REASON & REVELATION
AUGUST 2005
A MONTHLY JOURNAL OF CHRISTIAN EVIDENCES

THE HUMAN NERVOUS SYSTEM: EVIDENCE OF INTELLIGENT DESIGN [PART I]

Brad Harrub, Ph.D.

[EDITORS' NOTE: The following article is the first in a series of articles by Dr. Harrub that will appear in future issues of *R&R*. The intelligent design of the human body provides scientific evidence for God. In order to appreciate the complexity and design of the body's various systems, the reader may find some of these details cumbersome or tedious. Nevertheless, they demonstrate conclusively the handiwork of an Intelligent Designer. Dr. Harrub's academic expertise in anatomy and neurobiology well-equip him to author this series.]

INTRODUCTION

It is difficult to get through a major airport today without riding on a tram or air-train of some type. These unmanned transportation systems help travelers move quickly over long distances. Most people give no thought to the complexity of these transportation systems. We simply rely on them to be on time, stop at specific points, and open doors so that passengers can load and unload at particular locations. No one would argue this transportation system arose by chance or a non-purposive process. The ability to load passengers, travel to specific destinations, and unload passengers is the product of purposeful design.

Yet, within the nerve cells that compose the human nervous system is a similar transport system that is far more complex than man-made trams. Synaptic vesicles are loaded with specific neurotransmitters that are then delivered to the end terminal of the axon. Upon activation, these vesicles will "dump" their contents into the synaptic cleft (the space between nerve cells). This action requires the nerve cell to be able to manufacture neurotransmitters, correctly load specific transmitters into the correct vesicles, transport the vesicle to a specific place, store the vesicles until they are needed, empty the vesicle upon activation, and then "clean-up" after itself. **And this complex transportation system is just one small aspect of the human nervous system.** How could anyone critically evaluate this system and then ignore the manifestly evident design?

When examining each of the systems of the human body, the logical place to begin is with the nervous system. The nervous system is the collection of nerve cells and body tissues that regulate the body's response to internal and external stimuli by electrical and chemical signals. German anatomist Waldeyer-Hartz was the first person to maintain that the nervous system was built out of separate cells and their delicate extensions (Asimov, 1994, p. 446). He called the nerve cells "neurons," and his thesis that the nervous system is composed of separate neurons is known today as the neuron theory. Separately, these neurons are fruitless in trying to maintain homeostasis in the body. But purposefully arranged together, these individual cells perform feats that make most telecommunication systems appear primitive. Organs, glands, and vessels throughout the body are constantly controlled and coordinated by individual neurons, and each of these structures would be ineffective without nerve input and feedback. By comparison, lamps, stereos, television sets, hand mixers, and computers all carry-out specific functions, **but only if they are wired to an electrical source**. Similarly, the heart, kidneys, pancreas, bladder, and lungs carry out specific body functions, but without the "wiring" and input from the nervous system these organs would be completely useless.

This dependence on the nervous system poses a serious "chicken or egg" scenario for the body's multiple systems. Organs require the nervous system in order to function properly. But without the organs in place, what role would the brain

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play? This labyrinth of complexity gets even more astonishing once one considers that evolutionists must also identify why a creature would evolve a complex nerve cell without a brain to process the sensory information.

Consider the conundrum into which this complex system places evolutionists. In order for the brain to work, it must be able to send and receive input via nerves. Nerve cells are of little use without the spinal cord and brain to process and integrate the information. If the Darwinian Theory is correct, then nerves must have preceded the evolution of the brain (because the brain is composed of trillions of neurons). But without a processing unit, what purpose would such nerves serve? **Consider also that it takes a cell to make a cell**, thus the question of how and when these original nerve cells originated becomes extremely challenging for evolutionists. Surely, one cannot consider the complexity of the nervous system on both the macroscopic and microscopic levels without realizing that all of the parts are necessary and must be simultaneously intact to have a functioning system.

