On the Structure *of the* Proboscis *of Ophideres fullonica, an* Orange-sucking Moth. By Francis Darwin, M.B.

It must be premised that the fact of some Lepidoptera piercing vegetable tissues for the purpose of obtaining the juices is not a new one. In his 'Fertilisation of Orchids' my father shows that the lining membrane of the nectaries of certain orchids are bored through in this way. Moreover, Mr. R. Trimen informed my father that, at the Cape of Good Hope, a great deal of fruit is thus injured by Lepidoptera.[1]

I owe the material on which the following observations were made to the kindness of Mons. Anthelm Thozet, of Rockhampton, Queensland. A few dried specimens of *Ophideres fullonica* were sent by him to my father, together with his interesting account, published in a Queensland paper, of the injuries caused by the moth to the oranges in that part of Australia.

The antlia or proboscis of Lepidopterous insects is well known to be composed of the transformed maxillæ; each of these is channelled along its internal face, and the two demi-canals fit closely together, and form a complete channel or tube traversing the proboscis from end to end. Fig. 3 is a transverse section of the proboscis, *ch* being the channel, *tr* the large trachea, which run one in each half of the organ. The intrinsic muscles of the maxillæ which surround the tracheæ are here omitted.

The proboscis, of which only the distal portion is represented in Figs. 1 and 2, measured ·72 inch in length; the wings of the moth to which it belonged were too much broken for measurement, but a larger specimen gave a width of four inches from tip to tip of the extended wings, and had a proboscis ·74 inch in length.

The convex border of Fig. 1 represents in profile, the outline of the dorsal aspect of the proboscis; the concave border gives that of the ventral aspect. The saw-like or cutting portion of the proboscis—(*i. e.* from its tip to the barbs (*b*,

constant temperature of about 38·5° C. After three days the rosy coloration had entirely disappeared and the fluid remained colourless also afterwards, although an abundant floccular sediment has made its appearance.

[1] Since making the observation here recorded, I have seen a note on the structure of the proboscis of *Ophideres fullonica* by M. Künckel ('Comptes Rendus,' Aug. 30, 1875). It contains excellent drawings of the organ, together with a short description of it.

Figs. 1 and 2)—is roughly triangular in transverse section, *i. e.* bayonet-shaped. Of the three surfaces of the bayonet

Fig. 1.

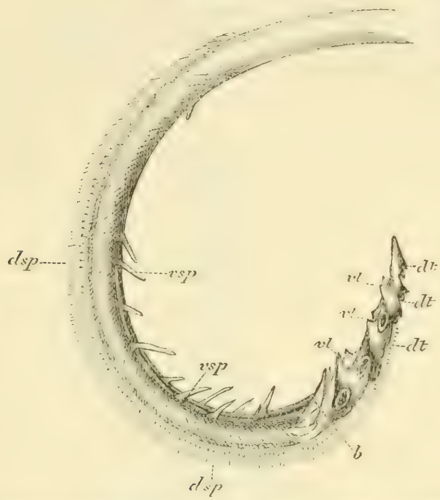

Fig. 1.—Proboscis of *Ophideres fullonica* drawn lying on one side.
vt vt. Ventral teeth.
dt dt. Dorsal teeth.
lt. Lateral teeth.
b. Lateral barbs.
dsp. Dorsal spines forming a frill along nearly one half of the length of the organ.
vsp. Ventral spines.

one forms the dorsal aspect of the proboscis and supports the frill of dorsal spines (*d, sp*, Fig. 1); the other two surfaces are symmetrical with each other, and may be called ventral-lateral surfaces, since they form the *sides* of the organ as seen in Fig. 1, and, by meeting along the edge (*g* in Fig. 2), they form its ventral aspect. The line (*g*) just mentioned is continuous with a narrow groove running along the ventral aspect of the proboscis (*g*, Figs. 2 and 3); at the distal extremity of the line (*g*) is seen the orifice (*o*), by which the channel traversing the proboscis opens externally on the ventral aspect, thus resembling the canula of a subcutaneous syringe.

It is clear that in using its proboscis the insect must employ a thrusting action, and not any kind of revolving movement; the proboscis must accordingly be considered as a saw, not as an augur or gimlet. It is, in fact, a bayonet-shaped saw, and must, therefore, have three cutting edges.

Along the *concave* border, in Fig. 1 (the ventral aspect) may be seen four pairs of teeth (*vt*, *vt*, &c.), making in all eight projecting points; these unite in forming one of the cutting edges of the saw. We obtain a bird's-eye view of this same edge in Fig. 2, where the symmetrical teeth (*vt*, *vt*) may

Fig. 2.

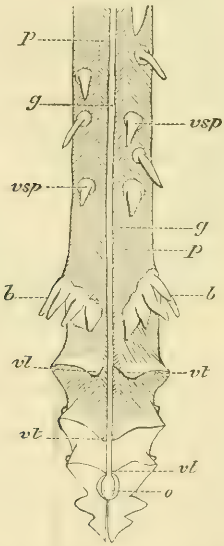

Fig. 2.—Bird's-eye view of the ventral aspect of the proboscis.
vt vt. Ventral teeth meeting in pairs on either side of the median line (*g*).
g. Narrow groove occupying the angle of the roof-like ridge of which the ventral aspect consists. The roof is supposed to rise towards the observer, *g* being merely a crack running along the roof-tree.
b. Barbs.
o. The orifice or external opening of the channel or tube of the proboscis.
p. See text.

be seen meeting each other in pairs along the line (*g*). The two other cutting edges of the bayonet-saw are formed by teeth projecting from the dorsal margins of the two lateral surfaces. One of these cutting edges is seen in profile in Fig. 1 (*dt*, *dt*). If we imagine a saw with a broad back, having a cutting edge along each margin of the *back*, as well as along the proper cutting edge, it will resemble the bayonet-shaped proboscis-tip.

