examine this question. PAINTER, DREW, and HILL[5], TAYLOR[6] and WIMBER[7] all present data which indicate that endogenous radiation can cause damage to the chromosomes. This brief report indicates the possible intrachromosomal damage that may follow the incorporation of radioactive compound into the chromosomes.

Larger scale experiments in which precise quantities of T–$H^3$ are injected into larvae will be carried out to examine more critically the mutagenic properties of the tritium atom after its incorporation into the chromosomes.

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*Zusammenfassung*

Die Aufnahme von $H^3$-Thymidin in 16 h alte männliche Larven von *Drosophila melanogaster* wurde autoradiographisch verfolgt und die mutagene Wirkung des einverleibten $H^3$-Thymidin durch die Bestimmung der Häufigkeit der geschlechtsgebundenen rezessiven Mutationen gemessen. Es zeigte sich, dass das der männlichen Larve der *Drosophila melanogaster* verabreichte $H^3$-Thymidin eine bedeutende Häufigkeit der Mutationen verursacht.

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[6] J. H. TAYLOR, Genetics *43*, 515 (1958).
[7] D. W. WIMBER, Proc. Nat. Acad. Sci., Wash. *45*, 839 (1959).

## Hormonal Control of Mating Behavior in an Insect[1]

Mating behavior in insects was not demonstrated until very recently to be influenced by endocrine glands. At one time it was thought that the activity of the gonads might be involved in this behavior, but it was shown that, for example, in *Lymantria*[2], *Gryllus*[3], and *Leucophaea*[4] gonadectomy in males as well as in females does not impair mating activity. Confirmatory results are also given here (Table). Furthermore, in females of *Diploptera*[5,6] mating occurs shortly after emergence, when the gonads are still inactive. Recently, it was observed that after the implantation of nymphal prothoracic glands into adult females of *Leucophaea* only a small percentage of these females mated[7]. This experiment was repeated, and again only 4 of 16 (25%) experimental animals accepted a male within 4 weeks after emergence. Apparently, the implantation of active prothoracic glands changes the normal response of adult females to courting males.

It remained to be seen whether this effect was direct or indirect, since implants of active prothoracic glands in adult females of *Leucophaea* inhibit the activity of the corpora allata. To test this point, females of *Leucophaea* were allatectomized one day after emergence and then were kept with normal males. In the experimental as well as control series 2 couples were placed together in each finger bowl, so that each female had a chance to mate with either of the 2 males.

In the normal control series, 90% of the females had accepted a male within 26 days after emergence as seen by the presence of a spermatophore in the bursa copulatrix (Table). By contrast, only about 30% of the allatectomized females accepted a male within the same period. Sham operated females mated as readily as normal animals (Table). From this it seems that mating in females of *Leucophaea* depends on the presence and activity of the corpora allata. This conclusion is supported by the observation that, in *Leucophaea*, mating normally occurs at a time when the corpora allata show histological signs of beginning activity, i. e. an increase in cytoplasmic content. Thus, the effect of the implantation of active prothoracic glands on the female response to courting males can be accounted for by the inhibition of the corpora allata[7].

Mating in normal and experimentally treated *Leucophaea*

| | No. of animals observed | No. of animals mated | |
|---|---|---|---|
| | | within 26 days after emergence | within 12 days after re-impl. of corpora allata |
| 1. Normal females | 156 | 141 = 90 % | — |
| 2. Castrated females | 16 | 15 = 94 % | — |
| 3. Normal females mated with castrated males | 58 | 55 = 95 % | — |
| 4. Allatectomized females | 36 | 11 = 30·5 % | — |
| 5. Sham allatectomized females | 16 | 14 = 87 % | — |
| 6. Allatectomized females that received four active corpora allata 26–30 days after emergence | 11 | — | 9 = 82% |

This conclusion is further substantiated by the following experiment: Eleven allatectomized females were kept with normal males for 26–30 days during which period they did not mate. Each of these 11 females then received implants of 4 active corpora allata taken from last instar nymphs 3–5 days after their molt. Corpora allata of such donors are known to be active, since after implantation into adult females they bring about egg maturation. Five days after the implantation of the corpora allata, 6 females had already accepted a male, and on the 12th day after the implantation a total of 9 (82%) of the experimental animals had mated (Table). In the 2 animals that had not mated when the experiment was discontinued on the twentieth day after re-implantation, the implanted corpora allata must have been quite inactive because the oocytes of these animals contained very little yolk. This experiment with re-implantation of the corpora allata demonstrates that in *Leucophaea* active corpora allata are involved in the responsiveness of females to courting males.

[1] Supported by U.S.P.H.S. Grant C-3413 administered by Dr. B. SCHARRER.
[2] J. TH. OUDEMANS, Zool. Jb. Syst. *12*, 71 (1899).
[3] J. REGEN, Zool. Anz. *35*, 427 (1910).
[4] B. SCHARRER, Personal communication.
[5] L. M. ROTH and E. R. WILLIS, Psyche *62*, 55 (1955).
[6] F. ENGELMANN, Biol. Bull., Woods Hole *116*, 406 (1959).
[7] F. ENGELMANN, Z. vgl. Physiol. *41*, 456 (1959).

