USE OF DROSOPHILA MELANOGASTER BRAIN MUTANTS FOR THE LOCALIZATION OF THE PACEMAKER OF CIRCADIAN LOCOMOTOR ACTIVITY RHYTHM.

C. Helfrich
Institut für Biologie I, Universität Tübingen, Auf der Morgenstelle 1, D-7400 Tübingen 1, Fed. Rep. of Germany

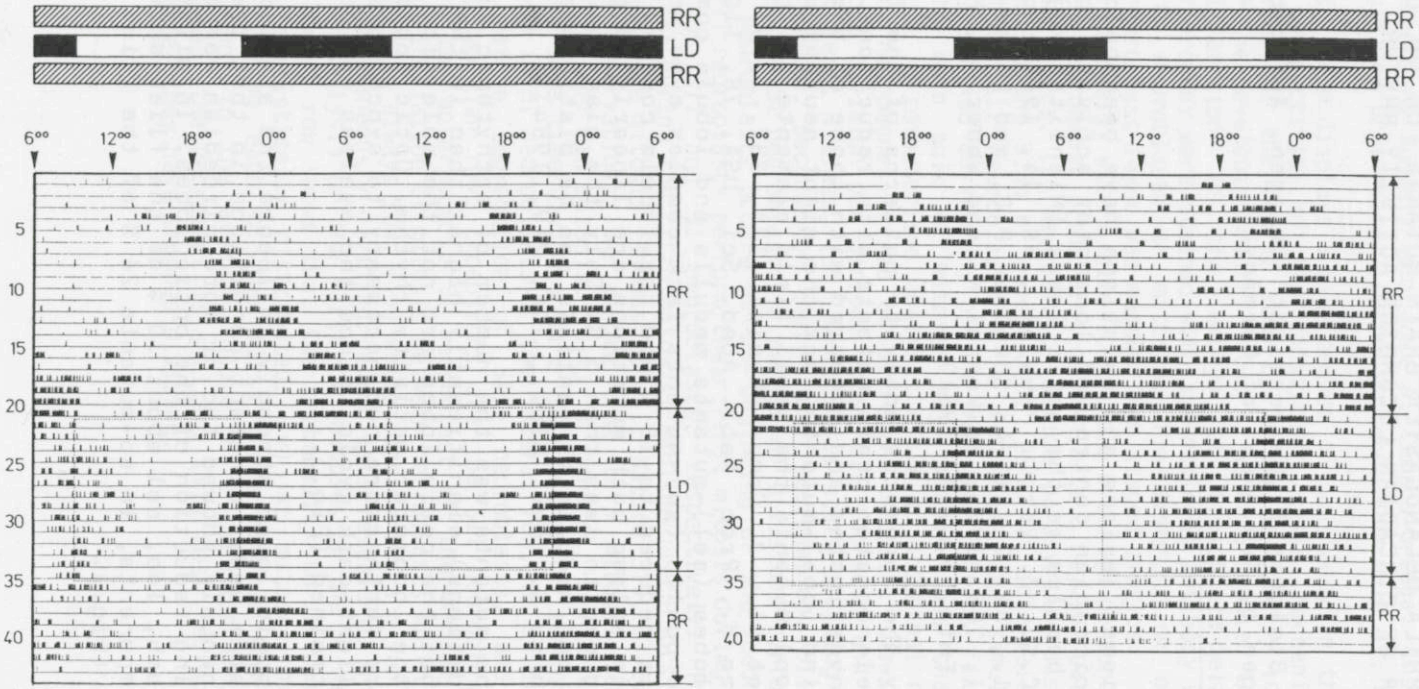
Transplantations, lesions and ablations have been helpful in tracing the site of circadian control of locomotor activity in cockroaches, crickets and beetles to the optic lobes (Nishiitsutsuji-Uwo J. and Pittendrigh C.S., Z. Vergl. Physiol., 58, 14, 1968; Roberts S.K., J. Comp. Physiol., 88, 21, 1974; Sokolove P.C. and Loher W.J., Insect Physiol., 121, 785, 1975; Balkenohl M. and Weber F., Mitt. dtsch. Ges. allg. angew. Ent., 3, 233, 1981).

