of your body-field, giving you a truly holistic picture of your state of well-being.

EXPLORING THE QUANTUM BODY

For all the strides made in health and medicine—from designer pharmaceuticals to stricter environmental standards to gene therapies—conventional science is falling short of successfully deciphering the complexities of the body. One aspect of the body being overlooked is its quantum nature. However, the NES theory of health is built around what happens in the body at the subatomic level. Physics underlies, even drives, chemistry. So to understand what is really happening in the body, you have to understand something about what is happening at the smallest known scale. This is the scale of electrons, protons, photons, and quarks—the entire "particle zoo" of quantum physics.

It's all relative, as they say, which is why understanding the levels of the body is so important. As physicist Kenneth W. Ford wrote, "By most measures, atoms are small. Yet to some scientists, they are gargantuan. These scientists—nuclear and particle physicists—are concerned

with what goes on in bits of space much smaller than atoms, smaller even than the tiny nuclei that sit at the centers of atoms. We call this world the *subatomic world.*"[23]

An atom, to use the scientific definition, is a unit of matter that has a central, positively charged nucleus surrounded by a system of electrons. It is very small, about 10^{-8} centimeters.[24] To get a sense of what that number means, imagine ten million atoms arranged side by side. They would cover a distance of less than one-tenth of an inch.[25] However, those are *atoms,* and we are talking about the *sub*atomic world, which is about protons and electrons and other things that can barely be called things, things that are smaller than atoms. Classical physics is fairly straightforward, but the quantum world is outright weird. We discuss quantum physics in the next chapter, but let us point out here that many of the particles of the quantum world are not even really "things" at all.

The fundamental quantum particles—"fundamental" meaning they are not made up of any smaller parts—such as electrons and quarks are not measurable by any normal, macroscopic standards. Scientists have searched for structure in the electron and found none even at distances of less than 10^{-18} meters. They have to set up experiments from which they can *infer* the characteristics of quantum particles, because the "stuff" of the quantum world cannot be apprehended directly. The truth is, the fundamental quantum particles are so infinitesimal that they cannot be considered to have structure at all. Thus they cannot be considered as material things, and the concepts of *measurement* and *observation,* two words often used in science, take on special meanings in quantum mechanics. The point is that quantum entities are not things but are probability waves. That is, an electron is less like a solid object, say a billiard ball, and more like a cloud, a fog of potentiality, with a probability of the electron being anywhere in that fog until it is measured. Only then, upon measurement (or more accurately, upon detection, since these entities are not measureable in terms of length, depth, and other such physical characteristics), can it be said to have a definite location.

Because the quantum domain is so unimaginably tiny, events there occur at equally unimaginable speeds. In conventional biology, although some of the chemical activities of the body occur in nanoseconds, they do not occur at anything approaching quantum speeds. Also, even though the component parts of a single cell are miniscule—400 meters of DNA could be curled up onto the period at the end of any sentence in this book[26]—they are gigantic in comparison with the size of the particles of the quantum world. Yet physicists, such as the late Richard Feynman, have said that quantum theory is necessary to understand the fundamentals of chemistry. One way to begin to clear our possible confusion about the differing rules at the different scales of matter—from the infinitesimal scale of the quantum world to the microscopic world of molecules and cells to the macroscopic world of tissues and organs—is to consider two important properties in biology: emergence and phase change.

Emergence refers to patterns in nature that arise as you move up the scale of reference. To put it in its simplest terms, it means that the whole is greater than the sum of the parts. Emergent properties often border on the miraculous, as seemingly chaotic processes produce order and symmetry at larger scales. For example, the individual ice crystals in a raging snowstorm come together to form a snowflake, or the electrical and chemical impulses of millions of neurons coalesce into a thought. Mathematician Ian Stewart marveled that nature's patterns "emerge from an ocean of complexity like Botticelli's Venus from her half shell—unheralded, transcending their origins."[27] Nobel Prize–winning physicist Robert B. Laughlin explained other qualities of this phenomenon that is so ubiquitous in nature and so fundamental to life: "Emergence means complex organizational structures growing out of simple rules. Emergence means stable inevitability in the way certain things are. Emergence means unpredictability, in the sense of small events causing great and qualitative changes in larger ones."[28]

Chemical bonding accounts for how atoms group together to form

molecules. Then molecules bind to make cells, cells cluster into tissues, which form into organs, and before you know it you have a living organism. Nowhere, at any of those levels, can you find the *one* organ or activity or process that *is* "life." Yet, put all those component parts together—and add in an external environment that supplies nutrients and light and other factors necessary to support life—and you get an *E. coli* bacterium, a mosquito, a salmon, a peacock, a rhinoceros, or a human being. Life is the grandest emergent property of all.

The other property we mentioned was phase change, also called phase transition. We are all familiar with phase changes in the macroscopic world. At room temperature, water is a fluid. Lower the temperature enough, and it forms ice. Raise the temperature enough, and it becomes gaseous and escapes into the air as vapor. Phase changes occur in the subatomic world as well. Beyond certain parameters, atoms lose their individuality and act collectively. Life itself may have emerged from the primordial soup as a phase change of aggregating molecules that catalyzed into a self-organizing, self-replicating organism. You can think of the loss of health or the regaining of it, if you have been ill, as a phase change in the body. Spontaneous regressions from cancer could fall into the class of phase change, as for no reason apparent to conventional science a tumor disappears overnight or within days.

One of the difficulties in pinpointing the cause of disease is that a small input, such as exposure to a toxin from the environment over a long period of time, can build up to a point that pushes the body over a threshold, after which very suddenly the system goes awry. Classical systems, which are governed by the physics of the everyday world, usually follow this pattern of change building up slowly over time and then reaching a breaking point. These are called linear systems, because they tend to follow a steady, sequential course. Nonclassical systems are nonlinear, which means that change often happens suddenly, with a dramatic shift occurring from a tiny, seemingly insignificant cause. (You have no doubt heard the popular metaphor for nonlinearity: a butterfly flapping its wings in Tokyo can affect the weather in Dallas.) The body

is a nonlinear, and some would say quantum, system that can experience a rapid shift from a small input. As biophysicist James Oschman reminds us, "In cooperative systems [such as the human body], large transitions can take place sharply and rapidly in response to minute inputs of energy."[29]

We mention emergence and phase change only to provide you with another window into the mystery of the body, for these phenomena provide evidence that what matters in nature is not only matter and energy but also *information*.

A BIOLOGY OF INFORMATION

As an example of how information drives energy and matter, we have only to think of water. One of the most intriguing questions in biology right now is how water works in the body—how an aggregate of water molecules in the body can serve as an information-carrying network that affects almost every physiological function. Water is, of course, crucial to life. Our bodies are more than 70 percent water. However, the water in your body is not like ordinary water. It displays unique characteristics that put the life in living things. For instance, the latest research shows that DNA and genes can carry out their functions only with the help of water. As Felix Franks, of the University of Cambridge, said in a *New Scientist* article, "The Quantum Elixir," "Without water, it is all chemistry, but add water and you get biology."[30]

Water in a living organism is called biological water. Can this type of water imprint and transmit information? Does water have memory? These are among the revolutionary questions facing frontier biologists, and they are finding that the answers are yes and yes. "The Quantum Elixir" article was devoted to water's role in biological activity—its behavior around DNA, in cells, and elsewhere in the body. The research reported on in the article has demonstrated that biological water is governed by a quantum energy called zero-point energy (ZPE), which is the lowest possible energy state of a quantum system. This ZPE

energy often is equated with the emptiness of space, with the vacuum. However, what we call empty space is in reality a froth of vibrations at the quantum level. Research into biological water suggests that as a result of the influence of these ZPE vibrations, water molecules in the body take on amazing properties, especially in regard to how hydrogen molecules bond to oxygen and other molecules. The studies also suggest that biological water somehow relays information to proteins so that they connect only to precise sequences of genes and not to others and that water molecules even warn proteins about nearby damaged DNA. To say that scientists are surprised by the strange qualities of biological water as an information-carrying network is an understatement. The author of the article, Robert Matthews, wrote, "Put bluntly, you owe your existence to quantum effects in water that make even the wackiest New Age ideas seem ho-hum."

History records how what was once deemed impossible often turns out to be very possible indeed. For example, at least one of the scientists cited in the article about the quantum nature of biological water thinks that the evidence leads scientists back to homeopathy, which has been dismissed as quackery by much of modern, Western science but has helped millions of ill people the world over. He suggests that homeopathy might be correct in its claim that water can be imprinted with information, that water has a memory.[31] Homeopathic remedies are made from substances, such as minerals or plants, that are placed in a solution, usually mostly water, which is then succussed (vigorously shaken). The solution is then diluted further and the procedure repeated, often until not a single molecule of the original substance remains in the remedy. All that remains is information. In effect, the remedy retains a memory of information about the healing substance that the body can recognize and use. Research conducted by NES extended this theory and resulted in the development of our own type of remedies, called Infoceuticals, which are encoded with information, but in a way wholly unlike the dilution and succussion method of homeopathy. If recent experimental evidence from mainstream scientists continues to mount

in homeopathy and NES's favor, conventional scientists might have to revise their opinions—and even their science.

For every question we ask about who we are and how our bodies work, nature teases us with new questions, plants new clues right under our noses, and opens us to new possibilities of how the body regulates itself. Nature's creativity and outright novelty challenge us to remain open to what seemed absurd, and even impossible, to previous generations. Thomas Kuhn, the late professor of the history of science, is famous for his analysis of how scientific thought can be grouped into paradigms, which shift over time. They do so not according to a smooth curve of increasing insight but by abrupt breaks with old philosophies and entrenched ideas. However, history shows us that most truly fundamental leaps forward in scientific understanding are shunned at first. Truly new insights are sometimes too radical an overturning of accepted theory or too threatening to business or academic interests to be evaluated impartially. You have only to think of germ theory, tectonic plate theory, quantum electrodynamics, and string theory to know that even ideas that are accepted widely in our day were dismissed as crackpot ideas by a previous generation of scientists.

