Part VI

The Human Component

Chapter 12

We Are Here

No modern work on quantum cosmology would be complete without an overview of life, as an element of the universe, and humans specifically, as the species that ponders it all. Humanity and intelligence have traditionally and conspicuously been absent from most conventional physicists' discussions of the universe. Cosmology—the study of the origin, evolution, and structure of the universe—has neglected to include humankind, implying that humanity is somehow not a part of the universe, that the universe as a whole must (or can) be studied without us in it.

This is, of course, patently absurd. It is analogous to studying a beach while disregarding the sand, or analyzing a rose bush while dismissing the petals on the flowers. Yet, the emergence of consciousness and intelligence is the most awe-inspiring of all cosmological developments, but is often reserved for other fields of inquiry, such as the cognitive sciences and philosophy.

In a universe that includes conscious and intelligent life, a study of quantum cosmology in its absence would be pitifully deficient. In the broadest sense, cosmology—the science of the universe—should include *everything*. It is for this reason that the sciences and philosophy *must* converge, must investigate the *complete* experience of what it means to be human.

Cosmology Includes *Us*

How did we get to consciousness, to intelligence? How did *we* happen?

About 4.5 billion years ago, Earth formed from aggregating hot, swirling matter left over from ancient supernovas. Every atom on Earth derives from "star stuff," including the atoms of our bodies.

The first hominid appeared about 4 million years ago in Earth's evolutionary history; the first *Homo sapiens* (our species) evolved about 100,000 years ago. Mathematically, humans have been a constituent of the universe for a modest portion of the Earth's age, and only a minuscule fraction of the universe's age.

100,000 is .00000222 % of 4,500,000,000 (4.5 billion)
100,000 is .000000667 % of 15,000,000,000 (15 billion)

Biologically, we differ only about 2–4% from most other mammals; differ only marginally from most nonmammals; and are even similar, in certain respects, to living plants. As a living entity, we share many of the same proteins as other living things; we produce many of the same enzymes and hormones. Indeed, we can even use hormones from other animals to augment our own physiology—insulin (from pigs), thyroxine (from cows), and estrogen (from horses) are examples.

What makes us different is our brains—that approximately three-pound mass of neurons and glial (support) cells between our ears. But our difference does not arise from brain size, or from specific structures, or convolutions, or even chemistry—many animals share similar brain physiology. We experience the same drives and emotions as other animals; there is no drive or emotion experienced by any particular animal species that we do not also experience.

The main distinction between humans and other animals is the manner in which our brains *function*—how our *minds* work.

The Human Brain

Though the terms *brain* and *mind* are often used interchangeably, the distinction between them is crucial to exploring consciousness. *Brain* may be defined as the actual anatomy—the neurons and their synapses as the fundamental entities in brain functions; *mind* is what the brain *does,* which includes producing consciousness.

Philosophers have always had a problem with the idea that mentality emerges from physicality. René Descartes concluded that the mind was completely indivisible and different from the body. Most modern scientists consider the Cartesian model erroneous.

The conventional view is known as *The Neuron Doctrine,* a model that regards brain and mind as an inseparable whole, functioning much as a computational organ, or biological computer. Until recently, The Neuron Doctrine has been the only model of human mental processes, including consciousness. But, as we will discover, The Neuron Doctrine still leaves us almost completely ignorant about how the brain produces an internal mental life.

The Triune Brain

Evolutionary processes are responsible for how the human brain is constructed and functions. Evolution does not happen linearly, progressing along a predictable path. It is a haphazard branching process in which recent developments build atop older structures having more fundamental functions. Each newer structure becomes ever more complex, adding functions, altering the workings of previous structures.

