Changes Observed in the FSH and LH Cells of the Adenohypophysis of *Presbytis entellus entellus* Following Cadmium Induced Testicular Necrosis[1]

A single injection of cadmium chloride in effective quantity causes severe damage to the scrotal testis. The changes that occur in the testis after cadmium administration are correlated with those noticed in the peripheral and central gonadotrophs of the adenohypophysis of the rat[2]. In the monkey *Macacus irus*, GIROD[3] observed cytoplasmic vacuolation of folliculotrophs (FSH cells) following s.c. injection of cadmium chloride. Detailed studies on the pituitary gland of the langur (*Presbytis e. entellus*) have shown 6 types of cells in the adenohypophysis whose functions are tentatively determined[4].

Fourteen sexually active male langurs were injected with cadmium chloride intratesticularly or subcutaneously at 1.0, 2.5, 5.0 and 10.0 mg/kg dose levels. The animals injected with higher dose (2.5, 5.0 and 10.0 mg) of cadmium were autopsied at an interval of 3, 33, 39 and 41 days, whereas the animals which received 1.0 mg/kg were autopsied at 126 days and 1 year of interval. The pituitary glands of these langurs were fixed in Helly's fluid for 24 h. Sagittal sections of the pituitary glands were cut 4 µm thick and were stained by Periodic Schiff's (PAS)-orange G-methyl blue technique of WILSON and EZRIN[5]. Pituitary glands of 2 untreated males served as controls.

In the langur, the FSH cells are large and oval in shape (Figure 1) measuring about 22 µm in diameter. Their granules, which are coarse, stain purple. These cells are concentrated in the zona tuberalis of the adenohypophysis. The LH cells are small, oval (Figure 3) and measure about 13 µm. Their fine granules stain magenta red. The LH cells are distributed throughout the adenohypophysis. Following cadmium administration, when the FSH cells initially undergo extensive cytoplasmic vacuolation (Figure 2), the LH cells exhibit increased granulation (Figure 4). At 1 year interval, after 1.0 mg/kg of cadmium injected intratesticularly, both these gonadotrophs exhibited recovery to normal condition. This cor-

[1] This work was supported by a grant from the Ford Foundation.
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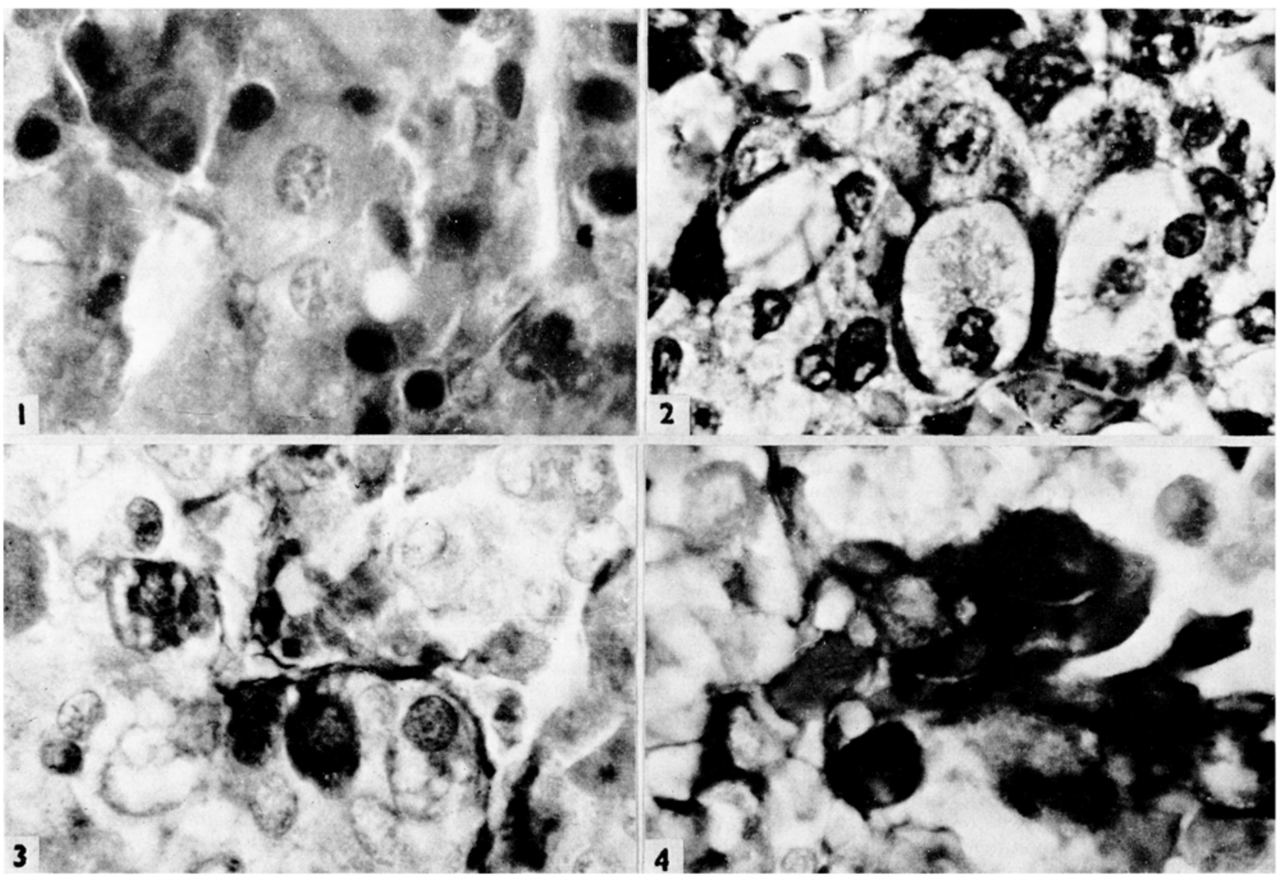

Fig. 1. Zona tuberalis of the adenohypophysis of an untreated male langur showing large oval FSH cell. ×1000.

