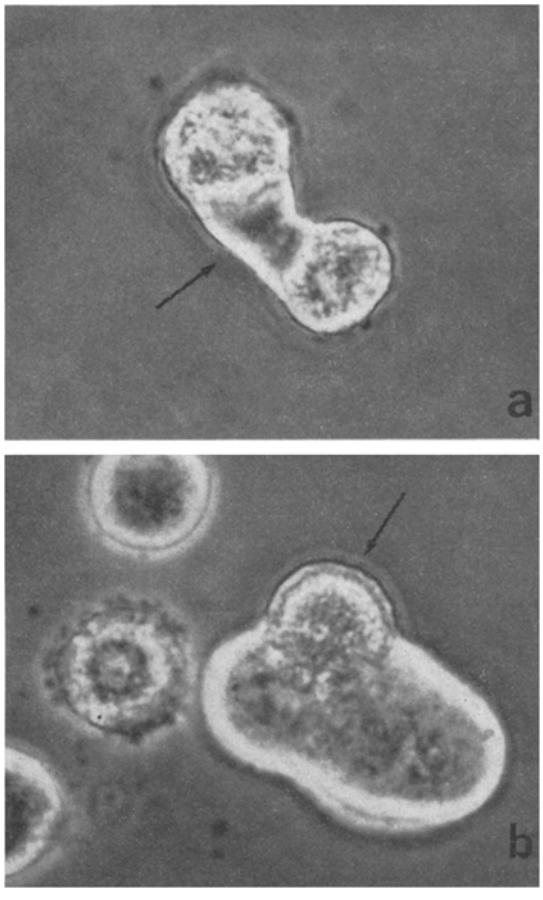

Fig. 3. Reactivity of ME cell to compound 48/80. a) Degranulation from a hybrid cell derived from 2 mast cells and 1 ETC (arrow). b) No degranulation from a hybrid cell formed from 1 mast cell (arrow) and 3 ETC. Degranulation from an adjacent mast cell was observed.

entirely absent in fused cells formed from 1 mast cell and 2 or more ETC. Disappearance of this degranulating activity was seen 10 min after incubation at 37 °C when fusion was still not completed.

These observations indicate that the reactivity of the mast cells to a histamine releaser changed according to the change in the membrane composition of mast cell. In the fusion of cells by virus, it has been reported that the membrane lipids of fusing cells undergo intermixing within 5 min[8], so it is considered that a membrane lipid bilayer of a new composition is formed in the ME cells. We have found the compound 48/80 binds specifically with acidic phospholipids[9], such as phosphatidylserine, phosphatidylinositol and phosphatidic acid; it was presumed that the binding site of this histamine releaser on the mast cell would be the acidic phospholipids in its membrane. It seems possible that the specific composition of the membrane lipids, including acidic phospholipids, in the mast cells is forming a receptor for compound 48/80. Based on this view, disappearance of the degranulating activity by the fusion of mast cells with ETC is probably due to the dissociation of the receptor of compound 48/80 by changes in the composition and distribution of membrane lipids in mast cells, although it is considered that loss of degranulating activity may also be attributed to mixing of cytoplasmic factors.

[1] I am grateful to Dr. K. Utsumi for valuable discussions and for the donation of HVJ.
[2] B. Uvnäs, Fedn Proc. *33*, 2172 (1974).
[3] D. Lugunoff, J. Cell Biol. *57*, 252 (1973).
[4] H. Harris, *Cell Fusion* (Clarendon Press, Oxford 1970).
[5] B. Ephrussi, *Hybridization of Somatic Cells* (Princeton Univ. Press, Princeton 1972).
[6] K. Sugiyama, Jap. J. Pharmac. *21*, 209 (1971).
[7] Y. Okada, Expl Cell Res. *26*, 98 (1962).
[8] T. Maeda, A. Asano, K. Ohki, Y. Okada and S. Ohnishi, Biochemistry *14*, 3736 (1975).
[9] K. Sugiyama and H. Yamasaki, Jap. J. Pharmac. suppl. *26*, 125 (1976).

The Circadian Rhythm of Oviposition in *Drosophila melanogaster:* A Genetic Latitudinal Cline in Wild Populations

R. Allemand and J. R. David[1]

Laboratoire d'Entomologie expérimentale et de Génétique (associé au C.N.R.S.), 43, boulevard du 11 novembre 1918, F-69621 Villeurbanne (France), 19 May 1976.

Summary. Under laboratory conditions with a photoperiod of 12 h at a light intensity of about 1100 lux, *Drosophila melanogaster* strains of different latitudinal origin showed significant differences in oviposition rhythm. These genetic differences follow a cline and may have an adaptative value.

