Recent developments in neurobiology: introduction to the symposium to honor Professor Douglas G. Stuart

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This year’s symposium “Recent Developments in Neurobiology” honors Dr Douglas G. Stuart, Regents’ Professor Emeritus of Physiology at the University of Arizona for his long-time contribution to research in the field of neural control of movement, and for his service to the development of neuroscience research in the State of Arizona and beyond (Fig. 1). In addition to his long list of research accomplishments (summarized subsequently), Professor Stuart served as the Head of Physiology at the University of Arizona, and as Associate Dean of Research at the UA College of Medicine. He was a founding member of the College of Medicine (1967) and was awarded Regents’ Professor status in 1990. Professor Stuart has over 120 experimental papers in scientific journals, and over 80 chapters, reviews and symposium papers. In the recent years, he provided overviews on motor control and on the history of movement neuroscience.

Topical annotated bibliography of Professor Stuart’s research


This review summarizes Professor Stuart’s work in 12 refereed articles, which advanced our understanding of single-cell activity in the hypothalamus using techniques that included (1) extracellular unitary and DC-potential recording in anesthetized and unanesthetized preparations, (2) thermal stimulation with self-designed Peltier thermodes, and (3) measurement of temperature gradients between arterial blood and the brain.

Neurophysiology: segmental motor system (1961–Present)

(Note: the term “segmental motor system” refers to (1) properties and central actions of posture-related and movement-related sensory feedback, (2) interneuron and motoneuron discharge properties, motoneuron recruitment, and associations between motoneuron, muscle fiber, and motor-unit properties for graded development of muscle force, and (3) segmental-pattern generation for the elaboration of intrinsic/rhythmic and learned/skillful movements).


This refereed article is an example of “outside-in” research and thinking, showing how measurement of footfall patterns during walking, trotting and galloping can be used to predict efficacy of spinal reflex activity during low-speed to high-speed quadrupedal cat locomotion.


An example of the use of advanced spinal cord electrophysiological techniques to unravel the details of spinal cord circuitry, which Professor Stuart learned from Anders Lundberg and the still-premier exponent of these techniques, Elzbieta Jankowksa.


A seminal study that used a cross-correlation technique to show how minute monosynaptic and
disynaptic EPSPs and IPSPs, attributable to the input of single sensory axons, could be measured in the cat spinal cord.


A review in an open-peer-reviewed journal, which summarized work (including over 15 of Professor Stuart’s refereed articles) on associations between motoneurons, muscle fibers, and motor-unit properties.


A seminal report, which used data from four other refereed articles by Professor Stuart’s group to compare the detailed, intracellularly recorded properties of motoneurons and ventral interneurons in unanesthetized slices of turtle spinal cord. This work challenged doctrinaire thought on spinal interneuronal properties.


This article provides the first-ever extracellularly recorded firing pattern of a hypothalamic cell in an unanesthetized intact mammal (cat). The technique subsequently became widely used on various mammalian species including nonhuman primates.


This article explained how to build a sophisticated device to deliver precise stretches and vibration to anesthetized and unanesthetized animals, including humans. This technique, too, became widely used.


Professor Stuart’s laboratory pioneered the use of a graphical programming language with Macintosh computers, as described in this and four other articles. Several laboratories now use this approach.

**Reviews on movement neuroscience (1963–present)**


An important review that introduced many Western workers to the post-Bernstein Russian group’s seminal work on locomotor control; it became widely used in predoctoral and postdoctoral training programs.


This review proposed several still-untested functions for proprioceptors on the basis of an “outside-in” approach to movement control, which was applied to work undertaken largely on the crab, cat, and human.


A widely quoted article on neural and neuromuscular fatigue mechanisms, which proposed four themes, and guided research for the next decade in several laboratories.


A provocative article that narrows the gap between the firing-rate properties of motoneurons, as studied electrophysiologically (“bottom-up”) in animal preparations, and the “top-down” study of the firing patterns of human motor units as fatigue ensues.
Editing movement neuroscience volumes (1976–present)
These three widely read postsymposium volumes are the quintessence of integrative and comparative approaches to the study of locomotion in the world’s leading laboratories. The symposia themselves not only promoted international collaborative efforts but were vehicles for advancing the careers of junior scientists including predoctoral and postdoctoral trainees.

History of movement neuroscience (1998–present)
This article shows how ideas on the neural control of movement, which were proposed in 1947 by Nicolai Bernstein on the basis of over 20 years of his research on largely human movement, were tested experimentally on high-decerebrate cats in the 1960s and early 1970s by a group of relatively young Russian neuroscientists and thereby considerably advanced our understanding of the neural control of locomotion.
A review that compares and contrasts the scientific careers of three neuroscientists who were born in the 19th century and who contributed substantially to 20th century thought on the neural control of movement. One, Sherrington, emphasized an “inside-out” approach whereas the other two preferred an “outside-in” strategy. The article also addresses the need for interdisciplinarity, interphyletic awareness, and transnationalism in the study of movement neuroscience.
This article reviews the academic lineage of Eccles: who trained him, whom he then trained and with whom he collaborated, and the subsequent impact of his trainees and collaborators on movement neuroscience. This is one of 10 articles on Eccles in a special issue of Progress in Neurobiology that was coedited by Professor Stuart.

Selected bibliography from Professor Stuart’s experimental work
1960–1969
1970–1979
1980–1989


1990–1999


2000–Present


Acknowledgments

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