BIOLOGY OF RICE THRIPS IN SRI LANKA
Stenchaetothrips (Baliothrips) biformis (Bagnall)

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SUMMARY

In Sri Lanka rice thrips *Stenchaetothrips (Baliothrips) biformis* (Bagnall) are found predominantly in the nurseries and in the seedling stage of rice crop. Biology of this insect has been investigated under planthouse conditions.

Sexes are separate. Eggs are laid in the upper epidermal tissue of the rice leaves. Life cycle of the insect is completed in the same host plant and it requires a period of 10 to 12 days. Both larvae and adults feed on the plant sap by puncturing the epidermis using the mouth cone. They pupate on the paddy plants within rolled leaves.

Comparing the morphological details of the adult with those of the Indian strain there are differences in the measurements of the head, prothorax, pterothorax, total body length and the forewing. The Sri Lankan strain is slightly bigger.

INTRODUCTION

Stenchaetothrips biformis (Bagnall) is a major pest of rice seedlings in Sri Lanka. This insect is also of economic importance as a rice pest in India, Thailand, Pakistan, Taiwan, Indonesia, Malaysia, Japan, Philippines and Vietnam. A survey of the literature showed that work on the biology and ecology of this pest was scanty. The only available description of *S. biformis* was that of Williams (1916) where some aspects of the morphology of this species have been briefly described.

This study of the biology of *S. biformis* was undertaken with a view to develop a mass-rearing technique as a first step for the screening of rice varieties for resistance to this pest. Resistant varieties emerging from such studies could be used as resistant donors in a breeding programme for commercial rice varieties.

MATERIALS AND METHODS

A regular supply of adults and larvae for these experiments was obtained from a laboratory culture of rice thrips *S. biformis*. For the culture, germinated rice (variety IR8) was planted in wooden boxes (23 × 15 × 8cm) at a spacing of 2.6 × 1.4cm. The seeds were planted at the rate of one per planting point. Seven to ten-day old seedlings were infested with adults obtained from the culture.

Temporary mounts of different stages of the life cycle were prepared for microscopical observation using the following technique. A chemical solution (60 percent ethyl alcohol, 10 parts + glycerine, 1 part + glacial acetic acid, 1 part) was used to preserve adults and larval forms. These specimens were removed from the above preservative and dehydrated through a series of alcohol and cleared in clove oil, xylol and mounted in Canada Balsam.

The life cycle and morphology of rice thrips was investigated on IR8 rice seedlings under planthouse conditions. Two day-old insects (a female and a male) were introduced on to the seedlings in a plastic pot (10 cm diam.). Observations on oviposition were recorded daily. Observations on hatching of eggs were recorded twice a day (8 a m and 4 p m). The larvae thus collected were used to observe the different stages, and to determine the duration of larval periods. Observations were made on fecundity, longevity of males and females and their sex ratio.

Morphological characters from slide preparations were sketched using a stereo-binocular microscope at a magnification of 400.

RESULTS AND DISCUSSION

Pest Description and Symptoms of Damage

S. biformis is a minute blackish-brown insect which is common in most parts of Sri Lanka on the younger leaves of rice in the seedling stage.

Two sexes of *S. biformis* show marked differences in size, colour and genitalia. Ratio of females to males is 6 : 1. Adults usually mate 3 to 4 days after emergence (Lewis, 1973). Eggs are inserted in the upper epidermal tissue of rice leaves and the entire life cycle is completed on

a single host plant. Larvae pupate within the rolled leaves from where they hatch. Life cycle from egg to adult lasts 10 to 12 days under planthouse conditions at an average day temperature of 27°C and a night temperature of 24°C.

According to Lewis (1973) who provides a detailed review of the literature on this subject, the method of feeding of Thysanoptera is still incompletely understood. Results of *S. biformis* feeding are however clearly apparent in rice seedlings.

Younger leaves are generally attacked in the initial stages of thrip infestation. These leaves continue to remain rolled longitudinally with thrips feeding and multiplying within the rolls. If such leaf rolls are opened as flat laminae for microscopic examinations, minute whitish feeding lesions associated with smaller but similar oviposition lesions are observed. Thrips feeding at high population intensities result in gradual collapse of leaf tissue and finally in the young leaves turning dull-brown. Discoloured areas coalesce and the whole leaf may dry up. This silvering and yellowing of leaves is often termed "white blight", "white spot" or "yellow spot" (Lewis, 1973). Thrips damage can be recognized even at a distance by this characteristic discolouration of the younger leaves of rice seedlings. Damage caused by thrips is quite different from that caused by leaf eating caterpillars.

Oviposition and Embryonic Development

S. biformis inserts its eggs singly in an incision made in the upper epidermal tissue by the ovipositor (Fig. 1). Eggs are laid either in short rows parallel to veins or they may be randomly distributed. In all cases the end of the egg which eventually becomes the cephalic end lies immediately beneath the epidermis with an egg resting among the pallisade cells at an angle with the upper leaf surface.

Eggs laid in the leaves can be seen as minute translucent swellings when viewed in transmitted light. Oviposition lasts 3 days: average egg lay is 14 to 24. Eggs (Fig. 2) are whitish in colour, with the chorion very delicate and transparent. On an average an egg measures 0.033mm in length and 0.015mm in width.

Eggs gradually change in shape with the advancement of embryonic development. Pigmentation of the eye spot is apparent 48 hours after incubation. Abdominal segmentation is clearly apparent on the third day.

Eclosis occurs at the end of the incubation period with the larva pushing itself out on the leaf surface; the head emerging first and then head region and thorax moving forwards and backwards. Initially the antennae are bent under the head while the legs flexed under the body. With the antennae and legs gradually extending to functional position the larvae move out of the chorion on to the rice leaf surface.

