Special Lectures

THEME A: DEVELOPMENT

Lineage Analyses of Developing CNS Tissues CME

Connie Cepko, PhD
Harvard Medical School and Howard Hughes Medical Institute

Lineage analyses describe the progenitor: progeny relationships in developing tissue. Lineage data can rule in, or out, particular models of how a cell achieves its fate, as well as when some of the fate-determining events occur. Lineages can be most definitively tracked using clonal methods, as afforded by retroviral infection. The interpretability of lineage data is further strengthened when mapping is done from identified types of progenitor cells. Recent studies using such methods in the retina and telencephalon will be presented.

Regulation of Neural Stem Cell Fate During Development and in the Adult CME

Yukiko Gotoh, PhD
University of Tokyo

This lecture will discuss how neocortical neural stem/progenitor cell (NPC) fate is regulated in a developmental stage-dependent manner. This lecture will also focus on the mechanisms underlying long-term maintenance of adult neural stem cells (NSCs), the differences between embryonic NPCs and adult NSCs, and the embryonic origin of adult NSCs.

THEME B: NEURAL EXCITABILITY, SYNAPSES, AND GLIA

Synaptic Organizing Complexes in Development and Neuropsychiatric Disorders CME

Ann Marie Craig, PhD
University of British Columbia

Synapse assembly, maturation, and plasticity are controlled by synaptic organizing complexes, presynaptic neurexins, and LAR-PTPs and their diverse postsynaptic partners. Genetics places these complexes centrally in a synaptic risk pathway for autism and other neuropsychiatric disorders. This lecture will discuss how these complexes cooperate in synapse development, confer specificity, balance excitation and inhibition, mediate plasticity, and promote an adaptable response to genetic risk.

Quantal Release and Its Requirements CME

Robert Edwards, MD
University of California, San Francisco

Quantal release by exocytosis requires the transport of classical neurotransmitters into secretory vesicles. Vesicular transport activity thus defines the membranes, as well as the cells capable of transmitter release. However, the three families of vesicular transporters differ in ionic coupling. This lecture will discuss the biophysical properties of the transporters, the properties of secretory vesicles that influence their function, and the implications for synaptic transmission, including quantal size, non-vesicular efflux, synaptic vesicle pools and transmitter co-release.

Cortical Circuits of Vision CME

Massimo Scanziani, PhD
University of California, San Francisco

The diversity of neuron types and synaptic connectivity patterns in the cerebral cortex is astonishing. How this cellular and synaptic diversity contributes to cortical function is just beginning to emerge. Using the mouse visual system as an experimental model, this lecture will discuss the mechanisms by which excitatory and inhibitory interactions among distinct neuron types contribute to the most basic operations in visual cortex. This lecture will highlight how a functional and structural analysis of cortical circuits allows us to bridge the gap between system and cellular neuroscience.

THEME C: NEURODEGENERATIVE DISORDERS AND INJURY

Capturing Immune Responses to Understand and Treat Neurodegenerative Disease CME

Eliezer Masliah, MD
University of California, San Diego

Neurodegenerative disorders are a leading cause of death in the aging population. Progressive accumulation and prion-like propagation of aggregated neuronal proteins may contribute to neurodegeneration. Developing strategies to increase clearance and diminish cell to cell transmission might be key to treat these disorders. Harnessing the power of the immune system by developing cellular and humoral immunization has been tested for the past years. This lecture will provide a perspective on the recent progress and challenges of utilizing immunotherapy for neurodegenerative disorders.

THEME D: SENSORY SYSTEMS

Genetic Dissection of Sensorimotor Circuits in the Spinal Cord CME

Martyn D. Goulding, PhD
Salk Institute for Biological Studies

Sensorimotor circuits in the spinal cord play essential roles in somatosensation and motor control. Studies defining the genetic programs controlling spinal cord development have opened up new avenues for exploring the cellular and functional organization of these circuits. This lecture will outline our current understanding of the spinal CPG circuits that control locomotion and the dorsal horn pathways that process and transmit cutaneous somatosensory modalities, highlighting the cutting-edge genetic and behavioral approaches that are being employed to map these circuits.

THEME E: MOTOR SYSTEMS

Circuits for Movement CME

Silvia Arber, PhD
Biozentrum, University of Basel and Friedrich Miescher Institute

Movement is the behavioral output of the nervous system. Animals carry out an enormous repertoire of distinct actions, spanning from seemingly simple repetitive tasks like walking, to more complex movements such as forelimb manipulation tasks. This lecture will focus on recent work elucidating the organization and function of neuronal circuits at the core of regulating distinct motor behaviors. It will show that dedicated circuit modules within different brainstem nuclei and their interactions in the motor system play key roles in action diversification.

