

Clinical Practice of Restorative Neurology of Progressive Neuromuscular Disorders

Prof. Milan R. Dimitrijevic

EAMDA AGM, Zagreb

5 October 2013

Recent Achievements in Restorative Neurology

1 Upper Motor Neuron Functions and Dysfunctions

Editors:
Sir John Eccles, Milan R. Dimitrijevic

 KARGER



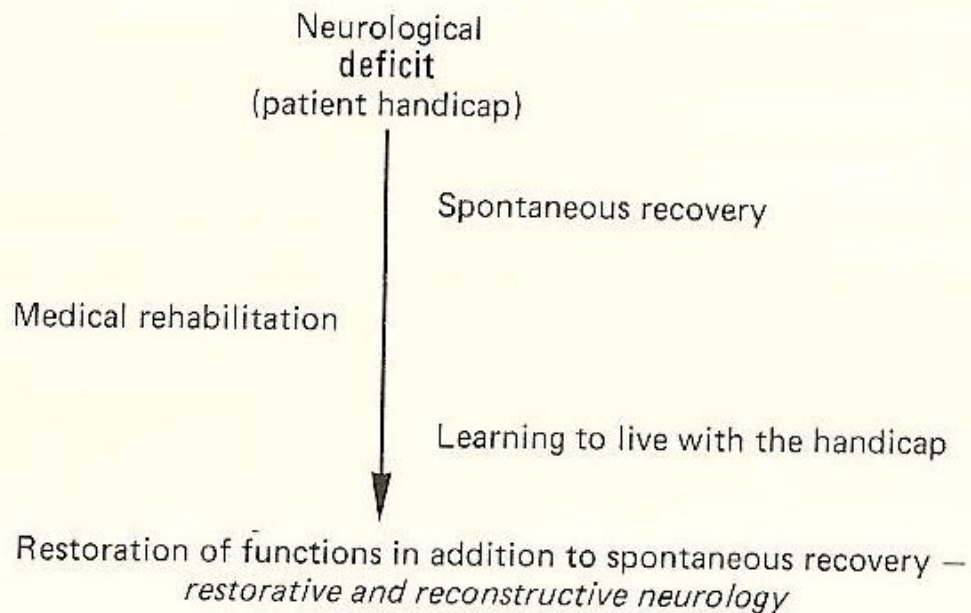


Fig.1. The place of restorative and reconstructive neurology after neurological deficit.

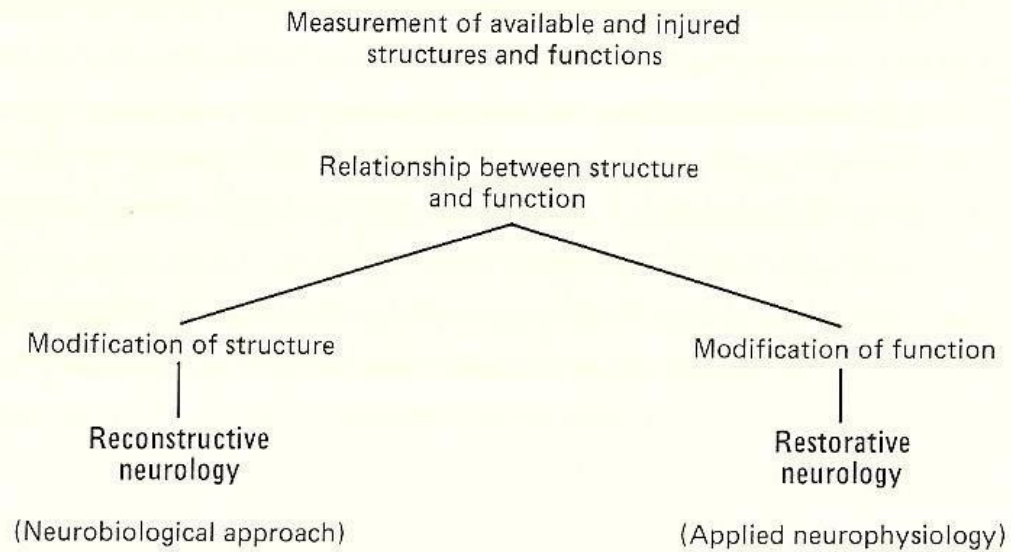
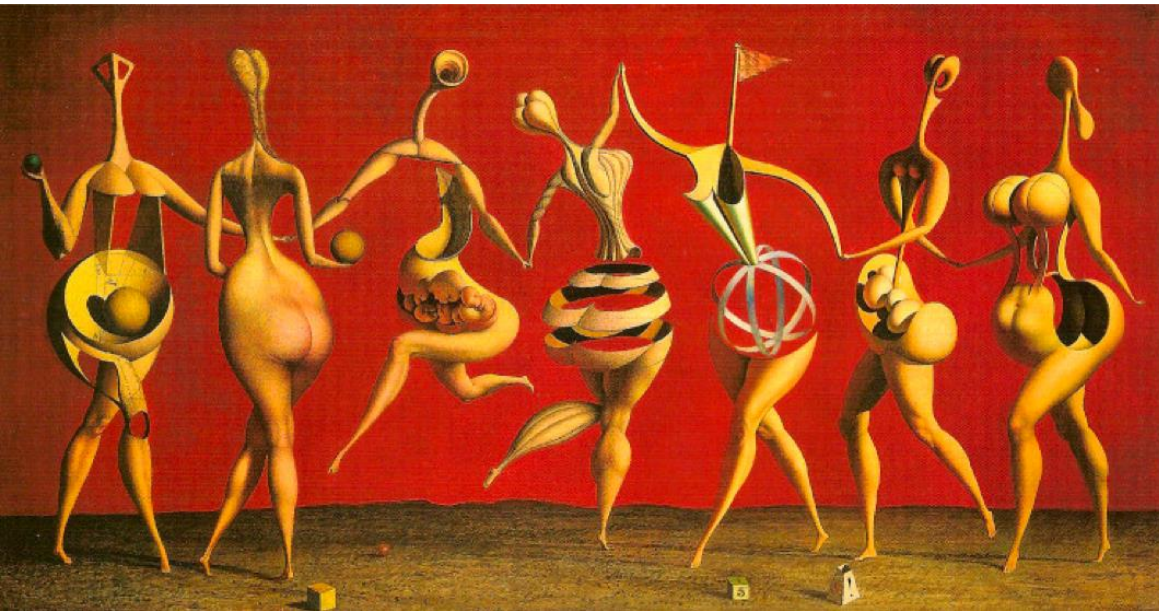


Fig. 2. Relationship between reconstructive and restorative neurology.