Immature Stages

First instar larvae (Fig 3A) are pale yellow and on average 0.835mm long and 0.232mm wide across the thorax. The head bears a short pair of seven segmented antennae and a pair of red pigmented eyes. The body is covered with long bristles. Newly hatched larvae are completely transparent but develop a few patches of colour with the ingestion of food While feeding larvae move slowly on the leaf surface. As feeding continues the young leaf rolls up longitudinally providing them with protection. First instar larvae nearly double their size in 3 to 4 days, after which they moult.

Second instar larvae (Fig. 3B) are white to light yellow and resemble the first instar except for the larger size. The body is on an average 1.161mm long and 0.234mm wide across the thorax. Eyes are large and black Long bristles are scattered all over the body with slightly longer ones being distributed on the last two abdominal segments. The second instar lasts 24 to 36 hours after which the larvae cease feeding and enter a less active prepupal stage (Fig. 3C).

The prepupal stage of *S. biformis* is pale yellow, the body measuring 1.05mm in length and 0.234mm in width, is very delicate. Eyes are red Small wing buds are visible at this stage and the antennae are freely directed forward. Other characters are essentially larval in nature. The prepupal stage lasts about 24 hours at the end of which pupation occurs.

The pupa (Fig. 3D) of *S. biformis* is pale yellow. The body is 0.973mm long and 0.234mm wide across the thorax. Pupal antennae are slightly longer than those of the prepupa and are deflected over the prothorax. Wing buds are longer than prepupa. Eyes are red. Fine bristles are scattered all over the body, with those on the last two abdominal segments being somewhat longer. Developing genitalia are visible in the abdominal region of the pupa. Ecdysis occurs at the end of 24 to 48 hours and a light brown adult of *S. biformis* emerges.

Adult

Adult females (Fig. 4) have a dark brown body. The head is blackish-brown and the thorax is lighter. The body is on an average 1.368mm long and 0.253mm wide across the thorax. The head is 0.145mm long and 0.140mm wide and is covered with small bristles. Eyes are dark brown and the distance between them is 0.072mm. There are three red ocelli between eyes, arranged in a triangle on the dorsal side of the head. The characteristic long mouth cone (Fig. 5) is directed ventrally towards the prothorax. The tip of the cone is black. The mouth cone is formed dorsally by the clypeus and the labrum and laterally by the galleal parts of the maxillae and the mandibles. The labium bears a pair of palps at its tips. There is a piercing organ within the cone, which consists of paired maxillary stylets and the left mandible (Lewis, 1973). The pair of seven segmented antennae (Fig. 6A) is directed forward and it is 0.197mm long.

The prothorax which is freely movable on the pterothorax is 0.134mm long and 0.234mm wide. Lateral aspects are rounded and bear a pair of legs 0.30mm long (Fig. 6B).

The pterothorax is 0.276mm long and 0.234mm wide across the thorax and in the female it bears two pairs of similar legs and two pairs of fringed wings (Fig. 6C and 6D). The last two joints of the legs bear a tarsus with a unique protrusible bladder which helps the insect to walk on most plant surfaces and cling to exposed tips of leaves (Heming, 1971 – 1972).

Wings reach the tenth abdominal segment and bear numerous fine hair-like bristles. Forewings are long and slender with wide marginal fringes. They are 0.73mm long and 0.07mm wide. The membranous fold or the anal area of the forewing is 0.127mm long and bears fine short bristles. The anterior vein bears about eight and the posterior vein eleven short bristles. Hind wings are about 0.648mm long and 0.054mm wide. They are also brown but paler than the forewings.

The ten-segmented abdomen is 0.683mm long and 0.253mm wide. The last two segments usually taper to a cone in the female, whereas the male has a blunt terminal end. The 9th segment is 0.108mm long and the 10th segment is 0.072mm long. There is a short spine at the postero-lateral margin of all segments except in the first segment. Each lateral margin also bears a spine at about the middle of its length. Four longer bristles are

found on the 9th and 10th segments. The ovipositor (Fig. 7) consisting of four curved saw-like valves, is carried beneath the 8th and 9th abdominal segments.

The male *S. biformis* is smaller than the female. The body is on an average 0.96mm long and 0.09mm wide across the thorax. The male has its genital organ (Fig. 8) on the 9th abdominal segment.

CONCLUSION

The time taken by the Sri Lankan strain of *S. biformis* to complete its life cycle was 10—12 days on the rice variety IR8 under planthouse conditions 27°—24° C of this study.

Work done by Williams (1916) on the Indian strain of the rice thrip gives details of adult anatomy. On comparing the morphological aspects with the Sri Lankan strain differences are found in the measurements of the head, prothorax, pterothorax, 9th and 10th abdominal segments, total body length and the forewing as given in Table 1. Although these measurements indicate that the Sri Lankan strain is slightly bigger, the two strains appear to be very much alike.

ACKNOWLEDGEMENTS

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Table 1. Comparison of the morphological measurements of the Sri Lankan and Indian strains of Stenchaetothrips (*Baliothrips*) *biformis*.

Morphological	*Measurements*	*Indian Strain*	*Sri Lankan Strain*
Head	Length	0.110mm	0.145mm
	Width	0.120mm	0.140mm
Prothorax	Length	0.130mm	0.134mm
	Width	0.146mm	0.234mm
Pterothorax	Length	0.172mm	0.276mm
	Width	0.208mm	0.234mm
9th segment	Length	0.081mm	0.108mm
10th segment	Length	0.052mm	0.072mm
Total body Length		1.040mm	1.368mm
Forewing	Length	0.66mm	0.73mm
	Width	0.046mm	0.07mm

LIST OF FIGURES

Figure 1. Cross section of rice (var. IR8) leaf showing an egg of *Stenchaetothrips biformis* within the mesophyll tissue. (*a*) egg contents, (*b*) egg shell, (*c*) cuticle, (*d*) upper epidermis, (*e*) bundle sheath, (*f*) stoma, (*g*) xylem, (*h*) phloem, (*i*) fibres, (*j*) mesophyll cells, (*k*) leaf area damaged by *S. biformis*.

