

# A BILATERAL GYNANDROMORPHIC *HARMACLONA TEPHRANTHA* FROM INDONESIA (LEPIDOPTERA: TINEIDAE)

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**ABSTRACT.**— The external morphology of a bilateral gynandromorphic tineid moth, *Harmaclona tephrantha* (Meyrick), is discussed. Both male and female sexual characters are approximately evenly divided between the left (female) and right (male) halves of the body, as shown by wing, abdominal, and genital structures. A brief review of the causes of gynandromorphism is provided, along with references to previous publications which discussed the genital morphology of gynandromorphic Lepidoptera.

**KEY WORDS:** *Abraxas*, Asia, Bhutan, Brunei, chromosomes, Diptera, Geometridae, gynandromorph, *Harmaclona*, homology, Lycaenidae, *Micrerethista*, *Mitoura*, morphology, Nymphalidae, Oriental, *Pseudatteria*, Southeast Asia, *Speyeria*, Sri Lanka, Sulawesi, Thailand, Tortricidae.

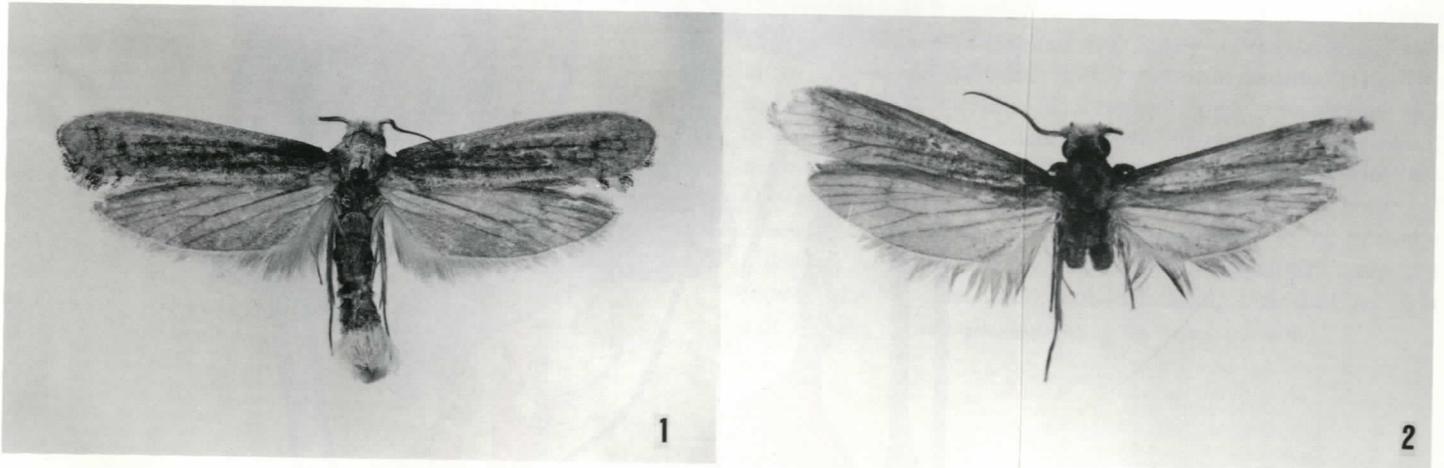


Fig. 1-2. *Harmaclona tephrantha* adults. 1. Normal female (29 mm); note abdominal corethrogne. 2. Bilateral gynandromorph, with female left half and male right half (21 mm). Wing spread in parentheses.

Gynandromorphism has probably been the most frequently reported genetic anomaly within Lepidoptera. The most obvious gynandromorphs are the bilateral forms in which one side is male and the other female, although the division is often imperfect. Mosaic patterns sometimes occur as well as anterior/posterior sexual separations (Cockayne, 1935). Bilateral gynandromorphs are especially remarkable in those sexually dimorphic, predominantly diurnal species—notably, in many butterflies.

Gynandromorphism is believed to result when one of two cytological anomalies occurs: the loss of a sex chromosome during one of the early cleavage divisions (Morgan and Bridges 1919) or to the simultaneous fertilization of a binucleate ovum (Cockayne 1935). Morgan and Bridges showed that gynandromorphs in most *Drosophila* are caused by the elimination of the

X-chromosome at the first division of the fertilized ovum or during mitosis at some subsequent cell division. They also concluded that most lepidopterous gynandromorphs are produced in the same manner, based on their study of *Abraxas grossulariata* Linnaeus (Geometridae). In Lepidoptera the sex chromosome lost is a Z-chromosome, the male being homozygous (ZZ) and the female heterozygous (ZW).