Definition of Restorative Neurology

- Branch of neurological sciences which applies **active procedures** to improve functions of the impaired nervous system through **selective structural** and **functional modification** of altered neurocontrol according to underlying mechanisms.
- This is a new **sub-specialty** that sought out clinically **unrecognized**, altered neural functions and **developed tools** that made use of **afferents and other biological modalities** to access those surviving neural circuits to modify their output and improve clinical function.

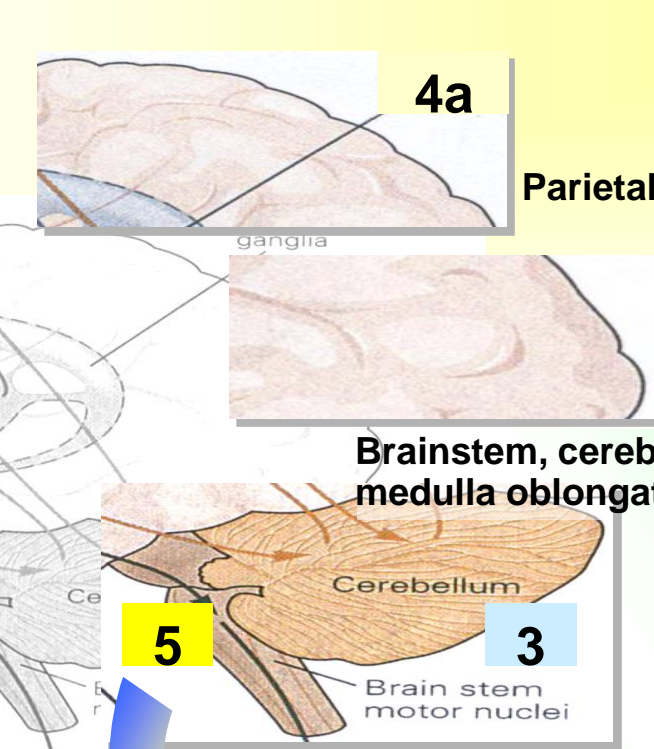
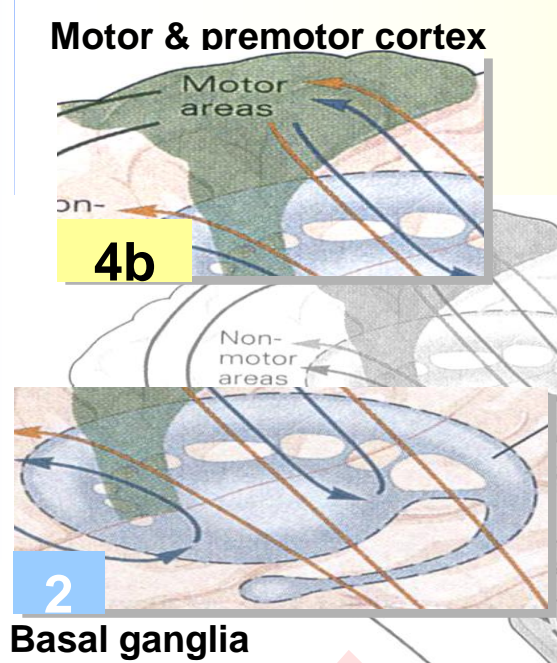
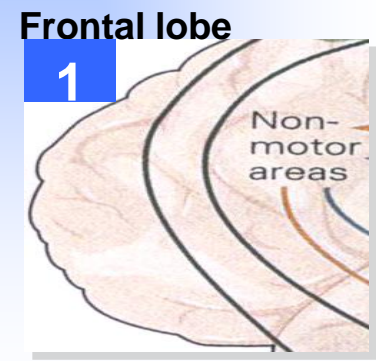
Veterans of Contemporary Medicine



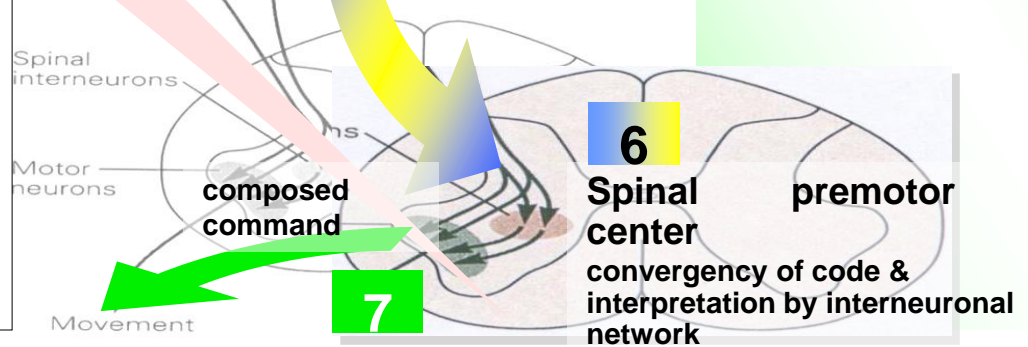
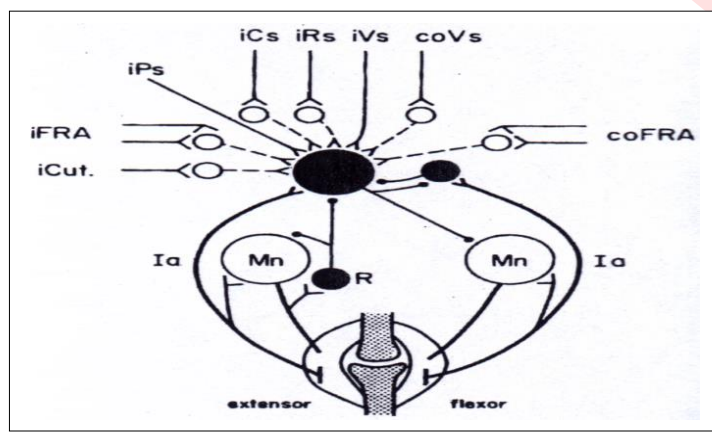
“Veterans of contemporary medicine” are people in special care units or nursing homes with incomplete recovery and poor quality of life.

