A COMPARATIVE STUDY OF THE FOUR SPECIES OF PADDY STEM-BORERS BELONGING TO THE GENERA *CHILOTRAEA* AND *CHILO* IN ASIA (LEPIDOPTERA: PYRALIDAE: CRAMBINAE)*

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INTRODUCTION

STUDIES have been carried out by a number of authors to describe various striped moth-borers attacking sugarcane, paddy and other graminaceous crops. Earlier workers based their studies on the general colour pattern of the wing and body of the moths, structure of the pupae and the coloured stripes on the body and arrangements of crochets in the prolegs of the caterpillars. The later workers in addition to the above-mentioned characteristics made a study of the wing venation, genitalia of male and female moths and chaetotaxy of the caterpillars.

Fletcher and Ghosh (1920), Ghosh (1921) and Fletcher (1928) based their classification of the graminaceous borers recorded by them in India on the colour pattern and the shape of the wing, body, palpi, etc., of the moths, structure of the pupae and the body colour, stripes and arrangement of crochets in the prolegs of the caterpillars. Kinoshita and Kawada (1932) showed the difference between *Chilo simplex* Butler and *Chilo zonellus* (Swinhoe) [now known under the names, *Chilo suppressalis* (Walker) and *Chilo partellus* (Swinhoe) respectively] comparing the chaetotaxy of the head capsule and genitalia of these two species. Isaac and Rao (1941) gave

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an account of the chaetotaxy of the known lepidopterous borers on sugarcane in India and included a key for their identification, while Isaac and Venkatraman (1941) described the pupae of these borers. Trehan and Butani (1948) discussed the systematic position of *Chilo partellus* (formerly known as *C. zonellus*) and gave an account of the chaetotaxy of the larva. Kapur (1950) described the common Crambid borers in India, added detailed descriptions of the wing venation of the different common genera, male and female genitalia and erected the new genus *Chilotraea* different from *Chilo* in having the frons produced forward but subrounded and Sc and R_1 fused in the forewing. Butani (1956) using characters which can easily be made out by using hand lens, such as body colour, stripes, arrangements of crochets in the prolegs and spiracles, published a note on their identification. Nair (1958) in his study of biology and control of *Chilotraea polychrysa* (Meyrick) [formerly known as *Proceras polychrysa* (Meyrick)] described the colouration of the stripes and the arrangements of crochets in the caterpillar and in somewhat detail the pupal morphology. Gupta (1938 and 1960) made a comparative study of the common species of striped Crambid borers on sugarcane basing the differentiation on the shape and colour of moths, chaetotaxy of the caterpillars, structure of the pupae, wing venation and genitalia of both sexes. Bleszynski and Collins (1962) recently considered the genus *Chilotraea* of Kapur as a synonym of the genus *Chilo* and included in it the species *Chilo auricilia*, *C. partellus*, *C. polychrysa* and *C. suppressalis* amongst the well-known borers of paddy. But they did not give any reasons for synonymyzing the genus *Chilotraea* with the genus *Chilo*. In the present paper, therefore, the genus *Chilotraea* has been retained by the authors.

Fracker (1915) earlier showed the importance of the study of chaetotaxy in differentiating the caterpillars using Greek alphabets for the nomenclature of the setae. Later Peterson (1959) published his volumes on "Larvae of Insects" using Fracker's terminology for the setae of Lepidopterous larvae. Although a few borers attacking sugarcane and other graminaceous crops also feed on paddy stem and the above-mentioned studies on sugarcane borers are useful, a careful comprehensive study of the chaetotaxy of all the striped borers attacking paddy, the structure of their pupae, the wing venation and genitalia of the moths has not been made so far. As a result of this, there is a confusion in the identity of the striped moth-borers attacking paddy. The present authors, therefore, made a detailed comparative study of the borers, pupae, wing venation and genitalia of the species, *Chilotraea auricilia* (Dudgeon), *Chilotraea polychrysa* (Meyrick), *Chilo suppressalis* (Walker) and *Chilo partellus* (Swinhoe). The results of the observations made are given in this paper along with keys and charts prepared for the

identity of the different species of borers. Nomenclature of the chaetotaxy of the head and body of caterpillars has been adopted after Peterson (1959) and Fracker (1915) respectively, wing venation after Comstock and Needham (1898 and 1899) and genitalia after Kapur (1950) and Jepson (1954). Terminology of female genitalia has been adopted after Tuxen (1956) while for the convenience of the study of the spines on the upper half of cremaster of the pupa a fresh nomenclature has been suggested.

Technique and Materials Employed

For the study of the chaetotaxy, caterpillars were cleared in 10% KOH, dehydrated in glacial acetic acid, passed into carboxylol, clove oil and xylol and mounted in Canada-balsam. About 8–12 fully grown caterpillars were mounted and several unmounted preserved and live specimens of each species were examined. No staining was necessary as the tubercles and setae were quite distinct enough for the study. For the genitalia, mounts were prepared in the same way. The genitalia were stained with acid fuchsin stain so as to observe the delicate membranous parts like bursa copulatrix, etc. The wings were treated with 10% KOH and the scales brushed off carefully and upgraded to 70% alcohol, stained in eosin dissolved in 70% alcohol and again upgraded to absolute alcohol. The wings were then passed through clove oil and xylol and later mounted in Canada-balsam. About 12–16 specimens of both fore and hindwings of each species were mounted. Sketches were made of pupal structure and of the caterpillars showing stripes and camera-lucida sketches were made to show chaetotaxy, wing venation and genitalia.

Species of Striped Stem-Borers Attacking Paddy in Asia

Observations made by the authors have shown the occurrence of four species of striped stem-borers attacking paddy in India. They are: (1) *Chilotraea auricilia* (Dudgeon), (2) *Chilotraea polychrysa* (Meyrick), (3) *Chilo suppressalis* (Walker) and (4) *Chilo partellus* (Swinhoe). Key for the separation of the two genera *Chilotraea* and *Chilo* is given below:—

1. Frons produced forward and conical with a corneous point at the apex 2

   Frons produced, smooth, subround without a corneous point (except in some specimens of *C. auricilia* where a minute to very minute point is present) 3

2. Sc and R_1 run separately . . . . . *Chilo* Zincken

3. Sc and R_1 fused for some distance. . . . . *Chilotraea* Kapur

DESCRIPTION OF THE DIFFERENT SPECIES

1. *Chilotraea auricilia* (Dudgeon)

Dudgeon (1905) included his original description of this species under the name *Chilo auricilia* and gave a brief account of the wings of the male and female moths. Kapur (1950) placed this species in the new genus *Chilotraea* erected by him and included an account of the moth and the genitalia. Gupta (1938, 1960) gave a detailed account of the chaetotaxy of the caterpillar, the pupal structure, the general colouration of the moth and the genitalia of male and female and described the species under the names *Diatraea auricilia* (Ddgn.) in 1938 and *Chilotraea auricilia* (Ddgn.) in 1960.

Larva

Cream to dull ochre in colour; head dark fuscous, body with 5 violet stripes the lateral stripes passing above the abdominal spiracles (Fig. 5). Abdominal crochets approximately triordinal towards the meson and practically uniordinal on the lateral side (Fig. 9) [Gupta (1960) considered them as biordinal]. Chaetotaxy of the head with the position of Pa almost in a line drawn on P1 and L1; Pb slightly outside the line drawn on P1 and P2; A2 comparatively shorter; Adfa very near to Adf2 (Fig. 13). Tubercle bearing Kappa group in first thoracic segment (T1) not showing constriction between kappa and eta. Body with epsilon partly associated with rho in the first abdominal segment (A1) (Fig. 25) [Gupta (1960) erroneously stated that epsilon is separate from rho]; lines drawn on setae alpha and beta converge cephalad on A8; rho situated above and cephalad of the spiracle on A8 (Fig. 29).

Pupa

Genae and thoracic spiracles projecting; frons normal; anterior region of the dorsum of each of the 5th, 6th and 7th abdominal segments with distinct spines (Fig. 33) arranged in a row along with a few minute spines above the row (Fig. 37); cremaster with 3 pairs of dorsal and one pair of ventral broad spines [Gupta (1960) observed only two pointed projections]; the postero-lateral and postero-dorsal spines either larger than or equal to the postero-ventral spines (Figs. 46 and 47).

Wing Venation

Forewing with apex slightly pointed, Sc and R1 fused together for some distance (Fig. 54). Hindwing with apex pointed, inner margin normal; M1 arising from Rs on a short stalk after the anterior angle of the discoidal cell; M2 and M3 arising on a common short stalk (Fig. 58).

Genitalia

♂. Harpe subquadrate; vinculum narrow, triangular; anellus with median membranous plate with lateral chitinized blunt lobes; aedeagus bifurcate, upper limb with a pointed projection situated dorsally in the middle, the apex being pointed and the lower limb tongue-like, bifid at the apex (Figs. 62, 66 and 68).

♀. Signum absent; bursa copulatrix short, slightly capitate; lamella antevaginalis semicircular wrinkled above the ostium bursae; lamella post-vaginalis distinct but small (Fig. 78).

Distribution

(i) *India.*—Borers of this species have been recorded by the authors in India on paddy at Gauhati, Jorhat, Kamalpur, Kauseria and Shillong in Assam; Kalimpong and Chandannagar in West Bengal; Sabour in Bihar; Bardoli in Gujarat; Katua in Jammu and Kashmir and Bhubaneswar in Orissa. The caterpillars were also recorded on sugarcane at Lucknow in Uttar Pradesh; on maize at Kalimpong in West Bengal. Earlier records were made on *juar* (Fletcher and Ghosh, 1920) and on sugarcane (Kapur, 1950).

(ii) *Other Countries.*—This species has also been recorded in Burma, Ceylon and Taiwan (Jepson, 1954).

2. *Chilotraea polychrysa* (Meyrick)

Meyrick (1932) originally described the species under the name *Diatraea polychrysa* from Malaya. Nair referred to the occurrence of this species for the first time from India in 1958 and included an account of the borer, moth and pupa.

Larva

General colouration, stripes and crochets are as in *Chilotraea auricilia*. Chaetotaxy of the head with position of Pa slightly below the line drawn on P1 and L1; Pb outside the line drawn on P1 and P2; A2 very minute; Adfa

TABLE

Tabular statement showing the differences in the stripes and chaetotaxy Chilo *attacking*

Name of the borer	Stripes (Figs. 1-8)	Crochets on the prolegs (Figs. 9-12)	Head (Figs. 13-16)
Chilotraea auricilia (Dudgeon)	Five violet stripes; lateral stripes pass above abdominal spiracles	Uniserial, almost triordinal, arranged in a complete circle	Position of Pb outside the line drawn on Pl and P2; Pa almost on the line drawn on Pl and L1, Adfa very near to Adf2; A2 shorter
Chilotraea polychrysa (Meyrick)	,,	,,	Position of Pb distinctly outside the line drawn on Pl and P2; Pa slightly below the line drawn on Pl and L1; Adfa very near to Adf2; A2 minute
Chilo suppressalis (Walker)	Five complete and two incomplete and broken violet stripes; lateral stripes pass on the abdominal spiracles; the sublateral broken stripes pass on Kappa groups on the abdominal segments	Uniserial, almost triordinal, arranged in complete circle; but lateral crochets are not close sometimes giving an appearance of incomplete circle	Position of Pb on the line drawn on Pl and P2; Pa slightly below the line drawn on Pl and L1; Adfa very near to Adf2; A2 longer
Chilo partellus (Swinhoe)	Four pinkish stripes; lateral stripes pass above spiracles on abdominal segments	Uniserial, almost triordinal, arranged in a complete circle	Position of Pb on the line drawn on Pl and P2; Pa on the line drawn on Pl and L1; Adfa almost midway between Adf1 and Adf2; A2 longer

very near to Adf2 (Fig. 14). This species differs from *C. auricilia* in having the tubercle bearing Kappa group in T1 slightly constricted in between kappa

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of the four species of borers belonging to the genera Chilotrae *and paddy in Asia*

I Thoracic segment (Figs. 17-20)	II Thoracic segment (Figs. 21-24)	I Abdominal segment (Figs. 25-28)	VIII Abdominal segment (Figs. 29-32)
Position of the Kappa group normal, without any constriction between kappa and eta	Normal	Epsilon partly associated with rho	Lines drawn through setae alpha and beta converge cephalad; rho set above and cephalad to the spiracle
Position of the Kappa group normal, but the tubercle bearing Kappa group shows a slight constriction in between kappa and eta	,,	Epsilon wholly associated with rho	Lines drawn through setae alpha and beta converge caudad; rho set above and cephalad to the spiracle
Kappa group a little cephalad to the vertical line of the spiracle	,,	Epsilon separate from rho	Alpha and beta are almost at equal distance from meson; rho situated just opposite to spiracle
,,	Presence of asetose tubercle in between theta and Pi group one in each of meso and metathorax	Epsilon separate from rho. Presence of asetose tubercle behind spiracle on each abdominal segment from A 1-7 inclusive	,,

and eta (Fig. 18); epsilon in A1 wholly associated with rho (Fig. 26); lines drawn through the setae alpha and beta converging caudad on A8 (Fig. 30).

