

Part 1.4

Aedeagus

Definitions

Aedeagus

The insect penis

Tunica

The outer layer of the aedeagus. Usually sclerotised and rigid. Connected externally to the anellus and apically to the vesica.

Vesica

The inner layer of the aedeagus. Usually predominantly hyaline and elastic. Continuous with the tunica at the apex of the aedeagus and invaginated within it. Continuous near the base of the aedeagus with the ductus ejaculatorius. Usually textured and bearing cornuti. It is everted into the female genital tract during copulation.

Ductus ejaculatorius

The duct through which spermatozoa are transported from the internal sexual organs to the aedeagus. It is continuous with the vesica and enters the tunica either at its base or through a perforation on its dorsal surface.

Cornuti

Sclerotisations raised from the surface of the vesica (or, rarely from the apex of the tunica).

Junctional bands

Sclerotised bands extending from the apex of the tunica into the vesica.

Junctional cornutus

A cornutus arising from a junctional band

The aedeagus (penis) (pl. aedeagi) emerges through the ring formed by the tegumen and vinculum, between the juxta (which supports it ventrally) and the transtilla (which supports it dorsally). It consists of an outer sheath, the **tunica**, and an inner layer, the **vesica**. The tunica is usually well-sclerotised and rigid, while the vesica is predominantly hyaline and much more elastic. The tunica and vesica are continuous at a fold around the perimeter of the apex of the aedeagus. The **ductus ejaculatorius** (ejaculatory duct) enters the aedeagus either at its basal end or through a perforation in the dorsal surface of the tunica. The sclerotization at the apex of the tunica is sometimes ornamented with carinae, scobinate patches or dentate projections; sclerotised bands at the apex of the tunica may recurve into the vesica (**junctional bands**). The membrane of the vesica is rugose and has a range of texturing that varies considerably from species to species. **Cornuti** and plaques of various types and sizes are commonly attached to the internal surface of the vesica.

The aedeagus in Family: Noctuidae



Figure 1: *Helotropha leucostigma* (Crescent). Left – 2 views of the aedeagus, right – aedeagus with vesica everted

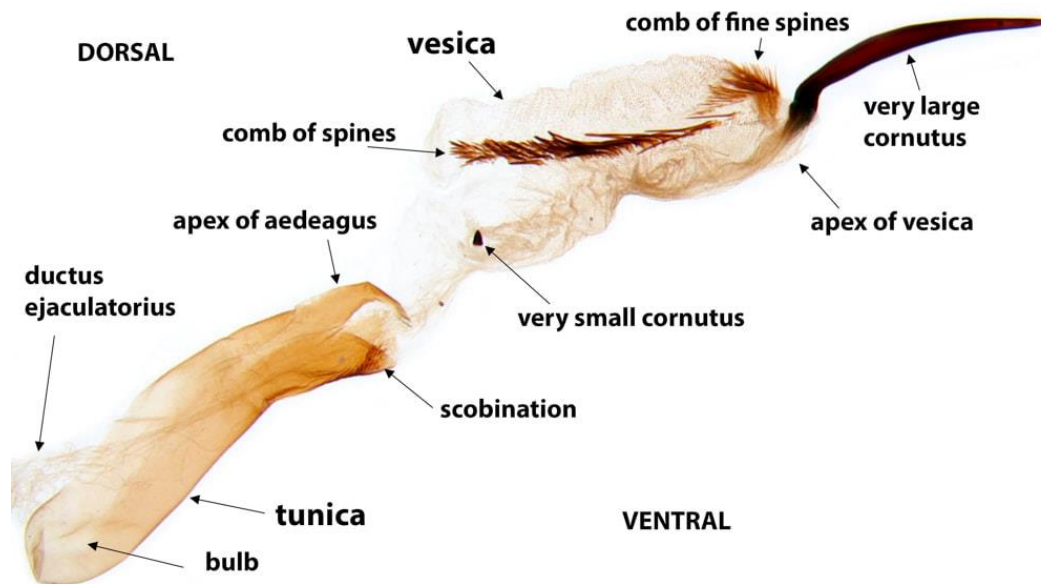


Figure 2: *Conistra rubiginea* (Dotted Chestnut) – aedeagus with vesica everted



The Noctuid aedeagus is usually a robust tube, curved ventrally (concave on its ventral side) or fairly straight, sometimes bulbed at the base, and usually a little shorter than the armature.

