# Notes on the earlier stages of Orchestes fagi L.

by

**Ivar Trägårdh.**

With 4 textfigures.

In a previous paper, »Contributions towards the Metamorphosis and biology of *Orchestes populi, O. fagi* and *O. quercus*»,[1] the author described the larvæ and pupæ of these beetles, especially with a view to investigate their structural adaptations to their leaf-mining habits.

Only of one species, *O. populi,* I was, however, able to examine the successive larval stages; of the other two I had only full-grown or nearly full-grown larvæ at my disposal and was consequently not in a position to describe any changes in the external morphology which they may undergo during their growth.

As pronounced changes take place in *O. populi* during its growth — thus in the 1st instar no prothoracic plates are developed, the head capsule is not retractible in the prothorax and the cuticle is quite smooth — we may, however, presume that the same is the case in *O. fagi* and *O. quercus*.

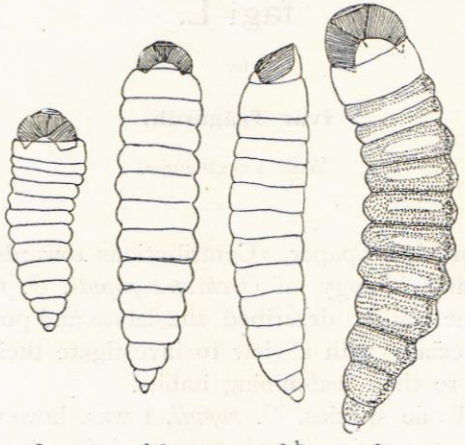
During a visit at Hvidkilde in the South of Fyn, Denmark, in the middle of May last year I had an opportunity of procuring the earlier larval stages of *O. fagi* and notice the beginning of the mines.

[1] Arkiv f. zoologi. Bd 6. N:o 7. Uppsala & Stockholm 1910.

## Metamorphosis.

The eggs are white, oval, 0,675 mm. long and 0,315 mm. wide. The 1st instar (Fig. 1) is 1,1 mm. long and 0,36 mm. wide, tapering gradually backwards from the prothorax. The intersegmental constrictions are very small and the segments not arched, but flat.

The cuticle is not clothed with cuticular spinulæ as in the last instar, but, as a compensation, there are on the I—VII abdominal segments, a little behind and above the



1 2 a 2 b 3

Fig. 1. 1st instar, dorsal view 30×1.
Fig. 2 a. 2nd » » » 30×1. Fig. 2 b. 2nd instar, side view 30×1.
Fig. 3. 3rd » » » 30×1.

stigmata, one pair of larger, conical bristles, pointing obliquely backwards, which obviously serve for locomotorial purposes.

Only the posterior edge of the head capsule is covered by the anterior edge of the prothorax. The mouth parts do not differ from those of the last instar. No tergal or sternal plates developed on prothorax.

2nd instar (2 a, b.) attaining a length of 1,7 mm. and a width of 0,4 mm. The body tapers much more slowly backwards than in the 1st instar, and the abdominal segments I—V are of equal width. The intersegmental constrictions

are no deeper than in the 1st instar, and the segments on lateral view only slightly arched.

The locomotorial bristles on the abdominal segments I—VII persist, but beside these the cuticle has become clothed with small spinulæ, especially at the sides of the body, subventrally. The head capsule is not more capable of being retracted in the prothorax than in the 1st instar, and there are no plates on the prothorax.

These changes take place in the 3rd instar (Fig. 3). This attains a length af 2,8 mm. Comparing it with the 2nd instar, we notice the following differences. The intersegmental constrictions, especially between the abdominal segments I—VII, have become much deeper, as in the last instar (comp TRÄGÅRDH l. c. Pl. I fig. 12); the cuticle is clothed with minute, pointed spinulæ, arranged in transverse rows and pointing backwards. On the ventral side the whole cuticle is clothed with them, except the prothorax, but on the dorsal side the prothorax, as well as the posterior half of the meso- and metathorax is naked, and at the top of the abdominal segments I—VII there are narrow, elliptical, naked areas, which are of equal size in segments I—III, but decrease in size backwards, so that the 7th one is only twice as wide as it is long. The lateral locomotorial bristles of instar I and II have disappeared.

Further differences are that the plates on the prothorax are developed, on the ventral side in the shape typical in the last instar, on the dorsal side narrower.

The 3rd instar thus perfectly resembles the full-grown larva, except for its smaller size, of course, and during its further growth the only noticeable change is the 4th instar having increased considerably more in width than in length.

## Comparison with O. populi.

If we compare the changes which take place during the growth of the larva with those of *O. populi,* the conformity of them in several respects is evident.