TABLE II

Tabular statement showing the differences in the structure of the pupae of four species of borers belonging to the genera Chilotraea and Chilo *attacking paddy in Asia*

Name of borer	Head (Figs. 33–36)	Thorax (Figs. 33–36)	Anterior region of the dorsum of 5th, 6th and 7th abdominal segments (Figs. 37–40)	Cremaster (Posterior end of the abdomen) (Figs. 41–45)	Size of the postero-dorsal, postero-lateral and postero-ventral spines (Figs. 46–53)
Chilotraea auricilia (Dudgeon)	Frons not projecting. Genae projecting	Thoracic spiracles projecting out distinctly	Distinct spines present forming a row; tiny indistinct spines distributed sparsely above the row of larger spines	4 distinct spines on each half, three on the dorsal half and one on the ventral half	Postero-dorsal spines either more prominent or equal in size to the postero-ventral spines. Postero-ventral spine without seta
Chilotraea polychrysa (Meyrick)	"		Distinct spines present forming a row. In addition to tiny spines some of intermediate size present above the row of larger spines	"	Postero-ventral spines larger and prominent, postero-lateral and postero-dorsal spines smaller; former without setae
Chilo suppressalis (Walker)	Frons produced ventrally in the anterior region. Genae not projecting	Thoracic spiracles not projecting out distinctly	No spines but the surface is shagreened	Only postero-dorsal and postero-lateral spines distinct; 1 or 2 pairs of setae present dorsally	Postero-lateral and postero-dorsal spines distinct. Postero-ventral spine indistinct with one or two setae on each side
Chilo partellus (Swinhoe)	Frons less produced; genae slightly projecting	Thoracic spiracles slightly projecting	Spines minute; intricately arranged sometimes giving an appearance of thick spiny dorsal bands	All 4 spines on each half distinct	All spines are almost equal in size; no setae present on the postero-ventral spines

TABLE III

Tabular statement showing the differences in wing venation of the moths of four species of borers belonging to the genera Chilotraea *and* Chilo *attacking paddy in Asia*

	Forewing			Hindwing				
Name of the borer	Angle of the apex	Condition of Sc and Rl	Angles of the discoidal cell	Angle of the apex	Origin of Ml	Basal areole	Origin of M2 and M3	Inner margin
Chilotraea auricilia (Dudgeon)	Slightly acute (Fig. 54)	Fused together for some distance (Fig. 54)	Posterior angle slightly distad (Fig. 54)	Slightly acute (Fig. 58)	Arising from Rs on a short stalk after the anterior angle of the discoidal cell (Fig. 58)	Normal (Fig. 58)	Arising on a shorter common stalk after the posterior angle of the discoidal cell (Fig. 58)	Normal (Fig. 58)
Chilotraea polychrysa (Meyrick)	Slightly acute (Fig. 55)	,, (Fig. 55)	,, (Fig. 55)	Slightly acute (Fig. 59)	Arising directly from Rs at the point of anterior angle of the discoidal cell (Fig. 59)	,, (Fig. 59)	Arising on a comparatively longer common stalk after the posterior angle of the discoidal cell (Fig. 59)	,, (Fig. 59)
Chilo suppressalis (Walker)	Rounded (Fig. 56)	Separate (Fig. 56)	Posterior angle almost in a line with anterior angle (Fig. 56)	Rounded (Fig. 60)	Arising from Rs on a short stalk after the anterior angle of the discoidal cell (Fig. 60)	Enlarged (Fig. 60)	Arising separately at the posterior angle of the discoidal cell (Fig. 60)	Enlarged (Fig. 60)
Chilo partellus (Swinhoe)	Sharply acute (Fig. 57)	,, (Fig. 57)	Posterior angle slightly distad (Fig. 57)	Slightly acute (Fig. 61)	Arising from Rs before the anterior angle of the discoidal cell (Fig. 61)	Normal (Fig. 61)	,, (Fig. 61)	Normal (Fig. 61)

TABLE

Tabular statement showing the differences in genitalia of the moths and Chilo *attacking*

Name of the borer	Male Genitalia			
	Harpe	Vinculum	Anellus	Aedeagus
Chilotraea auricilia (Dudgeon)	Subquadrate (Fig. 62, *h*)	Narrow, triangular (Fig. 62, *v*)	With median membranous plate with sclerotized blunt lateral projections (Fig. 68)	Bifurcate, upper limb with a pointed projection situated dorsally in the middle, the apex being pointed and the lower limb tongue-like, the apex bifid (Fig. 66)
Chilotraea polychrysa (Meyrick)	Broadly triangular (Fig. 63, *h*)	With truncated base (Fig. 63, *v*)	Highly chitinized, crescent shaped (Fig. 69)	Trifurcate; upper limb pointed with swollen middle, lower limbs U-shaped with blunt and slightly dilated tips with cornuti (Fig. 67)
Chilo suppressalis (Walker)	Elongated and triangular, the ventral margin being more convex (Fig. 64, *h*)	U-shaped (Fig. 64, *v*)	Without a median plate, the lateral arms broadly enlarged each with two lobes, the inner lobe drawn into a long blunt process (Fig. 74)	Bifurcate for about 2/3 of its length, the upper limb without a sharp apex, shape more cylindrical; the lower limb slender with clavate tip, the cornuti present on the inner margin (Fig. 72)
Chilo partellus (Swinhoe)	Apex blunt with a blunt projection near the base of the costa (Fig. 65, *h*)	Broadly V-shaped (Fig. 65, *v*)	With highly chitinized almost triangular median plate with long lateral processes (Fig. 75)	Bifurcate for about 2/3 of the length, upper limb with pointed apex and ventral triangular keel in the middle. The lower limb with clavate tip, having cornuti (Fig. 73)

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of four species of borers belonging to the genera Chilotraea *paddy in Asia*

Name of the borer	Female Genitalia			
	Lamella antevaginalis	Lamella postvaginalis	Bursa copulatrix	Signum
Chilotraea auricilia (Dudgeon)	In the form of semicircular wrinkled sclerite surrounding ostium bursae (Fig. 78)	Distinct, but small (Fig. 78)	Slightly capitate (Fig. 78)	Absent (Fig. 78)
Chilotraea polychrysa (Meyrick)	In the form of small projected chitinized piece broader than long (Fig. 79)	Indistinct (Fig. 79)	Clavate (Fig. 79)	Absent (Fig. 79)
Chilo suppressalis (Walker)	Not distinct, in the form of semicircular poorly chitinized area above ostium bursae (Fig. 80)	Indistinct with very indistinct wrinkles (Fig. 80)	Ostium bursae slightly enlarged; ductus bursae enlarged, uniformly thinly sclerotized with longitudinal wrinkles; corpus bursae clavate; the region in between enlarged ductus bursae and corpus bursae narrow and slender (Fig. 80)	Present; large with hook-like sclerotized minute bodies (Fig. 80)
Chilo partellus (Swinhoe)	Large plate-like with longitudinal wrinkles with bifid apex (Fig. 81)	Indistinct (Fig. 81)	Comparatively long, capitate, ductus bursae narrow (Fig. 81)	Present, small (Fig. 81)

Pupa

General shape and colour same as in *Chilotraea auricilia*. Difference occurs mainly in the cremaster. The postero-ventral spines are large and prominent and postero-lateral and postero-dorsal spines are less prominent (Figs. 48 and 49). The arrangement of spines on the anterior region of the dorsum of 5th, 6th and 7th abdominal segments almost similar to that of *C. auricilia* except for the presence of more minute and very minute spines above the row of the distinct spines (Fig. 38).

Wing Venation

Forewing as in *C. auricilia* with the apex slightly blunt (Fig. 55). Hindwing with apex slightly blunt, inner margin normal; M1 arising from Rs at the point of the anterior angle of the discoidal cell; basal areole normal; M2 and M3 arising on a long common stalk (Fig. 59).

Genitalia

♂. Harpe broadly triangular; vinculum with truncated base (Fig. 63); anellus highly chitinized, crescent-shaped (Fig. 69); aedeagus trifurcate, upper limb pointed with swollen middle, the lower limbs U-shaped with blunt and slightly dilated tips covered with cornuti (Fig. 67).

♀. Signum absent; bursa copulatrix comparatively short and clavate, base of ductus bursae chitinized; lamella antevaginalis in the form of small projected chitinized piece broader than long, lamella postvaginalis indistinct (Fig. 79).

Distribution

(i) *India.*—The borers of this species have been recorded by the authors exclusively on paddy at Kamalpur in Assam; Kalimpong and Chandannagar in West Bengal; Palghat and Trivandrum in Kerala; Kudikapalyam in Madras and Bhubaneswar in Orissa.

(ii) This species has also been recorded in Java and Malaya (Jepson, 1954).

3. *Chilo suppressalis* (Walker)

Original description of this species by Walker (1863) was under the name *Crambus suppressalis*. Description of the moth and the caterpillar including an account of stripes and crochets was made by Fletcher and Ghosh (1920) and Kapur (1950) described the moth and genitalia of male and female.

Larva

Dull yellow coloured; head, prothoracic shield and mid-dorsal tubercles of meso and metathorax are ochreous; with 5 distinct (one median, two subdorsal and two lateral) and 2 indistinct sublateral stripes, subdorsal stripes very broad, the lateral stripes pass on the spiracles, the broken indistinct sublateral stripes pass on the Kappa groups of the abdominal segments (Fig. 7). Crochets almost triordinal towards the meson and almost uniordinal towards the lateral side, forming almost complete circle, sometimes giving an appearance of incomplete circle due to the sparse arrangement of tiny lateral crochets (Fig. 11). Head with position of Pa slightly below the line drawn on P1 and L1; Pb on the line drawn on P1 and P2; A2 comparatively long; Adfa very near to Adf2 (Fig. 15). Kappa group in prothorax slightly cephalad to the vertical line of the spiracle (Fig. 19). Epsilon separate from rho in A1 (Fig. 27); rho opposite to the spiracle in A8 (Fig. 31).

Pupa

Head with frons produced forward; genae not projecting; thoracic spiracles slightly elevated; anterior region of the dorsum of 5th, 6th and 7th abdominal segments shagreened but without spines (Figs. 39 and 43); cremaster bearing one or two pairs of setae, with only postero-lateral and postero-dorsal spines which are not as distinct as in the other three species (Figs. 50 and 51).

Wing Venation

Forewing with apex blunt; Sc and R1 run separately; anterior angle of the discoidal cell almost in line with the posterior angle (Fig. 56). Hindwing with blunt apex; inner margin more enlarged; M1 arising from Rs after the anterior angle of the cell on a short stalk; basal areole larger; M2 and M3 arise almost at a point from the posterior angle of the discoidal cell (Fig. 60).

Genitalia

♂. Harpe elongated and triangular; the ventral margin being more convex; vinculum U-shaped (Fig. 64); anellus without a median plate, the lateral arms broadly enlarged each with two lobes, the inner lobe drawn into a long blunt projection (Fig. 74); aedeagus bifurcate for about $\frac{2}{3}$ of its length, the upper limb more cylindrical without a sharp apex, the lower limb slender with clavate tip and with cornuti present on the inner margin (Fig. 72).

♀. Signum present, very large with hook-like chitinized bodies; bursa copulatrix with ductus bursae enlarged, uniformly chitinized and longitudinally wrinkled; corpus bursae clavate, the region in between the enlarged ductus bursae and corpus bursae narrow and slender; ostium bursae slightly enlarged. Lamella antevaginalis not distinct, in the form of semicircular poorly chitinized area above ostium bursae; lamella postvaginalis very indistinct (Fig. 80).

Distribution

(i) *India.*—This species has been recorded by the authors exclusively on paddy at Gauhati, Jorhat and Kamalpur in Assam; Kalimpong in West Bengal; Sabour in Bihar and Sambalpur in Orissa. Earlier records of this species were by Fletcher and Ghosh (1920) under the name *rice chilo* at Pusa in Bihar.

(ii) *C. suppressalis* has been recorded also in China, Hawaii, Indonesia, Japan, Korea, Malaya, Philippines, Taiwan (Jepson, 1954), Thailand and South Vietnam.

4. *Chilo partellus* (Swinhoe)

The two species *Chilo zonellus* and *Chilo partellus* described originally under the genus *Crambus* by Swinhoe in 1884 and 1885 respectively have been considered as synonyms by Kapur (1950). Bleszynski and Collins (1962) while agreeing to the synonymy have used the name *C. partellus* as *zonellus* was stated to be preoccupied. Descriptions of moth, genitalia and wing venation were made by Kapur (1950) while Gupta (1960) described wing venation and genitalia of the moth, chaetotaxy of the caterpillar and pupal structure.

Larva

It can be differentiated from the other three species in having only 4 pinkish stripes (Fig. 4), the median stripe being absent, the lateral stripes passing above the abdominal spiracles (Fig. 8). Head with position of Pa on the line drawn on P1 and L1; Pb on the line drawn on P1 and P2; A2 comparatively long; Adfa almost midway between Adf1 and Adf2—this character is distinct from the other three species (Fig. 16). It can also be differentiated from the other species in having asetose tubercles one in each of meso and metathorax in between theta and Pi group (Fig. 24) and one in each of the abdominal segments 1–7 inclusive, behind the spiracle (Fig. 28); arrangement of crochets almost triordinal towards the meson and almost

uni or biordinal towards lateral side, forming a complete circle; rho in A8 situated before the spiracles (Fig. 32) [This fact has not been mentioned by Gupta (1938, 1960)].

Pupa

Frons bluntly projected, genae slightly projecting; thoracic spiracles slightly projecting. The shape and arrangement of spines on the anterior region of the dorsum of 5th, 6th and 7th abdominal segments are different from *Chilotraea auricilia*; the spines being very minute, innumerable and intricately arranged sometimes giving an appearance of thick dorsal spiny bands (Figs. 36 and 40). Cremaster with 3 pairs of dorsal and one pair of ventral broad spines; all are equal in size (Figs. 52 and 53).

Wing Venation

Forewing with apex sharply pointed; Sc and R1 run separately, posterior angle of the discoidal cell being slightly distad (Fig. 57). Hindwing with apex slightly pointed, inner margin normal; M1 arising from Rs within the area of the cell, basal areole normal; M2 and M3 never arise on a short stalk [as mentioned by Gupta, 1960)] but arise separately from the posterior angle of the discoidal cell (Fig. 61).

Genitalia

♂. Harpe with blunt apex and with a blunt projection near the base of the costa; vinculum broadly V-shaped (Fig. 65); anellus with highly chitinized almost triangular median plate with lateral processes (Fig. 75); aedeagus bifurcate for about $\frac{2}{3}$ of the length, upper limb with pointed apex and with a ventral triangular keel in the middle, the lower limb slender with clavate head having cornuti (Fig. 73).

♀. Signum present but very small; bursa copulatrix very long, capitate ductus bursae narrow, not well defined. Lamella antevaginalis very distinct in the form of large plate having longitudinal wrinkles, bifid posteriorly above the ostium bursae; lamella postvaginalis not distinct (Fig. 81).

Distribution

(i) *India.*—Caterpillars of this species have been recorded by the authors on paddy at Gauhati and Kauseria in Assam; Burdwan, Chandannagar, Kalimpong, Plassey and Ramnagar in West Bengal; Sabour in Bihar and Bhubaneswar in Orissa. Caterpillars were also recorded on *juar* at Mahadanapuram in Madras, Bodhan in Andhra Pradesh, Sabour in Bihar, Ranibennur

and Tumkur in Mysore; on maize at Kalimpong in West Bengal, Kolhapur in Maharashtra and Dalhousie in Punjab. Earlier records were made on sugarcane (Kapur, 1950), on 'sama' (*Panicum frumentaceum*), on 'marva' (*Eleusine indica*), on 'ragi' (*Eleusine coracana*), on '*bajra*' (*Pennisetum typhoideum*), on 'baijanti' (*Coix lachryma-jobi*) and on 'juar' (Fletcher and Ghosh, 1920).