PLANNING

SETTING



EXECUTING



1 + 2 + 3 + 4a + 4b + 5 + 6 = 7

Composition of integral of „movement command“:
brain „motor code“

Adapted from: Principles of Neural Science, 4th Edition, 2000; Encyclopedia of Neuroscience, Volume I, 1999

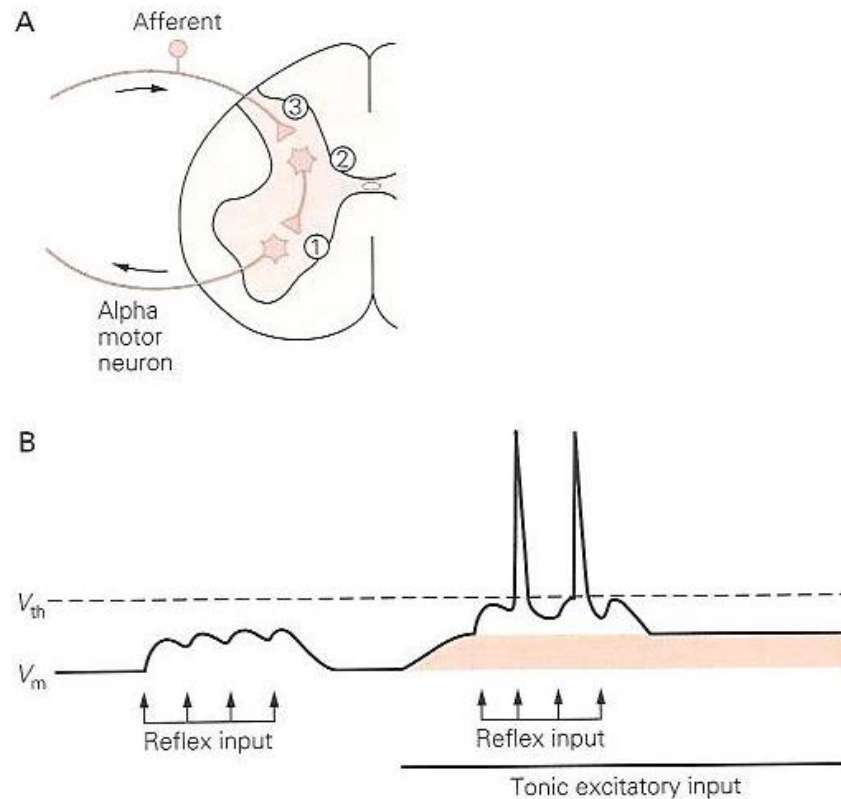
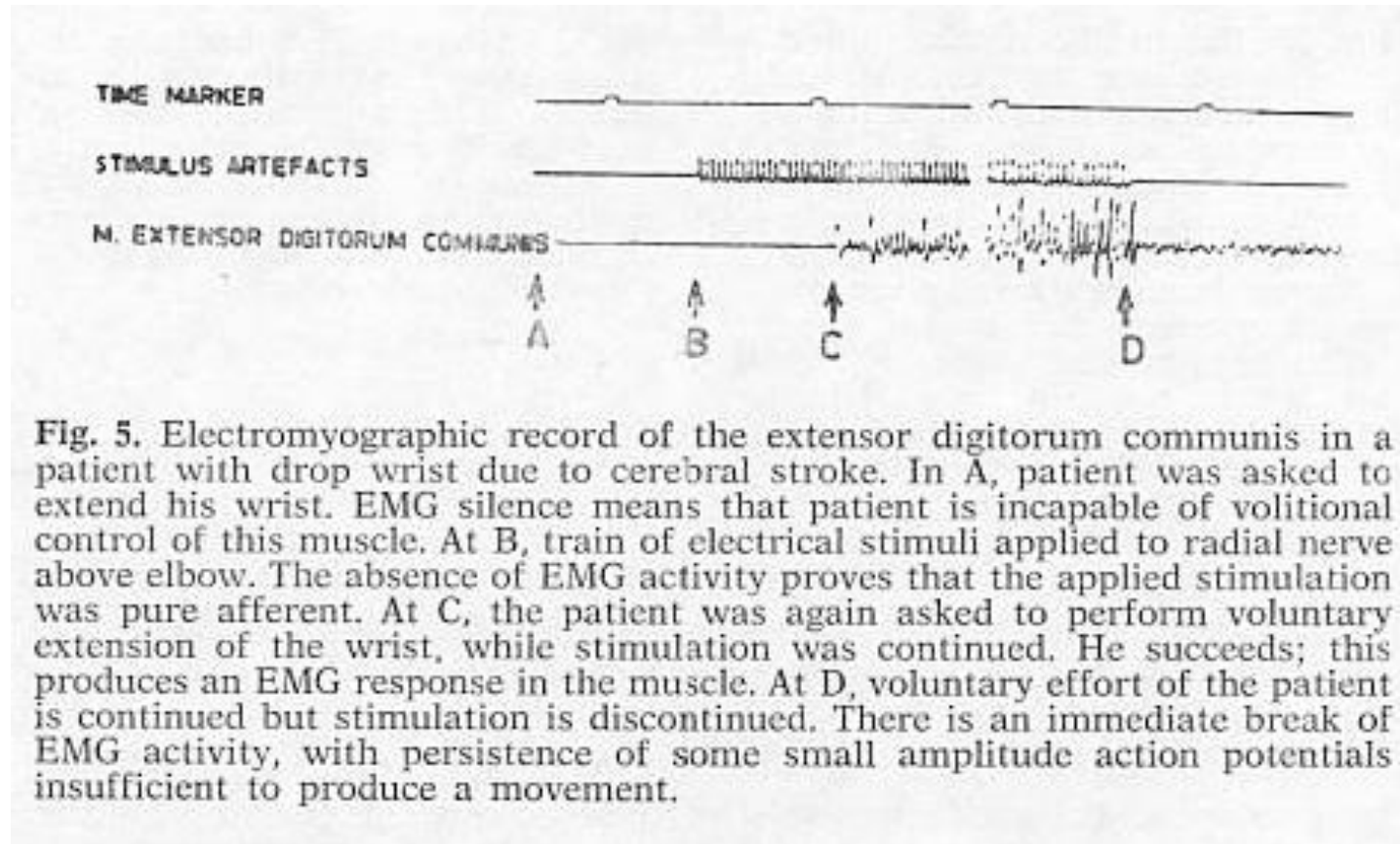


Figure 36-8 The strength of a spinal reflex can be modulated by changes in transmission in the reflex pathway.