Figure 2. Embryonic development of *S. biformis*.

A. An egg just after oviposition.

B. An embryo developing red pigmented eyes.

C. An embryo developing segments,

D. Fully grown embryo.
(*a*) egg shell, (*b*) eyes, (*c*) segments, (*d*) antennae.

Figure 3. Immature stages of *S. biformis*.

A. First instar larva.

B. Second instar larva.

C. Prepupa.

D. Pupa.

Figure 4. Adult female of *S. biformis*.

Figure 5. Mouth cone of an adult—*S. biformis*.
(*a*) clypeus, (*b*) labrum, (*c*) maxilla, (*d*) maxillary palps, (*e*) stylets, (*f*) labium, (*g*) labial palp, (*h*) antennal sockets.

Figure 6. *A*. Antenna of an adult thrip—*S. biformis*.

B. Thorasic leg of an adult thrip.

C. Hind wing of an adult thrip.

D. Forewing of an adult thrip.

Figure 7. Ovipositor of an adult female of *S. biformis* (enclosed in the abdominal segments).

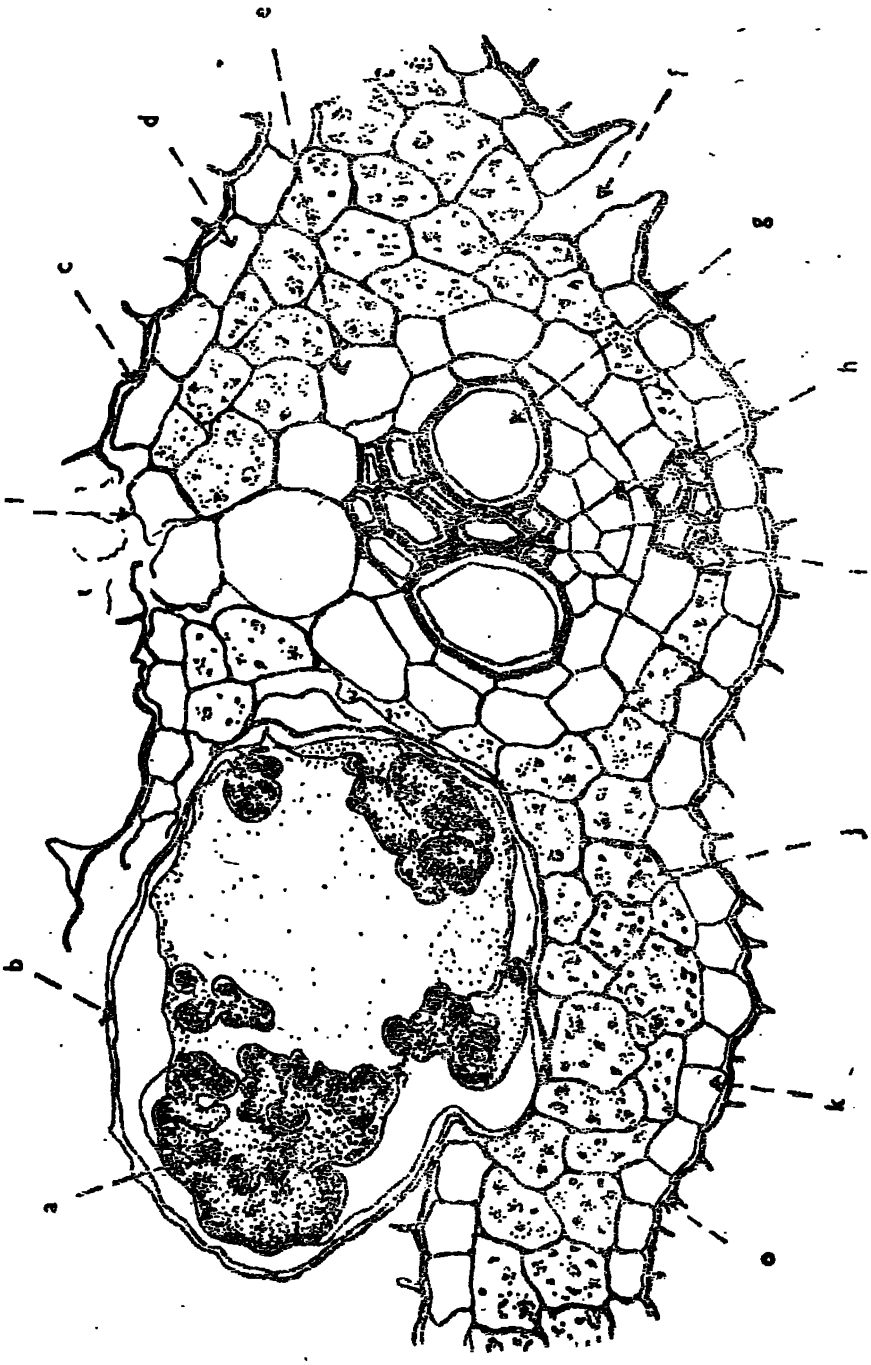
A. Ventral view.

B. Lateral view (ovipositor extruded).
(*a*, *b*, *c*) 8th, 9th and 10th abdominal segments, (*d*) ovipositor.

Figure 8. Abdominal end of an adult male of *S. biformis*.

