

424 Pathobiology of Neurologic Diseases

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The human nervous system is the organ of consciousness, cognition, ethics, and behavior; as such, it is the most intricate structure known to exist. More than one-third of the 23,000 genes encoded in the human genome are expressed in the nervous system. Each mature brain is composed of 100 billion neurons, several million miles of axons and dendrites, and $>10^{15}$ synapses. Neurons exist within a dense parenchyma of multifunctional glial cells that synthesize myelin, preserve homeostasis, and regulate immune responses. Measured against this background of complexity, the achievements of molecular neuroscience have been extraordinary. Advances have occurred in parallel with the development of new enabling technologies—in bioengineering and computational sciences; imaging; and cell, molecular, and chemical biology—and moving forward it is likely that the pace of new discoveries will only increase. This chapter reviews a number of the most dynamic areas in neuroscience, specifically highlighting advances in immunology and inflammation, neurodegeneration, and stem cell biology. In each of these areas, recent discoveries are providing context for an understanding of the triggers and mechanisms of disease and offering new hope for prevention, treatment, and repair of nervous system injuries. Discussions of the neurogenetics of behavior, advances in addiction science, and diseases caused by network dysfunction can be found in [Chap. 451](#) (Biology of Psychiatric Disorders); and new approaches to rehabilitation via harnessing of neuroplasticity, neurostimulation, and computer-brain interfaces are presented in [Chap. 487](#) (Emerging Neurotherapeutic Technologies).