



Preface

She loves him, observes the tourist upon beholding the image of the Pharaoh and his wife in the Egyptian Museum in Cairo. And indeed, the intimate scene depicting Tutankhamun and his queen Ankhesenamun (shown on the cover of our book) confers that impression even more than 3000 years after its creation. For the sensory physiologist who recognizes Ankhesenamun's gesture as a mechanosensory gentle touch, the sensation of a hand touching a shoulder is in molecular terms no simple process. In fact, more than 20 years of hard experimental work was necessary to shed some light on the molecular steps that convert, or transduce, physical contact into an electrical signal interpretable by the nervous system. As Laura Bianchi and Monica Driscoll outline in the first chapter of this book, the path toward understanding touch was paved by a creature much less noble than Tutankhamun: the soil nematode *Caenorhabditis elegans*. Painstaking genetic analysis of the worm's response to being experimentally touched and probed with an eyelash led to identification of the transduction channels in mechanosensory neurons, known collectively now as the degenerin family of ion channels. It is these proteins that translate mechanical stimuli into electrical signals that can be processed by the sensory neurons and eventually are interpreted by the organism as a sensory experience.

In all sensory cells transduction channels show fascinating adaptations to their task of reporting sensory stimuli. Imagine this: if Ankhesenamun speaks to her husband, or when the Pharaoh listens to his musicians playing cymbals and harp, tiny protein filaments tug at the transduction channels in his inner ear to excite mechanosensory hair cells and to produce a neuronal auditory signal. Robert Fettiplace describes in his chapter the biophysical examination of these exquisitely sensitive transduction channels.

In the world of chemoreception, transduction channels appear to be as numerous as the qualities of chemical stimuli. Acid-sensing ion channels respond to the simplest of all chemicals. They are opened by protons and probably serve multiple functions in the body, including the generation of heartache when ischemia turns things sour within the myocardium. Other chemoreception modalities are more conducive to Pharaoh's bliss. In particular, the metabotropic transduction cascades of taste and smell form the molecular basis of sensory pleasures, which were so highly cherished by the ancient Egyptians that the hieroglyphic determinative for happiness was a nose. The chemoreception chapters in our book describe the state of knowledge about transduction channels in chemosensory cells. Here we meet an entire zoo of different transduction channels, including cyclic nucleotide-gated cation channels, calcium-activated chloride channels, and a channel family that plays an increasingly prominent role in sensory physiology: the transient receptor potential channels. Transient receptor potential channels mediate sensory transduction in systems as diverse as mouse pheromone receptors, insect ommatidia, and human thermoreceptors, apparently acting as one of nature's multiple-purpose transduction components.

Looking at his wife is probably what makes the Pharaoh really happy. And, indeed, the beautiful daughter of Nefertiti must have been an exceptional visual experience. Just look at how the rays of the sun seem to caress her and her husband with tiny hands of light! The old Egyptians surely had a way of representing sensory perception in art. In modern days, we have learned to understand how photoelectrical transduction works in the light-sensitive cells of the retina. Dimitri Tränkner and Benjamin Kaupp describe the pivotal role that transduction channels play in such different visual tasks as looking at stars at night or beholding bright and colorful images such as the one on the book cover. And Armin Huber explains the ingenious method that flies use to achieve high temporal resolution in vision: the formation of multimolecular signaling complexes to rapidly drive transduction channels. If you have ever wanted to know why you can rarely catch the fly that annoys you, read this chapter. It won't help you in catching the insect, but you will understand why the bug is so fast.

In the concluding chapter, Robert C. Peters and Jean-Pierre Denizot discuss a sensory modality that Tutankhamun and Ankhesenamun did not use to perceive the world: electroreception. If not the Pharaoh, another denizen of Egypt is a master of electroreception. A small fish with a long nose, the elephant nose (*Gnathonemus petersii*), finds his way through murky waters by means of emitting and perceiving electrical signals. The elephant nose is one of the best-studied weakly electric fish, and it has slowly revealed how it does it. It is fascinating to read about the sensory equipment that electric fish employ to feel their way in the dark!

Thus, the authors of this book cover many sensory modalities and explain the generation of receptor currents in a wide range of sensory cells. They address their chapters to students of biology, physiology, and medicine, as well as to scientists interested in signal transduction, sensory physiology, and perception. And who knows – even some aficionados of Egyptian archaeology may wish to know more about the Pharaoh's senses.

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