Rec. zool. Surv. India, **68**: 161—272, 1975.

TAXONOMIC, BIOLOGICAL AND ECOLOGICAL STUDIES OF SOME INDIAN MEMBRACIDS (INSECTA : HOMOPTERA) PART I.

By

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INTRODUCTION

The family Membracidae has received little attention in India ever since the pioneering work of Distant in the early part of this century (1908, 1916). Besides very meagre descriptions, no mention was made by Distant of the host plants and of the sex of the insect described as the Type, and many species were left unfigured. In the wake of the modern concept of membracid taxonomy, it has become imperative to collect long series of male and female specimens belonging to the same population or reared from a single pair, in order to assess the range of individual variations and to reach a definite decision regarding the determination of species. With this point in view, an attempt is made to study the South Indian membracids from their taxonomic and biological angles. This paper deals with only the taxonomy of the family. and the biological and ecological studies of the group will be published under Part II of this work.

MATERIAL AND METHODS

The material discussed in this work was collected from all over South India during the years 1964-'68. Many species were also reared in their natural habitat by covering egg masses and nymphs with a fine netting to compare the results of laboratory experiments. Nymphs were reared in the laboratory on small pot plants enclosed in insect rearing cages. Thus long series of adults of both sexes could be obtained from laboratory cultures for systematic studies. Adults and the last nymphal instars were preserved by mounting on pins or by gumming on cards.

Two subfamilies of Membracidae occur in South India, the *Oxyrhachinae* and the *Centrotinae*. The Oxyrhachinae is separated from the Centrotinae by the presence of a rudimentary scutellum concealed by the pronotum, and by the development of propleural and mesopleural processes. In the Centrotinae the scutellum is always clearly visible, and the propleural and mesopleural processes are absent.

In the description of the species the important taxonomical characters, as illustrated for the common species, *Oxyrhachis tarandus* (Text fig. 2) to which continual reference will be made, are as follows :—

The position of *head*, whether directed obliquely downward or inclined backward; the proportion of length to width of head; the shape

of *fronto*-cl *clypeus* and the nature of its lobes whether fused or distinct; the position of *ocelli* in relation to eyes and to the *centro-ocular line* (c-o-l) which is an imaginary line drawn through the centre of the anterior margin of the base of the eyes when the head in a horizontal position is viewed from directly above; the nature of *metopidium* which is the declivous part of the pronotum from the base of head to the front of dorsum; the *humeral angles* which are lateral protuberances one on either side of pronotum above the eyes; the *supraocular callosities* which are irregular areas located on the metopidium above the eyes; the *suprahumeral horns*, also referred to as *suprahumerals* or *horns*; the *posterior* process which is by far the most important of all taxonomic characters: the posterior process may present a strong *gibba* in many species of Oxyrhachinae located above the metathorax or slightly behind it; the ridges or *carinae* usually conspicuous on the horns and on the posterior process; the nature of the tegmina whether presenting a *pterostigma* or not, the shape and size of the *apical cells*, the proportion of length to width of *first apical cell*; the number of *discoidal cells*, the colour patterns and the nature of apical limbus; the number of apical cells in the hind wings; the *scutellum* whether well developed or aborted, and the proportion of length to width of this structure.

The legs, as a rule, are not generally considered as important in the taxonomy but nevertheless prove indispensable in the diagnosis of the genus *Tricentrus* where the hind *trochanters* bear well developed teeth.

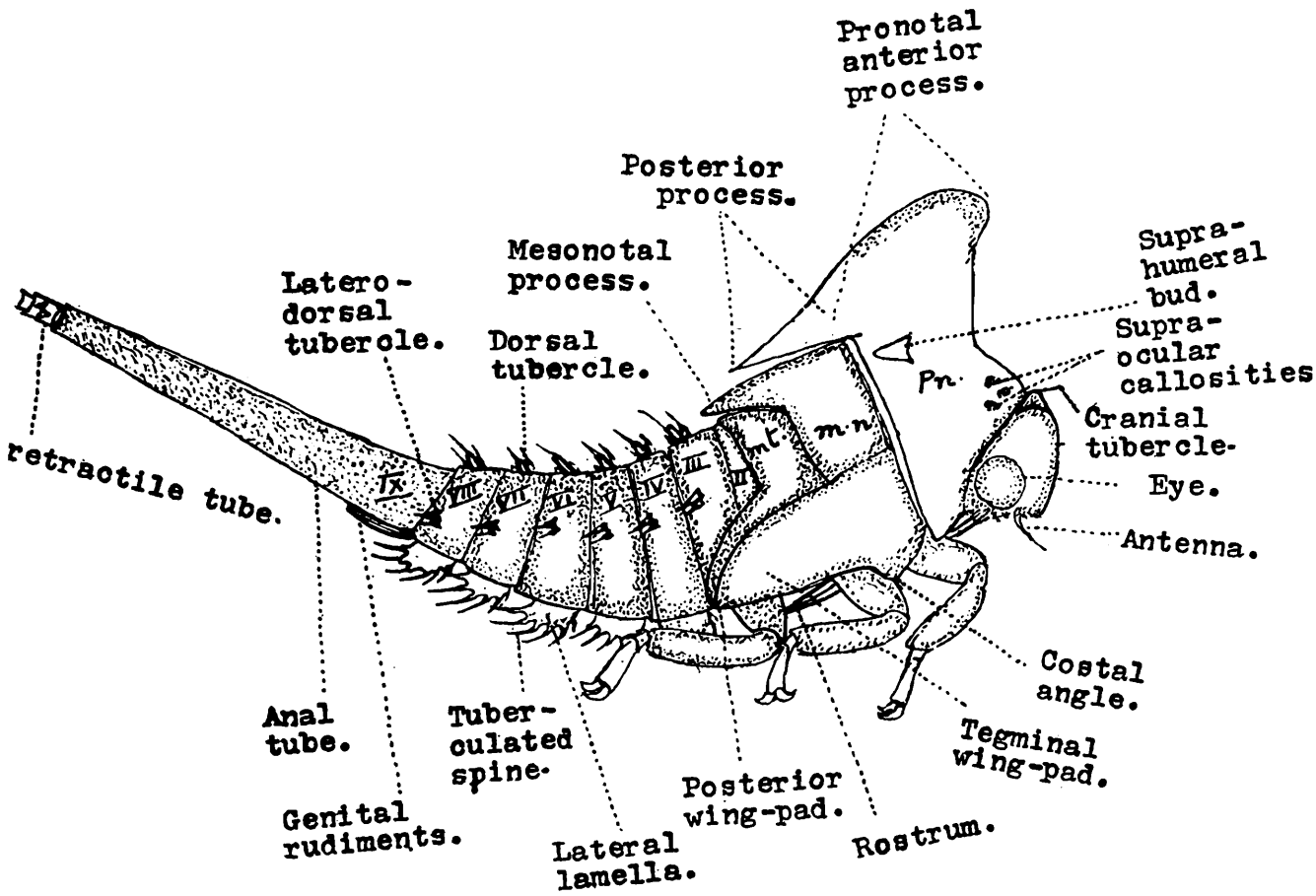
The *male genital structures*, namely, the *sternal plate* of the ninth abdominal segment, *lateral valves*, *parameres* and *aedeagus*, are of value at least as subsidiary characters.

It is not out of place to emphasise the fact that the adult membracids exhibit only a limited number of characters of taxonomic importance. On the contrary, a careful study of the nymphs, particularly in their last or fifth nymphal stage, has brought to light several characters which are used in description and based on which an attempt has been made to construct keys for genera and species; these characters to which continual references will be made are mentioned below and illustrated in Fig. 1.

Head : Cranial tubercules which are a pair of thorn-like or conical processes of vertex located above ocelli, rudimentary or obsolete in some, very prominent in others. The centro-ocular line (already stated) is of importance when ocelli are visible; the *subocular expansions* which are short acute tooth-like or flattened processes one on either side of vertex below eye, well developed in the Oxyrhachinae; the *foliate lobes*, one on either side of fronto-clypeus partially concealing it or fused with it.

Thorax.—The nature of metopidium whether convex in front, vertical or sloping backwards; the *pronotal crest*, which is a prominent ridge on the dorsum produced in some as an anterior process and a posterior process; the relative lengths of anterior and posterior processes when both are present (Text fig. 1a); the *suprahumeral buds* which are the rudiments of suprahumeral horns, present in some in the fifth instar as a

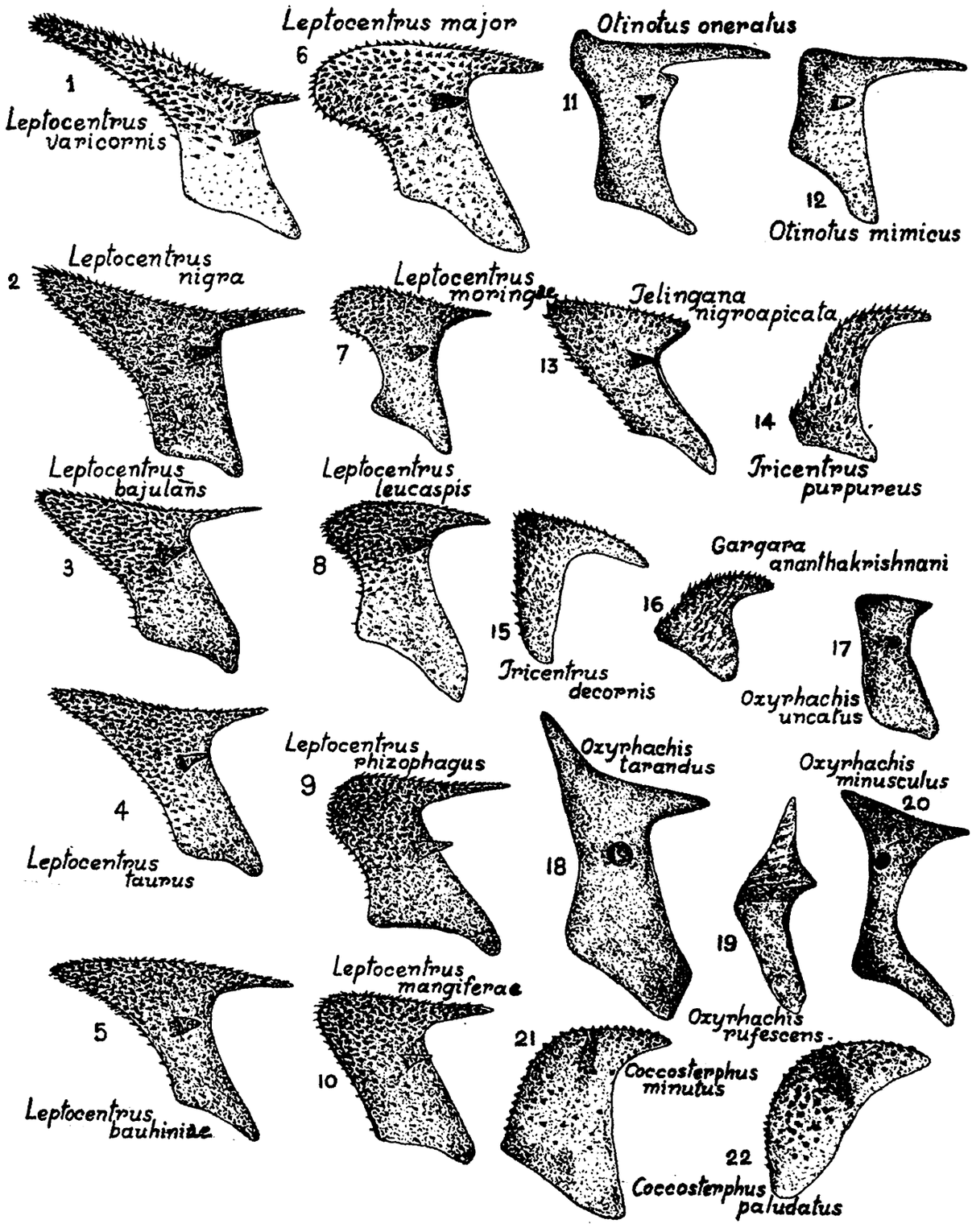
pair of small nodules or pointed conical processes; the wing-pads appearing in the third instar normally and assuming prominence in the last nymphal stage, extending backwards to a variable degree; the costal angles of tegminal wing pads, distinctly demarcated in some and inconspicuous in others.



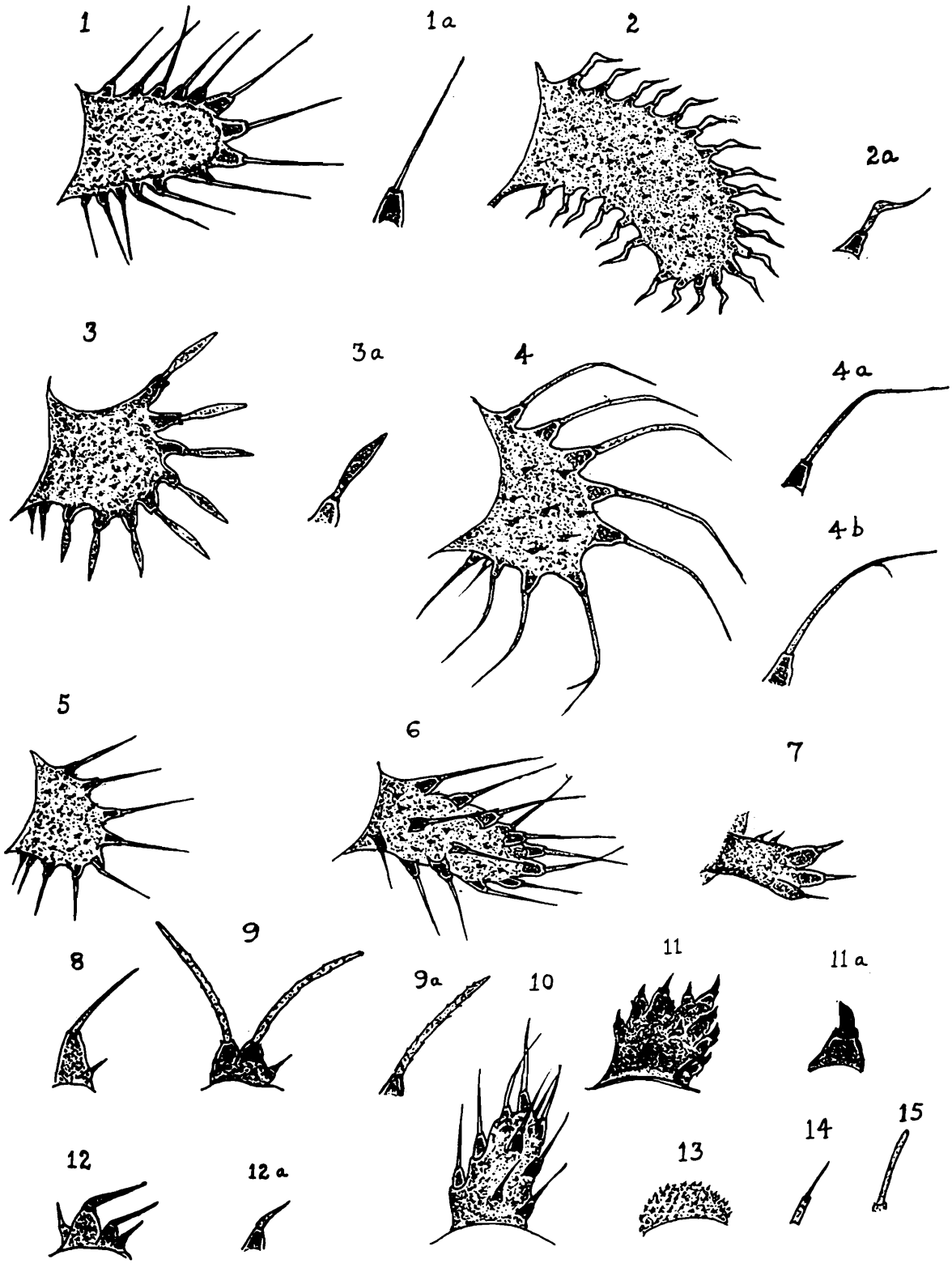
Text-fig. 1. *A Generalised Fifth Instar.*

Pn, Pronotum ; mn, Mesonotum; mt, Metanotum ; IX, Ninth segment forming the anal tube ; X, Tenth segment forming the eversible tube.