Figure 3: Aedeagi. Left – *Noctua comes* (Lesser Yellow Underwing), right – *Leucania comma* (Shoulder-striped Wainscot)

1) Ornamentation of the tunica – apical carinae and junctional bands

The Noctuid tunica shows a wide variety of ornamentation. Some of the range of variation is illustrated in the examples that follow.

Junctional bands are best displayed with the vesica everted. Not infrequently an apical carina marks the origin of a junctional band, and then several views may be required to display all its features.

Noctua comes (fig. 4) shows 2 junctional bands; one of these is a simple sclerotised band clearly connected to the apex of the tunica; the other is a scobinate band with a more tenuous connection to the tunica.



Figure 4: *Noctua comes* (Lesser Yellow Underwing) apex of aedeagus with vesica everted

Anarta trifolii (fig. 5) has a large subapical boss on the right side with a serrate linear carina on its apical side; it also has a very short junctional band (arrowed).

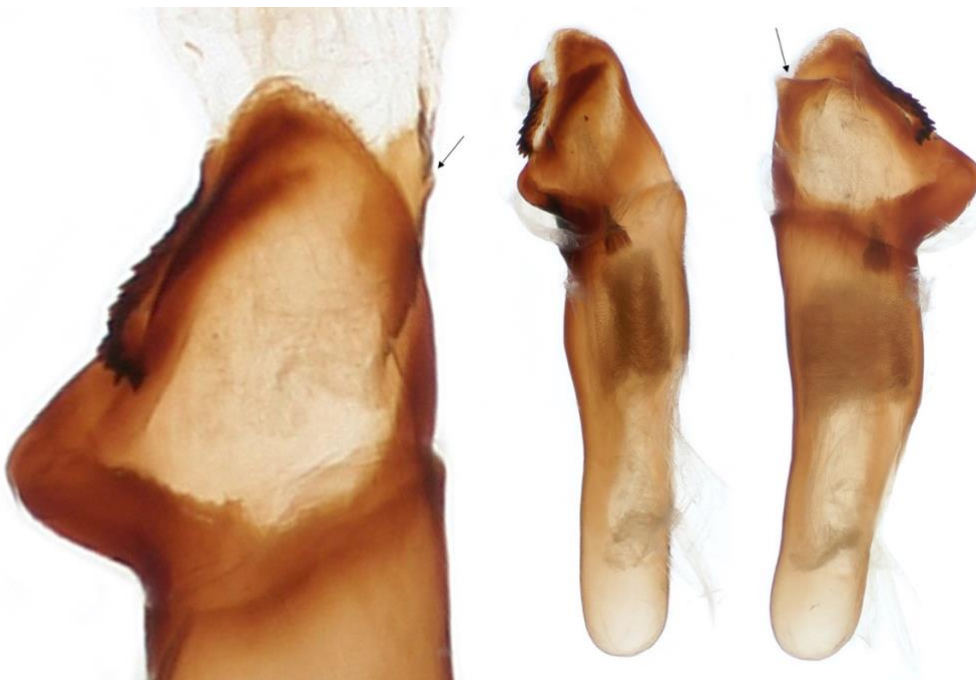


Figure 5: *Anarta trifolii* (Nutmeg) Left – apex of aedeagus with vesica everted, dorsal view; centre – aedeagus, dorsal view, right – aedeagus, ventral view

Orthosia gracilis (fig. 6) shows an increased density of sclerotization around the apex of the tunica, but this is not raised as a carina, and two junctional bands, one of which is bifid. The bifid band is distinctly dentate; the other longer band has a dentate basal carina and a strong subapical boss, much of its length shows a stippled pattern of sclerotization. The adjacent vesica is densely covered in sclerotised plaques with a linear arrangement.



Figure 6: *Orthosia gracilis* (Powdered Quaker) apex of aedeagus with vesica everted

Mesapamea secalis (fig. 7) has a strong dentate plaque at the apex of a junctional band – a junctional cornutus.



Figure 7: *Mesapamea secalis* (Common Rustic) apex of aedeagus with vesica partially everted

Arenostola phragmitidis (fig. 8). The apex of the tunica has a strong apical carina with two strands of dense sclerotization leading to a very strong laterally-directed process. The vesica has a comb of spines of variable size.



