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**ARTIFICIAL SELECTION FOR
WEIGHT AND ITS CONSEQUENCES
IN *TENEBRIO MOLITOR* L.**

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Artificial Selection for Weight and its Consequences in *Tenebrio molitor* L.

BEGINNING in 1946 a population of *Tenebrio molitor* (Coleoptera, Tenebrionidae) was reared continuously in standard optimal or sub-optimal conditions of food, temperature and humidity, avoiding as much as possible interferences of cannibalism and overpopulation. At the same time, artificial selection in favour of small and big pupal weights was undertaken and resulted in splitting the initial population into two strains, one labelled *F* (small weights), the other labelled *G* (big weights). The first eight years were mainly devoted to this work of selection, consisting in the removal of all *F*-pupæ weighing more than 160 mg, then more than 130 mg, and of all *G*-pupæ weighing less than 160 mg. From 1952 on, after about 12 consecutive generations of both strains, both appeared definitely homogeneous and no further selection was needed save in quite exceptional instances¹. It had also become obvious that by selecting for weights one had also selected automatically in favour of shorter or longer durations of larval development. Further attempts to split the two strains in order to obtain dwarf strains failed². Thus time had come to find out whether the two strains differed also in other respects. They do so indeed, to an extent that it is now possible to formulate a true physiological diagnosis involving quite a number of unexpected characters.

Compared with *G*, the *F*-strain differs as follows:

It produces advanced larvæ, pupæ and adults of bigger size and heavier weight. Its larvæ reach the pupal stage more rapidly (3 generations per annum being possible instead of 2). Its pre-pupal period (larval age with lower growth rate and reduced nutritional requirements³) is shorter and less variable⁴. Such differences in the developmental rate are correlated with discrepancies in the growth of the phosphorus content⁵. Very young *F*-larvæ are more affected by cold⁶. *F*-larvæ are more favoured when the food supplied is more truly optimal either by addition of yeast or when each larva is reared individually with superabundant flour^{2,4}. Nevertheless, the same larvæ are less affected when fed with cereal flours of poor quality⁴ or with artificial diets, especially with carnitine deficient mixtures^{7,8}. On the other hand, they may well need more potassium⁸. Adults of the *F*-strain are much less prolific and lay proportionally fewer fertile eggs⁹. But the same adults are less affected in their fecundity if their larvæ suffered from malnutrition¹⁰, and

they respond more positively when allowed to drink water⁸.

Clearly, several of the revealed characters are correlated and controlled by the same genetic features. Nothing is known of the genetics of the two strains and no cross-breeding was tried. Nevertheless, one cannot imagine that such a complex of statistical differences compatible with a still great individual variability should be controlled by a single allele genes system. Thus, we must conclude that, by selecting for weight only, one has induced a process of complex differentiation involving a number of biochemical characters. It must be emphasized that no morphological or structural difference was detected.

Surprisingly the recorded differences are by no means devoid of adaptative and evolutionary significance. Already in standard incubator conditions a small initial population of the *F*-strain will take advantage of its faster developmental rate to produce a second generation, then a third one . . . each being more numerous than the previous one. It will be so not only because adults will appear more rapidly but also because they will appear within a shorter period (± 7 weeks), the chances of mating being greater. On the other hand, a small initial population of the *G*-strain will encounter difficulties in producing further increasing populations owing to its longer larval life and to the fact that its adults will hatch within a much more extensive period (more than 12 weeks), the chances of mating being reduced. But this weakness will be compensated by the much greater fecundity (3 or even 5 times greater). In Nature and in warehouses, the factor 'chances of mating' is likely to have a still more selective value because the adults wander far when they have hatched, also because the life-cycle of the species is not phased genotypically with seasons. Here again speed of growth versus fecundity provides compensatory characters. Perhaps also the *G*-strain will suffer from its lower resistance to adverse nutritional conditions, but it seems that this could eventually be compensated by a better resistance to cold.

We have no grounds for supposing any occurrence of mutations during our continuous breedings of both strains, nor for postulating that some kind of genes recombination, entirely independent from weight, was submitted to selection in carefully kept populations. Yet artificial selection should not produce by itself anything other than the segregation of characters existing in the initial population. So to account for the fact that selection for weights brought about strains fitted to various ecological hazards we must assume that genes controlling growth, size, resistance and fecundity were already submitted to natural selection and more or less linked together in the earlier history of the initial population. The latter was certainly not exceptional on account of its variability: other populations examined by previous authors¹ exhibited

a similar heterogeneity of the same characters. It seems therefore that most natural populations of *Tenebrio molitor* carry similar incipient strains with different ecological values. These are maintained through the life of the species not only because of continuous inbreeding but also mainly because changing ecology keeps them in co-existence in continuously changing proportions.

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- ¹ Leclercq, J., *Physiol. Compar. et Oecol.*, **2**, 161 (1950); **4**, 89 (1955).
- ² Leclercq, J., *Bull. Soc. Roy. Sci. Liège*, **24**, 52, 60 (1955).
- ³ Huot, L., and Leclercq, J., *Arch. Intern. Physiol. Biochem.*, **66**, 270 (1958).
- ⁴ Leclercq, J., *Bull. Soc. Roy. Sci. Liège*, **25**, 296, 317 (1956).
- ⁵ Huot, L., Leclercq, J., and Florin, M., *Arch. Intern. Physiol. Biochem.* **67**, 461 (1959).
- ⁶ Leclercq, J., *Bull. Soc. Roy. Sci. Liège*, **25**, 336 (1956).
- ⁷ Fraenkel, G., and Leclercq, J., *Arch. Intern. Physiol. Biochem.*, **64**, 601 (1956).
- ⁸ Leclercq, J., *Arch. Intern. Physiol. Biochem.*, **68**, 500 (1960).
- ⁹ Moreau, C., and Leclercq, J., *Bull. Soc. Roy. Sci. Liège*, **32**, 157 (1963).
- ¹⁰ Collinet, C., *Bull. Soc. Roy. Sci. Liège*, **26**, 381 (1957).