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ALIEN SENSORY WORLDS

NEUROETHOLOGY, ECOLOGY AND FASCINATING ADAPTEDNESS

SHORT BIOGRAPHIES AND ABSTRACTS

COMMISSION FOR INTERDISCIPLINARY ECOLOGICAL STUDIES

KENTARO ARIKAWA graduated from Jiyugakuen College (Natural Sciences) and Sophia University Graduate School (Behavioral Biology) in Tokyo. As a 1st year graduate student he found out that butterflies sense light by their genitals. After receiving a PhD degree in 1983 and many years as a biology professor at Yokohama City University, he moved to SOKENDAI (Graduate University for Advanced Studies) in Hayama in 2006. Ken Arikawa also conducted research at the Australian National University in Canberra and at the Indiana University in Bloomington, USA. In 2022 he was awarded the prestigeous National Medal of Honor with Purple Ribbon by the Emperor of Japan.

Colors in the environment, the eyes, and the brain of butterflies

Butterflies are colorful and strongly vision-oriented animals. The Japanese yellow swallowtail, *Papilio xuthus*, uses sophisticated color vision when searching for flowers. Its color vision is tetrachromatic based on red, green, blue, and ultraviolet – sensitive photoreceptors. The resulting ability to discriminate colors rivals our own. How are the photoreceptors made spectrally diverse? How is the information on the wavelength of the light converted into 'color' in their tiny brain? It will be shown how we have addressed such questions and what scientists may enjoy in future studies.

MARIE DACKE is Professor of Sensory Biology at Lund University, Sweden. Her model organisms – the ball-rolling dung beetles – provide her with an excellent platform to understand how animals with miniature eyes and small brains navigate the world. She is a fellow of the Royal Entomological Society of London and the Royal Swedish Academy of Sciences. Marie Dacke has recorded over 130 episodes for a national nature show, is a Swedish Champion of popular scientific presentation and has written two books about the animals in her garden.

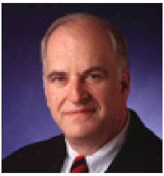
Dancing under the stars: How small creatures find their way

A human lost in the forest will soon start to walk in circles, while a dung beetle released in the same terrain rather moves steadfast along a given bearing. To achieve this, it has a compass in its head, eyes that look towards the sky and a well-choreographed dance that it frequently performs on top of its dung-ball. The beetle's unique and robust orientation behaviour, in combination with an accessible brain, make this insect ideal for understanding the fundamental visual and neural processes underlying orientation. Please join us on an overview of recent findings concerning how insects navigate our globe.

KRISTINE KRUG heads the Department of Sensory Physiology at the Otto-von-Guericke-University Magdeburg as Heisenberg Professor. She is also a Visiting Professor of Neuroscience at the University of Oxford. The long-term scientific aim of her research is to understand and control the neuronal signals that generate our rich visual experience. She investigates the structure and function of cortical circuits that shape perception and decision-making in monkeys and humans from single neurons to cognitive behavior.

Active vision in primates: the events that shape perception

Our visual experience is far more than what meets the eye. Bistable figures like the Necker cube or the art work of M.C. Escher highlight the cortical decision processes that shape our rich perceptual experience of the world. In the brains of non-human primates, we begin to understand these perceptual processes at the level of brain cells and circuits. Strikingly, we are also able to control some of these processes. I shall show how direct cortical interventions and altered behavioural context, such as reward and social influences, are both effective in altering perception in primates.



PETER NARINS, a leading specialist in amphibian auditory and vibrational communication, discovered the first example of a sexually dimorphic vertebrate sensory system and pioneered the use of robotics and MEMRI (Manganese-enhanced magnetic resonance imaging) to probe mechanisms underlying natural amphibian behavior in the field. He discovered three Asian frogs that communicate with ultrasound. Narins demonstrated amphibians exhibit the most acute vibrational sensitivity among vertebrates and that long-term changes in frog calls are sensitive indicators of global warming. His field studies and associated vibrational and auditory physiological investigations have profoundly altered our understanding of how vertebrates perceive the world.