The human brain is a collection of adaptations housed in a triune anatomy evolved over 250 million years (keep in mind that hominids have been around for only 4 million years; *Homo sapiens,* 100,000 years). Three main evolutionary levels of anatomy comprise the human brain:

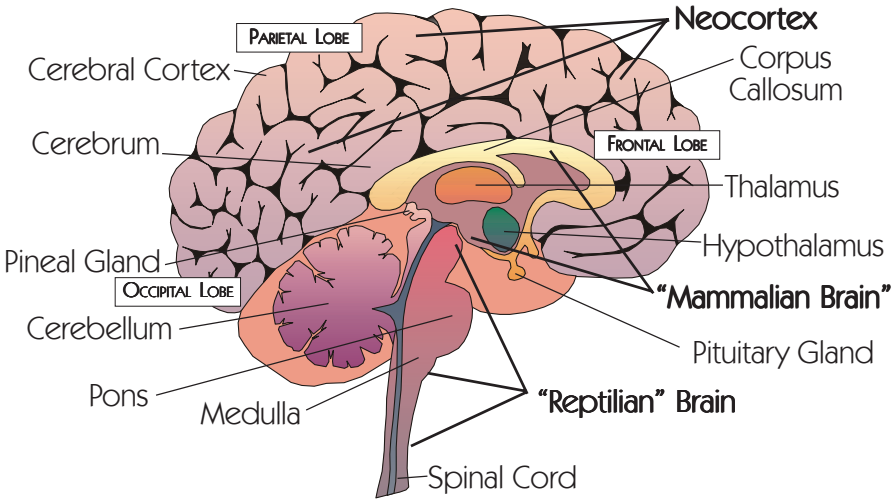
The reptilian brain (brainstem): primitive functions reside here, such as the startle reflex, fear, sex drive,

territoriality, and ritualistic display. It is essential to all autonomic functions: heartbeat, breathing, thermostat, swallowing, and visual tracking. The reptilian brain is the oldest of the brain's structures and is deep within the center of the brain, a bulb of neurons atop the spinal cord.

The mammalian brain (limbic system): the emotions—anger, love, joy, sadness, shame, pride, happiness, mirth, separation anxiety, etc.—are processed here. The mammalian brain evolved after the reptilian brain, neatly enveloping the bulb of the brainstem. All mammals, and some birds, possess this second evolutionary stage of brain structure.

The neocortex (reasoning brain): abstraction (art, representation, planning, strategy, symbols, language), free will, communication, and complex skills are processed here. The neocortex is the outermost layer of the brain, and is the most recent structure. Higher mammals and humans have a well-developed neocortex.

The chemistry of primitive and recent brain systems differs, evidenced by selective destruction of certain brain cells with specific toxins that leave other structures untouched. Because of this biochemical variance, these "three brains" sometimes have competing interests, creating disharmony and unease.



Right-Left Bicamerality

To further appreciate the ramifications of this disharmony, it is necessary to understand how each *hemisphere* of the human brain processes information.

Julian Jaynes, in his landmark and controversial book, *The Origin of Consciousness in the Breakdown of the Bicameral Mind*, asserts that the two hemispheres of the human brain were less integrated—if integrated at all—some three thousand years ago. The two hemispheres processed information independently, with little feedback across the *corpus callosum*—the neural network joining the two halves. Man, Jaynes asserts, was truly of "two minds."

The right brain had the nasty habit of reacting to internal dialog as messages from beyond itself, construing this internal chatter as emanating from angels, demons, or God. Interpretation occurs in the left brain, explaining, justifying the acts the right brain dictates. All creative, intuitive acts and ideas are right-brained and somewhat unconscious. They *happen*. It is up to the left brain to explain *why*.

The breakdown of bicamerality began due to developments in language and the exchange of ideas. But, unfortunately for the human, this dual consciousness is still with most of us today. It often causes great suffering. (Ever have an argument with *yourself?)*

Because the left and right hemispheres are different, they often do not agree; there is conflict. Witness the common response of "freezing" during an emergency situation. The left brain logically wants to act on the emergency; the right brain wants to run like hell. The left brain tries to shut down the right. There is mutual inhibition on both sides: Nothing happens. It is only when left and right are in accordance that there is serenity and a clear functioning mind.