Fig. 2. Following the administration of 10.0 mg/kg of cadmium, the FSH cells undergo cytoplasmic vacuolation. ×1000.

Fig. 3. Small oval LH cells of untreated male. Note the fine granules. ×1000.

Fig. 4. These cells exhibit intense granulation after cadmium treatment. ×1000.

related well with the restoration of both the germinal epithelium and interstitial tissue of the testes.

Following cadmium treatment in the rat, ALLANSON and DEANESLY[2] reported the reversion of central gonadotrophs responsible for LH secretion with the regeneration of the interstitium in the testes, whereas the peripheral gonadotrophs which secrete FSH retained castration features. In *Macaca irus*, GIROD[3] observed cytoplasmic vacuolation of FSH cells and hyperplasia of LTH cells. According to him, however, the LH cells did not show any significant change. Under hyperactivity, FSH and LH cells of the langur do not exhibit the characteristic hyalinization. However, like in *M. irus*[3], the FSH cells of the langur undergo cytoplasmic vacuolation initially following cadmium treatment.

Zusammenfassung. Da Kadmium schwere Schädigungen im Hoden hervorrufen kann, wurde die Adenohypophyse bei 14 männlichen *Presbytis entellus entellus* nach testikulärer Nekrose untersucht. Die verschiedenen Zellen der Adenohypophyse zeigen unterschiedliche Reaktionen, zum Teil mit Vakuolen und Granulationen. Nach Ablauf eines Jahres wird eine Erholung solcher Zellen beobachtet mit gleichzeitiger Regeneration des Hodenepithels und der Zwischenzellen.

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Competition Between Strains of *Drosophila willistoni* and *D. pseudoobscura*

An important component of the environment of a population is the presence of other species with which it may compete for the available resources of food and living space. Performance in competition may then be used as a measure of population fitness. We have studied experimentally the competition between 4 genetically different strains of *Drosophila willistoni* and one of *D. pseudoobscura*. 3 strains of *D. willistoni*, 'M18', 'M11' and 'RP3' were homozygous for wild second chromosomes obtained from natural populations. The fourth strain, 'POL', was established with the F_1 progenies of chain crosses among the previous 3 and 12 other strains, also homozygous for wild second chromosomes. The competition was studied at 3 temperatures, 20, 22 and 25 °C. The populations are maintained by the serial transfer technique[1]. The flies are counted once a week.

The results are summarized in Tables I and II. The outcome of the competition depends on both the genotype and the temperature. At 25 °C, *D. pseudoobscura* was eliminated by 3 strains of *D. willistoni*, but it eliminated the fourth. At 22 °C, *D. pseudoobscura* eliminated 2 homozygous strains, coexisted with a third, and was eliminated by the genetically polymorphic strain. At 20 °C the two species seem to be about even competitors. There is also an interaction between genotype and temperature. RP3 is the weakest competitor among all strains at 22 and 25 °C, but at 20 °C it is not significantly different from M11. The M18 and POL strains are approximately equal at 20 and 25 °C, but at 22 °C POL is the stronger competitor.

Table I. The outcome of the competition between *Drosophila willistoni* and *D. pseudoobscura* in the populations where one of the species was eliminated

Population	Species eliminated	Weeks to elimination
At 25 °C		
POL	*pseudoobscura*	18
M18	*pseudoobscura*	18
M11	*pseudoobscura*	43
RP3	*willistoni*	13
At 22 °C		
POL	*pseudoobscura*	54
M11	*willistoni*	41
RP3	*willistoni*	15

Table II. Mean number of flies in the populations where *Drosophila willistoni* and *D. pseudoobscura* coexist

Population	*D. pseudoobscura*	*D. willistoni*
At 20 °C		
POL	236 ± 19	737 ± 66
M18	152 ± 15	720 ± 55
M11	365 ± 27	453 ± 42
RP3	353 ± 23	449 ± 48
At 22 °C		
M18	112 ± 9	630 ± 41

The means are calculated from week 6–55. Number of counts = 48.

After 55 weeks, or some 20 generations, the two species coexist at 20 °C, their numbers oscillating around average values which depend on the genetic composition of the competing strains. The principle of competitive exclusion, or Gause's principle, is sometimes formulated: two species cannot coexist if they compete for the same limiting resources. Or, in more precise terms: two species cannot coexist if they inhibit the growth of the other species more than they inhibit their own growth. In the experimental populations, *D. pseudoobscura* and *D. willistoni* compete for the same limiting resources. The strains M11 and RP3 of *D. willistoni* and the *D. pseudoobscura* strain were studied in single-species cultures at 20 °C maintained in the same way as the two-species cultures. After an equilibrium was reached, the mean number of flies in the single-species populations was above 1200 for each of the *D. willistoni* strains and above 800 for *D. pseudoobscura*. These mean numbers are more than twice as large as the mean numbers in the two-species populations of these strains. The 2 species indeed inhibit each other's growth more than their own. These results confirm those obtained in the competition between *D. serrata* and *D. pseudoobscura*[2] and warrant the rejection of the principle of competitive exclusion[3].

Resumen. El resultado de la competencia entre *Drosophila willistoni* y *D. pseudoobscura* depende de la constitución genética de las estirpes que compiten y de la temperatura. A 20 °C las dos especies coexisten, lo cual indica que el principio de exclusión competitiva no es universalmente válido.

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