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[1] Marston, H. R., *J. Coun. Sci. Ind. Res.*, **8**, 111 (1935).
[2] Rothery, P., Bell, J. M., and Spinks, J. W. T., *J. Nutrition*, **49**, 173 (1953).
[3] Comar, C. L., and Davis, G. K., *J. Biol. Chem.*, **170**, 379 (1947).

Corpus allatum and Egg Production in Starved Milkweed Bugs

IN many insects, egg production requires special nutrition[1]. It has also been found, in most insects investigated, that the corpora allata are necessary for the normal function of the ovaries[2]. In the milkweed bug (*Oncopeltus fasciatus* (Dallas), Heteroptera, Lygaeidae), the ovaries of the female at the beginning of the adult stage are only slightly developed (Fig. 1*a*). When the female is kept in an incubator at 25° C. and fed on milkweed seeds and water, the ovaries may, after fifteen days, reach the size shown in Fig. 1*b*. Of fifteen females kept as described, nine had, at the age of fifteen days, already started oviposition, two more contained ripe eggs, while in four specimens the ovaries had only grown slightly. If the females are given only water and no seeds, they may survive for quite a long time, but no eggs are produced. After fifteen days, the size of the ovaries usually (ten specimens) is as shown in Fig. 1*c*, and only a slight growth has taken place.

At the same time, changes are observed in the incretory system. In the emerging female the corpus allatum is small (Fig. 1*a*, *ca*), but increases, as already shown by Novák[3], if she is fed. In the present material it increased to about twelve times the initial volume in fifteen days (Fig. 1*b*). In females given only water, the corpus allatum had, after fifteen days, increased only about 2·5 times (Fig. 1*c*). If the corpus allatum is transplanted from normally fed females in the oviposition period to females fed only on water, the latter will start egg production despite the lack of food. Of fourteen unfed females which thus received corpus allatum from fed females, eleven contained at later examination ripe eggs, two more showed a considerable growth of the ovaries, while only one specimen showed no reaction. Mostly two corpora allata were transplanted to each female, namely, at the age of five and ten days, and the specimen examined at the age of fifteen days; but when the transplantation was done only once, ripe eggs were still obtained. Fig. 1*d* shows the ovary of a fifteen-day old starved female which ten days earlier received the corpus allatum from a fed female. In most cases the corpus allatum was transplanted together with the corpora cardiaca and a fraction of the aorta. However, transplantation of only the posterior half of the corpus allatum with no traces of corpora cardiaca also resulted in egg development. When the females were kept alive for a sufficiently long period, they deposited eggs of normal size and shape. When the females were mated with normal males, the fertilized eggs developed to normal larvæ. In seven specimens muscles were transplanted as controls, but no changes in the ovaries were observed.

In the bug *Rhodnius*, also, fasting influenced both the corpus allatum and egg production[4], whereas in *Tribolium* and *Chrysopha* starvation prevented the normal development of the ovaries but not the growth of the corpora allata[5]. The two results of normal food supply, namely, growth of the corpus allatum and egg production, may in the milkweed bug be explained by presuming a primary influence on the corpus allatum, which then starts to function and secondarily induces egg development.

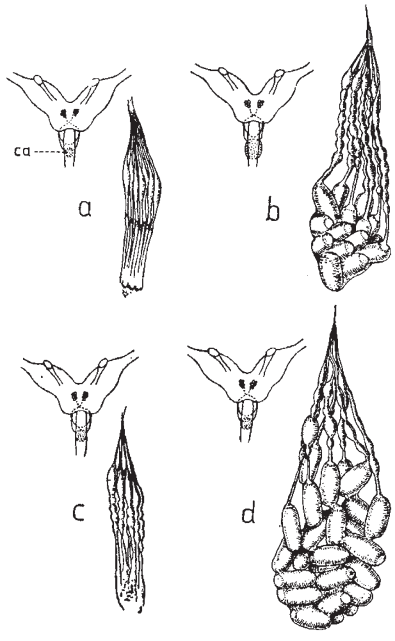

Fig. 1. The brain with the corpus allatum (*ca*) and the right ovary and lateral oviduct of females: (*a*) at the beginning of the adult stage; (*b*) 15 days old, fed; (*c*) 15 days old, starved; (*d*) starved, with corpus allatum transplanted from fed females

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[1] Trager, W., in Roeder, K. D., "Insect Physiology" (New York, 1953).
[2] Bounhiol, J. J., Trans. IX Int. Cong. Ent., 1951, **2**, 63 (1953).
[3] Novák, V. J. A., *Věstník Csl. zool. spol.*, **15**, 1 (1951).
[4] Wigglesworth, V. B., *Quart. J. Micro. Sci.*, **79**, 91 (1936).
[5] Palm, N.-B., *Kungl. Sv. Vet. Akad.*, Handl., (4), 1 (6) (1949).

Direct Observation of Hapten–Antibody Equilibria

IF the bivalency of antibodies, for which there is now considerable evidence, is accepted, it is to be expected that the addition of bivalent hapten to solutions of purified homologous antibody would bring about a linear association of alternating antibody and hapten molecules. The equilibrium extent of this association should be dictated solely by the value of the free energy of formation (ΔF^0) of a hapten–antibody bond and the concentration of the two reacting species. Hence a determination of the extent of association would provide the value of ΔF^0, and if this were done as a function of temperature the values of the entropy (ΔS^0) and the heat (ΔH^0) of bond formation would be available as well.