Figure 8: *Arenostola phragmitidis* (Fen Wainscot) aedeagus with vesica everted

Polymixis flavocincta (Fig. 9) has a bundle of needles ornamenting the apex of the tunica on the external surface. This bundle closely resembles a bundle of cornuti. If cornuti were defined as being a feature of the vesica this unusual situation would be problematic. So, in defining cornuti we have to allow for the possibility of them appearing on the external surface of the tunica.



Figure 9: *Polymixis flavocincta* (Large Ranunculus) aedeagus

In *Orthosia incerta* (fig. 10) the tunica bears a strong apical spine.



Figure 10: *Orthosia incerta* (Clouded Drab) apex of aedeagus with vesica everted

2) Sclerotisation in the vesica

I propose 6 general types of sclerotization of the vesica:

1. Suffusion – confluent sclerotization that is not raised from the surface, though it may occur in areas of vesica that are rugose or otherwise textured.
2. Stippling – any pattern of fine sclerotization in a predominantly hyaline area. It ranges from fine to coarse, diffuse to dense, but is always flat (not raised from the surface of the vesica when viewed in a standard binocular microscope at 40x magnification).
3. Spiculation – any pattern of fine sclerotization in which the individual sclerotised spicules are longer than broad with a pointed apex raised from the surface.
4. Plaques – any patch in which confluent sclerotization is thickened, but not raised above the surface sufficiently to be a cornutus.
5. Studding – coarse sclerotization raised above the surface, each stud broader than long and not pointed.
6. Cornuti – distinct sclerotisations that are clearly raised from the surface of the vesica.

There is some overlap between these types and one type often merges into another. The next few pages and images present some of the variety of stippling and plaques seen in the Noctuidae. Cornuti will be presented in the following section.

Agrochola lychnidis (fig. 11) shows typical stippling of the vesica.

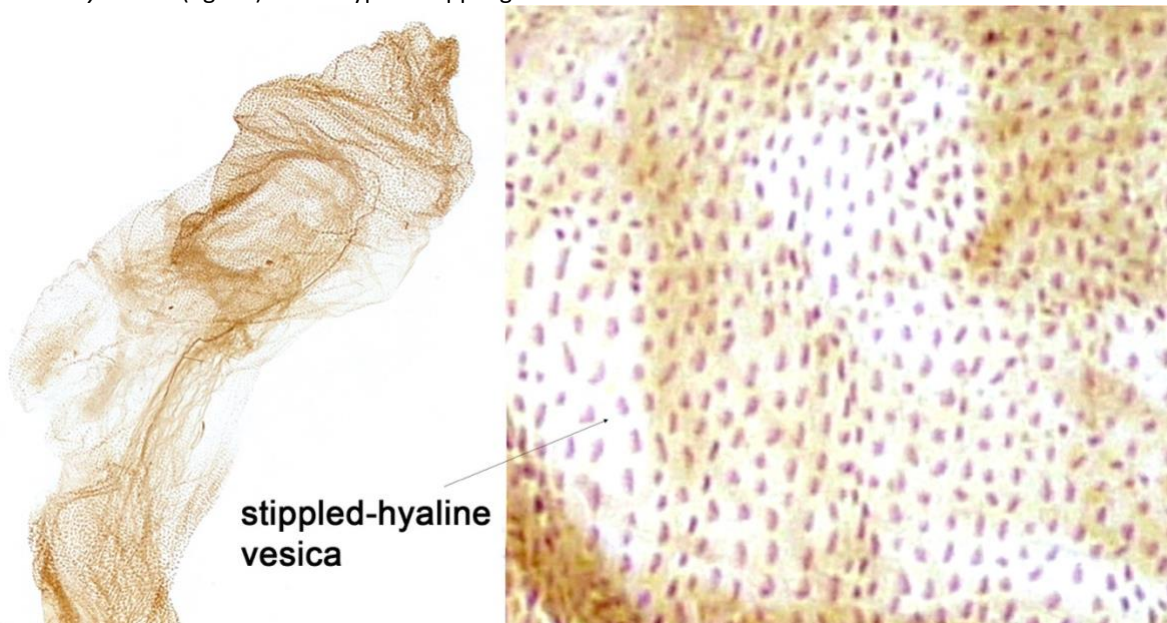


Figure 11: *Agrochola lychnidis* (Beaded Chestnut) vesica

Noctua comes (fig. 12) shows a range of stippling and spiculation from very fine to very coarse (and a small cornutus).

