INTERACTIONS OF NEURONS AND GLIAL CELLS DURING THE GENESIS OF SYNCHRONOUS BRAIN WAVES

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The study of the electrophysiological activity of the brain as a whole has acquired a well-established importance. Through experiments that are underway, we have opened a new field of investigation, studying relationships between neurons and glia in intact brain networks during physiological states such as wakefulness and sleep, and during pathological states such as epilepsy. Recent years have brought to attention the unexpected rich anatomical and electrophysiological properties of glial cells (in simple preparations such as cultures and slices). Much of the present neurobiological effort is invested in the further investigation of these properties. The research unit allows a multitude of approaches by investigating the same phenomenon from electrical and ionic angles. One of the major issues in neurosciences is related to the synchrony of cellular activity, especially in fields related to the interpretation of cognitive activity. One of the most straightforward approaches to reach that goal is through the recording of simultaneous intracellular activities at the very site of their occurrence. Experiments are therefore carried out in acute (anesthetized) or chronically implanted cats.

At the same time, I am involved in the study of the mechanisms underlying the genesis of the electroencephalogram (EEG). This research evolves along several lines:

1) Understanding of the cellular mechanisms contributing to the genesis of particular rhythms of the EEG such as spindles, delta, slow (0.1-1 Hz) or fast (beta-gamma) oscillations. As an example, in recent papers we have found that sleep slow (<1 Hz) and paroxysmal oscillations result from complex interactions of neurons and glial cells also involving the extracellular ionic composition [*J Neurophysiol (1999) 82:3108-3122*; *(2001) 85: 1346-1350; J Neurosci (2002) 22: 1042-1053*; *Cereb Cortex (2002) in press*]. Of particular interest for this meeting is the ability of training restricted regions of the brain to produce specific oscillation bursts in the gamma range (~40 Hz) [*PNAS (1997) 94:1985-1989*].

2) More recently, we became interested in the genesis of very slow or steady EEG components, also termed DC potential shifts. The understanding of the electrophysiological bases of these potentials may acquire a particular pertinence for their use in brain-computer interfaces. Preliminary data emphasize that, although brain cells might be involved in their generation, their role is limited to the effect they undergo from paracellular impingements arising in cerebral blood circuits.

These projects are supported by the Canadian Institutes for Health Research and by Fonds de la recherche en santé Québec.