Preface

Advances in neuroimaging and neuroscience hold significant promise for improving understanding of disorders of consciousness arising from severe brain injuries. The 87th Annual Conference of the Association for Research in Nervous and Mental Disease focused on the emerging findings in the field of disorders of consciousness. Held at the historic New York Academy of Medicine in New York City on December 7 and 8, 2007 the Disorders of Consciousness conference brought together a distinguished, small group of basic neuroscientists and clinical investigators engaged in fundamental investigation of arousal and mechanisms underlying large-scale forebrain integration, state-of-the-art neuroimaging studies of patients with disorders of consciousness, and experts in the fields of the neurology of consciousness and ethics who addressed the larger context in which the emerging neuroscience will be received and integrated. The intended goal of the conference was aimed at updating and advancing knowledge of diagnostic and prognostic methods, potential therapeutic strategies, and importantly identifying challenges for professionals engaged in the study of these patient populations.

Recent studies have underscored our contention that recovery of consciousness after severe brain injury remains poorly understood. Although public interest is high, the broad needs for systematic research in this emerging area of knowledge are currently unmet. The challenges are surprisingly difficult with a degree of diagnostic uncertainty that may range from the bedside in some patients who are unconscious, to those fully aware, as well as in patients with no evidence of behavioral responsiveness. As measurements of consciousness improve, behaviorally defined states—from "vegetative states" (no evidence of self or environmental awareness) to "minimally conscious states" (at least some evidence of awareness, excepting those patients in "locked-in states" (full consciousness with no motor control))—will reveal subcategories of patients whose level of consciousness we cannot at present identify with confidence. The contributions presented at the Disorders of Consciousness conference are likely to help form the scientific foundations for frameworks to systematically organize information and approaches to future clinical assessments of consciousness. Equally important is that the strategies for measurement and definition of these challenging disorders of consciousness will advance our basic understanding of human consciousness.

The current volume reflects contributions from each component of the program, beginning with a review on the relationship between mind and brain and its philosophical, scientific, and practical implications. Athena Demertzi *et al.*, from the Coma Science Group of Liège, and Adam Zeman *et al.*, from Edinburgh University and Peninsula Medical School, present their surveys on scientists' attitudes toward the mind–brain relationship and its relevance to clinical practice and to the formulation of scientific questions about the nature of consciousness.

The next two chapters deal with the fundamental studies of the mechanisms underlying large-scale forebrain integration and arousal in conscious perception. Edward Jones,

from the Center for Neuroscience, University of California, eloquently reviews the role of thalamo-cortico-thalamic networks and their potential substrate for synchronization of widespread cortical networks during high frequency oscillations considered critical for consciousness. Isabel Arrieta-Cruz and Donald Pfaff, from the Rockefeller University, New York, present experimental evidence from mice on the neuroanatomical pathways involved in an elemental form of "generalized arousal," discussing the potential implications for assessments of therapeutic measures using their animal model. The following section deals with *pathological* loss of consciousness in coma and epilepsy and with general anesthesia or the *pharmacological* modulation of human consciousness. Bryan Young, from the University of Western Ontario, first reviews the clinical and laboratory assessments of coma and related disorders, along with an analysis of how various conditions (*e.g.*, structural brain lesions, metabolic and toxic disorders) may impair consciousness. Lissa Yu and Hal Blumenfeld, from Yale University School of Medicine, New Haven, next discuss epileptic loss of consciousness, focusing on complex partial seizures; they provide functional neuroimaging evidence that temporal lobe seizure activity may disrupt cortical-subcortical connectivity, leading to depressed neocortical function and unconsciousness. Finally, the group of Emery Brown, from the Massachusetts General Hospital, Boston, discusses the possibilities, pitfalls, and methodological challenges of multimodal EEG-fMRI studies of loss of consciousness induced by anesthetics.

The subsequent two chapters deal with the recent advances in neuroimaging methods in the study of coma and related disorders of consciousness. Louis Puybasset's team, from the Pitié-Salpêtrière Hospital and Pierre et Marie Curie University of Paris, focuses on *structural* magnetic resonance imaging (MRI) technology, such as MR spectroscopy, and diffusion tensor imaging in predicting outcome from severe brain injury. They emphasize the importance of evaluating patients with disorders of consciousness early in the clinical course to better understand the natural history and its relationship to structural brain injuries. The following chapter by Adrian Owen's group, from Cambridge, deals with the diagnostic role of *functional* MRI in the assessment of consciousness in vegetative or minimally conscious patients. Introduction of neuroimaging into the clinical evaluation process will require a close collaboration among investigators and clinicians to organize the emerging knowledge so that scientific advances may help shape the care of patients. The relatively long time courses of recovery following severe brain injury emphasize the need to develop markers for identifying patients who may harbor further potential for meaningful recovery.

Andrea Kübler and co-workers, from the Universities of Würzburg and Tübingen, illustrate how brain computer interfaces might enable some severely brain damaged patients to functionally communicate their thoughts and wishes using spelling devices. Finally, Nicholas Schiff from Weill Medical College of Cornell University, New York, sums up the scientific rationale supporting the use of deep brain stimulation in the central thalamus as a method to improve consciousness in selected minimally conscious patients, discussing the potential mechanisms and limitations of these technological developments.

Last but not least, this volume tackles the ethical dimensions of the presented evolving research on disorders of consciousness. The final two chapters by James Bernat, from Dartmouth Medical School, New Hampshire, and by Joseph Fins, from Weill Cornell Medical College, New York, deal with the impact of clinical research and especially the emerging functional neuroimaging techniques on ethical issues of treatment, rehabilitation, and palliation in these challenging patients.

We thank our funding agencies, including the Dana Foundation and the James McDonnell Foundation, the New York Academy of Medicine, the Association for Research in Nervous and Mental Disease, the National Institutes of Health, the European Commission, the Mind Science Foundation, and the Belgian National Fund for Scientific Research for helping to make the conference and this book possible. We hope that our joint efforts will ultimately improve the care and understanding of patients suffering from disorders of consciousness.

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