

# Mechanisms and networks of motoneuronal control during sleep: introduction

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## Key words

*Atonia • Muscle twitches • REM sleep behavior disorder • Sleep apnea • Sleep bruxism*

The front and center questions in neuroscience today are “What and how is the brain thinking?” To find the answers, researchers “connect the dots” and look for clues based on electrical, magnetic, biochemical and behavioral signals generated in the nervous system. Ultimately, it is the motor activity, or more generally the outcomes determined by the levels of activity in the last order neurons that control the muscles and other effector organs, which informs us about the state of the brain in health and disease. This Special Issue offers a collection of review and research articles that focus on the mechanisms and networks underlying motoneuronal control during sleep. The topic may seem paradoxical, just as one of the stages of sleep that bears this name, because the roots of Western culture associated sleep with an immobility akin to death. Indeed, the phrase “*There she met Sleep, Death’s brother,*” attributed to Homer in *The Illiad* (Homer, 2008), inspired many artists and philosophers, including Virgil (70 BC - 19 BC), Ovid (43 BC - AD 17/18), William Shakespeare (1564-1616), Sir Thomas Brown (1605-1682), Percy Bysshe Shelley (1792-1822), and Edgar Allen Poe (1809-1849), to see sleep and life as opposites. It was so till Charles Dickens (1812-1870) called the parallel between sleep and death a “*poor hollow mockery [of sleep],*” and asked: “*Where, in the sharp lineaments of rigid and unsightly death, is the calm*

*beauty of slumber, telling of rest for the waking hours that are past, and gentle hopes and loves for those which are to come? Lay death and sleep down, side by side, and say who shall find the two akin*” (Dickens, 1960). This is perhaps not surprising from the man who also saw the Pickwickian syndrome for what it was -- a medical condition distinctly affecting breathing during wakefulness and sleep. Thereafter, scientific foundations of the modern concepts of sleep as an active and regulated state were developed by Constantine von Economo (1876-1931) based on his analysis of brains from patients with “*encephalitis lethargica*” (Economo, 1930; see Triarhou, 2006 for a historical overview). This was followed by a formal description of rapid eye movement (REM) sleep, a state characterized by extremely high level of brain activity (Aserinsky and Kleitman, 1953; Jouvet and Michel, 1958; Jouvet, 1962).

In this Special Issue, the readers will find ample review of early studies of motoneuronal control during REM sleep, most recent discoveries, and discussions of the phenomenology and mechanisms of motor suppression and activation during REM and non-REM sleep. Experiments testing new concepts in animal models and applications of the results to human sleep disorders such as obstructive sleep apnea syndrome, sleep bruxism and REM sleep behavior disorder are also discussed. And, yes, there

is also a discussion of the insights into the brain's thinking during REM sleep. I hope that the articles assembled in this Special Issue will satisfy both experts and newcomers, and that they will stimulate more research.

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