Cockayne (1935) questioned whether chromosome elimination was responsible for most gynandromorphs in Lepidoptera. Instead, he proposed that large numbers of lepidopterous gynandromorphs may have arisen from the fertilization of a binucleate ovum by different spermatozoa. Robinson (1971) explained that the latter is not a simple process because sex in Lepidoptera is determined by the heterogeneity of the sex chromosome in the

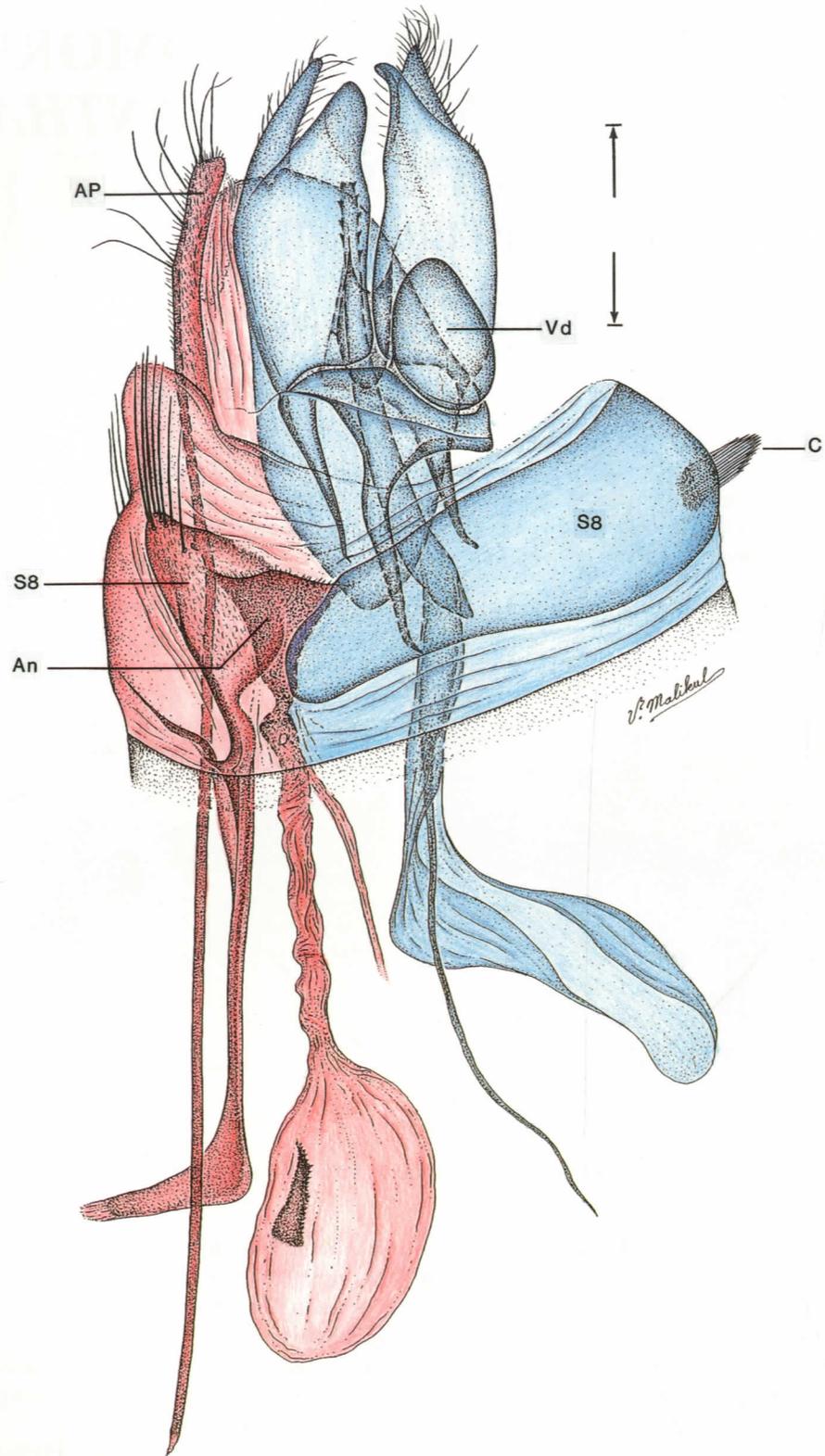


Fig. 3. *Harmaclona tephrantha*, bilateral gynandromorphic genitalia, ventral view, and eighth segment. Female left half shown in red, male half in blue. Scale = 0.5 mm. (An = antrum, AP = anterior apophysis, C = corematis, S = sternum, Vd = valvoid)