Michael Behe defined "irreducible complexity" as a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning (1996, p. 39). The nervous system is an excellent example of irreducible complexity. To propagate the nerve signal from one nerve cell to another requires molecular channels on the nerve cell to open and close in an orchestrated and coordinated fashion. If synaptic vesicles do not pick-up the correct neurotransmitter, or are not delivered to the correct region of the cell, or are unable to be stored, or are unable to deposit their contents into the synaptic cleft, then the whole system would break down and the human would soon suffer physiological abnormalities that could lead to death. All of the parts must work together in order for the system to function properly. A detailed examination of the nervous system quickly reveals that it is irreducibly complex, possessing an intricate arrangement that we are only now beginning to understand. And yet, this entire system is alleged to have arisen—not from an Intelligent Designer—but rather from millions of years of mutations and natural selection. A thorough investigation into the intricacies of this system soon demonstrates that design requires a Designer. [NOTE: The primary sources for the anatomy and physiology described below are drawn from Moore, 1992; Kandel, et al., 1991; and Netter, 1994.]

INTELLIGENT DESIGN

The concept of intelligent design is not a new phenomenon. Many classical philosophers like Plato recognized the concept that purposeful arrangement could only be possible in light of intelligent input. As Davis and Poe noted, "The idea of design suggests the existence of a designer. If the universe actually was designed, how did it come to be designed? More importantly for personal beings, if the universe actually was designed, who designed it?" (2002, p. 2). Because intelligent design implies that there is a designer, evolutionists are adamant that everything can be explained by purely naturalistic, materialistic causes. Immunologist Scott Todd observed: "**Even if all the data point to an intelligent designer, such an hypothesis is excluded from science because it is not naturalistic**" (1989, p. 423, emp. added). Evolutionist Julian Huxley affirmed: "At first sight the biological sector seems **full of purpose**. Organisms are built as if **purposefully designed**, and work as if in **purposeful** pursuit of a conscious aim. But the truth lies in those two words 'as if.' As the genius of Darwin showed, the purpose is **only an apparent one**" (1963, p. 16, emp. added). Twenty-five years after Huxley penned those words, Amherst Professor George Greenstein observed:

> As we survey all the evidence, the **thought insistently arises** that some supernatural agency—or, rather, Agency—must be involved. Is it possible that suddenly, without intending to, we have stumbled upon scientific proof of the existence of a Supreme Being? Was it God who stepped in and so providentially crafted the cosmos for our benefit? Do we not see in its harmony, a harmony so perfectly fitted to our needs, evidence of what one religious writer has called 'a preserving, a continuing, an intending mind, a Wisdom, Power and Goodness far exceeding the limits of our thoughts?' A heady prospect. **Unfortunately I believe it to be illusory** (1988, p. 27, emp. added).

Notwithstanding, the complexity and design observed in the human nervous system are anything but simply "apparent" or "illusory." The Darwinian Theory falls woefully short in providing a suitable answer to how nerve cells and the entire nervous system originated in the first place. Davis and Poe noted: "The challenge for those expressing only a materialistic explanation is to show how mutations and natural selection explain the complex and highly interdependent molecular systems" (2002, p. 202). That challenge has not and cannot be met.

In considering the nervous system one must ask the question: what makes it work? Were its atoms arbitrarily arranged by "nature"? Davis and Poe further remarked:

> A different approach to the information content of DNA is provided by

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Editors:

Brad Harrub, Ph.D.*
(*Neurobiology, University of Tennessee)

Dave Miller, Ph.D.*
(*Communication, Southern Illinois University)

ISSN:

1542-0922

Annual Subscription Rates:

$10.00 Domestic
$ 8.00 Domestic Bulk (5+ to same address)
$16.00 Canada & Overseas Airmail

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230 Landmark Drive
Montgomery, AL 36117-2752
U.S.A.

General inquiries, changes of address, or international callers:

Phone: (334) 272-8558
Fax: (334) 270-2002

Orders:

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the chemist-philosopher Michael Polanyi. Polanyi accepted the fact that materialists define life like a machine (forces and matter). Then he asked what makes something a machine. Is it the material from which the machine is composed, or is it the function of the machine? **Consider a pile of iron filings and a pair of scissors. There is no difference in the two at the atomic level. Where they differ is in their function.** Polanyi is saying that for any machine (non-biological or biological), we have to look beyond the physical-chemical components to the organizational function or purpose (p. 203, emp. added).

But most scientists do not want to consider that without a purposeful arrangement, the nervous system would be useless. Elaborate configuration reveals design, and design indicates a Designer. William Dembski remarked:

> Should design be permitted back into science generally and biology in particular? Scientists bristle at the very thought. For scientists who are atheists, design is an accident of natural history. Indeed, with no divine architect to start creation on its course, any designing agents, including ourselves, must result from a long evolutionary process that itself was not designed. For the atheist, design occurs at the end of an undesigned natural process and cannot be prior to it (1999, p. 122).