A. Ventral view.

B. Lateral view.
(*a*, *b*, *c*) 8th, 9th and 10th abdominal segments, (*d*) copulatory organ.



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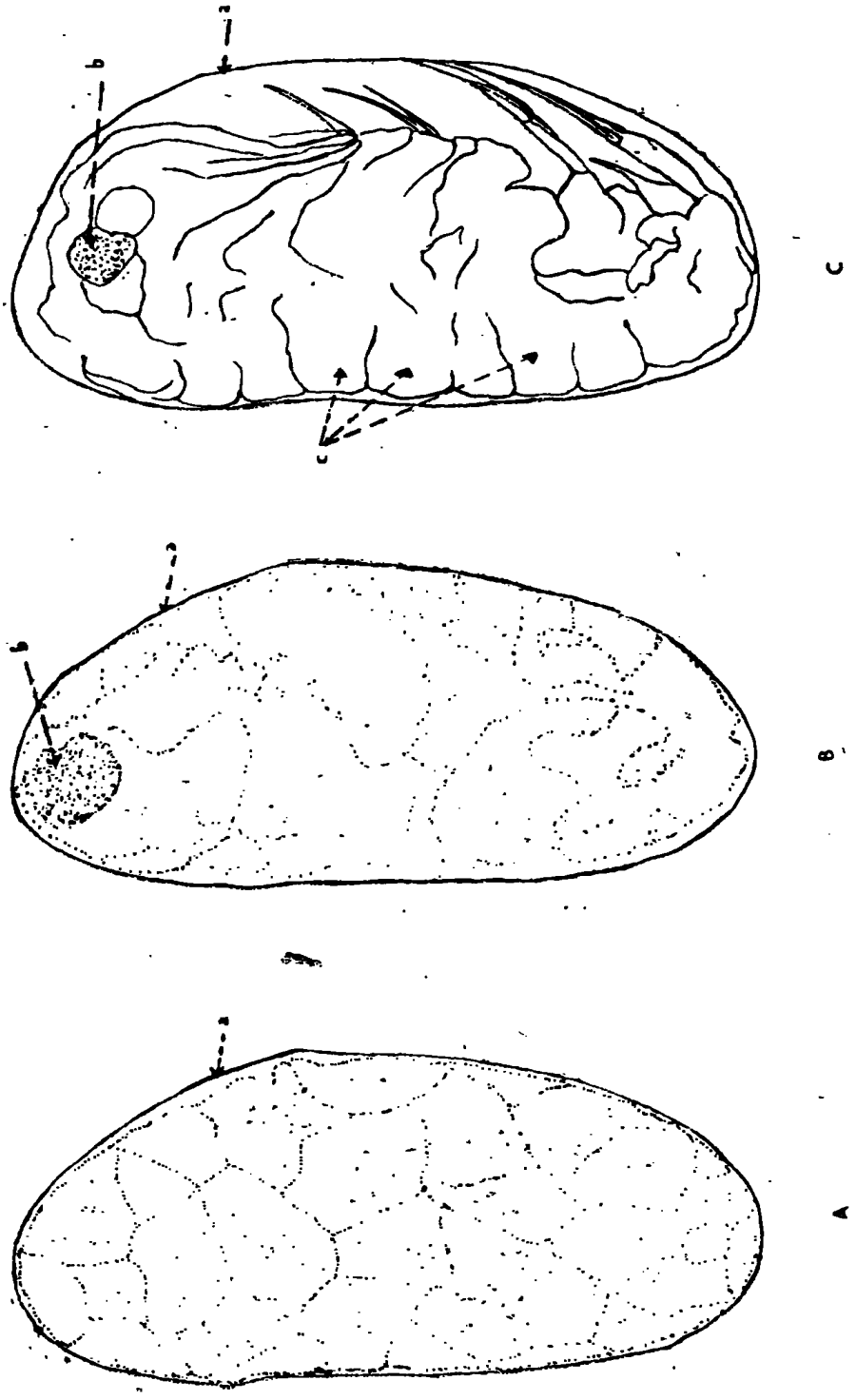

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B. An embryo developing red pigmented eyes.
C. An embryo developing segments.

Figure 2D.

Fully grown embryo.

(*a*) egg shell, (*b*) eyes, (*c*) segments, (*d*) antennae. (Magnification about 10×40).