A normal brain is mutually inhibitory. Blocking effects during internal conflict cause disinhibition of the blocked side:

Blocked Left:	despair, guilt, worry, hopelessness, melancholia
Blocked Right:	euphoria or indifference

Functions of Left and Right Hemispheres
Table 6.a

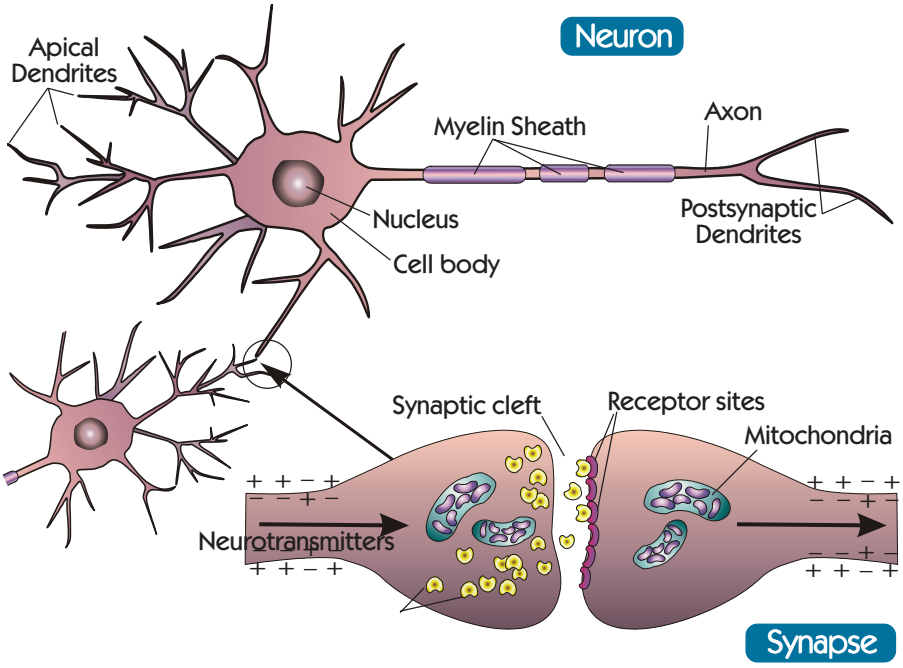
Left Brain	Right Brain
Vertical columns of neuronal connections	Horizontal axial connections
Dominant neurotransmitters are dopamine and acetylcholine (fine motor control—dexterity, speech)	Dominant neurotransmitter is norepinephrine (arousal to novel stimuli—visio spacial perception)
Language: syntax, semantics	Phonology, intonation, context, meaning
Literal meaning	Metaphor, symbolism
Functionality, practicality	Humor, esthetics
Sequential, linear	Spherical, holistic
Reduces to parts	Sees patterns, wholes
Classification, order	Visualization, imagination
Abstractions, analysis, mathematics	Depth perception, face recognition, emotional processing
Interpretive, justifying, explanatory	Responsive, reactive (does not know why), has more dislikes
Believes it is separate, an individual	Feels a sense of unity with a higher power—unable to express it
Is purposeful, directed	Enjoys just existing

The apparent disagreement between science and religion may have its foundations in brain anatomy. In general, scientific analysis resides in the left brain; spiritual experiences reside in the right hemisphere. The sense of self primarily emanates from the left temporal lobe; brain damage—especially in the left hemisphere—may cause a person to regard the right hemisphere as another "self," a mysterious detected presence. Stimulation in the right temporal lobe can produce illusions of hearing voices and seeing apparitions. Hemispheric "coherence" (in which electrical activity becomes synced between the two

hemispheres) occurs only during meditation, hallucinations, epileptic seizures, coma, and impending death. Part of the "natural" state of the human mind is one of duality; the brain and mind experience a constant discrepancy of interest.

How a Neuron Functions

The neuron axon membranes "fire" (through sodium and potassium ion exchange) and propagate traveling action potential "spikes" on the axonal surface, which upon reaching postsynaptic axon terminals, cause release of chemical neurotransmitters into the synaptic cleft. These in turn trigger dendritic membrane events in a second neuron, which culminate in another axon firing, more neurotransmitter release, and so on.



Curiously, in the *ephapses* of some neurons, firing occurs without neurotransmitter release; only about 15% of axonal action-potentials reaching presynaptic terminals result in actual release of neurotransmitters from vesicles.