Behavioural genetic variations are probably of great importance in evolutionary processes[2,3]. Such changes may be significant for the initiation of sexual isolation and also for the diversification into ecological niches.

In *Drosophila,* oviposition rhythm is a convenient trait for characterizing one behavioural aspect of species or populations[4]. Oviposition recordings can be easily made on an hourly basis and give highly reproducible results: the average curve, typical of a given strain, is reproduced almost exactly in successive and independent experiments[5].

Previous works[6,7] have demonstrated that *D. melanogaster* wild populations exhibit genetic latitudinal clines for certain biometrical traits (adult fresh weight and female ovariole number) and for a physiological trait, alcohol tolerance. Since behavioural differences are probably more directly linked to fitness, we decided to

[1] We thank F. Ayala, R. Grantham and D. Lewontin for help with the manuscript.
[2] Th. Dobzhansky, *Genetic of the Evolutionary Process* (Columbia University Press, New York 1970).
[3] P. A. Parsons, *Behavioral and Ecological Genetics* (Clarendon Press, Oxford 1973).
[4] R. Allemand, C. r. Acad. Sci., Paris *282*, 85 (1976).
[5] R. Allemand, Thèse de spécialité, Univ. Claude Bernard, Lyon (1975).
[6] J. David and C. Bocquet, Nature, Lond. *257*, 588 (1975).
[7] J. David and C. Bocquet, Experientia *31*, 164 (1975).

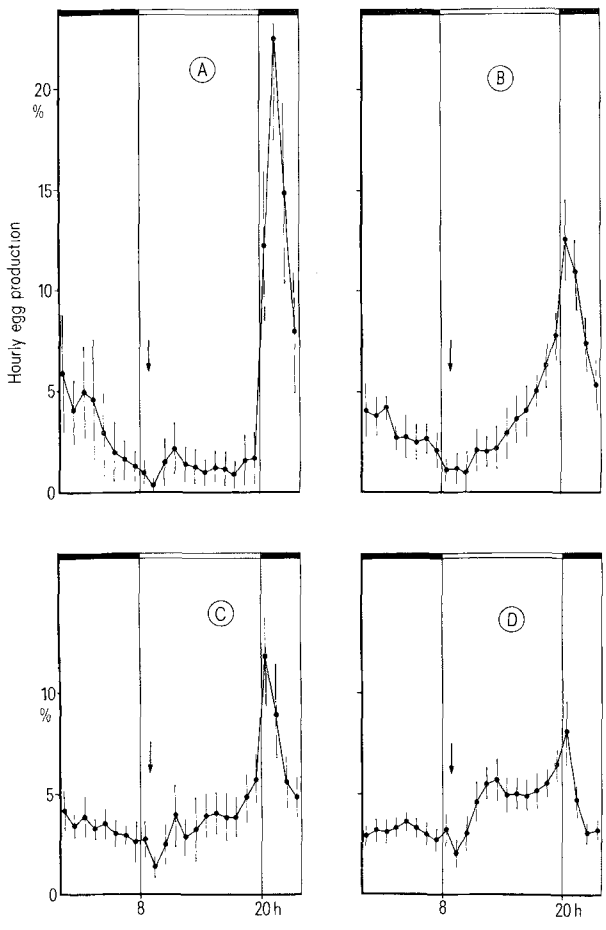

Fig. 1. Examples of oviposition curves of wild strains from different origins. Strains from A) Agboville (Ivory coast); B) Ouarzazate (Morocco); C) Sammeron (France); D) Helsinki (Finland).
Heavy and light horizontal bars indicate the photoperiodic cycle (LD 12:12). Hourly data are expressed in percent of the daily egg production; vertical lines around each point indicate the confidence intervals; arrows point to the time of changing the food medium (see ref. [5] for further information on methods). Each curve was established from several repetitions (A) 10; B) 13; C) 12; D) 25) and usually corresponds to a total oviposition of more than 3000 eggs.

