ABNORMALITIES AND REGENERATION IN CICINDELA.*

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I. Introduction.

The occurrence of certain abnormalities of the elytra and labrum of Cicindela collected in the wild state and in adults reared in the laboratory and the almost entire absence of abnormalities of the legs and antennæ led me to bring together the main facts at my disposal and to perform a few experiments to determine if possible the cause of the abnormalities. It is the purpose of this paper to point out the possibility of the use of the material for studies of the physiology of melanin pigment distribution by operative experiments during development.

II. Types of Abnormalities.

The abnormalities noted are confined chiefly to the elytra and the labrum. Figure 1 shows an abnormal labrum of a specimen of Cicindela tranquebarica of the green Nevada type with the small spots on the margin of the elytron as the only vestige of the usual markings of the species (Wickham '06). This labrum has a slender smooth and shiny projection at one side but suggesting a tearing from the center toward the outside which resulted in the slender strip being left hanging down freely. Such abnormalities are not common.

A second and relatively common type is shown (figures 4 and 5) in which one elytron is longer than the other and the form and color pattern sometimes modified. No abnormal legs have been noted in collected specimens.

III. The Production of Abnormalities in Experiments.

To learn something of the abnormalities of the labrum and legs twenty-six late larvæ and six pupæ of Cicindela punctulata were operated on. The operations were performed with sterile scissors and the larvæ placed in vertical burrows in sterile soil kept moist with a hydrogen peroxide solution. The operations were confined to the labrum and right hind leg.

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Four larvæ were cut in the center of the labrum; six pupæ were operated upon in the same manner. All the pupæ were treated essentially alike being cut from the center of the pupal labrum toward the left side and slightly upward. The results are tabulated below:

Location of cut	Part Removed or Attached	No. Operated on	No. Surviving	Results in Adult
In leg, Tarsal joints	removed	4	2	One showed shorter tarsal joints.
In leg, Tarsal joints	attached	4	3	No modification of adult.
Mid tibia	removed	9	4	No modification of adult.
Mid tibia	attached	2	1	No modification of adult.
Tibia femur joint	removed	3	2	No modification of adult.
Larval labrum in center	attached	4	4	No modification of adult.
Pupal labrum	attached	6	6	4 showed modification 1 recovered completely

The result of removing the legs are all the same except for the one shown in figure 8 which is a little shorter, has a little shorter spur and less numerous and shorter hairs. The pupal legs evidently develop in the upper part of the larval leg and modification results only when the basal portion is injured. Megusar '03, obtained similar results with other beetles. This fact explains the rareness of leg abnormalities.

The experiments on larval labrums gave no results. The pupæ operated on only emerged as adults in three cases. One died before the cuticula hardened. This individual's labrum had completely healed but a very dark area occupied the area near the cut. One that failed to emerge had healed the wound completely. The labrum of the other had almost degenerated. The two seen in figures 2 and 3 show some similarity to the one collected in Nevada. The Nevada specimen suggests that the abnormality is due to a tear in the labrum probably at the time of the last larval moult. The larval cuticula often sticks to the anterior part of the pupa when the surrounding conditions are dry and the Nevada dry climate would favor such accidents.

Elytral abnormalities shown in two species collected in Kansas were duplicated in Cicindela limbalis reared from a larva. Here a reduced color pattern accompanies a short elytron as in the specimen of wild tranquebarica. While this is the only elytral modification of exactly this type noted in wild individuals a type with holes in the elytra is more common in experiments. For example, two holes completely healed occured in an elytron with an irregular and distorted pattern, Fig. 7. While several hundred larvæ of each of several species were reared to maturity this kind of abnormality occurred only three or four times.

The peculiar elytral modifications are probably due to rough handling. It seems probable that the abnormal conditions result from pressure or slight injury during the pupal stage. The elytron being much crowded, the folds projecting outward are particularly liable to injury. The elytral openings in Fig. 7 are rounded and smoothly healed, the wing cavity being entirely closed and with cuticular covering on the edges. The comparatively frequent occurrence of elytral modifications in reared specimens as compared with their rather rare occurrence in nature justifies the above assumption. The abnormalities are not unlike those of Drosophila described by Morgan as mutations. Since the tiger beetle abnormalities occur in animals reared from wild stock which show extremely few such variations in thousands of specimens collected in the wild state an unusual burden of proof is necessary to establish such conditions as anything but abnormalities produced again and again by the necessary rough handling of cultures. If such proved true their apparent inheritance in Drosophila may only be a sensitiveness to handling.

The abnormalities of patterns and the reproduction of black pigment in wounded labral surfaces indicate that such material in the hands of a skillful investigator might, with suitable operations, show something of the physiology of pattern production. If the distribution of pigment can be controlled by suitable operations as is indicated by the work, it will have important bearing on the studies of insect patterns.

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BIBLIOGRAPHY.

Morgan, T. H. 1911. The origin of the nine wing mutations of Drosophila. Science, 33, pp. 496–99.

Megusar, F. 1903. Die Regeneration der Coleopteren. Arch. Ent. Mech. der Org. Bd. 25, pp. 148-234.

Shelford, V. E. 1908. Life histories and the larval habits of the tiger beetles (Cicindelidae) Linn. Soc. London. Jour. Zool. Vol. XXX, pp. 157-184.

Wickham, H. F. 1906. Races of Cicindela tranquebarica Herbst. Entomological News, 1906, pp. 43-48.

EXPLANATION OF PLATE XXIV.

Fig. 1. Abnormal labrum of a blue Nevada form of C. tranquebarica.

Figs. 2 and 3. Abnormalities in C. punctata produced by cutting into the labrum during the pupal stage.

Fig. 4. Long and short-elytroned form of C. sexguttata from Topeka, Kansas.

Fig. 5. Specimen of C. tranquebarica with short elytron bearing an abnormal pattern, from Dodge City, Kansas.

Fig. 6. Reared specimen of C. pupurea limbalis a right elytron similar to that of tranquebarica (Fig. 5). Note reduced markings. This deformity is supposedly due to rough handling.

Fig. 7. Elytron of C. limbalis with healed openings due to the death of certain parts of the folded pupal elytron.

Fig. 8. Right short hind leg of a specimen of C. punctulata in which the tarsal joints were removed just before pupation. The hairs are not well developed.

Fig. 9. Left normal hind leg of the same specimen of C. punctulata.


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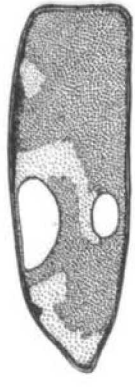
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