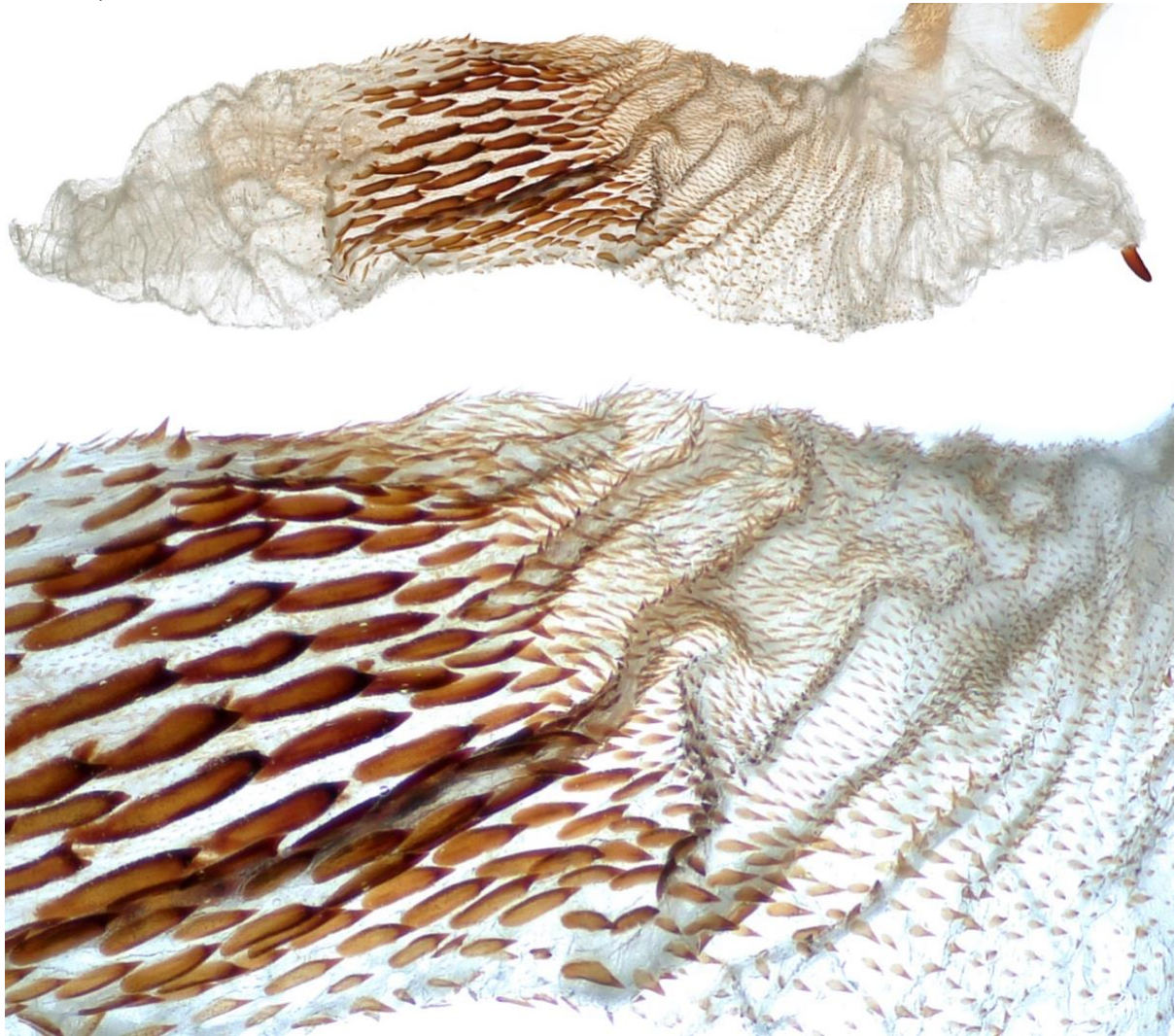


Figure 12: *Noctua comes* (Lesser Yellow Underwing) everted vesica, with an enlargement of the central area