Proper examination of the nervous system uncovers a world of irreducible complexity. However, most researchers today have a prior commitment, i.e., bias, to evolution and naturalism. Thus, they are left to try to explain away the idea of irreducible complexity. Dembski noted:

> But what about irreducible complexity? Can the Darwinian mechanism account for irreducible complexity? Certainly if selection acts with reference to a goal, it can produce irreducible complexity.... But the selection operating in biology is Darwinian natural selection. And this form of selection operates without goals, has neither plan nor purpose and is wholly undirected. The great appeal of Darwin's selection mechanism was, after all, that it would eliminate teleology from biology (Dembski, pp. 147-148).

Additionally, one must acknowledge that the nervous system not only demonstrates irreducible complexity, but it also exhibits "minimal function." That is, it is not good enough just to evolve a cell that can conduct a nerve signal. The signal must be conducted fast enough that it allows the animal sufficient time to react. A nerve cell that "works" is not good enough. It must be a neuron that works fast enough that it can serve a specific function. Consider also that humans possess both a voluntary and involuntary nervous system, composed of several different neuron types. The voluntary nerves are ones that are controlled by the individual (e.g., skeletal muscles). Involuntary muscles act without any direction from the individual (e.g., digestive muscles). Also bear in mind that each one of these different neurons receives excitatory or inhibitory input from a variety of neurotransmitters which must be present in the correct quantity at the synaptic junction in order to send the correct message.

Yet, evolutionists still maintain a naturalistic theory of origins. Ignoring the obvious, Darwinian philosopher, Helena Cronin avowed: "All this apparent design has come about without a designer. No purpose, no goals, no blueprints. Natural selection is simply about genes replicating themselves down the generations. Genes that build bodies that do what's needed—seeing, running, digesting, mating—get replicated; and those that don't, don't" (1997/1998, p. 80). Apparent **design** without a **designer**? So exactly where did those genes originate to allow one to see, run, digest, and reproduce? The evidence unequivocally points to a Designer!

FUNCTIONS OF THE NERVOUS SYSTEM

The human nervous system is composed of billions of nerve cells often referred to as neurons. Regarding just the nerve cells in the brain, Michael Denton, senior fellow in human molecular genetics at the University of Otago, in New Zealand, noted:

> Altogether the total number of connections in the human brain approaches 10^{15} or a thousand million million. Numbers in the order of 10^{15} are of course completely beyond comprehension. Imagine an area about half the size of the USA (one million square miles) covered in a forest of trees containing ten thousand trees per square mile. If each tree contained one hundred thousand leaves the total number of leaves in the forest would be 10^{15}, equivalent to the number of connections in the brain (1985, p. 330).

These nerve cells are responsible for sending electrical impulses from one part of the body to another. By monitoring both the internal and external environment, the nervous system is responsible for keeping the body in a state of homeostasis—maintaining a relatively constant internal environment. Often, the brain will be sent sensory messages from nerves in the body, alerting it that the temperature is cold, or that it is experiencing pain. The brain conversely sends out electrical messages that tell muscles to contract in an effort to immediately pull on a sweater or move the hand from a hot stove. In examining the swiftness of the brain compared to computers, Roger Lewin stated: "[T]he fastest computer clocks up a billion or so operations a second, which pales to insignificance beside the 100 billion operations that occur in the brain of a fly at rest (1992, p. 160). John Pfeiffer called the nervous system: "the most elaborate communications system ever devised" (1961, p. 4). That same year, Allison Burnett wrote an article in *Natural History* in which she declared: "The nervous system of a single starfish, with all its various nerve ganglia and fibers, is more complex than London's telephone exchange" (as quoted in Jackson, 2000, p. 53). However, the human nervous system is infinitely more complex than the starfish.

A densely branching Purkinje cell found in the cerebellum demonstrating the immense connectivity in the brain.

The primary functions of the nervous system can be divided into four main categories:

1. **Sensory input-reception**. The human body possesses millions of sensory receptors (e.g., auditory receptors, skin receptors, retinal cells, etc.) that help detect changes both within and outside the body. These receptors monitor things such as heat, light, pressure, smell, and electrolytic levels. This information is commonly referred to as sensory input and must be converted to a chemical signal which can then be sent to the brain.