Neuroethology of vertebrates living in seismic worlds

Golden moles are nocturnal, surface – foraging mammals with rudimentary vision. Several species possess massively hypertrophied mallei in their middle ears that confer substrate-vibration sensitivity through inertial bone conduction. 'Seismic' playback experiments suggest that in the absence of olfactory cues, golden moles are able to locate food sources solely using vibrations generated by the wind blowing the dune grass on the mounds. Laser measurements of the malleus in response to vibrational stimuli reveal a geophone-like ear with peak sensitivity to frequencies below 300 Hz. Functionally, golden moles appear to be low-frequency specialists that detect prey principally through substrate conduction.

HEINER RÖMER received his diploma and doctoral degree from the Ruhr-University Bochum, Germany. Supported by a Heisenberg Grant he collaborated with colleagues in Australia and Canada to perform neurophysiological field work in habitats differing in physical structure and acoustic properties. Since 1992 he has been Full Professor of Zoology at the University of Graz until his emeritation in 2016.

Acoustic communication in insects: Ecological challenges and surprising adaptations

Grasshoppers and crickets are well known for their 'songs', which the males use to attract females or in contests with other males. Information from a small number of auditory receptors and interneurons is used by the brain to decide what to do next. This is a challenging task, since these insects live in a structurally complex and noisy habitat with numerous sound sources from conspecifics, other species, and predators. New methods will be reported demonstrating how we studied hearing in the habitat to better understand their natural sensory world.

WOLFGANG RÖSSLER graduated and received his doctoral degree from the University of Marburg (1990) followed by postdoctoral research on auditory communication systems in bush crickets. He then moved to the University of Arizona in Tucson to study the development of olfactory systems in moths (1995–1999). As an Assistant Professor at the University of Göttingen back in Germany he studied olfactory processing in the clawed frog (1999–2001). Subsequently, he became Full Professor (2001) at the University of Würzburg and Chair of 'Behavioral Physiology and Sociobiology' (2011) and developed a research and training program focusing on the sensory neuroethology of social insects.

Olfaction and neural mechanisms in communicating social insects

Olfaction plays a crucial role in the behavior of social insects. Ants and bees, for example, communicate elaborately by pheromones and discriminate thousands of food-related odors with their sophisticated sense of smell. How is the complex olfactory world of insects encoded and perceived in their tiny brain? Olfactory adaptations in social insects will be highlighted, starting with the reception of the odorants on their antennae and proceeding with odor coding, memory, and multisensory perception in the brain.

GÜNTHER K.H. ZUPANC is a professor of biology at Northeastern University in Boston, Massachusetts. Having received a PhD in neurosciences from the University of California, San Diego, he served on the faculty of the Max Planck Institute of Developmental Biology, the University of Tübingen, the University of Manchester, and the International University Bremen. The focus of his research is on neural plasticity in the central nervous system of adult teleost fish. In addition to over 170 journal articles, he has authored or edited 14 books and special journal issues, including *Behavioral Neurobiology: An Integrative Approach*,which has become a standard text in teaching neuroethology. Zupanc is also Editor-in-Chief of the Journal of Comparative Physiology A.

When sensory systems stop talking to the motor side – insights from weakly electric fish

Weakly electric fish generate with their electric organ electric fields around their body. By analyzing distortions of this field through their elaborate electrosensory system, they gather information about their environment, including neighboring conspecifics. This information is used for electrolocation and electrocommunication. The fish's discharges are under control of an intrinsic oscillator in the brainstem. Modulations of the oscillator, and thus of the electric organ discharges, are mediated by sensory input. Extremely powerful modulations are induced by anesthetics, presumably by decoupling of the central motor control from the sensory input system. The discovery of this phenomenon has implications for our understanding of the neural mechanisms underlying the state of anesthesia, and for the development of new anesthetics.