

REFERENCES

Bicker, G. (1991). Taurine-like immunoreactivity in photoreceptor cells and mushroom bodies: a comparison of the chemical architecture of insect nervous systems. *Brain. Res.* 560, 201-206.

Bonini, N. M., Leiserson, W. M., and Benzer, S. (1993). The *eyes absent* gene: Genetic control of cell survival and differentiation in the developing *Drosophila* eye. *Cell* 72, 379-395.

Bonini, N. M., Bui, Q. T., Gray-board, L., and Warrick, J. M. (1997). The *Drosophila eyes absent* gene directs ectopic eye formation in a pathway conserved between flies and vertebrates. *Development* 124, 4819-4826.

Brand, A. H. and Perrimon, N. (1993). Targeted gene expression as a means of altering cell fates and generating dominant phenotypes. *Development* 118, 401-415.

Callaerts, P., Halder, G., and Gehring, W. J. (1997). Pax-6 in development and evolution. *Annu. Rev. Neurosci.* 20, 483-532.

Callahan, C. A. and Thomas, J. B. (1994). Tau- β -galactosidase, an axon-targeted fusion protein. *Proc. Natl. Acad. Sci. USA* 91, 5972-5976.

Cantera, R., Roos, E., and Engström, Y. (1999). Dif and Cactus are colocalized in the larval nervous system of *Drosophila melanogaster*. *J. Neurobiol.* 38, 16-26.

Caubit, X., Thangarajah, R., Theil, T., Wirth, J., Nothwang, H.-G., Rütger, U., and Krauss, S. (1999). Mouse Dac, a novel nuclear factor with homology to *Drosophila* dachshund shows a dynamic expression in the neural crest, the eye, the neocortex, and limb bud. *Devel. Dyn.* 214, 66-80.

Chen, R., Amoui, M., Zhang, Z., and Mardon, G. (1997). Dachshund and Eyes Absent proteins form a complex and function synergistically to induce ectopic development in *Drosophila*. *Cell* 91, 893-903.

Cheng, Y., Endo, K., Wu, K., Rodan, A. R., Heberlein, U., and Davis, R. L. (2001). *Drosophila fasciclinIII* is required for the formation of odor memories and for normal sensitivity to alcohol. *Cell* 105, 757-768.

Chenn, A., Braisted, J. E., McConnell, K. K., and O'Leary, D. D. M. (1997). Development of the cerebral cortex: mechanisms controlling cell fate, laminar and areal patterning, and axonal connectivity. In *Molecular and Cellular Approaches to Neural Development* (ed. W. M. Cowan, T. M. Jessell and S. L. Zipursky), pp. 440-473. Oxford Univ. Press, New York.

Cheyette, N.N., Green, P., Martin, K., Garren, H., Hartenstein, V., and Zipursky, S. L. (1994) The *Drosophila sine oculis* locus encodes a homeodomain-containing protein required for the development of the entire visual system. *Neuron* 12, 977-996.

Connolly, J. B., Roberts, I. J. H., Armstrong, J. D., Kaiser, K., Forte, M., Tully, T.,

and O'Kane, C. J. (1996). Associative learning disrupted by impaired G_s signaling in *Drosophila* mushroom bodies. *Science* 274, 2104-2107.

Crittenden, J., Skoulakis, E., Han, K., Kalderon, D., and Davis, R. L. (1998). Tripartite mushroom body architecture revealed by antigenic markers. *Learn. Mem.* 5, 38-51.

Czerny, T., Halder, G., Kloter, U., Souabni, A., Gehring, W. J., and Busslinger, M. (1999). *twin of eyeless*, a second *Pax-6* gene of *Drosophila*, acts upstream of *eyeless* in the control of eye development. *Mol. Cell.* 3, 297-307.

Davis, R. L. (1996). Physiology and biochemistry of *Drosophila* learning mutants. *Physiol. Rev.* 76, 299-317.