2. **Transmission**. Transmission refers to the propagation of a nerve impulse from one nerve cell to another. This communication is often referred to as synaptic transmission, because the synapse is the place where this action occurs. We know today that nerve cells use neurotransmitters to propagate these signals to other neurons. Neurons can respond to stimuli and conduct an impulse down the cell body because of a membrane potential that is established across the cell membrane. In other words, there is an unequal distribution of ions (charged atoms) on the two sides of a nerve cell membrane. By gating specific channels, an action potential (see more details below) is generated and passes the nerve signal down the axon and on to the next nerve cell. Nerve impulses can travel at speeds of up to 250-300 miles per hour, depending on the type of cells involved.

3. **Integration**. Integration occurs when the sensory input is processed in order to determine the best response. Commonly referred to as "thinking," this function is the product of all gathered information from both outside and inside the body.

4. **Response**. Response is commonly the motor output that results from integration. This step sends information to muscles, glands, and organs (often referred to as effectors) in an effort to generate a desired response.

Bear in mind that these four functions are constantly ongoing in a feedback loop. Responses are constantly modified as more sensory input is received. The nervous system has to be able to send and receive nerve signals simultaneously—and from multiple regions of the body. All four of these functions are necessary in order for the nervous system to be functional. For example, a system that can sense, transmit, and integrate is good; but without the ability to respond the other three functions are meaningless. Likewise, a system that can transmit, integrate, and respond is useless without sensory input. Are we to believe that these four functions evolved simultaneously? Impossible! Design is the only plausible explanation. As Nobel Laureate Sir Ernst B. Chain declared,

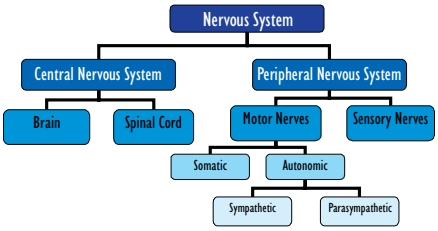
> I would rather believe in fairy tales than in such wild speculation. I have said for years that speculations about the origin of life lead to no useful purpose as even the simplest living system is far too complex to be understood in terms of the extremely primitive chemistry scientists have used in their attempts to explain the unexplainable. God cannot be explained away by such naive thoughts (as quoted in Clark, 1985, pp. 147-148).

Our thoughts precisely!

BASIC DIVISIONS OF THE NERVOUS SYSTEM

The human nervous system is divided into two major divisions: the central nervous system (CNS) and the peripheral nervous system (PNS). Both systems are needed in order to monitor adequately the internal **and** external environment. The requirement of both systems places yet another burden on evolutionists as they must explain the simultaneous origin of both. Yet this explanation remains a mystery. As Rao and Wu conceded: "During the evolution of the mammalian brain, regions connected to each other anatomically and functionally are thought to coevolve, **but mechanisms for co-evolution are not known**" (2001, p. 682, emp. added).

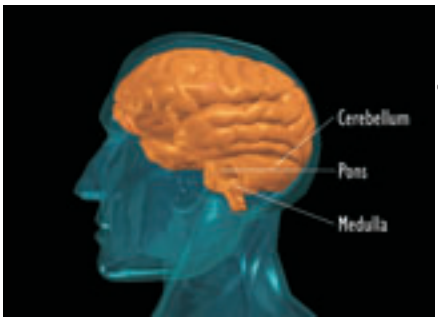
The central nervous system is composed of nerve cells which make up the brain and spinal cord. The spinal cord carries nerve inputs from the body to the brain, which allows for integration in the brain and then a response that is passed back to the spinal cord and on to the body. The peripheral nervous system consists of nerve cells located outside the brain and spinal cord. Nerve cells of the PNS that carry nerve signals **toward** the brain and spinal cord are called **afferent neurons.** Nerve cells that carry the signal **away** from the brain and spinal cord are known as **efferent neurons.** These two divisions compose the entire neuronal network within the human body, but each can be further subdivided into various regions.



CNS—Central Nervous System

The following are the main components of the central nervous system:

1. The **spinal cord** controls movement of the limbs and trunk. It conducts motor information from the brain to our various effectors: skeletal muscles, cardiac muscles, smooth muscles, and glands. Additionally, it receives and processes sensory information from the skin, joints, and muscles of the limbs and trunk.
2. The **brain stem**, often referred to as the hindbrain, consists of three parts: medulla, pons, and cerebellum.
   i. The **medulla**, located directly above the spinal cord, includes several centers responsible for vital functions, such as digestion, breathing, and control of heart rate.
   ii. The **pons**, located above the medulla, conveys information about movement from the cerebral hemisphere to the cerebellum.
   iii. The **cerebellum**, located behind the pons, modulates the force and range of movement and is involved in the learning of motor skills.