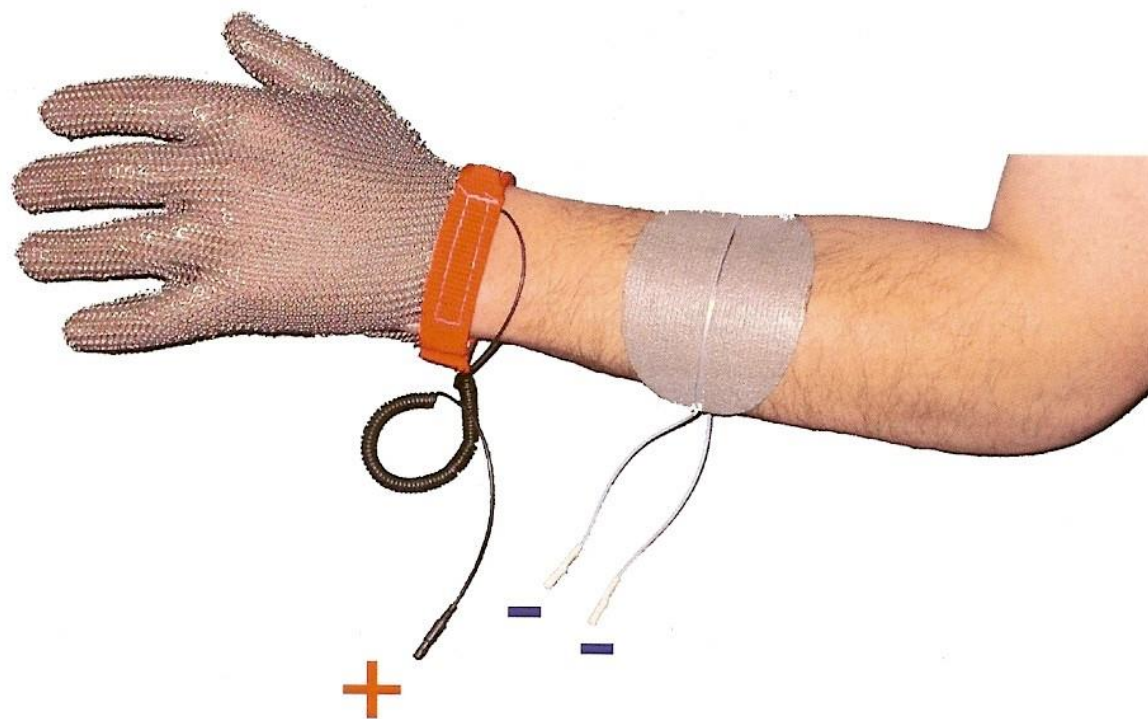
A. A reflex pathway can be modified at three sites: (1) alpha motor neurons, (2) interneurons in polysynaptic pathways, and (3) afferent axon terminals. Transmitter release from the primary afferent fibers is regulated by presynaptic inhibition (see Chapter 14).

B. An increase in tonic excitatory input maintains depolarization in the neuron (**shaded**) and enables an otherwise ineffective input to initiate action potentials in the neurons (V_{th} = threshold voltage; V_m = membrane potential).

External Facilitation for Restoration of Movement of Drop Wrist in Stroke Subject



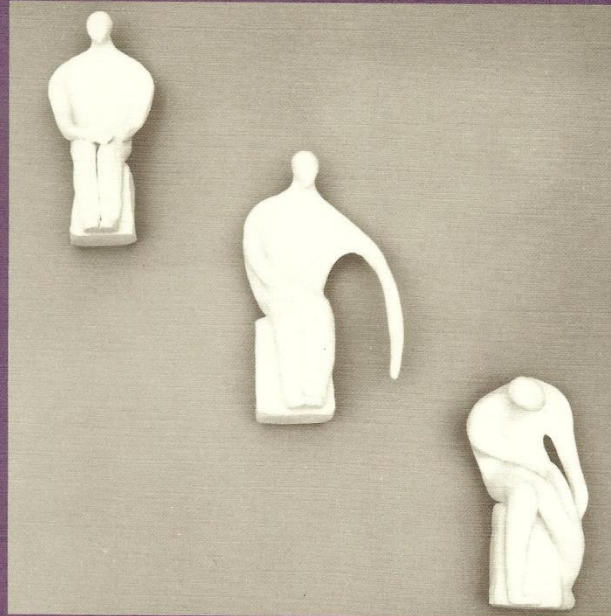
ETAN, Dubrovnik, y.1970



Recent Achievements in Restorative Neurology

³ Altered Sensation and Pain

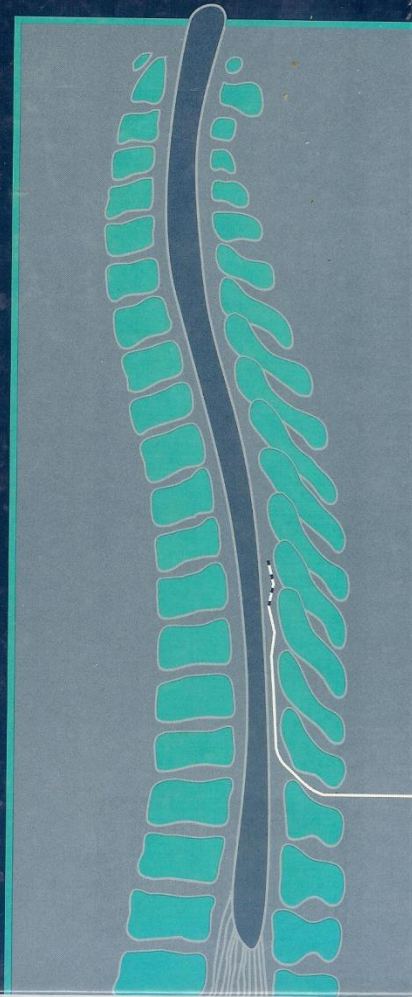
Editors: Milan R. Dimitrijević,
Patrick D. Wall, Ulf Lindblom



