

The Mind and the Brain: Neuroplasticity and the Power of Mental Force - Jeffrey M. Schwartz, Sharon Begley (2003)

Chapter 1. THE MATTER OF MIND

Nature in her unfathomable designs has mixed us of clay and flame, of brain and mind, that the two things hang indubitably together and determine each other's being, but how or why, no mortal may ever know.

—*William James*

Principles of Psychology, *Chapter VI*

What is mind? No matter. What is matter? Never mind.

—*T. H. Key*

Of all the thousands of pages and millions of words devoted to the puzzle of the mind and the brain, to the mystery of how something as sublime and insubstantial as thought or consciousness can emerge from three pounds of gelatinous pudding inside the skull, my favorite statement of the problem is not that of one of the great philosophers of history, but of a science fiction writer. In a short story first published in the science and sci-fi magazine *Omni* in 1991, the Hugo-winning author Terry Bisson gets right to the heart of the utter absurdity of the situation: that an organ made from basically the same material ingredients (nucleated, carbon-based, mitochondria-filled cells) as, say, a kidney, is able to generate this ineffable thing called mind. Bisson's story begins with this conversation between an alien commander and a scout who has just returned from Earth to report the results of his reconnaissance:

"They're made out of meat."

"Meat?"

"There's no doubt about it. We picked several from different parts of the planet, took them aboard our recon vessels, probed them all the way through. They're completely meat."

"That's impossible. What about the radio signals? The messages to the stars?"

"They use the radio waves to talk, but the signals don't come from them. The signals come from machines."

"So who made the machines? That's who we want to contact."

"They made the machines. That's what I'm trying to tell you. Meat made the machines."

"That's ridiculous. How can meat make a machine? You're asking me to believe in sentient meat."

"I'm not asking you, I'm telling you. These creatures are the only sentient race in the sector and they're made of meat."

"Maybe they're like the Orfolei. You know, a carbon-based intelligence that goes through a meat stage."

"Nope. They're born meat and they die meat. We studied them for several of their lifespans, which didn't take too long. Do you have any idea of the lifespan of meat?"

"Spare me. Okay, maybe they're only part meat. You know, like the Weddilei. A meat head with an electron plasma brain inside."

"Nope, we thought of that, since they do have meat heads like the Weddilei. But I told you, we probed them. They're meat all the way through."

"No brain?"

"Oh, there is a brain all right. It's just that the brain is made out of meat."

"So...what does the thinking?"

"You're not understanding, are you? The brain does the thinking. The meat."

"Thinking meat! You're asking me to believe in thinking meat!"

"Yes, thinking meat! Conscious meat! Loving meat. Dreaming meat. The meat is the whole deal! Are you beginning to get the picture, or do I have to start all over?"

It was some 2,500 years ago that Alcmaeon of Croton, an associate of the Pythagorean school of philosophy who is regarded as the founder of empirical psychology, proposed that conscious experience originates in the stuff of the brain. A renowned medical and physiological researcher (he practiced systematic dissection), Alcmaeon further theorized that all sensory awareness is coordinated by the brain. Fifty years later, Hippocrates adopted this notion of the brain as the seat of sensation, writing in his treatise on seizures: "I consider that the brain has the most power for man.... The eyes and ears and tongue and hands and feet do whatsoever the brain determines...it is the brain that is the messenger to the understanding [and] the brain that interprets the understanding." Although Aristotle and the Stoics rejected this finding (seating thought in the heart instead), today scientists know, as much as they know anything, that all of mental life springs from neuronal processes in the brain. This belief has dominated studies of mind-brain relations since the early nineteenth century, when phrenologists attempted to correlate the various knobs and bumps on the skull with one or another facet of personality or mental ability. Today, of course, those correlations are a bit more precise, as scientists, going beyond the phrenologists' conclusion that thirty-seven mental faculties are represented on the surface of the skull, do their mapping with brain imaging technologies such as positron emission tomography (PET) and

functional magnetic resonance imaging (fMRI), which pinpoint which brain neighborhoods are active during any given mental activity.

This has been one of the greatest triumphs of modern neuroscience, this mapping of whole worlds of conscious experience—from recognizing faces to feeling joy, from fingering a violin string to smelling a flower—onto a particular cluster of neurons in the brain. It began in the 1950s, when Wilder Penfield, a pioneer in the neurosurgery of epilepsy, electrically stimulated tiny spots on the surface of patients' brains (a painless procedure, since neurons have no feeling). The patients were flooded with long-forgotten memories of their grandmother or heard a tune so vividly that they asked the good doctor why a phonograph was playing in the operating theater. But it is not merely the precision of the mental maps that has increased with the introduction of electrodes—and later noninvasive brain imaging—to replace the skull-bump cartography beloved of phrenologists. So has neuroscientists' certainty that tracing different mental abilities to specific regions in the brain—verbal working memory to a spot beneath the left temple, just beside the region that encodes the unpleasantness of pain and just behind the spot that performs exact mathematical calculations—is a worthy end in itself. So powerful and enduring has been Alcmaeon's hypothesis about the seat of mental life, and his intellectual descendants' equating of brain and mind, that most neuroscientists today take for granted that once you have correlated activity in a cluster of neurons with a cognitive or emotional function—or, more generally, with any mental state—you have solved the problem of the origin of mental events. When you trace depression to activity in a circuit involving the frontal cortex and amygdala, you have—on the whole—explained it. When you link the formation of memories to electrochemical activities in the hippocampus, you have learned everything worth knowing about it. True, there are still plenty of details to work out. But the most deeply puzzling question—whether that vast panoply of phenomena encompassed by the word *mind* can actually arise from nothing but the brain—is not, in the view of most researchers, a legitimate subject for scientific inquiry. Call it the triumph of materialism.

To the mainstream materialist way of thinking, only the physical is real. Anything nonphysical is at best an artifact, at worst an illusion. In this school of philosophy, at least among those who don't dismiss the reality of mind entirely, the mind is the software running on the brain's hardware. Just as, if you got right down to the level of logic gates and speeding electrons, you could trace out how a computer told to calculate 7×7 can spit out 49, so you could, in principle, determine in advance the physical, neural correlates in the brain of any action the mind will ever carry out. In the process, every nuance of every mental event would be explained, with not even the smallest subtlety left as a possibly spontaneous (from the Latin *sponte*, meaning "of one's free will, voluntarily") occurrence.