Abdomen.—The abdomen of membracid nymphs, according to Funkhouser (1917) is composed of eleven segments of which the first segment is obsolete, the second one narrow, the third to the eighth inclusive more or less identical, the ninth forming the *anal tube*, the tenth and the eleventh rudimentary, telescoped and often eversible. Capener (1962) considers the anal tube as the eighth segment. Since the first abdominal segment is clearly visible as a narrow crescentic structure in the various species of *Gargara*, the numeration adopted by Funkhouser is followed in the present studies. The length of the anal tube bears a more or less definite relation to body length. Of particular value are the *abdominal dorsal tubercles* and *dorso-lateral* (latero-dorsal) *tubercles* with the spines borne on them, the *abdominal lamellae* which are pleural extensions of abdominal segments 3 to 8 and the nature of individual spines whether long and slender, short and stout, bent and acuminate, or tooth-like. (Text fig. 1b).



Text-fig. 1a. *Pronotal shapes in the last nymphal instars of different membracidae.*



Text-fig. 1b. *Types of lamellae, tubercules and spines met with in the membracid nymphs.*

1. Abdominal lateral lamella in *Tricentrus pilosus*; 2. in *Otinotus indicatus*; 3. in *Coccosterphus paludatus*; 4. in *Leptocentrus leucaspis*; 5. in *Tricentrus albomaculatus*; 6. in *Gargara mixta*; 7. in *Oxyrhachis rufescens*; 8. Abdominal dorsal tubercle in the first instar nymph of the genus *Leptocentrus*; 9. Prothoracic dorsal tubercle in the first instar of *Leptocentrus*; 10. Abdominal dorsal tubercle in fifth instar of *Gargara mixta*; 11. of *Coccosterphus tuberculatus*; 12. of *Leptocentrus taurus*; 13. of *Gargara extrema*.

1a. Long setiform spine borne on lamella in *Tricentrus pilosus*; 2a. bent spine borne on lamella in *Otinotus indicatus*; 3a. penicillate spine borne on lateral lamella of *Coccosterphus* and *Parayasa*; 4a. long acuminate spine, 4b, branched spine borne on lateral lamella of *Leptocentrus leucaspis*; 11a. short stout tooth-like spine on thoracic dorsal tubercle in *Coccosterphus paludatus*; 9a. stout cylindrical spine on thoracic dorsal tubercle in *Leptocentrus*; 12a. subspine on dorsal tubercle in *Leptocentrus*. 14. Sensory setae on cranial tubercles; 15. ? ?

Although Funkhouser (1917) realised the importance of nymphal characters in the taxonomy of the Membracidae, no attempt appears to have hitherto been made in this direction. The present studies have revealed that for each species many of the characters of each nymphal stage appear to be more or less constant. Of the five nymphal instars the first instar of all the species is characterised by a comparatively large, head with the rostral tip often reaching the anal segment. The thorax is simple, devoid of crests or extensions. The most obvious diagnostic feature of this stage in all the species is the presence of two *dorsal tuberculated bristles* on the anal tube. The general trends in the changes occurring in successive nymphal stages following the first, consist of a regular increase in size immediately after every moult, a progressive reduction of tuberculated spines on the head and thorax, a gradual increase in the size of the pronotum, the appearance and gradual development of pronotal processes and wing pads, a gradual increase in the size of the abdominal lateral lamellae and in the number of spines borne on them. Present studies on the postembryonic development of the membracids have also revealed a definite relation between the length of the anal tube and the total body length in the nymphal stages of various species. Since this aspect of the allometry appears to have an increasing value in the membracid taxonomy, an attempt was made here to take the total body length and the length of the analtu be of all the nymphal stages; from these, the growth ratio (k) and the initial growth index (b) were calculated by using the formula, $Y = bx^k$, where Y is the length of anal tube, 'x' is the theoretical value of Y when 'x' equals unity, and 'k' is the constant at which Y grows in relation to 'x' (vide Tables 3 and 3A).

The nymphs of all stages have been figured in most cases; where no appreciable differences of nymphal structure are noticed, only the fifth nymphal stage of those species have been drawn.

Camera lucida drawings were made for all the species presented here. Detailed account of the fifth nymphal stage has been given in view of its importance in the taxonomy of the Membracidae.

LIST OF SPECIES INCLUDED IN THE PRESENT STUDY

Subfamily *OXYRHACHINAE* Haupt, 1929

Tribe *Oxyrhachini* Distant, 1908

Genus *Oxyrhachis* Germar, 1835

1. *Oxyrhachis tarandus* (Fabricius)
2. *O. rufescens* Walker
3. *O. minusculus* n.sp.
4. *O. uncatus* Melichar
5. *O. krusadiensis* n.sp.
6. *O. brevicornutus* n.sp.

Subfamily *CENTROTINAE* Spinola, 1850

Tribe *Leptocentrini* Distant, 1908

Genus *Leptocentrus* Stål, 1866

7. *Leptocentrus rhizophagus* n.sp.
8. *L. mangiferae* n.sp.

9. *L. major* n.sp.
10. *L. bajulans* Distant
11. *L. leucaspis* Walker
12. *L. varicornis* n.sp.
13. *L. taurus* Fabricius
14. *L. nigra* n.sp.
15. *L. bauhiniae* n.sp.
16. *L. moringae* n.sp.

Genus *Telingana* Distant, 1908

17. *Telingana nigroalata* n.sp.
18. *T. consobrina* Distant

Genus *Otinotus* Buckton, 1903

19. *Otinotus oneratus* (Walker)
20. *O. mimicus* Distant
21. *O. indicatus* (Melichar) comb. nov.
22. *O. obliquus* n. sp.

Tribe *Centrotini* Goding, 1892

Genus *Tricentrus* Stål, 1866

23. *T. pilosus* n.sp.
24. *T. purpureus* n.sp.
25. *T. congestus* (Walker)
26. *T. albomaculatus* Distant
27. *T. decornis* n.sp.

Tribe *Gargarini* Distant, 1908

Genus *Gargara* Amyot & Serville, 1843

28. *Gargara mixta* (Buckton)
29. *G. albitarsis* n.sp.
30. *G. madrasensis* n.sp.
31. *G. extrema* Distant
32. *G. malabarica* n.sp.
33. *G. rustica* n.sp.

Tribe *Coccosterphini* Distant, 1908

Genus *Coccosterphus* Stål, 1869

34. *Coccosterphus minutus* (Fabricius)
35. *C. paludatus* Distant
36. *C. tuberculatus* (Motsch.)

Genus *Parayasa* Distant, 1916

37. *Parayasa maculosa* Distant

SYSTEMATIC ACCOUNT

Subfamily *OXYRHACHINAE* Haupt

This subfamily is diagnosed by the presence of a rudimentary scutellum entirely concealed by the pronotum, the presence of a propleural process developed from the lower margin of the propleura and directed downwards and backwards, and a metapleural process developed in a similar manner from the metapleura.

Tribe *Oxyrhachini* Distant

Head wider than long; vertex extended to form a foliate lower margin with a short lateral tooth and a rectangular foliate lobe. Thorax with pronotum with or without suprahumeral horns, posterior process extending beyond posterior angle of inner margin of tegmina ; tegmina with 5 apical and 3 discoidal cells; wings with 3 or 4 apical cells; tibiae somewhat foliate and flattened externally. Male genitalia with U-shaped aedeagus not serrated on inner margin, lateral valves with tuberculate lobes somewhat transverse; tips of parameres club-like; sternal plate trulliform.

Nymph in the last instar with a pair of large or rudimentary cranial tubercules, pronotal crest developed in front into a distinct horn, with a short posterior process extending over mesonotum; prominent spines or tubercles absent; abdominal lateral lamellae of segments 4-8 short, bearing rudimentary spines.

Genus **Oxyrhachis** Germar

(Type of the genus *Membracis taranda* Fabr.)

1835. *Oxyrhachis* Germar, *Rev. ent. Silb.*, **3**: 232.
1903. *Polocentrus* Buckton, *Mon. Memb.*: 254.
1905. *Ouranorthus* Buckton, *Trans. Ent. Soc. Lond.*, **9**: 322.
1908. *Oxyrhachis* Distant, *Fauna Brit. Indis*, **4**: 7.
1962. *Oxyrhachis* Capener, *Repub. S. Afr. Dept. Agr. Tech. Ser. ent. Mem.*, **8**: 9.

Head wider than long; upper margin arcuate and sinuate to eyes; eyes large and globate or subglobate; ocelli equidistant from each other and from the eyes or a little closer to the eyes or closer to each other and located on or above the centro-ocular line; pronotum with or without suprahumeral horns; metopidium convex, vertical or backwardly inclined, wider than high; suprahumeral horns, when present, directed forwards, outwards and upwards; posterior process broad and tectiform at base, with or without a distant gibba, tricarinate, with or without a ventral carina or keel on apical half; humeral angles prominent and blunt; a pair or episternal hooks on mesonotum; tegmina with 5 apical cells and 3 discoidal cells; wings with 3 or 4 apical cells and a strong hamulus on subcostal margin.

Key to South India species of **Oxyrhachis**

1 (10) Suprahumerals well developed; apical area of posterior process slightly or strongly elevated.

2 (7) Suprahumerals as long as or longer than space between bases, horizontal or slightly oblique.

3 (4) Posterior process extending beyond tips of tegmina; inferior margin of apical area of posterior process weakly serrate; ocelli equidistant from each other and from eyes and located on centro-ocular line. *.tarandus.*

4 (3) Posterior process just reaching tips of tegmina.

5 (6) Suprahumerals longer than space between bases; apical area of posterior process slightly elevated; ocelli nearer to each other than from eyes. *.rufescens.*

6 (5) Suprahumerals as long as space between bases; apical area of posteior process strongly elevated; ocelli nearer to eyes than from each other *.minusculus* n.sp.

7 (2) Suprahumerals shorter than space between bases; posterior process not reaching tips of tegmina.

8 (9) Suprahumerals subhorizontal, about two-third as long as space between bases, tips acute; inferior margin of apical area of posterior process strongly serrate; ocelli nearer to eyes than to each other and located on centroocular line. *..uncatus.*

9 (8) Suprahumerals horizontal, about one-fourth as long as space between bases, tips subacute; inferior margin of apical area of posterior process weakly serrate; ocelli closer to each other than to eyes and located just above centro-ocular line. *.krusadiensis* n.sp.

10 (1) Suprahumerals aborted to short stumps; apical area of posterior process not elevated, reaching upto 5th apical cell of tegmina; inferior margin of apical area of posterior process very weakly serrate. *brevicornutus* n.sp.

Oxyrhachis tarandus (Fabricius)

(Text-fig. 2)

1798. *Membracis taranda* Fabricius, *Ent. Syst. Suppl.* : 514.

1803. *Centrotus tarandus:* Fabricius, *Syst. Rhyng.* : 19.

1835. *Oxyrhachis tarandus:* German, *Res. ent. Silb.*, **3:** 232.

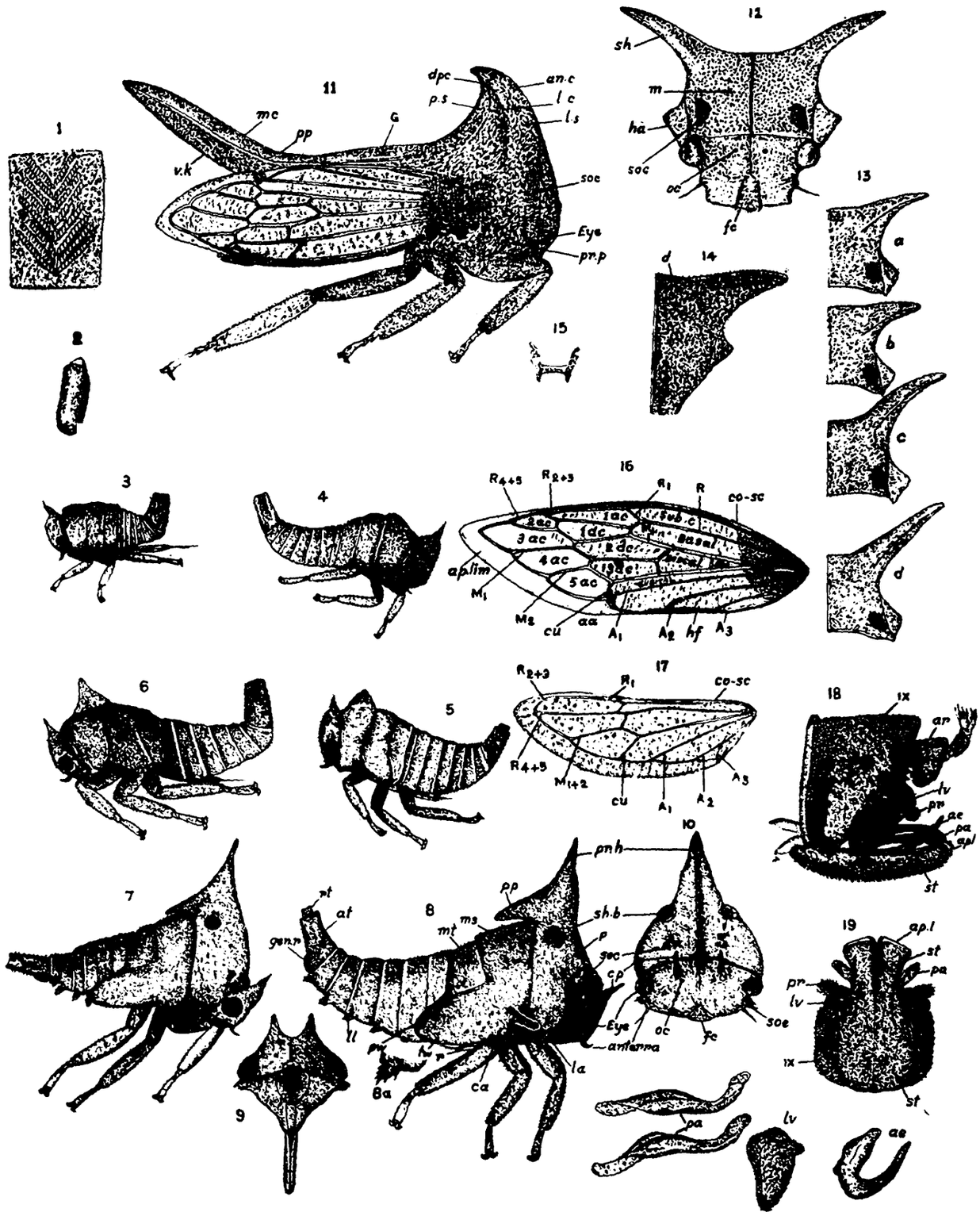
1903. *Polocentrus rufus* Buckton, *Mon. Memb.* : 254.

1903. *Polocentrus neuter* Buckton, *ibid.* : 254.

1962. *Oxyrhachis tarandus:* Capener, *Repub. S. Afr. Tech. Ser. Ent. Mem.*, **6:** 11.

A detailed description of this species has been given by Capener (1962). Specimens collected around Madras exhibit variations in their suprahumerals as illustrated in Text-fig. 2.

Fifth instar nymph.—General colour dark brown; vertex of head nearly twice as wide as long, sparsely covered with hairs, upper margin emarginate with slender, reduced cranial tubercles, each tapering to tip and terminating in a thin tuberculate hair, lower margin convex and sinuate, subocular expansions conical with small tubercles, eyes subglobate, ocelli invisible, frontoclypeus with free end strongly convex, rostral tip



Text-fig. 2. *Oxyrhachis tarandus* (Fabricius)

1. Arrangement of eggs on the host stem. 2. An egg. 3. First instar nymph. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar, male. 8. Fifth instar female. 8a. Addominal lateral lamella of fifth instar. 9. Head of fifth instar: 10. Frontal view of fifth instar. 11. Adult female. 12. Frontal view of female. 13. a, b, c, d. Variations in suprahumerals. 14. Right half of dorsal view of pronotum of male. 15. Scutellum. 16. Tegmina. 17. Hind wing. 18. Male genitalia, lateral view. 19. Male genitalia, ventral view.

reaching 2nd abdominal sternite; thorax sparsely pilose, hairs mounted on short tubercles; metopidium slightly sloping backwards; supraocular callosities black, irregular, bare; suprahumeral buds conspicuous ; pronotal anterior process in the female nymph large, its anterior margin sinuous, tip acuminate, directed upwards; posterior process prominent, gradually tapering backwards extending over basal two-thirds of mesonotum; in the male nymph the anterior process of pronotum broadly conical, tip acuminate; lateral carinae weak; median carina percurrent through metopidium; wing pads prominent, broad, extending beyond 3rd abdominal segment in female, beyond 4th abdominal segment in male; abdominal segments 5 to 8 with short conical lateral lamellae fringed with 4 or 5 short tuberculate spines; anal tube dark brown, closely pilose; genital rudiments conspicuous, being distinct in the two sexes.

Material studied.—A long series of males and females as well as nymphs collected from host plants—*Prosopis spicigera, Acacia arabica, Caesalpinia pulcherrima*—and material reared in the laboratory.