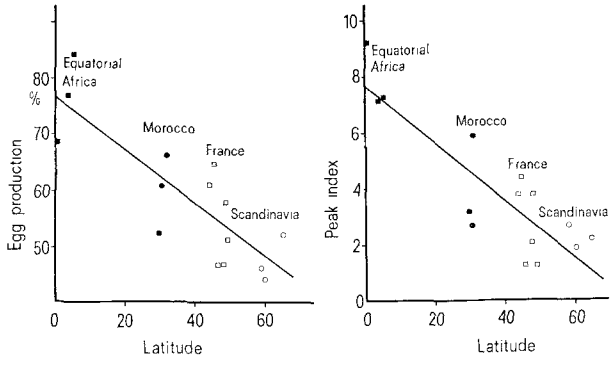

Fig. 2. Variations in oviposition rhythm with latitude of strain origin. A) percent of daily egg production during the 12 h of photophase; B) peak index, ratio of peak height to width. In both cases, a linear regression can be fitted to the observed points and the decrease with latitude is highly significant (A) $r = -0.82$, $p < 0.001$; B) $r = -0.86$, $p < 0.001$).

analyze the oviposition rhythm in 15 strains from Africa and Europe. Latitudes of origin of the strains ranged from 0° (Equator) to above 60° (Northern Europe). The longitudes were between 25° East and 10° West. For each strain, several repeated measurements (often more than 15) were made and an average curve was calculated. 4 examples of such curves are given in Figure 1.

Under the experimental conditions chosen (LD 12:12 cycle, light intensity about 1100 lux) egg laying is always at a low level during the photophase with a peak at the beginning of the scotophase. However, significant differences exist between the strains, with respect to the anticipation of the peak during the photophase and mainly the height of the peak. For an overall comparison of the 15 strains, two traits were chosen: the proportion of the eggs laid during the photophase and an index which characterizes peak size (ratio of height to width). Within each strain, these traits are correlated ($r = 0.85$) and, when plotted against the latitude of strain origin, they give similar results (Figure 2).

In both cases, a decrease with latitude is observed. 80% of the daily egg production in strains from equatorial countries is laid during the 12 h of darkness and the oviposition peak is about 8 times higher than it is wide. In strains from Scandinavia, females lay a little less than 50% of their eggs during darkness and the peak index is only about 2.

Since the experiments were made on strains reared under the same laboratory conditions, the differences described must have a genetic basis. In some cases, crosses were made between different strains and the curves for the F_1 offspring appeared intermediate between those of their parents. Usually, the measurements were made on strains recently collected from wild populations. Measurements were repeated in some strains after 1 or 2 years of laboratory rearing and these gave curves very similar to the initial ones. These observations suggest that several loci are involved in the genetic determinism of the rhythm. The apparent absence of genetic drift under laboratory conditions might be explained by a nearly homozygous state of the strains.

As emphasized in previous reports[6,7], regular latitudinal clines for a genetically based variation demonstrate the adaptative value of the trait and also may give an indication on the nature of the environmental factors which selected the wild populations. For example, an increase in size with latitude in *Drosophila* can be explained by a better tolerance to cold or to various environmental stresses[8,9]. An increase in alcohol tolerance can be interpreted as a modification of feeding habits[7]. The data presented here suggest that natural selection, which is probably responsible for any latitudinal cline, can modify a behavioural trait. Some preliminary experiments indicate that oviposition rhythm could depend on light intensity. For example, an equatorial strain laid more eggs during the photophase when the light intensity was lowered. The oviposition difference could thus be related to differences in light sensitivity. If such is the case, our results would have some similarities with variations in photopathic reaction previously described in *D. melanogaster*[10].

The latitudinal clines described in Figure 2 can be correlated with climatic conditions of the countries of origin. A significant correlation ($r = -0.70$, $p < 0.01$) was found with the amplitude of variations in day length in

[8] W. W. ANDERSON, Evolution *27*, 278 (1973).
[9] P. A. PARSONS, A. Rev. Genet. *7*, 239 (1974).
[10] J. MÉDIONI, C. r. Soc. Biol., Paris *152*, 1004 (1958).

summer. No significant correlations were found, however, either with the number of hours of sunshine during the year or with the light energy received at the earth surface. Of course, since temperature is strongly influenced by latitude, a positive correlation is also observed between the rhythm and the average annual temperature ($r = 0.75$) or the amplitude of thermal variations ($r = -0.84$). The adaptive significance of our data therefore cannot be ascertained with certitude. There is now increasing evidence that the whole *melanogaster* subgroup, and *D. melanogaster* itself, originated in tropical Africa[11]. We can therefore suppose that the rhythm tended to disappear as the geographic range extended northward. Flies establishing colonies in areas where the light conditions change considerably during the year became less sensitive to, or less dependent on, environmental light.

Much attention has recently been paid to the genetic polymorphism of wild populations and to the possible adaptive importance of oligogenic biochemical variants[12]. Some indications now exist that structural genes are not only the source of evolutionary changes, and that variations at the level of regulatory DNA should also be considered[13,14]. Polygenic traits, the genetic molecular basis of which remains unclear, could prove to be more interesting than previously believed.

