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I. Wissenschaftliche Mittheilungen.

1. On the larva of Lagoa, a Bombycine caterpillar with seven pairs of abdominal legs; with notes on its metameric glandular abdominal processes.

By Alpheus S. Packard, Brown University, Providence, R. J. U. S. A.

eingeg. 21. April 1892.

The following remarks may bear on the question of polypody in the higher metabolous insects. The normal number of pairs of abdominal legs in lepidopterous larvae, as is well known, is five. The only known exception is the larva af *Lagoa*, a genus of *Bombycine* Lepidoptera confined to North and South America, and usually referred to the Liparidae.

In 1864 in the Proc. Ent. Soc., Phil. III., 336, we remarked »There are seven pairs of abdominal or false legs«.

We afterwards called attention to the presence of two pairs of »false«, or abdominal, legs in the American Naturalist for July 1885, as follows:

Two years ago we found the fully fed caterpillars and also those before the last molt on scrub-oaks in Providence, and again noticed them while walking, then carefully examined them after placing them in alcohol, and again examined the specimens during the past winter. It is well known that caterpillars have no more than five pairs of »proplegs«, »false legs« or abdominal feet, as they are variously called, and so far as we have been able to learn the present caterpillar is the only one which has additional legs, even though rudimentary. As in all lepidopterous larvae, there are ten abdominal segments. In the larvae before the last molt there is a pair of rudimentary abdominal legs on the second abdominal segment, forming soft tubercles about one-third as large as the succeeding normal feet; the crown of hooks was wanting, but a tubercle on the anterior side corresponding to a similar one on the normal feet had five or six well marked stout spines, also two or three scattered ones in the middle, the tubercle being rounded, convex, not flattened at the end.

On the sixth segment, following the fourth pair of normal abdominal legs, is a pair of tubercles like those on the second segment and exactly corresponding in situation with the normal legs; situated externally are two long straight spines, but none homologous with those forming the crown. At the base in front of each tubercle is a tuft of sparse hairs, and on the outside is a chitinous spot bearing a dense tuft of hairs; these two tufts precisely agree in situation and appearance with those at the base of normal abdominal legs.

In the fully fed caterpillar the tubercles are exactly the same. It thus appears that in the *Lagoa* larva the first abdominal segment is footless; the second bears rudimentary feet; segments 3—6 bear normal proplegs; the seventh bears a pair of rudimentary legs; segments eight and nine are footless, while the tenth bears the fully developed anal or fifth pair of genuine proplegs.

While these two pairs of tubercles differ from the normal legs in being much smaller and without a crown of curved spines, they are protruded and actively engaged in locomotion, and in situation, as well as the presence of the basal tufts are truly homologous with the normal abdominal legs.

As this case is unique, no other Lepidopterous larva (except the allied *Chrysopyga*¹) being known to possess more than five pairs of abdominal legs, we for the third time carefully and repeatedly observed the caterpillar when alive, and watched the movements of the abdominal legs during locomotion, and saw how the two rudimentary pairs, viz., those on the 2d and 7th abdominal segments were raised and put down. With the triplet in hand and allowing the larva to walk on the edge of the tin box in which they had been confined, it was easy to see that the above mentioned proplegs were actively used, performing the same general acts of extension and retraction of the planta, as the

¹ Within the past year I find that Dr. H. Burmeister had described in 1879 in his elaborate Atlas de la description physique de la République Argentine, Lépidoptères, Pl. XXII, Figs. 6, 6 A, 6 B, 6 C the larva of *Chrysopyga undulata*, which is closely allied to *Lagoa* and has similar abdominal legs, those on the 2d and 7th segments being wart-like and without crotchets.

others, and like them serving to support the body. Those of the first pair, particularly, viz., those on the 2d abdominal segment, were observed to be nearly as large and as long as the normal uncinate legs, and to be retracted and then extended and applied to the surface of the object on which the larva was resting, in the same manner as the pair directly behind, which bear crochets; and the same was observed as regards the pair on the 7th segment. The abdominal leg on the 7th segment is represented in Fig. 1 pl planta; s a clavate seta.

To further prove to others, who might doubt whether these mobile and extensile processes were really legs at all, I made careful camera drawings of alcoholic specimens of the freshy hatched larva, and of one after the first molt. The rudimentary legs on the second and seventh abdominal segments are seen to have a well developed planta, though without crotchets, but bearing on the outside a pair of clavate setae just like those of the other legs.

The occurrence of temporary abdominal appendages in the embryos of insects in general is now well known. Wether these deciduous appendages occur in the embryos of Lepidoptera, Diptera and Hymenoptera has been called in question. The figures of Kowalevsky, and of Tichomiroff, appear to prove that in Lepidoptera at least such appendages do appear, though they are shorter lived and more evanescent than in Orthoptera, Coleoptera etc. In his last able work Vergleichende Studien am Keimstreif der Insecten, 1890 Graber appears to confirm Tichomiroff's observations and figures, concluding in respect to Bombyx mori as follows : Im Übrigen erscheinen sie aber den thoracalen Gliedmaßenanlagen vollkommen homotop, und wäre in dieser Hinsicht auch kein Grund vorhanden, ihre Homologie mit den Abdominalanhängen anderer Insecten, z. B. der Käfer und Geradflügler, in Zweifel zu ziehen.« And finally remarks: »Wenn wir also die Erhebungen der vorderen und hinteren Segmente, welche jedenfalls mit denen identisch sind, die sich zu wirklichen Extremitäten entwickeln, auch als Ansätze von Gliedmaßen betrachten, so müssen wir doch unbedingt sagen, daß hier das Stadium der Pantopodie nur eine ganz ephemere Dauer hat.« (p. 84.)