(ii) This species has also been recorded in Ceylon, Indonesia, Iraq, Japan, Nyasaland and Taiwan (Jepson, 1954).

CONCLUSIONS

We agree with Isaac and Venkatraman (1941) who pointed out that there are 4 'spines' on each half of the cremaster of the pupa, but disagree with Gupta (1960) who observed only 'two pointed projections' on each half in *Chilotraea auricilia*. Furthermore, Gupta's terminology '1A' in the forewing of Crambid borers does not agree with the authors of wing venation. 1A is absent in the forewing of Crambids and the vein which Gupta termed as 1A is actually 2A. Our observations are based on the terminology adopted by Comstock (1960) and Brues, Melander and Carpenter (1954). The descriptions and drawings of the male genitalia of *Chilo zonellus* (now *Chilo partellus*) by Kinoshita and Kawada (1932) do not agree with our observations. The aedeagus of *Chilo partellus* is bifurcate and the harpe is with a blunt process near the base of the costa. These characters were not observed by Kinoshita and Kawada. It is quite possible that they were dealing with another species altogether.

Confusion has arisen regarding the synonymy of the names *Chilo zonellus* (Swinh.) and *Chilo partellus* (Swinh.). Hampson (1896) had shown that *Crambus partellus* Swinh. and *Crambus zonellus* Swinh. are synonyms of *Chilo simplex* Butl. But the last-named species is now considered as *C. suppressalis*. Whole mounts of caterpillars, wings and genitalia of both sexes of *C. zonellus* and *C. partellus* made by the authors show clearly that these two names are synonyms. This inference is in agreement with their position in regard to synonymy as stated by Bleszynski and Collins (1962). As these authors have shown that the specific name *zonellus* is already preoccupied by Zeller's species *Euchromius zonellus* first described under the genus *Crambus* in 1847, the name *partellus* would become valid.

We agree with Kapur (1950) in his reasoning for erecting the genus *Chilotraea* on the basis of the shape of the frons and wing venation of the adult.

A. Key Based on the Morphology of the Caterpillar

*Head**

1. Adfa very near to Adf2 2
   Adfa almost midway between Adf1 and Adf2 . 3

2. Pb on the line drawn on P1 and P2 4
   Pb outside the line drawn on P1 and P2 . . . 5

3. Pb on the line drawn on P1 and P2; Pa on the line drawn on P1 and L1; A2 longer (Fig. 16) . . . . . *Chilo partellus* (Swinhoe)

4. Pa slightly below the line drawn on P1 and L1; A2 longer (Fig. 15) . . . . . *Chilo suppressalis* (Walker)

5. Pa slightly below the line drawn on P1 and L1; A2 minute (Fig. 14) . . . . . *Chilotraea polychrysa* (Meyrick)

   Pa almost on the line drawn on P1 and L1; A2 shorter (Fig. 13) . . . . . *Chilotraea auricilia* (Dudgeon)

Body

1. Epsilon in A1 separate from rho; rho in A8 situated opposite to spiracle (Figs. 31 and 32) 3

   Epsilon in A1 either partly or wholly associated with rho; rho in A8 situated above and cephalad to the spiracle (Figs. 29 and 30) . 2

2. Larva with five violet stripes, lateral stripes pass above abdominal spiracles (Figs. 5 and 6) . . 4

3. Larva with four pinkish stripes, median stripe absent, lateral stripes pass above spiracles on abdominal segments (Fig. 8) 5

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* On account of slight variations key for chaetotaxy of the head should be used in combination with key for chaetotaxy of the body for separation of the species.

Larva with five distinct and complete and two indistinct and incomplete stripes; lateral stripes pass on the spiracles of abdominal segments; sublateral incomplete stripes pass on Kappa groups on abdominal segments (Fig. 7) 6

4. Arrangement of crochets in complete circle. Tubercle-bearing Kappa group on T1 showing slight constriction in between kappa and eta (Fig. 18); epsilon wholly associated with rho in A1 (Fig. 26); lines drawn on setae alpha and beta on A8 converge caudad (Fig. 30) . . . . . *Chilotraea polychrysa* (Meyrick)

Tubercle-bearing Kappa group on T1 not showing constriction in between kappa and eta (Fig. 17); epsilon partly associated with rho in A1 (Fig. 25); lines drawn on setae alpha and beta on A8 converge cephalad (Fig. 29) . *Chilotraea auricilia* (Dudgeon)

5. Presence of asetose tubercle one in each of meso and metathorax in between theta and Pi group and one asetose tubercle behind the spiracle in each of abdominal segments 1–7 inclusive (Figs. 24 and 28) . . . . . *Chilo partellus* (Swinhoe)

6. Arrangement of crochets sometimes giving an appearance of incomplete circle due to sparsely arranged lateral crochets (Fig. 11); no asetose tubercles present on meso and metathorax and abdominal segments . . . *Chilo suppressalis* (Walker)

B. KEY BASED ON PUPAL STRUCTURE

1. Frons produced, genae and thoracic spiracles slightly projected 2

Frons not produced, genae and thoracic spiracles sharply projected 3

2. Frons more produced, genae not projecting; anterior region of the dorsum of 5th, 6th and 7th abdominal segments shagreened—without spines; cremaster with one or two pairs of setae and with only postero-lateral and postero-dorsal spines (Figs. 50 and 51) · *Chilo suppressalis* (Walker)

Frons less produced, genae slightly projecting; anterior region of the dorsum of 5th, 6th and 7th abdominal segments with minute intricately arranged spines sometimes giving an appearance of thick dorsal spiny bands · · 4

3. Spines distinct on the dorsum of 5th, 6th and 7th abdominal segments arranged almost in rows · · · · · · · · · · · 5

4. Cremaster without setae and with 3 pairs of dorsal and one pair of ventral broad spines, all of equal size (Figs. 52 and 53) · · · · *Chilo partellus* (Swinhoe)

5. Postero-ventral spines are large and prominent, postero-lateral and postero-dorsal spines are smaller (Figs. 48 and 49) · · · · · · *Chilotraea polychrysa* (Meyrick)

Postero-dorsal and postero-lateral spines either more prominent or equal to the size of postero-ventral spines (Figs. 46 and 47) · · *Chilotraea auricilia* (Dudgeon)

C. Key Based on Wing Venation

1. Forewing with Sc and R1 fused together for some distance · · · · · · · · · · · · 2

Forewing with Sc and R1 separate · · · · · 4

2. Apices of fore and hindwings slightly acute; hindwing with inner margin normal · · · 3

3. Hindwing with M1 arising from Rs on a short stalk after the anterior angle of the discoidal cell; M2 and M3 arising on a short common stalk (Fig. 58) . . . . . *Chilotraea auricilia* (Dudgeon)

Hindwing with M1 arising directly from Rs at the point of the anterior angle of the discoidal cell; M2 and M3 arising on a long common stalk (Fig. 59) . . . . . *Chilotraea polychrysa* (Meyrick)

4. Hindwing with M2 and M3 arising separately at the posterior angle of the discoidal cell . . 5

5. Apices of the fore and hindwings rounded. Hindwing with inner margin enlarged; M1 arising from Rs on a long stalk after the anterior angle of the discoidal cell; basal areole enlarged (Fig. 60) . . . . . *Chilo suppressalis* (Walker)

Apices of the forewing sharply acute and hindwing slightly acute. Hindwing with inner margin not enlarged; M1 arising from Rs before the anterior angle of the discoidal cell; basal areole normal (Fig. 61) . . . *Chilo partellus* (Swinhoe)

D. KEY BASED ON GENITALIA

Male Genitalia

1. Aedeagus bifurcate 2

Aedeagus trifurcate 3

2. Upper limb with ventral triangular keel in the middle 4

Upper limb not sharply pointed, without a ventral triangular keel in the middle . . . 5

Upper limb with the apex pointed and a pointed projection dorsally in the middle, lower limb tongue-like, the apex bifid; harpe

subquadrate; anellus with median membranous plate with sclerotized blunt lateral projections; vinculum narrow, triangular (Figs. 62, 66 and 68) . . . . . *Chilotraea auricilia* (Dudgeon)

3. Upper limb of the aedeagus pointed at the tip and swollen in the middle, lower two limbs U-shaped with blunt slightly dilated tips with cornuti; harpe triangular with broad base; anellus highly chitinized, crescent-shaped; vinculum with truncated base (Figs. 63, 67 and 69) . . . . . *Chilotraea polychrysa* (Meyrick)

4. Harpe with a blunt projection near the base of the costa; anellus with almost triangular chitinized median plate with long lateral processes; vinculum broadly triangular (Figs. 65 and 75) . . . . . *Chilo partellus* (Swinhoe)

5. Harpe without projection near base of the costa; anellus without a median plate, the lateral arms enlarged each with two lobes, the inner lobe drawn into a long blunt process beneath aedeagus; vinculum more U-shaped (Figs. 64 and 74). . . . . *Chilo suppressalis* (Walker)

Female Genitalia

1. Signum present 2

   Signum absent 3

2. Lamella antevaginalis very distinct, broad and longitudinally wrinkled with bifid apex; lamella postvaginalis not distinct; signum small, bursa copulatrix comparatively long and capitate (Fig. 81) . . . . . *Chilo partellus* (Swinhoe)

Lamella antevaginalis not distinct, in the form of semicircular poorly chitinized area above ostium bursae; lamella postvaginalis indistinct and with very indistinct wrinkles; signum large and prominent consisting of hook-like sclerotized minute bodies . . . 4

3. Lamella antevaginalis distinct but very small, broader than long in the form of elevated sclerite; lamella postvaginalis indistinct; bursa copulatrix clavate, base of ductus bursae sclerotized (Fig. 79) . . . . . *Chilotraea polychrysa* (Meyrick)

Lamella antevaginalis distinct in the form of semicircular wrinkled sclerite surrounding the ostium bursae anteriorly; lamella postvaginalis distinct but narrow; bursa copulatrix slightly capitate (Fig. 78) . . . . . *Chilotraea auricilia* (Dudgeon)

4. Ductus bursae enlarged, uniformly thinly sclerotized with longitudinal wrinkles; the region between enlarged ductus bursae and corpus bursae narrow and slender; corpus bursae clavate (Fig. 80) . . . . . *Chilo suppressalis* (Walker)

SUMMARY

A comparative account of the larval chaetotaxy, pupal structure, venation and genitalia of moths of four species of striped borers belonging to the genera *Chilotraea* and *Chilo* (Lepidoptera: Pyralidae: Crambinae) attacking paddy in Asia is given in detail. The species dealt with are *Chilotraea auricilia* (Ddgn.), *C. polychrysa* (Meyr.), *Chilo suppressalis* (Walk.) and *C. partellus* (Swinh.). Four tabular statements and four keys showing the differences in the chaetotaxy of the borers, pupal structure, wing venation and genital structures are also included to facilitate the accurate determination of these species.

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* Originals not seen.

EXPLANATION OF TEXT-FIGURES

FIGS. 1–4. Fig. 1. Dorsal view of the full-grown caterpillar of *Chilotraea auricilia* (Dudgeon), × 8. Fig. 2. Dorsal view of the full-grown caterpillar of *Chilotraea polychrysa* (Meyrick), × 8. Fig. 3. Dorsal view of the full-grown caterpillar of *Chilo suppressalis* (Walker), ×6½. Fig. 4. Dorsal view of the full-grown caterpillar of *Chilo partellus* (Swinhoe), ×6½.

dms., dorso-median stripe; *sds.*, sub-dorsal stripe; *ls.*, lateral stripe; *inc. sls.*, incomplete sublateral stripe.

FIGS. 5–8. Fig. 5. Diagrammatic sketch showing the position of stripes on the 1st abdominal segment of *Chilotraea auricilia* (Dudgeon), ×28. Fig. 6. Diagrammatic sketch showing the position of stripes on the 1st abdominal segment of *Chilotraea polychrysa* (Meyrick), ×32. Fig. 7. Diagrammatic sketch showing the position of stripes on the 1st abdominal segment of *Chilo suppressalis* (Walker), ×24. Fig. 8. Diagrammatic sketch showing the position of stripes on the 1st abdominal segment of *Chilo partellus* (Swinhoe), ×24.

dms., dorso-median stripe; *sds.*, sub-dorsal stripe; *ls.*, lateral stripe; *inc. sls.*, incomplete sub-lateral stripe.

FIGS. 9–12. Fig. 9. Arrangement of crochets on the 1st abdominal proleg of *Chilotraea auricilia* (Dudgeon), ×120. Fig. 10. Arrangement of crochets on the 1st abdominal proleg of *Chilotraea polychrysa* (Meyrick), ×12. Fig. 11. Arrangement of crochets on the 1st abdominal proleg of *Chilo suppressalis* (Walker) ×110. Fig. 12. Arrangement of crochets on the 1st abdominal proleg of *Chilo partellus* (Swinhoe), ×75.

FIGS. 13–16. Fig. 13. Chaetotaxy of the head of *Chilotraea auricilia* (Dudgeon), ×30. Fig. 14. Chaetotaxy of the head of *Chilotraea polychrysa* (Meyrick), ×30. Fig. 15. Chaetotaxy of the head of *Chilo suppressalis* (Walker), ×30. Fig. 16. Chaetotaxy of the head of *Chilo partellus* (Swinhoe), ×30.

A., anterior; *Adf.*, adfrontal; *E.*, epistomial; *F.*, frontal; *M.*, median; *L.*, lateral; *Ll.*, lateral (labrum); *O.*, ocellar; *P.*, posterior; *Up.*, ultra-posterior.

(Alphabets in capitals followed by number indicate seta ; alphabets followed by small letter indicate puncture).

FIGS. 17–20. Fig. 17. Camera lucida sketch showing the arrangement of setae on the 1st thoracic segment of *Chilotraea auricilia* (Dudgeon), ×35. Fig. 18. Camera lucida sketch showing the arrangement of setae on the 1st thoracic segment of *Chilotraea polychrysa* (Meyrick), ×35. Fig. 19. Camera lucida sketch showing the arrangement of setae on the 1st thoracic segment of *Chilo suppressalis* (Walker), ×35. Fig. 20. Camera lucida sketch showing the arrangement of setae on the 1st thoracic segment of *Chilo partellus* (Swinhoe), ×35.

α, alpha; β, beta; γ, gamma; δ, delta; ϵ, epsilon; ρ, rho; κ, kappa; η, eta; ν, nu; π, pie; σ, sigma.

