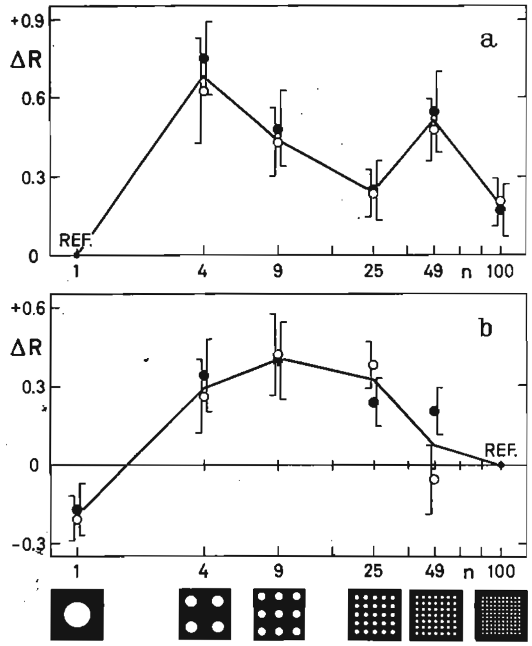
Götz, K.G. Max-Planck-Institut für biologische Kybernetik, Tübingen, Germany. Spontaneous preferences of visual objects in Drosophila.

Spontaneous preferences in a choice between two visual objects were established by the following experiments with Drosophila melanogaster. The test fly was allowed to walk for several hours on top of a ball, where it was maintained in stationary position and orientation to a 5x5 cm pattern on either side. The patterns were presented on a dark background in 10 cm distance to equivalent anterior regions of the left and the right eye. All patterns were equal with respect to the area and the luminance of the bright objects. The fly was mounted to a minute sledge, which prevented flight and monitored the translatory and rotatory displacements to a servo system. The servo system counteracted the displacements by appropriate rotations of the ball, which were then further evaluated.



The preferences ΔR in the two diagrams denote the revolutions per meter pathlength, which are made by the flies in the direction toward the n dots of the selected pattern if either 1 dot (a) or 100 dots (b) are used as the reference pattern. The means and the standard errors refer to experiments with 183 flies, which covered a distance of 7549 meters on top of the tread compensator. The following can be derived from the data:

1. The preference reaches a maximum at about n=4. The subsequent decrease correlates with the limited acuity of the visual system.
2. The spontaneous preferences are scarcely different during the initial (o) and the final (●) time period of the experiments.
3. The curves a and b coincide within the limits of error if allowence is made for the different origin of the ordinates. The third observation suggests that the additivity of the preferences is roughly accomplished in the present set of patterns. This is to say that the equation $\Delta R_{AB} + \Delta R_{BC} = \Delta R_{AC}$ holds for any three patterns A, B and C of the set. The underlying process of pattern discrimination appears to be simple, whenever the additivity of the preferences is established. Additivity cannot be expected if the spontaneous preference is a function of two or more independently variable parameters of the visual objects.

Chester, B. Flinders University, Adelaide, Australia. Factors affecting the expression of eyelessness (ey^2).

In selection experiments with eyeless Drosophila melanogaster (ey^2) the frequency of flies with one or both eyes absent declines with increasing age of culture, (Guthrie 1925; Morgan 1919; Spofford 1956; Chester 1969). Morgan (1929) proposed this effect was due to an alteration of the medium by the larvae.

Hunt and Burnet (1969) found deficiencies of thiamine to produce a significant increase in eye size in ey^2 flies. However, Sang and Burnet (1963, 1964) observed that shortages of folic acid and biotin produced significant reductions of eye size, and that eye size increased with increasing amounts of caesin and RNA (up to 0.1%) in the diet.

These results of Sang and Burnet appear contradictory to the selection experiment results where possible medium deficiencies with culture age produce increases in eye size. Therefore, the following experiments attempt to resolve this apparent contradiction of results.