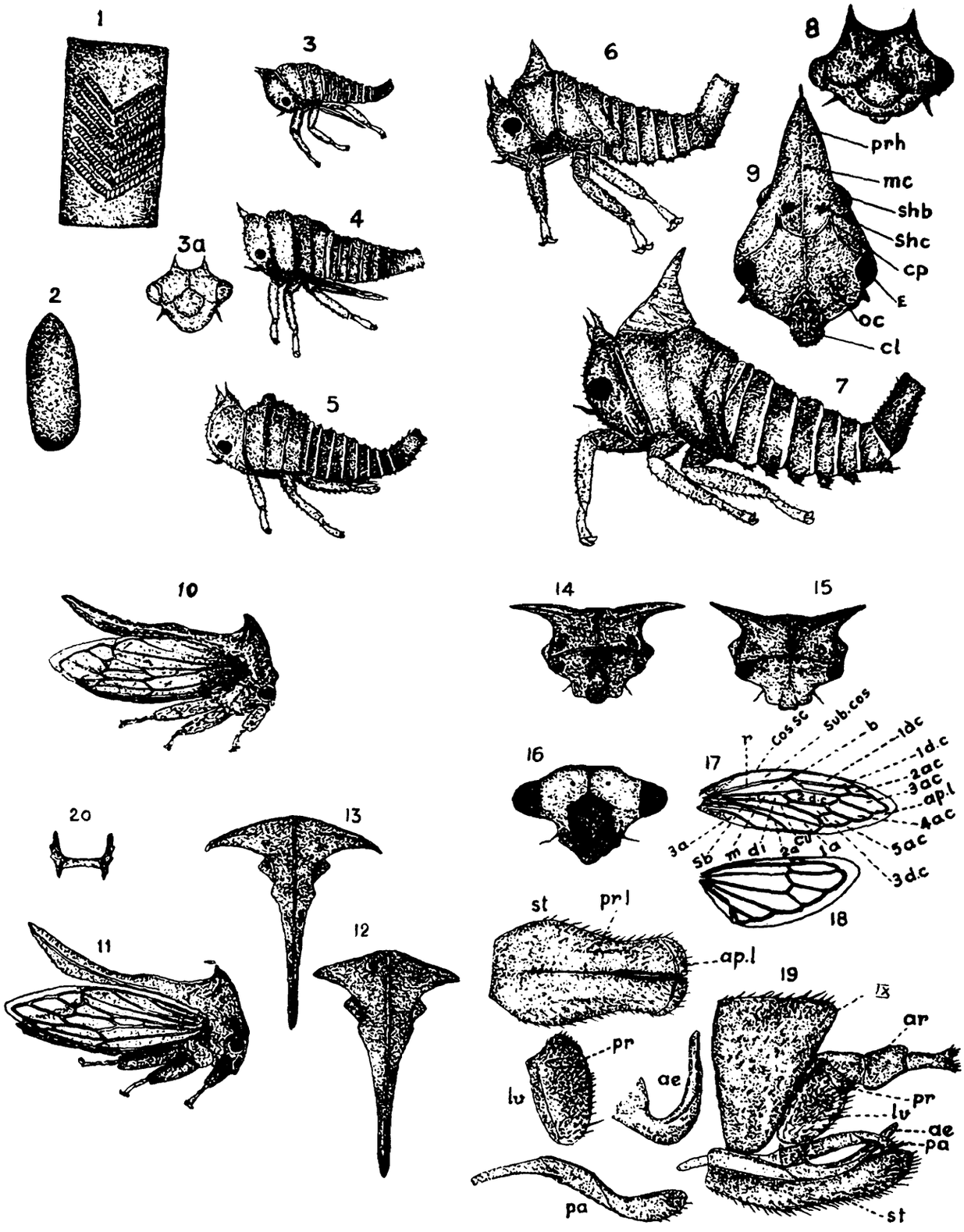
Oxyrhachis rufescens Walker

(Text-fig. 3)

1851. *Oxyrhachis rufescens* Walker, *List. Hom.* ii: 506.
1851. *Oxyrhachis rudis* Walker, *List. Hom.* ii: 509.

Female.—General colour ferruginous brown; head, twice as broad as long, vertex sinuate, punctate with short silvery hairs; cranial callosities not raised, lateral angles of foliate lobes rectangularly rounded, eyes subglobate, projecting lateral, pale white, ocelli convex, nearer to each other than from eyes and located above centro-ocular line; frontoclypeus extending very slightly below lower margins of foliate lobes, free end nearly truncate, fringed with long white hairs; metopidium nearly vertical, very slightly sloping backwards, densely pilose; supraocular callosities prominent, raised, bare, humeral angles prominent, tip subacute; suprahumeral horns broad, almost horizontal, longer than space between bases, seen in lateral view slender with apices subacute and directed backwards, seen from above flat dorsoventrally, seen in front more slender and a little more apically acute; anterior carina dark reddish brown, directed outwards, than backwards, lateral carina nearly straight, dorso-posterior carina curved forwards and outwards joining anterior carina in narrow curve; posterior process moderately gibbous at base, apical area moderately elevated, tip acute, just reaching tegminal apex, anterior margin weakly serrate, median carina strongly percurrent traversing the metopidium, lateral carinae pale brown; tegminathrice as long as broad, dull ochraceous, basal sixth coriaceous, reddish brown, punctate; veins pale brown, 1st apical cell four times longer than wide; hind wings with 3 apical cells; legs testaceous; abdomen dark reddish brown above, greyish tomentose below.

Measurements.—Length from frontal margin to tips of tegmina 6.75-8.0 mm., to tip of posterior process 6.7-7.85 mm.; width across tips of



Text-fig. 3. *Oxyrhachis rufescens* Walker

1. Egg-slits on host stem. 2. An egg. 3. First instar. 3a. Frontal view of first instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar. 8. Frontal view of head of fifth instar. 9. Frontal view of fifth instar. 10. Adult male. 11. Adult female. 12. Dorsal view of pronotum of female. 13. Dorsal view of pronotum of male. 14. Frontal view of male. 15. Frontal view of female. 16. Frontal elevation of head. 17. Tegmina. 18. Hind wing. 19. Male terminalia, lateral view,

suprahumeral horns 3.5-4.0 mm., at humeral angles 2.4-2.5 mm., at eyes 2.25-2.5 mm.

Male.—Smaller and darker than female; suprahumerals longer than in female, tip more acute with anterior carina more backwardly curved; genitalia as in *tarandus*, but apical lobes of sternal plate narrower, tuberculate process of lateral valve longer.

Measurements.—Length from frontal margin to tips of tegmina 6.25-7.0 mm., to tip of posterior process 6.0-6.8 mm., width across tips of horns 3.25-4.5 mm., at humeral angles 2.2-2.4 mm., at eyes 2.0-2.2 mm.

Fifth instar nymph.—General coloration dark ochraceous brown, but somewhat thickly covered with a white deposit of wax giving it a greyish appearance particularly in the cranial tubercles, suprahumeral buds, bases of pronotal process and ventro-lateral areas of abdomen; head with vertex strongly convex, twice as wide as long, cranial tubercles thorn-like with ribbed base and acute tip, bearing slender hairs throughout; eyes dark maroon; ocelli nearer to each other than from eyes and situated on the c-o-l ; subocular processes slender and tuberculate; frontoclypeus strongly convex, densely pilose, extending beyond lower margins of vertex; pronotum with metopidium convex, slanting forwards, pronotal anterior process broad at base, suddenly narrowed from two-thirds of its length, tip acute slightly inclined backwards; pronotal posterior process abbreviated, extending over base of mesonotum, very blunt and obtuse; suprahumeral buds small, black; wing pads narrow, obliquely directed downwards and backwards, costal angles not distinct; metanotum weakly indented, shallowly concave; abdominal lateral lamellae of segments 4 to 8 conical, bearing 5 to 7 tuberculate spines, those on 3rd segment much shorter; anal tube one-sixth of the body length.

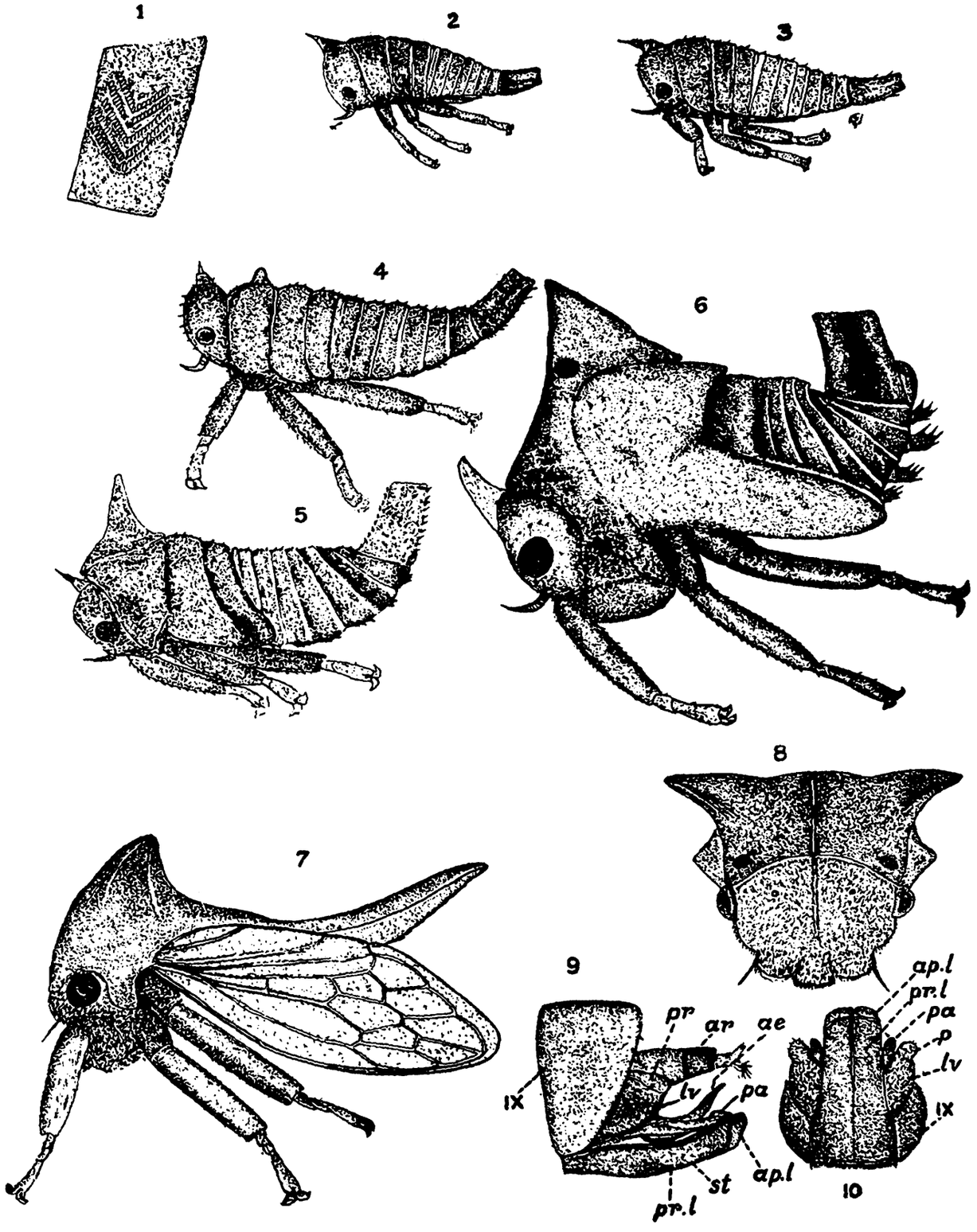
Host plants.—*Acacia arabica*, *Acacia melanoxylon*, *Acacia auriculiformis*, *Prosopis spicigera*, *Erythrina indica*, *Poinciana regia*, *Caesalpinia pulcherrima*, *Caesalpinia coriaria*, *Butea frondosa*, *Albizzia lebbeck*, *Glyricidia maculosa*, *Sesbania aegyptiaca*, *Cassia* sp., *Crotalaria juncea*, *Crotalaria verrucosa*, *Tamarindus indicus*, *Cyamopsis tetragonoloba*.

Material studied.—60 females, 18 males and numerous nymphs, Madras; 10.viii.1966.

Oxyrhachis minusculus n.sp.

(Text-fig. 4)

Female.—General colour ochraceous brown. Head wider than long, greyish brown, vertex weakly convex, subquadrate rather coarsely punctate with short pale white hairs, cranial callosities vestigial, lateral angles of foliate lobes first vertical and then broadly rounded, more densely pilose, eyes semiglobate, dark reddish brown, ocelli dark, distinctly nearer to eyes than to each other and located above centro-ocular line; frontoclypeus light brown, extending slightly beyond lower margins of foliate lobes, lateral angles rounded, tip truncate, pilose; rostrum extending slightly beyond posterior margins of hind coxae. Thorax



Text-fig. 4. *Oxyrhachis minusculus* n. sp.

1. Egg-slits on host stem. 2. First instar. 3. Second instar. 4. Third instar. 5. Fourth instar. 6. Fifth instar. 7. Adult female. 8. Frontal view. 9. Male genitalia, lateral view. 10. Male genitalia, ventral view.

with pronotum distinctly punctate, metopidium almost vertical and slightly sloping backwards, pilosity denser near bases of suprahumerals and posterior process; supraocular callosities small, irregularly shaped; suprahumeral horns, as viewed from lateral aspect directed upwards and a little backwards; viewed from front, directed outwards, then slightly upwards and curving backwards; viewed from above, dorso posterior carina slightly curved forwards and outwards; humeral angles prominent, tips subacute; posterior process tectiform, strongly tricarinate with a weakly developed gibba above the level of metathorax and first abdominal segment, apically laterally compressed rising well above anal angle, ventral keel ampliate, as deep as dorsal keel and weakly serrate, apex acute, not exactly reaching tips of tegmina. Lateral areas of thorax with white tomentose patches; tegmina subhyaline, a little wrinkled, two and two-third times longer than wide, veins brown, basal sixth coriaceous and brownish, a fuscous spot at anal angle, first apical cell as long as second discoidal cell, 1st and 3rd discoidal cells equal in length. Legs with tibiae castaneous, tarsi pale-brown. Abdomen dark-brown, lateral sternal areas with white tomnetose spots.

Measurements.—Length from frontal margin to tips of tegmina 5.0-5.4 mm., to tip of posterior process 4.8-5.0 mm. width across tips of suprahumeral horns 3.5 mm., at humeral angles 2.6-2.8 mm., at eyes 2.2-2.4 mm.

Male.—General colour black with shades of brown; slightly smaller than female.

Measurements.—Length from frontal margin to tips of tegmina 5.0 mm., to tip of posterior process 4.7 mm., width across tips of suprahumeral horns 3.4 mm., at humeral angles 2.0 mm., at eyes 2.3 mm.

Nymph.—Fifth instar. General coloration chocolate brown; head directed backwards, cranial tubercules very prominent, nearly cylindrical, tip subacute; vertex subplanate at base, twice as wide as long, eyes dark-brown, ocelli nearer to eyes than from each other and located on centro-ocular line; pronotum concave in front, somewhat receding, supraocular callosities, in the form of three irregular bare areas; suprahumeral buds prominent, dark brown; anterior process conical, nearly twice as long as posterior process which extends over mesonotum beyond middle; wing pads dark reddish brown, very large, extending upto 6th abdominal segment, costal angles well demarcated, fringed with tuberculated spines, abdominal segments telescoped, tip raised up; lateral lamellae of segments 5 to 8 moderately developed, nearly cylindrical, inclined backwards with posterior margins fringed with 4 or 5 tuberculate spines; anal tube black, one-fifth as long as total body length.

Host plant.—Casuarina equisetifolia.

Holotype female; paratypes 15 females and 8 males; nepionotypes 10, Madras, -.iv.1967, Vellore, 20 females and 8 males, -.v.1967.

O. minusculus appears to be very near to *tarandus* and *rufescens* in possessing well developed, nearly horizontal suprahumeral horns and the posterior process having its apical area upturned, but it differs from both

tarandus and *rufescens* in the smaller size and the shorter suprahumerals which are as long as the space between their bases; from *tarandus* it differs in the nature of the posterior process which just reaches the tegminal apex; from *rufescens* it differs in the position of ocelli which are nearer to eyes than to each other.

Oxyrhachis uncatus Melichar

(Text-fig. 5)

1903. *Oxyrhachis uncatus* Melichar, *Hom. Faun. Ceylon,*: 108.
1903. *Centrotus nectaris* Buckton, *Mon. Memb.* : 246.