FIGS. 21–24. Fig. 21. Camera lucida sketch showing the arrangement of setae on 2nd thoracic segment of *Chilotraea auricilia* (Dudgeon), ×35. Fig. 22. Camera lucida sketch showing the arrangement of setae on 2nd thoracic segment of *Chilotraea polychrysa* (Meyrick), × 35. Fig. 23. Camera lucida sketch showing the arrangement of setae on 2nd thoracic segment of *Chilo suppressalis* (Walker), × 28. Fig. 24. Camera lucida sketch showing the arrangement of setae on 2nd thoracic segment of *Chilo partellus* (Swinhoe), × 26.

α, alpha; β, beta; ρ, rho; ϵ, epsilon; θ, theta; κ, kappa; η, eta; ν, nu; π, pi; σ, sigma; *at*, asetose tubercle.

FIGS. 25–28. Fig. 25. Camera lucida sketch showing the arrangement of setae on the 1st abdominal segment of *Chilotraea auricilia* (Dudgeon), ×35. Fig. 26. Camera lucida sketch showing the arrangement of setae on the 1st abdominal segment of *Chilotraea polychrysa* (Meyrick), × 35. Fig. 27. Camera lucida sketch showing the arrangement of setae on the 1st abdominal segment of *Chilo suppressalis* (Walker), × 26. Fig. 28. Camera lucida sketch showing the arrangement of setae on the 1st abdominal segment of *Chilo partellus* (Swinhoe), × 28.

α, alpha; β, beta; ρ, rho; ϵ, epsilon; κ, kappa; η, eta; μ, mu; ν, nu; π, pi; τ, tau; σ, sigma; *at*, asetose tubercle.

FIGS. 29–32. Fig. 29. Camera lucida sketch showing the arrangement of setae on the 8th abdominal segment of *Chilotraea auricilia* (Dudgeon), × 35. Fig. 30. Camera lucida sketch showing the arrangement of setae on the 8th abdominal segment of *Chilotraea polychrysa* (Meyrick), × 35. Fig. 31. Camera lucida sketch showing the arrangement of setae on the

8th abdominal segment of *Chilo suppressalis* (Walker), × 26. Fig. 32. Camera lucida sketch showing the arrangement of setae on the 8th abdominal segment of *Chilo partellus* (Swinhoe), × 28.

α, alpha; β, beta; ρ, rho; ϵ, epsilon; κ, kappa; η, eta; μ, mu; π, pi; σ, sigma.

FIGS. 33–40. Fig. 33. Lateral view of pupa of *Chilotraea auricilia* (Dudgeon), × 9. Fig. 34. Lateral view of pupa of *Chilotraea polychrysa* (Meyrick), × 9. Fig. 35. Lateral view of pupa of *Chilo suppressalis* (Walker), ×7½. Fig. 36. Lateral view of pupa of *Chilo partellus* (Swinhoe), ×7½. Fig. 37. Arrangement of spines on the dorsum of 5th abdominal segment of the pupa of *Chilotraea auricilia* (Dudgeon), ×37½. Fig. 38. Arrangement of spines on the dorsum of 5th abdominal segment of the pupa of *Chilotraea polychrysa* (Meyrick), ×37½. Fig. 39. Arrangement of spines on the dorsum of 5th abdominal segment of the pupa of *Chilo suppressalis* (Walker), ×37½. FIG. 40. Arrangement of spines on the dorsum of 5th abdominal segment of the pupa of *Chilo partellus* (Swinhoe), × 37½.

f., frons; *g.*, gena.

FIGS. 41–45. Fig. 41. Postero-ventral region of the pupa of *Chilotraea auricilia* (Dudgeon), × 22. Fig. 42. Postero-ventral region of the pupa of *Chilotraea polychrysa* (Meyrick), ×22. Fig. 43. Postero-lateral region of the pupa of *Chilo suppressalis* (Walker), × 21. Fig. 44. Postero-ventral region of the pupa of *Chilo suppressalis* (Walker), × 22. Fig. 45. Postero-ventral region of the pupa of *Chilo partellus* (Swinhoe), × 22.

s., seta.

FIGS. 46–53. Figs. 46 and 47. Dorsal and ventral views of the cremaster of the pupa of *Chilotraea auricilia* (Dudgeon), × 45. Figs. 48 and 49. Dorsal and ventral views of the cremaster of the pupa of *Chilotraea polychrysa* (Meyrick), × 45. Figs. 50 and 51. Dorsal and ventral views of the cremaster of the pupa of *Chilo suppressalis* (Walker), × 45. Figs. 52 and 53. Dorsal and ventral views of the cremaster of the pupa of *Chilo partellus* (Swinhoe), × 45.

pd., postero-dorsal spine; *pl.*, postero-lateral spine; *pv.*, postero-ventral spine; *s.*, seta.

FIGS. 54–57. Fig. 54. Forewing of *Chilotraea auricilia* (Dudgeon), × 8. Fig. 55. Forewing of *Chilotraea polychrysa* (Meyrick), × 8. Fig. 56. Forewing of *Chilo suppressalis* (Walker), × 8. Fig. 57. Forewing of *Chilo partellus* (Swinhoe), × 8.

A., Anal; *Cu.*, Cubitus; *M.*, Media; *R.*, Radius; *Sc.*, Subcosta; *D.*, Discoidal cell.

FIGS. 58–61. Fig. 58. Hindwing of *Chilotraea auricilia* (Dudgeon), × 8. Fig. 59. Hindwing of *Chilotraea polychrysa* (Meyrick), × 8. Fig. 60. Hindwing of *Chilo suppressalis* (Walker), × 8. Fig. 61. Hindwing of *Chilo partellus* (Swinhoe), × 8.

A., Anal; *ba.*, basal areole; *D.*, Discoidal cell; *Cu.*, Cubitus; *M.*, Media; *Rs.*, Radial sector; *Sc* + *R1*-Subcosta + first Radial vein.

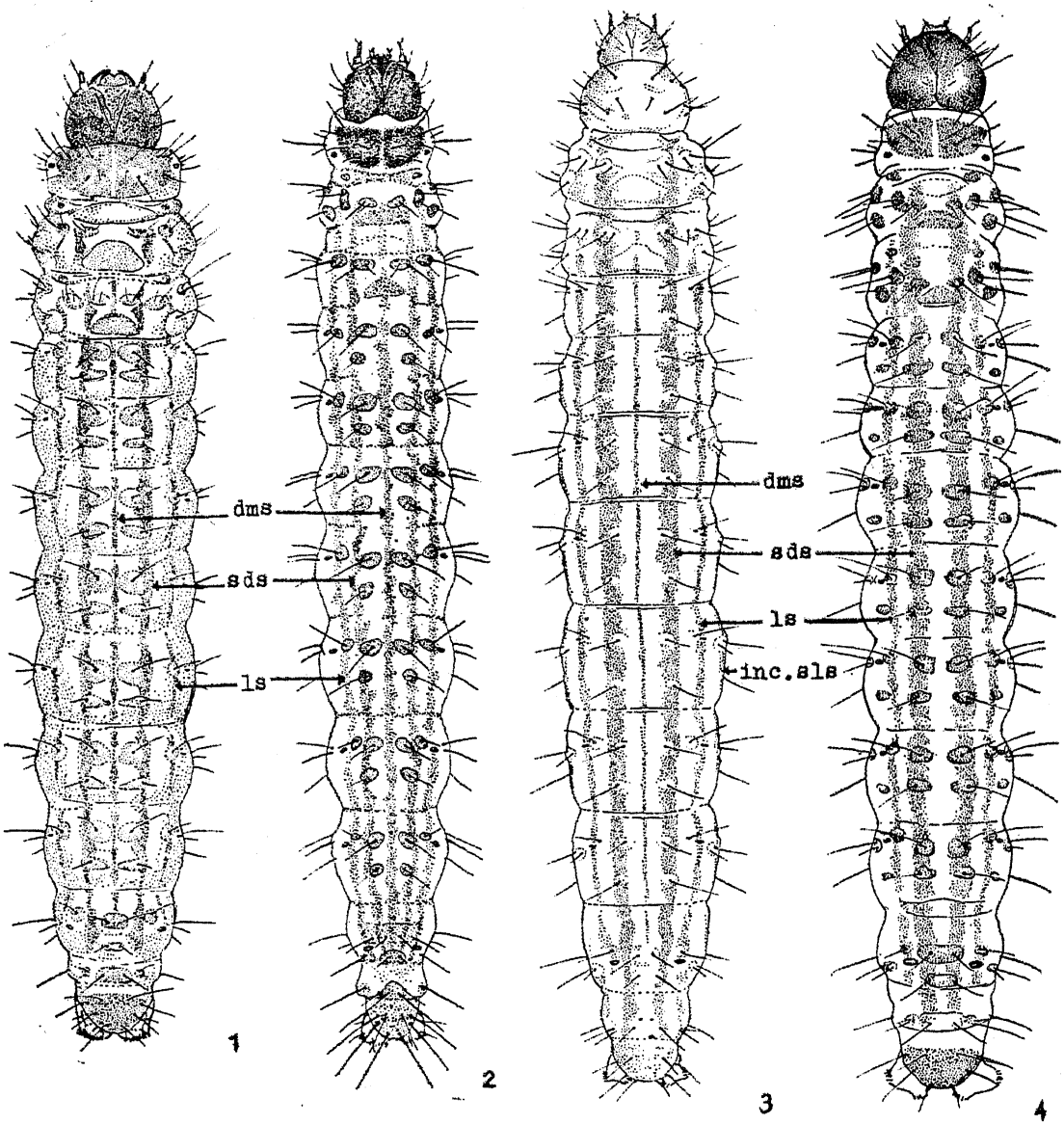
FIGS. 62–65. Fig. 62. Male genitalia of *Chilotraea auricilia* (Dudgeon), × 36. Fig. 63. Male genitalia of *Chilotraea polychrysa* (Meyrick), × 36. Fig. 64. Male genitalia of *Chilo suppressalis* (Walker), × 24. Fig. 65. Male genitalia of *Chilo partellus* (Swinhoe), × 30.

h., harpe; *v.*, vinculum.

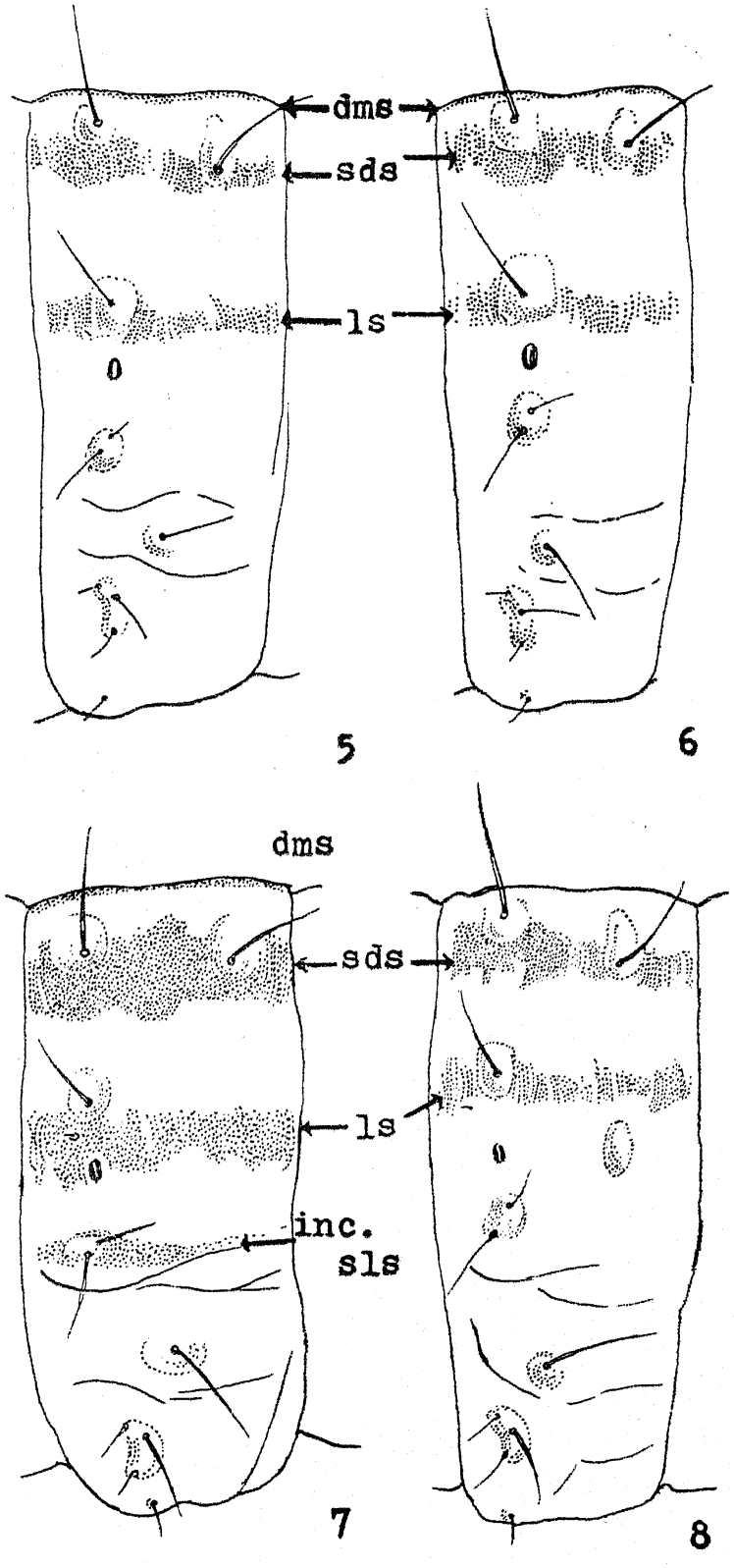
FIGS. 66–77. Fig. 66. Aedeagus of *Chilotraea auricilia* (Dudgeon), × 66. Fig. 67. Aedeagus of *Chilotraea polychrysa* (Meyrick), × 53. Fig. 68. Anellus of *Chilotraea auricilia* (Dudgeon), × 66. Fig. 69. Anellus of *Chilotraea polychrysa* (Meyrick), × 53. Fig. 70. Position of aedeagus and anellus in *Chilotraea auricilia* (Dudgeon), × 66. Fig. 71. Position of aedeagus and anellus in *Chilotraea polychrysa* (Meyrick), × 53. Fig. 72. Aedeagus of *Chilo suppressalis* (Walker), × 33. Fig. 73. Aedeagus of *Chilo partellus* (Swinhoe), × 40. Fig. 74. Anellus of *Chilo suppressalis* (Walker), × 33. Fig. 75. Anellus of *Chilo partellus* (Swinhoe), × 40. Fig. 76. Position of aedeagus and anellus in *Chilo suppressalis* (Walker), × 33. Fig. 77. Position of aedeagus and anellus in *Chilo partellus* (Swinhoe), × 40.

