

CHAPTER ONE

A PLAY OF LIGHT

It was foggy out, but a bright, luminous fog that promised sunshine would break through within an hour or so. I was sitting at the kitchen table, daydreaming—waiting for that second cup of coffee to kick in. I could easily squander a whole morning like that in those days, mulling over some existential conundrum or another. Like a face-off with a classic Zen koan, it was just another way to wrestle the analytical mind into exhausted submission, in the hope that something fresh and valuable would emerge. But the real answers seemed forever elusive.

Somewhere in the mental mix were the perennial questions about the nature of consciousness: what is the relationship of the mind to the brain, and what, if anything, is the soul? Most of these musings were hard to square with the sterile, reductionist paradigm then current—that the brain was nothing more than a biological computer and a clumsy, unreliable one at that—destined soon to be displaced by the bright and shiny, super-efficient supercomputers of the future.

Scientists in general and neurobiologists in particular seemed curiously incurious about the subject of consciousness, unwilling to tackle the problem or even to admit that there was one. René Descartes,

three centuries before, had set the course of Western science by hacking the living universe into the two separate spheres of mind and matter, graciously relegating the question of consciousness to philosophers and priests. As far as any self-respecting neurobiologist was concerned, only that which could be examined and measured and verified with brain probes seemed worthy of scientific consideration. As for the rest—the inner experience—was it really even happening?

This was 1980; the neurobiological sciences were still firmly in the grip of *epiphenomenalism*—the doctrine that consciousness is merely an “epiphenomenon” (an incidental byproduct) of the brain’s physiological processes. Epiphenomenalism’s peculiar and scientifically untenable postulate is that the conscious “self” is simply an illusion—immaterial in both senses of the word—a secondary phenomenon of no real importance, having no power to affect either the brain or the body.

In any event, I didn’t set out that morning to deal a death blow to Cartesian dualism or to solve the mind/body problem. I was simply enjoying a cup of coffee, minding my own business, looking out the kitchen window at the morning fog.

Slowly, out of the gray haze, there came to my mind an image. It was the simplest, most innocuous thing, like a tiny seed taking root in the moist, mushy soil of my brain—teeming as it was in those days with a great deal of speculation, but as yet unencumbered by many actual facts. This image persisted and grew, and gradually elaborated into a more complete picture and a hunch, and then a hypothesis and a theory; and before I got up from the table that morning I found I had a full-fledged *Weltanschauung* (I’d use the English term “worldview,” but it doesn’t quite capture the Wagnerian feel of the experience) ricocheting between the walls of my skull. It was a delightful, giddy feeling, like a secret window had opened up to a new dimension.

What I saw in my mind’s eye was a circle of lights, maybe eight lights in all, each blinking on and off in succession—a beautiful, rotating pattern of glowing lights. All at once I realized that these were brain cells—neurons—that I was visualizing: eight neurons connected in a ring, one firing into the next, the last firing into the first—creating this illusory movement of light in the same way that the blinking of theatrical chase lights causes glowing patterns to appear to revolve around a theater marquee.

I knew that neurons did not actually visibly *glow* when they fired... or *did* they in some sense? A neuron does produce a rather spectacular, seemingly extravagant electrical voltage when it fires, as an explosive flow of positively charged sodium ions streams through voltage-gated channels in the cell membrane. Any such displacements of charged atoms—including the electric “currents” that flow along the neuron’s axon and dendrites—induce corresponding changes in the local flux density of the magnetic field. These complex interactions between the electric and magnetic fields are mediated by real and virtual *photons*, the quantum particles responsible for the propagation of light and other forms of electromagnetic radiation. Therefore, perhaps the ostensibly “invisible” electromagnetic pulse generated by a firing neuron is in actuality *visible*—discernible to the indwelling consciousness as a minute, localized pulse of *light!*

Then it dawned on me that the steady pattern of firing in this ring of eight neurons would be of a predictable frequency, completing a circuit in a specific time interval: say, eight one-hundredths of a second. In other words, the ring of neurons formed a simple oscillating resonator. By joining together multiple, identical units of eight such neurons, the brain could easily create miniature timing mechanisms, groups of oscillators all operating synchronously.