Michael Faraday, who developed the first modern theory of electricity in the nineteenth century, was trained as a bookbinder and had no formal scientific training, but his theory became the impetus for all the later breakthroughs in understanding electromagnetism. Academic scientists rejected his theory when he first made it public, more for who he was than for what he was proposing. One critic even suggested smugly that Faraday, who had no university degrees, "ought to return to sixth form mathematics before venturing into Laplacian physics."[32] Similarly, Clair Patterson waged a career-long campaign against the petroleum industry and other corporate and even government interests to prove that lead is toxic to humans. His unrelenting efforts finally resulted in the banning of lead from gasoline, paint, and other consumer products and to stricter standards for airborne lead levels.[33] Physicist George Zweig, who in 1964 was one of the first theorists to propose the reality of quarks—which have

since been verified as the most fundamental of all subatomic particles—was denied a post at an American university because a prestigious faculty member claimed his work was that of a charlatan.[34]

The problems of "doing science" persist even today, and perhaps the difficulties are worse than ever. It takes money to pursue science, and it takes publication in peer-reviewed journals to get your science noticed. If you don't fit into the mainstream establishment, you are unlikely to get a hearing for your ideas. Even if you do, science progresses at the proverbial snail's pace. The Institute of Medicine reported in 2001, to the dismay of members of the medical establishment, that it takes an average of "15 to 20 years for new scientific knowledge to percolate down into everyday medical practice."[35]

Theoretical shifts that could change the very understanding of the fundamentals of science can take even longer to become widely known and accepted. Physiologist Gilbert Ling provides a sobering example of how slow science can be to change, even when a radical new theory is backed by impeccable and replicable experiments.[36] For forty years Ling has waged a battle to revise cell theory. Most biologists still view the cell as a bag of liquid enclosed in a semipermeable membrane that has tiny pumps that control what gets through the membrane and into the cell, such as oxygen and nutrients, but Ling has shown that cells cannot possibly work according to the membrane-pump theory. We won't go into the reasons why here, for the explanations are complex. However, as one example, experiments with frog muscle cells proved that to move important ions, such as sodium, in and out of cells via a channel-pump process, cells would need 15 to 30 times *more* energy than is available to them. Ling's research has revealed an alternative mechanism that not only solves the "pump problem," as many researchers call it, but also explains many other processes that have mystified cell biologists. (As an aside, his research also indicates that the water in cells displays unique properties, properties very different from those of regular [nonbiological] water and ones that display the signature of the quantum realm, just as the most current research is confirming.)

Despite the importance of these experiments, Ling's theory, called the association–induction hypothesis, has been slow to find acceptance. You have to wonder why. After all, cells are the very building blocks of life, and how they function has enormous ramifications for health, if for no other reason than because most pharmaceuticals work at the cellular level. Pharmaceuticals often have unintended side effects because they disrupt cells they are not intended to target. Biologists don't understand enough about cell functioning to control those unintended effects. You would think that researchers would welcome a model that better reveals the inner workings of the cell and that can revolutionize the effectiveness of pharmaceuticals. However, as Ling argues, it is not the quality of his or his colleagues' science that is the problem but the threat of their new model to the status quo of the profession of biology in general. Scientists who have built careers on a particular biological model are slow to accept evidence that their model may be flawed.

There are legions of other scientists we could name whose ideas upset the status quo and so were initially rejected, suppressed, or ignored until so much evidence was amassed as to make their theories acceptable or until the cultural climate changed in their favor. We mention the above examples only to remind readers that science, which in an idealistic world is thought of as impartial and objective, is in practice subject to cultural, political, and personal concerns that can mean real breakthroughs can take decades to filter down to the people who pay for and most benefit from them—the public. If history is any guide, progress cannot be stopped, and it is the public itself that propels science forward. One has only to look at the billions of dollars spent annually on complementary health care for evidence that the public wields power over its own destiny, as well it should.

The examples of frontier biology that we have highlighted in this chapter provide evidence that the biologists of the future will need to shift their focus from the purely chemical aspects of biology to its quantum aspects, especially to how information is stored, transmitted, and regulated in the body at the subatomic level. Peter Fraser, whose

research led to the creation of the Nutri-Energetics Systems model of the human body-field, independently reached conclusions that are only now coming to light in biology, chemistry, and physics, such as the relevance of zero-point energy to the proper functioning of the body. The NES model grew from a foundation of analyzing the information regulation processes in the body at the quantum level. As Peter says, there is one medicine, but it has two aspects: the biochemical and the bioenergetic. NES represents the first comprehensive synthesis of these two aspects of health.

The truth in the case of biology is that there is a deeper reality to our bodies than conventional science is willing to allow. It is at the quantum level that we find the master control processes that so profoundly influence our health and well-being. In the next two chapters, we take a closer look at these more-fundamental aspects of the body. We first delve into the world of quantum physics and then review research into bioenergetics by pioneering scientists who have followed where nature led. To appreciate the fundamental shift in health care that NES is proposing—and delivering in its clinical system, the NES–Professional System—you have to be grounded in a bit of both physics and bioenergetics. So, let's continue our exploration into the deepest, most elusive aspects of the body—its energy and information.

2

The Microworld and the Macroworld

It is quite obvious that there are problems with the Standard Model [of physics]. However, there is nothing particularly unhealthy about such a situation. There are often problems with theories in physics, at least with those that lie on the frontiers of science. If there were no problems, then theoretical speculation and experimental research would come to a halt. Physicists would not know what to do next.

Richard Morris, *The Edges of Science*

FOR THE PAST FEW HUNDRED YEARS (and historically as far back as the Greeks), the Western approach to science has been reductionist. Scientists seek to know what something is made of and how it works by probing into and taking apart the object of their study, whether a bacterium, a human cell, or an atom. For example, physicists learn about the characteristics of quantum particles by accelerating streams of atoms or quantum particles to as close to the speed of light as they can and then crashing the particles into each other. The force annihilates the particles, showering detectors with the even smaller particles from

which they are made. In this way physicists learn which particles are truly elementary (have no constituent parts) and which are composite particles (e.g., the proton and neutron, which are made of various kinds of smaller particles called quarks). The physicists' tool—the accelerator—is not called an "atom smasher" for nothing! Using this or similar methods, physicists discovered most of the four hundred or so members of the particle zoo of the quantum realm.

The method is not so different in biology. To study a cell, biologists dissolve it in a solution or grind it and then separate out its constituent parts, destroying the cell in order to study it. This is reductionist science at its best. It works beautifully. By taking apart cells, biologists learned that they have a complex and intricate structure. However, this is not *integrative* science. As cell biologist Franklin M. Harold wrote, "We know in our hearts that a cell is far more than an aggregate of individual molecules; it is an organized, structured, purposeful and evolved whole. Unfortunately, analytical practice dictates that we begin our inquiries by grinding the exquisite architecture of the living cell into a pulp. No wonder, then, that the integrative perspective is woefully absent from the molecular view of life as it has developed over the past half-century."[1]

Integrative science strives to understand the whole, in which emergent properties express themselves and so reveal functions and processes that are undecipherable and even undetectable at lower levels. Integrative science is about connections at the systems level, about patterns that are revealed holistically, and about simplicities that arise from a cluster of complexities. *It is a science of synthesis.*

The most recent paradigm in medicine, although it is still in its infancy, is called "integrative medicine," which is a holistic, rather than a reductionist, approach to health. It is a medical mind-set that acknowledges that healing and curing are qualitatively different, that a person is more than his or her disease, and that there is not only a mind-body connection but also a spirit-mind-body connection. Integrative medicine is what author and physician Larry Dossey would classify as Era

III medicine.[2] Dossey views the recent history of medicine as having evolved through three eras. Era I started in the mid-nineteenth century, when medicine was just beginning to become scientific. The physicians of that era considered the body a machine and consciousness an emergent property of the neurophysiology of the brain. By the mid-twentieth century, medicine had begun to enter Era II. Science was studying the placebo effect, which showed clearly that the mind influences the body. Stress, emotions, and other psychological states were recognized as affecting, and in some cases even causing, disease. Lifestyle choices became almost as important a factor in health as genetics or exposure to pathogens or toxins. Attitude, such as the will to live or an optimistic outlook, was identified as an important predictor of who would have a good outcome from a therapy and who might not. We are still in the midst of Era II medicine, of what might be called mind-body medicine. We see only the first glimmers of the dawning of Era III medicine, the hallmark of which is the "nonlocal mind." The term *nonlocal* refers to action at a distance, or how your mind can influence things, people, and events that are spatially separated from you. Era III medicine is built upon the growing body of evidence that consciousness can exist outside of the body and that focused or directed intention can have a healing effect, such that praying for someone could have a positive effect on the state of that person's health. This is truly both an *energy*-based and an *information*-based medicine.

Dossey is not alone in his assessment that the use of focused consciousness and directed energy or intention will be important aspects of the medicine of the future. Cardiac surgeon Mehmet Oz, who combines Eastern and Western medical techniques into his surgical practice, declares that many of his heart surgery patients do better when they also learn how to meditate, use guided imagery, and receive adjunct complementary therapies such as acupuncture and foot reflexology.[3] Acupuncturist Michael Wayne, in his book *Quantum-Integral Medicine,* argues that patients can harness their minds to ramp up their bodies' innate self-healing capabilities, so they can be their own doc-

tors to a much larger extent than ever thought possible.[4] Physicist Amit Goswami, in *The Quantum Doctor: A Physicist's Guide to Health and Healing,* posits that all healing is ultimately dependent upon the proper use of energy, both of the physical body and the conscious mind.[5] Perhaps the best known advocate of Era III medicine is physician and best-selling author Deepak Chopra.[6]

In allopathic medicine—the system of conventional medicine that is taught in most medical schools and that most people use—integrative health care has come to refer to the practice of using both conventional and complementary healing approaches, something that more allopathic physicians have come to accept—or at least tolerate—because millions of their patients are using complementary therapies even while they seek conventional medical care. For complementary physicians and practitioners, however, the term *integrative medicine* takes on a more holistic meaning, implying that the body has healing capabilities that most allopathic doctors would deny. In actuality, there is a deep ideological split between the two groups. Allopathic physicians work within the domain of biochemistry and see themselves as healers. They have acquired the knowledge to attempt to fix what has gone wrong in the body; their main tools are surgery and the pharmaceuticals and other synthetic compounds that can supply the body with what it lacks. Complementary health professionals, for the most part, would deny that they are healers. They consider the *patient* the healer of his or her own body. Complementary practitioners see themselves more as *facilitators,* helping patients to harness their bodies' own inner resources. These inner resources are fundamentally consciousness-based and/or energy-based. Moreover, complementary practitioners are not focused only on the body but also on the whole patient, including that person's lifestyle, emotional state, environment, hopes and dreams, relationships, and everything that goes into being a full and productive human being.

Where does Nutri-Energetics fit into this picture? We acknowledge the mind-body connection and even the spirit-mind-body connection,

but we have not gone so far as to declare that our physical health is dependent only on the state of our consciousness. It very well may be, and some of our research has hinted at how consciousness influences the body, but we are first and foremost concerned with the *energies* of the body and the *information* that directs those energies. Our model describes a comprehensive energetic physiology of the body and even of the mind, for emotions are not separate from the body, and an energetic pathology for how illness develops and how health can be restored. The NES model is unique, so far as we have been able to determine. It is *integrative* health care in the truest sense of that term; we integrate physics and biology to activate the body's own healing capabilities. Our theory helps explain why complementary modalities, such as acupuncture and homeopathy, work, although our method of health care is as different from those two practices as they are from each other.

