

## References

- Ai H, Kanzaki R. 2004. Modular organization of the silkworm antennal lobe macroglomerular complex revealed by voltage-sensitive dye imaging. *J Exp Biol* 207:633-644.
- Anton S, Hansson BS. 1994. Central processing of sex pheromone, host odour, and oviposition deterrent information by interneurons in the antennal lobe of female *Spodoptera littoralis* (Lepidoptera: Noctuidae). *J Comp Neurol* 350:199-214.
- Anton S, Homberg U. 1999. Antennal lobe structure. In: Hansson BS, editor: *Insect Olfaction*. Berlin: Springer. p 97-124.
- Aonuma, H. 2002. Distribution of NO-induced cGMP-like immunoreactive neurones in the abdominal nervous system of the crayfish, *Procambarus clarkii*. *Zoolog Sci* 19:969-979.
- Aonuma H, Niwa K. 2004. Nitric oxide regulates the levels of cGMP accumulation in the cricket brain. *Act Biol Hung* 55: 65-70. (in press)
- Bicker G. 2001. Nitric oxide: an unconventional messenger in the nervous system of an orthopteroid insect. *Arch Insect Biochem Physiol* 48:100-110.
- Boeckh J, Boeckh V. 1979. Threshold and odor specificity of pheromone-sensitive

- neurons in the deutocerebrum of *Antheraea pernyi* and *A. polyphemus* (Saturniidae).  
J Comp Physiol A 132:235-242.
- Boeckh J, Ernst KD, Sass H, Waldow U. 1984. Anatomical and physiological characteristics of individual neurons in the central antennal pathway of insects. J Insect Physiol 30:15-26.
- Boeckh J, Tolbert LP. 1993. Synaptic organization and development of the antennal lobe in insects. Microsc Res Tech 24:260-280.
- Buck LB, Axel R. 1991. A novel multigene family may encode odorant receptors: a molecular basis for odor recognition. Cell 65:175-187.
- Christensen TA, D'Alessandro G, Lega J, Hildebrand JG. 2001. Morphometric modeling of olfactory circuits in the insect antennal lobe: I. Stimulation of spiking local interneurons. BioSystems 61:143-153.
- Christensen TA, Heinbockel T, Hildebrand JG. 1996. Olfactory information processing in the brain: encoding chemical and temporal features of odors. J Neurobiol 30:82-91.
- Christensen TA, Hildebrand JG. 1987. Male-specific, sex pheromone-selective projection neurons in the antennal lobes of the moth *Manduca sexta*. J Comp Physiol A 160:553-569.

- Christensen TA, Waldrop BR, Harrow ID, Hildebrand JG. 1993. Local interneurons and information processing in the olfactory glomeruli of the moth *Manduca sexta*. *J Comp Physiol A* 173:385-399
- Christensen TA, Waldrop BR, Hildebrand JG. 1998. Multitasking in the olfactory system: context-dependent responses to odors reveal dual GABA-regulated coding mechanisms in single olfactory projection neurons. *J Neurosci* 18:5999-6008.
- Christensen TA, White J. 2000. Representation of olfactory information in the brain. In: Finger TE, Silver WL, Restrepo D, editors: *The Neurobiology of Taste and Smell*, Second Edition. New York: Wiley-Liss. p 201-232.
- Clyne PJ, Warr CG, Freeman MR, Lessing D, Kim J, Carlson JR. 1999. A novel family of divergent seven-transmembrane proteins: candidate odorant receptors in *Drosophila*. *Neuron* 22:327-338.
- De Vente J, Steinbusch HWM, Schipper J. 1987. A new approach to immunocytochemistry of 3',5'-cyclic guanosine monophosphate: preparation, specificity, and initial application of a new antiserum against formaldehyde-fixed 3',5'-cyclic guanosine monophosphate. *Neuroscience* 22:361-373.
- Distler PG. 1989. Histochemical demonstration of GABA-like immunoreactivity in cobalt labeled neuron individuals in the insect olfactory pathway. *Histochemistry*

91:245-249.

Distler PG, Boeckh J. 1996. Synaptic connections between olfactory receptor cells and uniglomerular projection neurons in the antennal lobe of the American cockroach, *Periplaneta americana*. J Comp Neurol 370:35-46.

Distler PG, Boeckh J. 1997a. Synaptic connections between identified neuron types in the antennal lobe glomeruli of the cockroach, *Periplaneta americana*: I. Uniglomerular projection neurons. J Comp Neurol 378:307-319.

Distler PG, Boeckh J. 1997b. Synaptic connections between identified neuron types in the antennal lobe glomeruli of the cockroach, *Periplaneta americana*: II. Local multiglomerular interneurons. J Comp Neurol 383:529-540.