KARGER

ATLAS OF HUMAN SPINAL CORD EVOKED POTENTIALS

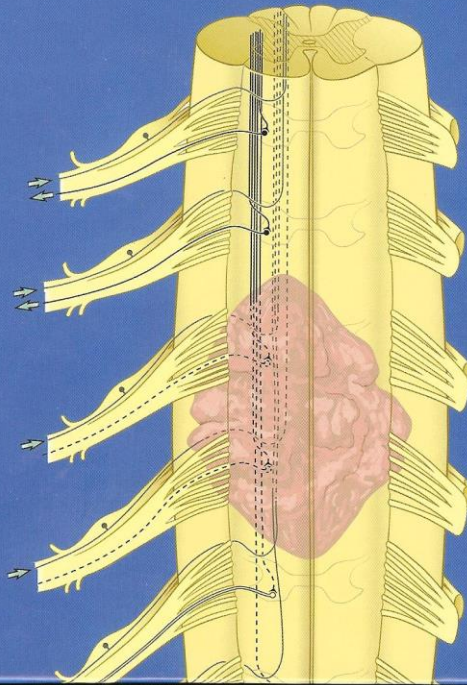
Milan R. Dimitrijević
John A. Halter



EDITED BY

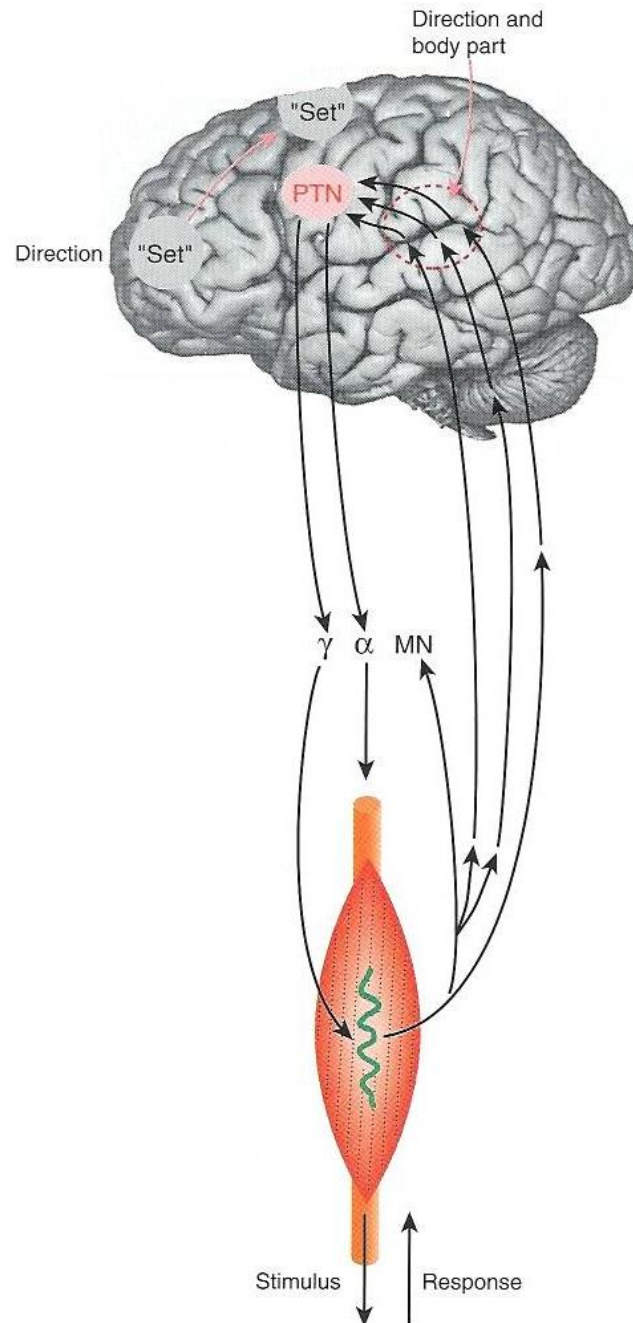
MILAN R. DIMITRIJEVIC, BYRON A. KAKULAS,
W. BARRY MCKAY, and GERTA VRBOVÁ

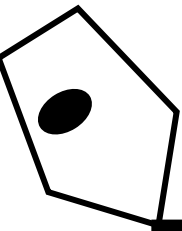
Restorative Neurology of Spinal Cord Injury