NES is concerned with the bioenergetics of the physical body. The term *bioenergetics* has at least two distinct meanings. In conventional biology, it refers to the study of how the cells of the body perform work. In a more general sense, the term describes a relatively recent area of study about the physics of the body, that is, the study of the possible quantum processes of the body. We believe quantum fields—which are fields of information—interact to form a complex system that drives chemistry and influences the deepest mechanisms of biology; they have a structure in the body and also link the body with the environment in complex feedback loops of energy and information. In fact, our research suggests that these energetic systems in the body form a master informational control system for the physiology of the body, directing its biochemistry and physiology. Ours is a theory about the functioning of what we call the human body-field. Peter Fraser has mapped this body-field, and together he and Harry Massey have been able to create a biotechnology, called the NES–Professional System, that can analyze (in a process called a "scan") the relative state of the body-field to determine its level of functioning. The NES Infoceuticals are liquids that are specially imprinted, or encoded, with information that corrects the

distortions in the human body-field that were identified via the scan. When distortions are corrected, the body-field then directs the physical body back toward homeostasis, so that it can once again work to keep itself healthy.

That existence of quantum processes and energy fields in the human body is a relatively recent scientific discovery. This area of modern research is still in its infancy, but in actuality the evidence for the energetic reality of the body goes back decades, and even to antiquity if you include spiritual and metaphysical wisdom instead of only laboratory results. We are not going to review that history here, but suffice it to say that most people interested in alternative healing methods have heard of *qi* (also spelled *chi,* and pronounced "chee"), *prana,* the *élan vital,* meridians, chakras, and other terms for the energy of the body from cultures around the world. However, NES is not working with these kinds of energies, which for the most part are cosmic, metaphysical energies that pervade the universe. We repeat that we are dealing with energies that are measurable; they are the energies of matter. We are not seeking to define new energies that have so far escaped the notice of science. We are, instead, finding how the known energies and fields of physics work in the human body. NES falls into the category of biophysics because we are concerned not with metaphysics, but with physics, albeit the physics of physiology.

Most conventional scientists who have expressed an opinion about complementary modalities charge that these therapies have no basis in reality, that complementary practitioners are working with phantom energies that belong more to spirituality than to physiology. They no doubt feel this way because so many complementary models are unable to explain themselves in the language of science. However, NES is different in this respect, too. We have formulated a comprehensive model of how the quantum body-field regulates the processes of the physical body (which is described in parts 2 and 3). Our findings have applications to many complementary practices, especially traditional Chinese medicine, homeopathy, and acupuncture, providing them with an explanation that

is based in physics instead of what amounts to metaphysics.

Just what is this quantum physics we keep talking about? It's time we introduced you to the fundamental tenets of quantum theory. Although space limitations require that we cover only a few key concepts of quantum theory, even this abbreviated, layperson's description of the field will orient you enough to understand how bioenergetics is revolutionizing our understanding of the body and what it means to be healthy.

CLASSICAL AND QUANTUM PHYSICS

Physics can be divided into two main theories. Classical theory is built on Newton's laws and applies to the macroscopic world, our everyday world, and the cosmos at large. Quantum theory concerns itself with the subatomic world and also with how matter behaves at extremely high speeds (i.e., near the speed of light, so the theory also has relevance to cosmology).[7] However, it is more accurate to say quantum *theories,* for there are about a half dozen competing theories that attempt to account for the outright weirdness of the quantum world.

The most widely accepted theory is called the Standard Model of quantum mechanics, with its more than four hundred quantum particles (physicists call this the particle zoo). Essentially, the Standard Model is a quantum theory that explains the fundamental particles and their interactions while also accommodating classical theories, such as Einstein's theories of general relativity and special relativity. As with any theory, it can be thought of as an *interpretation* of a body of experimental data, mathematical knowledge, and theoretical speculations. However, it has a number of problems, as we will describe, so physicists keep searching for better interpretations of the quantum facts. Some of the alternatives include the many worlds theory, which tells us that every possible course of action must be taken. In life, for every decision you make, you include certain possibilities and exclude all others. In the many worlds theory, every possibility is being played out; however, these individual realities split off into parallel worlds, or dimensions, that are inaccessible, so you

will never run into the uncountable other yous who are living out the consequences of every possible outcome of every possible choice. Then there is string theory, which sees the world as made up of tiny, vibrating packets of energy called strings. This theory holds that the world is multidimensional, although most of the other six dimensions (there are competing theories about how many dimensions there actually are) other than our three physical dimensions (and that of time) are curled up into spaces so small we cannot access them. String theory rose in stature more than twenty years ago to become the prime alternative to the Standard Model, and it has since been extended into brane theory, which is also called M theory. However, string theory is entirely mathematical, and because accelerators (those atom smashers we talked about earlier) cannot achieve the extremely high speeds, and so cannot achieve the extraordinary high energies, needed to test string theory—and may never be able to test it—its star is fading of late.[8] These are only two of the many theories of quantum physics, but we are going to talk mostly about the Standard Model, which is based on the Copenhagen interpretation and the Heisenberg uncertainty principle.

THE BIZARRE QUANTUM WORLD

The quantum world is the realm of matter smaller than atoms. It is an inanimate, nonliving world governed by rules very different from those that govern the classical macroworld. In fact, in a rather mind-numbing philosophical claim, most physicists would call it a "shadow world" that is entirely abstract and mathematical. They posit that although everything in our world is dependent on the quantum nature of the universe, the quantum world is *not* the real world. This philosophical conundrum, however, doesn't stop quantum mechanics from being at the heart of modern science.

At the infinitesimal quantum scale, nature is downright quirky. For example, every particle has an antiparticle, also called a virtual particle. These ghostly particles pop out of nothingness for tiny fractions

of a second by borrowing energy from real particles or from the seething energies of the zero-point field (ZPF), which will be described in more detail later but generally can be thought of as a pervasive field that underlies the material universe and contains the lowest possible state of energy, which is the vibrational energy of particles as they pop in and out of existence. The real world exists only because of the interactions between these virtual and real particles: in a whisper of time nothing becomes something and then goes back to being nothing. Yet we, and our world, continue to exist.

We can never directly observe the things of the quantum realm; we can only discover what goes on there indirectly—and what we find is a world that is so counterintuitive, so rife with paradox, that physicists themselves shake their heads in wonder and disbelief. Niels Bohr, one of the fathers of quantum mechanics, once said that anyone who has not been shocked by quantum physics has not understood it. Other physicists, such as Richard Feynman, have claimed that the facts of quantum theory cannot be understood—they are simply too illogical—so we must accept them at face value. In other words, it makes no sense to ask why nature is this way, it just is.

What is so shocking about the quantum realm? Well, for starters, the very act of measuring a particle, say a photon or an electron, changes it. Thus, we can never know everything there is to know about the state of quantum matter, which is the gist of the Heisenberg uncertainty principle. There are fundamental limits about what we can know about a quantum entity, say a particle, at any one time, which is a very different state of affairs from how science functions in our classical macroworld. If you throw a softball, you can, according to classical rules, know precisely both how fast it is going and where it is at every point in its trajectory. With a quantum softball, however, the more you know about the ball's speed, the less you can know about its location. There are limits in the quantum world to how accurately you can determine multiple parameters of an object at the same time. To use an amusing example, if you were driving a quantum car, when you looked

at the speedometer to check your speed, you would suddenly be unable to know precisely where you were!

To reiterate, the Heisenberg uncertainty principle says that by measuring information about one property of a quantum particle or system, you sacrifice accurate knowledge about other properties. However, the problem is not a matter of the quantum system being too complex to understand or of not having tools sophisticated enough to examine the object properly: it is *fundamentally impossible* to know simultaneously everything that is going on with a particle at the quantum level. Our level of accuracy in measuring, and by extension in knowing, has a definite limit because conducting an experiment to find out about this world actually *changes* the world.

One of the reasons the quantum realm is an uncertain world is that particles are not discrete, individual objects. Forget what you were taught in high school physics: atoms are not like little solar systems, with electrons orbiting a nucleus like tiny planets orbiting a sun.[9] Particles are waves, too! This is what the Copenhagen interpretation is all about. Named in honor of Danish physicist Niels Bohr, who first offered it as an explanation for the quirky nature of the quantum world, the Copenhagen interpretation says, basically, that matter has two complementary aspects: matter is both wave and particle *at the same time*. However, you can "see" a quantum entity in only one form or the other—either as a wave or a particle—when you study it. When you are not measuring a subatomic particle, it coalesces back into being *both* wave and particle. Therefore, it makes no logical sense to ask what a quantum entity is when you are not measuring it or otherwise "collapsing" it from the world of probability into the world of actuality.

SHEDDING SOME LIGHT ON QUANTUM WEIRDNESS

This peculiar view of reality started with light. It is a no-brainer that light is a wave. After all, sunlight streams to Earth, a shaft of light

breaks apart to its constituent colors in a prism, and a flashlight sends out a beam of light. However, in 1905 Albert Einstein, following in the footsteps of some earlier physicists, posited that light also has a particle nature—it comes in discrete "packets." He was eventually proved to be correct, and another physicist, Max Planck, called these packets of light "quanta," the word from which quantum theory gets its name. Because a packet of light was thought of as a particle, the new particle needed a name—the photon.

What was so alarming about the strange new nature of light was that when you probed it to see what it was like—is light a particle or is it a wave?—the answer you got depended *only* on what kind of experiment you performed. One of the most famous experiments in quantum physics, called the double-slit experiment, proved that light seemed to "know" what researchers were doing! If they were seeking the wave nature of light, light accommodated them and revealed itself as a wave, but if they were trying to find photons, light would reveal itself as a stream of discrete particles. The only interpretation of the experiment that made sense was that light is both a wave and a particle at the same time. Some scientists even coined a new term for this strange state of matter—*wavicles*—but it never caught on. The stunning conclusion scientists reached from various forms of the double-slit experiment is that the fundamental nature of light is unknowable (neither purely wavelike nor purely particle-like) unless it is constrained in some way, such as by how we choose to study it. Quantum entities are said to be in a superposition of states: when they are not being detected in some way, which scientists often refer to as measuring a particle, they occupy all possible states at the same time.