The image became more elaborate, with rings of neurons of all sizes and shapes interconnecting with other rings, forming more complicated patterns of interaction—some rings working in harmony with one another, some out of sync with and therefore dampening the activity of others. For example, the ring of eight neurons could operate in conjunction with a ring of four such neurons in a tighter circle. That ring of four neurons would complete the shorter circuit in half the time, and could therefore be used to maintain a frequency twice that of the ring of eight. A ring of sixteen neurons would take twice as long, sixteen one-hundredths of a second in this case, to complete a circuit and could therefore oscillate at half the frequency.

In musical terms this would represent an octave above and an octave below the original frequency. As a musician, I recalled that all of the basic chordal structures and rhythmic patterns that make tonal music so immediately accessible (and universally enjoyable) are invariably formed from simple ratios, fractional relationships of whole numbers. A ring of five neurons with a ring of six neurons could

resonate a minor third (with a pitch ratio of 6:5). A ring of four neurons with a ring of five neurons could resonate a major third (with a pitch ratio of 5:4).

It struck me that all of this oscillation imagery I was seeing in my mind made sense to me because of my familiarity with music, musical instrument construction, and acoustics: that complex sound waves can be produced—or reproduced—by combining the effects of many independent oscillators. But this was a *visual* image, and the medium that was resonating here was not sound, but *light*!

I realized that these resonators were basic building blocks that could be cunningly arranged by the craftsman-like hand of natural selection through the course of many hundreds of millions of years of evolution, developing and perfecting an elaborate multisensory resonator of visual, auditory, and other sense data. This meant that one of the main functions of the brain was to produce this *sensorium*, the vast sound and light extravaganza, for the benefit and entertainment of the indwelling soul. It didn't occur to me at that time what the darker, existential ramifications of such an intimate relationship of body and soul might mean philosophically. It just seemed like a welcome relief from the confines of the soul-deadening "brain-as-computer" model that was so pervasive in the scientific literature of the day.

What *these* neurons were doing seemed quite different from the type of active information processing one would expect to see if they were indeed the neurobiological analogues of computer circuits. The *activity* of these neurons was completely *passive*. They behaved collectively more like a vibrating medium than like individual intelligent agents.

And all were receiving streams of input data from sense organs—eyes and ears translating waves of light and sound into patterns of neural resonance. I imagined all sorts of configurations: rings in which the labor was divided between those neurons with a particularly "bright" electromagnetic discharge—which actually formed part of the plane of presentation—and the rest, which were hidden below, like members of an ancient drumming circle, whose job it was to keep a steady beat.

Yet it wasn't just the mechanistic oscillations of those fleshly neurons that seemed so amazing to me. However unimaginably intricate

may be the meshwork of axons and dendrites of the hundred billion neurons that make up the human brain, when all is said and done, those neurons are simply *cells*, progeny of the same fertilized egg that also produced the cells of the liver, the heart, and the spleen. Neurons likewise exist entirely within the material world, the earthbound spawn of our genes and DNA. How could *they* then be the conduit to the subtle and mysterious realms of consciousness?

What became clear to me on that day was that there was *another* medium oscillating simultaneously in absolute synchrony, creating a perfect three-dimensional mapping of every pulse in the chain of neuronal firings—and it wasn't an "epiphenomenon." It was the main event! The medium I'm referring to is the *electromagnetic field*, a constant but ever shifting feature of the living brain. Although this field is also a completely objective reality, made tangible in electroencephalogram printouts or indirectly visible in the colorful displays of functional magnetic resonance imaging devices, we are nonetheless broaching a much more mysterious and incorporeal realm of energy and light.

The images produced by these machines are only crude approximations of the actual electromagnetic field. No one has yet seen an accurate image of the true form of this neurobiologically produced electromagnetic field in the kind of microscopic detail that I'm trying to describe here. Actually, you *have* seen such an image. In fact you are seeing one at this very moment as you read this page! What I'm suggesting is that your own consciousness—your mind, your *soul*, if you will—is a complex and highly organized entity, as intricately structured as the brain itself. The mind has evolved in complexity in concert with the brain, for the mind's primary task is to receive and experience the resonant images that are continuously produced upon the brain's surfaces. The mind operates quite literally as *the* real-time functional electromagnetic imaging device *par excellence*.