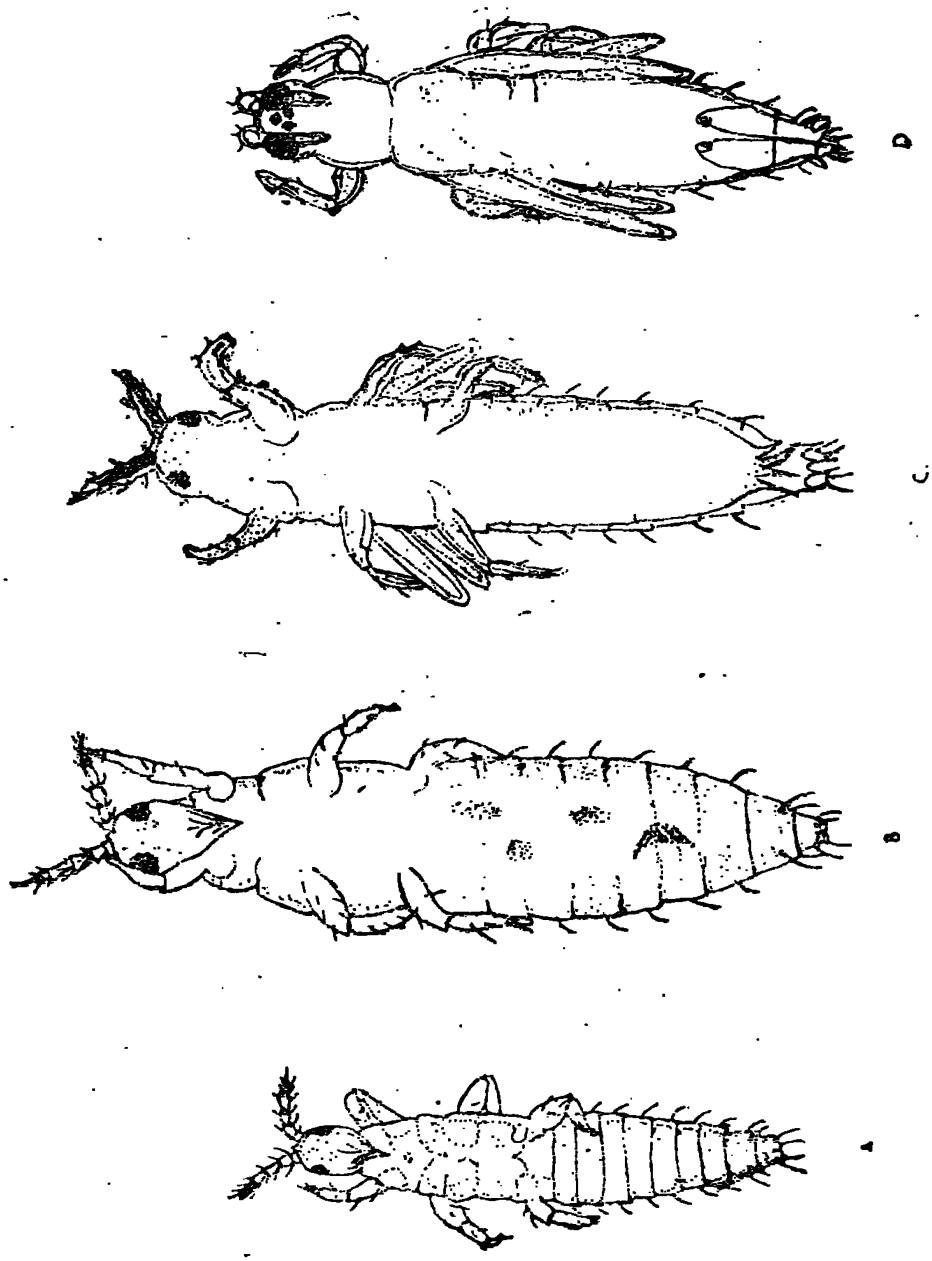


Figure 3. Immature stages of *Stenchaetothrips biformis*.
A. First instar larva. *B.* Second instar larva. *C.* Prepupa. *D.* Pupa. (Magnification about 6×10).

