

Triune Brain Concept

Based on Paul MacLean; Prepared by Jay E. Gould 10/9/03

Looking at the overall anatomical relationships of the brain (see figure at end), notice how the most recently evolved *neomammalian* neocortex of the cerebral hemispheres surrounds the older *paleomammalian* limbic system, which in turn surrounds the ancient *reptilian* upper brainstem (basal ganglia, and diencephalon).

This division of the brain into three parts constitutes what MacLean calls the Triune Brain of mammals (meaning three brains in one). This conceptualization represents a hierarchical organization of the brain from an evolutionary perspective. Note, however, that although it is an interesting way of viewing general relationships between structure and function in the brain, this theory from the early 1960's--which is only summarized here--is a vast oversimplification, and advances in neuroscience research have shown it not to be correct in all of its details.

1. At the core of the human brain is the old proto-reptilian brain, or R-complex, which is responsible for innate, stereotyped, species-typical behavioral patterns necessary for survival of self and species. It is involved with reflexive and instinctive behaviors such as feeding, fighting, fleeing, and reproduction--the so-called Four F's. Behaviors included are aggression, territoriality, dominance, ritual displays and other nonverbal communication, as well as social conformity (examples: xenophobia, paranoia, war, military pageantry and goose stepping, graduation processions, bowing to authority, and symbolism; e.g., phallic symbols, the cross, the hammer and sickle, and flags.) The proto-reptilian brain is made up primarily of the upper brain stem (referred to as the striatal complex); i.e., the base of the forebrain: diencephalon, basal ganglia, and part of the olfactory system. The hypothalamus of the

diencephalons plays a particularly important role in the four F's, as well as regulation of the endocrine system and the autonomic nervous system. It is at the center of the body's survival and gene replication machinery.

2. Wrapped intimately around this core is the old paleomammalian brain. This consists of what is called the limbic system, i.e., the limbic cortex (or lobe) and connecting brainstem structures. The paleomammalian brain is responsible for enhanced emotion and motivation (and thus also visceral regulation), as well as enhanced learning and memory. It provides for greater flexibility of behavior and integrates messages from both inside and outside the body (which is required for a sense of personal identity). It is involved in emotional bonding between parent and child for prolonged care of young (which includes nursing, and audio-vocal communication for maintaining contact), and it is also involved in play behavior (which young mammals--but not other species--use to learn adult behavior).

3. The third and outer portion of the brain is the neomammalian brain. It consists of the neocortex, which is greatly expanded in the higher mammals, as well as connected thalamic structures. It is concerned primarily with what is happening in the external world. It is responsible for complex stimulus analysis, precise and variable/learned aspects of motor control, further enhancement of learning and memory, and abstract, rational thought. In humans it is also responsible for language, planning, introspection, and self-awareness (consciousness). According to MacLean, it is the source (or site/locus) of foresight, hindsight, and insight. It reasons, plans, worries, and invents. The prefrontal cortex appears to be particularly involved in these functions (consider, e.g., the effects of prefrontal lobotomy).

It has been suggested by some that a breakdown in communication among the parts of the triune brain is responsible sometimes for pathological behavior. An example would be the split between rational thought and emotion found in schizophrenia. More commonly, most of us have probably experienced, at one time or another, what might represent a relatively minor and temporary occurrence of a neuro-communication breakdown. Specifically, I am thinking of when we suddenly explode in an outburst of emotion while at the same time our rational mind is conscious of the event but incapable of bringing the behavior under control. Indeed, we may feel as if we are two individuals in one: that which is doing the acting, the paleomammalian and proto-reptilian brain, and that which is passively observing, the rational neomammalian brain. Perhaps the prefrontal link between the neocortex and limbic system (which is the major connection between these two divisions of the brain) gets temporarily blocked due to hyperactivity in the paleomammalian brain when we are unusually emotionally aroused. As a result, the rational brain cannot regulate our emotional, instinctive behaviors.

MacLean has proposed that rather than the rational, neomammalian brain, it is the paleomammalian brain, the seat of emotion, that is responsible for perceptions of what is true, i.e., what is reality. It is the paleomammalian brain, moreover, that is responsible for the feelings of oneness with the universe that are associated with ecstatic, mystic, religious, and drug states (as demonstrated by the aura of psychomotor/ temporal lobe-limbic system epilepsy). MacLean believes that the most fundamentally important philosophical implication of his work is that our so-called "rational" perceptions of truth are merely neocortical *rationalizations* for feelings welling up from the limbic system--the seat of emotion. How then are we to trust our beliefs and ideas about ourselves and the rest of the universe?

Figure 2-1. The "triune brain." In its evolution the human forebrain expands along the lines of three basic formations that anatomically and biochemically reflect an ancestral relationship, respectively, to reptiles, early mammals, and late mammals. The three formations are labeled at the level of the forebrain that constitutes the cerebral hemispheres comprised of the telencephalon and diencephalon. From MacLean (1968).