I had read enough of the Christian and Sufi mystics and had practiced Zen meditation long enough to know that light was not simply a *metaphor* for consciousness. Time and again in the sacred writings of nearly all religious traditions *Light* is referred to as the very stuff and substance of the mind and of the soul. Somehow, I surmised, this *Light*, this *neurobioluminescent quantum field*, must be the bridge

between the physical and the metaphysical, the direct link between the material and the spiritual worlds.

Disturbances of the electromagnetic field involve the release and absorption of photons and other elementary particles. These photons' energy states may or may not place them within the narrow band of wavelengths corresponding to the spectrum of *visible* light, but it seemed entirely possible that an indwelling consciousness could be sensitive to a much broader spectrum of electromagnetic energy, and would perceive it all as various forms of light (or, for non-visual data, as patterned vibrations of some other regions of the electromagnetic spectrum where sound, smell, taste, and touch are displayed).

And realizing all of this, I thought to myself, "Maybe the brain isn't a computer at all! Perhaps it's more like a Stradivarius violin!"—one capable of resonating all of the sense modalities into subtle patterns of light. Maybe the neurons of the visual cortex, for example, aren't all arranged in hectic "telecommunication networks" with one another, their axons and dendrites sending a flurry of relevant data bits back and forth in order to "figure out" the world conceptually. What if the bright display of a firing neuron is an end in itself—a *pixel* (like one of the tiny dots of phosphorus on a color television screen)? What if the important *information* being transmitted is simply the appearance and disappearance of this speck of *light*, which in conjunction with the well-timed firings of billions of other neurons forms the panoramic image that we experience in our mind's eye as a three-dimensional visual field—a detailed reconstruction of reality—meticulously recreated from the patterns of light received by the eyes?

Perhaps all of the sense modalities are perceived similarly as shifting patterns in the electromagnetic field. In that case—as odd as it sounds—the brain should really be viewed more like a *gland* that *secreted* organized patterns of light—perceived by the soul within what was always presumed to be the dark confines of the skull. Maybe the firing of neurons is the closest approach biological matter can make to the realm of the spirit; and it is *light*, electromagnetic radiation, that is the "substance" of this interaction of brain and mind, body and soul.

Here was a model that matched more closely how it felt to me to be a human being. I relished the thought that I wasn't a computer after all; I was actually a finely tuned musical instrument! There was a reason why harmony felt harmonious, and chaos chaotic—why my

mind and spirit responded so joyously to a Bach concerto or the complex geometric patterns of a Persian carpet. It was all about ratios, proportions, the Golden Mean, relationships, rhythms, and major and minor chords.

Analogue, not digital! My experience of consciousness wasn't the bottom line of a complex, binary calculation of ones and zeros. Nor did it in any way resemble the instantaneous parallel processing of all permutations of logical trajectories that gave the insufferable illusion of genius to the computer chess master, *Deep Blue*.

In the twenty-seven years since that foggy morning breakthrough I've grown to appreciate the intricate computational data processing that actually does go on in the brain, and my either/or position on the computer/resonator issue has given way to a both/and. In fact these two metaphors hardly begin to express the actual complexity of the systems that sustain the inner experience of an embodied sentient being. But this insight was a starting point and, at the time, a great source of liberation in my thinking.

This isn't exactly neuroscience—not yet, anyway. It's simply a *Gedankenexperiment*, consisting so far almost entirely of unbridled speculation. But the mind is a wild elephant and a mystery, and it may not give up all of its secrets to the sober scientists who are in charge of its investigation. Are they really even looking for that deep, subtle realm of consciousness that is the source of all beauty, wonder, and intuition? Is it really a more rational and objective stance to posit the *absence* of a spiritual dimension rather than to acknowledge, after a moment of reluctant introspection, its indisputable *presence*?