FIGS. 78–81. Fig. 78. Female genitalia of *Chilotraea auricilia* (Dudgeon), × 24. Fig. 79. Female genitalia of *Chilotraea polychrysa* (Meyrick), × 24. Fig. 80. Female genitalia of *Chilo suppressalis* (Walker), × 24. Fig. 81. Female genitalia of *Chilo partellus* (Swinhoe), × 24.

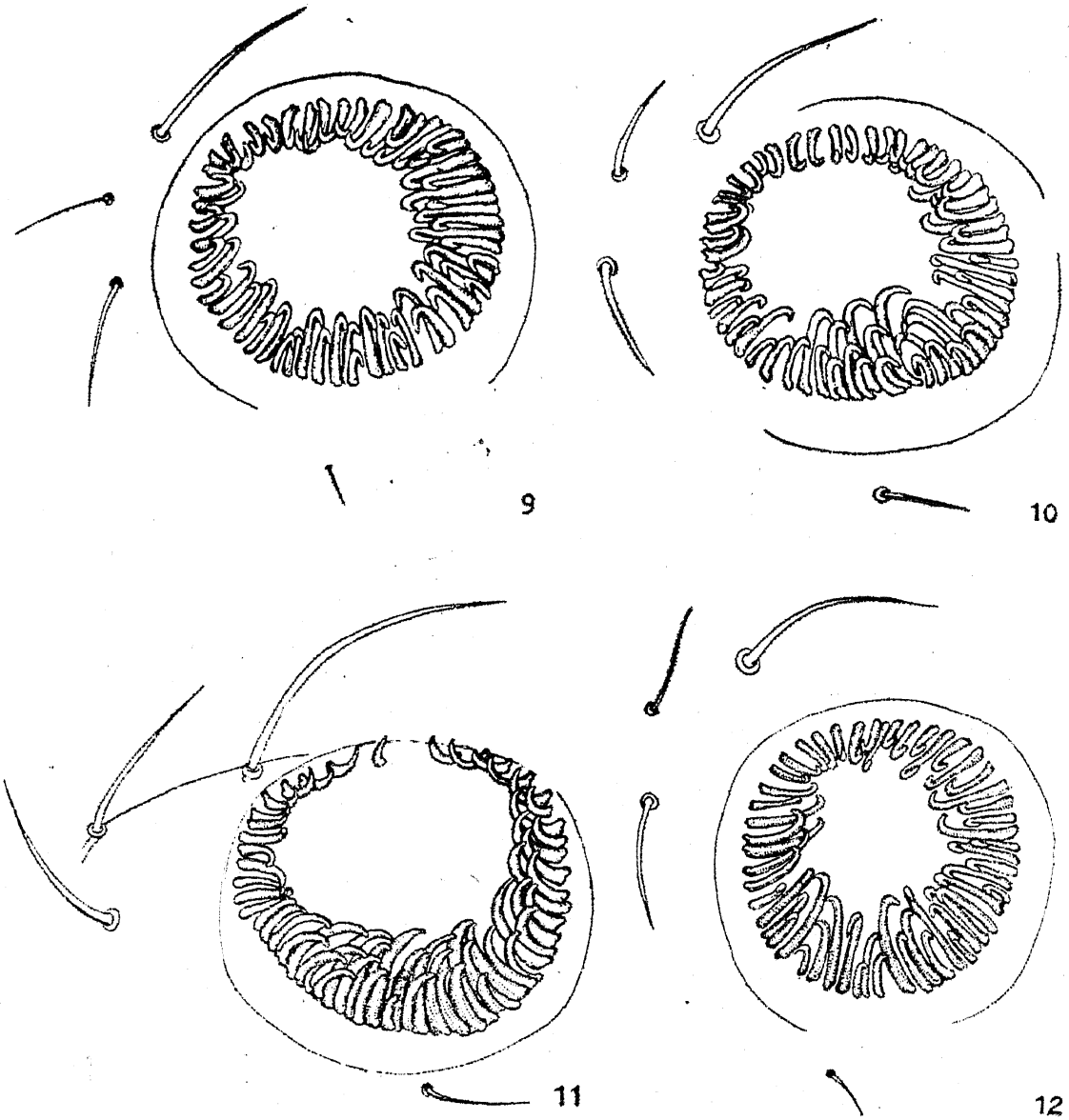
apo-ant., apophysis anterior; *apo.p.*, apophysis posterior; *crp.bu.*, corpus bursae; *du.bu.*, ductus bursae; *lla.*, lamella antevaginalis; *llp.*, lamella postvaginalis; *o.b.*, ostium bursae; *sig.*, signum.



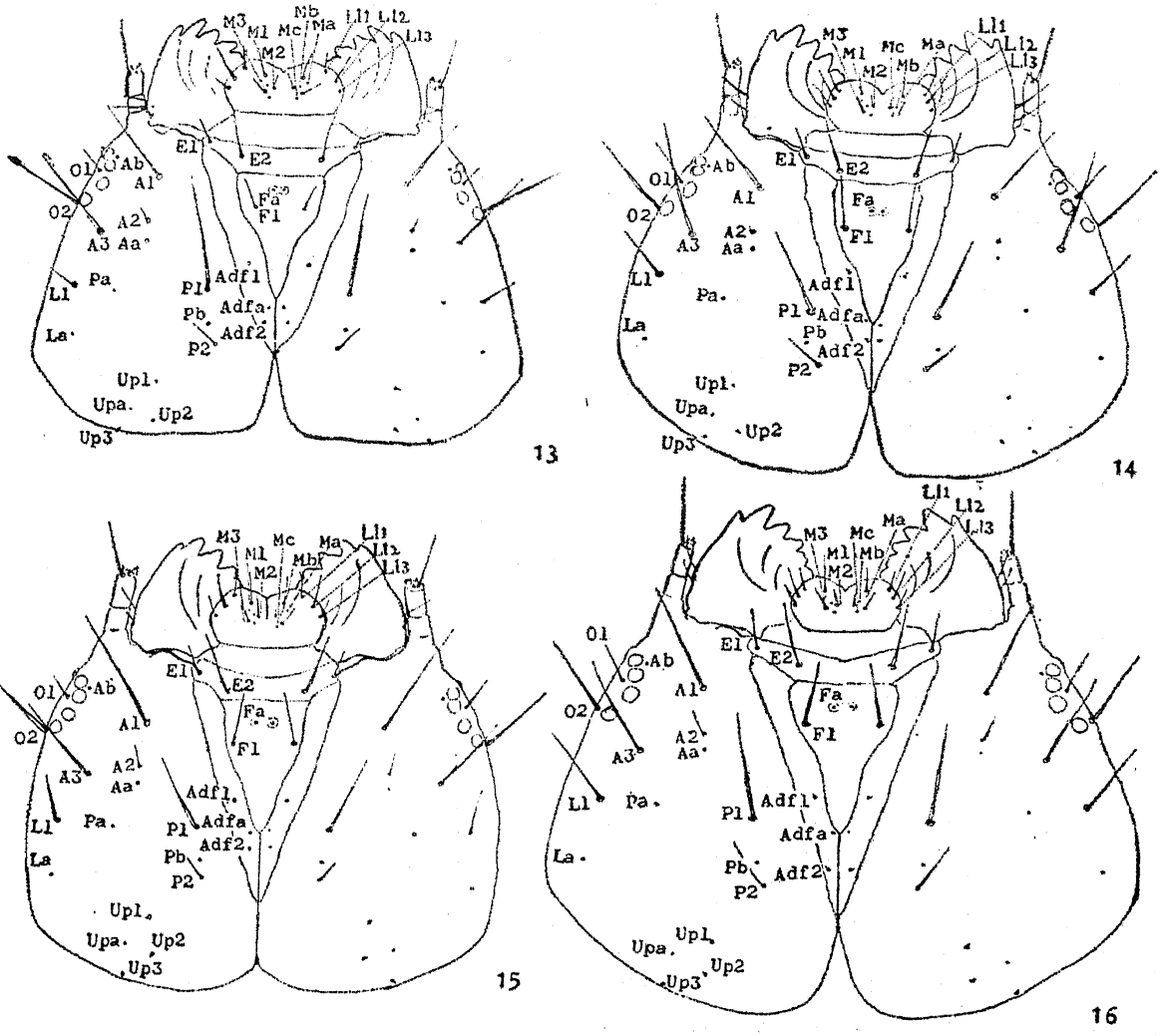
FIGS. 1-4



FIGS. 5–8



FIGS. 9–12


M3
Mb
Ma
Ll1
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E2
Fa
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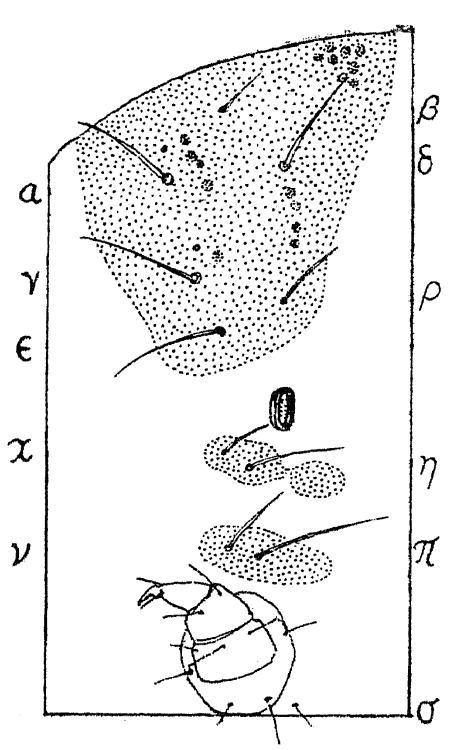
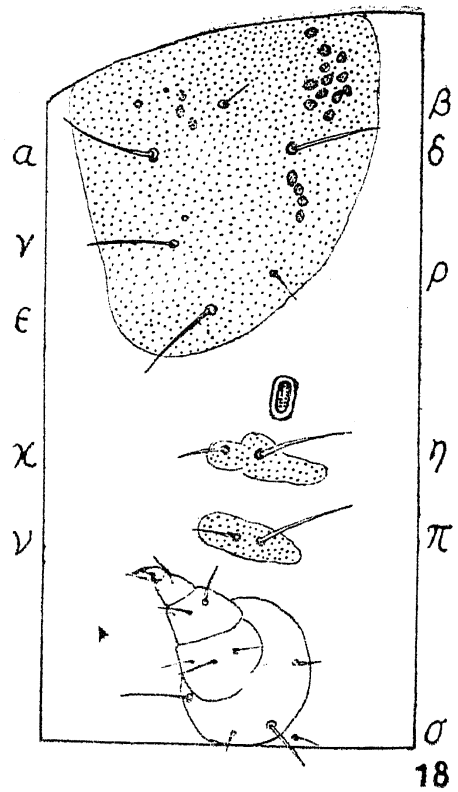
A2
A3
Aa
Pa
Ll
Pl
Adf1
Adfa
Pb
Adf2
La
P2
Upl
Upa
Up2
Up3
13
14
15
16

FIGS. 13–16



17



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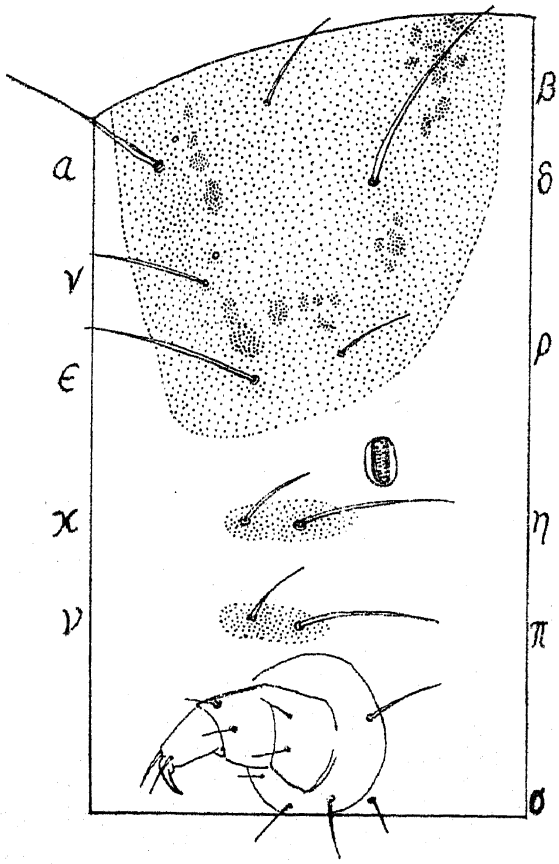