For the first experiment, eggs were collected within two hours of being laid by $eyeless^2$ flies from stocks which had been subjected to selection for eyeless expression for twelve generations. The eggs were placed in three sets of tubes of yeasted medium - one set containing 300-350 eggs per tube, another set containing 100-120 eggs per tube, while the third set contained 18-25 eggs per tube. The first set of tubes should be grossly overworked and hence the medium depleted, while the larvae in the third set of tubes should be subjected to far smaller medium deficiencies - if any, at all. The results are shown in Table 1.

Table 1. Effect of larval density upon frequency of "eyes absent"

Density		Replicates	Total Flies	Percent eyes absent
Very high	(300-350 eggs/vial)	2	338	20.9
High	(100-120 eggs/vial)	5	396	30.9
Low	(18- 25 eggs/vial)	10	160	34.7

Heterogeneity $\chi^2_2 = 27.67 \quad p < 0.001$

"Very high c.f. "High" $\chi^2_2 = 19.11 \quad p < 0.001$

"High" c.v. "Low" $\chi^2_1 = 1.48 \quad p > 0.05$

$$\text{Percent eyes absent} = \frac{100 \text{ x number of eyes completely absent}}{2 \text{ x number of flies}}$$

(Individual χ^2 values calculated from 2 x 2 contingency tables)

The significantly lower percentage of eyes absent in the "very high" density table shows that a depletion of the medium does not increase the expressivity of eyeless^2.

In the second experiment eyeless^2 flies were reared on medium previously worked for 9 days by eyeless^2. The medium was carefully removed from the culture vials, separated into the upper worked-portion and the lower unworked-portion, and all larvae removed. The two portions were placed in different sets of tubes, and further eyeless^2 flies reared on them. The results were compared with eyeless^2 flies reared on normal medium as a control. The results are shown in Table 2.

Table 2. Percent eyes absent in eyeless^2 flies reared on medium removed from previously used culture vials and separated into "worked" and "unworked" portions.

Treatment	Total flies	percent eyes absent
"worked" medium (W)	184	30.2
"unworked" medium (U.W.)	225	24.9
Normal medium - control (C)	2136	25.5

Heterogeneity $\chi^2_2 = 5.8 \quad p > 0.05$

W. c.f. C $\chi^2_1 = 3.82 \quad p > 0.05$

U.W. c.f. C $\chi^2_1 = 0.084 \quad p > 0.05$

W. c.f. U.W. $\chi^2_1 = 2.67 \quad p > 0.05$

(Individual χ^2 values calculated by 2 x 2 contingency tables)

No significant difference of results is observed indicating that the working, and hence depleting of the medium by larvae, does not have any significant effect on the adult eye formation.

This lack of medium effect on the adult eye disagrees with the results of both Sang and Burnet (1963, 1964), and Hunt and Burnet (1969). However, Hunt and Burnet (1969) state that "the relevant environmental factors must be, to a great extent if not entirely, density dependent". From this, and the results of experiment 1 where the "high density" tubes gave a significantly lower percent of eyes-absent than the lower density tubes, it appears that possibly population size rather than medium effect is affecting the percent of eyes absent in adults. Whether this "crowding effect" operates through a rapidly lost volatile substance or by some mechanical effect is not known, but considerable evidence has been accumulated (Chester, 1969) to show that the effect does operate. Therefore, it is necessary to control rigorously the larval density when studying the expressivity and penetrance of eyeless.

References: Chester, B.M., 1969 Unpublished B.Sc. (Hons.) Thesis, Flinders University of South Australia; Guthrie, D.D., 1925 J. Expt. Zool. 42: 307-314; Hunt, D.M. and B. Burnet, 1969 Genetics Res. 13: 251; Morgan, T.H., 1929 Publ. Carneg. Inst. 399: 139-168; Spofford, J.B., 1956 Genetics 41: 938-959; Sang, J.H. and B. Burnet, 1963 Genetics 48: 1683; Sang, J.H. and B. Burnet, 1964 Heredity 19: 170.