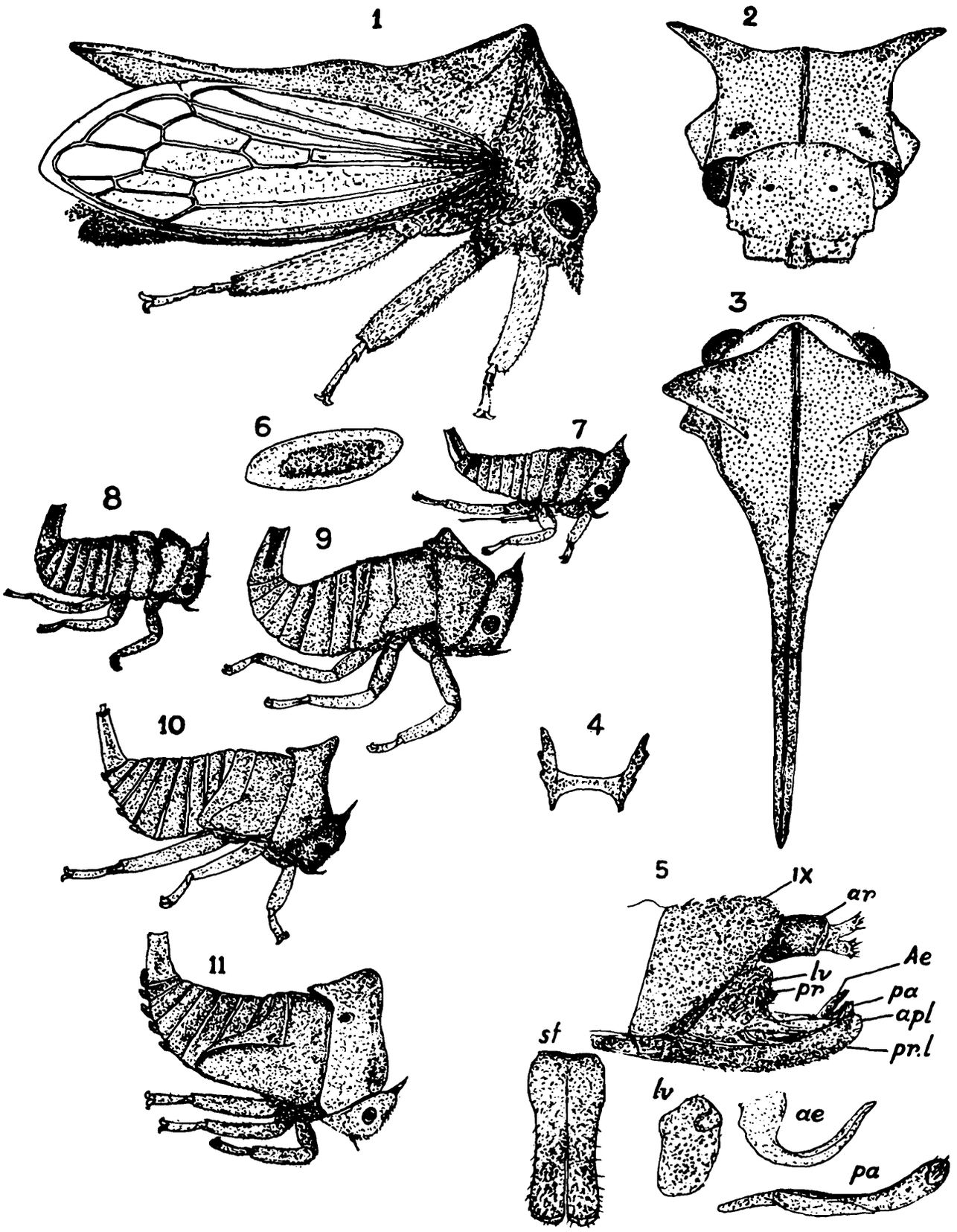
Female.—General coloration brownish ochraceous. Head with vertex subquadrate, broader than long, finely punctate, with long sparse silvery white hairs; upper margin slightly arcuate, sinuate, lateral angles of foliate lobes rectangular, inner angles inwardly acute; eyes nearly subglobate, reddish brown; ocelli succineous, nearer to eyes than to each other and located on the c-o- line; frontoclypeus nearly as wide as long, slightly extending below margins of foliate lobes, tip truncate and pilose with white hairs; rostrum reaching to posterior coxae; pronotum brownish ochraceous, finely punctate with sparse pale white hairs; median carina yellowish brown and strongly percurrent; metopidium twice as broad as high, strongly punctate at bases of horns, convex, gradually sloping backwards; supraocular callosities small, bare, margins obscure; suprahumeral horns about two-third as long as distance between their bases, subhorizontal, apices subacute, viewed from above flattened dorsoventrally with weak yellowish brown dorsal carina; viewed from lateral aspect appearing much shorter, viewed from the front more upwardly curved, tricarinate, apices obtusely acute; posterior process slightly gibbous behind base, hardly reaching apex of tegmina, apex slightly turned upwards, inferior margin weakly serrate; tegmina thrice as long as wide, subhyaline, basal sixth coriaceous and punctate, wrinkled, veins reddish brown, first apical cell three times longer than wide, as long as second discoidal cell; legs ochraceous; lateral areas of body, and abdomen below cretaceously tomentose.

Measurements.—Length from frontal margin to tips of tegmina 6.5-7.0 mm., to tip of posterior process 6.2-6.8 mm., width across tips of suprahumerals 3.0-3.5 mm., at humeral angles 2.3-2.5 mm., at eyes 2.0-2.2 mm.

Male.—Similar to female, with horns slightly shorter. Terminalia, with aedeagus U-shaped, tuberculate process of lateral valve shorter, parameres club-like, sternal plate black, densely pilose, with apical lobes small and inconspicuous.

Measurements.—Length from frontal margin to tips of tegmina 6.3-6.74 mm., to tip of posterior process 6.1-6.6 mm., width across tips of suprahumeral horns 2.75-3.2 mm., at humeral angles 2.2-2.4 mm., at eyes 1.9-2.1 mm.

Fifth instar nymph.—Colour greyish brown with very little deposit of waxy secretion making ventro-lateral parts of abdomen whitish; head turned backwards; vertex nearly twice as wide as long; cranial



Text-fig. 5. *Oxyrhachis uncatus* Melichar

1. Adult female. 2. Frontal view of female. 3. Dorsal view of pronotum. 4. Scutellum. 5. Male genitalia, lateral view. 6. An egg. 7. First instar. 8. Second instar. 9. Third instar. 10. Fourth instar, 11. Fifth instar.

tubercles thin, slender, thorn-like; metopidium slightly convex in front, vertical, anterior process of pronotum short and broadly rounded; posterior process extending over about middle of mesonotum, tip blunt; supraocular callosities indistinct, suprahumeral buds small, concolorous; wing pads greyish, their bases pale ochraceous, extending beyond 3rd abdominal segment, costal angles fringed with tubercles; abdomen brown with a short sharp lateral lamella posteriorly edged with short tuberculate spines on segments 5 to 8; anal tube about one-sixth the length of body, normally held more or less vertically, bordered with rows of fine tuberculate hairs; genital rudiments prominent.

Host plant.—Prosopis spicigera.

Material studied.—26 females, 10 males and numerous nymphs; Madras, 10.viii.1967; 4 females and 10 fifth nymphal instars, Rameswaram, 18.ix.1967.

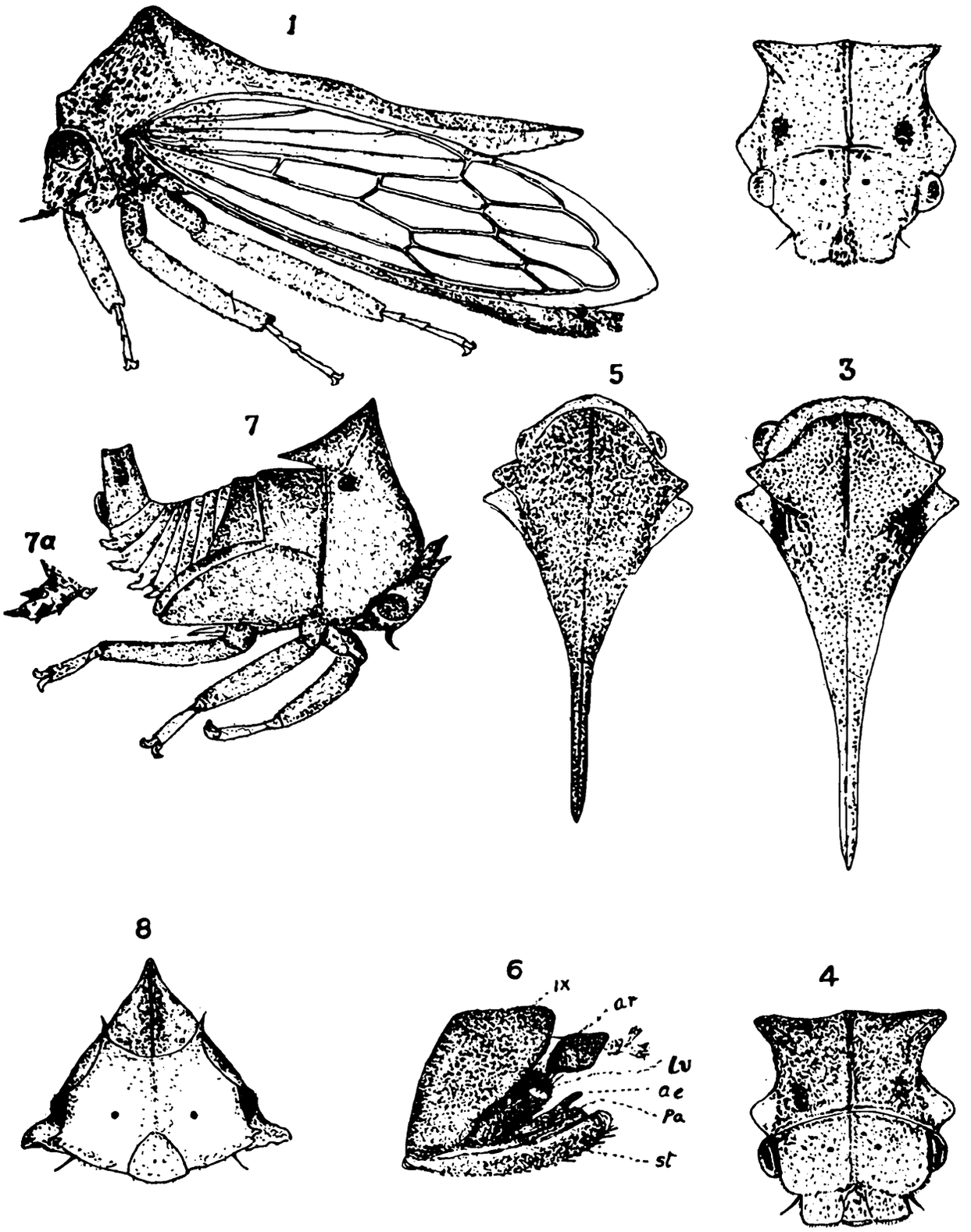
Oxyrhachis krusadiensis n.sp.

(Text-fig. 6)

Female.—General colour reddish brown. Head with vertex subquadrate, about twice as wide as long, yellowish brown, coarsely punctate with short pale adpressed hairs arising from punctures; upper margin slightly arcuate, lower margins gradually slopping to foliate lobes which are reddish brown, nearly truncate and inwardly deflexed to the frontoclypeus, eyes prominent, subglobate, pale white, ocelli dark brown, closer towards each other than from eyes and located just above centro-ocular line; fronto-clypeus reddish brown with tip slightly upturned and truncate; labrum and rostral base whitish pubescent, tip of rostrum reaching base of hind coxae. Thorax, with pronotum light reddish brown, coarsely punctate, with short pale white hairs, lateral areas of sternite with white pubescence; metopidium nearly one and a half times as wide as high, strongly sloping backwards, base convex; supra-ocular callosities inconspicuous, suprahumeral horns short, weakly carinate, subparallel, as viewed from front directed laterad with tips slightly curved downwards, subacute, dark brown, as viewed from above much narrower; posterior process reddish brown, somewhat darker just behind horns, basally tectiform, with a strong gibba above the second abdominal segment, median and lateral carinae parallel upto three-fourths of their length, apex nearly acute and only slightly raised, reaching upto the tip of 5th apical cell of tegmina, ventral keel ampliate and weakly serrate; tegmina hyaline, nearly three and three-fourths as long as wide, base very narrowly coriaceous and punctate, veins reddish brown, fringed with short hairs, 2nd apical cell smallest, 1st and 3rd discoidal cells nearly identical, apical limbus broad, legs with coxae, trochanters and femora dark brown, tibiae slightly foliate, light brown, tarsi paler.

Measurements.—Length from frontal margin to tips of tegmina 6.5 mm., to tip of posterior process 5.5 mm., width across tips of suprahumeral horns 2.0 mm., at humeral angles 2.5 mm., at eyes 2.2 mm.

Male.—Similar to female. Length from frontal margin to tips of tegmina 6.0 mm., to tip of posterior process 5.1 mm., width across tips



Text-fig. 6. *Oxyrhachis krusadiensis* n. sp.

1. Adult female. 2. Frontal view of female. 3. Dorsal of pronotum of female. 4. Frontal view of male. 5. Dorsal view of pronotum of male. 6. Male terminalia, lateral view. 7. Fifth instar, lateral view. 7a. Abdominal lateral lamella of fifth instar. 8. Frontal view of fifth instar.

of suprahumeral horns 1.85 mm., at humeral angles 2.3 mm., at eyes 2.1 mm.

Fifth nymphal instar.—Pale-green in life, changing to greyish brown in cabinet specimens. Head nearly twice as wide as long, cranial tubercules of moderate size; eyes fuscous brown, ocelli distinctly nearer to eyes than from each other and located on centro-ocular line; subocular processes broadly conical with tubercles; fronto-clypeus highly arched at base, nearly truncate at lower margin which never projects beyond the lower margins of vertex; thorax approximately as long as abdomen; metopidium convex in front, slightly sloping backwards, suprahumeral buds inconspicuous; supraocular callosities indistinct; pronotal anterior process conical, projecting upwards and slightly forwards, tip acute, lateral carinae distinct; posterior process less than half as long as anterior process, extending over three-fourths as long as mesonotum, tip acute, wing pads large, extending to 5th abdominal segment, costal angles not demarcated; abdominal segments 5 to 8 fairly large, slightly curved backwards and fringed with 5 or 6 tuberculate spines; anal tube a little less than one-fifth the length of body; genital rudiments large, extending over basal half of anal tube.

Host plant.—Cassia sp.

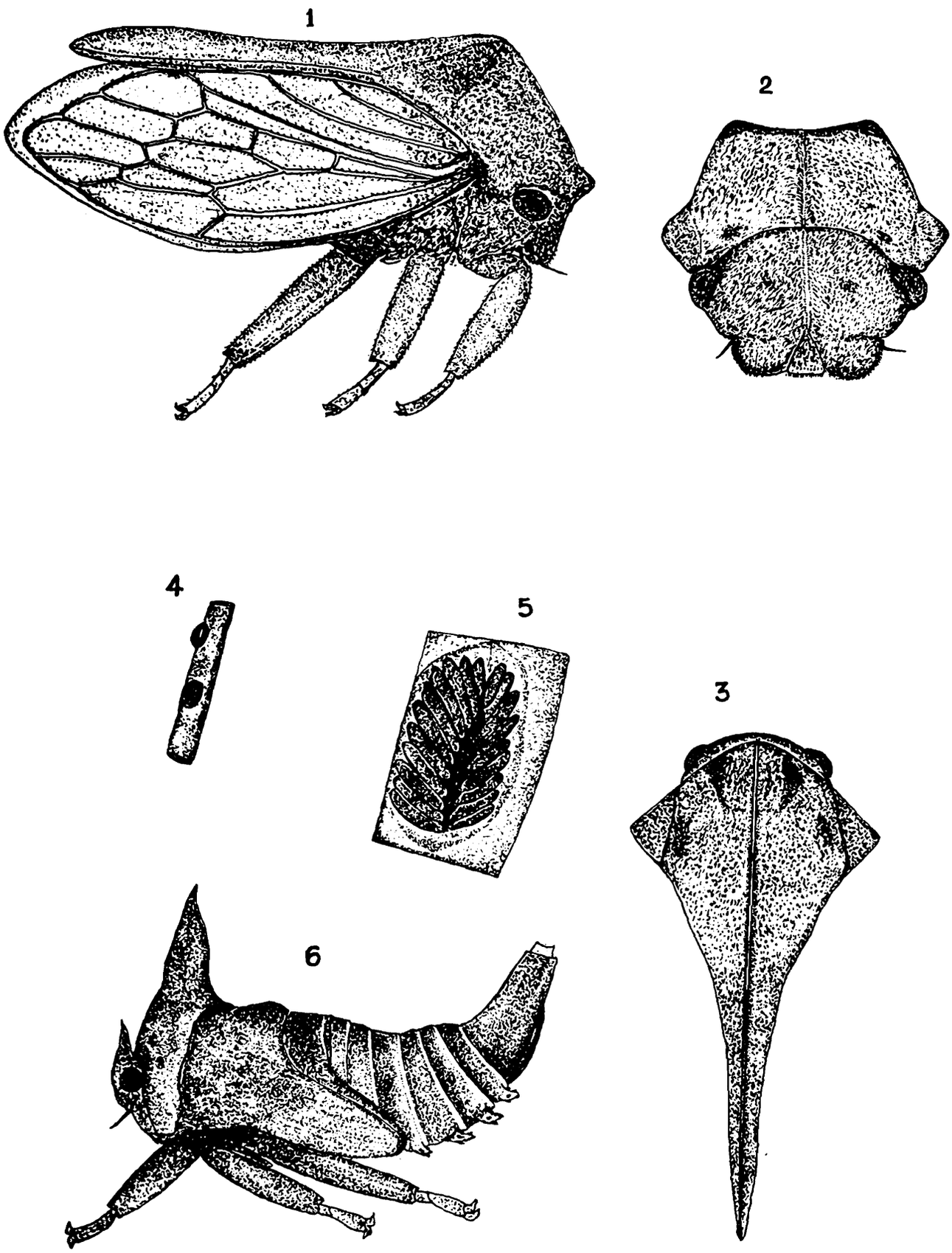
Holotype female; paratypes 25 females and 12 males; nepionotypes 15 fifth instar nymphs; Krusadai Islands, Pamban, 19.ix.1967; 8 females, 8 males and 9 fifth instar nymphs, Madras, 2.x.1968.