Elphick MR, Rayne RC, Riveros-Moreno V, Moncada S, O'Shea M. 1995. Nitric oxide synthesis in locust olfactory interneurons. J Exp Biol 198:821-829.

Ernst KD, Boeckh J. 1983. A neuroanatomical study on the organization of the central antennal pathways in insects III. Neuroanatomical characterization of physiologically defined response types of deutocerebral neurons in *Periplaneta americana*. Cell Tissue Res 229:1-22.

Flanagan D, Mercer AR. 1989a. An atlas and 3-D reconstruction of the antennal lobes in the worker honeybee, *Apis mellifera* L. (Hymenoptera: Apidae). Int J Insect

- Morphol Embryol 18:145-159.
- Flanagan D, Mercer AR. 1989b. Morphology and response characteristics of neurons in the deutocerebrum of the brain in the honeybee *Apis mellifera*. J Comp Physiol A 164:483-494.
- Fonta C, Sun XJ, Masson C. 1993. Morphology and spatial distribution of bee antennal lobe interneurons responsive to odours. Chemical Senses 18:101-119.
- Galizia CG and Kimmerle B. 2004. Physiological and morphological characterization of honeybee olfactory neurons combining electrophysiology, calcium imaging and confocal microscopy. J Comp Physiol A 190:21-38.
- Galizia CG, McIlwraith SL, Menzel R. 1999. A digital threedimensional atlas of the honeybee antennal lobe based on optical sections acquired by confocal microscopy. Cell Tissue Res 295:383-394.
- Galizia CG, Menzel R. 2001. The role of glomeruli in the neural representation of odours: results from optical recording studies. J Insect Physiol 47:115-130.
- Gascuel J, Masson C. 1991. A quantitative ultrastructural study of the honeybee antennal lobe. Tissue Cell 23:341-355.
- Hansson BS, Anton S, Christensen TA. 1994. Structure and function of antennal lobe neurons in the male turnip moth, *Agrotis segetum* (Lepidoptera: Noctuidae). J Comp

Physiol A 175:547-562.

Hansson BS, Christensen TA. 1999. Functional characteristics of the antennal lobe. In:

Hansson BS, editor: Insect Olfaction. Berlin: Springer. p 125-161.

Hansson BS, Christensen TA, Hildebrand JG. 1991. Functionally distinct subdivisions of the macroglomerular complex in the antennal lobe of the male sphinx moth *Manduca sexta*. J Comp Neurol 312:264-278.

Hansson BS, Ljungberg H, Hallberg E, Löfstedt C. 1992. Functional specialization of olfactory glomeruli in a moth. Science 256:1313-1315.

Hildebrand JG. 1996. Olfactory control of behavior in moths: central processing of odor information and the functional significance of olfactory glomeruli. J Comp Physiol A 178:5-19.

Hildebrand JG, Shepherd GM. 1997. Mechanisms of olfactory discrimination: converging evidence for common principles across phyla. Annu Rev Neurosci 20:595-631.

Homberg U, Christensen TA, Hildebrand JG. 1989. Structure and function of the deutocerebrum in insects. Annu Rev Entomol 34:477-501

Homberg U, Montague RA, Hildebrand JG. 1988. Anatomy of antenno-cerebral pathways in the brain of the sphinx moth *Manduca sexta*. Cell Tissue Res

254:255-281.

Homberg U, Müller U. 1999. Neuroactive substances in the antennal lobe. In: Hansson BS, editor: Insect Olfaction. Berlin: Springer. p 181-206.

Hoskins SG, Homberg U, Kingan TG, Christensen TA, Hildebrand JG. 1986. Immunocytochemistry of GABA in the antennal lobes of the sphinx moth *Manduca sexta*. Cell Tissue Res 244:243-252.

Joerges J, Küttner A, Galizia CG, Menzel R. 1997. Representations of odours and odour mixtures visualized in the honeybee brain. Nature 387:285-288.

Kaissling K-E, Kasang G. 1978. A new pheromone of the silkworm moth *Bombyx mori*. Naturwissenschaften 65:382-384.

Kanzaki R. 1998. Coordination of wing motion and walking suggests common control of zigzag motor program in a male silkworm moth. J Comp Physiol A 182:267-276.

Kanzaki R, Arbas EA, Hildebrand JG. 1991. Physiology and morphology of protocerebral olfactory neurons in the male moth *Manduca sexta*. J Comp Physiol A 168: 281-298.

Kanzaki R, Arbas EA, Strausfeld NJ, Hildebrand JG. 1989. Physiology and morphology of projection neurons in the antennal lobe of the male moth *Manduca sexta*. J Comp Physiol A 165:427-453.