Let's take a moment to visit the double-slit experiment, for it is an experiment that shattered much of the certainty of classical science and first revealed the weirdness of the quantum world. This experiment not only revealed wave-particle duality but also suggested that the observer or the act of measuring affects the state of the quantum world. Modern versions of the original experiment continue to intrigue

and even astound scientists because they reveal a bizarre phenomenon called nonlocality (also called entanglement and action at a distance), which we will discuss later in this chapter and elsewhere in this book. What follows is, by necessity, a simplified description of the double-slit experiment.

In the classic double-slit experiment, scientists send a stream of photons (or other type of particle) from a single source through their apparatus, forcing the photons to go through one of two tiny holes or slits along the path, call them slit A and slit B, before arriving at a detector. Let's imagine that for the first experiment the scientists close slit A and leave slit B open. They let loose the stream of photons. As expected, many of the photons will pass through the open slit B to hit a detector. They build up as a scattering of points across a region of the detector, thereby indicating that the photons are discrete particles. Think of shooting a gun at a target set up across a field. There will be a random pattern or, depending on your aim, a cluster of hits as the individual bullets contact the target.

Then the scientists conduct a second experiment, in which they leave both slits open. They fire a stream of photons toward the detector. You might think that some of the photons would go through slit A and some through slit B and that as a result there would be two sets of bulletlike patterns at the detector. You would be wrong! Instead, what happens is that over time the strikes at the detector add up in a strange way, creating alternating dark and light bands. (See figure 2.1.) This banded or fringed pattern is a classic interference pattern, and it is created *only* by waves. The photons are now showing their wave nature. Yet why should they? The only difference in the experiment was that two slits were left open instead of one.

This is where the quantum strangeness takes over. As we said, it is as though the photons know the experimental setup. If one slit is open—meaning that there is only one path the photons can take—then they act like particles, firing through the open slitlike bullets, but if both slits are open, meaning that there is more than one path the

photons can take, then they spread out like a wave and take all possible paths. Think of water rushing through a seawall that has been breached in several places. The water will flow through wherever it can. With two slits open, the photons act sort of like water: they go wherever they can, by every possible path. They display their wave nature.

The really strange thing is that even if you leave both slits open but slow down the flow of photons so that you can verify that only one photon at a time goes through a particular slit, you still will get the wave interference pattern. This result makes no (common) sense at all, because you just tracked *individual* photons, like bullets, going through one slit or the other. What this experiment shows is that when presented with more than one path, *a single photon goes through both holes at once*, so the pattern at the detector builds up over time as an interference pattern, which is a wave phenomenon. How can a single photon go through two holes simultaneously? Well, it can't if it is behaving like a particle, but it can if it is spread out and acting like a wave. Somehow the photons "know" the state of the experiment. One hole open, behave like a particle. Two holes open, behave like a wave. The manner in which a quantum entity presents itself to us is determined by how the experiment is conducted, which, philosophically at least, suggests that the subatomic world is somehow connected at a very deep level with living, conscious observers.

One consequence of wave-particle duality is that when you are not looking at a particle, say a photon or an electron, you cannot say it is anywhere in particular. Until you measure it, the photon or electron has an equal probability of being here or there. You have to assume that it is *everywhere* at the same time. An unobserved particle is not a point-like thing but is more cloudlike, smeared out, a fog of possibility that cannot be pinned down until you observe it. The act of measurement or observation is said to collapse the wavefunction, turning one possibility among many into an actuality. ("Wavefunction" is the mathematical expression that describes the quantum entity, determining its position in time.) Hence, probability and statistics entered the world of quantum

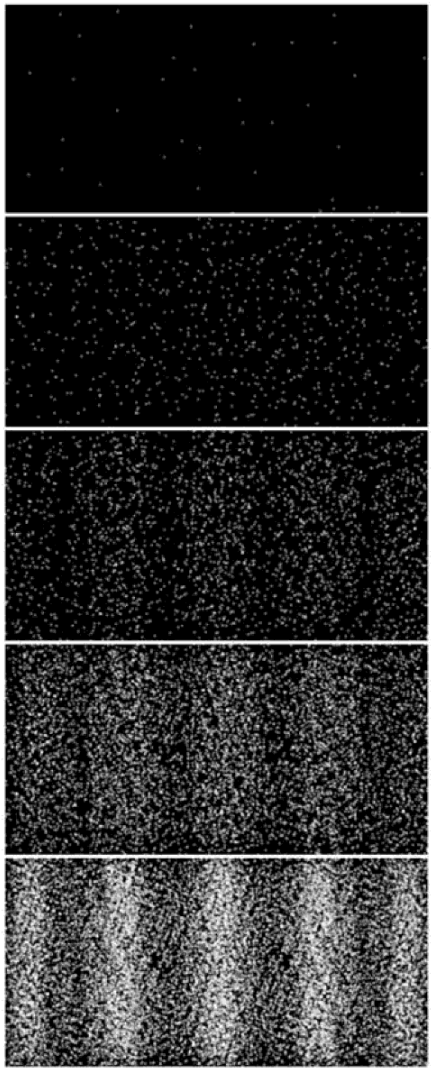

Figure 2.1. In the double-slit experiment, when particles have only one possible path to follow, they hit the detector in a random strike pattern, although clustered in alignment with the slit they went through (first two boxes). This is the classic particle pattern. When particles have more than one path, they take every possible path at once, so the pattern at the detector builds over time to form an interference pattern, which looks like bands of alternating dark and light areas (last three boxes). An interference pattern is created only by waves. The double-slit experiment confirmed what physicists call the wave-particle duality of fundamental quantum entities.

physics, which represented an enormous shift from the certainty that defines measurements in the classical macroworld. (For a more in-depth discussion on waves, including illustrations, see chapter 13.)

No matter where they turned in the quantum world, scientists found equally strange properties of matter. They discovered not only that photons displayed a dual wave-particle nature but also that a host of other particles did, too. In fact, back in the early 1920s, Louis de Broglie, a young Ph.D. student (who, incidentally, was also a prince), argued in his dissertation that there are such things as "matter waves." Basically, he said, *all* matter, not just subatomic particles, has not only a particle nature but a wave nature as well. His was a radical idea, and his dissertation committee thought that perhaps it was too radical to be remotely realistic and so considered rejecting his thesis, but after much deliberation, they finally passed him and awarded him a doctorate in physics. Their good judgment was rewarded in 1927, when experiments proved de Broglie correct. In 1929 he was awarded the Nobel Prize for this theory. The de Broglie matter wave (also called a pilot wave) will play a part in our story later, but for now it is only important for you to realize that at the subatomic level all matter has both wavelike properties and particle-like properties. How quantum entities show themselves depends on our method of observation or measurement.

The wave-particle duality paradox has been minutely examined in many variations of the original double-slit experiment and in many other kinds of experiments over the years, and one interpretation of the results is a theory of quantum physics that says consciousness affects the nature of reality. If something exists only when it is measured, then a logical conclusion, which some physicists have indeed reached, is that *nothing* exists with any certainty unless we observe it, for the conscious human mind is the ultimate measuring instrument. As a consequence, modern quantum physics shape-shifts into metaphysics. For the most part, though, physicists simply prefer not to think about these kinds of philosophical implications.

The double-slit experiment and both its practical and its philo-

sophical implications rattled physicists back in the early days of the young quantum science. Physicist Richard Feynman once claimed that the double-slit experiment is the deepest mystery of quantum science. Over the years, as physicists explored wave-particle duality, the study of quantum physics developed into several distinct disciplines. For example, quantum mechanics is the study of particles and their behaviors, whereas quantum electrodynamics (QED) is the study of the interaction of matter and light, and more generally concerns itself with the wave (or field) aspects of nature. At the level of the quantum realm, QED demonstrates that everything is connected. The world is a vast web of relationships, with everything affecting everything else. Theoretically, because of the wave (or field) nature of the quantum world—and the phenomenon of entanglement, which we will discuss later in this chapter—a particle in my body "knows" what is going on with all the other particles in the universe. Every particle is correlated with or may even causally affect every other particle across the expansive fabric of space-time. Theoretically, at least, ours could be a participatory universe, in which each conscious being affects the expression of the material world.

TROUBLE IN QUANTUMLAND

Despite its mind-stretching implications, the Standard Model of quantum theory grew in stature because it could make precise predictions and experiments kept confirming those predictions to exquisite levels of accuracy. Quantum theory was a huge success, so much so that physicists heralded quantum theory—and QED in particular—as the ultimate answer. They considered it a theory capable of explaining everything. Quite literally, they expected that most of the deepest questions about the universe would be answered by the middle of the twentieth century. Soon they would have a grand unification theory, which would unite all the known forces and particles of nature, and it would be based on the Standard Model.

As we write, at the start of the twenty-first century, those high hopes have been dashed, for scientists in many disciplines have begun grumbling that something is wrong in Quantumland. They are correct, but we have space in this chapter to highlight only a few of those problems.

We can turn to Gordon Kane and his article "The Dawn of Physics Beyond the Standard Model" to review a few of the ten great mysteries of quantum theory as it now stands.[10] One of the biggest problems is that the Standard Model has no place for gravity. A grand unification theory must unite the four fundamental forces of nature: electromagnetic force, weak force, strong force, and gravity. So far, quantum theory has been able to unify all of these forces except for gravity. The more scientists study gravity—and it has been the focus of intense study not only by physicists but also by cosmologists—the more mysterious it appears to be. That is a whole other story, but suffice it to say that the Standard Model's complete lack of success in integrating gravity with the three other fundamental forces is, as Joseph Chilton Pearce once wrote in another context, a huge crack in the cosmic egg!

Another inadequacy that Kane lists is that the Standard Model cannot account for cold, dark matter—a type of matter that scientists believe makes up at least a quarter of the material universe but cannot be directly observed because it does not emit or reflect electromagnetic energy. No known particles in the particle zoo of the Standard Model can account for this matter. Worse, the Standard Model cannot explain fundamental aspects of the big bang theory, the predominant theory of the creation of the universe. The Standard Model's fatal flaw, however, may be that it cannot account for the origin of mass. There are different kinds of mass, such as inertial mass (how resistant something is to a change of its direction or speed, which refers to kinetic energy) and gravitational mass (what we commonly think of as something's weight in a gravitational field). Einstein's famous formula, $E = mc^2$ expresses the equivalence of energy and mass, so physicists often talk about a subatomic particle's mass by referring to its kinetic energy, which they measure in a unit of energy called an electronvolt. To explain the mass of subatomic particles,

physicists have proposed a new field, called a Higgs field, which is still only theoretical as it has not been detected. They propose that particles gain mass through their interactions with this Higgs field, but, as Kane says, "the Standard Model cannot explain the very special forms that the Higgs interactions must take" to account for particle mass.[11]

Many physicists now are willing to admit that if the Standard Model is to survive, it must be radically altered. However, even altering the theory may not be enough. As Kane asserts, "In expressing these mysteries, when I say the Standard Model *cannot* explain a given phenomenon, I do not mean that the theory has not yet explained it but might do so one day. The Standard Model is a highly constrained theory, and it cannot *ever* explain the phenomena [listed in his article]."[12]

A growing number of maverick scientists agree with Kane and so are searching for alternatives to the Standard Model of quantum theory. We call these scientists "mavericks" because they truly are going against the status quo. Despite the profound flaws of the Standard Model, it is one of the most experimentally well-verified theories in the history of science. Most scientists choose not to shine a light into the shadowy areas where things are not working so well—or not at all. It's simply better to ignore the problems or to hope that someone, some day, will come up with a fix. Unfortunately for them, most of the fixes are radically overturning what have become almost sacred tenets of the Standard Model.