Davis, R. J., Shen, W., Heanue, T. A., and Mardon, G. (1999). Mouse *Dach*, a homologue of *Drosophila dachshund*, is expressed in the developing retina, brain and limbs. *Dev. Genes Evol.* 209, 526-536.

de Bell, J. S. and Heisenberg, M. (1996). Expression of *Drosophila* mushroom body mutations in alternative genetic backgrounds: a case study of the mushroom body miniature gene (*mbm*). *Proc. Natl. Acad. Sci. USA* 93, 9875-9880.

Ferveur, J., Stortkuhl, K., Stocker, R., and Greenspan, R. (1995). Genetic feminization of brain structures and changed sexual orientation in male *Drosophila*. *Science* 267, 902-905.

Gehring, W. J. and Ikeo, K. (1999). *Pax 6*: mastering eye morphogenesis and eye evolution. *Trends Genet.* 15, 371-377.

Goto, S. and Hayashi, S. (1997). Cell migration within the embryonic limb primordium of *Drosophila* as revealed by a novel fluorescence method to visualize mRNA and protein. *Dev. Genes Evol.* 207, 194-198.

Grenningloh, G., Rehm, E. J., and Goodman, C. S. (1991). Genetic analysis of growth cone guidance in *Drosophila*: Fasciclin II functions as a neuronal recognition molecule. *Cell* 67, 45-57.

Halder, G., Callaerts, P., and Gehring, W. J. (1995). Induction of ectopic eyes by targeted expression of the *eyeless* gene in *Drosophila*. *Science* 267, 1788-1792.

Halder, G., Callaerts, P., Flister, S., Walldorf, U., Kloter, U., and Gehring, W. J. (1998). Eyeless initiates the expression of both *sine oculis* and eyes absent during *Drosophila* compound eye development. *Development* 125, 2181-2191.

Han, P. L., Levine, L. R., Reed, R. R., and Davis, R. L. (1992). Preferential expression of the rutabaga gene in mushroom bodies, neural centers for learning in insects. *Neuron* 9, 619-627.

Hanson, I. and Heyningen, V. V. (1995). *Pax-6*: more than meets the eye. *Trends Genet.* 11, 268-272.

Heisenberg, M. (1998). What do the mushroom bodies do for the insect brain? An introduction. *Learn. Mem.* 5, 1-10.

Hirth, F., Therianos, S., Loop, T., Gehring, W. J., Reichert, H., and Furukubo-Tokunaga, K. (1995). Developmental defects in brain segmentation caused by mutations of the homeobox genes *orthodenticle* and *empty spiracles* in *Drosophila*. *Neuron* 15, 769-778.

Ito, K., Awano, W., Suzuki, K., Hiromi, Y., and Yamamoto, D. (1997). The *Drosophila* mushroom body is a quadruple structure of clonal units each of which contains a virtually identical set of neurons and glial cells. *Development* 124, 761-771.

Ito, K. and Hotta, Y. (1992). Proliferation pattern of postembryonic neuroblasts in the brain of *Drosophila melanogaster*. *Dev. Biol.* 149, 134-148.

Ito, K., Suzuki, K., Estes, P., Ramaswami, M., Yamamoto, D., and Strausfeld, N. (1998). The organization of extrinsic neurons and their implications in the functional roles of the mushroom bodies in *Drosophila melanogaster* Meigen. *Learn. Mem.* 5, 52-77.

Kozmik, Z., Pfeffer, P., Kralova, J., Paces, J., Paces, V., Kalousova, A., and Cvekl, A. (1999). Molecular cloning and expression of the human and mouse homologues of the *Drosophila dachshund* gene. *Dev. Genes Evol.* 209, 537-545.

Lee, T. and Luo, L. (1999). Mosaic analysis with a repressible cell marker for studies of gene function in neuronal morphogenesis. *Neuron* 22, 451-461.

Lee, T., Lee, A., and Luo, L. (1999). Development of the *Drosophila* mushroom bodies: Sequential generation of three distinct types of neurons from a neuroblast. *Development* 126, 4065-4076.

Lin, D. M., Fetter, R. D., Kopeczynsky, C., Grenningloh, G., and Goodman, C. S. (1994). Genetic analysis of Fasciclin II in *Drosophila*: Defasciculation, refasciculation, and altered fasciculation. *Neuron* 13, 1055-1069.

