Outlook

The experiments conducted in this thesis open several different perspectives for future projects. These could cover methodological aspects as well as physiological aspects both of the olfactory system's periphery and the AL.

Methodology

One methodological aspect extensively covered in the discussion was the putative relationship between Ca^{2+} imaging and electrophysiological recordings. Ideally this question would be solved in a simultaneous approach, i.e. imaging the ORN Ca^{2+} responses while doing single sensillum recordings. All the necessary technical expertise and equipment, i.e. *Drosophila* Ca^{2+} imaging and single sensillum recordings, would be available at the institute. Elucidating the relationship between electrical and Ca^{2+} ORN activity would help to clarify the interpretation of results obtained by Ca^{2+} imaging.

Complete description of olfactory input

In order to cover the entire input to the *Drosophila* olfactory system it is necessary to screen the responses of all adult ORN classes. For a long time only a few Gal4-lines were freely available (Vosshall et al., 2000). With the publication of two recent papers, now the majority of ORs expressed in the adult fly are available as OR-Gal4 lines (Couto et al., 2005;Fishilevich and Vosshall, 2005), thus enabling the completion of the MRRs of the Drosophila olfactory system.

While presentation of single odors allows for the identification of activating and inactivating odors it does not allow for identification of antagonistic odors. It is possible that there are hidden Or22a antagonists among the large group of Or22a non-activating odors. In order to find these antagonists one would have to present mixtures of one non-activating odor and one activating odor with known expected response amplitude. Reduced or abolished responses to the activating odor would identify the non-activating odor as antagonistic ligand. Knowledge about antagonistic odors could further advance our understanding of odor-receptor interactions.

The antennal lobe network

As pointed out in the discussion the actions of the AL network is much debated. The evidence for presynaptic inhibition presented here indicates one of its modulatory roles. Further exploration of presynaptic inhibition could include more pharmacological experiments like the application of GABA itself and application of the ionotropic GABA antagonist bicuculline. It has been shown that the sensitivity of *Drosophila* ionotropic GABA receptors to PTX and bicuculline critically depends on their subunit constitution (Zhang et al., 1995). Thus testing bicuculline in addition to PTX is necessary in order to understand fully the extent of presynaptic inhibition mediated by ionotropic GABA receptors. Furthermore, there is recent evidence for metabotropic GABA receptors on *Drosophila* olfactory projection neurons (PN) (Wilson and Laurent, 2005). Application of the metabotropic GABA antagonist CG54626 could show whether such receptors are also involved in presynaptic inhibition of *Drosophila* ORNs as shown for vertebrates (Aroniadou-Anderjaska et al., 2000;Murphy et al., 2005;Wachowiak et al., 2005;Wachowiak and Cohen, 1999).

The conclusions on *Drosophila* AL physiology so far are all based on direct comparison between the input to the AL provided by the ORNs and the output of the AL presented by the PN activity (Ng et al., 2002;Wang et al., 2003;Wilson et al., 2004). It is however questionable whether this is a valid approach: as long as the 'transfer function' of ORN neuronal activity to PN neuronal activity remains unknown it is also unknown what is really compared between ORN and PN activity. A different approach would be to do an intralevel (i.e. within the ORN level and within the PN level) comparison rather than an interlevel (between the ORN and the PN level) comparison.