NONLOCALITY: SPOOKY ACTION AT A DISTANCE

Experiments into one particular area of quantum physics—called quantum entanglement—are yielding surprising results that are overturning long-held beliefs. Entanglement is a curious property of some particles that yokes them together forever. When two particles—or atoms or molecules—are entangled, you no longer can think of them as separate entities, but rather as a holistic system. They become more like a single object, even when the two individual particles are separated by vast distances.

The history of entanglement is immensely fascinating, and if you are interested you can read about it on the Internet and in most physics books. Basically, the theory proposes and experiments have verified that if two particles were ever connected—if they were created together, interacted during the course of their existence, or share certain inherent properties—then they are *forever* entwined. Measuring a property of one particle of the pair means you know something specific about the other particle, even if that second particle is separated from the first by light-years. Entanglement shows how the quantum realm is based on nonlocality, which means basically that local causes can have distant effects, even when there is no possible way a signal or force could travel between two objects fast enough to form a cause-and-effect relationship.

As an example, imagine a pair of particles, A and B. We want to measure a quantum property called spin, which can take one of two states, which for the sake of simplicity we will call spin up and spin down. Each quantum particle is in a superposition of states, so it is both spin up and spin down at the same time, until it is measured and "chooses" one state or the other. (It's true! That's quantum physics for you!) At the moment of measurement, if particle A shows itself as having spin up, then the other particle, particle B, *must* have the opposite spin, down. What's more, particle B must remain correlated to particle A no matter how far apart the two particles are. Say, for instance, that before they measure particle A, scientists send particle B flying off to the outer reaches of the Milky Way. When they measure particle A, they will instantly know the state of particle B (it will have the opposite spin of particle A). What happens to one particle in the pair *instantaneously* affects what happens to the other particle. How can that be? Particle B is at the edge of our galaxy. For information to reach particle B instantaneously, it would have to violate the law that nothing can travel faster than the speed of light.[13]

There actually is no causal explanation for entanglement, and by extension nonlocality, within the domain of the Standard Model, but the phenomenon is real. It has been experimentally verified beyond a

doubt. Einstein famously called nonlocality "spooky action at a distance," and for him this phenomenon meant that something was seriously wrong with quantum theory. However, as we have said, the phenomenon is well tested, and by using it scientists have explored the teleportation of entangled quantum particles. However, until only a few years ago, they thought entanglement was a strictly quantum phenomenon, that it could not occur in the macroworld, at the level of atoms, never mind anything larger. Then, in 1998, scientists managed to deal a severe blow to that belief by entangling relatively complex macroscopic particles called fullerenes and other, even larger molecules, as discussed in the following section.

WHERE QUANTUM AND CLASSICAL PHYSICS MEET

Scientists have always assumed that there is some boundary at which the quantum rules give way to the classical rules of our everyday world, and that the Heisenberg uncertainty principle and the Copenhagen interpretation's measurement problem are not applicable in the macroworld. Our normal, everyday world shows itself only via classical physics rules, not quantum ones. An apple, person, or mountain is not a probability that coalesces into matter only when we observe it. During a hike, while you are gazing up at the beauty of the trees around you, you can stub your toe on an unseen rock on the trail. Scientists were sure that somewhere, at some level, there was a clear boundary that separated the quantum world from the classical world. The shift across that hypothetical boundary represents the greatest "phase change" of them all, but until very recently no one had been able to detect where and how it happens.

It turns out there is no well-defined boundary after all. In 2003, Markus Arndt and Anton Zeilinger, of the Institute for Experimental Physics in Austria, were able to show experimentally the wave nature of molecules, such as the biomolecule tetraphenylprophyrin and the

massive (by biological standards) fluorinated "buckyball."[14] Science has always told us that the molecules in the macroworld definitely show properties of being particles, so according to the Standard Model they should not display any quantum wavelike properties. But they do. In fact, as of the writing of this book, the fluorinated buckyball holds "the world record for the most massive single particle to display quantum interference."[15] (Interference, remember, is a wave phenomenon.) The result of these experiments is that the crack in the cosmic egg has widened, for these molecules are huge by quantum standards and so should be affected only by the rules of classical physics. Arndt and Zeilinger's experiments are among the first to indicate that there may be no clear-cut division between the quantum and classical worlds.

The cracks in the cosmic egg widen even more if we take this idea farther by suggesting that subatomic particles themselves may be "appearances" and not "real" things at all. In other words, the universe is dominated by waves, not particles. This idea is not new. It goes back to one of the fathers of quantum physics, Erwin Shrödinger, who called particles *Schaumkommen* (most commonly translated as "appearances") and to de Broglie's matter waves. The NES model of the human body-field agrees with a radical theory of quantum physics called space resonance theory, conceived by physicist Milo Wolff, which posits that most particles are indeed only appearances caused by the interaction (interference) of waves, as will be explained in more detail later in this book. Wolff posits that as two waves (of certain types) interact, the very shape of space itself changes, and that what appear to us as different particles really are the different characteristics of space (differing resonances). A theory by physicist John G. Cramer, called the transactional interpretation, also suggests that waves, not particles, may be primary in nature.

Such wave-dependent theories are gaining wider acceptance in the physics community as it becomes clear that they can explain many of the paradoxes and mysteries of the quantum Standard Model, such as wave-particle duality, nonlocality, and entanglement. In fact, a recent

experiment by physicist Shahriar Afshar in part verifies the hypotheses of Wolff and Cramer. This experiment has rocked the world of physics, and its results are extremely controversial, as discussed in the following section.

THE END OF PHOTONS?

Afshar carried out a new version of the double-slit experiment, and his results may overturn the original interpretation of that experiment.[16] Remember that the Standard Model interpretation of the double-slit experiment suggests that subatomic "things" exhibit wave-particle duality. Remember also that a subatomic entity such as an electron or photon exists in a superposition of states. In the quantum realm, particles and waves cannot be said to exist in any specific form when we aren't looking at them (measuring and/or observing them). Until they appear in our real world when we collapse the wavefunction, we can't know anything about them with any certainty—not what they are or where they are. Until it is measured, a quantum "thing" is in every possible state at the same time!

Afshar's recent variation on the double-slit experiment may change that interpretation. He contends that he has been able to capture both the particle and wave signatures of a subatomic particle in a *single experiment*. In fact, he believes that the wave aspect of matter takes precedence and that it is the interference of all the waves of the cosmos that results in the appearance of matter (nature's particle aspect). This experiment seems to confirm Schrödinger's intuition that the wave aspect of matter dominates and that particles are illusions that arise out of the behavior of quantum field interactions. The result from Afshar's initial experiment flies in the face of the Standard Model, meaning, as he says, that "something everyone believed for 80 years may be wrong." That "something" to which he is referring is the particle aspect of the photon, for according to Afshar, light may be *only* a wave. He says that if his results hold up, then "we have no other choice

but to declare the idea of Einstein's photon dead." The implications of Afshar's experiment, if independently verified, are enormous. As he said, "if the same results are obtained in analogous experiments using particles other than photons then the debate would cover the whole of quantum mechanics."

Wolff and Cramer, as we earlier indicated, are two of the physicists who have been theoretically championing the idea of a wave-dominant reality, although Afshar is among the first physicists who may have demonstrated this premise experimentally. It goes without saying that Afshar's interpretation of the experiment is extremely controversial among mainstream physicists, for it would overturn the established assumptions of the Standard Model. However, even some of the founders of quantum theory would have been on his side. Along with Shrödinger, other physicists, including Einstein, de Broglie, and David Bohm, felt that wave-particle duality and the resulting probabilistic nature of physics showed that the Standard Model was incomplete. They felt there must be underlying laws that would explain away quantum indeterminacy. Today, there are many who join them in the assessment that the Standard Model needs to be radically amended. As Nobel laureate David Gross admitted, at the close of a physics conference in 2005, physicists today are in a "period of utter confusion."[17] However, paradigms die hard, so much so that physicists such as Wolff, Cramer, Afshar, and others usually have a difficult time getting a fair hearing for their theories or acceptance for their experiments.

Anyone paying attention to the state of the field will likely agree that physics is on the cusp of another revolution, one that could change how we think about reality—and ourselves. That revisioning is likely to be every bit as radical as when quantum theory burst onto the scene in the early twentieth century. One of the most important consequences of this upheaval could be a new way of thinking about the body, for it seems only reasonable to assert that if quantum physics underlies everything, and certainly chemistry, then it is also primary in the human body. Thankfully, the paradigm is shifting, and we are finding such

evidence, especially in the human body. Bioenergetics and biophysics are growing disciplines that will eventually make inroads into the staid terrain of conventional medicine. As you are reading this book, biologists and others are dusting off mounds of old research and reexamining the work of many researchers from the early part of last century. These researchers were once dismissed as charlatans at worst or as sadly misguided at best, but now open-minded biologists and biophysicists are realizing what many of them really were—visionaries and pioneers. We humbly acknowledge that we stand on their shoulders, and we turn now to a brief overview of some of their evidence for the biophysics—the quantum nature—of the body.

3

The Intelligence of the Body

Quantum physicists discovered that physical atoms are made up of vortices of energy that are constantly spinning and vibrating; each atom is like a wobbly spinning top that radiates energy. Because each atom has its own specific energy signature (wobble), assemblies of atoms (molecules) collectively radiate their own identifying energy patterns. So every material structure in the universe, including you and me, radiates a unique energy signature.