What is the possible mechanism of this hormonal effect on mating behavior in an insect? As ROTH and WILLIS[8] have shown, the female of some cockroach species, including *Leucophaea*, takes an active part in courtship. An odorous substance excreted by the male causes the female to feed on his tergal gland, and by so doing she stimulates the male to copulate. Unless the female responds in this particular way to the courting male, no mating occurs. To test whether the antennae serve as the organs of smell in this female behavior, the antennae were removed from 16 females shortly after emergence. None accepted a male in an observation period of 26 days. Perhaps, then, the failure of allatectomized females to mate depends on some alteration of their ability to perceive the male odor. Whether the corpus allatum hormone acts on the olfactory center in the brain or directly on the sensory receptors on the antennae, or whether it conditions the female in an entirely different way cannot be determined at the present time.

It will be of interest to learn whether in other insect species the corpora allata likewise influence the mating behavior of the females. Experiments in this direction are under way. It might be worth mentioning that in *Diploptera* allatectomized females are courted and mate as readily as normal animals. The female of *Diploptera*, however, differs from *Leucophaea* in that she plays a rather passive role during courtship[5]. The female of the *Cecropia* moth is also more or less inactive during courtship; even the isolated abdomen of the female is properly mated by the male[9]. Perhaps the corpus allatum hormone conditions the females only in those species where the female actively takes part in courtship, i. e., in species where the proper sequence of courting events consists in mutual interaction between the sexes.

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*Zusammenfassung*

Von normalen *Leucophaea*-Weibchen werden etwa 90% nach der Adulthäutung innerhalb von 4 Wochen begattet, von allatektomierten Weibchen unter gleichen Zuchtbedingungen nur etwa 30%. Wurden allatektomierten Weibchen 26 Tage post operationem aktive Corpora allata reimplantiert, so kopulierten 82% innerhalb von 12 Tagen. Kastrierte Weibchen zeigten Normalverhalten.

Die Wirkung der Allatektomie auf die Kopulationsbereitschaft wird diskutiert.

[8] L. M. ROTH and E. R. WILLIS, Smith. misc. Coll. *122*, No. 12 (1954).

[9] C. M. WILLIAMS, Personal communication.

## The Intercalated Disc of the Goldfish Heart[1]

Previous electron microscopic investigations have revealed the presence and the fine structure of the intercalated disc in the cardiac muscle of a variety of vertebrates, e.g., mammal[2–6], chick[7], turtle[8], and the toad[9]. The intercalated disc is one of the first structures to arise in the embryonic cardiac tissue[7,10–12]. Its origin and micromorphology are intimately related to those of intercellular bars[8,9,11,12], and its structure is also quite similar to that of the Z-line of cardiac and striated muscle[9,10]. The intercalated disc, in fact, appears to be a specialized type of the ubiquitous intercellular bar, modified in certain contractile tissues such that it interrupts, in simple or complex pattern, the longitudinal myofibrillar pattern, whether found in simple forms as hydroids[13] or in complex forms as in the insectan dorsal vessel[11], and as in the higher vertebrate cardiac muscle, and conducting system[12,14]. It, therefore, would be extremely surprising, and significant, for cellular theories and for phylogenetic concepts, were the intercalated disc to be lacking in the fish as previously reported[15,16].

Electron microscopic preparations were made of the various regions of the heart of the common goldfish (*Carassius auratus*). The methods were the standard ones of fixation in 2% buffered osmium tetroxide, dehydration in graded ethanols, infiltration with a 9:1 mixture of butyl- and methyl-methacrylates, and final embedding in the mixture of methacrylates, initiated with 2% Lucidol, and polymerized at 47°C. Thin sections were cut with a Porter-Blum microtome, using a diamond knife, and the sections examined in a Siemens' Elmiskop I.

*Results.* – As in mammals, the heart muscle is cellular. The fibers themselves are narrow, one to three fibrils wide in the plane of sectioning (Fig. 1). The cytoplasm appears granular, and contains a large number of mitochondria, which are often long or irregular in shape (Fig. 1). Pinocytotic vesicles are frequently observed, and the endoplasmic reticulum is abundant and highly organized. The Golgi complex is often large, contains the several vesicular and dictyosomal components, is usually located in the residual cytoplasmic area, and often has multivesicular bodies[17] associated with it. The fibrils show all the cross striations including a well-developed N-line (Fig. 7). The Z-band is relatively less dense and less wide than in the mammalian cardiac fiber but shows the vesicular nature (Fig. 2, 4, 7) and has the relations to the endoplasmic reticulum that are common to the mammalian fiber.

[1] This study was aided by a grant from the National Heart Institute, of the National Institutes of Health, Department of Health, Education, and Welfare; Bethesda, Maryland.

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