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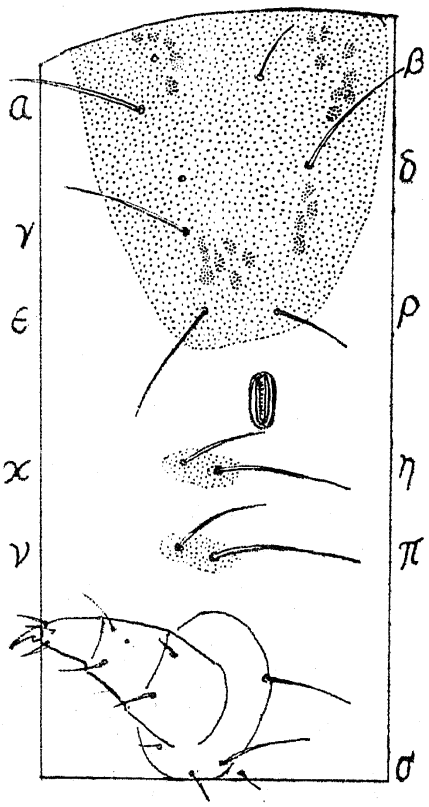
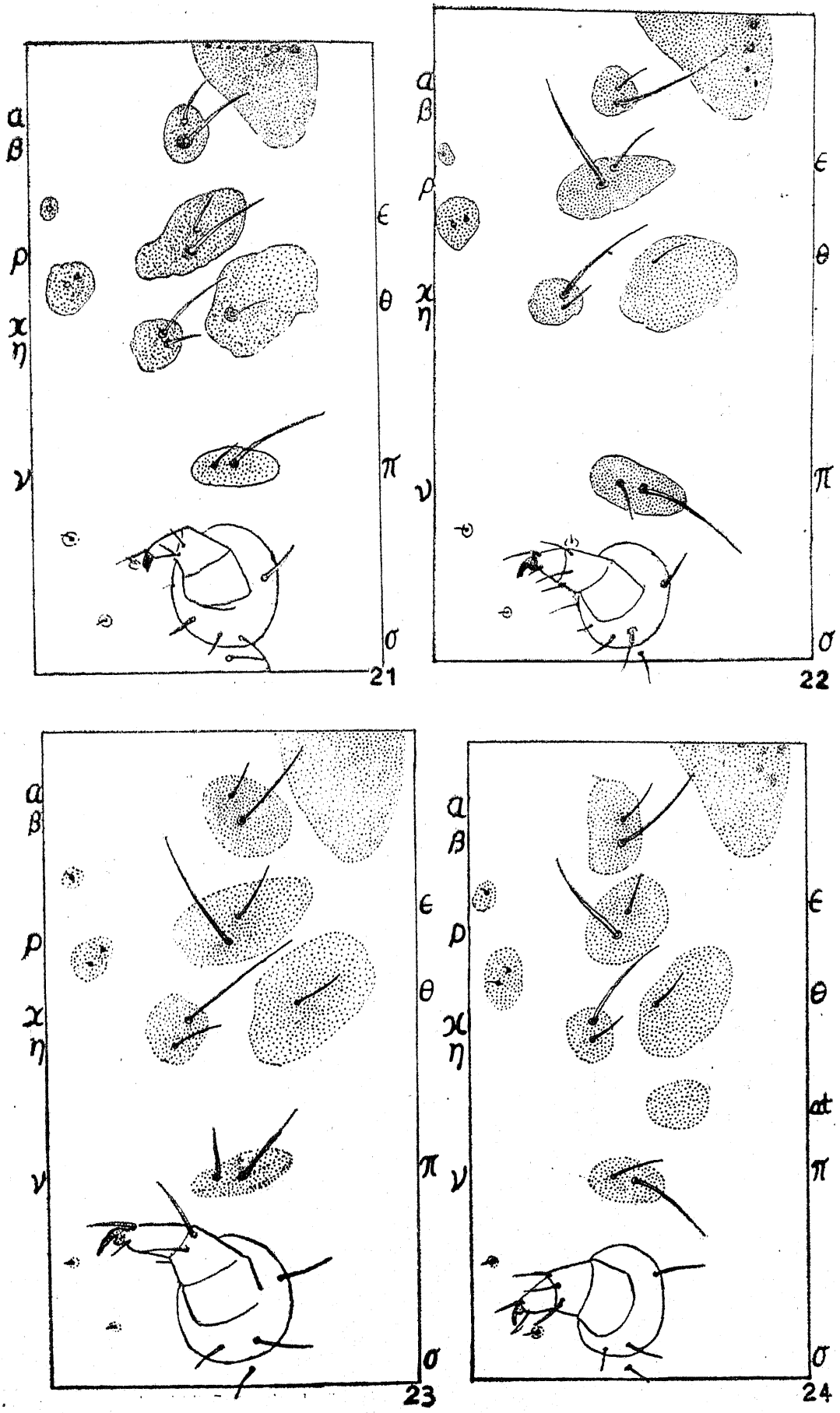
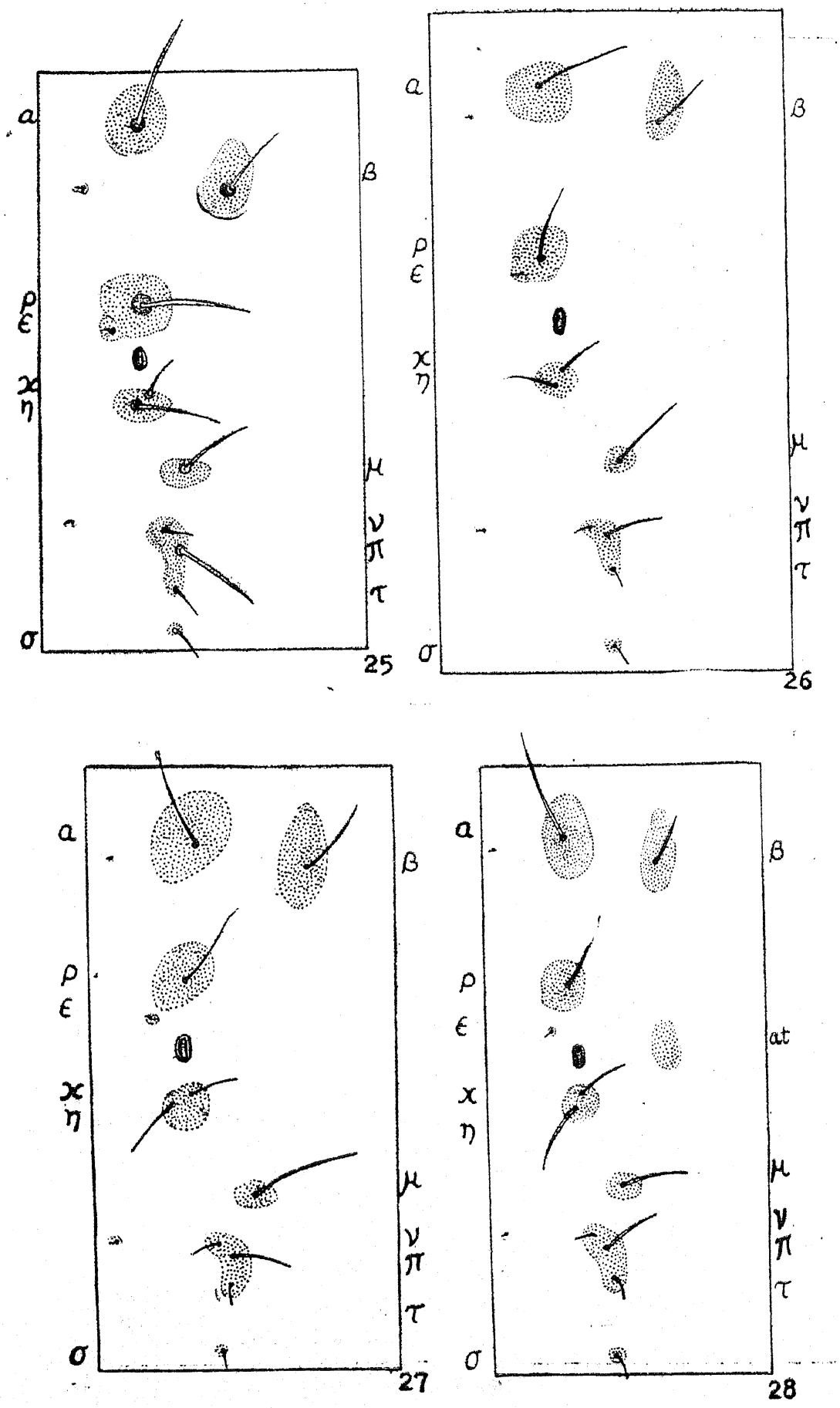


