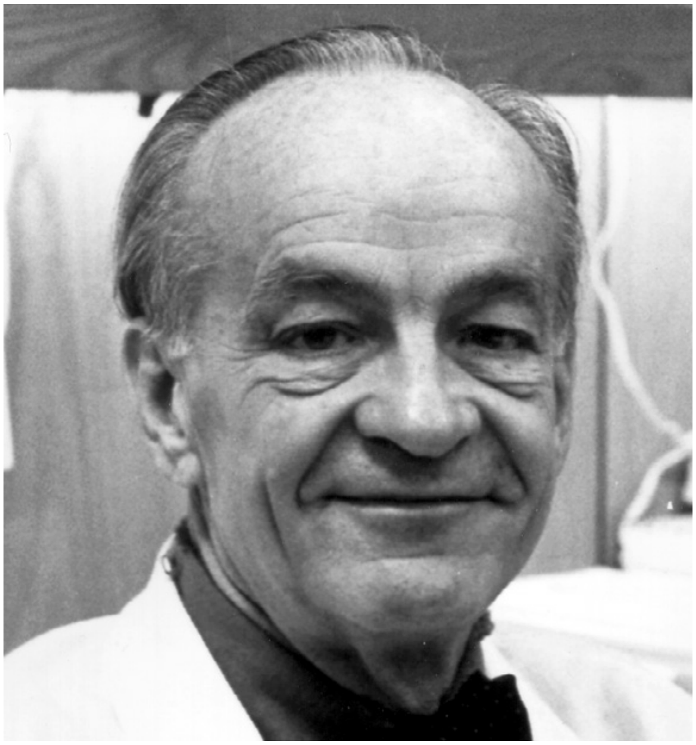
THE FACULTY OF MEDICINE
Harvard University

Elwood Henneman



In 1955, at the time Elwood Henneman was invited to Harvard, there was no department of Neurobiology and indeed the word was not familiar. Pre clinical instruction in functional aspects of the nervous system was the responsibility of departments of Physiology and the department at Harvard under the leadership of Walter B. Cannon excelled in almost all aspects of what we now term Neurobiology. Cannon himself worked on the autonomic nervous system, Alexander Forbes was a leader in electrophysiology, Hallowell Davis in special senses and Philip Bard in the central nervous system. After Eugene Landis succeeded Cannon in 1944, the focus of the department shifted and for the next ten years neurophysiology languished. Elwood Henneman was recruited to remedy this situation, strongly supported by Philip Bard who had become Chairman of the department of Physiology at the Johns Hopkins.

Elwood graduated from Harvard College in 1937 and from medical school at McGill University in Montreal, where he continued with neurological training. Influenced by Wilder Penfield at the Montreal Neurological Institute, a leader in the localization of function in the cerebral cortex, Dr. Henneman sought further training in central nervous system physiology in Professor Bard's department at Hopkins. After serving in the Navy in WW II he returned to Bard's department. In collaboration with Vernon Mountcastle he investigated the localization of electrical potentials in the brain evoked by sensory afferents. They showed that the tactile surface of the body is represented in the ventro lateral thalamus by a three dimensional "figurine" of the body. Illustrations from this now "classical" work are reproduced in modern textbooks of physiology, psychology and neurology. In this period, also, Henneman mapped the reciprocal projections linking the cerebral and cerebellar cortices.

Dr. Henneman then spent two years at the Illinois Neuropsychiatric Institute in Chicago and another two years with David Lloyd at the Rockefeller Institute in New York. In Chicago with Klaus Uma he found that mephenesin, a drug that causes flaccid paralysis of skeletal muscle, acted by inhibiting interneurones, thus blocking excitatory impulses to spinal motor neurones, results which attracted international attention. They also noted the drug Atranquilized@ normal cats; the first use of the word in pharmacology. Subsequent more clinically useful drugs like meprobamate (Miltown) were called tranquilizers. In Lloyd's laboratory at the Rockefeller, Dr. Henneman mastered the latest technical advances in electrophysiology before returning to Hopkins as Assistant Professor of Physiology.