Noctua janthe (fig. 13) has a rugose plaque in the vesica



Figure 13: *Noctua janthe* (Lesser Broad-bordered Yellow Underwing) part of vesica

Diloba caeruleophala (fig. 14) has a densely spiculate vesica with a stippled plaque

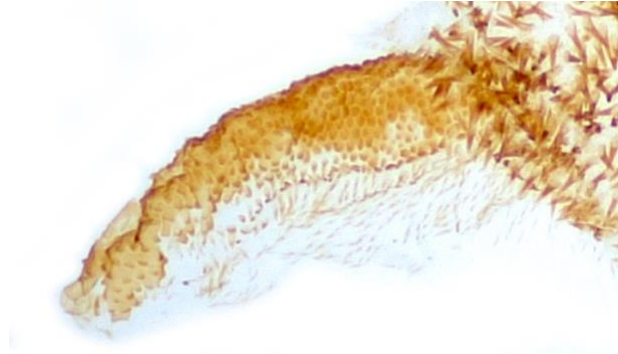


Figure 14: *Diloba caeruleocephala* (Figure-of-eight) part of vesica

Simyra albovenosa (Fig. 15) has a spined plaque and a rugose plaque

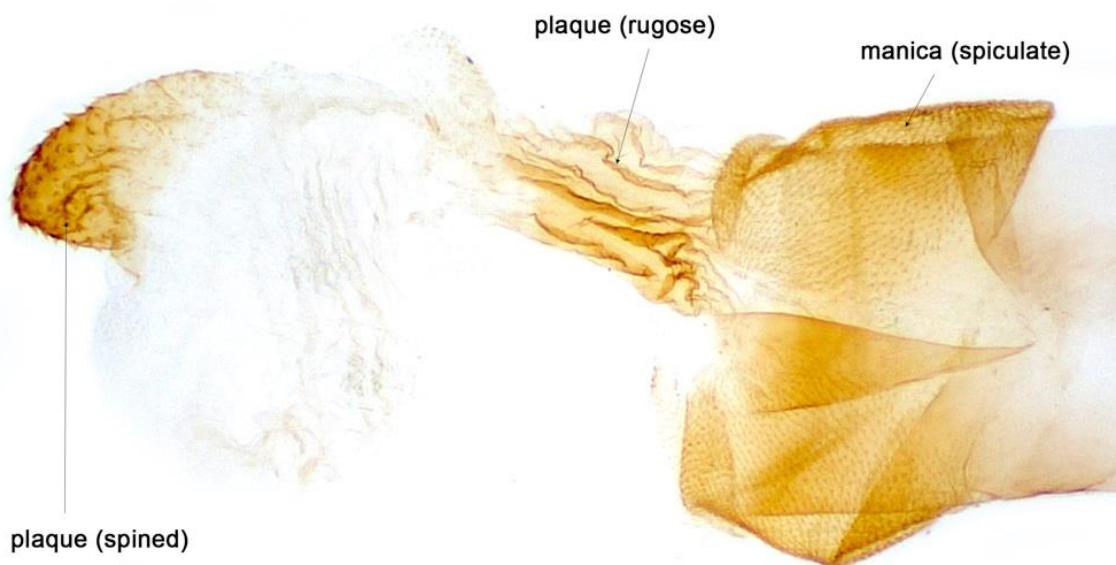


Figure 15: *Simyra albovenosa* (Reed Dagger) apex of aedeagus with vesica everted

3) Cornuti

I propose 8 overlapping types of cornuti.

- **Needles:** elongate, parallel-sided for most of their length, with a pointed apex and usually fairly straight.
- **Spines:** elongate, tapering from base to apex over most of their length, with a pointed apex and may be straight or curved.
- **Thorns:** with a distinct broad basal portion and a tapering apical portion, with a pointed apex and usually curved. Typical thorns have a flat base plate and an elongate curved spike.
- **Horns:** are longer than broad with a rounded apex, straight or curved.
- **Studs:** are very short, usually small and broader than long, with a round base.
- **Plaque-cornuti:** are broader than long, but not small and round; they may be, smooth, horned, scobinate, dentate or ridged.
- **Irregular:** not fitting any of the above patterns
- **Junctional:** either situated at the apex of the tunica or on a junctional band

All cornuti have a base in contact with the vesica (or the apex of the tunica) and are raised away from the surface. Needles and spines have the base and projection of similar diameter. Thorns have a base distinctly broader than the spike. The essential feature of a horn is that it tapers to a rounded apex, so it has to have a large enough diameter over much of its length to make a reasonable determination that the apex is not pointed. Studs and plaques have a greater diameter at the base in contact with the vesica than the length of the projection away from the vesica.