We feel warrented then, in the present state of the subject to conclude that in *Lagoa* the crotchetless abdominal legs in question represent a persistent condition of the embryonic appendages. They are certainly of some use to the insect, and thus have survived because they, in a partial way to be sure, have been of service. Those on the 1st and 8th segments have probably disappeared from disuse.

If these conclusions are correct then Lagoa, in respect to its abdominal legs, even if we do not take into account certain other characteristics, is a survivor of an ancient and very generalized type, and represents, as no other known caterpillar, the polypodous ancestor of all Lepidoptera.

The lateral abdominal glandular processes. — Another archaic feature in *Lagoa* is the presence of seven pairs of permanently everted, finger-shaped processes on the first seven abdominal segments. Fig. 1 represents a lateral view of the seventh abdominal segment, with the dorsal (d), sd subdorsal, with their venomous setae, and long



spinulated hairs, and i the infra-spiracular tubercle; the lateral glandular process at lgp, and situated behind and a little lower than the spiracle sp.

There are seven pairs of these metameric processes; a pair to each of the first seven abdominal segments. They are situated near to and directly behind, but a little lower down than the spiracles, and above the infra-spiracular tubercles. Indeed they occupy the exact position of the evaginable lateral glands of *Hyperchiria io* and *Hemileuca maia*, and other Hemileucidae. In shape they are elongated pyriform, conical, and somewhat digitiform, being slightly contracted at the base. They remind one of the shape of the appendages of insect-embryos just when the joints are beginning to appear. The free end is conical, rounded and imperforate. They are not capable of being retracted, and appear to be permanently evaginate, since each pair along the side of the abdomen is of the same general length and size, none being either wholly or in part retracted.

To examine the microscopic structure of these processes transverse and longitudinal sections of the insect in the first and last larval stages were made, and stained, some with alum cochineal and others with alcoholic cochineal. In a longitudinal section (Fig. 2) the lumen (l)is seen to be a deep narrow cavity; it is composed of a thin mucuslike coagulated fluid, containing granules of varying degrees of fineness, which take the stain readily. At the mouth of the lumen are collected fine nuclei (bc) which take a dark stain; they are surrounded by a slight transparent pale protoplasmic envelope, and are probably blood-corpuscles².

The glandular cells themselves are modifications of the cells of the hypodermis. Those in the free end of the process are very much elongated, and the large nucleus is situated near the outer, broader end of the cell. In some of the nuclei, which are oval, indistinct nucleoli are to be seen. The nucleus is densely filled with granules, the chromatin, which take a deep stain. The specimens had been preserved in alcohol, for at least three years, so that the exact histological structure of the nuclei could not be clearly brought out, but in the general appearance of these glandular cells there is a strong and suggestive resemblance to those of the pleuropodia of insect-embryos, figured and described by Mr. W. M. Wheeler³, though the masses of chromatin are not so distinct and isolated.

We are disposed to regard these organs as homologous with the prothoracic osmateria of the larvae of Papilionidae, and the eversible lateral abdominal glands of *Hemileuca* and *Hyperchiria*, the sternal and dorsal eversible repugnatorial glands of various other lepidopterous larvae; also wich the repugnatorial prothoracic glands of certain

² My friend Mr. W. M. Wheeler, to whom I have shown the accompanying sketch, also thinks these are blood corpuscles; and he suggests that the granular matter adjoining is the blood-plasm.

³ W. M. Wheeler, On the appendages of the first abdominal segment of Embryo insects. Trans. Wisconsin Acad. Sc., Arts, etc. VIII. p. 87-140. Sept. 20. 1890.

Phasmidae⁴, the pair of abdominal evertible glands of the imago of the Arctians, Pyrrhoretia isabella and Leucarctia acraea 5. They differ however in not being capable of withdrawal into the body-cavity, as in numerous alcoholic specimens examined they are all of the same general length and size, and moreover the cuticle at and near the base is rough and spinulated like that on the other parts of the body, and besides they are concealed by the dense hairs. I have not perceived any odor emanating from these larvae, which are otherwise sufficiently protected by their venomous setae; these larvae being difficult to handle on this account. Further observations may prove that the secretion is odorous, either oozing trough the rather thick cuticular walls of the process, or remaining within the body and filling the lumen. At all events, the unusual number (seven pairs) of such processes 6 are an archaic feature, and in connection with the composite or generalized structure of the insect in all its stages make it a remarkable and highly interesting form.

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2. The Development of the Genital Organs, Pseudo-Heart (Ovoid Gland), Axial and Aboral Sinuses in Amphiura Squamata.

By E. W. MacBride BA (Cantab.) BSc (London). (Preliminary Notice.)

eingeg. 21. April 1892.

The investigations which form the subject of the present memoir were carried on in the Zoological Station at Naples, during a period of six months from October 1891 to April 1892. My original object was to study the development of the genital organs in Echinoderms; and *Amphiura squamata* was the only form available at the time of my arrival in Naples.

In tracing the origin of the primitive germ cells, I soon discovered their close relation to the organ which in England is generally called the »heart« or »pseudoheart«. I then traced the development of the latter and of the sinuses in connection with it: and so far as I can

⁴ S. H. Scudder, Odoriferous glands in Phasmidae. Psyche, I., 168, April 14. 1876.

⁵ J. B. Smith, Scent-organs in some Bombycid moths. Entomologica Americana. II. No. 1. p. 79—80. July, 1886. — See also Morrison, H. K., On an appendage of the male *Leucarctia acraea*. Psyche, I., p. 21—22. 1874.

⁶ Here might be mentioned the 8 pairs of retractile lateral abdominal processes of *Phyllocnistis*, mentioned by Chambers in Psyche, III., p. 67, July, 1880, Febr. 12, 1881. p. 135-137, the nature of which need further investigation.

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