The cuticle in both is quite smooth in the 1st instar

and the intersegmental constrictions small; furthermore, the body tapers less and more slowly backwards, the prothorax has no shields and the head capsule is not, or only to a very small extent, covered by the prothorax.

While, however, in *O. populi* the features of the fullgrown larva appear already in the 2nd instar, in *O. fagi*[1] they do not appear until in the 3rd instar.

The larvæ differ also in another respect. In the 1st instar of *O. populi* there are no structures for locomotorial purposes, whereas in the 1st instar of *O. fagi* there are on the abdominal segments I—VII a pair of comparatively large locomotorial bristles, laterally.

During the further growth of both larvæ structures for locomotorial purposes develop, especially dorsally and ventrally, in *O. populi* also laterally, the cuticular granulæ being pointed on the lateral projections, semispherical on the rest of the body — in *O. fagi* preferably dorsally, where the thin transversal, naked areas at the top of the abdominal segments I—VII presumably are of locomotorial use.

Thus, in *O. fagi* the 1st instar, and to a certain extent also the 2nd one, as the lateral bristles exist beside the cuticular spinulæ, are provided with lateral locomotorial structures, while in the subsequent instars they are provided especially with dorsal ones.

## Formation of the mines.

This difference suggests that during these stages of its development the conditions under which the larva lives its life as a miner are different. And this is also the case. During the earlier period of its life the larva is exclusively a tunnel-miner, later it becomes a blotch miner.

From the egg-chamber in the median nervule the larva makes a narrow gallery, running more or less parallel to a side nervule, straight, or only slightly winding, towards the

[1] It ought to be pointed out, that I have not been able to follow one larva of either species during its development, but have applied the terms »1st instar etc.» according to the different sizes of the larvæ combined with the structural differences.

edge of the leaf. This gallery widens only very little as it approaches the edge of the leaf, and, to judge from the size of the larvæ found at the edge of the leaf, at the end of the gallery, this is made by the larvæ during the 1st and 2nd instar. Arrived at the edge, the larva follows that for a short distance and then commences constructing a blotch mine, which widens gradually towards the middle of the leaf.

It is obvious that the conditions in a tunnel mine differ form those of a blotch mine. In the former the upper and under cuticle of the leaf is pressed very closely to the body, and dorsal or ventral spinulæ would to all appearance be of little use, as there is very little room for contracting and extending the body; the only room where locomotorial structures can be applied to the walls are at the sides of the body, since at least a small interspace is bound to arise there. In the blotch mine on the other band there is ample room between the roof and the floor, and here locomotorial structures of the later instars can be brought into action.

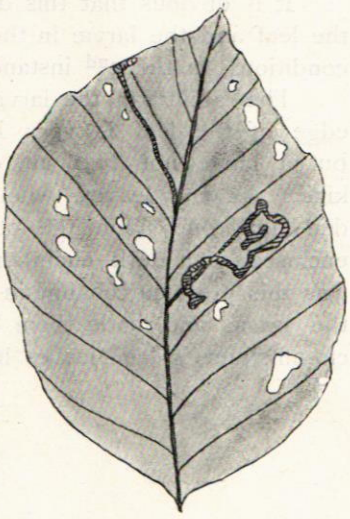


Fig. 4. Leaf of beech-tree. Nat. size. On the left side a normal gallery is delineated. On the right a gallery made partly after the leaf has been picked. We notice that the gallery runs straight for $^2/_3$ of the distance between the median nervule and the edge: this part was made before the leaf was picked: afterwards the gallery doubles back on itself and winds both to the left and to the right: the holes are eaten by the adult beetles.

## Tropism of larva.

An interesting feature in connection with the formation of the gallery of the larvæ is that the galleries on the leaves, as long as they are on the trees, always run straight towards the edge, but as soon as the leaves are picked, the larvæ appear to lose their capacity of taking their bearings.

On the right side of the leaf, delineated in fig. 4, such a gallery is to be seen; we notice that the gallery is not continued towards the edge, but turns backwards in irregular windings.

It is obvious that this difference is caused by the fact of the leaf and the larvæ in the 1st instance being under natural conditions, in the 2nd instance under abnormal ones.

The ability of the larva to find its way straight to the edge of the leaf is very likely due to a kind of *tropism*, but I have not had an opportunity of studying which kind. As the leaves, when picked, were put into a wooden box, one upon the other, and the larvæ thus became enclosed in a dark chamber, it is, however, possible that it was this profound change in the environments which confused the larvæ and made them lose their bearings, not only the circumstance of the leaves having been picked off.