female. In normal oogenesis three abortive nuclei (or polar bodies) are produced as the result of two unequal meiotic cell divisions. The eventual egg nucleus is usually the one that has become the most centrally positioned within the ovum, while the polar bodies are those that move to a more peripheral position to be later pinched off and discarded. Robinson (1971) proposed two main scenarios in which a binucleate ovum could be formed. The simplest would be for one of the products of the first polar body to move into the central part of the ovum. Thus, there would be two centrally placed nuclei, each available for fertilization. A second method would be the accidental inclusion of two nuclei in the same egg, a process observed by Doncaster (1914) in the oogenesis of *Abraxas grossulariata* (Geometridae).

Although numerous reports of gynandromorphs are scattered through the Lepidoptera literature, typically little mention is made of morphological modifications other than the obvious color dimorphism. One of the earlier papers (Kusnezov, 1916) is all the more valuable in that it treats in some detail the genital morphology of several gynandromorphs. The five species examined by Kusnezov represented both bilateral and mosaic gynandromorphs that possessed either predominantly male or female genitalia. Not content with merely portraying bizarre examples, Kusnezov reviewed the homology of male and female structures using the uniquely paired structural matchups presented by bilateral gynandromorphy. In particular, Kusnezov showed the male uncus to be the homologue of the paired anal papillae, thus indicating that a divided uncus represents a more primitive state than does the fused condition. He reconfirmed the tegumen to be a complex structure homologous to the fused ninth and tenth tergites of the female. He also reported a paired structure, the papillae genitales (morphologically the inner pair of the gonapophyses), in the ninth segment of the female to be homologous to the male valvae.

Obraztsov (1962) discussed at some length the morphology of an unidentified gynandromorphic tortricid, *Pseudatteria* species. He reported the right half of the genitalia to be typically male and the left half female. Because of the extent of morphological change, he could not place the specimen to species and suggested that it could be undescribed. The genital morphology of a bilateral mosaic gynandromorph of *Mitoura gryneus* (Hübner) (Lycaenidae) was illustrated by Shuey (1984). Shuey also compared the predominantly male genitalia to a normal male. The right half of this specimen was typically male with the left half of both the wing pattern and genitalia consisting of a mosaic of male-female features. More recently, Skillman and Heppner (1992) report the genitalia of a bilateral gynandromorph of *Speyeria diana* (Cramer) (Nymphalidae) also to be sexually bilateral. Although the genitalia of this specimen were not figured, the left side was described as being male and the right side female, as was also shown in the wing pattern.

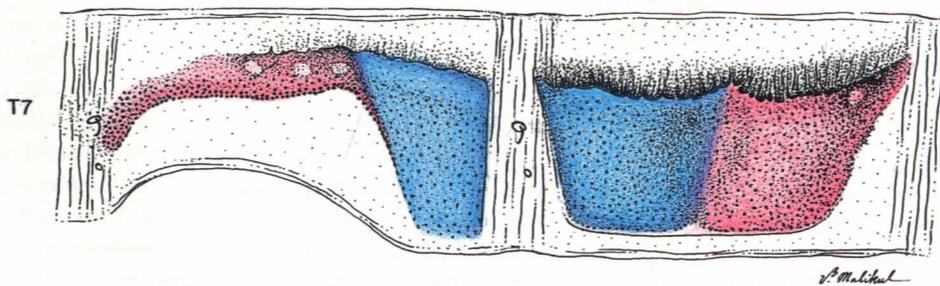
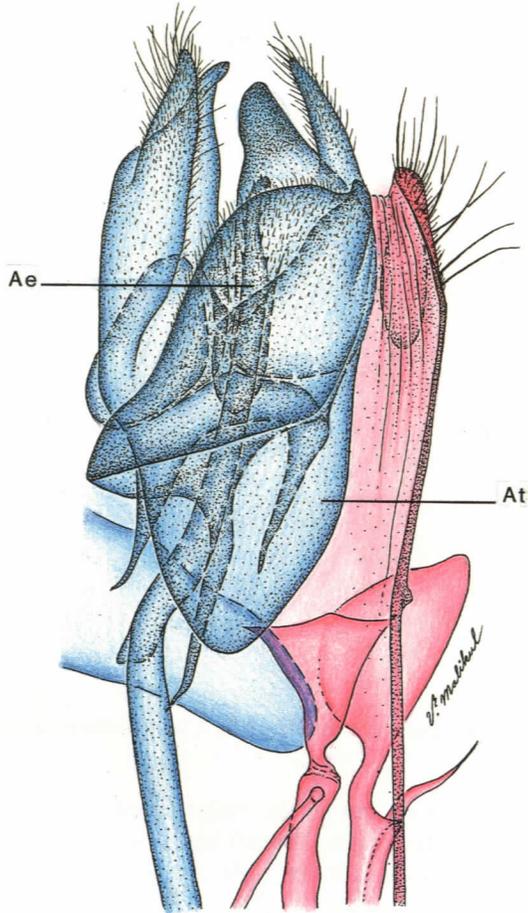