20

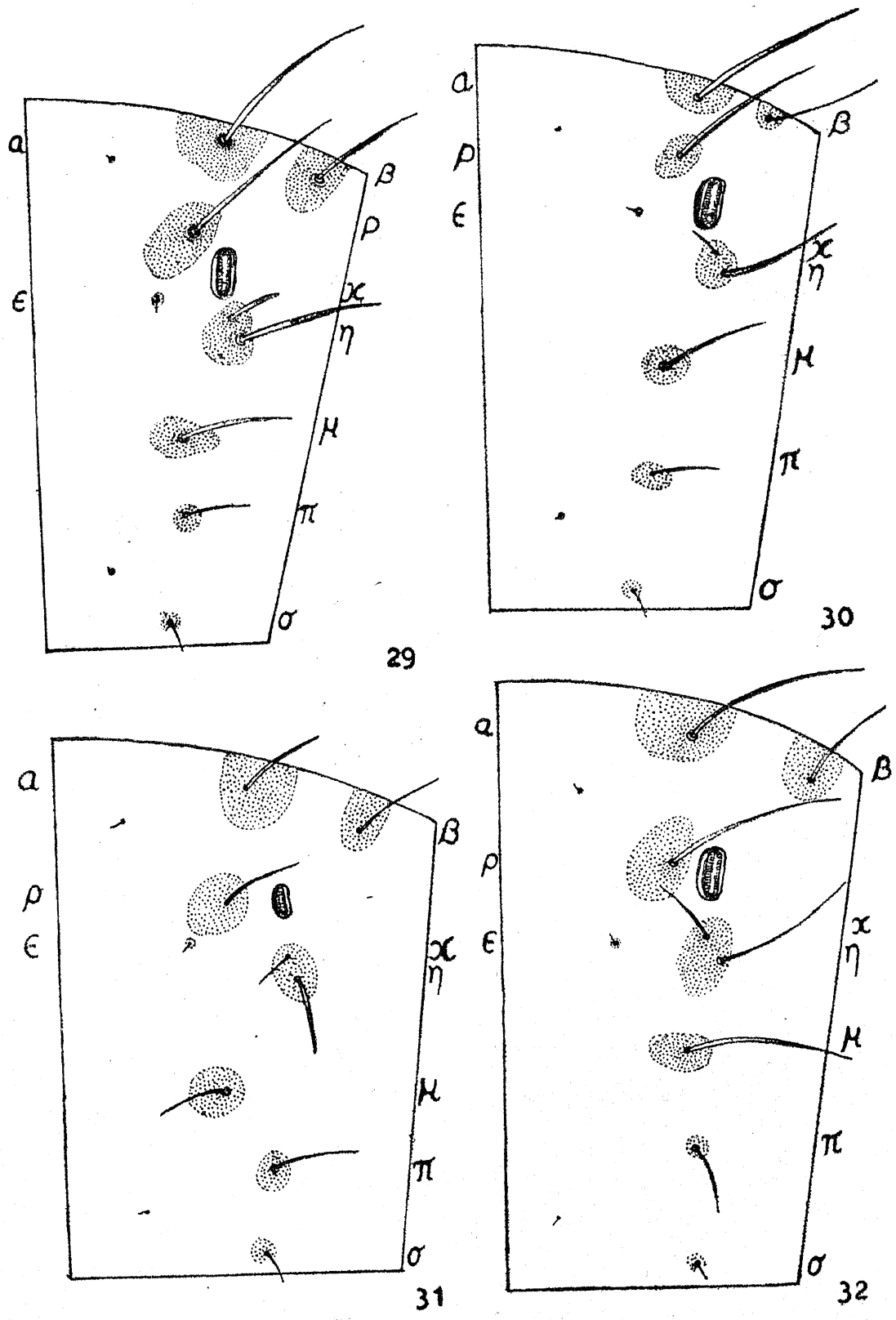
FIGS. 17–20



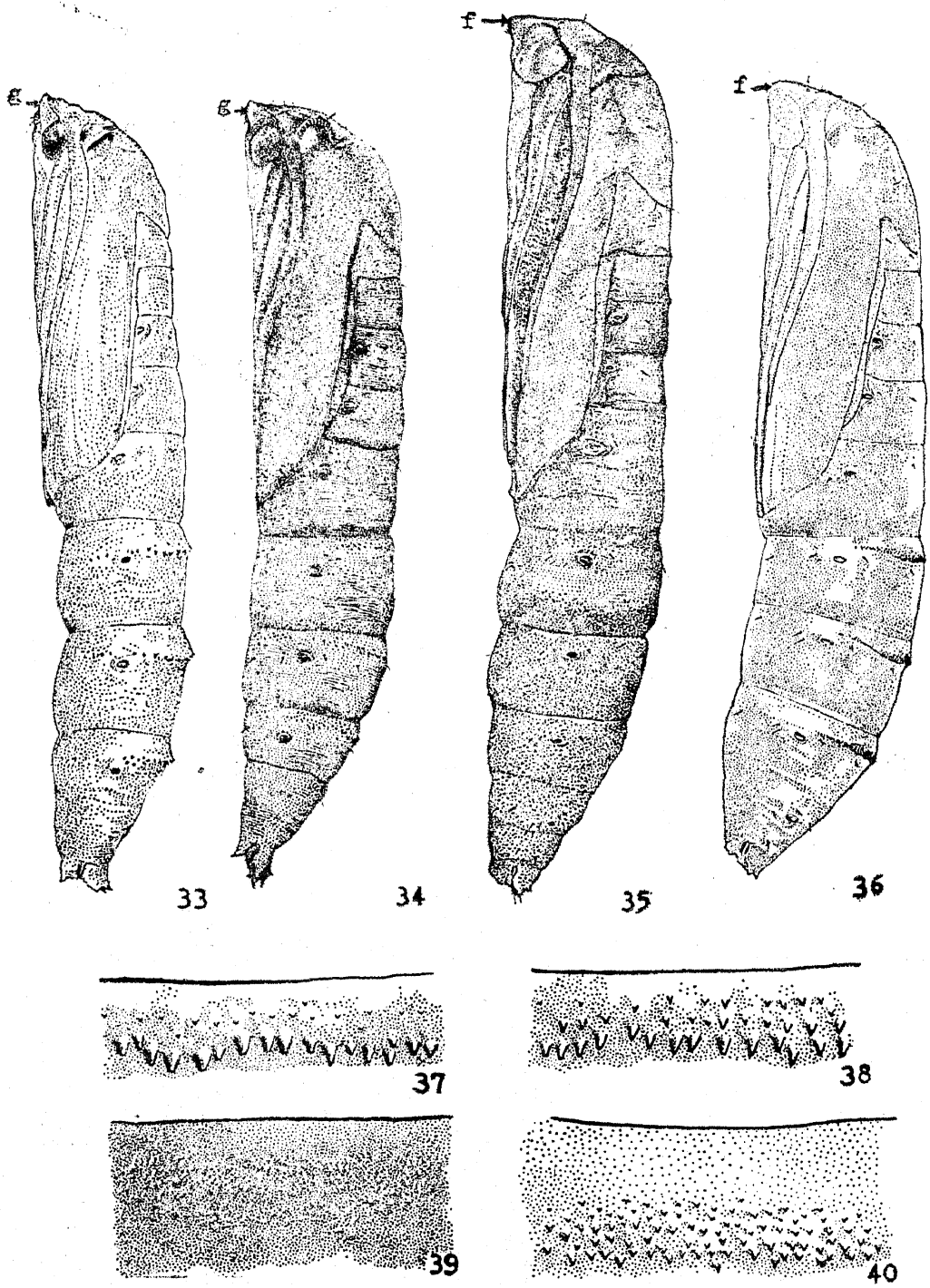
FIGS. 21–24



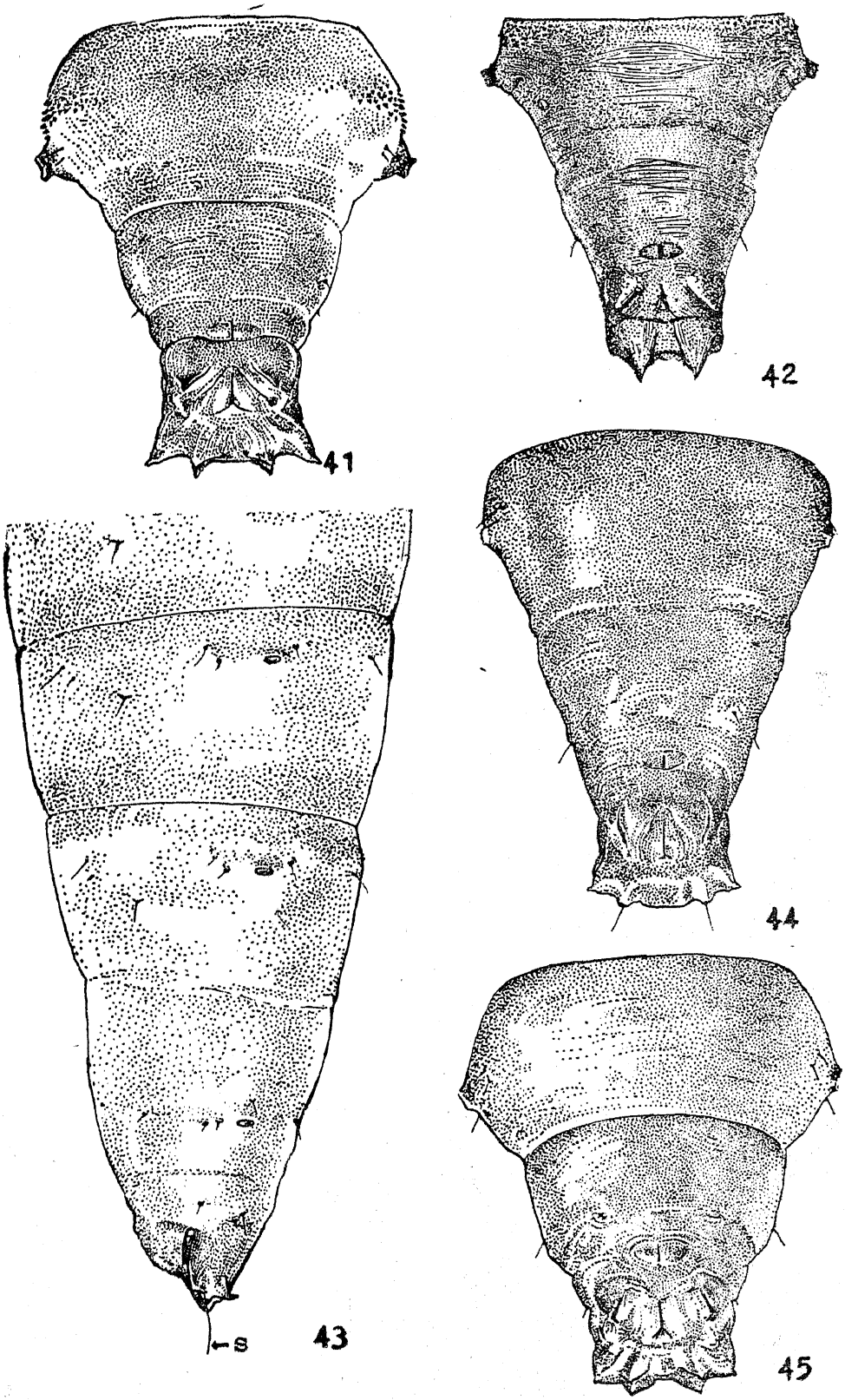
FIGS. 25–28



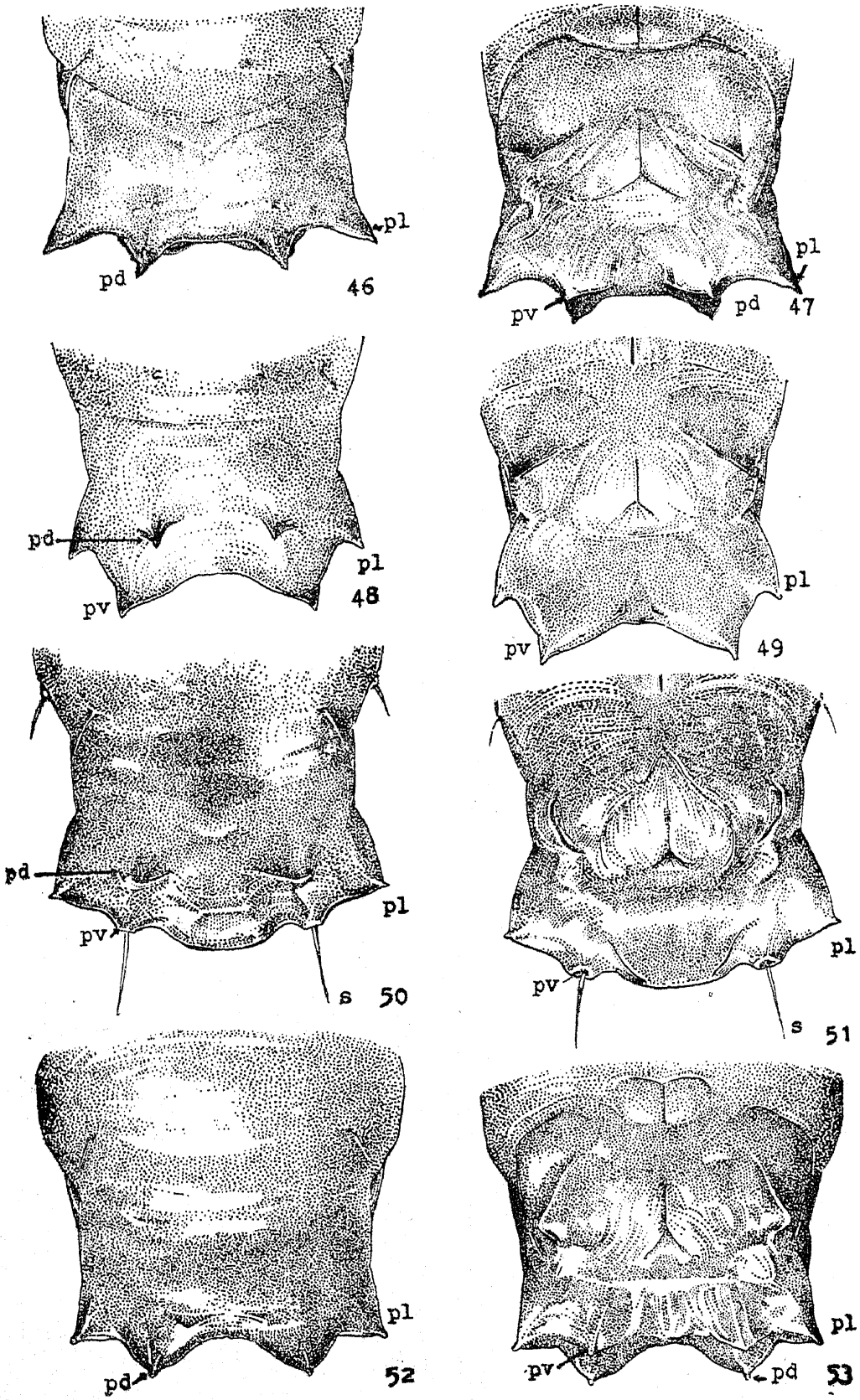
FIGS. 29–32



FIGS. 33–40



FIGS 41-45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pd
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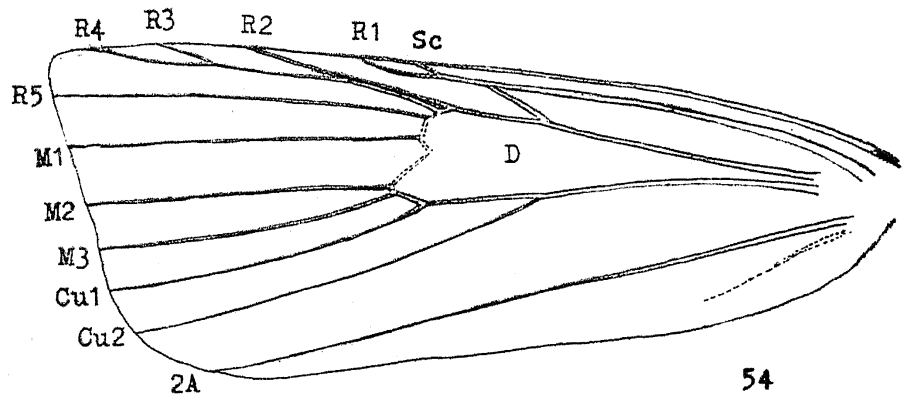
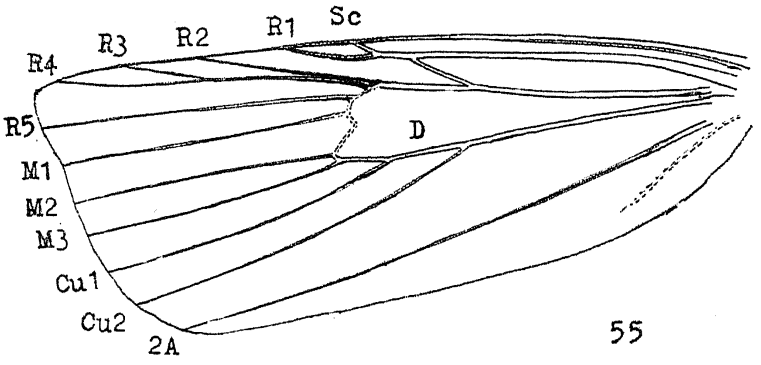
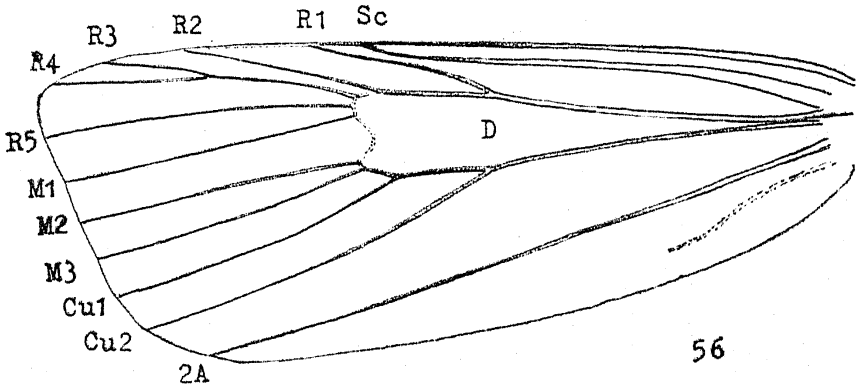
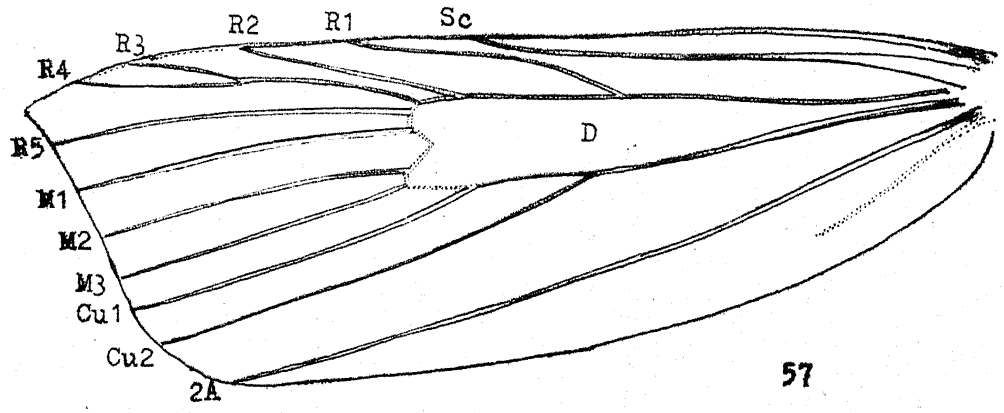
pv
pd
47
pd
pl
pv
48
pl
pv
49
pd
pl
pv
s
50
pl
pv
s
51
pl
pd
52
pl
pv
pd
53