[11] L. Tsacas and D. Lachaise, Ann. Univ. Abidjan, Série E, *7*, 193 (1974).
[12] R. C. Lewontin, *The Genetic Basis of Evolutionary Change* (Columbia University Press, New York 1974).
[13] M. C. King and A. C. Wilson, Science *188*, 107 (1975).
[14] G. B. Kolata, Science *189*, 446 (1975).

Gnawing Activity, Dietary Carbohydrate Deficiency and Oothecal Production in the American Cockroach (*Periplaneta americana*)

D. E. Bignell

Department of Biology, York University, 4700 Keele Street, Downsview (Ontario, Canada M3J 1P3), 20 April 1976.

Summary. The gnawing activity of adult female cockroaches was assessed by the dry weight loss of cotton fibre supplied to individual insects. In animals maintained on a carbohydrate-deficient diet the use of fibre was significantly less than in animals receiving a balanced diet. A comparison with controls showed that under both dietary regimes access to a fibre source did not significantly increase the mean total number of oothecae produced.

The gnawing of wood, cardboard, paper and other fibrous materials is a characteristic activity of cockroaches. Wharton, Wharton and Lola[1] have observed that in the American cockroach gnawing is restricted to adult females and is intensified when oothecal production begins following mating. Although no quantitative data was given, they also observed that when paper was gnawed some of the fibre was ingested and passed through the gut. The following explanations of gnawing activity can be offered: 1. The consumption of plant fibres may provide a supplementary energy source, since cellulase is present in the alimentary canal[1]. 2. Gnawing may supply debris with which the insect covers the deposited ootheca or cements it to the substratum[2]. 3. Gnawing creates crevices in the substratum in which the ootheca can be partly or completely hidden at deposition[3,4]. 4. Gnawing may have a physiological correlate, for example, the stimulation of secretions with which the cement is mixed[2].

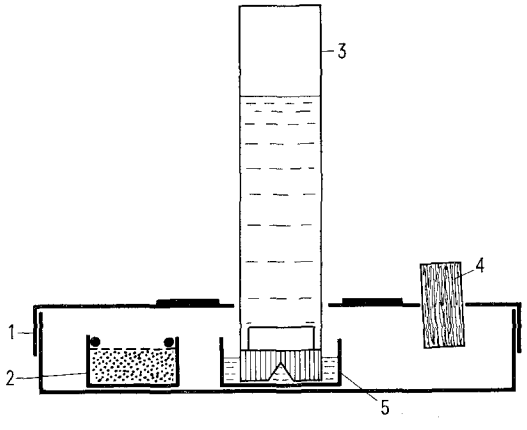

Fig. 1. Cockroach culture chamber for feeding studies. 1, Plastic petri-dish, 100 × 15 mm, with weighted lid; 2, diet planchet with 1/8 inch wire screen and retaining ring; 3, inverted water vial, with notched plastic cap; 4 cotton fibre; 5, hard plastic drinking trough.

The first two of these explanations can be tested if the use of fibre by the adult female is quantified. In the experiments described here isolated mated females were provided with a fibre source the displacement or uptake of which was followed by decrease of dry weight. Correlation was sought with feeding activity and the number of oothecae produced. Additional insects were maintained on a carbohydrate-deficient diet to test whether increased uptake of fibre would occur under these circumstances.

Methods. Adult females of *Periplaneta americana* were taken from stock cultures 2 months after adult emergence and placed individually in culture chambers containing a tared diet, a water trough and where appropriate approximately 0.3 g of cotton dental roll (Johnson and Johnson Ltd., No. 2). The design of the chamber is shown in Figure 1. Exhausted diet planchets were replaced and deposited oothecae removed during a daily inspection of the cultures which were maintained for 18 weeks at 25 °C. The photoperiod was 12L/12D.

Results. The dietary regimes and data on consumption and oothecal production are shown in the Table. In Group 1 insects were maintained on a diet of ground Purina brand dog food and provided with cotton fibre. An approximately linear correlation was obtained between the consumption of dog food and the total number of oothecae produced per insect (Figure 2A; $r = +0.88$). However, no linear correlation was obtained between

[1] D. R. A. Wharton, M. L. Wharton and J. E. Lola, J. Insect. Physiol. *11*, 947 (1965).
[2] P. Rau, Ann. ent. Soc. Am. *36*, 221 (1943).
[3] P. Rau, Trans. Acad. Sci. St. Louis. *25*, 57 (1924).
[4] M. A. H. Qadri, Bull. ent. Res. *29*, 263 (1938).