A friend of mine, the neurosurgeon Joseph Bogen, recalled to me a remark that the Nobelist David Hubel made to him in 1984: "The word Mind is obsolete." Hubel was stating exactly the conclusion of researchers who equate their brain scans and

neuronal circuit diagrams with a full understanding of mental processes. Now that we understand so much about the brain, this reasoning holds, there's no longer any need to appeal to such a naïve term, with its faint smack of folk psychology. As Hubel said to Bogen, the very word *mind* "is like the word *sky* for astronomers." It's only fair to note that this view has not been unanimous. In fact, no sooner had brain imaging technology produced its neat maps than neuroscientists began to question whether we will "understand the brain when the map...is completely filled with blobs," as the neurobiologists M. James Nichols and William Newsome asked in a 1999 paper. "Obviously not," they answered. Still, in many sophisticated quarters, *mind* was becoming not merely an obsolete word but almost an embarrassing one.

But if you equate the sequential activation of neurons in the visual pathway, say, with the perception of a color, you quickly encounter two mysteries. The first is the one that befuddled our alien commander. Just as the human brain is capable of differentiating light from dark, so is a photodiode. Just as the brain is capable of differentiating colors, so is a camera. It isn't hard to rig up a photodiode to emit a beep when it detects light, or a camera to chirp when it detects red. In both cases, a simple physical device is registering the same perception as a human brain and is announcing that perception. Yet neither device is conscious of light or color, and neither would become so no matter how sophisticated a computer we rigged it up to. There is a difference between a programmed, deterministic mechanical response and the mental process we call consciousness. Consciousness is more than perceiving and knowing; it is *knowing* that you know.

If it seems ridiculous even to consider why a handful of wires and transistors fails to generate subjective perceptions, then ask the same question about neurons outside the brain. Why is it that no neurons other than those in a brain are capable of giving the owner of that brain a qualitative, subjective sensation—an inner awareness? The activity of neurons in our fingertips that distinguish hot from cold, for example, is not associated in and of itself with conscious perception. But the activity of neurons in the brain, upstream of the fingertips' sensory neurons, is. If the connection linking the fingers to the brain through the spinal cord is severed, all sensation in those fingers is lost. What is it about the brain that has granted to its own neurons the almost magical power to create a felt, subjective experience from bursts of electrochemical activity little different from that transpiring downstream, back in the fingertips? This represents one of the central mysteries of how matter (meat?) generates mind.

The second mystery is that the ultimate result of a rain of photons falling on the retina is...well, a sense. A sense of crimson, or navy blue. Although we can say that *this* wavelength of light stimulates *this* photosensitive cone in the retina to produce *this* sense of color—650 nanometers makes people with normal color vision see red, for instance—science is silent on the genesis of the feeling of red, or cerulean, or other *qualia*. This is the term many philosophers have adopted for the qualitative, raw, personal, subjective feel that we get from an experience or

sensation. Every conscious state has a certain feel to it, and possibly a unique one: when you bite into a hamburger, it feels different from the experience of chewing a steak. And any taste sensation feels different from the sound of a Chopin étude, or the sight of a lightning storm, or the smell of bourbon, or the memory of your first kiss. Identifying the locus where red is generated, in the visual cortex, is a far cry from explaining our sense of redness, or why seeing red *feels* different from tasting fettuccine Alfredo or hearing “Für Elise”—especially since all these experiences reflect neuronal firings in one or another sensory cortex. Not even the most detailed fMRI gives us more than the physical basis of perception or awareness; it doesn’t come close to explaining what it feels like from the inside. It doesn’t explain the first-person feeling of red. How do we know that it is the same for different people? And why would studying brain mechanisms, even down to the molecular level, ever provide an answer to those questions?

It is, when you think about it, a little peculiar to believe that when you have traced a clear causal chain between molecular events inside our skull and mental events, you have explained them sufficiently, let alone explained the mind in its entirety. If nothing else, there’s a serious danger of falling into a category error here, ascribing to particular clusters of neurons properties that they do not possess—in this case, consciousness. The philosopher John Searle, who has probed the mysteries of mind and brain as deeply as any contemporary scholar, has described the problem this way: “As far as we know, the fundamental features of [the physical] world are as described by physics, chemistry and the other natural sciences. But the existence of phenomena that are not in any obvious way physical or chemical gives rise to puzzlement.... How does a mental reality, a world of consciousness, intentionality and other mental phenomena, fit into a world consisting entirely of physical particles in fields of force?” If the answer is that it doesn’t—that mental phenomena are different in kind from the material world of particles—then what we have here is an *explanatory gap*, a term first used in this context by the philosopher Joseph Levine in his 1983 paper “Materialism and Qualia: The Explanatory Gap.”

And so, although correlating physical brain activity with mental events is an unquestionable scientific triumph, it has left many students of the brain unsatisfied. For neither neuroscientist nor philosopher has adequately explained how the behavior of neurons can give rise to subjectively felt mental states. Rather, the puzzle of how patterns of neuronal activity become transformed into subjective awareness, the neurobiologist Robert Doty argued in 1998, “remains the cardinal mystery of human existence.” Yet there is no faster way to discomfit a room of neuroscientists than to confront them with this mind-body problem, or mind-matter problem, as it is variously called. To avoid it, cellular neurophysiologists position their blinders so their vision falls on little but the particulars of nerve conduction—ions moving in and out, electrical pulses traveling along an axon, neurotransmitters flowing across a synapse. As the evolutionary biologist Richard Lewontin puts it, “One restricts one’s questions to the domain where materialism is unchallenged.”

Materialism, of course, is the belief that only the physical is ontologically valid and that, going even further, nothing that is not physical—of which mind and consciousness are the paramount examples—can even exist in the sense of being a measurable, real entity. (This approach runs into problems long before minds and consciousness enter the picture: time and space are only two of the seemingly real quantities that are difficult to subsume under the materialist umbrella.) For a sense of the inadequacy of equating what neurons do with what minds experience, consider this thought experiment, based on one first advanced by the Australian philosopher Frank Jackson. Imagine a color-blind neuroscientist who has chosen to study color vision. (Jackson called her Mary.) She maps, with great precision, exactly what happens when light of a wavelength of 650 nanometers falls on the eyes of a volunteer. She laboriously traces the pathway that analyzes color through the lateral geniculate body of the thalamus, along the sweeping fibers of the optic radiation, into the primary visual cortex. Then she carefully notes the activation of the relevant areas of the visual association cortex in the temporal lobe. The volunteer reports the outcome: he sees red! So far, so good. The neuroscientist has precisely described the stimulus—light of a precise wavelength. She has meticulously traced the brain circuits that are activated by this stimulus. And she has been told, by her volunteer, that the whole sequence adds up to a perception of red.

