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John Newport Langley, English Physiologist, 1852-1925

John Newport Langley's career spanned over 50 years in which he made seminal discoveries and taught a generation of students who would go on to make significant contributions in neurophysiology, including among many, Charles Sherrington. Remarkably, over the course of his career, he covered just two broad topics, which he explored deeply and with steadfast determination. The first fifteen years Langley devoted to the physiology of glandular secretion. The chief results of his work on the salivary glands were compiled and published as part of *Schafer's Text Book of Physiology, 1898*. For the next thirty-five years and up until his death in 1925, he focused on what would become his life's passion -- establishing the main anatomical and functional lines of the autonomic nervous system. It is this latter line of study for which Langley is best known today.

In retrospect, it is quite natural that Langley would expand his narrow focus from the sympathetic and cranial nerves of glandular secretions to the broader function of the autonomic nervous system. He was essentially applying the same technical skills to answer a more expansive question. Two outside events also spurred him on. First, his senior colleague at Cambridge, Walter Gaskell, had learned of the results of two separate heart studies on the cardiac effects of vagus nerve stimulation and was intrigued by the opposite reactions observed by each. In one study, two German researchers (brothers Ernst and Eduard Weber) reported stopping the heart by stimulating the vagus nerve. In the other study, researchers reported increasing the heart rate by stimulating the sympathetic nerve. Gaskell subsequently completed a series of experiments on the physiology of the heart and demonstrated that these opposing actions were generated by two antagonistic subsystems of the vegetative system. In this way, Gaskell explained the wide range of cardiac effects of vagus stimulation that had puzzled early physiologists.

Second, against this backdrop, Langley also had the opportunity to study the effects of a new chemical agent, nicotine. Langley, along with his colleague, William Dickinson, discovered that nicotine interrupted the transmission of nerve impulses. This finding allowed them to complete a detailed functional and structural analysis of the sympathetic and parasympathetic systems. Langley and Dickinson were also able to disrupt the communication from the central nervous system such that they could isolate the actions of the autonomic nervous system. In this way, Langley was able to conclusively demonstrate the independence of the autonomic nervous system and was able to chart its functional and structural composition. Ultimately, he was able to divide the autonomic nervous system into three separate and distinct parts: sympathetic (intensified internal body activity), parasympathetic (decreased internal body activity), and enteral (intestinal) systems—a delineation that is still in use today.

Langley's methodology is of critical importance in understanding both the benefit and the limitation of his findings on the autonomic nervous system. Because Langley was able to "disconnect" the brain from the autonomic nervous system, he was able to prove the independent action of the autonomic nervous system on internal organs. In doing so, he laid a major stepping-stone for the scientists who followed. But because of his approach focused on isolating the autonomic nervous system, he excluded the possibility of any influence of the brain, a notion that would later be successfully explored by Walter Hess who found that the thalamus and hypothalamus provided significant influence over the autonomic nervous system and the activities of the internal organs. Langley's contributions altered the way in which the human nervous system was perceived. **Following is a summary chart showing this changing perspective:**

HUMAN NERVOUS SYSTEM

CENTRAL NERVOUS SYSTEM (CNS)

BRAIN & SPINAL CORD

Mediates & directs body's external activity using inter-neural pathways to take in & send out information.

Receives external sensory input notification ← ← ← ← *Takes in* external sensory input

Determines necessary external action/inaction

Sends directive to engage external motor response → → → *Engages* external motor response

PERIPHERAL NERVOUS SYSTEM

SOMATIC NERVOUS SYSTEM

Integrated with the CNS to manage the body's external response system.

AUTONOMIC NERVOUS SYSTEM

Independently manages, mediates and informs the body's internal response system (without help from the CNS).

Takes in internal sensory input

Independently determines necessary internal action/inaction

Engages internal motor response in organ, gland, or smooth muscle

SYMPATHETIC SYSTEM	PARASYMPATHETIC SYSTEM	ENTERIC SYSTEM
Stimulation	Relaxation	