Two years later, when Dr. Henneman came to Harvard, he was uniquely prepared to teach an entire course in neurophysiology almost single handed in a series of stimulating lectures and well-planned laboratory experiments. He introduced 150 students each year to the complexities of electronic amplifiers and oscilloscopes without losing sight of the essential neurophysiology. The students were able to record and analyze evoked potentials from the sensory cortex of anesthetized cats, thereby sharing the excitement of important experiments that had only recently been published.

At the same time, Henneman began the series of investigations for which he is best known, namely elucidation of the functional organization of the neuromuscular system in terms of the dimensional, electrical and metabolic properties of its individual components. These generalizations may be summarized:

> 1) Each afferent nerve fiber from a muscle stretch receptor divides within the spinal cord to innervate more than 90% of the motoneurons that innervate that muscle.
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> 2) The susceptibility of each spinal motoneuron to excitation or inhibition is a function of its size. The smallest neurons are the most easily excited and least readily inhibited; large cells are the least susceptible to excitation and are most readily inhibited.
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> 3) Motoneurons are brought into action by afferent input in order of their size and they are inhibited in reverse order. This "size principle" governs all systems projecting to motoneurons, including local segmental reflexes, long spinal reflex pathways and descending systems from brainstem and above.
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> 4) Finally, the size, metabolism and functional properties of muscle fibers are precisely matched to the motoneurons that innervate them. Small motoneurons innervate small muscle fibers that contract slowly and have the metabolic apparatus required for sustained aerobic contraction. In contrast, large motoneurons innervate large muscle fibers contract rapidly utilizing anaerobic metabolism.

These generalizations provide an understanding of motor control in which anatomy, histochemistry and electrophysiology are closely interwoven. The "Henneman size principle" is widely regarded as the most important advance in motor control since Sherrington. At a time when most neuroscientists focused on cellular physiology, Henneman looked beyond individual units to seek understanding of how the individual units act together to achieve coordinated control of function in complex systems.

Henneman's publications and also his lectures, were distinguished by exceptional style and clarity of exposition, enlivened by whimsical humor. Most of his experimental work was carried out by himself alone or in collaboration with one or two graduate or postdoctoral students. The editor in chief of the J. Neurophysiology once told a member of this Memorial Minute committee that Henneman's papers were the most important papers he had received for publication in the journal.

When a separate department of Neurobiology was established in the mid 60's by Steven Kuffler, Elwood was invited to join but he chose instead to remain in the department of Physiology. He became a full professor in 1969 and in 1971 became chairman of the department of Physiology which he served faithfully until his formal retirement in 1984.

Elwood was something of a "lone wolf" although he enjoyed social gatherings, as at the Senior Common Room of Dunster House and the American Academy of Arts and Sciences in Cambridge. One of his junior colleagues at McGill University (now a professor at Harvard) described him as "…. a glamorous figure; he exuded optimism, his bow tie was always perfectly tied, his shirts were beautifully ironed, and his face was usually lit by a slightly mischievous grin." As an undergraduate he was a star on the Harvard tennis team and he was also an excellent downhill skier and wind surfer. His strong physique enabled him to survive a series of major surgical operations, including installation of an artificial aortic valve, coronary bypass surgery and emergency repair of a dissecting aortic aneurism. The latter operation was indeed spectacular because the aneurism occurred in Amphitheater C while he was lecturing to the first-year class. He diagnosed the problem himself from the referred pain and ordered students in the front row to alert surgery at the Brigham where he was rushed to the operating room. It was a very close call.

In 1950 Elwood married Karel Toll, a neurologist who became associated with the Mass General Hospital after they moved to Boston with their two young daughters.

In 1975 Karel and Elwood suffered the tragic loss of their elder daughter, Cyrena and in 1983 Karel herself died of ovarian cancer. Elwood continued to write scholarly reviews until his death from circulatory failure on February 22, 1996. He is survived by his daughter, Mrs. Abby Friedman of Rowe, Mass.

Respectfully submitted,

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