Littleton, J. T., Bellen, H. J., and Perin, M. S. (1993). Expression of Synaptotagmin in *Drosophila* reveals transport and localization of synaptic vesicles to the synapse. *Development* 118, 1077-1088.

Liu, L., Wolf, R., Ernst, R., and Heisenberg, M. (1999). Context generalization in *Drosophila* visual learning requires the mushroom bodies. *Nature* 400, 753-756.

Livesey, F. J. and Cepko, C. L. (2001). Vertebrate neural cell-fate determination: lessons from the retina. *Nature Rev. Neurosci.* 2, 109-118.

Mardon, G., Solomon, N., and Rubin, G. M. (1994). *dachshund* encodes a nuclear protein required for normal eye and leg development in *Drosophila*. *Development* 120, 3473-3486.

McBride, S. M., Giuliani, G., Choi, C., Krause, P., Correale, D., Watson, K., Baker, G., and Siwicki, K. K. (1999). Mushroom body ablation impairs short-term memory and long-term memory of courtship conditioning in *Drosophila melanogaster*. *Neuron* 24, 967-977.

Nagao, T., Endo, K., Kawauchi, H., Walldorf, U., and Furukubo-Tokunaga, K. (2000). Patterning defects in the primary axonal scaffolds caused by the mutations of the *extradenticle* and *homothorax* genes in the embryonic *Drosophila* brain. *Dev. Genes Evol.* 210, 289-299.

Nassif, C., Noveen, A., and Hartenstein, V. (1998). Embryonic development of the *Drosophila* brain. I. Pattern of pioneer tracts. *J. Comp. Neurol.* 402, 10-31.

Nignorn, A., Healy, M. J., and Davis, R. L. (1991). The cyclic AMP phosphodiesterase encoded by the *Drosophila* *dunce* gene is concentrated in the mushroom bodies neuropile. *Neuron* 6, 455-467.

Niimi, T., Seimiya, M., Kloter, U., Flister, S., and Gehring, W. J. (1999). Direct regulatory interaction of the *eyeless* protein with an eye-specific enhancer in the *sine oculis* gene during eye induction in *Drosophila*. *Development* 126, 2253-2260.

Noveen, A., Daniel, A., and Hartenstein, V. (2000). Early development of the *Drosophila* mushroom body: the roles of *eyeless* and *dachshund*. *Development* 127, 3475-3488.

O'Dell, K., Armstrong, J., Yang, M., and Kaiser, K. (1995). Functional dissection of the *Drosophila* mushroom bodies by selective feminization of genetically defined subcompartments. *Neuron* 15, 55-61.

Pignoni, F., Hu, B., Zavitz, K. H., Xiao, J., Garrity, P. A., and Zipursky, S. L. (1997). The eye-specification proteins So and Eya form a complex and regulate multiple steps in *Drosophila* eye development. *Cell* 91, 881-891.

Prokop, A. and Technau G. M. (1991). The origin of postembryonic neuroblasts in the ventral nerve cord of *Drosophila melanogaster*. *Development* 111:79-88.

Prokop, A. and Technau, G. M. (1994). Normal function of the *mushroom body defect* gene of *Drosophila* is required for the regulation of the number and proliferation of neuroblasts. *Dev. Biol.* 162, 321-337.

Qiu, Y. and Davis, R. L. (1993). Genetic dissection of the learning/memory gene *dunce* of *Drosophila melanogaster*. *Genes Dev.* 7, 1447-1458.

Quiring, R., Walldorf, U., Kloter, U., and Gehring, W. J. (1994). Homology of the *eyeless* gene of *Drosophila* to the *Small eye* gene in mice and *Aniridia* in humans. *Science* 265, 785-789.

Rybak, J. and Menzel, R. (1993). Anatomy of the mushroom bodies in the honey bee brain: the neuronal connections of the α lobe. *J. Comp. Neurol.* 334, 444-465.