O. krusadiensis is nearest to *crinitus* Buckton and *uncatus* Melichar, but differing from both in the much shorter posterior process which extends upto 5th apical cell of tegmina; from *crinitus* it differs in the larger size of body and from *uncatus* in the much shorter suprahumeral horns.

Oxyrhachis brevicornutus n.sp.

(Text-fig. 7)

Female.—General colour ochraceous brown. Head, with vertex wider than long, vertical, declivous, vertex slightly convex, subquadrate, strongly arcuate at base, very finely punctate, with extremely short adpressed sparsely distributed silvery hairs, cranial callosities inconspicuous; lateral angles of foliate lobes reddish brown, broadly obtusely rounded, eyes subglobate, pale white with shades of black, ocelli shining white, nearer to eyes than to each other and located on the c-o-line; fronto-clypeus never extending below lower margins of foliate lobes, tip truncate, pilose; lateral lobes prominent; thorax, with prontum finely punctate, lateral areas somewhat dark ochraceous, devoid of dense pilosity; metopidium strongly backwardly sloping, anterior margin not obumbrant, punctate, short hairs sparsely distributed, supraocular callosities moderate, humeral angles prominent, light brown, tips broadly rounded and somewhat blunt; suprahumeral horns reduced to very short stumps and directed upwards, dark brown; posterior pronotal process tricarinate, broad at base, ampliate beneath, not gibbous at base, nearly straight to two-third its length, apical one-third slightly



Text-fig. 7. *Oxyrhachis brevicornutus* n. sp.

1. Adult female. 2. Frontal view. 3. Pronotum, dorsal view. 4. Egg masses on host stem. 5. Arrangement of eggs. 6. Fifth instar nymph.

broader with lateral and dorsal carinae fuscous, dorsal carina conspicuous, strongly pe:current through metopidium, inferior margin very weakly serrate, tip directed downward reaching to about the tip of fourth apical cell of tegmina; tegmina hyaline, nearly two and a half times as long as wide, basal sixth coriaceous, finely distinctly punctate and dark brown, veins strong, yellowish brown with 3 discoidal cells, the 1st discoidal cell narrowest, discal cell as long as 3rd discoidal cell; hind wings with 3 apical cells. Abdomen reddish brown with shades of black.

Measurements.—Length from frontal margin to tips of tegmina 5.4 mm., to tip of posterior process 4.8 mm., width across tips of suprahumeral horns 1.5 mm., at humeral angles 2.5 mm., at eyes 2.2 mm.

Male.—Similar to female but suprahumeral horns practically obsolete. Length from frontal margin to tips of tegmina 5.2 mm., to tip of posterior process 4.7 mm., width across tips of humeral angles 2.3 mm., at eyes 2.2 mm.

Fifth nymphal instar.—General coloration ochraceous brown; head obliquely directed downwards and backwards; eyes large, vitreous, subglobate, ocelli invisible; cranial tubercules prominent and slender, apically ochraceously tuberculate, about three-fourth as long as the longest abdominal lamella, subocular processes extending outwards, bi-tuberculate; rostrum extending to first abdominal segment; pronotum brown with sparse pilosity, metopidium vertically convex, supraocular callosities imperfectly shaped; anterior process erect, gradually tapering from base, tip acuminate, slightly inclined backwards, posterior process short, extending over basal one-fourths of mesonotum, tip acute, suprahumeral buds absent; wing pads ochraceous and testaceous at base, extending upto middle of 5th abdominal segment, costal angles indistinct; meso-and meta-thoracic tergites dark brown; abdominal tergites light brown with posterior margins greyish; lateral lamellae of segments 5 to 8 with short tubercles inclined backwards, fringed with a few short spines; anal tube slightly less than one-fifth of total body-length; rudimentary ovipositor dark brown, extending over basal two-thirds of anal tube.

Host Plant.—Prosopis spicigera: Holotype female; paratypes 8 females and 5 males; nepionotypes 6 (fifth instar nymphs), Madras; 30.vii. 1968.

This interesting species is nearest to the African species, *Oxyrhachis brevicornis* (Jacobi) in the nature of the posterior process, and to *O. insularis* (Capener) in the suprahumeral horns which are obsolete, but differing from both in having only 3 apical cells in the hind wings.

Key to species of **Oxyrhachis** Germar *based on Fifth instar nymphs*

1 (10) Suprahumeral buds present.

2 (5) Anterior pronotal process projecting vertically upwards; wing pads reachnig the 3rd abdominal segment.

3 (4) Posterior pronotal process prominent, gradually tapering backwards extending over basal two-thirds of mesonotum; wing pads broad.. . .. *tarandus* Fabr.

4 (3) Posterior pronotal process abbreviated, broadly rounded; wing pads narrow. ... .*rufescens* Walker.

5 (2) Anterior pronotal process directed obliquely forwards.

6 (9) Tip of anterior pronotal process acute or subacute; wing pads extending upto 5th abdominal segment; posterior pronotal process extending over basal three-fourth of mesonotum; ocelli visible.

7 (8) Colour chocolate brown; anterior pronotal process nearly twice as long as posterior process; cranial tubercles very prominent; costal angles of wing pads distinctly demarcated..
....*minusculus* n.sp.

8 (7) Colour pale green in life; anterior pronotal process more than two and a half times as long as posterior process; cranial tubercules of moderate size; costal angles of wing pads not demarcated.
.*krusadiensis* n.sp.

9 (6) Tip of anterior pronotal process broadly rounded; wing pads extending upto the 4th abdominal segment; posterior pronotal process extending over basal half of mesonotum; ocelli obscure.
.*uncatus* Melichar.

10(1) Suprahumeral buds absent; anterior pronotal process more than 4 times as long as posterior process; posterior process extending over basal one-fourth of mesonotum.. ..
brevicornutus n.sp.

Subfamily *CENTROTINAE* Spinola

This subfamily is diagnosed by the presence of a well developed scutellum which is always clearly visible if sometimes partly concealed, and the absence of propleural and mesopleural processes. The subfamily is divided into four tribes, *Centrotini*, *Leptocentrini*, *Coccosterphini* and *Gargarini*.

Key to tribes of the South Indian Centrotinae

1(2) Hind wings with 4 apical cells..
Leptocentrini

2(1) Hind wings with 3 apical cells.

3(4) Scutellum clearly visible; suprahumerals present or absent..
Centrotini

4(3) Scutellum partly concealed; suprahumerals absent.

5(6) Scutellum abortive in the middle; tegminal veins finely or coarsely tuberculate; a distinct pterostigma present or absent; pronotum tuberculate or not. ....
Coccosterphini

6(5) Scutellum complete in the middle but weakly chitinised; tegminal veins not tuberculate; a distinct pterostigma absent, rarely an inicpient pterostigma present; pronotum not tuberculate..
Gargarini

Tribe *Leptocentrini* Distant

The diagnostic characters of this tribe are the presence of 4 apical cells in the hind wings, prominent frontoclypeal lobes and the fully exposed scutellum.

Key to the genera of **Leptocentrini**

1(4) Base of posterior process distant from or rarely touching apex of scutellum; posterior process more or less arcuate and declivous.

2(3) Scutellum triangular, about as wide as long, apically emarginate; disc of pronotum convexly elevated.. *Leptocentrus*.

3(2) Scutellum much longer than broad, apex acute; disc of pronotum not or slightly elevated.... .. . *Telingana*.

4(1) Base of posterior process contiguous with or only slightly above scutellum and tegmina; posterior process slender, not arcuate, slightly sinuate; scutellum wider than long.. *Otinotus*.

Genus **Leptocentrus** Stal

(Type of the genus *Centrotus altifrons* Walker)

1866. *Leptocentrus* Stål, *Hem. Afr.* **4**: 87-90.

1903. *Rabduchus* Buckton, *Mon. Memb.*: 270.

1968. *Leptocentrus:* Capener, *Repub. S. Afr. Dept. Agr. Tech. Ser. Ent. Mem.* **17**: 33.

Head vertical, about thrice as wide as long, upper margin of vertex arcuate and sinuate, eyes hemispherical, ocelli closer to eyes than to each other and located above, rarely on, the c-o-line; frontoclypeus with tip rounded; extending well beyond free margins, lateral lobes prominent; pronotum moderately elevated, metopidium about twice as wide as high, humeral angles prominent and blunt; suprahumeral horns well developed, arcuate from dorsal aspect, usually strongly tricarinate; posterior process tricarinate, usually strongly arcuate, emerging dorsally from posterior half of pronotum, distant from scutellum and tegmina, usually impinging on tegmina at tip, extending far beyond apex of clavus; scutellum triangular, about as wide as long, apex emarginate; tegmina without pterostigma, with 5 apical cells and 2 discoidal cells, the apical veins straight; hind wings with 4 apical cells.

Key to South Indian species of **Leptocentrus**

1(4) Posterior process remote from scutellum and inner margins of tegmina from base to apex.

2(3) Posterior process straight; suprahumerals narrow, slightly recurved, about equal in length to width between bases; ocelli slightly above c-o-l; tegmina pale bronzy; small species.. .. *bajulans*

3(2) Posterior process slightly sinuate; suprahumerals broad, rubust, strongly recurved, slightly longer than width between bases; ocelli located on the c-o-l; tegmina smoky hyaline, costal margin, apical limbus and basal sixth dark marooned; large greyish black species ... *major* n.sp.

4 (1) Posterior process distant from scutellum, apex very near to or impinging on inner margins of tegmina.

5 (8) Posterior process substraight from base, slightly arched at middle, tip acuminate; suprahumerals moderately recurved.

6 (7) Dark brown; pronotum not pubescent; suprahumerals longer than space between their bases; lateral areas of sternum white tomentose; ocelli located on the c-o-l. .*rhizophagus* n.sp.

7 (6) Greyish brown; pronotum pubescent; suprahumerals approximately as long as space between bases; lateral areas of sternum greyish, not white tomentose; ocelli located above c-o-l.. .*mangiferae* n.sp.

8 (5) Posterior process moderately or strongly elevated at base, then substraight to tip.

9(12) Suprahumerals robust, strongly recurved; tip of posterior process impinging on inner angles of tegmina.

10(11) Metopidium broader than high; posterior process moderately convexly elavated at base; tip passing beyond 5th apical cell; tegmina pale bronzy ochraceous, base and apical half of costal margin black .*taurus* Fabr.

11(10) Metopidium higher than wide; posterior process prominently abruptly elevated at base; then declivous, apical fourth acuminate, tip not extending beyond 5th apical cell; tegmina shining ochraceous, extreme base, distal half of costal margin, tip of 1st apical cell and adjacent area of apical limbus shaded with black. ... .*nigra* n.sp.

12 (9) Suprahumerals moderately developed, gently recurved; distal fourth of posterior process straight, acuminate, tip never impinging on inner margin of tegmina. .. .*bauhiniae* n.sp.

13(16) Suprahumerals more than two times longer than space between bases; ocelli located above c-o-l.

14(15) Black; pronotum not pilose; suprahumerals basally raised upwards, then divergent; tegmina shining ochraceous, black on costal margin and apical limbus; tarsi yellowish... .. .*leucaspis* Walker.

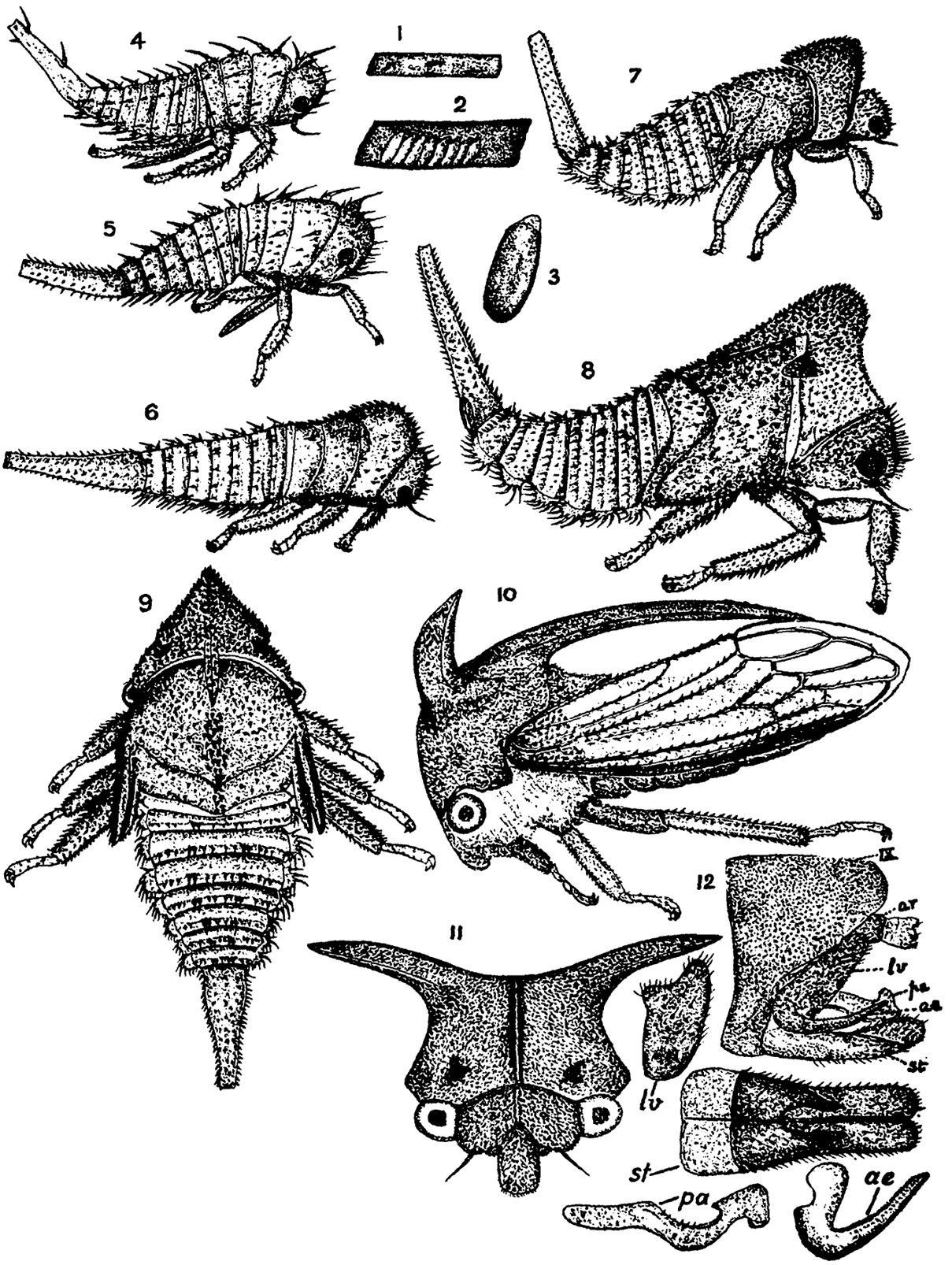
15(14) Greyish brown; pronotum longly pilose; suprahumerals not basally raised upwards, length highly variable; tegmina subhyaline, costal margin not black; tarsi brown. .. .*varicornis* n.sp.