Fig. 4-5. *Harmaclona tephrantha*: 4. Bilateral gynandromorphic genitalia, dorsal view. Female half in red, male in blue. Scale = 0.5 mm. (Ae = aedeagus, At = apotheca). 5. Bilateral gynandromorphic seventh abdominal segment. Female half in red, male in blue. Scale = 1 mm. (T = tergum)

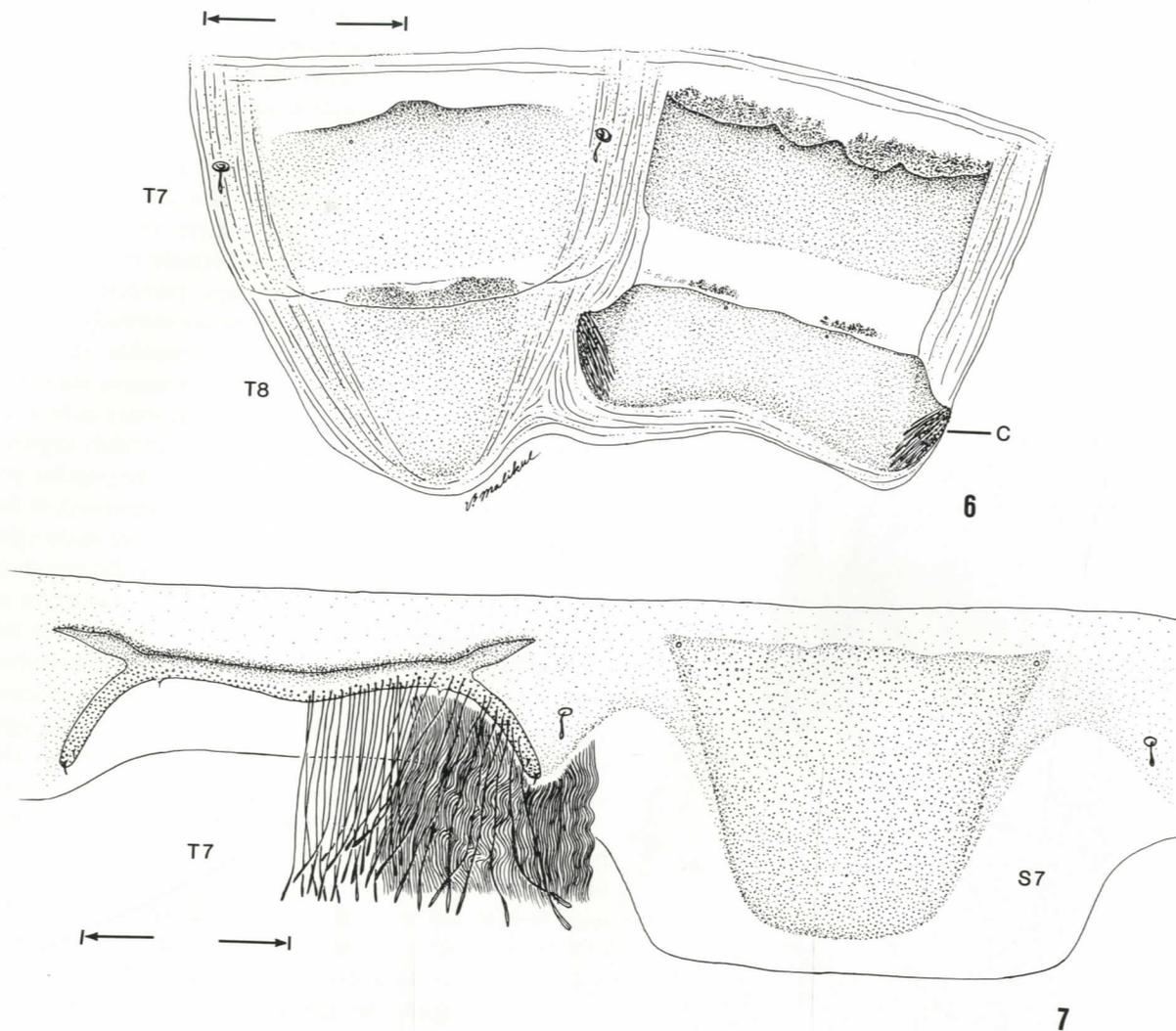


Fig. 6-7. *Harmaclona tephrantha*, normal male and female abdominal segments: 6. Male, segments 7 and 8. 7. Female, segment 7, with corethogyne partially illustrated. Scales = 1 mm. (C = corematis, S = sternum, T = tergum)

### *Harmaclona tephrantha* (Meyrick)

In the course of my studies on the tineid genera *Harmaclona* and *Micrerethista*, I have examined a bilateral gynandromorph of *Harmaclona tephrantha*. The specimen (Fig. 2) was collected October 1985 at Hog's Back Camp, 492m, Dumoga-Bone National Park, Sulawesi Utara, Indonesia. The species occurs through southern Asia in generally lowland (0-1300 m) mixed forests from Bhutan and Sri Lanka eastward through Thailand and Indonesia as far as Brunei. The sexes of this species are similar in wing pattern with the females (Fig. 1) generally larger in size.

The gynandromorph is almost equally divided into a masculine right side and a feminine left side. The right forewings are distinctly smaller, measuring 10mm long and 2.0mm broad at their greatest width (subapically across at the apex of the discal cell), compared to 11.2mm and 2.6mm respectively for the female left wing. The hindwings are also sexually distinct, with a single large frenulum present on the right side and two smaller frena on the left. The antennae of *H. tephrantha* are likewise sexually

dimorphic with that of the males shortly bipectinate to nearly filiform in the female. The left antenna in the gynandromorph is typically female, but the right antenna is largely missing and could not be examined.

The abdominal sclerites of both *Harmaclona* and its sister genus, *Micrerethista*, demonstrate pronounced sexual dimorphism. Arising from the seventh tergum (T7) of the female is a large mat of fine hairs (corethogyne). In addition, the tergite is reduced to a slender transverse sclerite (Fig. 7), which in the male is unmodified and typically quadrate in form (Fig. 6). The males usually possess a small bilateral pair of scale tufts (coremata) on the eighth sternum which are lacking in the greatly reduced S8 of the female. In the gynandromorph the bilateral separations of these sexually dimorphic specializations are maintained (Fig. 5). More than one half of the left side of T7 resembles the typical female condition, complete with corethogyne (only partially shown); the right side of the tergite broadens to resemble the male counterpart. Even the only slightly dimorphic seventh sternite has preserved its sexuality, with the left margin more