OXFORD

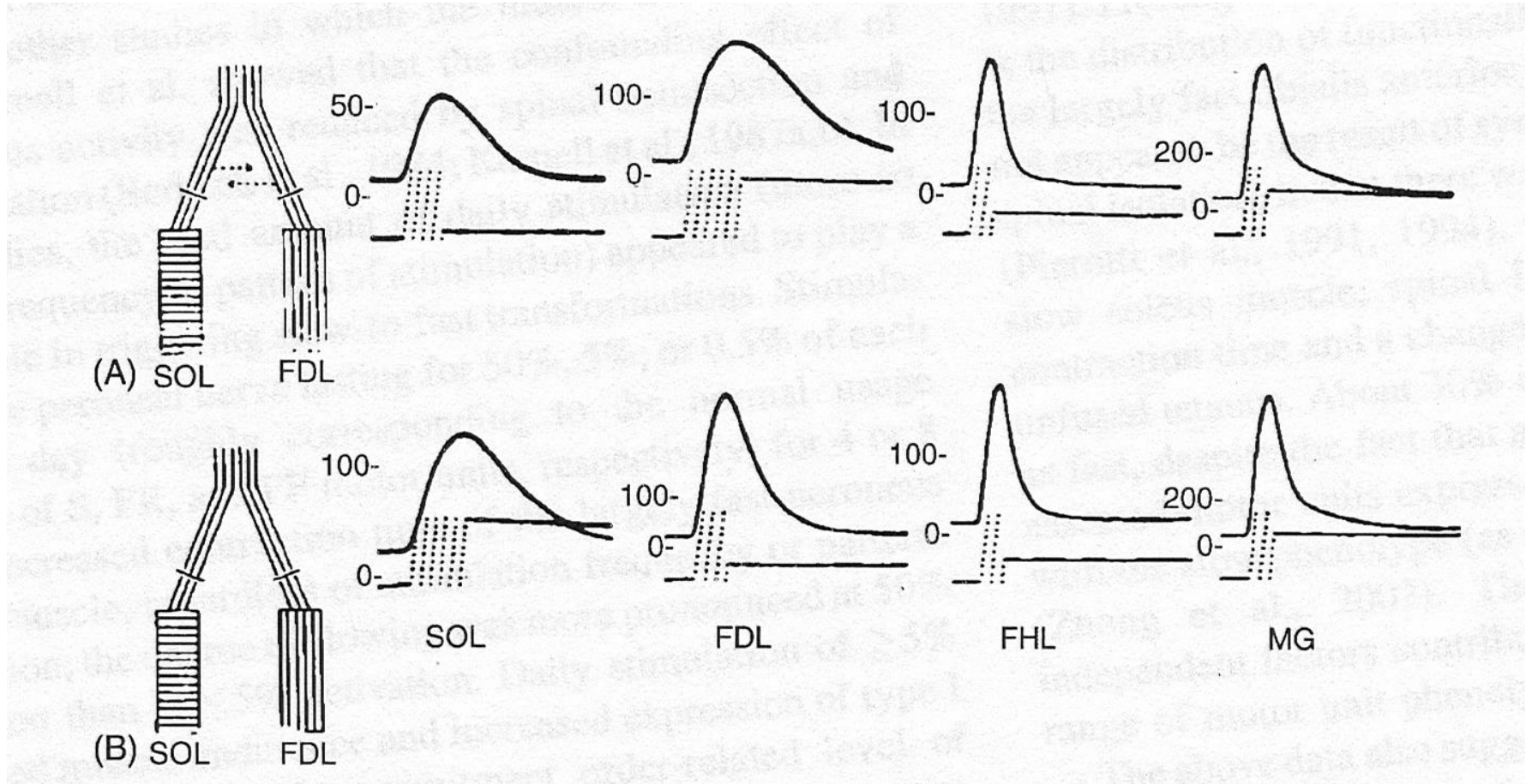
Long loop reflexes





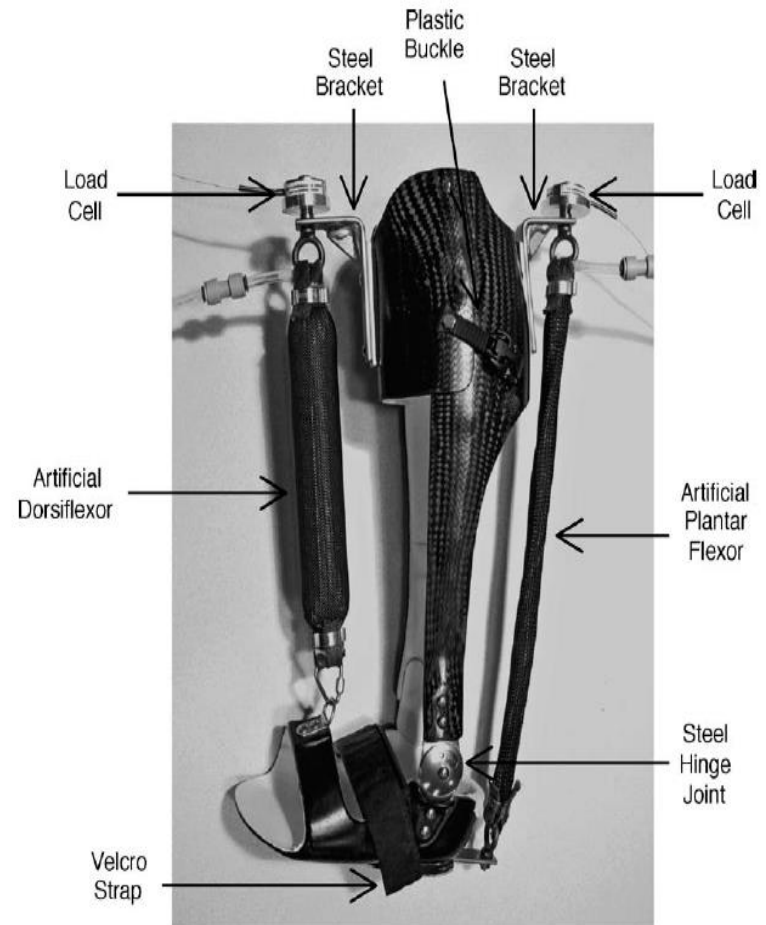
Buller et al.

J. Physiol. 1960 (Lond.) 150, 417- 439

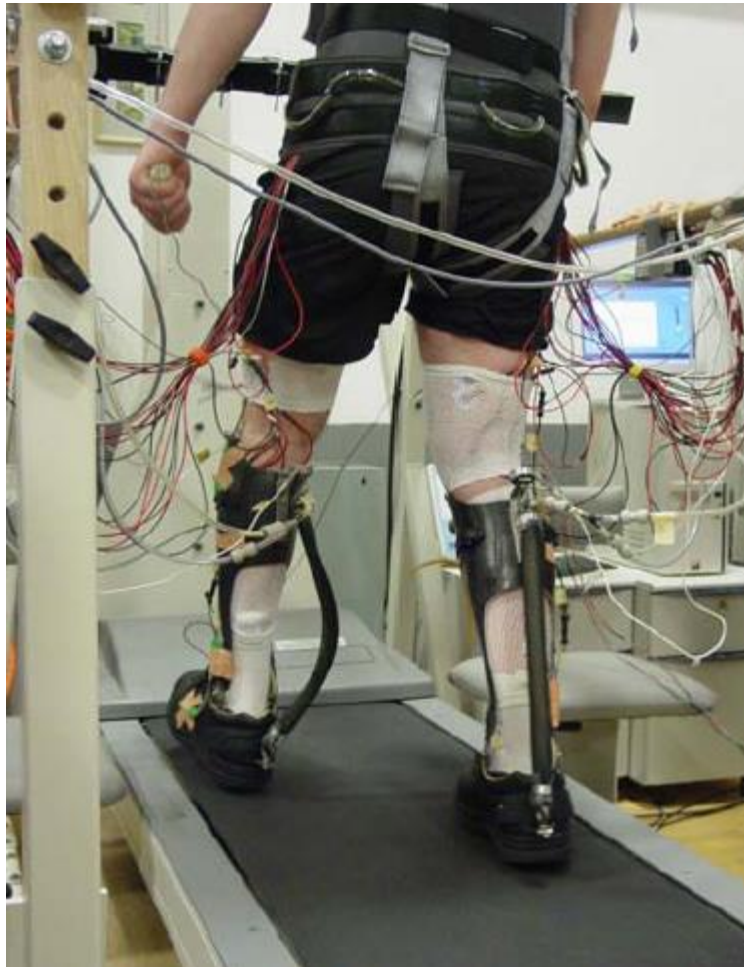


LOWER limb powered ankle orthosis

- Ankle foot orthosis powered by artificial muscles
 - Pneumatically powered ankle foot orthosis using proportional myoelectrical control