Cell biologist Bruce H. Lipton,
The Biology of Belief

THE TWENTY-FIRST CENTURY is being called the century of biology, but it might better be called the century of quantum biology. Within the past few decades, scientists have found, among many other startling findings, that the body may be holographic in nature, cells in the human body emit light, immune cells have neuronlike synapses, the connective tissue of the body forms a sophisticated information network not unlike a second nervous system, muscles may store memories,

and water can be imprinted with information. As they develop ever more sophisticated tools and ask new kinds of questions, researchers are proving that the body is more of a self-organizing, intelligent network of information than ever thought possible. Their progress largely is the result of applying physics to biology.

It goes without saying that the body is one of the most complex of living systems. However, biophysics is not the physics of traditional scientists; it takes a more creative, and ever daring, approach to understanding the nature of living systems. As Koichiro Matsuno and Raymond C. Paton wrote, "Biology is not about applying quantum mechanics as it is already known through the experiences of traditional physics, but rather about an attempt to extend quantum mechanics in the manner that the physicists have not tried."[1]

The study of possible quantum processes in the body is still in its infancy, but one area of intense interest is the electromagnetic processes in the body—light in the body. Scientists once thought that electric energy and magnetic energy were different, but eventually they were found to be two aspects of one force. The varying lengths and frequencies (energy levels) of electromagnetic waves make up the electromagnetic spectrum. The electromagnetic spectrum ranges from radio waves (long wavelengths and low energies) to X-rays and gamma rays (short wavelengths and high energies), with visible light falling at about the midpoint. Of course, modern science has known for decades that the body contains all kinds of energies, including electromagnetic energy. Because the brain produces different kinds of electromagnetic waves (e.g., alpha, beta, delta, theta), doctors can detect brain states using an electroencephalograph (known as an EEG) and determine the electrical state of the heart using the electrocardiograph (known as an ECG).

Magnetics is big business in medicine, especially in imaging. Most readers will be familiar with the MRI (magnetic resonance imaging) machine, which uses magnetics to create an image of tissue by measuring tissue density. It is a static technology. However, the newer fMRI (functional magnetic resonance imaging) is a dynamic technology that

images parts of the body, such as the brain, as they are working. For instance, in the brain, fMRI measures blood flow, volume, and oxygenation and so can see how different parts of the brain become active as the person whose brain is being imaged carries out different tasks. An fMRI machine is able to create three-dimensional images of body tissues by exciting the protons in our cells. Protons have magnetic properties, so they can be thought of as tiny biomagnets. They are part of the nuclei of hydrogen atoms, and hydrogen is part of the trillions of water molecules in our bodies. The fMRI machine creates an extremely strong magnetic field (estimated to be about thirty thousand times the strength of Earth's magnetic field) and then fires radio waves at the patient's body, which affect the orientation of the proton biomagnets, causing them to transmit at a particular frequency. The fMRI machine then uses mathematical calculations and other techniques to construct a hologram of the body part that the machine has scanned.

The fMRI machine may, in fact, be medicine's first holographic instrument. Traditionally, a hologram is a three-dimensional image created on a two-dimensional photographic plate.[2] When coherent light (such as laser light) is shined on the plate, the image leaps off the flat surface into three dimensions, seeming to float in midair. You can rotate the image to see it from all directions. (What you are seeing, really, is a record of wave interference patterns and phase.) A hologram doesn't have to be a photographic image. Some maverick scientists posit that our brains and even our entire universe are holograms or display holographic properties.

A hologram has some curious properties. Let's say we make a hologram of an apple. If you cut up that hologram, instead of getting bits and pieces of the apple image, you get many *complete* apple images, only each apple is smaller and a bit less clear than the original. If you rotate your holographic apple, it would look exactly as though you were turning a real apple in your hand. Move the top of the image toward you, and the apple's stem comes into view; move the top away from you far enough and you'll see the bottom of the apple.

It is important to remember that a hologram is really nothing more than a display of the intensity of the light—a record of the photons—given off by an object or scene. Bioluminescence is the light emitted by living organisms; it is the collective light given off by individual "biophotons." Biophotonic and bioelectromagnetic research dominate the study of energies in the body, so that is where we will begin our review of bioenergetics. Before we do, let us take a moment to comment on two aspects of biophysics research that present special challenges to those who study possible quantum processes in the body.

One of the many difficulties in testing biological systems—human or otherwise—for quantum processes is that the studies must be conducted *in vivo,* which means with living, not dead, tissue. This requirement, of course, presents challenges most other scientists, even conventional biologists, do not face. Biologists usually take cells apart to study them. It is reductionist, not integrative, science. Studying dead or ground up cells can teach us a lot, but it cannot tell us much about the coherent quantum processes that emerge only within the matrix of a living system. So biophysicists, because they ideally must study live human beings or live tissue, have huge methodological challenges to surmount as they work to turn their young science into a thriving, mature science.

The second challenge facing frontier scientists is one more of belief than of methodology. Conventional scientists deny that quantum effects can ever be detected in the body (or in anything much larger than atoms) because of a phenomenon called decoherence, which rests on two pillars: size and environment. The rule is that the larger the mass of an object, the smaller the de Broglie matter wave, which represents the wave aspect of matter and, hence, is its quantum signature. Because the de Broglie matter wave is incredibly small in comparison with the mass of a human body, we cannot detect, and so cannot extract, any quantum information from our bodies. In addition, it is claimed that decoherence cannot be detected because all macroscopic objects are in interaction with complex environments, and there is no

way to separate coherent quantum information from the "noise" produced by those interactions. In other words, physical things much larger than atoms are too messy—there are too many intricate and complex interactions going on for scientists to be able to sort out only the quantum signals of the object. The only way to do that, according to the Standard Model of quantum physics, is to isolate the object or system from the environment to keep it from any interaction with light, heat, gas molecules, and other things that could collapse the quantum wavefunction. Because we cannot yet do that, conventional scientists tell us that the quantum-classical boundary can never be breached, decoherence rules, and as a result, macroscopic objects are subject only to the laws of classical physics.

Not so fast! Nature often has a way of one-upping science. Recently researchers have observed quantum interference in the macroworld, detecting the nature of large molecules. As previously stated, they have been able to entangle atoms and large molecules, which means they have coaxed individual particles to pair up to work as a team. At the quantum level, entangled photons make lasers possible, and entangled electrons account for superconductivity. Entanglement was thought to be a quantum-only process. However, recent breakthroughs in macroscopic entanglement are breaching the boundary science had thought was impenetrable.[3]

For example, Brian Juldgaard and his team of researchers have entangled cesium gas molecules. Other scientists have entangled sodium ions and even atoms, which are huge by quantum standards. Scientists have even entangled subatomic particles and then teleported the information carried by the particles, a phenomenon that previously had been only a plot device for science fiction novels. That fabled fixed boundary between the microworld and the macroworld is slipping, and it's slipping faster than ever expected. In fact, more and more physicists and biologists, and especially consciousness researchers, are realizing that the reductionist scientific methods and theories of the past cannot ever adequately explain life and the processes of living systems. They are turning to quantum

physics for explanations, and they are detecting its fingerprints almost everywhere they look. What they are finding may change the face of quantum physics, because, as Mark Buchanan wrote, although it may seem as though information arises from quantum particles, the reality may be exactly the opposite: "Quantum particles might be catching their behaviour from the information they contain."[4]

More and more evidence is being amassed in favor of the theory that life, at a level more fundamental than that shown through chemistry, is dependent on fields of information: a cell knows how and when to divide, a protein knows how and when to fold itself into an intricate three-dimensional structure, and a muscle knows how and when to react to the intention someone has of moving her leg. Many, many researchers are teasing out the information processes of the body, and they are finding that those information networks are directed by quantum, not classical, rules.

Information and quantum entanglement are, of course, at the heart of consciousness studies as well. Many researchers are positing that entanglement may explain consciousness—and they are able to show it, macroscopically. For example, in his book *Entangled Minds: Extrasensory Experiences in a Quantum Reality,* Dean Radin, laboratory director at the Institute of Noetic Sciences and former researcher into paranormal phenomenon for the US government, describes an experiment in which researchers not only were able to show entanglement of brain states but also were able to capture the physical, biological effect of entanglement.[5] Two subjects were placed in two widely separated rooms that were specially screened to prevent electromagnetic and other kinds of energies from penetrating. Each subject was hooked up to a machine that could pinpoint his brain activity. A light was pulsed into the eyes of one of the subjects, causing a specific part of his brain to become active. At the time of the light pulsation into the first subject's eyes, the brain of the other subject, who was in the other room and so not exposed to any light pulsation, also became active in the same spot, as indicated by the brain scanning technology. This is a nonlocal, and

hence quantum, event. The only plausible explanation is that the brain waves of the two subjects somehow became entangled at the quantum level. What is truly astounding in this experiment and others like it is that there was *a nearly instantaneous transfer of information that caused very real effects in the macroscopic world.* The mechanism for this transfer appears to be a quantum field of *consciousness* that, because of some form of entanglement (a form not currently understood within the parameters of the Standard Model of quantum mechanics), can transmit information about the state of one subject's brain to the brain of another subject instantaneously. The fact that the effect was nearly instantaneous across space and penetrated an electromagnetically screened room means that no electromagnetic energy signal could have been the cause. The change, then, must have been mediated through an *information field,* which is not constrained by relativity theory.

Such experiments mystify even frontier scientists, for they suggest that at some deep, fundamental level we are all connected. The most plausible mechanism for such a web of relationships is the field effect—that fields of information permeate the universe and everything is part of this intricate web of relationships, linking us in ways we have only begun to imagine, never mind explore. In terms of decoherence, such experiments suggest that a fixed boundary between the quantum and the nonquantum worlds is an illusion. Everything in the universe is entangled with everything else, so everything, at some primordial level, affects or correlates with everything else.

A few conventional biologists are beginning to see that isolating the study of life from its environment creates a false dichotomy. They suggest that the way to broach the presumed barrier between the microworld and the macroworld is to learn to measure the particle/mass/object system *and* the environment in which it is entangled. For example, mathematician Chris Clarke reasoned, "Decoherence is the loss of quantum information to the environment; but the universe as a whole *has no environment.* Cosmologically, information is never lost. . . . This suggests . . . that the universe remains coherent;

it was, is and always will be a pure quantum system. The non-coherence of medium scale physics . . . is only an approximate consequence of our worm's-eye view."[6]

Radin and his colleagues in consciousness and paranormal research may be accomplishing what Clarke is suggesting is possible—measuring the object of study in interaction with the environment. It also may be what NES has accomplished in measuring the human body-field. Conventional science tends to isolate objects for study. However, a NES assessment is not a measure of the *isolated* body-field but instead is a measure of the functional integrity of the body-field *in relation to the environment,* both inner and outer. That is, it is a measure of the state of the body-field in relation to everything from the external environment (electromagnetic waves, gravity, exposure to pollutants and toxins, and so on) and from the person's internal state (his or her emotions, diet, cellular metabolism, and the like). You might say it is a measure of the state of the body-field's *feedback loops.* Biologists will tell you that nothing living exists in isolation. Even single-cell organisms need to receive input, such as food, from the environment. The physics of life is the physics of loops of information that provide feedback between the organism and the environment, so that the organism can constantly adjust itself and maintain homeostasis. Biologists even have names for the formal studies of the feedback loops between cells and living organisms and their environments—systems biology and epigenetics (which means "control above genetics").

