LETTERS TO THE EDITORS

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The Corpus Allatum and the Control of Metamorphosis in Insects

MOULTING in *Rhodnius* is initiated by a hormone secreted in the dorsum of the brain, and the premature metamorphosis of the young stages is prevented by a second hormone, the juvenile hormone secreted by the corpus allatum¹⁻³. This conception of growth regulation in insects has proved applicable to Orthoptera⁴⁻⁷, Lepidoptera⁸⁻¹⁰ and Coleoptera¹¹. In the Diptera, on the other hand, the composite 'ring gland' appears actively to induce metamorphosis, as though it were secreting a metamorphosis-promoting hormone¹².

There is, however, some evidence that the central part of the ring gland, the part representing the corpus allatum, restrains the differentiation of the imaginal disks in the early stages in *Drosophila*¹³, and recently Vogt¹⁴ has found that the corpus allatum of the adult *Drosophila* implanted into the larva will cause a local suppression of adult characters.

This last observation implies that the corpus allatum of the adult insect is once more secreting the juvenile hormone. In the grasshopper *Melanoplus*, Pfeiffer⁶ has shown that such is the case; and she has even suggested that the yolk-forming hormone of the adult insect may prove to be identical with the juvenile hormone of the young stages.

I have recently found that this is so, apparently, in *Rhodnius*. The corpus allatum of the adult *Rhodnius*, implanted into a 5th stage nymph, causes it to develop into a giant 6th stage nymph; and the secretion from the corpus allatum of the 4th stage nymph will induce egg production in the decapitated adult female.

I have found also that there is a second factor in metamorphosis. The corpus allatum of the moulting 5th stage nymph in *Rhodnius* not only ceases to secrete the juvenile hormone, but also it actively removes from the blood any traces of the juvenile hormone that remain. The decapitated 4th stage nymph exposed to the moulting hormone from the 5th stage nymph undergoes a precocious metamorphosis; but the adult characters are differentiated more completely if the 5th stage nymph retains its corpus allatum. The corpus allatum of the 5th stage

nymph in the late stages of moulting or of the newly moulted adult, implanted into intact 3rd or 4th stage nymphs, reduces the activity of the juvenile hormone so that when they reach the 5th stage some of them show a partial metamorphosis (Figs. 1 and 2).

This effect is always diffused throughout the body; it is never localized in the region of the implant, as the effect of the juvenile hormone often is. It is unlikely, therefore, that it is due to the secretion of an imaginal or metamorphosis hormone.

I suggest that it may be the active elimination of juvenile hormone in the Diptera which creates the impression of a 'metamorphosis-promoting hormone'. If it be supposed that these two factors, the cessation of secretion of the juvenile hormone and the active elimination of this hormone, differ in their relative importance in different insects, we may perhaps have the basis for a theory of metamorphosis which will be applicable to all groups of insects.

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¹ Wigglesworth, V. B., *Quart. J. Mic. Sci.*, **76**, 191 (1934).

² Wigglesworth, V. B., *Quart. J. Mic. Sci.*, **79**, 91 (1936).

³ Wigglesworth, V. B., *J. Exp. Biol.*, **17**, 201 (1940).

⁴ Pfugfelder, O., *Z. wiss. Zool.*, **149**, 477 (1937).

⁵ Pfugfelder, O., *Z. wiss. Zool.*, **152**, 384 (1939).

⁶ Pfeiffer, I. W., *Trans. Conn. Acad. Arts and Sci.*, **36**, 489 (1945).

⁷ Scharrer, B., *Endocrin.*, **38**, 35 (1946).

⁸ Bounhiol, J., *Bull. Biol.*, Suppl. **24**, 1 (1938).

⁹ Piepho, H., *Biol. Zbl.*, **60**, 367 (1940).

¹⁰ Piepho, H., *Arch. Entw. Mech.*, **141**, 500 (1942).

¹¹ Radtke, A., *Naturwiss.*, **30** (1942).

¹² Hadorn, E., *Rev. Suisse Zool.*, **48**, 495 (1941).

¹³ Vogt, M., *Biol. Zbl.*, **63**, 395 (1943).

¹⁴ Vogt, M., *Nature*, **157**, 512 (1946).

Evolutionary Significance of Periodicity of Variation-Intensity and Population-Flux in the Desert Locust

THE periodic mass-increase in the population of the desert locust, *Schistocerca gregaria* (Forskål), which ranges from Africa to India, is a phenomenon known since Biblical times. The compilation of historical records of the last century and a half has established an average 11-year cycle of mass-increase, although the individual periods are far less regular. Following Uvarov's work^{1,2}, the existence of two phases, namely, the swarming or *gregaria* phase and the non-swarming or *solitaria* phase, has also been established. These phases differ morphologically and in other ways, are connected by a graded series of intermediates, and are evidently of no genetical significance; they can be produced at will by the simple process of crowding and thinning.

The last cycle of increase lasted from about 1926 until 1931, followed by a *solitaria* period of several years. We are now in the middle of another cycle which started in 1940. As a result of considerable work in various countries during the last fifteen years, we now possess a fairly comprehensive knowledge of the migrations and population-flux of this species. Briefly, the species in *solitaria*-years is confined to certain desert tracts extending from West Africa via the Red Sea coast to the Persian coast and Western India, including Rajputana; the population is low, usually not exceeding about 1,000 per sq. mile, and often much less. In *gregaria*-years the population increases enormously (considerably more than 10,000 per sq. mile) and the range also increases, the species spreading to Southern Europe (extending even to

Fig. 1

Fig. 2

Fig. 1. NORMAL 5TH STAGE NYMPH

Fig. 2. 5TH STAGE NYMPH FOLLOWING IMPLANTATION OF CORPUS ALLATUM OF YOUNG ADULT INTO THE 3RD STAGE, SHOWING PARTIAL METAMORPHOSIS