16(13) Suprahumerals shorter than space between bases, horizontal, slender; ocelli located on c-o-l; tarsi light yellow; greyish brown species.. .*moringae* n.sp.

Leptocentrus rhizophagus n.sp.

(Text-fig. 8)

Female.—General colour dark brown. Head obliquely directed backwards, three times wider than long, vertex distinctly arcuate at upper margin, lower margins broadly rounded, greyish white, with scattered silvery hairs; frontoclypeus greyish white, bordered by black streaks with long sparsely distributed hairs, two and a half times longer than wide, extending to two-thirds of its length beyond lower margins of vertex, basal lobes prominent, tip of frontoclypeus nearly truncate; eyes dark reddish brown, prominent, projecting laterad; ocelli located on centro-ocular line, black, distinctly nearer to eyes than to each other; antennae pale white, two-third as long as frontoclypeus; thorax with pronotum light brown with shades of black, pilose, lateral areas of sternum cretaceously sericeous, metopidium much broader than high, vertical upto about half of its height, then gradually sloping backwards



Text-fig. 8. *Leptocentrus rhizophagus* n. sp.

1. Twig showing egg slits. 2. Egg slit cut open. 3. A single egg. 4. First instar. 5. Second instar. 6. Third instar. 7. Fourth instar. 8. Fifth instar (lateral view) 9. Fifth instar (Dorsal view) 10. Adult female. 11. Frontal view. 12. Male genitalia, lateral view.

towards disc; supraocular callosities conspicuous, irregularly shaped, black; humeral angles not prominent, light yellowish brown, tips blunt; suprahumeral horns reddish brown, pilose, longer than space between their bases, as seen from lateral aspect stout at base, obliquely curved forwards, then upwards, distal one-fifth directed backwards, tips acute; as seen in front much narrower, carinae weak; posterior process reddish brown, a little raised from disc and obliquely backwardly directed, more or less arcuate, tip acuminate, passing over three-fourth the length of 5th apical cell of tegmina, impinging on inner angles of tegmina; median carina strongly percurrent along metopidium; tegmina three times as long as wide, hyaline, distal third of costal margin fuscous, base somewhat coriaceous, veins light brown, pilose; scutellum white tomentose at lateral basal angles, wider than long, narrowly emarginate; undersurface of abdomen dark brown, pubescent; trochanters, femora and bases of tibiae dark reddish brown, apical two-thirds of tibiae and tarsi light yellow.

Measurements.—Length from frontal margin to tips of tegmina 6.3 mm., to tip of posterior process 5.3 mm., width across tips of suprahumerals 4.9 mm., at humeral angles 2.4 mm., at eyes 2.3 mm.

Male.—Smaller, nearly similar to female; frontoclypeus jet black, humeral angles more conspicuous; genitalia, with aedeagus finely serrate on inner margin, tip sub-acute, parameres rectangularly truncate in lateral aspect, sparsely setose on inner margin; lateral valves broadly triangular, processes well chitinised and almost concolorous, fringed with short bristles; sternal plate highly chitinised at base, lobes at apex inconspicuous, broadly rounded.

Fifth instar nymph.—General coloration pinkish brown, though variable; head pilose, directed backwards, base of vertex strongly arcuate, eyes prominent, pinkish or dark brown, surrounded by numerous bristles; ocelli closer to eyes than to each other and located on centro-ocular line; rostral tip reaching middle of metathorax; pronotal anterior process broadly rounded, distinctly shorter than posterior process, densely spinose; tip obtuse, posterior process extending over three-fourth the length of mesonotum, suprahumeral buds conspicuously large, dark brown; mesonotal process blunt, partially overlapping metanotum; wing pads dark brown, extending up to 3rd abdominal segment, costal angles distinct; tibiae light brown with distinct transverse bands which disappear in preserved specimens; abdominal dorsal tubercless hort, their spines suberect; lateral lamellae semicircular, each provided with 7 to 9 long curved spines inclined caudad, subspines scattered over lamellae; anal tube black at distal half, as long as the rest of abdomen, highly eversible.

Host plant.—Prop roots of *Ficus bengalensis.*

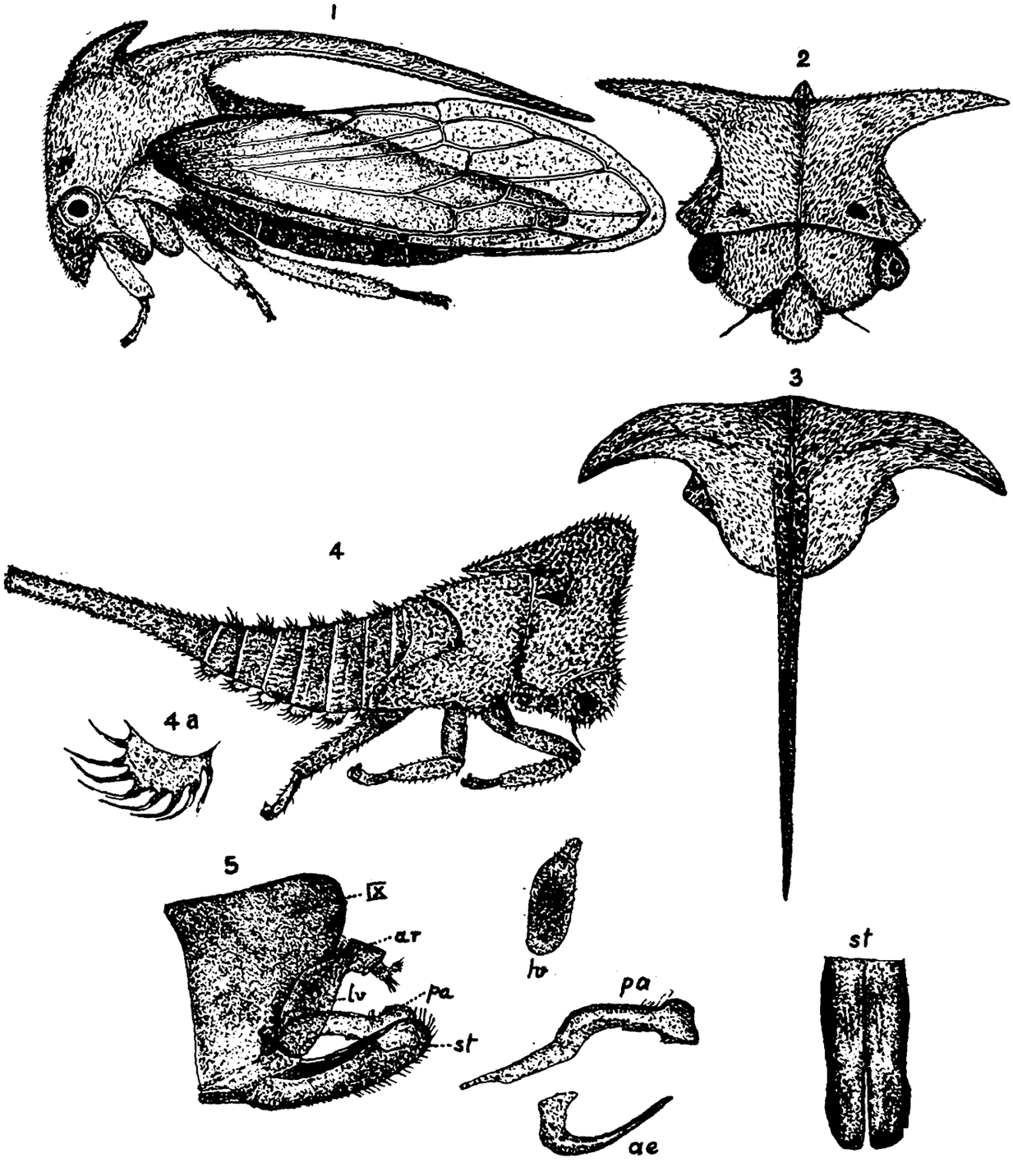
Holotype female; 47 female and 19 male paratypes; 38 nepionotypes, Madras, July to September, 1966.

Leptocentrus rhizophagus is nearest to *obliquus* Walker in the ferruginous body coloration, obliquely straight posterior process which impinges on the tegminal inner margins and in the hyaline tegmina, but differs in the much longer and less oblique suprahumerals and in the position of ocelli.

Leptocentrus mangiferae n.sp.

(Text-fig. 9)

Female.—General coloration greyish brown; head more than twice as wide as long, vertex brown, tinged with shades of black, pilose with



Text-fig. 9. *Leptocentrus mangiferae* n. sp.

1. Adult female. 2. Frontal view of female. 3. Dorsal view of pronotum. 4. Fifth instar nymph. 4a. Abdominal lateral lamella of fifth instar. 5. Male genitalia, lateral view.

short closely adpressed silvery hairs, declivous, upper margin arcuate, lower margins downwardly sloping; frontoclypeus longly pilose, speckled with black spots, longer than wide, extending below lower margins of vertex for about two-thirds its length, tip rounded; eyes pale white, globate, projecting laterad; ocelli shining white, located a little above centro-ocular line, slightly closer to eyes than to each other; pronotum greyish brown, finely punctate, with short pale white hairs, lateral areas of sternum pale brown, not white tomentose; metopidium wide as high, nearly vertical, with an inconspicuous bare supraocular callosity on either side; humeral angles prominent; suprahumeral horns as long as space between bases, as seen from above, stout at base, more or less foliate, from base directed upwards, then gradually turned backwards upto humeral angles, tips subacute; posterior process basally raised above the scutellum, tricarinate, almost straight upto half of its length, then sinuate and acuminate to tip, never impinging on inner angles of tegmina, extending upto middle of 4th apical cell; median carina strongly percurrent; tegmina about three and a half times longer than wide, clearly hyaline, brown pilosity at base, veins basally brown, gradually becoming lighter towards apex; scutellum white tomentose at basal lateral third, rest rusty brown, tip emarginate; abdomen light brown with shades of black, ovipositor concolorous with abdominal sternites.

Measurements.—Length from frontal margin to tips of tegmina 6.9 mm., to tip of posterior process 6.0 mm., width between tips of suprahumerals 5.0 mm., at humeral angles 2.8 mm., at eyes 2.6 mm.

Male.—Differing from female in the dark brown coloration; length from frontal margin to tips of tegmina 6.7 mm., to tip of posterior process 5.9 mm., width across suprahumerals 4.8 mm., at humeral angles 2.5 mm., at eyes 2.5 mm.

Fifth instar nymph.—Closely resembling that of *rhizophagus* from which it differs in the relative length of pronotal anterior and posterior processes and the absence of transverse dark bands on tibiae. General coloration reddish brown; in some, pale brown; head twice as wide as long, reddish brown; vertex planate at base, cranial tubercules obsolete, tuberculate spines slender and closely arranged, eyes reddish, ocelli fuscous brown, as close to eyes as from each other and located on the centro-ocular line; rostrum reaching middle of metathorax; prothorax light brown; metopidium vertical with spines projecting forwards; anterior extension of pronotum blunt, broadly rounded, directed obliquely upwards; pronotal crest as long as or longer than posterior process which is contiguous with mesonotum and extending over two-thirds of its length; suprahumeral buds black, moderately developed, with backwardly directed acute tips; tegminal wing pads reddish brown, extending over 3rd abdominal segment, costal angles distinctly demarcated; legs yellowish on tibiae, dark bands absent; abdomen excluding anal tube as long as thorax; arrangement of dorsal tubercles and lateral lamellae as in *rhizophagus;* anal tube dark brown, as long as rest of abdomen.

Host plant.—Mangifera indica.

Holotype female; 8 female and 9 male paratypes, 12 nepionotypes, Madras, 4.ix.1965.

This species is nearest to *rhizophagus* from which it differs in the greyish brown coloration, pubescent pronotum, absence of tomentosity in the lateral areas of sternum, and in the position of ocelli which are located above the centro-ocular line.

Leptocentrus major n.sp.

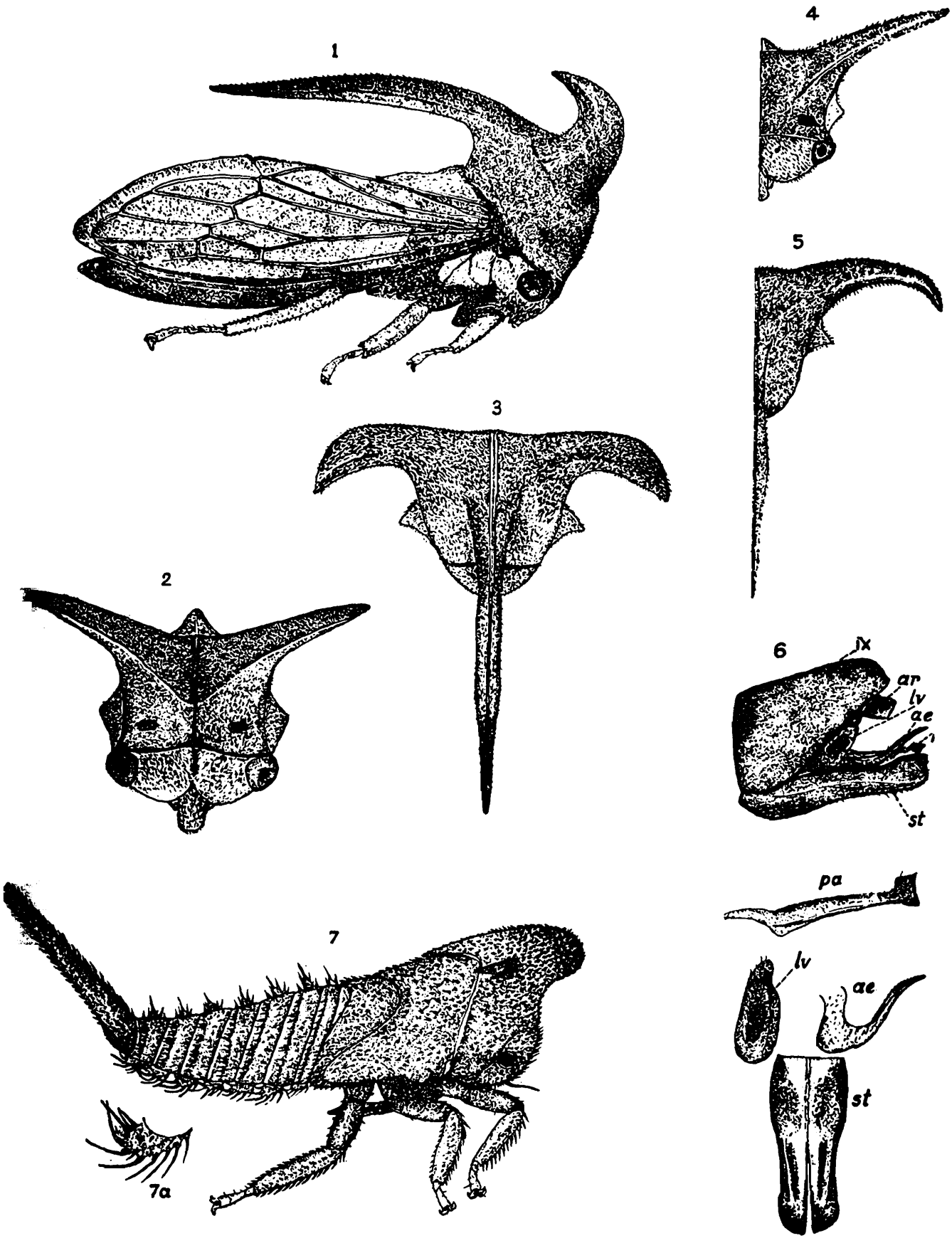
(Text-fig. 10)

Female.—Head greyish black, directed obliquely backwards, densely pilose with silvery hairs; vertex sinuous, eyes chestnut brown; ocelli passing through centro-ocular line and closer to eyes than to each other; frontoclypeus broadly rounded at free end, extending to two-thirds of its length below lower margins of vertex, longly pilose; thorax with pronotum coarsely punctate, black dorsally and cretaceously sericeous laterally; metopidium somewhat obumbrant, convex, slightly wider than high; supraocular callosities irregular in shape, prominent, black; humeral angles broadly conical, tips subacute, sparsely pilose; suprahumeral horns slightly longer than space between their bases, in lateral view obliquely directed forwards, then upwards and strongly recurved backwards beyond middle; tips acute; as viewed in front, much narrower, widely divergent, dorsal carinae shining black, nearer to posterior margin; posterior process robust, obliquely curved immediately after its origin from disc, raised well above scutellum, then extending horizontally backwards, sinuate beyond middle, strongly tricarinate, the central carination finely percurrent through metopidium, apical region black, acuminate, tip sharp, remote from tegmina; scutellum clothed with silvery white hairs, as broad as long, tip emarginate; tegmina about three times longer than wide, base coriaceous, costal margin, apical limbus and basal sixth dark marooned, rest shaded black, veins stout, reddish brown; legs basally black, tibiae brown, tarsi yellowish; abdominal sternites uniformly black; ovipositor robust.