Can we now say that our neuroscientist knows, truly and deeply *knows*, the feeling of seeing red? She certainly knows the input, and she knows its neural correlates. But if she got out of bed the next morning to find that her color blindness had miraculously remitted, and her gaze fell on a field of crimson poppies, the experience of “red” at that instant would be dramatically and qualitatively different from the knowledge she had gained in the lab about how the brain registers the color red. Mary would now have the conscious, subjective, felt experience of color.

We needn’t belabor the point that there is a very real difference between understanding the physiological mechanisms of perception and having a conscious perceptual experience. For now, let’s say the latter has something to do with awareness of, and attention to, what is delivered for inspection by the perceptual machinery of the central nervous system. This conscious experience, this mental state called a sense of red, is not coherently described, much less entirely explained, by mapping corresponding neural activity. Neuroscientists have successfully identified the neural correlates of pain, of depression, of anxiety. None of those achievements, either, amounts to a full explanation of the mental experience that neural activity underlies. The explanatory gap has never been bridged. And the inescapable reason is this: a neural state is not a mental state. The mind is not the brain, though it depends on the material brain for its existence (as far as we know). As the philosopher Colin McGinn says, “The problem with materialism is that it tries to construct the mind out of properties that refuse to add up to mentality.”

This is not exactly the view you find expressed at the weekly tea of a university neuroscience department. For the most part, the inevitable corollary of materialism known as identity theory—which equates brain with mind and regards the sort of neuron-to-neuron firing pattern leading to the perception of color as a full explanation of our sense of red—has the field by the short hairs. The materialist position has become virtually synonymous with science, and anything nonmaterialist is imbued with a spooky sort of mysticism (cue the *Twilight Zone* theme). Yet it is a misreading of science and its history to conclude that our insights into nature have reduced everything to the material.

The advent of materialism is widely credited to Isaac Newton, who is considered the intellectual father of the view that the world is an elaborate windup clock that follows immutable laws. (Or, as Alexander Pope put it in his famous couplet, “Nature and Nature’s laws lay hid in night:/God said, ‘Let Newton be!’ and all was light.”) But that represents a misreading of Newtonian physics. It is true that, by discovering the law of gravity, and realizing that its manifestation on Earth (that famous, if apocryphal, falling apple) and its manifestation in space (tethering the Moon to Earth, and Earth and planets to the Sun) are simply different aspects of the same phenomenon, Newton in some sense largely eliminated the divine from the ongoing workings of the universe. But Newton himself did not believe in pure materialism. Although he rid his clockwork universe of the hand of God, Newton replaced it with something just as immaterial—fields of force. In contrast to the materialist doctrine, which holds that the world is a set of objects that interact through direct contact, Newton’s theory of gravity posited action at a distance. Just how, exactly, does Earth keep the Moon from flying away into space? Through gravity. And what is gravity? An ineffable force that pervades all space and is felt over essentially infinite distances. There is no connective tissue, no intervening matter between the mutual gravitational pulls of objects separated by vast distances across a vacuum. You cannot touch a gravitational field (although you can, of course, feel its effects). Newton himself squirmed under the implications of this: “That one body may act upon another at a distance, through a vacuum, without the mediation of anything else...is to me so great an absurdity that I believe no man who has...any competent faculty of thinking can ever fall into it. Gravity must be caused by an agent...but whether this agent be material or immaterial is a question I have left to...my readers.”

This is not the view that most people associate with classical Newtonian physics. Laypeople as well as most scientists believe that science regards the world as built out of tiny bits of matter. “Yet this view is wrong,” argues Henry Stapp, a physicist at the Lawrence Berkeley National Laboratory high in the hills above Berkeley, California. At least one version of quantum theory, propounded by the Hungarian mathematician John von Neumann in the 1930s, “claims that the world is built not out of bits of matter but out of bits of knowledge—subjective, conscious knowings,” Stapp says. These ideas, however, have fallen far short of toppling the materialist worldview, which has emerged so triumphant that to suggest humbly that there

might be more to mental life than action potentials zipping along axons is to risk being branded a scientific naif. Even worse, it is to be branded nonscientific. When, in 1997, I made just this suggestion over dinner to a former president of the Society for Neuroscience, he exclaimed, "Well, then you are not a scientist." Questioning whether consciousness, emotions, thoughts, the subjective feeling of pain, and the spark of creativity arise from nothing but the electrochemical activity of large collections of neuronal circuits is a good way to get dismissed as a hopeless dualist.

Ah, that dreaded label.

The dualist position in the mind-matter debate dates back to the seventeenth-century French philosopher René Descartes (1596–1650). Although the problem of mind and matter is as old as the philosophy of the ancient Greeks, Descartes was the first modern scientific thinker to grapple seriously with the strangeness of mind, with the fact that the mental realm seems to be of an entirely different character from the material world. His solution was simplicity itself. He posited the existence of two parallel yet separate domains of reality: *res cogitans*, the thinking substance of the subjective mind whose essence is thought, and *res extensa*, or the extended substance of the material world. Mental stuff and material (including brain) stuff are absolutely distinct, he argued. Material substance occupies space (Descartes was big on space: he invented analytic, or Cartesian, geometry), and its behavior can be explained by one piece of matter's mechanically pushing around another piece of matter. Descartes believed that all living things, including all "brute animals," were just "automata or moving machines" that act "according to the disposition of their organs, just as a clock, which is only composed of wheels and weights, is able to tell the hours and measure the time more correctly than we can do with all our wisdom." In Descartes's mechanical clockwork cosmology, all bodies, including living bodies, were automatons, moving around like the mechanical puppets that were fashionable showpieces in the gardens of noblemen of the day. The human body was no exception. Descartes regarded the brain as a machine, subject to mechanistic, deterministic rules, and the body as an automaton. In his 1664 *Traite de l'homme*, Descartes included a charming illustration modeling reflexive behavior. He showed a man's foot edging into a fire; the message "hot!" is depicted traveling through sensory nerves to the head and then back down to a muscle in the leg. This path results in the foot's reflexively pulling out of the blaze. Descartes's careful tracing of the path is one of the earliest examples of those endless neural-correlates discoveries so beloved of twentieth-century neuroscientists.