Neuroscientists skirt these deeper spiritual issues by referring to this conundrum as the *binding problem*: “How are the attributes of an object, which are analyzed separately in physiologically distinct areas of the brain, bound together?” Ever leery of invoking anything resembling the *homunculus*, “the little man inside the head,” or, God forbid, the *soul* as a causative unifying agent, brain researchers and cyberneticists constrain themselves in their search to the tangible neuronal structures and their associated physiological activity—what they seek is a form of consciousness entirely *of* the neurons, *by* the neurons and *for* the neurons.

To my mind, it's as if a race of robotic aliens were to discover an automobile on an uninhabited earth and puzzle over how it ran itself.

Studying the odd positioning of the pedals, steering wheel, and gear shift, the alien scientists may entirely ignore the well-worn upholstery and muddy carpets, the cigarette lighter, the glove box, and the vanity light—obvious and telltale signs of a human presence—and go on puzzling forever over the “binding problem.”

Neuroscience has been hamstrung by the burdensome legacy of Descartes: his dissection of reality into *res cogitans* and *res extensa*—“the thinking thing” (mind or spirit or soul) and “the extended thing” (physical matter, forces and energies)—the first the purview of religion and philosophy, the second of science. Still to this day most neurobiologists cringe at the use of the word soul (or if they do use it, they hold it at a distance with punctuation’s equivalent of a pair of latex gloves, indicating that it should be read, with a marked tone of disdain, as—the “soul”—). I refuse to put the word in scare quotes. I don’t disown it; nor do I, as a loyal Buddhist, take myself to *be* the soul. But I certainly do embrace it as my most prized possession.

We all approach this study with some established prejudices. Are we willing to ease up a bit in this—in what is perhaps the most important investigation we humans will ever attempt: a final unveiling of the secret life of consciousness? We must carefully consider every clue, from whatever far-flung field or discipline it may come.

Remember the fable and its moral: that the part of the elephant that you are holding on to, as we all grope about in the dark tent, whether it feels like a fan, a rope, a snake, a spear, a wall, or the trunk of a tree, is only one aspect of a vast reality—the infinite mystery of the mind. Neuroscientists have their way of approaching the enigma. Mystics, gifted with insight, also have vital information to share. This is everyone’s story. Not only the poets and philosophers, the artists and musicians, but every man, woman, and child—all who secretly yearn to know what it truly means to be alive and awake—are wholeheartedly welcomed to join in *this* conversation.

A SUMMARY OF CHAPTER ONE

This new theory of consciousness was born from the insight that a class of neurons in the brain may actually be functioning in the same manner as the colored pixels (the tiny phosphorescent dots) on a television screen. Individually, their firings produce only infinitesimal electromagnetic bursts of an inwardly visible light, perhaps in an assortment of wavelengths (an array of colors). In the aggregate, however, this coherent, spatially extended, fine-grained quantum electromagnetic field is directly experienced by and as the Light of consciousness. These presentation neurons are the natural conduit between the body (matter) and the mind (an energetic field of Light).

Presentation neurons can be arranged in circular rings, one firing into the next, like colored lights around a theater marquee. Since the constituent neurons can be made to fire at predictable rates, these rings behave like simple oscillators or resonators. Paired rings of various sizes are able to resonate and display simple ratios. In musical terms, for example, a ring of five neurons with a ring of six neurons forms a pitch ratio of 6:5 and can resonate—and therefore present to consciousness—an interval of a minor third. The neural resonance chamber can be compared to a violin—one that produces and resonates tremendously complex patterns of Light. The brain serves as an aesthetic device by means of which consciousness determines what is pleasing (desirable) and displeasing (undesirable).

These “pixels” and resonators are the building blocks used by natural selection to improve and refine the presentation. In due course they evolve into a platform that supports and presents the vast sound and light extravaganza that now surrounds you: the sensorium.

The electromagnetic field produced by the brain is minutely detailed, and it is precisely at this level of detail that we directly experience sights, sounds and bodily sensations. Even high resolution images of the electromagnetic field surrounding the cerebral cortex give no hint as to how intricately the field is actually arranged for presentation at the microscopic level.