- Kanzaki R, Mishima T. 1996. Pheromone-triggered 'flipflopping' neural signals correlated with activities of neck motor neurons of a male moth, *Bombyx mori*. *Zoolog Sci* 13: 79-87.
- Kanzaki R, Shibuya T. 1986. Identification of the deutocerebral neurons responding to the sexual pheromone in the male silkworm moth brain. *Zoolog Sci* 3:409-418.
- Kanzaki R, Soo K, Seki Y, Wada S. 2003. Projections to higher olfactory centers from subdivisions of the antennal lobe macroglomerular complex of the male silkworm. *Chem Senses* 28:113-130.
- Kanzaki R, Sugi N, Shibuya T. 1992. Self-generated zigzag turning of *Bombyx mori* males during pheromone-mediated upwind walking. *Zoolog Sci* 9:515-527.
- Koontz MA, Schneider D. 1987. Sexual dimorphism in neuronal projections from the antennae of silk moths (*Bombyx mori*, *Antheraea polyphemus*) and the gypsy moth (*Lymantria dispar*). *Cell Tissue Res* 249:39-50.
- Kramer E. 1975. Orientation of the male silkworm to the sex attractant bombykol. In: Denton DA, Coghlan J, editors: *Mechanisms in Insect Olfaction*. New York: Academic Press. p 329-335.
- Laissue PP, Reiter C, Hiesinger PR, Halter S, Fischbach KF, Stocker RF. 1999. Three-dimensional reconstruction of the antennal lobe in *Drosophila melanogaster*.

J Comp Neurol 405:543–552.

Laurent G. 1999. A systems perspective on early olfactory coding. *Science* 286:723-728.

Laurent G. 2002. Olfactory network dynamics and the coding of multidimensional signals. *Nature Rev Neurosci* 3:884-895

Laurent G, Stopfer M, Friedrich RW, Rabinovich MI, Volkovskii A, Abarbanel HD.

2001. Odor encoding as an active, dynamical process: experiments, computation, and theory. *Annu Rev Neurosci* 24:263-297.

Leitch B, Laurent G. 1996. GABAergic synapses in the antennal lobe and mushroom body of the locust olfactory system. *J Comp Neurol* 372:487-514.

Malun D. 1991a. Inventory and distribution of synapses of identified uniglomerular projection neurons in the antennal lobe of *Periplaneta americana*. *J Comp Neurol* 305:348-360.

Malun D. 1991b. Synaptic relationships between GABA-immunoreactive neurons and an identified uniglomerular projection neuron in the antennal lobe of *Periplaneta americana*: A double-labeling electron microscopic study. *Histochemistry* 96:197-207.

Marin EC, Jefferis GS, Komiyama T, Zhu H, Luo L. 2002. Representation of the glomerular olfactory map in the *Drosophila* brain. *Cell* 109:243-255.

- Masson C, Mustaparta H. 1990. Chemical information processing in the olfactory system of insects. *Physiol Rev* 70:199-245.
- Matsumoto SG, Hildebrand JG. 1981. Olfactory mechanisms in the moth *Manduca sexta*: response characteristics and morphology of central neurons in the antennal lobes. *Proc R Soc Lond B* 213:249-277.
- Müller U. 1997. The nitric oxide system in insects. *Prog Neurobiol* 51:363-381.
- Nighorn A, Gibson NJ, Rivers DM, Hildebrand JG, Morton DB. 1998. The nitric oxide-cGMP pathway may mediate communication between sensory afferents and projection neurons in the antennal lobe of *Manduca sexta*. *J Neurosci* 18:7244-7255.
- Obara Y. 1979. *Bombyx mori* mating dance: an essential in locating the female. *Appl Entomol Zoolog* 14: 130-132.
- Okada K, Kanzaki R, Kawachi K. 1996. High-speed voltage-sensitive dye imaging of an in vivo insect brain. *Neurosci Lett* 209:197-200.
- Rospars JP. 1983. Invariance and sex-specific variations of the glomerular organization in the antennal lobes of a moth, *Mamestra brassicae*, and a butterfly, *Pieris brassicae*. *J Comp Neurol* 220:80-96.
- Rospars JP. 1988. Structure and development of the insect antennodeutocerebral system.

