



# Mircea Steriade

## 1924–2006

György Buzsáki & Denis Paré

The saying “It does not matter where you come from, what matters is where you are going” surely applies to Mircea Steriade, who died on April 14, 2006 at age 81 after a long fight with cancer. Born to a father with only four years of elementary school education and a strict mother who devoted much of her life to her son’s education, Steriade became one of the principal founders of systems neuroscience. His productivity increased over the years; he never retired, and he worked on manuscripts until his death. After becoming the Head of the Department of Physiology at Laval University, he quickly reverted to full time research, “the only activity that seems worth spending time on.”

Trained as a clinical neurologist at the University of Bucharest, Romania, Steriade soon discovered his passion for research and acquired a PhD at the Institute of Neurology, Romanian Academy of Sciences in 1955. Those were tough days in Eastern Europe. Nevertheless, as an idealistic fighter opposing the occupation of Romania during WWII, he enjoyed exceptional privileges, including a postdoctoral fellowship in Frédéric Bremer’s laboratory in Bruxelles, Belgium.

Although they never published together, Steriade regarded Bremer as his true mentor, whose work and personality were decisive for his career. Bremer’s studies of sleep-wave cycles in his *encéphale isolé* and *cerveau isolé* ‘brain slice’ preparations opened the door for relating structure to function. Steriade’s favorite structures, the brainstem, thalamus and neocortex, took their significance during this period. Returning home, he ran a laboratory at the Institute of Neurology, Bucharest, but he soon became disillusioned with the government and felt isolated. When criticized (and eventually censured) by the communist party for publishing in American journals, Steriade sent more papers to Western periodicals. When Ceaușescu came to power in 1965 and maintaining contact with the outside world became increasingly difficult, Steriade decided to leave home.

In 1968, Steriade got an exit visa for France to attend a scientific meeting. In his mid-forties, he learned that getting an independent position as an Eastern European refugee scientist in Paris was not easy—as he repeatedly complained in private. In Marseille, he met Jean-Pierre Cordeau, on sabbatical from the University of Montréal, who invited him to Canada. A few months later, he was offered professorship at Laval University in Quebec City. He enthusiastically accepted without inquiring about salary, lab space, tenure and other earthly issues, and only politely asked: “Where is Quebec City?” Steriade arrived in Canada in those days of August 1968 when Soviet tanks crushed the Prague Spring. The Romanian authorities retained his family; his daughter, Donca, now a linguist at MIT, did not join him until 1974. During his “exile,” Steriade began a new life and established a very productive

laboratory. He attracted talented students and fellows and nurtured them for brilliant academic carriers, usually one by one in the tradition of great maestros.

Throughout his career, Steriade focused on the mechanisms of thalamocortical oscillations. In Laval, he studied thalamic and cortical neurons during the sleep-wake cycle, establishing that the brain is not at rest during sleep. He showed that sleep is a dynamic state during which thalamic and cortical activity is re-organized to generate oscillations at various frequencies. Another major achievement of his new laboratory was to disclose the “pacemaker” role of the thalamic reticular nucleus in the generation of sleep spindles and the importance of low-threshold calcium spikes *in vivo*, linking the *in vivo*, *in vitro* and *in silico* worlds. This interesting triangle of methods and philosophies often clashed, making each new wave of discoveries even more exciting. How these different techniques fertilized each other in thalamic research should stand as an example for investigators in other fields.

In 1993, Steriade and his collaborators published three landmark papers in the *Journal of Neuroscience*, describing a cortical oscillatory pattern that they simply termed “slow” oscillation because its frequency was less than 1 Hz. Despite its modest name, the new pattern was catapulted to fame because it brought together basic and clinical investigations on delta patterns, cortical spindles and K-complexes of sleep. As with sleep spindles, the slow oscillation was soon reproduced in cortical slice preparations *in vitro*, sparking a new wave of productive research. Steriade recognized this connection between synchronous sleep patterns and epileptic discharges, and the mechanisms of paroxysmal epileptic activity in the neocortex became an important research topic in the last decade of his life.

No matter what subject he immersed himself in, he ardently emphasized the differences between results *in vivo* and in simplified *in vitro* preparations. He repeatedly said that complex behavioral states, such as sleep, perception, vigilance and motor control, could only be approached *in vivo*. In response to objections about technical limitations in intact brains, he went back to the lab and emerged with double and triple intracellular recordings, often in drug-free awake animals. In his last paper (with his long-time friend, Rodolfo Llinás), Steriade hypothesized that changes in thalamocortical rhythms cause several neuropsychiatric conditions.

Steriade was a prolific writer and published nearly 400 papers and 8 books. With his cross-cultural awareness, allied with his generosity, sense of humor and deep appreciation of literature and music, he became an eminent figure in his adopted city and a member of the Royal Academy of Sciences of Canada. A passionate and articulate speaker, he won respect from supporters and competitors alike. He received many prizes, of which he most cherished the Claude-Bernard Medal from the University of Paris and the Marie-Victorin prize from Quebec. His legacy will endure in the great fondness and admiration with which he will be remembered by many colleagues, friends, and former students around the world. ■

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