Measurements.—Length from frontal margin to tips of tegmina 9.0 mm., to tip of posterior process 7.0 mm., width across tips of suprahumeral horns 5.9 mm., at humeral angles 3.2 mm., at eyes 3.0 mm.

Male.—Smaller and darker than female; posterior process slender, not sinuate; length from frontal margin to tips of tegmina 7.7 mm., to tip of posterior process 6.0 mm., width across tips of suprahumeral horns 5.4 mm., at humeral angles 2.4 mm., at eyes 2.3 mm.

Fifth instar nymph.—General coloration pale brown; head obliquely turned backwards; vertex emarginate at base, cranial tubercules obsolete; eyes pale white, subglobate, ocelli black, closer to eyes than from each other and located above centro-ocular line; thorax slightly shorter than abdomen excluding anal tube; arrangement of spines on tubercles of thorax similar to that of *rhizophagus*; metopidium receding in front and curving forwards into pronotal crest, somewhat recurved, ending in broadly rounded tip; pronotal posterior process much shorter, contiguous with mesonotum, extending to about half of its length; suprahumeral buds large, tips pointed; wing pads darker than rest of thorax, extending only slightly backwards; costal angles broadly rounded; dorsal tuberculate spines of abdominal segments more or less erect, each



Text-fig. 10. *Leptocentrus major* n. sp.

1. Adult female. 2. Frontal view. 3. Dorsal view of pronotum. 4. Frontal view of male (right half). 5. Dorsal view of male pronotum (right half). 6. Male genitalia. 7. Fifth instar nymph. 7a. Abdominal lateral lamella of fifth instar.

tubercle bearing 4 or 5 spines of varying length; lateral lamellae semicircular, bearing 9 or 10 slender tuberculate spines besides small subspines; anal tube as long as rest of abdomen, characteristically raised and highly eversible.

Host plant.—Michelia champaca.

Holotype female; 9 female and 9 male paratypes, 6 nepionotypes, Madras, 8.viii.1968.

This species is nearest to *bajulans* Dist. in the strongly tricarinate posterior process which is well remote from tegmina; in the black coarsely punctate pronotum, strongly centrally carinate recurved long suprahumerals and in the black colour of tegminal costal margin it comes close to *leucaspis* Walker; it differs from both *bajulans* and *leucaspis* in its larger size, tegmina shaded black all over, and the posterior process sinuous beyond middle.

Leptocentrus bajulans Distant

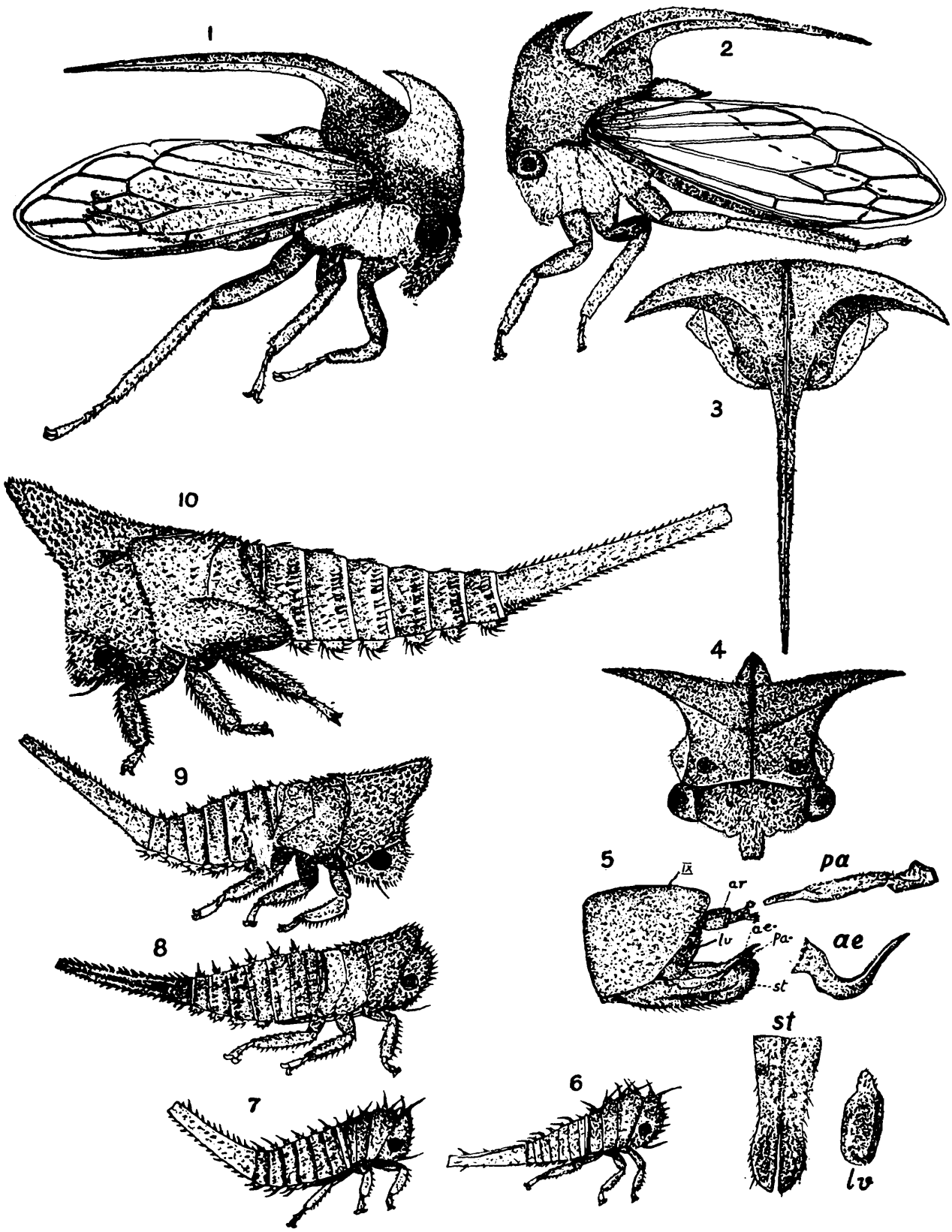
(Text-fig. 11)

1916. *Leptocentrus bajulans* Distant., *Fauna Brit. India, Append.* **6**: 155.

Female.—General coloration black; head thrice as wide as long; longly pilose with pale white hairs; base of vertex arcuate, sides obliquely sloping downwards to clypeus; eyes pinkish, subglobate; ocelli succineous, nearer to eyes than to each other and situated slightly above centro-ocular line; frontoclypeus projecting three-fourths of its length beyond lower margins of vertex, tip truncate, longly pilose, lateral lobes small, distinct; pronotum thickly coarsely punctate, with long white hairs emerging from punctures; metopidium vertical, broader than high, sparsely hairy, supraocular callosities oval, bare; humeral angles brownish, hairly, broadly conical, tips blunt; suprahumeral horns strongly tricarinate, viewed from lateral aspects, broad, directed obliquely outwards and upwards, their tips strongly recurved and acute, anterior carina strong; posterior process slender, arising from posterior half of disc, curved at base, remote from scutellum and tegmina, strongly tricarinate, median carina percurrent through metopidium, lateral carinae reddish brown, apex acute, passing over the posterior angle of inner tegminal margin; scutellum reddish brown, pilose at lateral areas; tegmina thrice as long as broad, pale bronzy, wrinkled, first apical cell nearly eight times longer than broad, basal part slightly dark, coriaceous, veins light reddish brown; legs darker upto distal fourth of femora, tibiae yellowish, tarsi pale white with black spots.

Measurements.—Length from frontal margin to tips of tegmina 6.0 mm., to tip of posterior process 4.8 mm., width across tips of suprahumerals 4.0 mm., at humeral angles 2.0 mm., at eyes 2.2 mm.

Male.—Similar to female but darker; pilosity denser; posterior process longer, its tip passing beyond fifth apical cell of tegmina; terminalia closely resembling that of *major*.



Text-fig. 11. *Leptocentrus bajulans* Distant

1. Adult male. 2. Adult female. 3. Dorsal aspect of pronotum of female. 4. Frontal view of female. 5. Male genitalia, lateral view. 6. First instar nymph. 7. Second instar. 8. Third instar. 9. Fourth instar. 10. Fifth instar.

Measurements.—Length from frontal margin to tips of tegmina 6.0 mm., to tip of posterior process 5.3 mm., width across tips of suprahumerals 3.8 mm., at humeral angles 1.8 mm., at eyes 2.0 mm.

Fifth nymphal instar.—General coloration leafy green; head highly bristled; 2.5 times wider than long, inclined backwards; vertex planate; eyes dark brown, ocelli succineous, located slightly above centro-ocular line, closer to eyes than to each other; metopidium slightly convex; suprahumeral buds conspicuously large and directed backwards; pronotal anterior process obliquely extended forwards and upwards, tip blunt; pronotal posterior process about half as long as anterior process, extending over three-fourths of length of mesonotum; wing pads large, reaching the middle of 3rd abdominal segment with distinct costal angles; abdominal dorsal tuberculate spines much reduced and adpressed to body, lateral lamellae semicircular, each with 7 to 9 slender spines; anal tube black at distal one-third, nearly as long as rest of abdomen.

Host plant.—Casuarina equisetifolia

Material studied.—6 females, 4 males, 36 nymphal instars, Madras, 4.ix.1967.

Leptocentrus leucaspis Walker

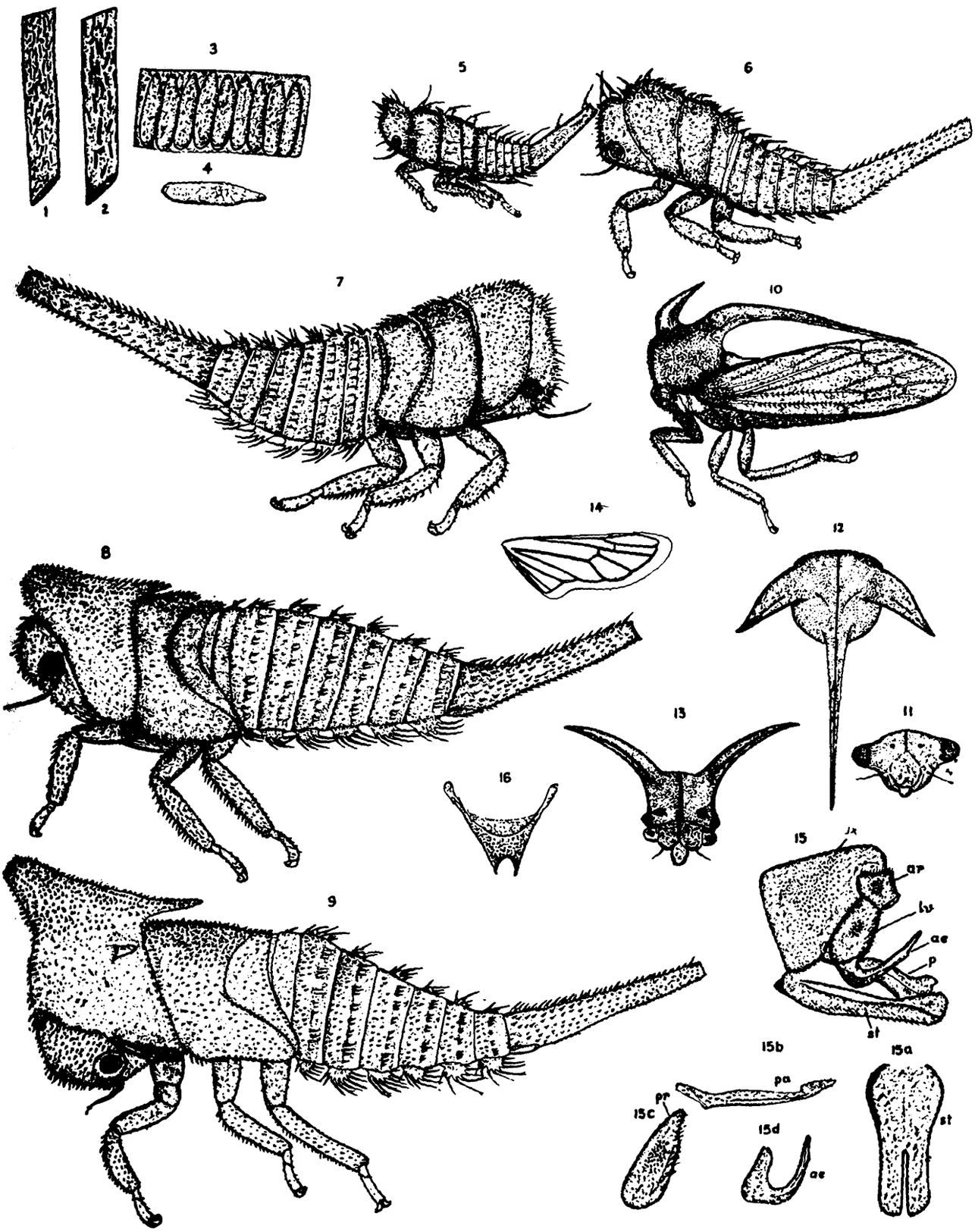
(Text-fig. 12)

1851. *Centrotus taurus* Walker, *List. Hom.* ii: 602.

1858. *Leptocentrus leucaspis* Walker, *List. Hom. Suppl.*: 158.

Female.—General colour black; head nearly thrice as broad as long; upper margin of vertex strongly arcuate and sinuate, lower margins weakly sinuate; eyes hemispherical, black, directed laterad; ocelli slightly closer to eyes than to each other and located just above centro-ocular line; pronotum black, not pilose, strongly punctate, metopidium somewhat convex and vertical, wider than high, disc convex; supra-ocular callosities large, irregularly rounded; humeral angles dark brown, tips acute; suprahumeral horns slender, more than two times as long as space between bases, viewed from front obliquely raised and much divergent, tips acute, viewed from above strongly carinate, flattened, obliquely directed backwards, seen from lateral aspect, raised upwards, then outwards, tips turned backwards; posterior process tricarinate, dorsal carination percurrent over metopidium, strongly convexly recurved from near base, achieving its maximum height above scutellum, then moderately arched, apical fourth impinging on tegminal inner margin, tip acute, touching the posterior end of 5th apical cell or slightly passing beyond it; in some, tip slightly raised; tegmina shining ochraceous, costal margin and apical limbus black, base black, punctate, coriaceous, first apical cell nearly 7 times longer than wide, veins reddish brown; hind wings with 4 apical cells; scutellum black, as broad as long, tip broadly emarginate; basal two-thirds of scutellum and lateral areas of sternum cretaceously sericeous; legs with tibiae yellowish.

Measurements.—Length from frontal margin to tips of tegmina 7.0-7.6 mm., to tip of posterior process 5.5-6.0 mm , width across tips of



Text-fig. 12. *Leptocentrus leucaspis* Walker

1. Egg-slits on host stem. 2. Bark of twig removed to show the egg-slits. 3. An egg-slits cut open. 4. An egg. 5. First instar nymph. 6. Second instar. 7. Third instar. 8. Fourth instar. 9. Fifth instar. 10. Adult female. 11. Head, frontal elevation. 12. Pronotum, dorsal view. 13. Front view. 14. Hind wing. 15. Male genitalia, lateral view. 15a. Sternal plate ; b, paramere, c, lateral valve : d, aedeagus. 16. Scutellum.

suprahumerals 6.4-7.0 mm., at humeral angles 2.5-2.7 mm., at eyes 2.0-2.2 mm.

Fifth nymphal instar.—General coloration light brown, in some greyish, mottled with black spots; head twice as wide as long across eyes; base of vertex strongly sinuate, longly pilose; eyes pale white, ocelli transparent, closer to eyes than to each other and located above centro-ocular line; frontoclypeus greyish white, longly pilose, extending slightly beyond lower margins of vertex; rostral tip reaching hind coxae; prothorax nearly as long as pterothorax, speckled with closely arranged short stout spines on the crest, sparsely arranged on lateral aspects; pronotal anterior process directed obliquely forwards and upwards with broadly rounded tip, nearly two and a half times longer than pronotal potserior process which extends over basal half of mesonotum, tip acute; tuberculate spines on mid dorsal region of pterothorax short and stout; suprahumeraul buds small, with blunt tips; mesonotal process short; tegminal wing pads greyish brown, large, costal angles inconspicuous and sparsely hairy; abdomen laterally compressed with 9 visible segments, the first segment narrow, the ninth one forming anal tube; dorsal tubercles of abdominal segments suberect, inclined backwards; lateral lamellae, of moderate size, crescentic, bordered by 8 or 9 slender spines showing a tendency to fork; anal tube black distally, shorter than the combined length of 1-8 segments of abdomen; dorsal row of spines on anal tube erect and conspicuous.