Descartes defined mind, in contrast to matter, by what it lacks—namely, spatial extent and heft. And he recognized another difference. Reflexes and other attributes or expressions of matter, he argued, are subject to scientific inquiry. Conscious, subjective experience is not. Descartes's separation of nature into a physical realm and a mental/experiential realm, each dynamically independent of the other, thus gave an indirect benefit to science. The seventeenth century saw what threatened to be a to-the-death struggle between science and the Church,

which perceived science as a threat. Descartes's declaration that reality divides neatly into two realms reassured the Church that the province of science would never overlap, and therefore never challenge, the world of theology and the spiritual. Science ceded the soul and the conscious mind to religion and kept the material world for itself. In return for this neat dividing up of turf, Descartes hoped, religious leaders would lay off scientists who were studying natural laws operating in the physical, nonmental realm. The ploy was only partly successful for Church-science relations. Descartes himself was forced to flee Paris for Holland in search of greater tolerance.

But this division of reality into mind and matter was also something of a scientific debacle. Separating the material and the mental into ontologically distinct realms raised the white flag early in the mind-body debate: science abandoned the challenge of explaining how the components of the physical world found expression in the mental world. And thus was Cartesian dualism born. Today, three and a half centuries later, his belief endures. If there is a single fundamental underpinning in the intellectual tradition of Western scientific thought, it is arguably that there exists an unbridgeable divide between the world of mind and the world of matter, between the realm of the material (which is definitely real) and the realm of the immaterial (which, according to the conventions of science, is likely illusory).

Yet Cartesian dualism ran into trouble almost immediately. Descartes's material automaton was, in its human form, an automaton with a difference: it was capable of voluntary, volitional, freely willed movement. By exerting its will, Descartes declared, the immaterial human mind could cause the material human machine to move. This bears repeating, for it is an idea that, more than any other, has thrown a stumbling block across the path of philosophers who have attempted to argue that the mind is immaterial: for how could something immaterial act efficaciously on something as fully tangible as a body? Immaterial mental substance is so ontologically different—that is, such a different sort of thing—from the body it affects that getting the twain to meet has been exceedingly difficult. To be sure, Descartes tried. He argued that the mental substance of the mind interacts with the matter of the brain through the pineal gland, the organ he believed was moved directly by the human soul. The interaction allowed the material brain to be physically directed by the immaterial mind through what Descartes called "animal spirits"—basically a kind of hydraulic fluid.

Even in his own time Descartes's dualism fell far short of carrying the day, and its principal antagonist, materialism, quickly reared its head. In the mid-1600s, with the advent of neuroscience, researchers began to piece together new theories of the relationship between mind and brain, discovering basic biological mechanisms underlying conscious feelings and thoughts. On the basis of these findings, the French physician Julien Offray de la Mettrie (1709–1751) asserted that mind and brain are merely two aspects of the same physical entity, and that this three-pound collection of cells sitting inside our skull either entirely determines, or is somehow identical with, mental experience. In his 1747 book *L'homme machine* (Man the

Machine), La Mettrie gained notoriety by attempting to show that humans are in essence nothing but automatons. In this he was taking to its logical conclusion a chain of reasoning that had begun when Descartes proclaimed an entirely mechanical understanding of every living thing save humans. Even more than Descartes, La Mettrie applied the methods of experimental medical science to bolster his bold claim. He described the brain as the organ of thinking and maintained that brain size determines mental capacity. And he compared the workings of the brain to those of musical instruments. "As a violin string or a key of the clavichord vibrates and renders a sound," he wrote, "so the brain's chords struck by sound waves are stimulated to render or to repeat the words which touch it." Perhaps the most remarkable aspect of La Mettrie's perspective is how contemporary it sounds in this, the age of computer intelligence.

Thus were born the dueling ontologies, with partisans of matter like La Mettrie squaring off against those like Descartes who believed that mental events cannot all be reduced to physical ones. For more than three centuries after Descartes published his thesis, philosophers battled over which entity, mind or matter, was the basic stuff of the world. Philosophers including Leibniz, Berkeley, Hume, Kant, Mach, and James contended that matter is but a uniquely objective and substantial form of mind. This position is not far different from that held by many contemporary physicists, who believe that matter is merely a concentrated form of energy. It is this position that most closely mirrors my own. On the other side of the dualist divide, thinkers such as Hobbes, La Mettrie, Marx, Watson, B.F. Skinner, and Daniel Dennett have argued what has become the consensus position of mainstream science: that mind truly is, in essence, nothing but matter, and our subjective experience that mind is something special or different is just an illusion. The mind is entirely and completely derived from the brain's matter.

Within the scientific if not the philosophical community, the rise of scientific materialism in the midnineteenth century seemed to leave Cartesian dualism in the dust. Materialism not only became the reigning intellectual fashion; it emerged as virtually synonymous with science. In fields from biology to cosmology, science is portrayed as having vanquished the nonmaterial explanations that prescientific cultures advanced for natural phenomena. The mysterious forces once believed to trigger storms have been reduced to permutations of air pressure and temperature. The ghosts behind electric phenomena have been revealed as moving particles. The materialist view of mind holds that there is no more to all this than neurons doing their electrochemical thing. As Colin McGinn puts it: "This is not because neural processes merely cause conscious processes; it's because neural processes are conscious processes. Nor is it merely that conscious processes are an aspect of neural processes; it is rather that there is nothing more to a conscious state than its neural correlate."

The neural connections that form brain circuits are necessary for the existence of mind as we know it. To check this, simply imagine a skull emptied of its brain; when the brain is gone, so are the contents of the mind. Or consider that when the

brain is damaged, so is the mind (usually). Or that those neural correlates we've been mentioning are undeniably real: when the mind changes, so does the brain (leaving aside which causes which). To some scientists this is all there is, and mind can thus be fully explained by brain, by matter. The materialist conceit holds that brain is all that's needed—there is no more to the feeling of fear than a tickling of the amygdala, no more to the sound of a whisper than an excitation in the auditory cortex. And there is no more to the sense of free will—the sense that we can choose whether to look left or right, to pick this flower or that, to slip in this CD or that one—than delusion and ignorance about what, exactly, the brain is doing in there. Mind, the theory goes, is just brain with more lyrical allusions. Neural correlates to every aspect of mind you can think of are not merely correlates; they are the essence of that aspect of mind. If introspection tells us otherwise—if it tells us that these “qualia” have an existence and a reality that transcend the crackling and dripping of neurons, and that the power to choose is not illusory—well, then introspection is leading us astray. If introspection tells us that there is more to mind than this, then introspection is flawed. What we think we know about our minds from the inside is wrong, as misguided as an aborigine's examining a television and concluding that there are living beings inside.