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3. The **midbrain** is a portion of the brain that controls many sensory and motor functions, including eye movements and the coordination of visual and auditory reflexes.
4. The **diencephalon** is composed of two structures: the thalamus and hypothalamus.
   i. The **thalamus** is an area that processes most of the information that reaches the cerebral cortex from the rest of the central nervous system.
   ii. The **hypothalamus** is the area that regulates autonomic, endocrine, and visceral function.
5. The **cerebral hemispheres** are what many people consider as "the brain." The left and right hemispheres are able to communicate with each other through a portion of the brain known as the corpus collosum. The cerebral hemispheres consist of the cerebral cortex and three deep-lying structures: the basal ganglia, the hippocampus, and the amygda-

loid nucleus. The basal ganglia participates in regulating motor performance; the hippocampus is involved with aspects of memory storage; and the amygdaloid nucleus coordinates autonomic and endocrine responses in conjunction with emotional states (Kandel, et al., 1991, p. 9).

PNS—Peripheral Nervous System

The peripheral nervous system, unlike the central nervous system, has nerve cells that come in contact with the environment. It also includes the twelve cranial nerves that descend directly from the brain. The PNS is composed of two major subdivisions: somatic and autonomic nervous systems. Somatic nerves control the muscular system and are responsible for external sensory receptors. The autonomic nervous system is involuntary and is responsible for maintaining proper function of the internal organs. The autonomic system can be further divided into parasympathetic and sympathetic subdivisions. Sympathetic nerves are primarily responsible for the "fight or flight" response, while the parasympathetic nervous system acts as an antagonist that returns the body to its normal resting state. The cell bodies of peripheral nerves are often found in clusters known as ganglia. A closer look into these two primary divisions reveals not only colossal complexity, but also intelligent design.

CENTRAL NERVOUS SYSTEM

Every human begins life as a single fertilized cell. About twenty-two days after fertilization, a hollow region known as the neural tube begins to develop (Moore and Persuad, 1993, p. 385). The cells located within this hollow tube will eventually multiply, migrate, and become the brain and spinal cord. This oversimplified description gives little recognition to what must occur on the cellular level to get from the neural tube to the central nervous system. One study simplified this developmental process:

> Neurons are natural migrants; most, if not all, of the neurons in the mammalian nervous system migrate from their places of birth to their locations of function. In the brain, neurons usually originate in the ventricular zone, where their precursor cells proliferate. They can then migrate radially to other layers in the brain, or tangentially (in a direction parallel to the surface of the brain) to other regions of the brain. Radial migration is dependent on radially aligned glial fibers, whereas tangential migration is independent of glial cells and **perhaps** relies on contacts with other neurons (Rao and Wu, 2001, p. 680, emp. added).

Who can believe that such a complex process could have evolved from non-living material? And bear in mind, this is the simplified version. In their classic textbook *Molecular Biology of the Cell,* Nobel Laureate James Watson and his coauthors noted:

> Most of the components of a typical nervous system—the various classes of neurons, sensory cells, and muscles—**originate in widely separate locations** in the embryo **and are initially unconnected**. Thus, in the first phase of neural development the different parts develop according to their own local programs, following principles of cell diversification common to other tissues of the body, as already discussed. The next phase involves **a type of morphogenesis unique to the nervous system: a provisional but orderly set of connections is set up** between the separate parts of the system through the outgrowth of axons and dendrites along **specific routes**, so that the parts can begin to interact. In the third and final phase, which continues into adult life, the **connections are adjusted and refined** through interactions among the far-flung components in a way that depends on electrical signals that pass between them (see Alberts, et al., 1994, p. 1119, emp. added).

Uncomplicated process? Definitely not! And note that embryonic development only gets the "network" up and running—it does not include the actual conduction of nerve impulses throughout the body.