Cell biologist and former Princeton University professor Bruce Lipton, in his book *The Biology of Belief,* wrote about his own scientific and personal epiphany of how information (in the form of feedback between cells and their environments) constitutes intelligence in the body. He said, as he was trying to keep isolated cell cultures alive for study, "Twenty years after my mentor Irv Konigsberg's advice to first consider the environment when your cells are ailing, I finally got it. DNA does not control biology, and the nucleus of the cell itself is not

the brain of the cell. Just like you and me, cells are shaped by where they live. In other words, it's the environment, stupid."[7]

Although much more research needs to be done to prove the following conjecture, NES may be the first biotechnology that can measure the state of a person's health by taking into account the *entanglement* of the environment with the body (via the body-field). A NES–Professional System scan may be measuring whether the information that cells are receiving from the external and internal environments is getting through to them properly, in a state that is coherent and undistorted. A series of NES scans over time may be peeling back the layers of the holographic body-field, the information fields that record everything that has happened to the person over time and the effects of everything to which he or she has been exposed, and accessing the information stored in each layer.

The scientific paradigm is shifting, and bioenergetics and biophysics are blossoming disciplines that could eventually make inroads into the staid terrain of conventional medicine. In fact, we at NES are so bold as to suggest that living, organic systems will turn out to be something like a "third realm" of nature. Classical physics and quantum physics currently are seen as the two primary, but separate, realms of nature. This third realm likely will reveal itself as a fusion or integration of the two. The next great revolution is happening now—and it is about the *integrative* properties of life. The revolution depends on our continuing to discover new methods, both intellectual and technological, for exploring living, breathing human beings (and other organisms) and the special properties that define life. As we do, a new medicine will emerge—a view of health that integrates both our physical and energetic aspects. Let's look now at some of the evidence for this new view of the body.

BIOPHOTONS

German biophysicist Fritz-Albert Popp is widely considered the father of modern bioelectromagnetic research, having coined the term *bio-*

photon in the 1970s.[8] He is a man fascinated by light, especially how light interacts with the body, and his research is largely responsible for spurring scientists from around the world to unlock the secrets of how the body produces and uses ultraweak light and other electromagnetic waves.

Among Popp's early major discoveries was that carcinogenic compounds use light differently than do noncarcinogenic compounds. Many chemicals absorb light and then can be made to re-emit that light. What Popp found was that carcinogenic compounds somehow changed the light signal used by cells, jumbling it before the cells re-emitted it. What's more, to his and others' amazement, Popp found that carcinogens particularly liked to scramble light at a frequency of 380 nanometers. He came to believe that this was a special wavelength in regard to the body, and he soon made a connection to the photo-repair mechanisms by which cells repair the damage done to them by ultraviolet rays from the sun and other sources. Photo-repair is a well verified but little understood process, and Popp made the daring intellectual leap of positing that to conduct photo-repair, cells must themselves be emitting light. As he probed farther, he was shocked to discover that there is one wavelength at which the cellular photo-repair process works most efficiently. You guessed it—at 380 nanometers! Perhaps, he reasoned, compounds that cause cancer do so because they block the precise wavelength of light that the cells need to repair ultraviolet damage.

To further explore light in the body, Popp needed new technology that could detect such light at ultraweak intensities. Bernhard Ruth, one of his graduate students, rose to the challenge, and soon he and Popp were using the new technology to explore whether living cells emit light. They started with cucumber seeds, and they indeed found light, but, they reasoned, perhaps the light was a by-product of photosynthesis. So they grew cucumber seeds in the dark and tested them under conditions that would guarantee that photosynthesis would have no effect. They still found light. What's more, they found *coherent* light.

As previously explained, it is thought that quantum processes give way to classical ones in the hot, wet environment of the body because heat and chaotic influences from the environment lead to decoherence of the quantum signals. That Popp found *coherent* light in the body amounted to an overturning of some of the most deeply entrenched beliefs in physics and biology. What's so special about coherent light? Well, it means that individual photons somehow become connected and cooperative, working together to transmit information about the state of the system. Think of an unruly crowd of fans at a football game suddenly focusing their attention and rising together in groups to do the wave cheer. That's coherence at work. The individuals are still individuals, but for a certain amount of time they come together, acting as one, in a purposeful behavior that has meaning. No one believed quantum particles in the body could cooperate like that. After further research, Popp came to believe that the source of the coherent light in the body is DNA. He believes that DNA uses light signals to coordinate the hundreds of thousands of chemical processes that occur every second in every cell of the body.

Popp eventually tested his theory on both healthy and ill people. What he found was intriguing. The cells of healthy people emitted coherent light, but in ill people, the emitted light was scrambled or their cells emitted either too much or too little coherent light. Journalist Lynne McTaggart, in recounting the results of those early tests, wrote:

> In every instance, the cancer patients had lost these natural periodic rhythms and also their coherence. The lines of internal communication were scrambled. They had lost their connection with the world. In effect, their light was going out.
>
> Just the opposite occurred with multiple sclerosis. MS was a state of too much order. Individuals with this disease were taking in too much light, and this was inhibiting the ability of cells to do their job. . . . MS patients were drowning in light.[9]

The results of Popp's experiments have not yet led to any viable therapies, but they pointed researchers in directions they had never thought to go. Indeed, many researchers around the world followed Popp's lead, studying bioluminescence in the body and the role of biophotons in health and disease. As one example, a team led by Korean scientists confirmed what other researchers in Germany, Japan, Russia, Poland, Italy, China, and the United States have found—that the body does indeed emit ultraweak coherent light. In their article "Biophoton Emission from the Hands," the Korean-led team reported that they detected 34 percent more biophotons (in the range of 300–650 nanometers) coming from the hands of their twenty healthy volunteers than could be expected if the photons were simply a result of natural background emissions. They also confirmed that the biophotons were not created as a consequence of thermal radiation or body heat.[10]

THE CELL

In chapter 1, we briefly mentioned Gilbert Ling's revamping of cell membrane theory.[11] He and many other molecular and cell biologists do not believe that the sodium-potassium, membrane-pump theory of the cell can be correct. Their reasons include that cells do not have enough energy to keep the pumps working and that the cell membrane sac by itself does not allow sodium ions to pass through it, as the pump-channel theory predicts. Whereas conventional biologists identify the cell nucleus, which contains DNA, as the command center of the cell, Ling raises the cell protoplasm to primary status in cell functioning. This protoplasm, a kind of internal cellular matrix, has been the focus of intense study by frontier scientists, for it appears that the most vital functioning of the cell takes place here. In fact, the cellular protoplasm matrix may be more important than the DNA that is curled up in the nucleus of every cell. However, Ling is not the only scientist overturning established wisdom about cell functioning.

Lipton sees the cell membrane as primary and, like Ling, views the cell nucleus, and DNA, as less important. He has recounted experiments with enucleated cells, which are cells from which the nucleus has been removed. DNA is supposed to program everything vital to the life of a cell, to be the cell's "brain." However, cells in which the nucleus, and hence the DNA, had been removed survived, and functioned, for more than two months! Lipton wrote, "Viable enucleated cells do not lie about like brain-dead lumps of cytoplasm on life-support systems. These cells actively ingest and metabolize food, maintain coordinated operation of their physiologic systems (respiration, digestion, excretion, motility, etc.), retain an ability to communicate with other cells, and are able to engage in appropriate responses to growth and protection-requiring environmental stimuli."[12]

Although these enucleated cells cannot divide or reproduce parts of proteins they need for long-term survival, Lipton's experiments demonstrate, nonetheless, that the nucleus is not the control center of the cell. The enucleated cells can function normally, they just can't reproduce, which leads Lipton to suggest that biologists who believe a cell's intelligence is in the nucleus are confusing a cell's gonads for its brain! Instead, he believes the cell membrane is the primary information control-and-command center. The cell membrane receives signals from the outside world, interprets those signals in relation to its condition and that of all the other cells of the body, and then transmits the appropriate information into the interior of the cell. Those environmental signals, for instance, can cause cells to spur protein shape changes, and the changes in turn pass information on to the DNA in the cell nucleus. Lipton wrote, "Studies of protein synthesis reveal that epigenetic [above the level of genes] 'dials' can create 2000 or more variations of [regulatory] proteins from the same gene blueprint."[13]

The blueprint of life, then, may not be DNA, but rather our cells' ability (intelligence) to communicate with the environment. Cells are not isolated bags of fluid that are containers for life's engine (DNA) but rather are the receiver-antenna systems—the broadcast stations—

for sending instructions to DNA by monitoring environments both internal to the body and external to it. These feedback loops then coordinate life's essential functions.

Other researchers are conducting experiments that are confirming that the cell's primacy as a communication center for the body is at least partly dependent on its ability to serve as the receiver of environmental input. W. R. Adey, a researcher of bio-electromagnetism, reviewed what he called the "growing scientific consensus" among cell and molecular biologists that cells are sensitive to external fields, such as environmental electromagnetic fields, and that these fields impart information that cells use at the atomic level to coordinate physiological activity.[14] Physicist Herbert Fröhlich, whose work we will discuss in more detail later in this chapter, found that cells oscillate, or vibrate, in a collective way that allows a kind of cooperative information network, or field, to be set up in the body. (These oscillations have come to be known as Fröhlich oscillations.) Information can travel almost instantaneously to every nook and cranny of the body via such a field. Fröhlich also postulates that the collection of cells that makes up the living matrix of the body form a crystalline array by which the body becomes extremely sensitive to environmental signals. We could cite many, many other studies that show how the boundaries between the cell's interior (and our genetic material) and the external environment are less rigid than conventional biologists would have us believe. However, we trust that our point has been made: cells may be thought of as having a kind of intelligence, actively cooperating in vast communication networks within the body and between the body and its environment.

THE CONNECTIVE TISSUE MATRIX

The body is abuzz with signals and messages that keep the complex machinery of its biology functioning. We tend to think of the brain as the generator of the body's intelligence, but information is being sent

and received continuously to and by the nervous and muscular systems, the network of connective tissue, the circulatory and immune systems, and many other biological structures and systems. Recent studies have revealed that this communication is coordinated not only by the brain but also by the connective tissue that forms a far-reaching network in the body.