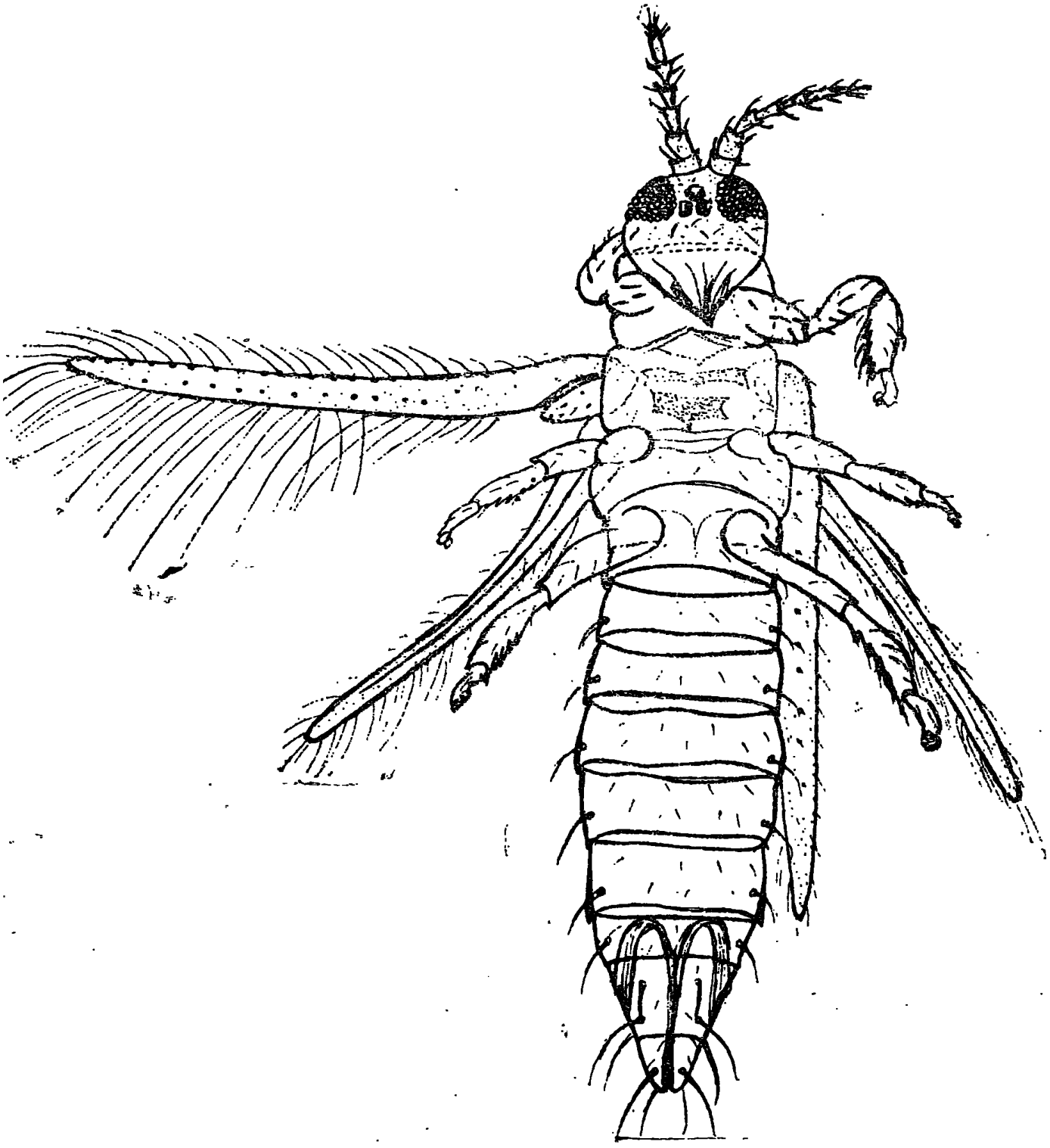
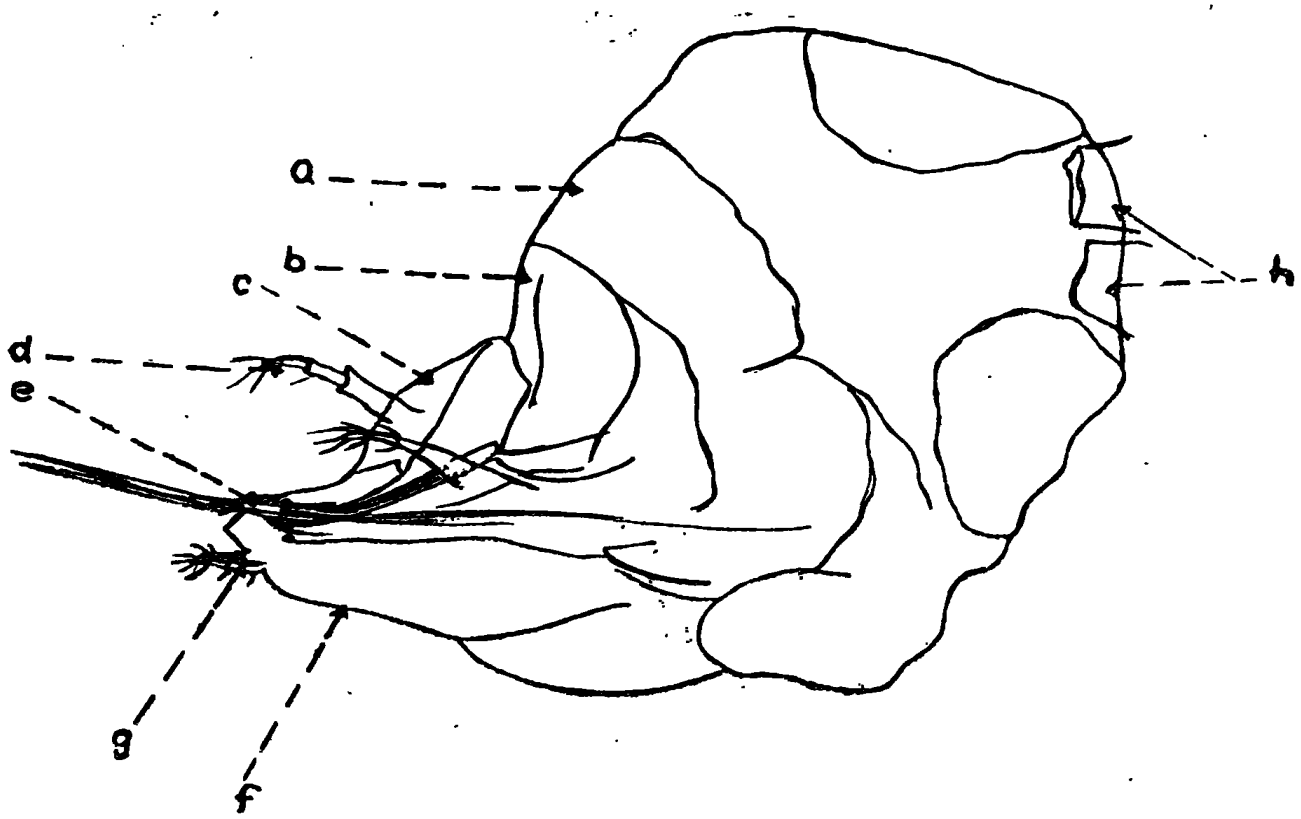


Figure 4. Adult female of *Stenchaetothrips biformis*. (Magnification about 6 × 10).



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(*a*) clypeus, (*b*) labrum, (*c*) maxilla, (*d*) maxillary palps, (*e*) stylets, (*f*) labium, (*g*) labial palp, (*h*) antennal sockets,
(Magnification about 5×40).