Materialism, it seems fair to say, has neuroscience in a chokehold and has had it there since the nineteenth century. Indeed, there are those in the neuroscience community whose reductionist bent is so extreme that they have made it their crusade “to eliminate mind language entirely,” as the British neuroscientist Steven Rose bluntly puts it. In other words, notions such as feeling, and memory, and attention, and will—all crucial elements of mind—are to be replaced with neurochemical reactions. This materialist, reductionist camp holds that when we have mapped a mental process to a location in the brain, and when we've worked out the sequence of neurochemical releases and uptakes that is associated with it, we have indeed fully explained, and more important understood, the phenomenon in question. Mystery explained. Case closed.

Or is it? Some of the most eminent neuroscientists have questioned the materialist position on the mind-matter enigma. The Canadian neurosurgeon Wilder Penfield, after a long career dedicated to explaining the material basis of mind, in the end decided that brain-related explanations are intrinsically insufficient. Charles Sherrington, the founder of modern neurophysiology, contended in 1947 that brain processes alone cannot account for the full range of subjective mental phenomena, including conscious free will. “That our being should consist of two fundamental elements offers, I suppose, no greater inherent improbability than that it should rest on one only,” he wrote. One of Sherrington's greatest pupils, Sir John Eccles, held similar views. Eccles won a Nobel Prize for his seminal contributions to our understanding of how nerve cells communicate across synapses, or nerve junctions. In his later years, he worked toward a deeper understanding of the mechanisms mediating the interaction of mind and brain—including the elusive notion of free will. Standard neurobiology tells us that tiny vesicles in the nerve endings contain

chemicals called neurotransmitters; in response to an electrical impulse, some of the vesicles release their contents, which cross the synapse and transmit the impulse to the adjoining neuron. In 1986 Eccles proposed that the probability of neurotransmitter release depended on quantum mechanical processes, which can be influenced by the intervention of the mind. This, Eccles said, provided a basis for the action of a free will.

It is fair to say that the debate instigated by Descartes over the mind-body problem has not ended at all; it has instead become almost painfully sophisticated and complex. Among the warring theories in play today we have (in one contemporary rundown) "the identity theory, the central state theory, neutral monism, logical behaviorism, token physicalism and type physicalism, token epiphenomenalism and type epiphenomenalism, anomalous monism, emergent materialism, eliminative materialism, various brands of functionalism"—and, undoubtedly, enough additional isms to assign one to every working philosopher in the world. A few words on a small handful of these philosophies of mind and matter (listed from most to least materialistic) should capture the flavor of the debate and give a sense of the competing ideas.

- **FUNCTIONALISM**, or "Mentalistic Materialism" as the neurosurgeon Joe Bogen has termed it, denies that the mind is anything more than brain states; it is a mere by-product of the brain's physical activity. As the philosopher Owen Flanagan puts it, "Mental processes are just brain processes," and understanding what those brain processes are and how they work tells us all there is to know about what mind is. This view recognizes only material influences. Paul and Patricia Churchland and Daniel Dennett are leading advocates of such materialist views, which are closely akin to behaviorism. The materialist position goes so far as to deny the ultimate reality of mental "events" like our color-blind scientist's sudden experience of the redness of a peony, as well as the actual fact of consciousness itself. Other than the action potentials coursing through brain circuits, they insist, there is nothing more to the workings of the mind—at least, nothing that science needs to address. If we hold tenaciously to such quaint notions as experiential reality, consciousness, and the ontological validity of qualia, it is only out of ignorance: once science parses the actions of the brain in sufficient detail, qualia and consciousness will evaporate just as the "vital spark" did before biologists nailed down the nature of living things. Materialism certainly has one thing going for it. By denying the existence of consciousness and other mental phenomena, it neatly makes the mind-matter problem disappear. No mind, all matter—no mind-matter problem.

- **EPIPHENOMENALISM** acknowledges that mind is a real phenomenon but holds that it cannot have any effect on the physical world. This school acknowledges that mind and matter are two separate beasts, as are physical events and mental events, but only in the sense that qualia and consciousness are not strictly reducible to neuronal events, any more than the properties of water are reducible to the chemical characteristics of oxygen and hydrogen. From this perspective, consciousness is an epiphenomenon of neuronal processes.

Epiphenomenalism views the brain as the cause of all aspects of the mind, but because it holds that the physical world is *causally closed*—that is, that physical events can have only physical causes—it holds that the mind itself doesn't actually cause anything to happen that the brain hasn't already taken care of. It thus leaves us with a rather withered sort of mind, one in which consciousness is, at least in scientific terms, reduced to an impotent shadow of its former self. As a nonphysical phenomenon, it cannot act on the physical world. It cannot make stuff happen. It cannot, say, make an arm move. Epiphenomenalism holds that the brain is the cause of all the mental events in the mind but that the mind itself is not the cause of anything. Because it maintains that the causal arrow points in only one direction, from material to mental, this school denies the causal efficacy of mental states. It therefore finds itself right at home with the fundamental assumption of materialist science, certainly as applied to psychology and now neuroscience, that "mind does not move matter," as the neurologist C. J. Herrick wrote in 1956. Put another way, all physical action can be but the consequence of another physical action. The sense that will and other mental states can move matter—even the matter that makes up one's own body—is therefore, in the view of the epiphenomenalists, an illusion.

Although epiphenomenalism is often regarded these days as the only generally acceptable alternative to stark materialism, one problem with this position is that it contradicts our basic core experience that mental states really do affect our actions. To deny the causal efficacy of mental states altogether is to dismiss the experience of willed action as nothing but an illusion. Another critical problem with epiphenomenalism (and other schools that deny the causal efficacy of mind) was raised in 1890 by the psychologist and philosopher William James. The basic principles of evolutionary biology would seem to dictate that any natural phenomenon as prominent in our lives as our experience of consciousness must necessarily have some discernible and quantifiable effect in order for it to exist, and to persist, in nature at all. It must, in other words, confer some selective advantage. And that raises an obvious question: What possible selective advantage could consciousness offer if it is only a functionless phantasm? How could consciousness ever have evolved in the first place if, in and of itself, it does nothing? Why, in short, did nature bother to produce beings capable of self-awareness and subjective, inner experience? True, evolutionary biologists can trot out many examples of traits that have been carried along on the river of evolution although not specifically selected for (the evolutionary biologists Stephen Jay Gould and Richard Lewontin called such traits *spandrels*, the architectural term for the elements between the exterior curve of an arch and the right angle of the walls around it, which were not intention-ally built but were instead formed by two architectural traits that were "selected for"). But consciousness seems like an awfully prominent trait not to have been the target of some selection pressure. As James put it, "The conclusion that [consciousness] is useful is...quite justifiable. But if it is useful, it must be so through its causal efficaciousness."