Additionally, the brain and the spinal cord are protected by bony elements. They are also covered by three membranes known as meninges. The meninges are connective-tissue layers that provide support to the brain and spinal cord. The outermost layer is the dura mater. The second layer is the arachnoid layer, which is more delicate, and is so-named because it often resembles a spider web. The innermost membranous covering is the pia mater. It is a very thin covering composed primarily of fibrous tissue covered on its outer surface by a sheet of flat cells that are believed to be impermeable to fluid. These three layers form a protective envelope that allows the brain and spinal cord to be bathed constantly in cerebral spinal fluid, also playing a key role in forming a blood-brain barrier. They also prevent spinal fluid from leaking out as cranial nerves leave the skull. Did all three of these essential layers evolve simultaneously? And if so, from what did they evolve? The brain and spinal cord are dependent on these three layers in order to prevent cerebral-spinal fluid leakage and to maintain the blood-brain barrier. Does it seem logical that there was a "transition stage" for these layers when they were unable to bathe the brain in cerebral spinal fluid or provide a complete blood-brain barrier?

The Brain

Neuroscientists are working diligently to try to demonstrate that the brain/mind can be explained simply by neurons firing. They categorically reject any possibility of dualism—the theory that the brain and mind are independent entities. However, just because they refuse to acknowledge this very real possibility does not mean that it does not exist. British anthropologist and evolutionist Sir Arthur Keith acknowledged: "The brain, from being an instrument fit for anthropoids, passed on to a state in which the range of feeling, understanding, and of manipulative skill, became fit for men. **To ask me to believe that the evolution of man has been determined by a series of chance events is to invite me to give credit to what is biologically unbelievable**" (1947, p. 217, emp. added).

While they have set ambitious goals in determining the physiology of the brain, the truth is, this field has yet to keep pace with its vaulting aspirations. The reality of an Intelligent Designer continues to plague neuroscientists as they look deeper and deeper into the mechanisms underlying the brain. Nevertheless, they are **committed** to explaining the brain without admitting that it demonstrates purposeful arrangement and complex design. As William Dembski observed,

> For all the obstacles it faces in trying to reduce intelligent agency to natural causes, neuroscience persists in the Promethean determination to show that the mind does ultimately reduce to neurophysiology. Absent a prior commitment to naturalism, this determination will seem misguided. On the other hand, given a prior commitment to naturalism, this determination is readily understandable (1999, p. 216).

[NOTE: The topic of the brain and mind have already been covered in detail in previous issues of *Reason & Revelation.* The reader is encouraged to read the January and February 2004 issues at URL: http://www.apologeticspress.org/articles/1.] By way

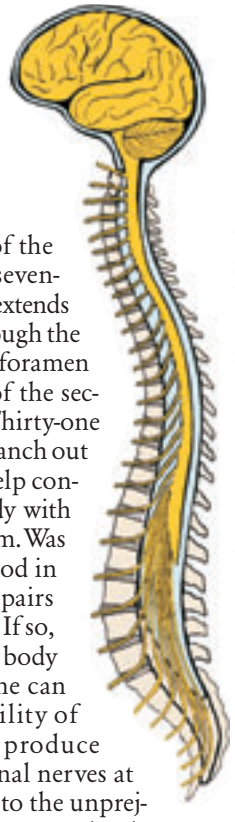
of quick review, the average human brain weighs only about three pounds and is covered with convolutions and wrinkles (known as sulci). The purpose of these furrows is to provide more surface area for the brain. Hidden within the gray and white matter of the brain is the most intricately wired communication network in the world. That three pound organ represents literally billions of interconnected nerve cells and millions of protective glial cells which, according to evolutionists, simply arose by pure chance from nonliving matter.

The brain has been estimated to contain 100 billion (10^{11}) neurons (Kandel, et al., p. 18), each a living unit within itself. While most neurons share similar properties, they can be classified into "perhaps as many as 10,000 different types" (p. 18). How long did it take for each one of these 10,000 different cell types to evolve? Additionally, over 100 trillion electrical connections are estimated to be present throughout the human brain, which has been said to be more than "all the electrical connections in all the electrical appliances in the world." In describing this awesome organ, Wysong noted:

> The human brain weighs about three pounds, contains ten billion neurons with approximately 25,000 synapses (connections) per neuron. Each neuron is made up of 10,000,000,000 macromolecules. The human mind can store almost limitless amounts of information, (a potential millions of times greater than the 10^{15} bits of information gathered in a lifetime—I. Asimov), compare facts, weigh information against memory, judgment and conscience and formulate a decision in a fraction of a second (1976, p. 340, parenthetical item in orig.).