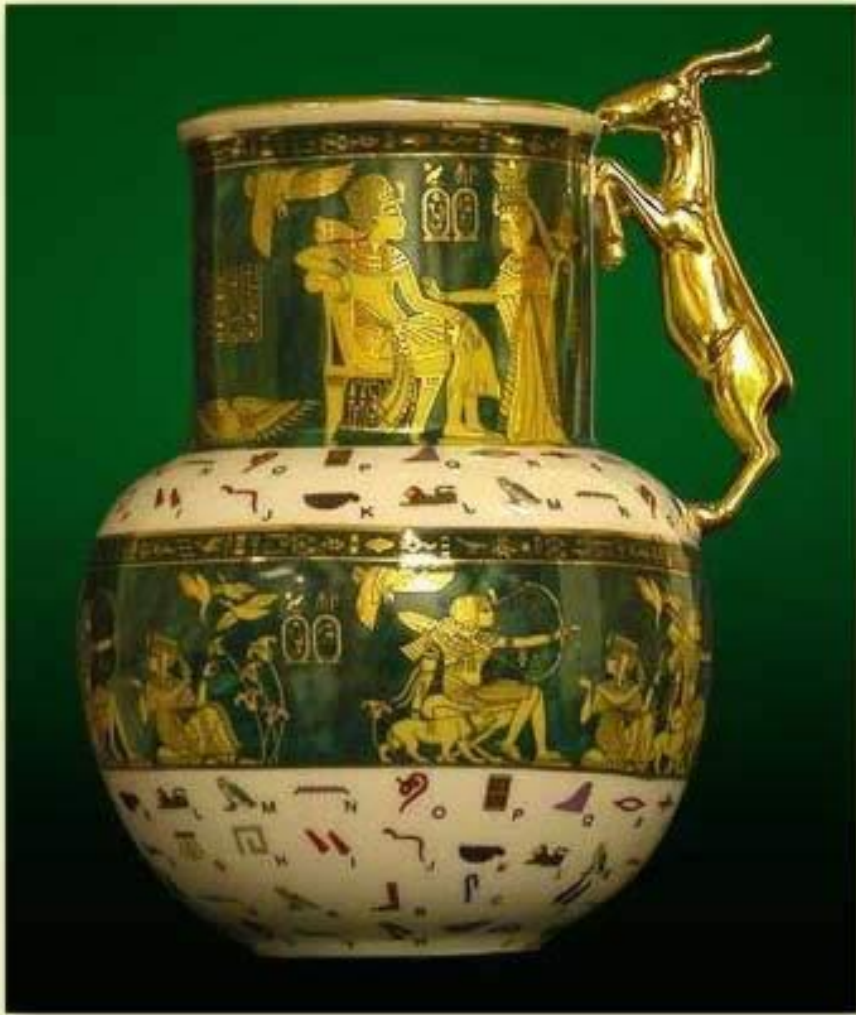


LOWER limb, active powered ankle orthosis & robotic devices for assisting treadmill stepping



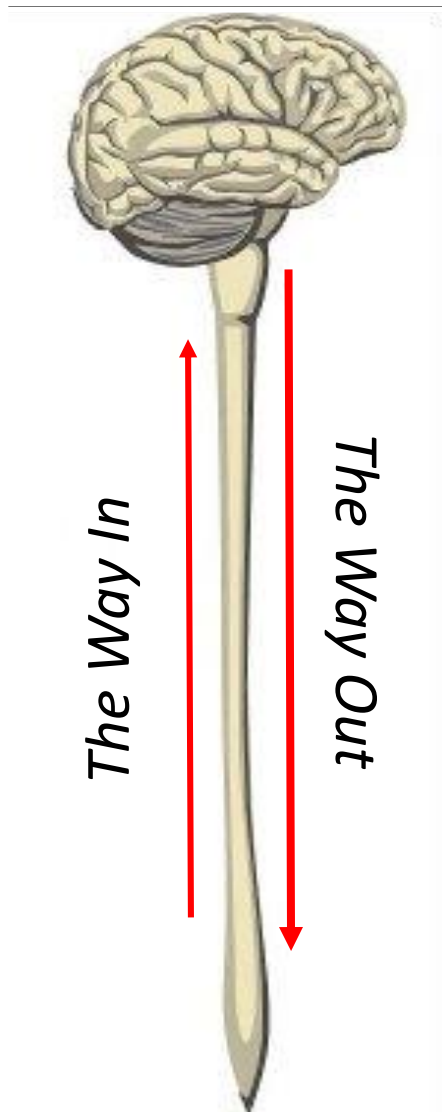
Movement

Ancient arts



Modern performance





THE WAY IN AND THE WAY OUT

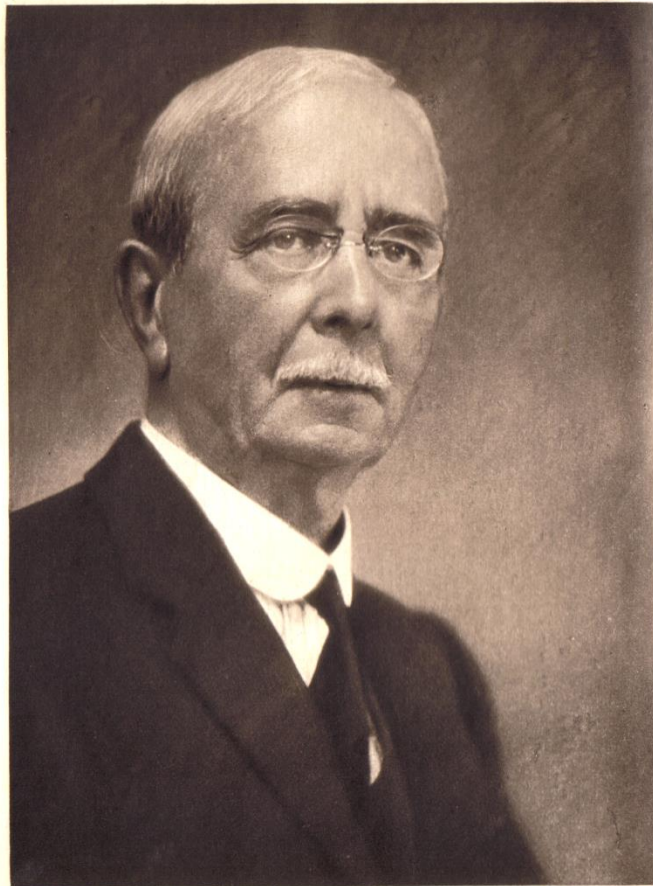
*Francois Magendie, Charles Bell and
the Roots of the Spinal Nerves*

WITH A FACSIMILE OF CHARLES BELL'S
ANNOTATED COPY OF HIS
Idea of a New Anatomy of the Brain

