A Midsummer Night's Dream: ISOT in Stockholm

by Lauren M. Dembeck

The 16th International Symposium on Olfaction and Taste (ISOT) was held in the island city of Stockholm, Sweden, at the newly completed Stockholm Waterfront congress hall. Home of the Nobel Prize, it was a fitting local for this appetizing gathering. This year ISOT sported ~774 attendees. It was organized by Bill Hansson, a pioneer in the field of chemical ecology, and was hosted by the European Chemoreception Research Organization, the American Association for Chemoreception Sciences, and the Japanese Association for the Study of Taste and Smell. The meeting saw a variety of systems all focused on chemosensation from the role of olfaction in human mate choice to the pseudogenization of taste receptors in cetaceans.

The keynote and plenary speakers were Cori Bargmann, Charles Zuker, Rickard Ignell, Kristin Scott, and Nobel laureate, Linda Buck. Bargmann (Rockefeller University) delivered an intriguing plenary session on the use of microfluidics to create temporal and spatial odorant gradients to study behavioral response in *Caenorhabiditis elegans*. She showed that, despite the fixed anatomical development of these neurons, information processing can be modified by genetic variation, internal physiological state, and the macro-environment. Charles Zuker (Columbia University) shared results from a novel approach to explore the representation of taste *in vivo* using two-photon imaging in mice. His techniques provide a basis for future studies of neural circuits for taste. Ignell (Swedish University of Agricultural Sciences) discussed how the cotton leafworm *Spodoptera littoralis* alters its olfactory preference for various plant odors in response to mating; these changes have implications for the acquisition of new host plants. Kristin Scott (UC Berkeley) discussed her work on taste perception in Drosophila. Her research team utilized an integrative approach including molecular, behavioral, and calcium imaging studies to characterize a large family of ~60 gustatory receptors. Their work demonstrates that taste cells are specifically tuned to different taste categories and result in specific behaviors. Linda Buck (HHMI) delivered the Delwart lecture on her ground breaking work on olfactory receptors and work on trace amine-associated receptors (TAARs). TAARs are expressed in the mammalian

nose and like classical odorant receptors show one neuron-one receptor expression. TAARs are evolutionarily conserved from fish to humans and may have a role in detecting social cues.

Concurrent sessions with specific foci included aquatic olfaction, central mechanisms of taste learning and memory, and much more. Here, I share some examples of exciting work in the field. Using mice as a model system, Jeffrey Isaacson (UC San Diego) showed that the representation of odors as combinatorial codes of active mitral cells in the olfactory bulb is plastic; recent experience modifies mitral cell activity such that they are more strongly activated by less-familiar odorants. Scott Waddell (Oxford University) presented work on reward signaling through octopamine and dopamine in *Drosophila*. His studies show that octopamine regulates short-term appetitive responses to sweet taste and contributes to memory retrieval. However, this requires a functional dopaminergic system leading to the conclusion that the insect reward system may be more similar to that of mammals than previously recognized. Yoshihiro Yoshihara (RIKEN Brain Science Institute) shared work on olfactory circuits in zebrafish. His team identified three types of olfactory receptor neurons: ciliated, microvillous, and cryptic. These contribute to two distinct neural pathways that distinguish various types of olfactory cues. Stuart Firestein (Columbia University) gave an exciting talk on the pharmacology of odorant receptors. Focusing specifically on the rat I7 receptor, which is activated by octanal, his research shows that I7 can accept different conformers. He showed that adding steric bulk, such as a phenol ring, makes it a better I7 ligand. By using odorant receptors as model G-protein coupled receptors we may be able to expand our knowledge on how to create improved ligands for pharmaceutical uses.

There were also some fascinating talks on non-model systems. Julie Hagelin (University of Alaska) gave an intriguing presentation on the role of olfaction in auklets and petrels. Since birds generally have impressive visual courtship displays, the study of bird olfaction has been neglected. However, Auklets have specialized hair cells at the base of their necks. These cells produce a citrusy scent, octanal. Given that octanal repels ticks, higher levels of octanal result in and signal higher mate quality. Continuing on the theme of studying olfaction in non-model organisms, Christina Drea (Duke University) presented work on olfactory-guided mate choice in ring-tail lemurs. Drea hypothesized that chemical cues in lemurs may serve as "honest signals" of mate choice. Her works showed that lemurs in mating conditions have more complex chemical profiles and prove to be more interesting to conspecifics in behavioral assays. She was also able to show that genome-wide heterozygosity and diversity at the Major Histocompatability Complex is correlated with chemical diversity and that injured lemurs produce less odors than healthy ones. Based on this evidence, she concluded the ring-tailed lemurs show condition-dependent signaling, which could be a basis for mate selection based on both "good genes" and "good fit".

Representing NCSU and the W.M. Keck Center for Behavioral Biology, Robert Anholt and Coby Schal both delivered platform presentations. Anholt discussed his recent work on olfactory behavior. The research consisted of genome-wide association analyses of the olfactory response of the *Drosophila melanogaster* Genetic Reference Panel to 14 odorants. His group identified 571 genes harboring SNPs associated with phenotypic response to one or more odorants. Many of the genes identified fall into gene ontology categories associated with development of the nervous system. Schal discussed the evolution of sugar aversion in the German cockroach. In some populations of *B. germanica*, a "glucose-averse" trait evolved in response to deadly baits containing glucose. His research suggests that these cockroaches may express glucose receptors on the bitter taste receptor neurons of the paraglossae, a small pair of appendages near the mouth.

In addition to the exceptional platform presentations, there were over 400 posters. Some I found interesting included the decline of olfactory performance of patients suffering from autism spectrum disorders, the detection of acidity in the mouse vomeronasal organ, and the presence of taste receptors as nutrient sensors in the heart. I presented my work using the *Drosophila melanogaster* Genetic Reference Panel on natural variation in cuticular hydrocarbons, some of which are sexual pheromones; in collaboration with the Schal lab, I described differences not only in the total amount of cuticular hydrocarbons present across the lines, but also in specific compounds, many of which are novel. These results may offer insight into the link between variation in pheromone composition with mating behavior and incipient speciation.

The conference closed with a delectable banquet at the Vasa Museum. The museum is built around the 333 year old Vasa ship, a warship that sank on her maiden voyage in 1628. Surrounded by history and enjoying a magnificent dinner with both new and familiar colleagues was a thoroughly satisfying way to end the conference. The next ISOT meeting will be held in Yokohama. Start writing now!

The Vasa ship in the Vasa museum in Stockholm