Needles, spines, thorns and horns may have a bulbed base, giving each of them a bulbed subcategory e.g. 'bulbed horn'.

In suggesting this classification, I recognise that the range of variation within, and overlap between the types, and the clustering of cornuti of differing shapes, often makes it problematic to apply these terms unequivocally.

Needles and spines are often arranged in groups:

- Comb: with a single line of needles or spines
- Brush: set in a linear band more than one needle or spine in width
- Ribbon: as for brush but very elongate
- Cluster: a group of needles or spines which are not arranged as a comb or brush, in which the cornuti are longer than the longest diameter of the base of the group
- Mat: a group of needles or spines which are not arranged as a comb or brush, in which the cornuti are shorter than the longest diameter of the base of the group

Some of the range of variation of cornuti is given in the illustrations that follow.

Leucania comma (fig. 16) shows a finely stippled vesica with a single moderate slightly sinuate spine, a small mat of spines and a larger elongate mat of densely packed spines



Figure 16: *Leucania comma* (Shoulder striped Wainscot) everted vesica

Orthosia gracilis (fig. 17) shows a single bulbed horn and a cluster of small to moderate spines. The horn is set at the apex of a short diverticulum adjacent to an area in which the vesica shows a linear arrangement of plaque. The cluster is set at the apex of a longer diverticulum with a stippled-hyaline membrane.



Figure 17: *Orthosia gracilis* (Powdered Quaker) cornuti

Acrionicta alni (fig. 18) has a mat of spines set on a diffusely sclerotised rugose base; much of the rest of the vesica is stippled-hyaline; the tunica has a spiral band of dense apical sclerotization but no carinae or junctional bands.



Figure 18: *Acrionicta alni* (Alder Moth) left – aedeagus, centre – aedeagus with vesica everted, right everted vesica, lateral view

Nyctobrya muralis (fig. 19) has two horned plaque-cornuti, one larger than the other. The tunica is without apical carinae or junctional bands. The vesica is diffusely stippled.



Figure 19: *Nyctobrya muralis* (Marbled Green) everted vesica

Hydraecia micacea (fig. 20) has a large bulbed horn and a dentate plaque-cornutus. The latter is in a position close to the apex of the tunica and could be termed a junctional cornutus, but it is not on a junctional band and is more strongly associated with a sclerotised plaque in the vesica. There is suffusion of the vesica in contact with the tunica, but this does not amount to a junctional band. The apex of the tunica shows a dentate patch and a scobinate patch.



Figure 20: *Hydraecia micacea* (Rosy Rustic) above – aedeagus with everted vesica, below – detail showing cornuti

Apamea remissa (Fig.21) has a spine arising from a rugose plaque, a situation that appear to be intermediate between a standard spine and a bulbed thorn; i.e the bulb of a bulbed cornutus is a further development of a rugose plaque of the vesica. The illustration also shows 2 strong junctional bands one of them with a dentate apical sclerotisation that is intermediate between a boss and a plaque cornutus.



Figure 21: *Apamea remissa* (Dusky Brocade) 2 views of the apex of the aedeagus with the vesica everted

Amphipyra berbera (fig. 22) has a brush of a variety of bulbed spines and twisted needles some of which have slightly clubbed apex, and a short comb of much shorter spines close to the apex of the tunica.



Figure 22: *Amphipyra berbera* (Svensson's Copper underwing) everted vesica

Some cornuti are irregular not fitting the usual patterns. In *Orthosia cerasi* (fig. 23) the individual cornuti are very fine, almost hair-like, and arranged in a swirl. The tunica has two junctional bands, one long and one short. The vesica is mostly stippled-hyaline with some areas much more densely stippled than others and it also shows a small series of long linear plaques.



Figure 23: *Orthosia cerasi* (Common Quaker) left – apex of aedeagus with vesica everted, right – cornuti