Rybak, J. and Menzel, R. (1998). Integrative properties of the Pe1 neuron, a unique mushroom body output neuron. *Learn. Mem.* 5, 133-145.

Schäfer, S., Bicker, G., Ottersen, O. P., and Storm-Mathisen, J. (1988). Taurine-like immunoreactivity in the brain of the honeybee. *J. Comp. Neurol.* 268, 60-70.

Schürmann, F. W. and Erber, J. (1990). FMRF amide-like immunoreactivity in the brain of the honeybee *Apis mellifera*: a light-and electron microscopical study. *Neuroscience* 38, 797-807.

Serikaku, M. A. and O'Tousa, J. E. (1994). *sine oculis* is a homeobox gene required for *Drosophila* visual system development. *Genetics* 138, 1137-1150.

Shen, W. and Mardon, G. (1997). *sine oculis* is a homeobox gene required for *Drosophila* visual system development. *Development.* 124, 45-52.

Skoulakis, E. M. C., Kalderon, D., and Davis, R. L. (1993). Preferential expression in mushroom bodies of the catalytic subunit of protein kinase A and its role in learning and memory. *Neuron* 11, 197-208.

Stocker, R. F., Heimbeck, G., Gendre, N., and de Belle, J. S. (1997). Neuroblast ablation in *Drosophila* *P[GALA]* lines reveals origins of olfactory interneurons. *J. Neurobiol.* 32, 443-456.

Stoykova, A. and Gruss, P. (1994). Roles of Pax-genes in developing and adult brain as

suggested by expression patterns. *J. Neurosci.* 14, 1395-1412.

Stoykova, A., Fritsch, R., Walther, C., and Gruss, P. (1996). Forebrain patterning defects in Small eye mutant mice. *Development* 122, 3453 -3465.

Strausfeld, N. J. (1976). *Atlas of an insect brain.* Springer-Verlag, Berlin/Heidelberg/New York/Tokyo.

Strausfeld, N. J. (1999). A brain region in insects that supervises walking. *Prog. Brain Res.* 123, 273-284.

Strausfeld, N. J., Hansen, L., Li, Y., Gomez, R. S., and Ito, K. (1998). Evolution, discovery, and interpretations of arthropod mushroom bodies. *Learn. Mem.* 5, 11-37.

Strausfeld, N. J. and Hidebrand, J. G. (1999). Olfactory systems: common design, uncommon origins? *Curr. Opin. Neurobiol.* 9, 634-639.

Strausfeld, N. J. and Li, Y. (1999a). Organization of olfactory and multimodal afferent neurons supplying the calyx and pedunculus of the cockroach mushroom bodies. *J. Comp. Neurol.* 409, 603-625.

Strausfeld, N. J. and Li, Y. (1999b). Representation of the calyces in the medial and vertical lobes of cockroach mushroom bodies. *J. Comp. Neurol.* 409, 626-646.

Technau, G. and Heisenberg, M. (1982). Neural reorganization during metamorphosis

of the corpora pedunculata in *Drosophila melanogaster*. *Nature* 295, 405-407.

Tettamanti, M., Armstrong, J., Endo, K., Yang, M., Furukubo-Tokunaga, K., Kaiser, K., and Reichert, H. (1997). Early development of the *Drosophila* mushroom bodies, brain centers for associative learning and memory. *Dev. Genes Evol.* 207, 242-252.

Truman, J. and Bate, M. (1988). Spatial and temporal patterns of neurogenesis in the central nervous system of *Drosophila melanogaster*. *Dev. Biol.* 125, 145-157.

Verkhusha, V. V., Otsuna, H., Awasaki, T., Oda, H., Tsukita, S., and Ito, K. (2001). An enhanced mutant of red-fluorescent protein DsRed for double labeling and developmental timer of neural fiber bundle formation. *J. Biol. Chem.* 276, 29621-29624.

Yang, M., Armstrong, J., Vilinsky, I., Strausfeld, N. J., and Kaiser, K. (1995). Subdivision of the *Drosophila* mushroom bodies by enhancer-trap expression patterns. *Neuron* 15, 45-54.