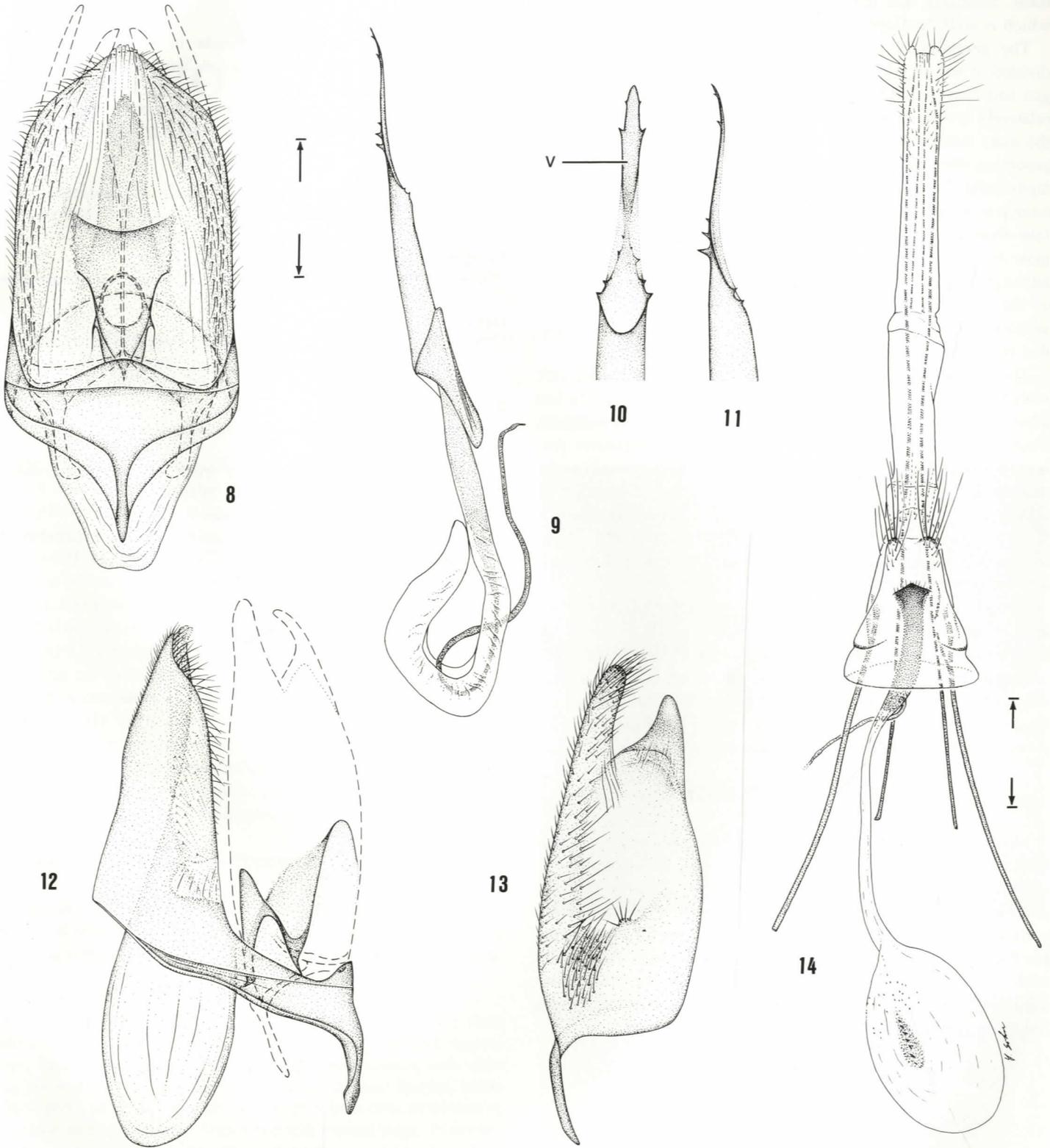


Fig. 8-14. *Harmaclona tephrantha*, normal genitalia: 8. Male genitalia, ventral view (0.5 mm). 9. Aedeagus, lateral view. 10. Apex of aedeagus enlarged, ventral view. 11. Lateral view of figure 10. 12. Lateral view of figure 8. 13. Right valva. 14. Female genitalia, ventral view (1 mm). Scale lengths in parentheses. (V = vitta)

tapered than the right (Fig. 5), thus resembling the normal female form. Similarly, the left side of S8 lacks the male corematis which is well developed on the masculine right side (Fig. 3).

The genitalia of bilateral gynandromorphs can be equally divided or not. In either case, the unpaired organs (e. g., aedoeagus and bursa copulatrix) usually appear nearly normal. In the relatively few examples reported (Obraztsov, 1962; Shuey, 1984), the male morphology tends to predominate, with extra lobes or processes often evident. This is true for the gynandromorph of *H. tephrantha* (Fig. 3-4). The male genital component is the most complete with both valvae represented as well as a small valvoid lobe from the base of the right valva. Comparison with typical male *H. tephrantha* (Fig. 8-13) reveals that the gynandromorph, although noticeably deformed, is still recognizable to species. One of the most diagnostic features of this species is the elongate, spinose projection (vitta, Fig. 9-11) at the apex of the aedoeagus that is also evident in the gynandromorph.

The female component in Fig. 3-4 consists only of the left side with no duplication of the other half. The left anal papilla lies adjacent to the almost fully developed, fused uncus-tegumen. Those portions of the posterior apophysis and ovipositor preserved appear relatively normal but shorter than is typical for the species (Fig. 14). The anterior apophysis is more deformed, with a thickened, sharply bent anterior end. The bursa copulatrix is largely intact but more reduced in length. The antrum, ductus bursae, and signum, in particular, are much shorter than normal, and the signum is more sclerotized.

Because the abdomen of this specimen was prepared for study in the customary manner by maceration in KOH, the 'soft' portions of the reproductive anatomy could not be examined. I am unaware of any studies of this nature involving bilateral gynandromorphs. Consequently, it would be of some interest if the internal reproductive morphology of such a specimen could be properly preserved and studied eventually.

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