- EMERGENT MATERIALISM argues that mind arises from brain in a way that cannot be fully predicted from or reduced to brain processes. The attributes of

mind, that is, cannot be explained solely by brain's physical activity. Further, according to this view, mind may have the power to effect both mental and physical change. Emergentists like Steen Rasmussen suggest that, sometimes, a high-order, emergent property like mind has the power to exert an effect on the lower-order processes that created it. In other words, what emerges can affect what it emerges from.

The Nobel-winning neuroscientist Roger Sperry taught at the California Institute of Technology from 1954 until his death in 1994. Best known for his study of "split brain" patients (many of whose surgeries severing the connections between the right and left cerebral hemispheres were actually performed by Joe Bogen), Sperry produced the most detailed and scientifically based version of emergent materialism. He variously called his own emergent theory "mentalism," "emergent mentalism," or just "the new mentalism." At first, he argued only that mind is not reducible to cerebral activity, echoing the mainstream emergent position that mind arises from brain as a unique entity whose attributes and power cannot be predicted, or even explained, from its material components alone. But later Sperry became uneasy with the triumph of materialism in neuroscience and what he called its "exclusive 'bottom-up' determination of the whole by the parts, in which the neuronal events determine the mental but not vice versa." As a result he later espoused a view that mental states can indeed have causal efficacy. In contrast to agnostic physicalism (discussed later), which allows mental states to influence other mental states only through the intermediary of the brain, emergent materialism grants to some mental states the power directly to change, shape, or bring into being other mental states, as well as to act back on cerebral states. In the years just before his death, Sperry hinted that mental forces could causally shape the electrochemical activity of neurons.

This represented a radical new vision of the causal relations between higher-order mental processes and neuronal events. What Sperry termed "mental forces" could, he argued, direct the electrochemical traffic between neurons at the cellular level. This view thus argues that emergent mental properties can exert top-down causal control over their component parts—"the downward control by mental events over the lower neuronal events." This, as we will see in Chapter 2, describes very well the control by an OCD patient's mind of his neuronal events, specifically the activity in the pathological circuits underlying the disease. Sperry was at pains to point out that his belief did not constitute dualism (that dreaded word!) in any Cartesian sense, but rather a radically revised form of materialism in which the mind is not only emergent but also causal. He maintained (as classical, non-science-based dualists do not) that the myriad conscious experiences cannot exist apart from the brain; he did not posit an unembodied mind or consciousness as, again, classical dualists do. The mental forces he considered causally efficacious were no spooky, nonmaterial, preternatural entities. As he put it in 1970, "The term [mental forces]...does not imply here any disembodied supernatural forces independent of the brain mechanism. The mental forces as here conceived are inseparably tied to the cerebral structure and its functional organization." They

shape and direct the lower-level traffic of electrical impulses. The form of causal efficacy Sperry proposed was one that adherents of materialist, bottom-up determinism dismissed—namely, one in which “higher-level” mental properties exert causal control over the “lower level” of neurons and synapses. In this scheme, Sperry wrote in 1965, “the causal potency of an idea, or an ideal, becomes just as real as that of a molecule, a cell, or a nerve impulse.” He fervently hoped that the new view of mind would integrate “traditionally conflicting positions on mind and matter, the mental versus the material,” and that “science as a whole may be in the process of shifting away from its centuries-old microdeterminate materialist paradigm to a more valid macromental model for causal explanation and understanding.”

Not even a Nobel Prize offered adequate shielding from the brickbats hurled at Sperry for this plunge into the mind-and-matter wars. When the English psychologist Oliver Zangwill visited Caltech in August 1970, as Joe Bogen recounts, he expressed to Sperry his concern that if “Sperry went on in this vein it is likely to diminish the impact of his many marvelous achievements.” How, Bogen asked, did Sperry react? Very little, replied Zangwill. From about 1980, almost all of Sperry’s writings were about consciousness and mental forces acting from the top down. When he was honored at Caltech in 1982 on the occasion of his Nobel, those who had come to know him only recently assumed, recalls Bogen, “that he’s gone religious like so many old folks.” By 1990, even Caltech professors who had known Sperry for four decades “had given up trying to defend or even to understand ‘the philosophy of his later years,’ as one of them put it.”

Although Sperry put great stress on the reality of the mind in the causal chain, when pressed he seemed to fall back on classical materialist assumptions. He emphatically denied the importance of quantum mechanics for understanding mind-brain relations, insisting that Newtonian physics was entirely up to the task. “It remains true in the mentalist model that the parts...determine the properties of the whole, i.e. microdeterminism is not abandoned,” he wrote in his last major paper. “The emergent process is...in principle, predictable.” Thus the mental forces he was so fond of referring to were themselves determined from below. To those, like me, who were becoming committed to the genuine power of mental force and its integral role in a quantum-based mind-brain theory, Sperry’s views seemed like a refined form of epiphenomenalism.

· AGNOSTIC PHYSICALISM also holds that mind derives exclusively from the matter of the brain. In contrast to the epiphenomenalists and functionalists, however, adherents of this school acknowledge that this may not be the whole story. That is what the “agnostic” part reflects: those who subscribe to this worldview do not deny the existence of nonmaterial forces, just as an agnostic does not actively deny the existence of God. Rather, they regard such influences, if they exist, as capable of affecting mental states only as they first influence observable cerebral states. William James falls into this camp. Joe Bogen is careful to distinguish physicalism from materialism. The former holds that the mental does not change without the physical’s (that is, brain states) changing, too. This says

nothing about the existence of nonmaterial influences on the mind. It simply asserts that any such influences must work through the brain in order to affect the mind. In contrast, materialism transcends physicalism in actively denying the existence of nonmaterial influences.

In explaining his own position, Bogen recounts an argument he once had with the philosopher Paul Churchland about the mystery of how brain produces mind, and the need some philosophers and neuroscientists perceive to invoke something immaterial and without spatial extent to affect the brain. Churchland burst out, "Throughout the history of this subject the mind has been considered to be between God and brain. But now you presume to put the brain between God and mind." To which Bogen replied, "Exactly so, which is how I can be a committed physicalist while remaining agnostic or even indifferent about the immaterial."

