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.

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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].

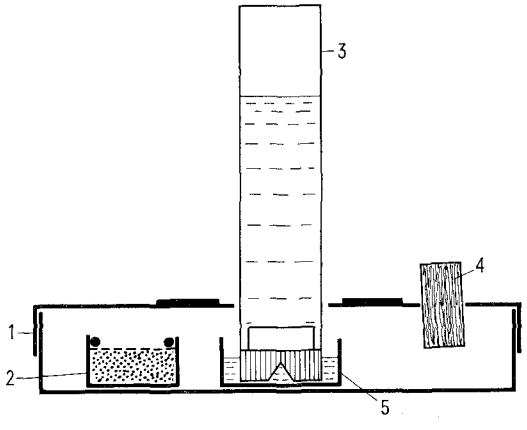

Fig. 1. Cockroach culture chamber for feeding studies. 1, Plastic petri-dish, 100 × 15 mm, with weighted lid; 2, diet planchet with 1/8 inch wire screen and retaining ring; 3, inverted water vial, with notched plastic cap; 4 cotton fibre; 5, hard plastic drinking trough.

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

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Diet consumption, weight loss of cotton fibre and oothecal production under 4 balanced or carbohydrate-deficient dietary regimes

Group[a]	Regime	Mean total diet consumed per insect (g ± SD)	Mean total weight loss of fibre per insect (mg ± SD)	Mean total number of oothecae per insect (± SD)
1	Dog food	2.7281 ± 0.6198		18.32 ± 8.75
	Cotton fibre		19.1 ± 13.1	
2	Dog food	2.6237 ± 0.1014	–	15.08 ± 5.55
3	Carbohydrate-deficient[b] diet	1.1828 ± 0.2306		6.16 ± 3.41
	Cotton fibre		9.5 ± 7.3	
4	Carbohydrate-deficient[b] diet	1.1618 ± 0.2313	–	9.30 ± 1.70

[a] 25 Insects per group.
[b] Compounded from casein protein (86% by weight), yeast extract (10%) and Hawk-Owser salt mixture (4%).

the dry weight loss of fibre and oothecal numbers (Figure 2B; $r = +0.003$). As a control Group 2 received the same diet, but no fibre. Comparing Groups 1 and 2, no significant differences in the means of total diet consumption or of total oothecal numbers per insect were found.

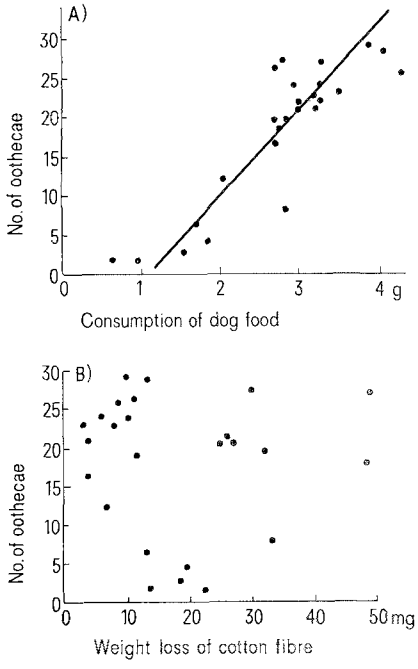

Fig. 2. Relationship between the number of oothecae produced during an 18-week period and A) consumption of dog food, B) dry weight loss of cotton fibre. Each dot represents the data from 1 insect.

Group 3 was maintained on a carbohydrate-deficient diet, with fibre provided. A control group again received the same diet, but no fibre (Group 4). No significant difference in the mean total consumption of the diet was found, but the experimental group produced fewer oothecae. Although this difference in mean oothecal numbers is relatively small, it is sufficient to be significant ($p < 0.01$). Both groups receiving carbohydrate-deficient diet produced significantly smaller mean total numbers of oothecae than the group maintained on dog food ($p < 0.01$). In addition the mean total dry weight loss of fibre was significantly less for insects maintained on the carbohydrate-deficient diet than for those provided with dog food ($p < 0.01$).

A number of deposited oothecae from each group were incubated in a moist container. Hatching was observed in each case.

Conclusions. The dry weight loss of fibre was greatest in groups receiving a balanced diet. Even in this case, however, the weight loss was less than 1% of the weight of diet consumed despite the fact that the dental roll became considerably roughened in appearance as a result of gnawing. Although it is not possible to distinguish by this gravimetric method between fibre displaced and fibre ingested, the provision of fibre did not increase the number of oothecae produced, irrespective of whether the diet was balanced or deficient in a carbohydrate source. The degradation of cellulose in the alimentary canal does not, therefore, appear to be of significance to reproductive performance in the female cockroach. The possibility remains that gnawing may provide the insect with materials for covering the deposited ootheca, but no clear evidence exists to support this thesis. The probable explanation of gnawing activity is that it prepares a suitable site for oothecal deposition, or is correlated with a physiological event not directly related to the nourishment of the fertile female.

Sex Attractant Responses of Male Oriental Fruit Moths to a Range of Component Ratios: Pheromone Polymorphism?[1]

R. T. CARDÉ[2], T. C. BAKER[2] and W. L. ROELOFS
Department of Entomology, New York State Agricultural Experiment Station, Geneva (New York 14456, USA), 7 May 1976.

Summary. Attraction of male *Grapholitha molesta* to different ratios of an attractant blend is not correlated with individuals or behavioural classes optimally responsive to different mixtures.

Intraspecies pheromone polymorphism has been documented in several insects. Certain halictine bees utilize individual specific odours both to distinguish nest mates (other females) from conspecific intruders and for male recognition of previously non-receptive females[3]. In *Drosophila melanogaster* genetic variation among the courtship pheromone bouquet is a requirement for stimulation of either sex[4,5], and this negative assortative mechanism appears to minimize inbreeding. In the pyralid moth *Ostrinia nubilalis* both geographical and intrapopulation differences in the attractiveness of *cis*-11- and *trans*-11-tetradecenyl acetate admixtures have been hypothesized to reflect genetic variation within a single species[6], and hence indicate the potential for rapid evolution of new