Special Lectures (cont.)

Understanding Mammalian Microcircuits: Let Inspiration Guide the Way CME

Jack L. Feldman, PhD
University of California, Los Angeles

More than 25 years since our discovery of the pre-Bötzinger Complex, the core of the circuit for breathing, the underlying mechanisms governing its dynamics remain elusive and are much more complex than we first thought. This lecture will address how novel emergent mechanisms, but not pacemakers, inhibition, or bursting, are likely to be critical and describe the roles the pre-BötC plays in regulation of body function, other movements, and emotion. The neural circuit controlling breathing is inimitably tractable and may inspire general strategies for elucidating other neural microcircuits.

THEME F: INTEGRATIVE PHYSIOLOGY AND BEHAVIOR

Bitten: Understanding and Modulating Mosquito Attraction to Humans CME

Leslie B. Vosshall, PhD
Rockefeller University

By the act of feeding on our blood, female mosquitoes spread dangerous infectious diseases such as malaria, dengue, zika, and yellow fever to humans. We attract mosquitoes via multiple sensory cues, including emitted body odor, body heat, and carbon dioxide in the breath. The mosquito perceives differences in these cues, both between and within species, to determine which animal or human to target for blood-feeding. This lecture will focus on the genes and circuits that drive this dangerous behavior and how it is modulated by the internal physiological state of the mosquito.

From Song to Synapse: Vocal Communication in Sparrows, Finches, and Mice CME

Richard D. Mooney, PhD
Duke University School of Medicine

The interplay between hearing and vocalization is critical to vocal communication and vocal learning. Recent research using both songbirds and mice has provided keen insights into the neural circuits and mechanisms that mediate this sensorimotor interplay. This lecture will cover recent progress in understanding how auditory experience engages and shapes motor systems to enable vocal learning, how motor systems modulate hearing during vocalization and other movements, and the neural circuitry that produces vocalizations used for social communication.

THEME G: MOTIVATION AND EMOTION

Translational Neuroepigenetic Insights of Addiction Vulnerability CME

Yasmin L. Hurd, PhD
Icahn School of Medicine at Mount Sinai

Drug addiction involves complex interaction of dynamic processes that contribute to individual vulnerability from early stages of development and during different phases of life by linking genetic factors with environmental experiences. This lecture will focus on the neurobiological insights we have gained about the molecular underpinnings of substance abuse (particularly cannabis and opiates) using multidisciplinary translational approaches in humans and animal models. The work presented will illuminate epigenetic mechanisms associated with addiction risk, even across generations.

THEME H: COGNITION

Deciphering the Dynamics of the Unconscious Brain Under General Anesthesia CME

Emery N. Brown, MD, PhD
Massachusetts Institute of Technology

General anesthesia is a drug-induced reversible coma. A primary mechanism by which anesthetics induce altered states of arousal is by producing large, structured oscillations that impair communication among brain regions. This lecture will discuss the neurophysiology of these oscillations and how they change with drug and patient age. It will show new ways to control the anesthetic state and induce rapid emergence from anesthesia. Studying mechanisms of anesthesia is a largely untapped way of studying the brain.

The Social Brain in Human Adolescence CME

Sarah-Jayne Blakemore, PhD
University College London

Social cognitive processes involved in navigating an increasingly complex social world continue to develop throughout human adolescence. In the past 20 years, neuroscience research has shown that the human brain develops both structurally and functionally during adolescence. Areas of the social brain undergo significant reorganization during the second decade of life, which might reflect a sensitive period for adapting to the social environment.

THEME I: TECHNIQUES

Dendritic Spines Shaping Memory and Behaviors CME

Haruo Kasai, MD, PhD
Graduate School of Medicine, University of Tokyo

Spiny protrusions of dendrite, called dendritic spines, are the major postsynaptic sites for excitatory synaptic transmission in the brain. New studies indicate that spines act as memory elements, and do so by their structural plasticity. Such cell motility regulates functional connectivity and enables Hebbian and reinforcement learning in the cortex and basal ganglia. Motility can be spontaneous, and such fluctuations may determine memory persistence and stabilize recurrently connected networks. Spine motility connects cell biology to mental functions and disorders.

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