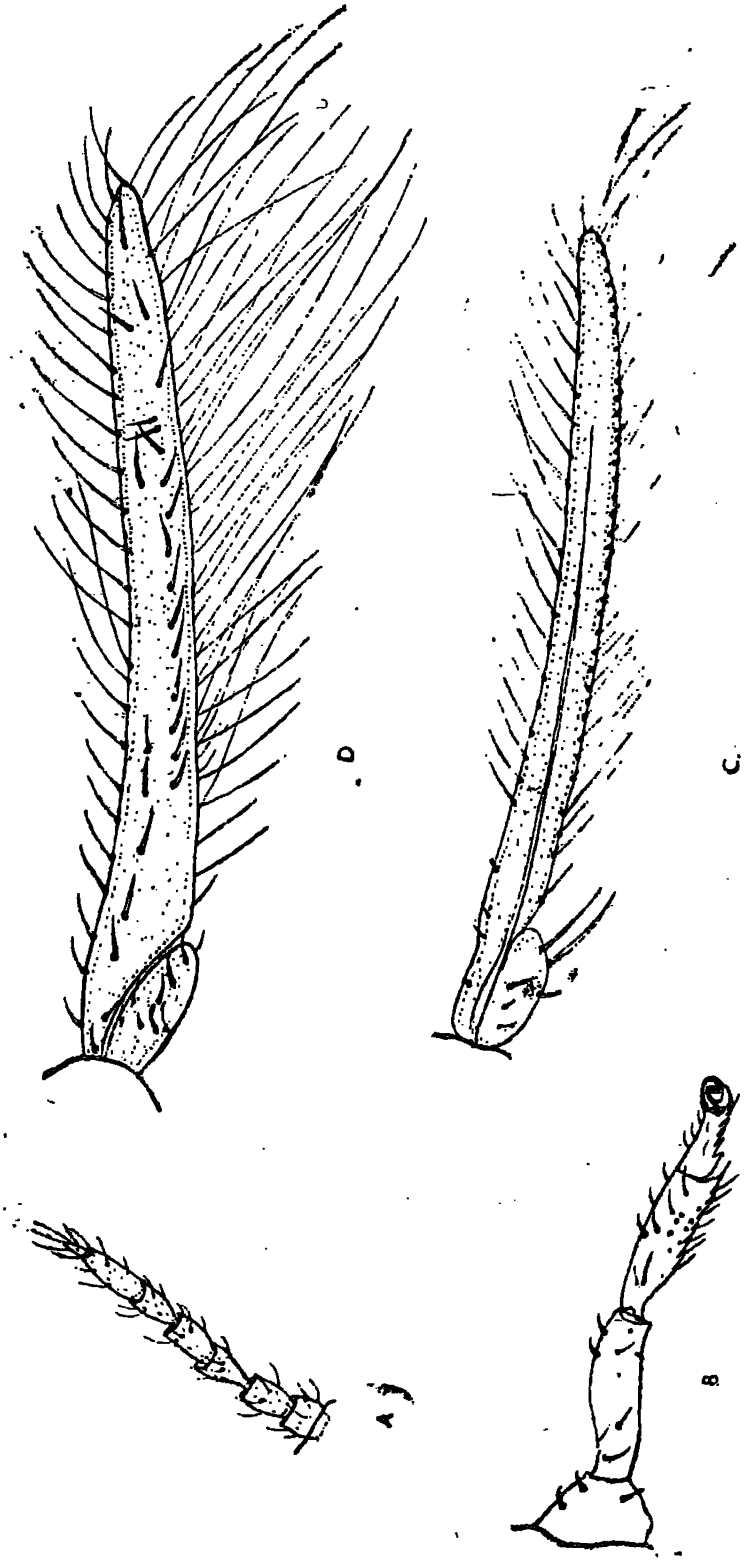
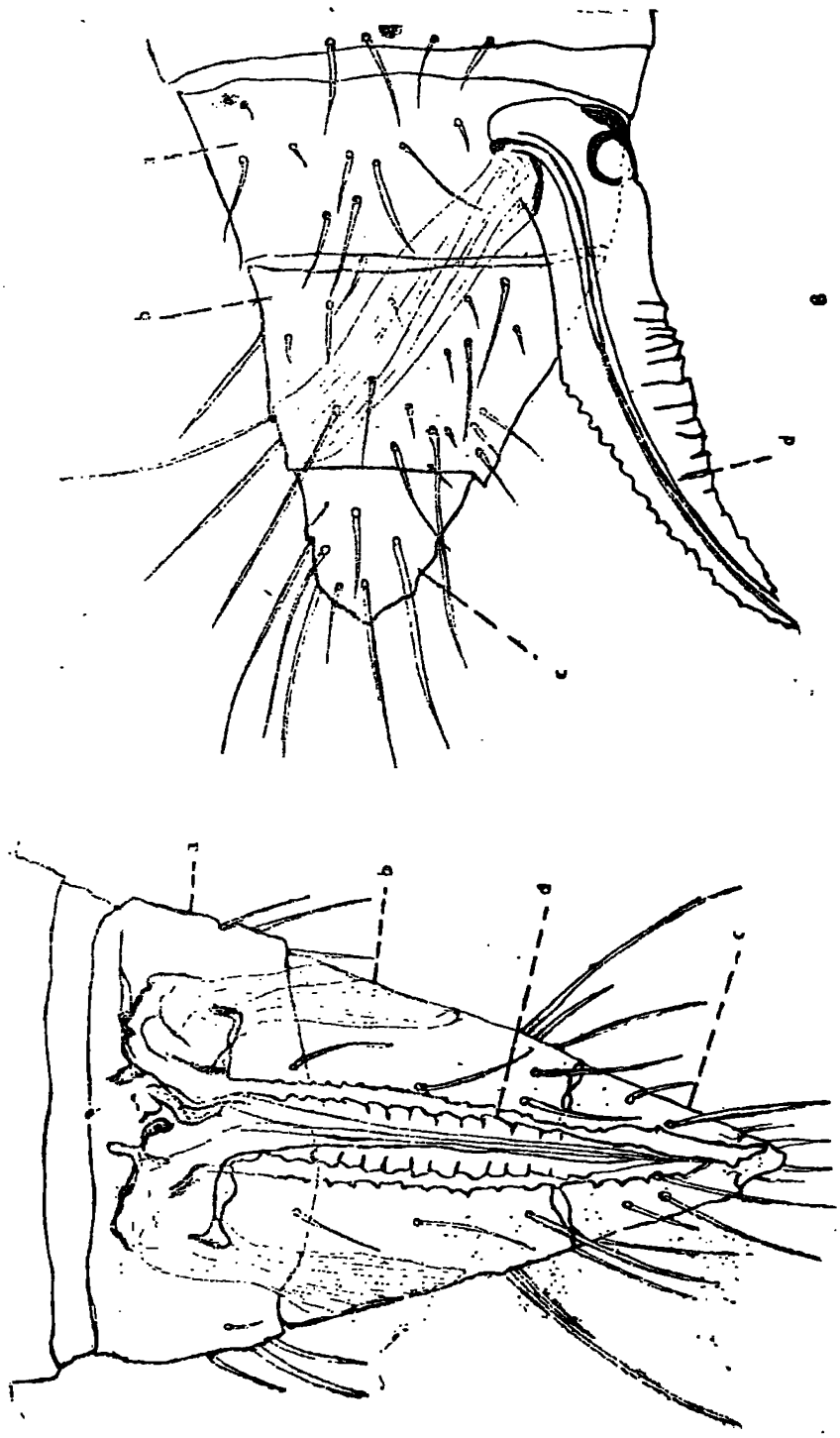