- PROCESS PHILOSOPHY, a school greatly influenced by Alfred North Whitehead, holds that mind and brain are manifestations of a single reality, one that is in constant flux. It thus is compatible with classical Buddhist philosophy, which views clear and penetrating awareness of change and impermanence (*anicca* in Pali) as the essence of insight. Thus, as Whitehead put it, "The reality is the process," and it is a process made up of vital transient "drops of experience, complex and interdependent." This view is strikingly consistent with recent developments in quantum physics.

- DUALISTIC INTERACTIONISM holds that consciousness and other aspects of mind can occur independently of brain. In this view, mental states have the power to shape brain or cerebral states—and, going even further, the mind cannot in any sense be reduced to the brain. Although mind depends on brain for its expression, brain is by its very material nature not sufficient to explain mind completely, for consciousness and everything else lumped under this thing called mind are categorically different beasts from brain and everything else material. John Eccles, who along with the philosopher Karl Popper for many years gallantly championed this view, put it this way not long before his death: "The essential feature of dualist-interactionism is that the mind and brain are independent entities...and that they interact by quantum physics." Scientists and philosophers in this camp reject materialism to the point of actually positing a nonmaterial basis for the mind. Even worse, they seem to have a penchant for speaking about the possibility of life after death, something no self-respecting scientist is supposed to do in public (although both Eccles and Penfield did). Even scientists and philosophers who question whether simply mapping neural correlates can truly provide the ultimate answer have doubts about dualistic interactionism: neuroscientists may have worlds to go before they understand *how* brain gives rise to mind, but even in a field not generally marked by certainty they are as sure as sure can be that it does, somehow, manage the trick.

Even this abbreviated rundown of mind-brain philosophies would not be complete without what the Australian philosopher David Chalmers calls "don't-have-a-clue materialism." This is the default position of those who have no idea about the

origins of consciousness or the mind but assert that "it must be physical, as materialism must be true," as Chalmers puts it. "Such a view is held widely, but rarely in print." One might add that many working scientists hold this view without really reflecting on the implications of it.

Although none of these worldviews has ended the mind-matter debate, most philosophers who study consciousness nevertheless hew largely to some form of the reductive materialist creed. But there are notable exceptions. Dave Chalmers is one of those arguing for what he calls "a non-reductive ontology of consciousness"—in other words, an approach that does not reduce consciousness to a (mere) physical process. Chalmers says that he "started out life as a materialist, because materialism is a very attractive scientific and philosophical doctrine." But he became more and more dissatisfied with the dogmatic materialist ontology that posits that all aspects of consciousness are a logically entailed and perhaps metaphysically necessary outcome of materialist processes. He therefore began to focus on the explanatory gap between the material and the mental—between explanations of how neurons work, on the one hand, and our felt, inner awareness on the other. Even if we knew everything about every field and iota of matter in the universe, in other words, it is hard to see how that knowledge would produce that elusive "Aha!" moment, when we all say, *Oh, right, so that's how consciousness is done* (in the way we might react, say, to a materialist explanation of how the liver produces bile). Those neuronal mechanisms, Chalmers concluded, would never in and of themselves add up to consciousness. Physical form and function add up to more physical form and function. "To truly bridge the gap between the physical nature of brain physiology and the mental essence of consciousness, we have to satisfy two different conceptual demands," Chalmers told the public television series "Closer to the Truth" in 2000. "It's not yet looking very likely that we're going to reduce the mind to the brain. In fact, there may be systematic reasons to think there will always be a gulf between the physical and the mental."

If that gulf is unbridgeable, Chalmers therefore argues, consciousness might profitably be regarded as what he calls a "nonreductive primitive," a fundamental building block of reality, just as mass and electric charge, as well as space and time, are nonreductive primitives in theories of the physical world. Taking consciousness as a primitive rather than as an emergent property of the physical brain, Chalmers's search for a nonreductive ontology of consciousness led him to what he calls panprotopsychism. The *proto* reflects the possibility that the intrinsic properties of the basic entities of the physical world may be not quite mental, but that collectively they are able to constitute the mental (it is in this sense of *proto* that physics is "protochemical"). In this view, mind is much more fundamental to the universe than we ordinarily imagine. Panprotopsychism has the virtue of integrating mental events into the physical world. "We need psychophysical laws connecting physical processes to subjective experience," Chalmers says. "Certain aspects of quantum mechanics lend themselves very nicely to this."

In particular, if consciousness is an ontological fundamental—that is, a primary element of reality—then it may have the power to achieve what is both the best-documented and at the same time the spookiest effect of the mind on the material world: the ability of consciousness to transform the infinite possibilities for, say, the position of a subatomic particle as described by quantum mechanics into the single reality for that position as detected by an observer. If that sounds both mysterious and spooky, it is a spookiness that has been a part of science since almost the beginning of the twentieth century. It was physics that first felt the breath of this ghost, with the discoveries of quantum mechanics, and it is in the field of neuroscience and the problem of mind and matter that its ethereal presence is felt most markedly today. “Quantum theory casts the problem of the connection between our conscious thoughts and the activities of our brains in a completely new light,” argues my physicist friend Henry Stapp. “The replacement of the ideas of classical physics by the ideas of quantum physics completely changes the complexion of the mind-brain dichotomy, of the connection between mind and brain.”

As the millennium turned, a smattering of neuroscientists finally began to accept that consciousness and the mind (as opposed to mere brain) are legitimate areas of scientific inquiry. This is not to say that the puzzle of how mind is interconnected with brain is anywhere close to solution, but at least researchers are letting it into the lab, and that is a signal change from the recent past. “When I first got interested in [the problem of consciousness] seriously and tried to discuss it with brain scientists,” recalled John Searle in 2000, “I found that most of them were not interested in the question.... Consciousness seems too airy-fairy and touchy-feely to be a real scientific subject.” Yet today neuroscientists flock to conferences with *consciousness* in their names, write books with *consciousness* in their titles, and contribute to a journal that boldly proclaims itself the *Journal of Consciousness Studies*. Two Nobel laureates have moved on from the work that won them an invitation to Stockholm, to pursue the puzzle of consciousness: Francis Crick, who with James Watson shared the Nobel Prize in Physiology or Medicine for determining the structure of DNA, mused in his book *The Astonishing Hypothesis* that the seat of volition might be found in a deep crevasse in the cortex called the anterior cingulate sulcus; Gerald Edelman, who shared the 1972 Nobel for working out the molecular structure of antibodies, argued that consciousness arises from the resonating interplay of assemblies of neurons. More and more scholars are concluding that our deep inner sense of a mental life not fully encompassed by the electrochemical interactions of neuronal circuits is not delusional. As the German neuroscientist Wolf Singer puts it, these elements of consciousness “transcend the reach of reductionistic neurobiological explanations.” More and more neuroscientists are admitting to doubts about the simplistic materialistic model, allowing, as Steven Rose does, that brain has an “ambiguous relationship to mind.”