Even men who hold no belief in God will admit that the brain is the most complex matter in the Universe. In the January 16, 1997 issue of *Nature*, Sir Francis Crick's close collaborator, Christof Koch, wrote: "The latest work on information processing and storage at **the single cell (neuron) level reveals previously unimagined complexity and dynamism**" (385:207, parenthetical item in orig., emp. added). His concluding remarks were: "As always, we are left with a feeling of awe for the amazing complexity found in Nature" (385:210).

In trying to defend the notion that the brain was merely a product of evolution, Steven Pinker declared: "Our organs of computation are a product of natural selection" (1997, p. 36). Yet, why would natural selection select for an organ that consumes enormous amounts of energy and produces lots of heat? For example, a newborn's brain consumes 60% of its available energy (Gibbons, 1998, 280:1345), while adults devote 20% of their cardiac output to this organ—which only accounts for two percent of our body weight (Van De Graaf and Fox, 1989, p. 438). So the question then becomes, if humans (and their brains) evolved, why would nature "select" for a larger brain that consumes more energy? Or, as the late Stephen Jay Gould asked: "But why did such a large brain evolve in a group of small, primitive, tree-dwelling mammals, more similar to rats and shrews than to mammals conventionally judged as more advanced? And with this provocative query I end, for we simply do not know the answer to one of the most important questions we can ask" (1977, p. 191, emp. added).



Spinal Cord

The average length of the human spinal cord is seventeen inches. It normally extends from the brainstem through the largest hole in the skull (foramen magnum) to the level of the second lumbar vertebrae. Thirty-one pairs of spinal nerves branch out from the cord, which help connect the rest of the body with the central nervous system. Was there a transitional period in which only two or three pairs of spinal nerves existed? If so, how did the rest of the body receive input? Surely one can comprehend the inability of mindless evolution to produce thirty-one pairs of spinal nerves at the outset. Once again, to the unprejudiced mind, design is seen to be the superior explanation.

The end of the spinal cord is known as the conus medullaris, and from this a bundle of lumbar and sacral nerves descends. These nerves resemble a horse's tail, and have been termed appropriately *cauda equina*. A cross section of the spinal cord reveals a gray "butterfly" surrounded by white matter with spinal nerves coming off at specific intervals. The ventral wings of the butterfly (often referred to as ventral horns) contain the cell bodies of the efferent (motor) neurons. The dorsal wings (dorsal horns) contain the axons of afferent (sensory) neurons. Is this specific arrangement purely coincidental? The major functions of the spinal cord are reflex reactions, limited integration, and transmission of sensory information to the brain, and then motor signals from the brain to effectors. Integration occurs on the spinal cord with certain kinds of reflex actions (e.g., when a physician taps your knee cap and the leg flexes). By processing reflex information at the spinal cord, the human body can respond quicker if danger is imminent.

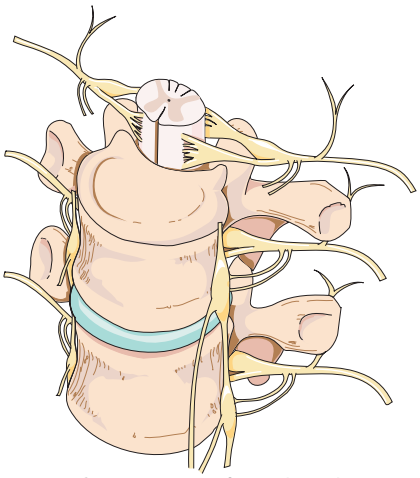
The white matter surrounding the gray matter of the spinal cord is composed of myelinated axons (covered in part II) that are ascending and descending on the spinal cord. These axons are organized into well-defined tracts, with the ascending tracts carrying sensory information

to the brain, and the descending tracts carrying motor information from the brain to the body. These spinal tracts are named according to the endpoint regions and are located in a specific region of the white matter. For instance, the lateral spinothalamic tract carries pain and temperature information up to the thalamus and is located in the lateral aspect of the white matter. The corticospinal tract carries motor signals from the cortex down the spinal cord to the trunk and limbs. Interestingly, when a pain sensation on the left side of the body enters the left posterior horn of the spinal cord, it synapses and the next neuron then crosses over to the right side of the cord and ascends up the cord in the white matter to synapse in the thalamus. No one would suggest that a complex cloverleaf interstate entrance-exit system simply developed by chance; yet these spinal tracts are far more complex and are composed of living cells rather than inorganic asphalt.

PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system consists of nerve cells which are outside the brain and spinal cord. Included are sensory neurons found on the skin as well as those involved in smell, taste, hearing, and sight. The PNS is often divided into two subdivisions: sensory and motor neurons. Sensory neurons carry information **to** the central nervous system, while the motor division neurons carry signals **away** from the central nervous system.

Cranial nerves are highly specialized, and vary in function—from light-receptor cells in the eye to cells detecting taste in the tongue. These nerves often carry both sensory and motor fibers, and act without any input from the individual. Cranial nerves, unlike spinal nerves, drop directly out of the brain and then proceed to their target organ. Recall, however, that the brain is completely encased in bone, making this task much more difficult than it might appear. So exactly how do these twelve cranial nerves get to where they need to go, and how do they "know" exactly where to go? Keep in mind that these are living cells within the body that are receiving no input from the external environment. Quite simply, they make their way to their destination via well-placed foramen (or "holes"). Each pair of nerves has a specific "hole" through which it descends in order to reach a target, such as the eye (optic nerve) or the heart (vagus nerve). If you were to take a skull and pour water where the brain is normally positioned, you would observe water coming out of several different holes. These foramen allow the cranial nerves to connect the brain with their target organs. But how did these holes come into being? Did they evolve? Did the cranial nerves simply creep over time out of the brain and then await the appearance of holes in the skull? **And those numerous foramen should not be quickly dismissed.** The brain is constantly bathed in cerebral spinal fluid—a fluid that must not "leak" out of the cranium. The formation of the holes and the dural layers that prevent this "leakage" point unmistakably to an Intelligent Designer. Just like an onion being peeled, each layer uncovered within the nervous system reveals a greater depth of complexity and design.



Cross section of spinal cord

Somatic vs. Autonomic Nervous System

The body was designed in such a way that humans have control over certain components, while the body itself regulates other aspects. Consider that nature could not possibly evolve a voluntary nervous system in conjunction with an involuntary system, along with a processing unit (the brain) that can integrate all of the incoming information. College textbooks allude to the fact of both systems, without any suggestion as to how they might have actually occurred. Students are expected to accept this "fact" as a part of the complete evolutionary scenario. No one looking at the Great Wall of China would argue that all of those stones came together over millions of years by "random chance." Yet, the somatic and autonomic nervous system is far more complex, and composed—not of rocks—but of living tissue! The objective individual is forced to conclude that such intricacy extends far beyond the realm of chance!

[to be continued]

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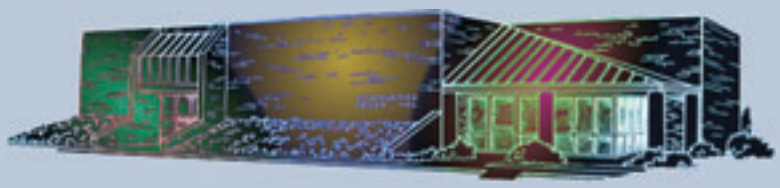

THE AP SPANISH WEB SITE IS NOW ON-LINE

Moisés Pinedo

Thanks to God's blessing and your generous support, the official AP Spanish Web site is now a reality! Our efforts to defend the Christian Faith are now being instantly multiplied by this additional avenue of outreach. Are you aware that Spanish and English are in a virtual dead heat to be the second most spoken language in the world? As of 1999, Spanish had 332 million speakers, while English had 322 million. [NOTE: Both were far behind Chinese, with 885 million, though if people who speak English as a **second** language were included, English would come out on top.] And what's more, about 5.8 percent of the people who use the Internet speak Spanish, making it the No. 4 language in the Internet community, following English (51.3 percent), Japanese (8.1 percent), and German (5.9 percent). Close behind is Chinese with 5.4 percent, followed by French with 3.9 percent. [Source: "Spanish Facts and Stats," (On-line), URL: http://spanish.about.com/library/weekly/aa070300a.htm.]

In its continuing mission to provide the world with evidence for the truth of the Gospel of Jesus Christ, Apologetics Press is endeavoring to cross language barriers. The Apologetics Press Spanish Department is in the capable hands of Moisés Pinedo and Michael Cortez. These two men, who have chosen to use their special talents in service to others, deserve accolades for their untiring efforts to pioneer this unique and timely tool.

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May God bless this additional effort to apprise people of their duty to Him.

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