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SYMPOSIUM. THE COMPUTATIONAL NEURON. T.J. Sejnowski, Howard Hughes Medical Institute and The Salk Institute, La Jolla, CA (Chairperson); C. Koch, Caltech, Pasadena, CA; R. J. Douglas, Oxford University, Oxford, England; W. W. Lytton, Neurology Department, University of Wisconsin, Madison, WI; A. Bell, Free University of Brussels, Belgium.

Nonlinear properties of neurons due to voltage-sensitive ionic currents and synaptic conductances have important consequences for how neurons compute. Detailed computer models of single neurons based on anatomically-reconstructed morphologies, known synaptic strengths, and measured channel kinetics are presented that illustrate new computational principles. In the introduction, Sejnowski will motivate the need for modeling single neurons and outline the computational techniques that are available. Koch will show that synaptic conductances can dynamically modulate the properties of dendrites in cortical pyramidal neurons; Douglas will demonstrate models of neurons implemented in analog VLSI silicon circuits that vastly enhancing the speed of these models; Lytton will present simulations of synaptically-driven entrainment of thalamocortical neurons and cortical pyramidal neurons. Bell will examine the question of why dendrites have active currents, making a provocative prediction for their self-organization during development. From these modeling studies a new view of computational processing is emerging in which the intrinsic dynamical properties of neurons interact with network properties to produce large-scale coherent activity in neural populations.