It will be seen that the teeth on the ventral edge of the saw point towards the tip, those forming the two dorsal edges pointing in the opposite direction. Therefore, as the saw is thrust into the orange, the ventral teeth will begin to cut; as it is withdrawn the dorsal ones will take up the work. If a man were to work with a saw, which besides the usual teeth possessed others on its back pointing in the reverse direction, and if he were, besides sawing in the usual way, to cut another piece of wood at each back stroke with the *upper* edge, he would have to press first with the lower edge of his tool and then with the upper one. This alternation of pressure is effected in the saw of Ophideres in a curious manner. In Fig. 1 three strong ridges with corresponding depressions may be seen running obliquely across the side of the proboscis, each being continuous with one of the projecting ventral teeth; in this drawing they are necessarily represented by light and shade, but in Fig. 2 they are seen in profile. It is clear that the effect of the obliquity of these ridges will be to make the ventral teeth "bite" as the saw *enters* the fruit, and that the moment it begins to be withdrawn the pressure will be taken off the ventral teeth and transferred to the dorsal ones, which are thus in their turn forced up against the part of the wound on which they have to work. Moreover these ridges, assisted by the barbs (*b*, Figs. 1 and 2), convert each lateral surface of the saw into a rasp; the curious peg-like teeth (*l t*), of which there are three on each lateral surface, aid in the same object. Whether the frill of delicate spines (*dsp*, Fig. 1) on the dorsal aspect assist in the rasping or sawing action I cannot determine, nor what the special function of the stronger spines in the ventral surface (*vsp*) may be.

Mr. A. G. Butler has been so good as to inform me that *Catocala nupta* would be a fair representative of the nearest British allies of Ophideres. In accordance with its simple nectar-sucking functions, the proboscis of Catocala is very different in structure to that of Ophideres.[1] It ends in a blunt tip, and has none of the saw-like teeth and ridges described in Ophideres; it is covered on its dorsal aspect with a number of curved spinous hairs and with blunt papillæ like those figured by Newport ('Cyc. of Anat. and Phys.,' vol. ii, p. 900) on the proboscis of *Vanessa*

[1] Mr. Butler says that "the Catocalidæ differ much in the form of the palpi from the Ophideridæ;" so that some difference might be expected in the structure of the proboscis.

atalanta. The chitinous parts forming the channel and the rest of the proboscis are very much stronger in Ophideres than in Catocala, and the muscles which serve to extend the proboscis and make it into a stiff rod are more developed. The proboscis of Ophideres is apparently unable to roll up into the *close* helix which we find in Catocala and most Lepidoptera. Each half of a Lepidopterous proboscis is said (Newport, loc. cit.) to be made up of a number of superimposed rings, and in the proboscis of Catocala five transverse lines are seen marking out these rings. In Ophideres, however, these file-like markings are oblique instead of directly transverse, and at a point (*p*, Fig. 2) they are abruptly bent at an acute angle, making a beautiful series of V's on each side of the line (*g*); the point (*p*) is shown also in the section (Fig. 3). The oblique rings give a curious imbricated appearance to the periphery of each half of the proboscis.

FIG. 3.

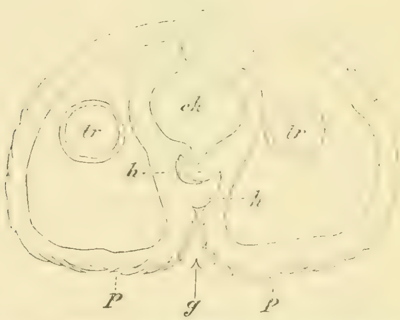

FIG. 3.—Transverse section of the proboscis (not the sawing part. Semi-diagrammatic).

ch. The channel or tube of the proboscis.
tr tr. The large trachea running down each half of the organ.
h h. Locking apparatus, keeping the two halves in contact.
g. Groove running down ventral surface of proboscis.
dsp. Shows the position of the dorsal frill of spines; these are so delicate that nearly all are broken in making sections.
m. The space filled up by muscle which is here omitted.
p. Corresponds to *p* in Fig. 2. See text.

Finally, the apparatus which locks the two halves of the organ together is very remarkable. Fig. 3 is a section of the proboscis showing the strong curved teeth (*h, h*) which, by closely hooking into one another, must effectually prevent dislocation; the delicate spines (*dsp*) on the dorsal surface may perhaps contribute to the same result. Neither

Newport nor Kirby and Spencer give clear descriptions or figures of any such locking mechanism, and in Catocala it is very slightly developed. It is remarkable that, owing to the development of the processes (*h h*), the proboscis ceases to be, strictly speaking, a bilaterally symmetrical organ.