

NOTES ON THE STRUCTURE OF THE THORAX AND
MAXILLÆ IN INSECTS.

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(PLATE I.)

When one looks at the complicated structure of the thorax in a fly or a bee, it seems almost impossible to tell much of the origin of the parts. But it is not so difficult to unravel the tangle if we start at the right end. Several years ago while looking at some Chilopods one point in the solution occurred to me. I published upon it at that time, and since then have often been confirmed in the view then expressed that the segments of the thorax are compound. It is generally admitted to day (more so than ten years ago) that the Chilopods are closely related to the ancestors of the winged insects; and no one, I think, can study them without arriving at that conclusion.

If we look at one of the lower and simpler Chilopods, as a *Geophilus* or *Mecistocephalus* (Plate I, fig. 8), we will notice that the head is followed by a series of segments, subequal in size, each bearing a pair of legs, and (except the first) spiracles. If one examines a more compact Chilopod, as *Scolopocryptops*, two kinds of segments are seen, the larger with spiracles, the smaller without them. In *Lithobius* (Plate I, fig. 1) this process has gone further, the small segments are smaller, the large are larger, and overlap or even cover the small ones. In *Cermatia* the dorsal scutæ of the small segments have coalesced with the large segments. This, I believe, has happened to all insects; what we consider a segment of the thorax being really two segments united. There are various external points of proof. One that I previously advanced is that in *Machilis* there are jointed appendages to the abdomen which appear to represent legs. Similar appendages are attached to the middle and hind coxæ; these, then, may represent the legs to the other segments of the thorax. Three years ago Mr. Walton called attention to the structure of the coxa, showing that there are present the basal parts of two appendages; the trochantin and epimeron representing basal joints of a leg now no further developed. He reasoned from this that the thorax was compound. He did not then know of my article. I have given (Plate I, fig. 7) a side view of the coxa of a *Panorpa* where one can see that the coxa shows these two sets of basal joints. This appearance is readily noted in most Neuroptera (very clearly so in Psocidæ), and can be made out by a little study on many of the higher insects.

In my note of ten years ago I stated that I thought the prothorax might not be compound, but now I consider that it is

formed of two segments as are the meso- and metathorax. One will see that this is probable by a glance at the figure of a *Lithobius* (Plate I, fig. 1). Many insects show a transverse groove on the pronotum. It is seen that the spiracles of the small segments have disappeared in *Lithobius*. This has a direct bearing on the question, if it be true (as the best evidence seems to show) that the wings of insects originate from rudimentary spiracles. Since there are not in the lowest Chilopod any spiracles on the first segment, this will explain why there have been no prothoracic wings in insects. If we look again at a *Lithobius* (Plate I, fig. 1) we notice that behind the thorax is a segment not followed by a smaller one. This will become the median segment of insects, in some forms united to the thorax.

Are the abdominal segments of insects compound? I do not know of positive evidence, but in looking at *Lithobius* one would think that the abdominal segments were also compound. In many insects there are indications of transverse division on some of the abdominal segments. Still one cannot argue too literally from *Lithobius*, for *Lithobius* is not the ancestor of insects but only closely related thereto.

If we compare the head end of the lower and higher Chilopods we notice that there has been an increase in the size of the poison-claw, and a more or less definite coalescence with the head. It would seem, therefore, that in insects a more complete coalescence has been accomplished. And it is so. The Chilopod (Plate I, figs. 1, 5, 6, 8) has a pair of mandibles; a lip with jointed lobes each side; a pair of slender jointed appendages, sometimes called maxillæ; and the poison-claws overlapping all. What has become of these parts in insects? If we examine the larva of a Perlid (Plate I, figs. 2, 4), we see mandibles, lip with lobes or palpus, and a complicated maxilla. In side view, this looks much like the poison-claw, and it is. In some Perlid larvæ, one can, with a little care, separate the maxilla into two separate and independent structures, without rupturing the teguments. The inner part is the palpus, with its own basal joints, normally concealed by the stipes and cardo. The outer and larger part is the old poison-claw, now galea and lacinia. In most insects the pressure of the former poison-claw against the palpus has resulted in a coalescence and twisting of parts. However, in many insects (Carabidæ, etc.), the galea is divided into two segments, thus showing that it represents an appendage as well as the palpus. The lacinia, I should guess, is developed from a spur at the base of a joint. A similar articulated piece is found in the mandibles of some beetles (as Cetonidæ). Thus I believe that the maxillæ of insects represent two pairs of appendages fused together at base; and that each segment of the insect thorax is composed of two primitive segments.

I shall not now go into the rise of the clypeus and labrum, only to note that in the Chilopod there is a piece bent down between the large and approximate antennæ, which, as the antennæ separate, will become more prominent, and as the mouth moves forward will become dorsal in position.

