A Possible Endocrine Mechanism for Inducing Diapause in the Eggs of *Adelphocoris lineolatus* (Goeze) (Hemiptera: Miridae)[1]

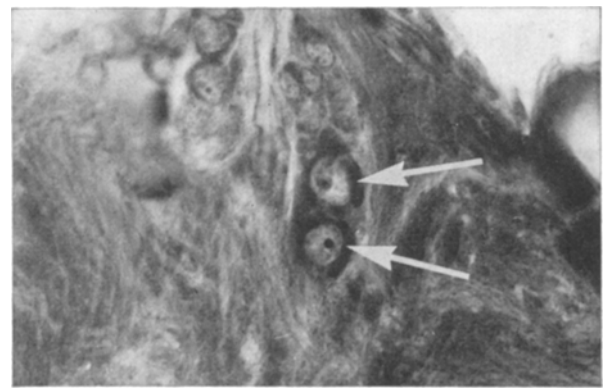
Adelphocoris lineolatus (Goeze) is a bivoltine insect in southern Minnesota but has only one complete generation per year in the northern agricultural areas of Saskatchewan[2]. The photoperiod experienced by the adult females seems to influence the induction of diapause in the egg stage of the Saskatchewan population but does not appear to have the same influence on the life cycle of the Minnesota insects. When Saskatchewan adults are maintained at 20 °C and 70% relative humidity and under a photoperiod of 16 h photophase/8 h scotophase, all eggs enter diapause; with the adults under a 14 h photophase/10 h scotophase, about 15% of the eggs hatch within 40 days after laying; with the adults under a 12 h photophase/12 h scotophase, about 25% of the eggs hatch within 40 days. Further reduction in the length of the photophase/scotophase ratio seems to have no effect and photoperiod has no effect during the nymphal instars. However, the photoperiod does not have these effects on the Minnesota population. Almost all of the eggs from first generation adults hatch within 40 days after laying and over 90% of the eggs of the second generation enter diapause, irrespective of the photoperiod under which the adults are maintained.

Whether diapause be facultative or obligatory, endocrine systems have been shown to exercise control over its induction, maintenance, or termination in many insects[3]. In an attempt to determine whether there is any neuro-endocrine involvement in the induction of diapause in *Adelphocoris*, the neuro-endocrine structures of the adult females were examined histologically. About 75 specimens from each of the Minnesota generations and about 150 Saskatchewan specimens were examined, with about equal numbers selected from adults reared under the three photoperiods. Specimens were fixed in aqueous Bouin's or Helly's fluid, embedded in paraffin, sectioned at 4–6 μ, and stained with chrome alum-hematoxylin-phloxin[4] or aldehyde fuchsin[5]. No differences in neuro-endocrine activity attributable to the photoperiod itself were noted, but marked differences between the diapause-producing and non-diapause-producing females were noted in the 10 type B cells[6] of the thoraco-abdominal ganglionic centre.

In the Minnesota females that produce diapause eggs and in all the Saskatchewan specimens examined, these neurosecretory cells undergo a period of pronounced activity, beginning on the 5th or 6th day after emergence and continuing throughout the pre-oviposition period. The B cells appear to vary in outline according to the plane in which they are cut, but most are pear-shaped with the axon leaving from the attenuated part. The nuclei are round and contain one nucleolus. The cytoplasm is acidophilic, staining reddish with the Gomori technique and greenish or greenish-blue with aldehyde fuchsin. During the period of activity, the cells and their nuclei enlarge markedly and stainable granular material can be seen in the cytoplasm of the cells (Figure) and along their axons where it is distributed peripherally. The axons from each cell body extend for a short distance toward the neuropile of the ganglion, but their ultimate destination is unknown. In the Minnesota females that produce non-diapause eggs, these neurosecretory B cells are barely visible, do not exhibit an increase in volume or in nuclear size, or show any other characteristics of a cyclical activity throughout the pre-oviposition period. No marked differences in the B cells of the suboesophageal-prothoracic ganglion or the brain, in the basophilic A cells of the brain, or in the corpus allatum or corpora paracardiaca were noted between the diapause-producing and non-diapause-producing females of this insect.

These observations suggest that the neurosecretory cells of the thoraco-abdominal ganglion in the adult female of *Adelphocoris* produce a substance that induces diapause in the eggs. It seems significant that the production and release of the B cell substance occurs at a time when the developing eggs are beginning their most active period of growth.

In *Bombyx mori* it has been demonstrated that the suboesophageal ganglion of the female produces a diapause-inducing hormone that determines whether or not the eggs will enter diapause[7–9]. Normally the egg batch is all of one type, diapause or non-diapause, but mixed batches do occur. These mixed batches may be due to differential absorption of a limited supply of the diapause hormone[7]. The histological evidence presented here indicates that a similar mechanism may operate in *Adelphocoris*, although a different group of neurosecretory cells is involved.



Two type B neurosecretory cells (arrows) in the thoraco-abdominal ganglionic centre of a 10-day-old, diapause-producing adult female *Adelphocoris lineolatus*. Bouin; chrome alum-hematoxylin-phloxin; approximately × 520.

Résumé. Adelphocoris lineolatus (Goeze) est un Insecte bivoltin en Minnesota, mais qui n'a qu'une seule génération annuelle en Saskatchewan. L'induction de la diapause dans l'œuf semble être influencée en partie par la photopériode à laquelle est soumise la femelle. Dans le cas des femelles adultes destinées à pondre les œufs diapauses, les cellules neurosécrétoires du type B du ganglion thoraco-abdominal, pendant les derniers deux tiers de la période précédant la ponte, produisent et déchargent un colloïde neurosécrétoire. Quant à la première génération de la population de Minnesota qui produit les œufs non-diapauses, ces cellules ne montrent aucun caractère d'activité sécrétoire.

A. B. Ewen

Research Station, Canada Agriculture, Saskatoon (Saskatchewan, Canada), February 3, 1966.

[1] Contribution No. 242, Research Station, Canada Agriculture, Saskatoon, Saskatchewan.

[2] C. H. Craig, Can. Ent. *95*, 6 (1963).
[3] A. D. Lees, *The Physiology of Diapause in Arthropods* (Cambridge University Press, 1955), p. 151.
[4] G. Gomori, Am. J. Path. *17*, 395 (1941).
[5] A. B. Ewen, Trans. Am. microsc. Soc. *81*, 94 (1962).
[6] A. B. Ewen, J. Morph. *111*, 255 (1962).
[7] S. Fukuda, Gen. comp. Endocrin., Suppl. *1*, 337 (1962).
[8] K. Hasegawa, J. Fac. Agric. Tottori Univ. *1*, 2 (1952).
[9] K. Hasegawa, J. exp. Biol. *40*, 517 (1963).