Preface

This issue of *Brain, Behavior and Evolution* contains reviews based on the presentations at the 2010 Karger Workshop that took place on November 11 in San Diego, Calif., USA. This 22nd workshop, entitled ‘Diversity in Cortical Organization’, included speakers who presented and discussed recent advances in our understanding of the variability in the organization of the neocortex of mammals and suggested how neocortex might have emerged from a homolog in premammalian ancestors.

I introduced the workshop by reviewing the areal organization of cortex across the 6 major clades of mammals, focusing on mammals with relatively small brains and little neocortex because the fossil record indicates that early mammals were small and had small brains and little neocortex. Such comparisons suggest that early mammals had few cortical areas, perhaps 15–20, and these areas were rather poorly differentiated histologically. However, our understanding of cortical organization is limited for many taxa, and thus there is a great need for further study.

Our special guest, Suzana Herculano-Houzel of the Universidade Federal do Rio de Janeiro, Brazil, developed a new method for determining the number of cells and neurons in brains and parts of brains, i.e. the isotropic fractionator method, and has used this method to provide a wealth of new observations on the cerebral cortex and other parts of brains. Her studies of brains of different sizes in rodents, primates, and other mammals challenged the popular assumption that the rate of increase in numbers of neurons from species of small-to-large brains is the same for all mammals. Comparisons of pri-

mate and rodent brains of different sizes revealed that the cerebral cortex of primates gains more neurons with increasing size than does cerebral cortex of rodents. This means that the cortex in a small monkey has about twice the number of neurons as does the cortex in a large rodent of approximately the same brain size. Because neuron numbers reflect the computational capacities of cortex, this scaling difference in numbers of neurons is perhaps one of the most significant differences between rodent and primate brains.

Suzana’s broad scope, including comparisons of neuron densities in the cerebral cortex, cerebellum, and the rest of the brain of several taxa, was followed by a presentation by Christine Collins focused on describing regional and areal differences in the densities of neuron populations in prosimian primates, New World monkeys, and Old World monkeys. Following results presented in an early study, neuroscientists have long assumed that the same number of neurons would be found beneath any small unit of cortical surface, e.g. contained in a hypothetical cortical column, taken from any cortical area of any mammalian species, except for the primary visual cortex of primates where twice as many neurons would be encountered. While it is the case that neurons were more densely distributed in the primary visual cortex of all primates studied, Christine found that neuron density within the primary visual cortex varies across primate species and across parts of the primary visual cortex representing central compared to peripheral vision within a species. Other cortical areas and regions also vary in neuron density in ways that reflect sensory or integrative spe-

cializations. A greater range of neuron densities across cortical areas in Old World monkeys compared to prosimian galagos suggests that some of the cortical areas of Old World monkeys, especially some of the sensory areas, are more specialized in Old World monkeys.

After a refreshing lunch break, Leah Krubitzer of the University of California, Davis, reminded us that rodents represent an extremely successful and varied mammalian radiation, and this variation provides many opportunities for comparative research, yet nearly half of the recent published studies on brain organization and function are of rats and mice. Here, with her coauthors Katharine Campi and Dylan Cooke, Leah presents an extensive review and discussion of how cortical organization varies with lifestyle across rodent species.

The workshop closed with two intriguing discussions of comparative studies of cortical development by Zoltán Molnár of the University of Oxford, UK, and Luis Puelles of the University of Murcia, Spain. Both presentations ad-

ressed the issue of how neocortex evolved with the advent of mammals. We now recognize that neocortex is not new but is homologous with the dorsal cortex (pallium) of reptiles and the hyperpallium of birds. However, it has been challenging to determine how neocortex evolved from a homologous structure in ancestral amniotes as the synapsid radiation that led to mammals over the course of 320 million years left no other surviving branches for comparative study. Thus, both Zoltán and Luis have turned to studies of cortical development to provide suggestions for how the thick, layered neocortex (isocortex) of mammals evolved from a much simpler structure. These speakers considered changes in the roles of the progenitor cells that generate neocortex and the significance of different paths of cell migration in the emergence of layers and cell types in neocortex.

I hope the readers find these papers on the origins and variability of cortex in mammals to be as informative and enjoyable as I have.

Jon H. Kaas