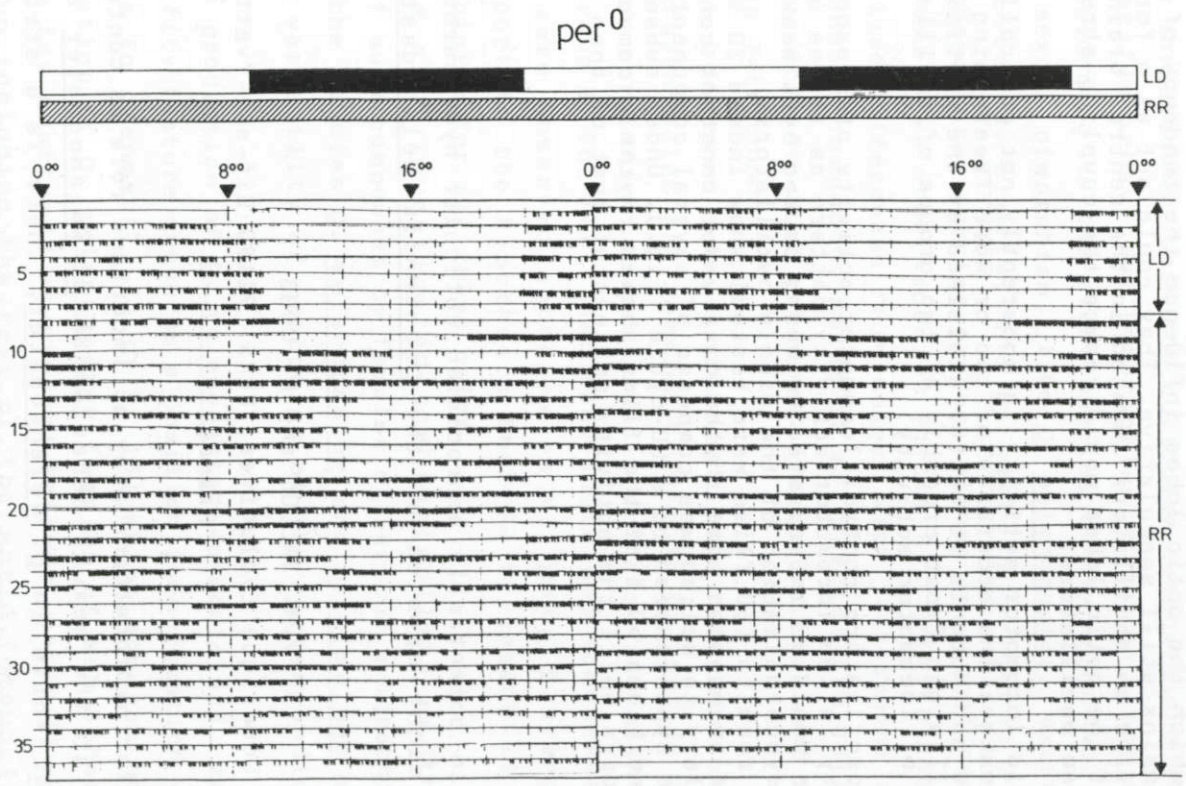
In this study the locomotor activity patterns of the following Drosophila melanogaster brain mutants with reductions in the optic lobes were investigated and compared with those of the wildtype: Optomotor blind (omb)-mutants lack the giant neurons and lobula plateless (lop)-mutants the small field elements of the lobula plate (Heisenberg et al., J. Comp. Physiol.,124, 287, 1978; Fischbach K.F. and Heisenberg M., Proc. Natl. Acad. Sci. USA, 78, 1105, 1981). In small optic lobes (sol)-mutants medulla and lobula complex are reduced to 50 %. Sine oculis (so)-mutants lack complex eyes and the lamina, the medulla is reduced to 18 % and the lobula complex to 40 %. In the double-mutants sol;so both mutations are linearly added; the optic lobes are reduced to less than 5 %. Only the giant neurons of the lobula plate and medulla tangentials can be distinguished (Fischbach K.F. and Technau G., Dev. Biol., 104, 219, 1984).

In none of the mutants was the number of arrhythmic flies (under constant conditions) significantly higher than in the wildtype, indicating that the optic lobes are not the sole site of a pacemaker controlling the locomotor activity rhythm. Optic lobes, complex eyes and ocelli are furthermore not necessary to synchronize the activity rhythm to a light-dark cycle, since the eyeless and ocelliless mutants are still entrained (Fig.).

However the optic lobes strongly influence the stability of the circadian system under constant conditions in that the number of flies that simultaneously showed two or more circadian components increased with increasing reduction of the optic lobes. In wildtype flies and in the mutants omb, lop, sol about 10 % of the flies showed two or more circadian components, in so-mutants 26 % of the flies and in sol;so-mutants 86 % (Fig.).

sol; so




per 0
LD
RR
0°°
8°°
16°°
0°°
8°°
16°°
0°°
LD
RR
5
10
15
20
25
30
35

The way in which the optic lobes influence the tendency of the rhythm to split remains still speculative. They could act as a form of coupling device on oscillators located in the central brain. A reduction of the optic lobes would reduce the coupling strength between these oscillators.

In Drosophila locomotor activity is apparently not controlled by a single pacemaker: The occurence of two or more freerunning components in wildtypes and mutants is better explained by the participation of several oscillators (most propably of two groups of oscillators) in the control of locomotor activity.

If several oscillators control locomotor activity of Drosophila, arrhythmicity in the locomotor activity pattern as it was observed in per^0-mutants could be interpreted as being caused by a weakening of the mutual synchronization of the single oscillators.
Preliminary results (60 flies were tested) show indeed 20 % of the per^0-mutants to possess some rhythmicity under constant conditions which, similary to sol;so was composed of several components. All per^0-mutants were synchronized to a LD-cycle (Fig.). Under subsequent constant conditions 50 % of the flies showed rhythmic components for at least 2 days until the activity pattern of most of them became arrhythmic.

Variations in potentially aphrodisiac cuticular hydrocarbons among the eight species of the Drosophila melanogaster subgroup.

J.M. JALLON and M. COBB
Biologie et Génétique Evolutives, CNRS, 91190 Gif-sur-Yvette
France

Cuticular hydrocarbons play an important role as contact pheromones in the sexual behavior of D. melanogaster and D. simulans. While in D. melanogaster, there is a strong qualitative sexual dimorphism among cuticular hydrocarbons, with dienes only in females, in D. simulans males and females show only quantitative differences and share 7-tricosene as a major cuticular component. 7,11 dienes are more efficient than 7 monoenes, with 27 ± 2 carbons, as aphrodisiacs for D. melanogaster males, while 7 tricosene stimulates the precopulatory behavior of D. simulans males.