Figure 6. *A.* Antenna of an adult thrip—*Stenchaetothrips biformis*, *C.* Hind wing of an adult thrip.
B. Thorasic leg of an adult thrip. *D.* Forewing of an adult thrip. (Magnification about 5×40).



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B. Lateral view (ovipositor extruded).

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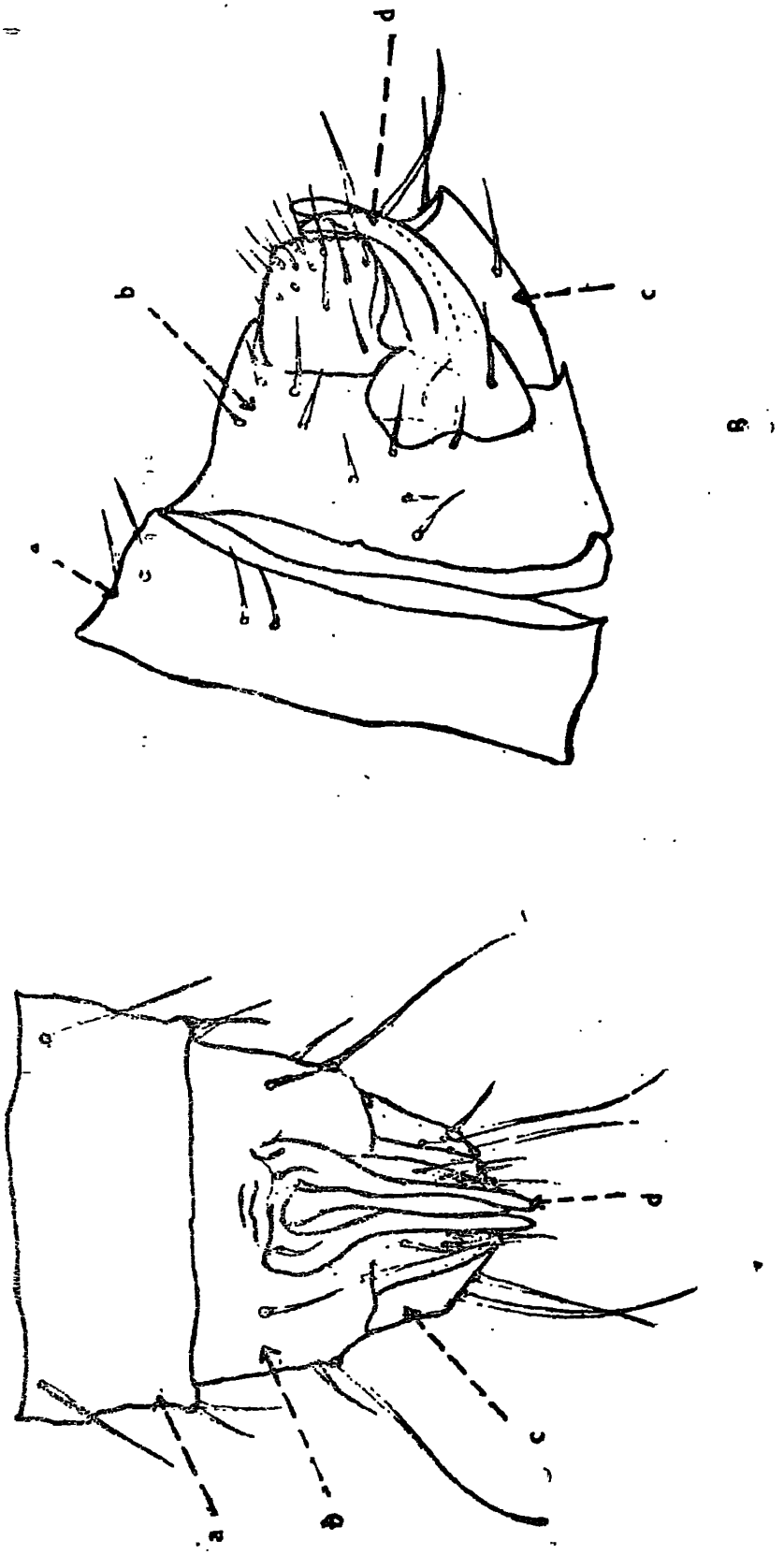

Figure 8. Abdominal end of an adult male of *Stenchaetothrips biformis*.
A. Ventral view. *B*. Lateral view. (*a*, *b*, *c*) 8th, 9th and 10th abdominal segments (*d*) copulatory organ.
(Magnification about 5×40).