PAUL F. CRANFIELD, M.D., Ph.D.
The Rockefeller University, New York

Paris, France

February 22, 1847



A. H. Biddle, photographer

Emory Walker, Del. photo

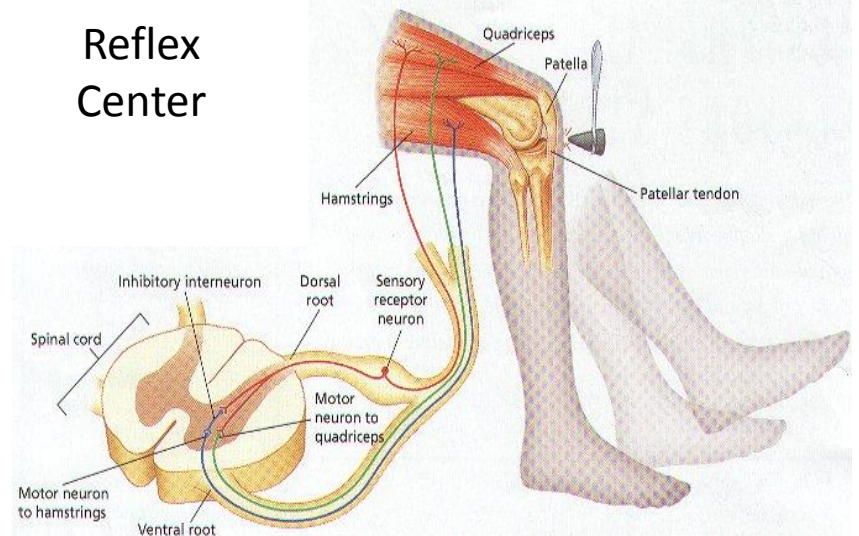
C. S. Sherrington

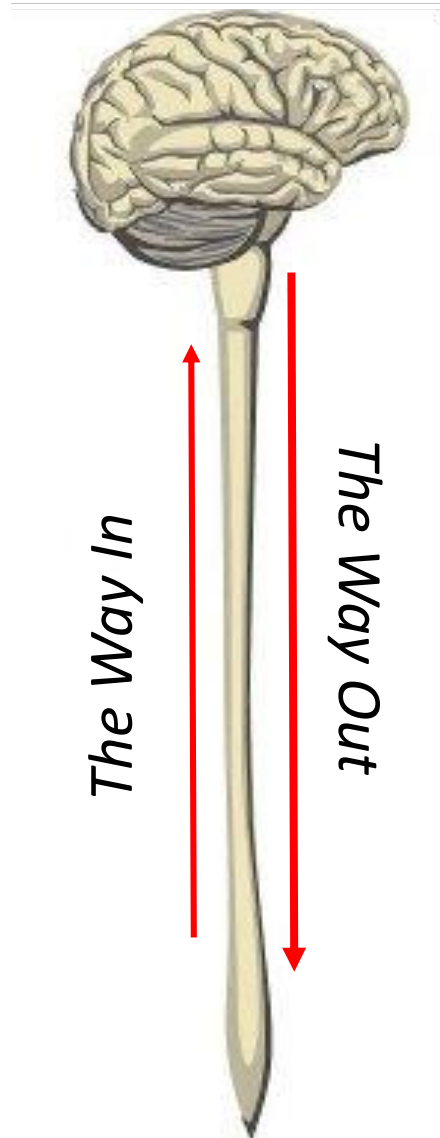
THE INTEGRATIVE ACTION OF THE NERVOUS SYSTEM

by
SIR CHARLES SHERRINGTON
O.M.

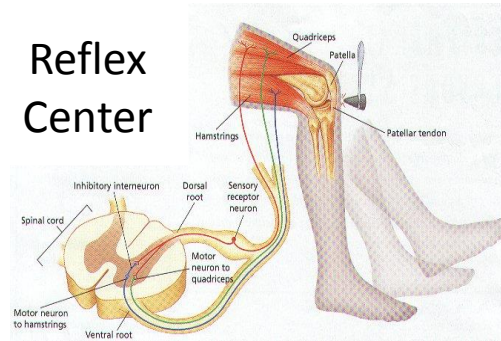
WITH A NEW FOREWORD
BY THE AUTHOR
&
A BIBLIOGRAPHY OF
HIS WRITINGS

Reflex Center

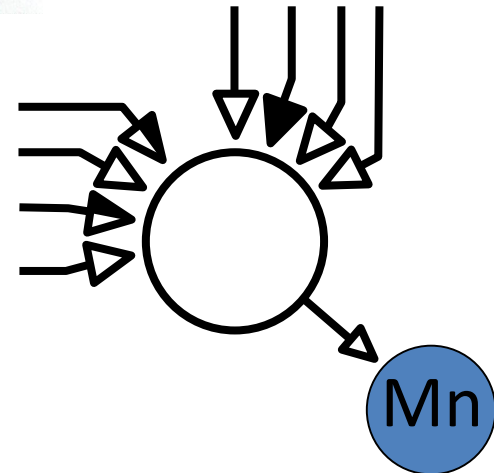




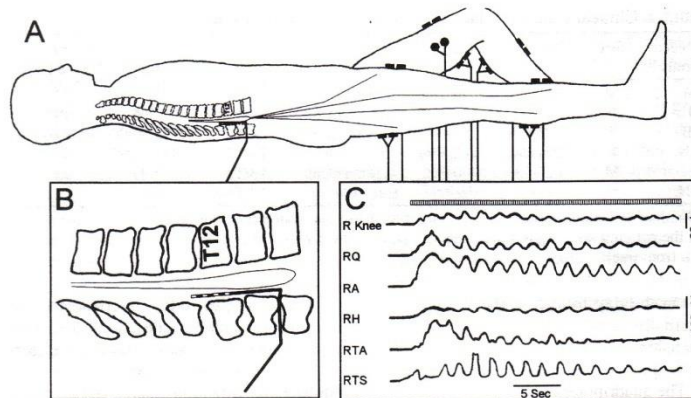
Reflex Center



Premotor Center



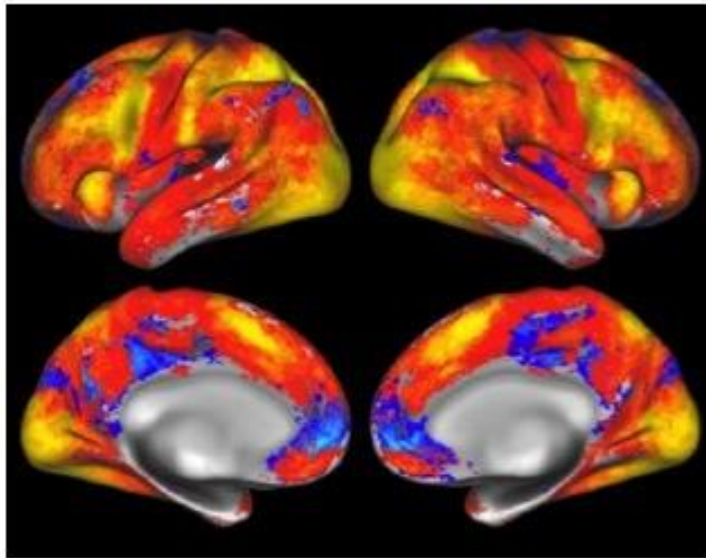
Pattern Generator



Significance

- For technical sciences – Biomedical engineering
 - External control of movement by afferent input
- For medical sciences – Restorative neurology
 - Assessment and augmentation of residual subclinical
- For biological sciences – Human neurosciences
 - Neurocontrol within population of processors and their modification of processing functions by afferent input

The BRAIN Initiative



New tools for brain research

The Blue Brain Project



Simulation of Synaptic Activity