- Int J Insect Morphol Embryol 17:243–294.
- Rospars JP, Chambille I. 1981. Deutocerebrum of the cockroach *Blaberus craniifer* Burm. Quantitative study and automated identification of the glomeruli. J Neurobiol 12:221–247.
- Rospars JP, Hildebrand JG. 1992. Anatomical identification of glomeruli in the antennal lobes of the male sphinx moth *Manduca sexta*. Cell Tissue Res 270:205–227.
- Sachse S, Galizia CG. 2002. Role of inhibition for temporal and spatial odor representation in olfactory output neurons: a calcium imaging study. J Neurophysiol 87:1106–1117.
- Sachse S, Rappert A, Galizia CG. 1999. The spatial representation of chemical structures in the antennal lobe of honeybees: steps towards the olfactory code. Eur J Neurosci 11:3970–3982.
- Schäfer S, Bicker G. 1986. Distribution of GABA-like immunoreactivity in the Brain of the honeybee. J Comp Neurol 246:287–300.
- Sadek MM, Hansson BS, Rospars JP, Anton S. 2002. Glomerular representation of plant volatiles and sex pheromone components in the antennal lobe of the female *Spodoptera littoralis*. J Exp Biol 205:1363–1376.
- Schneider D, Kaissling K-E. 1957. Der Bau der Antenne des Seidenspinners *Bombyx*

*mori* L. II. Sensillen, cuticulare Bildungen und innerer Bau. Zool Jb (Anat)

76:223-250

Scholz NL, Chang ES, Graubard K, Truman JW. 1998. The NO/cGMP pathway and the development of neural networks in postembryonic lobsters. J Neurobiol 34:208-226

Seki Y, Aonuma H, Kanzaki R. 2005. Pheromone processing center in the protocerebrum of *Bombyx mori* revealed by nitric oxide-induced anti-cGMP immunocytochemistry. J Comp Neurol 481:340–351.

Steinbrecht RA. 1970. Zur Morphometrie der Antenne des Seidenspinners *Bombyx mori* L.: Zahl und Verteilung der Riechsensillen (Insecta, Lepidoptera). Z Morphol Tiere 68:93-126

Steinbrecht RA. 1973. Der Feinbau olfaktorischer Sensillen des Seidenspinners (Insecta, Lepidoptera). Z Zellforsch 139:533-565

Stengl M, Zintl R, De Vente J, Nighorn A. 2001. Localization of cGMP immunoreactivity and of soluble guanylyl cyclase in antennal sensilla of the hawkmoth *Manduca sexta*. Cell Tissue Res 304:409-421.

Stocker RF. 1994. The organization of the chemosensory system in *Drosophila melanogaster*: a review. Cell Tissue Res 275:3-26

Stocker RF, Lienhard MC, Borst A, Fischbach K-F. 1990. Neuronal architecture of the

antennal lobe in *Drosophila melanogaster*. Cell Tissue Res 262:9-34.

Stopfer M, Bhagavan S, Smith BH, Laurent G. 1997. Impaired odour discrimination on desynchronization of odour-encoding neural assemblies. Nature 390:70-74.

Stopfer M, Wehr M, Macleod K, Laurent G. 1999. Neural dynamics, oscillatory synchronization, and odor codes. In: Hansson BS, editor: Insect Olfaction. Berlin: Springer. p 163-180.

Strausfeld NJ. 1976. Atlas of an insect brain. Berlin Heidelberg New York: Springer.

Sun XJ, Fonta C, Masson C. 1993. Odour quality processing by bee antennal lobe interneurons. Chemical Senses 18:355-377.

Sun XJ, Tolbert LP, Hildebrand JG. 1997. Synaptic organization of the uniglomerular projection neurons of the antennal lobe of the moth *Manduca sexta*: a laser scanning confocal and electron microscopic study. J Comp Neurol 379:2-20.

Tanaka J, Markerink-van Ittersum M, Steinbusch HWM, De Vente J. 1997. Nitric oxide-mediated cGMP synthesis in oligodendrocytes in the developing rat brain. Glia 19:286-297.

Terada M, Kazawa T, Seki Y, Kanzaki R. 2003. Three-dimensional reconstruction and identification of the antennal lobe glomerular structures in *Bombyx mori*. Zoolog Sci Abstr. 20:1580

- Tolbert LP, Hildebrand JG. 1981. Organization and synaptic ultrastructure of glomeruli in the antennal lobes of the moth *Manduca sexta*: a study using thin sections and freeze-structure. *Phil Trans R Soc Lond B* 213:279-301.
- Vosshall LB. 2000. Olfaction in *Drosophila*. *Curr Opin Neurobiol* 10:498-503.
- Vosshall LB, Amrein H, Morozov PS, Rzhetsky A, Axel R. 1999. A spatial map of olfactory receptor expression in the *Drosophila* antenna. *Cell* 96:725-736.
- Vosshall LB, Wong AM, Axel R. 2000. An olfactory sensory map in the fly brain. *Cell* 102:147-159
- Wang JW, Wong AM, Flores J, Vosshall LB, Axel R. 2003. Two-photon calcium imaging reveals an odor-evoked map of activity in the fly brain. *Cell* 112:271-282.
- Wong AM, Wang JW, Axel R. 2002. Spatial representation of the glomerular map in the *Drosophila* protocerebrum. *Cell* 109:229-241.