As a result, a whiff of dualism is once again rising, like the smoke from a long-extinguished campfire, within the scientific community. "Many people, including a past self of mine, have thought that they could simultaneously take consciousness seriously and remain a materialist," writes Dave Chalmers. "This is not possible.... Those who want to come to grips with the phenomenon must embrace a form of dualism. One might say: you can't have your materialist cake and eat your consciousness too." Instead, Chalmers argues that it is time, and it is necessary, to sacrifice the simple physicalist worldview that emerged from the scientific revolution and stood science in good stead for the last three centuries. Although philosophers and scientists both have been known to argue that materialism is the only worldview compatible with science—"dualism is inconsistent with evolutionary biology and modern physics and chemistry," Paul Churchland asserted in 1988—this is simply false. Nor is it justifiable to hew to materialism in the misguided belief that embracing dualism means embracing something supernatural, spiritualistic, nonscientific. To the contrary: scientists questioning reductive materialism believe that consciousness will turn out to be governed by natural law (even if they haven't a clue, yet, about what such a law might look like). As Chalmers says, "There is no a priori principle that says that all natural laws will be physical laws; to deny materialism is not to deny naturalism."

In a welcome irony, centuries of wrestling with the mind-matter problem that arose from the clash between dualism and materialism might come down to this: dualism, with its assertion that there are two irreconcilable kinds of stuff in the world, and materialism, with its insistence that there is only the material, should both be tossed on the proverbial trash heap of history. Dualism fails to explain the relationship between mind and matter, in particular how the former can be functionally conjoined with the latter; materialism denies the reality of subjective states of sentience. Dualism leads us to a dead end; materialism doesn't even let us begin the journey.

At a meeting on consciousness held in Tucson in the spring of 2000, I was delighted when the philosopher John Searle asserted his belief that volition and the will are real, able to influence how the material stuff of the brain expresses itself. After the session, Dave Chalmers needled me for enjoying Searle's talk so much. Well, I had: it seemed to me that Searle was the first mainstream philosopher to question whether the physical realm could account for all our mental experiences. Chalmers said that's not what he heard Searle say. In fact, Dave grinned, he would bet me twenty dollars that Searle had not at all denied "causal closure of the microphysical"—that is, the belief that only physical causes can bring about physical effects, which would preclude the nonmaterial mind's affecting the physical brain. I took the bet. Let's ask him, Dave said. No no, I objected: he'll deny it; let's get a copy of his paper and see for ourselves. During the break I went to the exhibit hall and found the *Journal of Consciousness Studies* booth, where Searle had dropped off a preliminary version of his paper. I wheedled a photocopy out of them. In it appeared this argument for the causal efficacy of the rational mind:

[Neuro]physiological determinism [coexisting] with psychological libertarianism is intellectually very unsatisfying because, in a word, it is a modified form of epiphenomenalism. It says that psychological processes of rational decision making do not really matter. The entire system is deterministic at the bottom level, and the idea that the top level has an element of freedom is simply a systematic illusion.... If [this] is true, then every muscle movement as well as every conscious thought is entirely fixed in advance, and the only thing we can say about psychological indeterminism at the higher level, is that it gives us a systematic illusion of free will.

[This] hypothesis seems to me to run against everything we know about evolution. It would have the consequence that the incredibly elaborate, complex, sensitive and—above all—biologically expensive system of conscious rational decision making would actually make no difference whatever to the life and survival of organisms. Epiphenomenalism is a possible thesis, but it is absolutely incredible, and if we seriously accepted it, it would make a change in our world view more radical than any previous change, including the Copernican Revolution, Einsteinian relativity theory and quantum mechanics.

We found Searle after the session, and Chalmers asked him point blank. “Of course I do not deny causal closure,” Searle shot back. I wasn’t surprised; most scientists seem to have a morbid fear of saying that anything nonphysical can have causal efficacy in the physical realm. The furthest most scientists and philosophers are willing to go is to acknowledge that what we think of as mental events act back on the brain only through the physical states that give rise to those mental events. That is, brain state A may give rise to mental state A? as well as brain state B—but the causal actor in this case was brain state A and not mental state A?.

Anyway, at an end-of-conference party that evening at Chalmers’s house, I paid Dave the twenty dollars we’d bet. I did note, though, that Searle’s insisting on causal closure of the physical world was logically inconsistent with his argument that volition is real and able to affect the physical matter of the brain. I hope the beginnings of an answer to this quandary will emerge from the data I will present showing the critical role of willed effort in generating self-directed cerebral change. In any event, as I said to Dave when I handed him the twenty dollars, “This story still has a long way to go.”

Wrestling with the mystery of mind and matter is no mere academic parlor game. The rise of modern science in the seventeenth century—with the attendant attempt to analyze all observable phenomena in terms of mechanical chains of causation—was a knife in the heart of moral philosophy, for it reduced human beings to automatons. If all of the body and brain can be completely described without invoking anything so empyreal as a mind, let alone a consciousness, then the notion that a person is morally responsible for his actions appears quaint, if not scientifically naïve. A machine cannot be held responsible for its actions. If our minds are impotent to affect our behavior, then surely we are no more responsible

for our actions than a robot is. It is an understatement to note that the triumph of materialism, as applied to questions of mind and brain, therefore makes many people squirm. For if the mysteries of the mind are reducible to physics and chemistry, then “mind is but the babbling of a robot, chained ineluctably to crude causality,” as the neurobiologist Robert Doty put it in 1998.

In succeeding chapters we will explore the emerging evidence that matter alone does not suffice to generate mind, but that, to the contrary, there exists a “mental force” that is not reducible to the material. Mental force, which is closely related to the ancient Buddhist concepts of mindfulness and karma, provides a basis for the effects of mind on matter that clinical neuroscience finds. What is new here is that a question with deep philosophical roots, as well as profound philosophical and moral implications, can finally be addressed (if not yet fully solved) through science. If materialism can be challenged in the context of neuroscience, if stark physical reductionism can be replaced by an outlook in which the mind can exert causal control, then, for the first time since the scientific revolution, the scientific worldview will become compatible with such ideals as will—and, therefore, with morality and ethics. The emerging view of the mind, and of the mind-matter enigma, has the potential to imbue human thought and action with responsibility once again.