

Mircea Steriade (1924–2006)

Mircea Steriade, founder and editor in chief of *Thalamus and Related Systems*, died on April 14, 2006 after a long battle with lung cancer. Few outside his immediate family knew the seriousness of his condition and even when the end was imminent he determinedly held off the last moments until he had corrected the proofs of his final paper.

Mircea Steriade was born in Bucharest, Romania and received his medical degree and advanced training as a neurologist at the University of Bucharest (1945–1962). By 1955 he had discovered a passion for research, mainly involving clinico–pathological studies, and had also gained a PhD from the Institute of Neurology of the Romanian Academy of Sciences. He considered himself one of the heirs to the strong Romanian school of Neurology that grew up around Georges Marinesco during the first two decades of the twentieth century. Marinesco, a protégé of Charcot, also left a legacy of strong ties to French neurology. Steriade's early studies in neurology reflected this, and his growing interest in brain mechanisms of sleep and arousal led him to seek postdoctoral experience in one of the foremost laboratories of the French-speaking scientific world. It was not difficult for him to obtain permission to spend a lengthy period of time in the laboratory of Frédéric Bremer at Brussels because as a student Steriade had been involved in resistance to the Axis government during World War II and, thus, he enjoyed certain privileges under the post-war, Romanian régime.

It was in Bremer's laboratory during 1957–1958 that Steriade found his métier and, although he never published with Bremer, there can be no doubt that the latter exercised a profound influence over his younger associate, guiding him into what was to be a life-long study of the interactions between the forebrain and brainstem in the control of the conscious state.

Returning home to Bucharest, Steriade established The Laboratory of Neurophysiology at the Institute of Neurology, serving as Director of the same, and he commenced publishing papers, mainly involving electroencephalographic recordings in experimental animals, in the French and English literature. As a sign of things to come, however, he began studies with extracellular and intracellular recordings from single neurons as well.

Steriade's work on the responses of the visual cortex to light-evoked activity and their modulation by stimulation of the brain stem was sufficiently good to find acceptance in some of the better European and American journals of the time. However the increasing isolationism of the Romanian régime made him a target for censure and he concluded that, to further his experimental career, he would have to leave his native country. In 1968 he obtained an exit visa to attend a scientific meeting in Paris and there he stayed, although his prospects of obtaining a permanent position in France were very small. Fortunately, thanks to the intervention of Jean-Pierre Cordreau, he received an offer to take up a position in the Physiology Department at Laval University in Quebec. This he accepted without knowing the nature of the position or even where Quebec City was located. His family were not permitted to leave Romania and it was several years before his



Figure 1. Mircea Steriade (1924–2006)

daughter was able to join him. In 1968 he became head of the department at Laval, a post he held until the end of his life. Very much in character with his love for science, he never permitted his administrative responsibilities to stand in the way of his continuing engagement with the experimental laboratory.

Steriade's first investigations in his Canadian laboratory involved the recording of alterations in evoked activity in the cerebral cortex during sleep and wakefulness in monkeys and cats, and the role of the ascending systems of the brainstem in regulating these alterations. It was a theme that he was to pursue for the remainder of his career, keeping it alive when it became unfashionable and, eventually and largely through his efforts, seeing it transformed again into one of the most important in modern integrative neuroscience. He was a master experimenter who continued to adopt and improve new electrophysiological methods as they were introduced. He never lost sight of the whole animal, of the importance of its state of arousal on the activities of neurons throughout the brain, and of the influence that neurons in one part of the brain such as the cerebral cortex and brainstem might have over those in other regions such as the thalamus and basal ganglia. For this reason, he was always a champion of the *in vivo* preparation and a wise critic of the limitations of *in vitro* preparations, however valuable at the single-cell level, in revealing the

functions of the intact brain. Not that he ignored work in *in vitro* slice preparations. He simply adapted the techniques for *in vivo* work. In this way, for example, he showed by intracellular recording in the intact animal how the *t* current, which was discovered in slices of the thalamus by Jahnsen and Llinás, played such a profound role in the slow-wave oscillations of thalamus and cortex that characterize the transformation from wakefulness to sleep and *vice versa*. And when told that the rigors of *in vivo* recordings imposed limitations on the collection of data related to the integrative properties of cortical and thalamocortical networks, he went into the laboratory and produced simultaneous intracellular recordings from two, three and more interconnected neurons in unanesthetized animals. His work in this field is unlikely to be surpassed for a very long time to come.

Among his contributions, Mircea Steriade pioneered research that identified the network operations and neuronal properties in cortico–thalamic systems, which are implicated in the generation of normal brain rhythms during different states of vigilance and different types of electrical seizures. He was the first to demonstrate the role of GABAergic thalamic reticular neurons in the production of sleep spindles. Using intracellular recordings in animals and field-potential recordings during human sleep, he discovered a new type of sleep rhythm, the slow oscillation, which is generated intracortically

and has the capacity to produce the coalescence of different brain rhythms, generated in cortex or thalamus, within complex wave-sequences. Thus, he considered the cortex and the thalamus to be a unified neuronal network. He also demonstrated the role of brainstem acetylcholinergic neurons in the control of thalamo–cortical systems during brain-activated states. In one of his recent monographs, he exposed dissimilarities between the results of experiments conducted *in vivo* and *in vitro*, and argued for the necessity for studies of global behavioral states to be carried out in intact brain preparations.

Throughout his career as a North American scientist, Steriade was mentor and guide to a succession of excellent students, most of whom went on to successful careers in neuroscience many becoming leaders in their own right. He was also a congenial colleague to other scientists and although by no means undemanding, his demands invariably were those that stemmed from intellectual rigor or the desire to carry a joint project to fruition. His broad and deep knowledge that extended far outside science into the realms of literature and music made him an enjoyable companion in many different venues. He will be sadly missed and we dedicate this and the following issues of *Thalamus and Related Systems* to his memory.

Edward G. Jones and Rodolfo R. Llinás