Bioenergetics research is showing that many types of biological molecules are configured in a crystalline lattice that allows the molecules to be packed together tightly, so that signals are able to race through the lattice network of molecules at nearly instantaneous speeds. The connective tissue in the body, in particular, appears to be an efficient transmitter of information. This matrix is composed of several different kinds of tissues, generally called fascial tissue, that run through the body at varying depths. The Langer's lines, or tension lines, are a network of superficial fascia that lies just under the skin, and the perineural system is a web of connective tissue that spreads throughout the body around nerves, allowing neural waves from the brain to propagate through the entire body. The digestive and lymphatic systems are formed from a type of connective tissue called collagen, and the muscular system is made of still another kind of connective tissue, myofascia. As Oschman wrote in *Energy Medicine in Therapeutics and Human Performance:*

> All movements, of the body as a whole and of its smallest parts, are created by tensions carried through the connective tissue fabric. It is a liquid crystal material and its components are semiconductors. . . . One of the semiconductor properties of connective tissue is *piezoelectricity*, from the Greek, meaning "pressure electricity." Because of piezoelectricity, every movement of the body, every pressure and every tension anywhere, generates a variety of oscillating bioelectrical signals or microcurrents and other kinds of signals. . . .[15]

Because cells are surrounded by and embedded in connective tissue, they can communicate via this piezoelectrical network, turning the

body into one vast electromagnetic signaling system so that every cell knows what every other cell is doing.

Other studies show that connective tissue—as a major information network—may be crucial to many of the body's other critical functions. It may mediate the body's emotional state (because memory, especially traumatic memory, may be stored in muscles and other tissues), its ability to deal with toxins, and the capacity of cells to efficiently process energy (in the form of ATP). The connective tissue matrix may be the most unexplored territory of the body when it comes to information processing, and discovering its riches is bound to drastically change the way we think of health and treat illness.

MICROTUBULES

Cells themselves contain their own type of connective tissue—the cytoskeleton. Among other structures, a cell's cytoskeleton contains microtubules—miniscule hollow tubes—that have become a focus of study in biophysics because quantum processes in the microtubules of the brain may explain the mechanisms of memory and even account for consciousness itself. In fact, one of the most promising theories for explaining consciousness comes from biophysics researchers who postulate that consciousness is holographic. Whereas conventional brain researchers describe consciousness as arising from the electrochemical processes that occur across synapses and being dependent on neurons, biophysics researchers postulate that microtubules may actually be the structures from which consciousness, in whole or in part, arises, for within them occurs the strange process of quantum tunneling.[16] This is a well-verified process in physics in which particles, such as electrons, can travel from one place (inside the microtubules) to another (outside the microtubules) without having to travel the distance in between! In other words, quantum particles can go through walls without actually going through the walls. They just appear on the other side. Scientists speculate that the quantum nature of this process

allows information to be distributed in the body almost instantaneously.

Other researchers suggest that memory is found not just in the brain but is distributed throughout the body, with the implication that the microtubules in the cytoskeleton of cells play a crucial role in body-memory storage and distribution. As you will see later in this book, the NES model of health recognizes that microtubules, and cavities of all shapes and sizes, are vital to the health of the body, for one of their most important functions appears to be as collectors of zero-point energy, which is vital to the constitution of the body and its well-being.

THE PERINEURAL SYSTEM

Dr. Robert O. Becker is a pioneer in the study of the effects of electromagnetic waves on health.[17] The area of his research that most intrigues us in this chapter is his insight into the workings of the perineural system, that web of connective tissue that surrounds nerves and that can be thought of as a separate nervous system. The central nervous system, which is brain-dependent, is known for its speed. When you are in danger, you can't think, you have to react. The sympathetic division of your autonomic nervous system provides the rush of energy that helps you respond quickly when you are threatened.

However, for most of the day-to-day physiological functions that keep you alive, precision is preferable to speed. Your cells, tissues, and organs have to perform work that is exacting, such as producing a specific hormone in just the right amount and at just the right time. When they don't, illness, especially chronic illnesses, can result. The brain-based system is more skilled in getting messages where they need to go quickly rather than getting every detail of the message correct. Becker describes the perineural system as the perfect system to transmit this kind of precise information because it transfers information via very slow waves. He views the perineural system as an analog system, whereas the brain-based nervous system is a fast-pulse, digital system.

Peter's research supports and confirms aspects of Becker's work. In part 2 of this book, we describe how NES grew out of Peter's initial search for a deeper understanding of the acupuncture meridians. These medians are thought to be energy channels in the body, but what kind of energy runs through them and how that energy affects the body is largely unexplained. In traditional Chinese medicine there is a belief that a life-force energy, called qi, flows through these meridian channels, many of which lie just under the skin. Deeper inner channels branch from the main channels, but these inner meridians do not have acupuncture points at the skin level as do the surface meridians. Qi must flow properly through the meridians to all parts of the body for a person to be healthy and emotionally balanced.

Many Chinese and other texts suggest that the meridians are in fact linked intimately (from an informational perspective) with the skin, which is, after all, the largest organ of the body. It is widely believed that acupuncture needles, which are inserted through the skin, may be stimulating energy channels that travel through the body. These channels appear to be connected to the Langer's lines, the superficial connective tissue that lies just beneath the skin, but Peter did not find that this was case. In his experiments, he found that the meridians, especially the liver meridian, are linked tightly to the deeper layers of connective tissue and barely "talk" to the skin or upper layers at all. It is likely that the NES Integrators, as Peter came to call the information "route maps" of the body, are connected not to the Langer's lines but rather to the perineural system. This surprising result tallies with the work of Becker and other scientists who view the connective tissue as an information network that is critical to the proper functioning of the body and the maintenance of health. These findings also corroborate the theories of Ida Rolf, the developer of the deep-tissue therapy, Rolfing, that is named after her, and the developers of the various forms of myofascial release therapy, who believe that the condition of a person's deep-layer connective tissue reflects the state of their overall health.

THE IMMUNE SYSTEM

That the matrix of connective tissue carries information as a kind of second brain—or another type of nervous system—in the body is not the stuff of science fiction. Also, more than the connective tissue network may be involved in forming this information highway. One recent study, reported in *Scientific American* in 2006, shows that synapses, which until now have been found only in the neural network of the brain, have been discovered in the immune system. Researchers have found immune cells that grow structured but adaptable connections that look like and appear to work like the synapses in the brain.[18] They speculate that these immune cells may "form an information-sharing network to fight disease."

Although their findings are controversial, these immunologists posit that the functions of these immune system synapses "could include initiating communication, or terminating it, or serving to modulate the volume, so to speak, of signals between two cells." They also have discovered that viruses may be able to exploit these immune cell synapses. One research team mentioned in the article reported seeing "'viral synapse' phenomena, and so it seems that viruses, which are known for hijacking cellular machinery to copy their genetic material, may also be able to co-opt cellular mechanisms for communication to propel themselves from one cell to another."

COHERENT FIELDS

The history of vibrational medicine is too long and complex to properly review in this chapter, but several aspects of this discipline are crucial to our investigation of the bioenergetic and quantum processes in the body. Resonance in particular is turning out to be an important method of intercellular communication. The term *resonance* refers to shared frequencies within a system. It takes two forms: destructive or constructive. A classic example of the destructive force of resonance is a platoon of soldiers marching across a bridge. Because they are march-

ing in step, their boots strike the bridge at the same time, which sets up a shared frequency, or resonance. The combined vibrations cause a ramping up of energy. As the resonance from the soldiers' footfalls travels through the structure of the bridge, the bridge begins to vibrate at the same energy level as the footfalls, and the resonance between the two can actually cause the structural integrity of the bridge to give way, causing a collapse. In a more familiar example, the resonance set up between a singer and a crystal wine goblet can cause the goblet to shatter.

Resonance also can be constructive, as when it takes the form of coupled oscillators, which form coherent fields. Individual systems, which each might be chaotic on their own, can take on new qualities or characteristics as the individual elements coalesce into an ordered whole. Visible light is a stream of freewheeling photons, but focus that stream of light, making it supercoherent, and you have a laser. In the body, coherent resonant fields may enable individual molecules, cells, and even organ systems to share information.

Albert Szent-Györgyi, a Nobel prize–winning biochemist who made major discoveries in the 1940s about how certain cell molecules (specifically mysoin) control muscle functioning, is considered by many to be among the leading figures in the history of bioenergetics.[19] Many of his speculations about how the body works have been verified by a later generation of biophysics researchers. One of Szent-Györgyi's ideas was that energy transfer in the body is mediated by coupled oscillators, which are two separate things that link up, often through resonance, to work together as a single system. Think of two pendulums connected by a rod. Set one of the pendulums swinging and through resonance it will cause the other pendulum to begin to swing as well. What's more, the two pendulums will become synchronized, with their motion perfectly matched. That motion is transferred through resonance, making a coupled harmonic oscillator. Szent-Györgyi surmised that cells in the body might work according to a similar process.

Research has since shown that amino acids, proteins, and many

the clinic and a respected researcher of alternative health care. During their conversation, Harry asked Kenyon who he thought were the best researchers into alternative health care in the world. He named Peter Fraser among a few others, and on Harry's request, he provided Peter's contact information. A few months later, Harry actually wrote to Peter, an Australian, telling him of his interest in alternative therapies and asking about his work. Peter replied, sending Harry a paper on his bioenergetic theory. Although Harry did not understand much of Peter's theory, he posted the paper on his website.

By September 2000, Harry had succeeded in building his Internet business, and he decided to go to the United States. He would combine business in California with personal research, for he had heard there was a thriving alternative health care community there and was hopeful he would find someone or some method that would help him. Over the previous few years, Harry had been educating himself about bioenergetics and biophysics—about the energies of the body. He even explored subjects as varied as electronics, computers, chaos theory, and information theory. He felt there was something promising in this bioenergetic approach to healing, but none of the makers of the biotechnologies he knew about or had tried could provide a coherent theory of how they worked. They seemed to be missing something important, but Harry could not yet figure out what that something was.

Harry spent more than a year in the United States, and while there he got the education he was seeking. He made dozens of contacts with alternative healers and bioenergetics scientists, and he began to apply himself to bioenergetics as rigorously as he had to every other endeavor he had undertaken. Although he was still so ill that he could work only a few hours a day before collapsing into bed, he made the most of both his work time and downtime.

During that downtime, while resting in bed, Harry thought for hours at a time about the subtle energies of the body, the role of consciousness in health, how energy-based biotechnologies work to connect the real world with the virtual world, and just about every other