Regarding the history of the compound thorax theory, it may be well to record that Hagen in 1889 said he thought each segment was composed of three, one each for the legs, the spiracles, and the wings; but his views are not at all in line with mine, and were unknown to me in 1893 when I broached my theory. In 1900 Mr. Walton, upon studying the coxa, concluded that the thorax was composed of six segments. He was then unaware of the papers by Hagen and myself. Kolbe in his "Einführung" gives practically the same version of the segmentation of the thorax that I have given. Kolbe's work was finished late in 1893, but was issued in parts, and the part dealing with this matter must have appeared about 1891, although unknown to me in 1893.

Since I have written this paper (which was on the program for presentation last fall) I have seen a paper by Verhœff (published in May, 1903), in which he accepts the compound nature of the thorax and gives names to the parts, as follows:

- between head and prothorax—Microthorax;
- between pro- and mesothorax—Stenothorax;
- between meso- and metathorax—Cryptothorax.

He shows that in *Japyx* the cryptothorax still retains the spiracle, and he finds traces of these segments in various insects.

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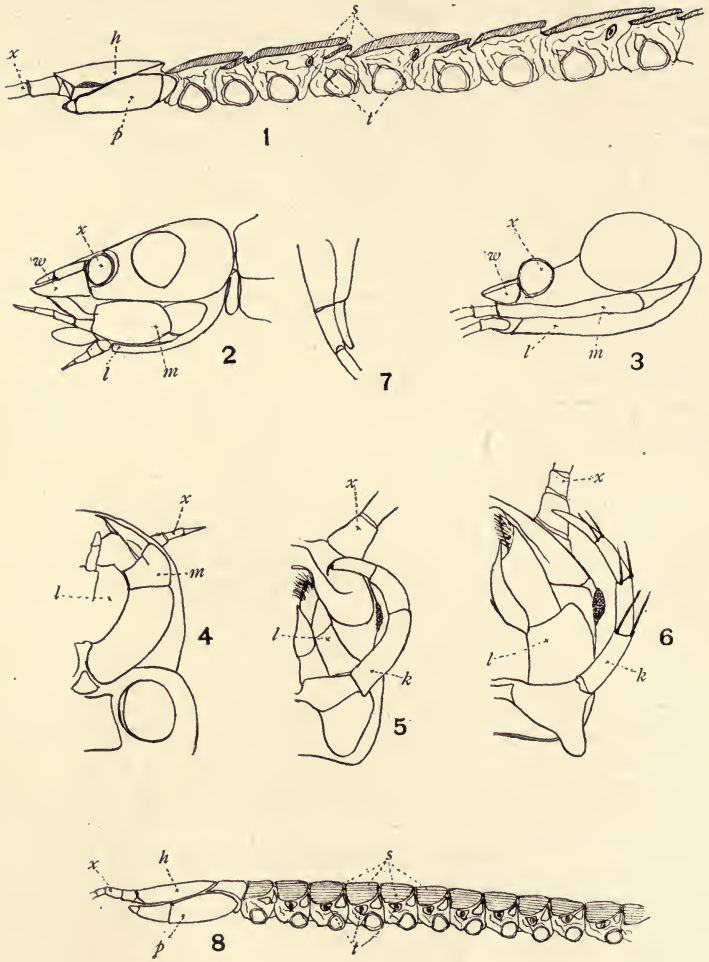


PLATE I.

EXPLANATION OF PLATE I.

1. *Lithobius*, anterior part of body.
2. Head of larva of Perlid.
3. Head of adult *Perla*.
4. Mouth parts of Perlid larva.
5. Mouth parts of *Lithobius*.
6. Mouth parts of *Cermatia*.
7. Coxa of *Panorpa*.
8. *Mecistocephalus*, anterior part of body.

Legend:

h, head; *l*, lip; *m*, maxillæ; *k*, leg I, which becomes part of maxilla; *p*, poison-claw; *s*, dorsal scutæ; *t*, spiracles; *w*, mandible; *x*, antenna.

Dr. Gill asked Mr. Banks whether his views as to the mouth parts of insects corresponded with those of Prof. John B. Smith. Mr. Banks replied that he did not believe that Prof. Smith's investigations had been carried on along the same line as his own. He did not believe that Prof. Smith suspected that the maxilla was a compound organ.

The subject of Myriapoda and their relation to insects and other Arthropods was discussed by Messrs. Morris, Gill, Banks and Ashmead. Dr. Gill said he thought Mr. Banks' theories as set forth in his paper just read were plausible, although, of course, it remained to be seen whether further investigation would bear them out.

—Mr. Schwarz exhibited and described a structure made by a Psyllid larva on the leaves or young shoots of *Piscidia erythrina*, the fish-killing plant of the West Indies, at Key West, Florida, and at Cayamas, Cuba. He stated that among the numerous species of North American Psyllidæ there are comparatively few that are gall-makers, or that cause deformations in the various parts of the plant they affect. Only two nest-making or nest-spinning Psyllidæ have hitherto been known, and these only from Australia, *i. e.*, the genera *Spondylia* and *Cardiaspis*, as explained by him in a paper read before the Society some time ago.* The species from Key West forms a

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