FIGS. 46–53

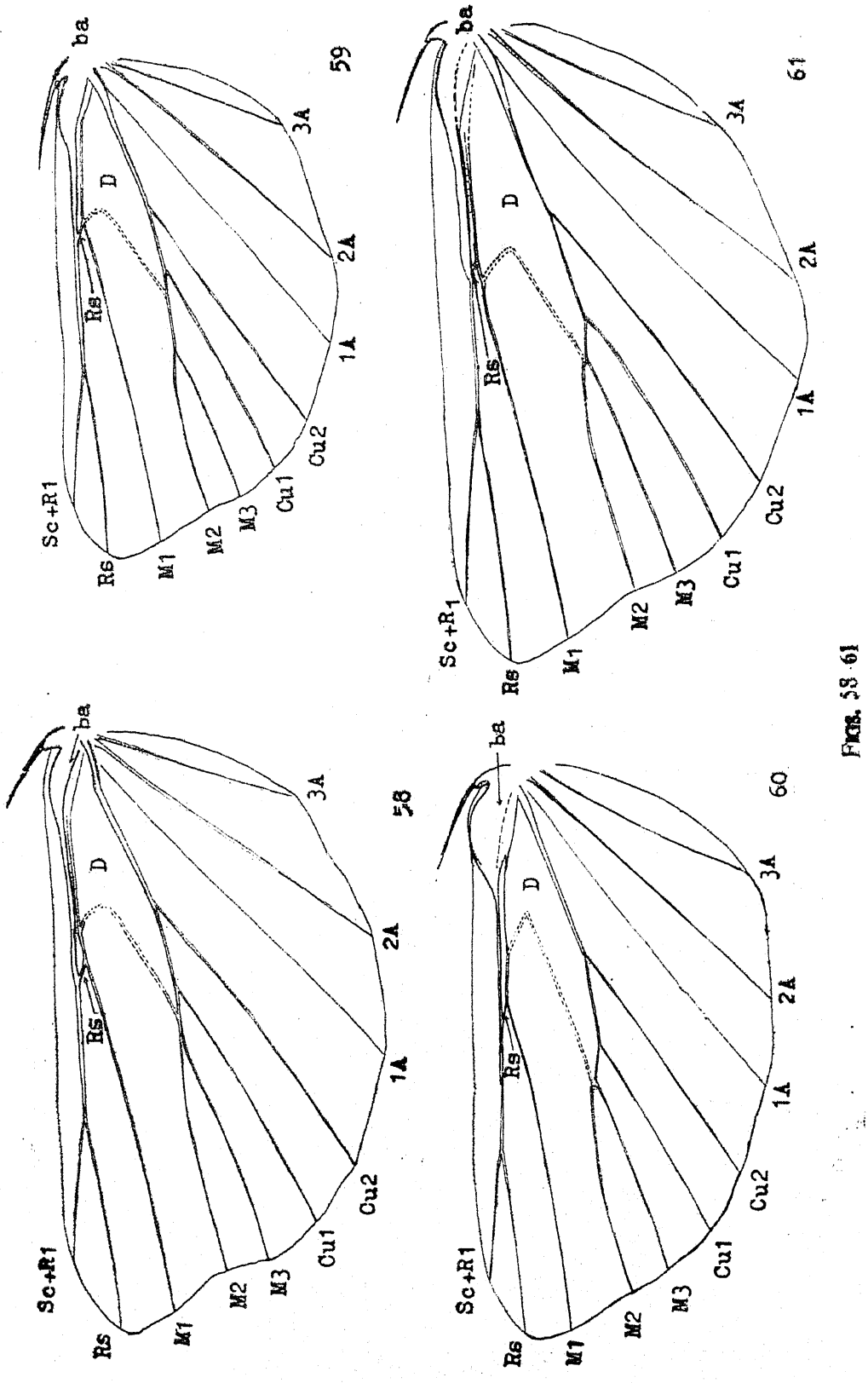

R4
R3
R2
R1
Sc
R5
M1
D
M2
M3
Cu1
Cu2
2A
54


R4
R3
R2
R1
Sc
R5
D
M1
M2
M3
Cu1
Cu2
2A
55

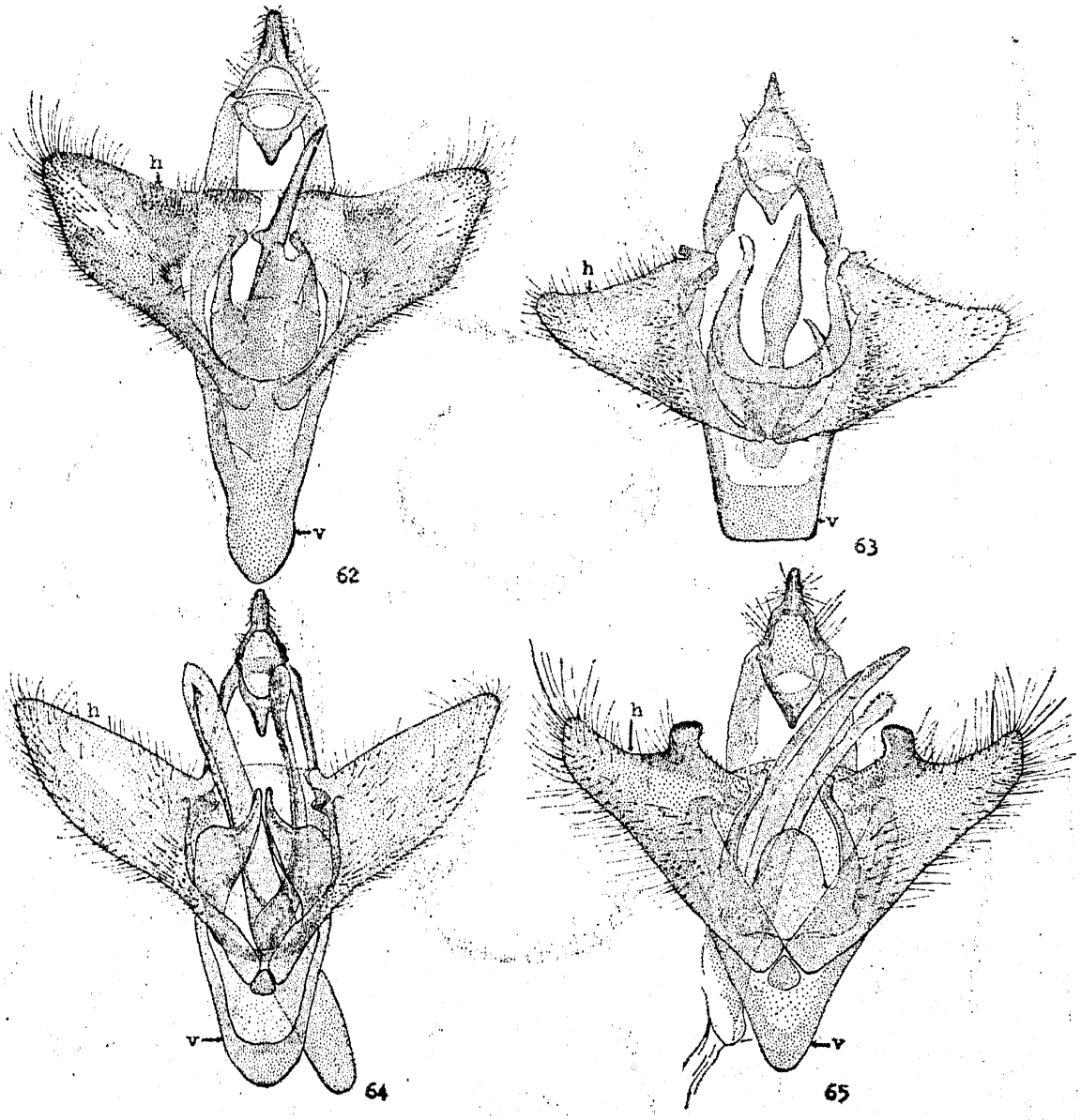

R3
R2
R1
Sc
R4
R5
D
M1
M2
M3
Cu1
Cu2
2A
56


R2
R1
Sc
R3
R4
R5
D
M1
M2
M3
Cu1
Cu2
2A
57

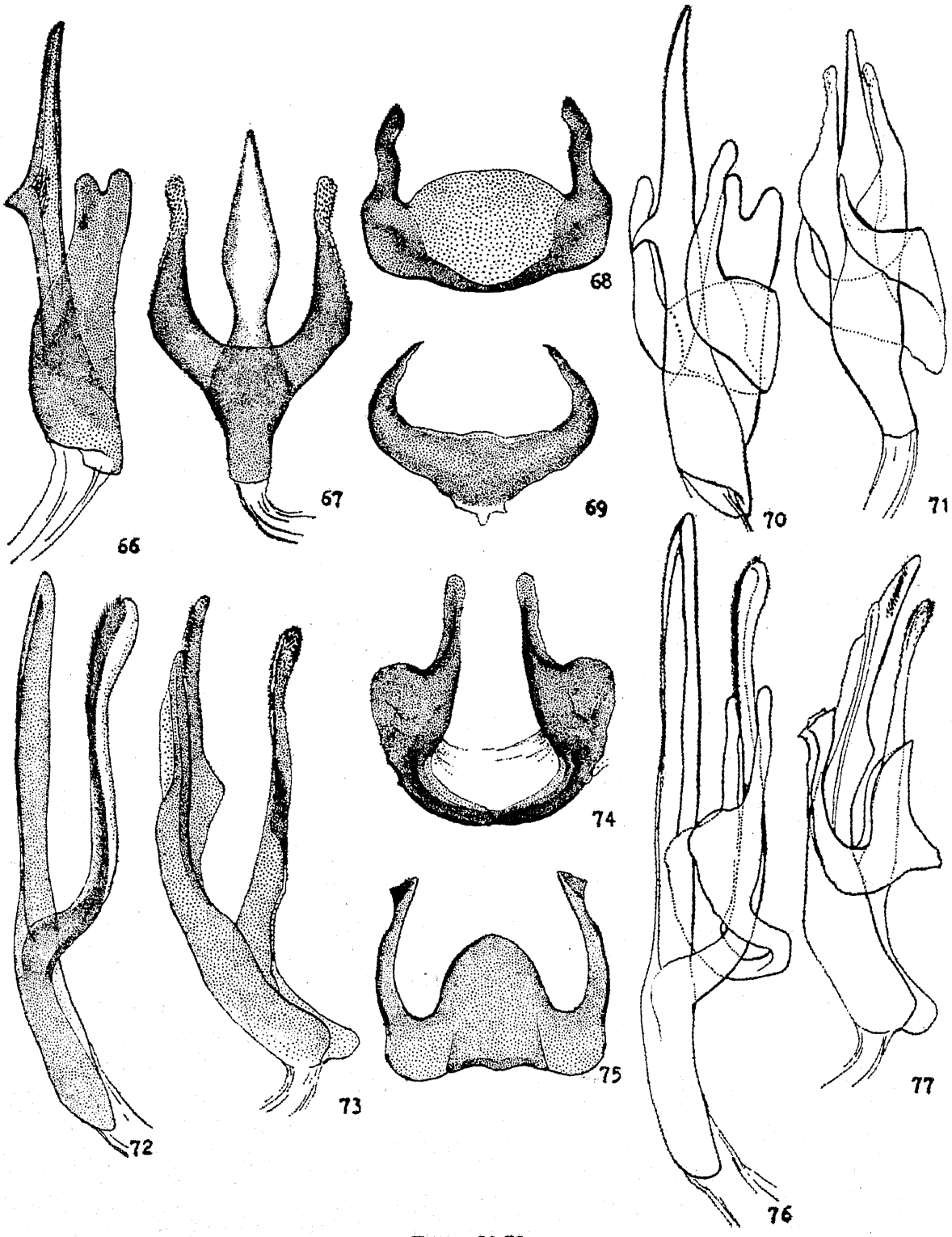
FIGS. 54–57



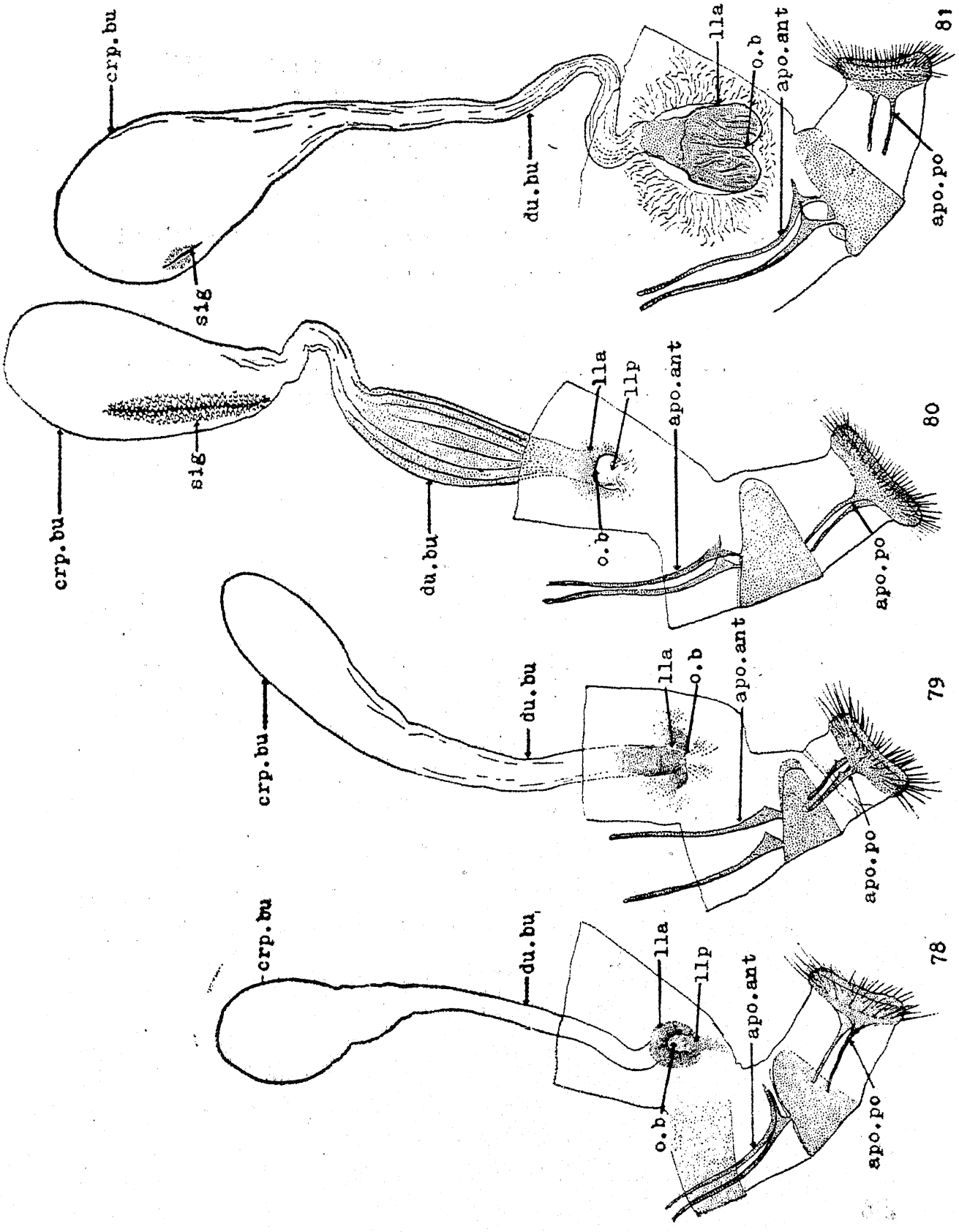
FIGS. 58-61



FIGS. 62–65



FIGS. 66-77


crp.bu
sig
du.bu
lla
o.b
apo.ant
apo.po
81
crp.bu
sig
du.bu
lla
llp
o.b
apo.ant
apo.po
80
crp.bu
du.bu
lla
o.b
apo.ant
apo.po
79
crp.bu
du.bu
lla
llp
o.b
apo.ant
apo.po
78

FIGS. 78–81