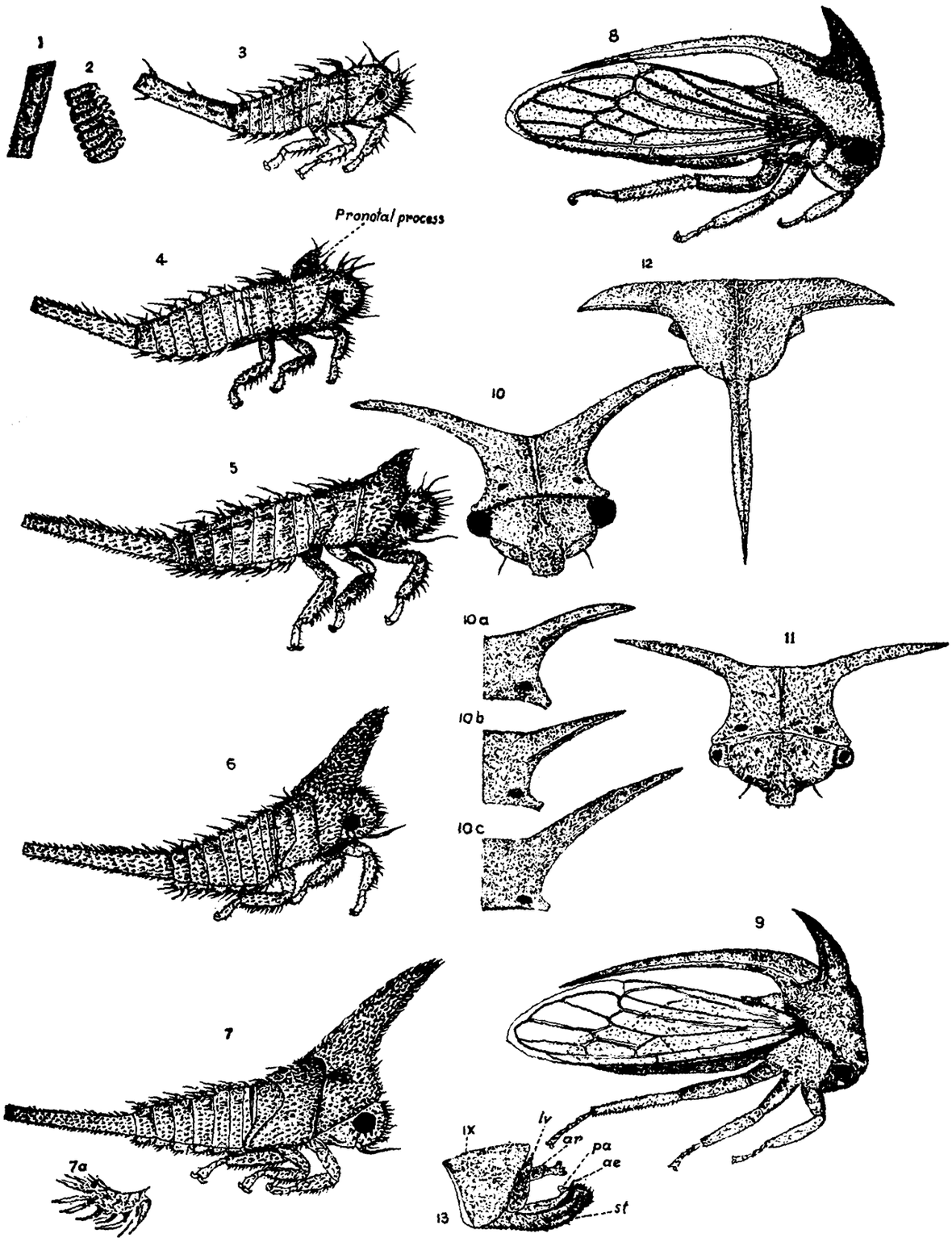
Host plants.—*Terminalia catappa, Pongamia glabra.*

Material studied.—65 females, 60 males and numerous nymphs, Madras, July to October, 1966.

Leptocentrus varicornis n.sp.

(Text-fig. 13)

Female.—General colour greyish brown; head yellowish brown, broader than long declivous, arcuate at base of vertex, coarsely punctate; frontoclypeus greyish with black spots, longly pilose, lower margin extending to one-third of its length beyond vertex; eyes light reddish brown, projecting lateral; ocelli black, located above centro-ocular line, closer to eyes than to each other. Thorax greyish black at sides shading to black dorsally; metopidium one and a half times wider than high; finely punctate, not pilose, supraocular callosities not prominent, humeral angles short, tips subacute, suprahumerals very long, rather slender, widely divergent, not abruptly curved from base, obliquely directed upward, tip acute and moderately curved backward, seen from above much flattened, as seen in front much narrower, finely tricarinate, carinae black, width across tips of suprahumerals more than three times their width at bases; posterior process slender, reddish brown, tricarinate, recurved from near base, widely separated from scutellum, extending as far back as the 4th apical cell of tegmina, gradually acuminate, impinging on tegmina at apex; tegmina subhyaline, base punctate and dark brown, veins stout and yellowish brown; hind wing with 4 apical cells. Legs reddish brown, except tarsi which are yellowish. Abdomen black.



Text-fig. 13. *Leptocentrus varicornis* n. sp.

1. Eggslits on host stem. 2. An egg mass. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar. 7a. Abdominal lateral lamella of fifth instar. 8. Adult female. 9. Adult male. 10. Frontal view of female. 10a, b, c : Variations in suprahumerals. 11. Frontal view of male. 12. Dorsal aspect of female pronotum. 13. Male genitalia,

Measurements.—Length from frontal margin to tips of tegmina 6.1 mm., to tip of posterior process 5.44 mm., width between tips of suprahumeral horns 5.0 mm., between bases of suprahumerals 1.5 mm., at humeral angles 2.4 mm., at eyes 2.4 mm., length of suprahumeral 2.5 mm.

Male.—Slightly smaller than female; body uniformly yellowish brown except abdominal undersurface which is dark brown; eyes greyish black; metopidium less punctate; sparsely pilose, supraocular callosities more distinct; posterior process amber brown.

The species exhibits notable variations with regard to the length and angle of inclination of suprahumerals, length of horns ranging from 2.1 to 2.6 mm., the degree of divergence ranging from nearly horizontal to distinctly oblique upturned conditions.

Fifth nymphal instar.—General colour light reddish brown. Head highly pilose; vertex somewhat convex with basal margin planate, cranial tubercules obsolete; ocelli slightly closer to eyes than to each other and located on c-o-line; pronotum with vertical metopodium and conspicuous suprahumeral buds; pronotal anterior process extraordinarily long, slightly curved at middle and ending in an acute point; spines on pronotal process dense; pronotal posterior process short, about one-sixth as long as anterior process, extending over just half the length of mesonotum; costal angles of wing pads broadly rounded; dorsal tuberculate spines of thorax and abdomen long, erect or suberect; spines on abdominal lateral lamellae 8 or 9 in number, slender and curved backwards with distinct subspines. Anal tube dark brown, as long as the rest of abdomen.

Host plant.—Zizyphus jujuba.

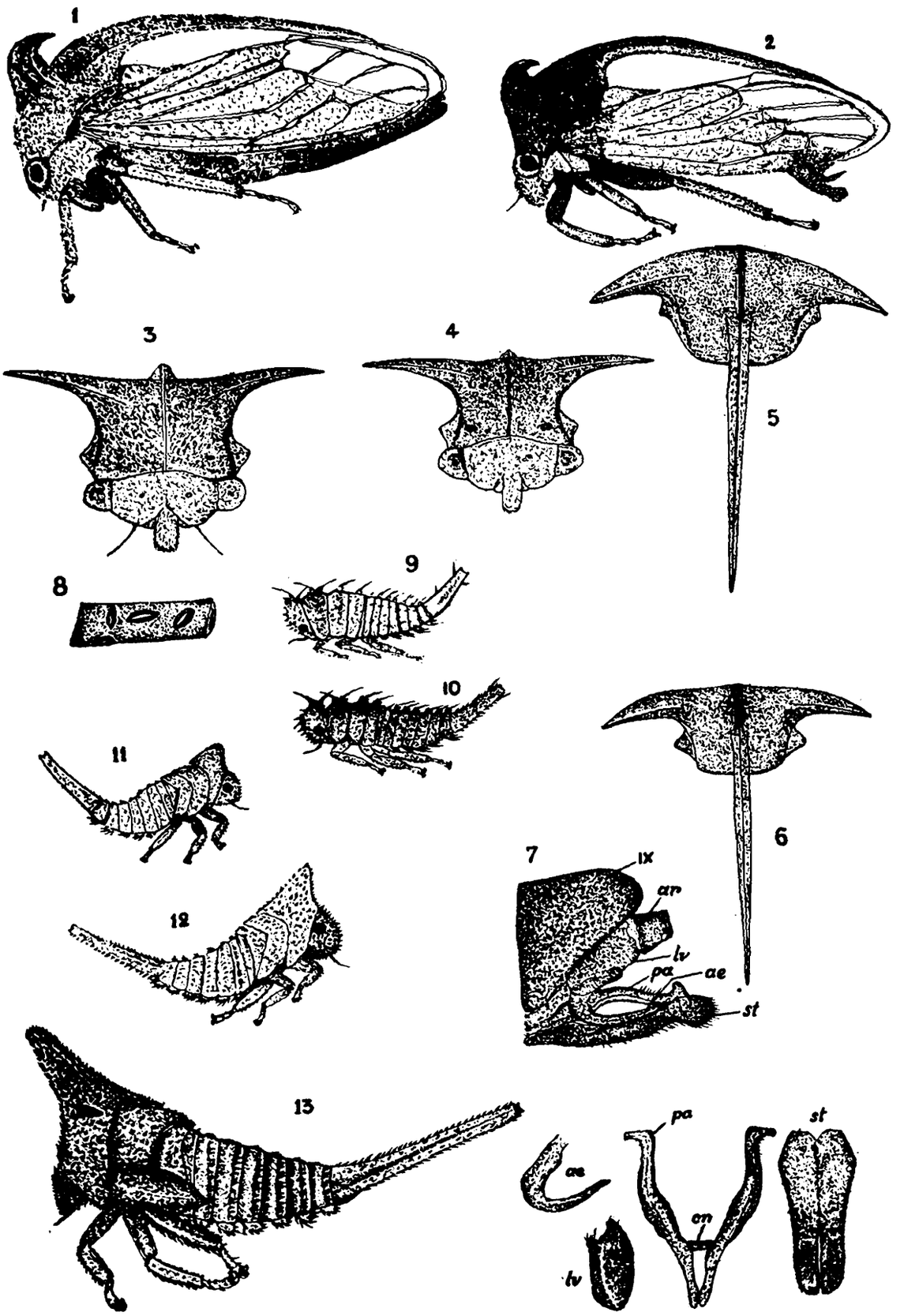
Holotype female; 8 female and 9 male paratypes, 18 nepionotypes, Madras, 6.viii.1966.

This species is related to *leucaspis* Walker and *longispinus* Distant in the presence of very long, slender, divergent, suprahumerals; it differs from both in the smaller size, lighter body coloration, in the highly variable suprahumerals and in the less oblique and more straight posterior process; from *leucaspis* it differs in the subhyaline nature of tegmina which never shows any black shades on costal margin. The 5th instar nymph of *varicornis* is unique in the very long pronotal anterior process.

Leptocentrus taurus Fabricius

(Text-fig. 14)

1775. *Leptocentrus taurus* Fabricius, *Syst. Ent.* 675.
1778. *Cicada taurus:* Goeze, *Hemiptera,* **2:** 147.
1795. *Membracis taurus:* Weber, *Rhyngota,s* 19.
1798. *Membracis rupicapra* Fabricius, *Syst. Suppl.*: 514.
1803. *Centrotus scutellaris* Fabricius, Rhyngota,: 19.
1846. *Membracis tricornis* Fahirmaire, *Soc. Ent. de France, Ann.* **4:** 511.
1851. *Centrotus terminalis* Walker, *List Hom.*, **2:** 694.
1885. *Leptobelus scutellaris:* Atkinson, *J. Asiatic Soc. Bengal,* **54:** 83.



Text-fig. 14. *Leptocentrus taurus* Fabricius

1. Adult female. 2. Adult male. 3. Frontal view of female. 4. Frontal view of male. 5. Dorsal view of pronotum of female. 6. Dorsal view pronotum of male. 7. Male genitalia, lateral view. 8. Twig with egg-slits. 9. First instar. 10. Second instar. 11. Third instar. 12. Fourth instar. 13. Fifth instar.

Female.—General colour black; head three times wider than long, greyish black, coarsely punctate, sparsely pilose, basal margin of vertex convex, lateral margins obliquely sloping downwards, eyes reddish brown, hemispherical; ocelli black, nearer to eyes than to each other and situated slightly above centro-ocular line; antennae as long as frontoclypeus; frontoclypeus slightly convex, thrice as long as broad, with three-fourths of its length extending beyond lower margins of vertex, tip broadly rounded, longly pilose; lateral lobes distinct, small; pronotum black, thickly coarsely punctate with closely adpressed pale white hairs; metopidium dark reddish brown, vertical, nearly twice as wide as high; supraocular callosities inconspicuous; humeral angles greyish brown, sparsely pilose, tips subacute; suprahumeral horns robust, longer than space between their bases, seen in front subhorizontal, much narrower and less recurved, as seen from above strongly tricarinate, the dorsal carina closer to posterior margin, as seen from lateral aspect, turned slightly upwards and then strongly recurved, tips acute; posterior process strongly tricarinate above, abruptly convexly elevated from near base, then sub-straight, passing beyond 5th apical cell, apex black, impinging on the inner margin of tegmina, central carina percurrent through metopidium; tegmina pale bronzy ochraceous, three and a half times longer than wide; distal half of costal margin black, basal sixth opaque, coriaceous and punctate; first apical cell about 8 times longer than wide; hind wings with 4 apical cells; scutellum as broad as long, tip narrowly emarginate; basal part of scutellum and lateral areas of sternum cretaceously sericeous; tibiae reddish brown; abdomen black beneath.

Measurements.—Length from frontal margin to tips of tegmina 7 mm., to tip of posterior process 5.8-6.6 mm., width across tips of suprahumerals 5.0-5.2 mm., at humeral angles 2.4-2.7 mm., at eyes 2.2-2.4 mm.

Male.—General colour jet black; smaller than female; suprahumerals more strongly recurved. Genitalia, with aedeagus 'U' shaped, connective plate of parameres rectangular, lateral valves oblong, twice as long as broad, dark brown, process short, nodular, fringed with short hairs; apical third of sternal plate forked, punctate, longly and densely pilose, lobes inconspicuous.

Measurements.—Length from frontal margin to tips of tegmina 6.0-6.5 mm., length to tip of posterior process 5.0-5.4 mm., width across tips of suprahumerals 4.6-4.8 mm., at humeral angles 2.2-2.4 mm., at eyes 2.0-2.2 mm.

Fifth nymphal instar.—Colour leafy green in life but fading to ochraceous in cabinet specimens; vertex of head convex, covered with sparse bristles, tubercular bases black, rostrum reaching 2nd abdominal segment; base of vertex weakly arcuate without conspicuous cranial tubercules; ocelli somewhat projecting, closer to eyes than to each other and located above centro-ocular line; lower margin of frontoclypeus on a line with lower margins of vertex; lobes distinct; pronotum with vertical metopidium; anterior process obliquely raised forwards and upwards, tip narrowly rounded, covered with closely arranged short tuberculate spines; posterior process about one-third as long as anterior process; extending backwards over mesonotum, tip acuminate; suprahumeral buds black at base, moderately developed; wing pads greenish,

marked with brown or black dots; abdominal segments slightly telescoped, tip raised upwards, dorsal tubercles of abdomen short, their spines adpressed to body; lateral lamellae with 7 to 10 slender spines; anal tube about one and a fourth longer than rest of abdomen; genital rudiments black or dark brown.

Host plants.—*Acacia arabica*, *Acacia melanoxylon*, *Albizzia lebbec*, *Tamarindus indicus*, *Capparis sepiaria*, *Zizyphus jujuba*, *Erythrina indica*, *Vernonia cinerea*, *Artabotrys odoratissimus*, *Crataeva religiosa*, *Ipomea biloba*, *Hibiscus rosasinensis*, *Thespesia populnea*, *Feronia elephantum*, *Anacardium occidentale*, *Cyamopsis tetragonoloba*, *Bauhinia tomentosa*, *Bauhinia purpurea*, *Casuarina equisetifolia*, *Solanum torvum*, *Solanum melongena*, *Eranthemum* sp.

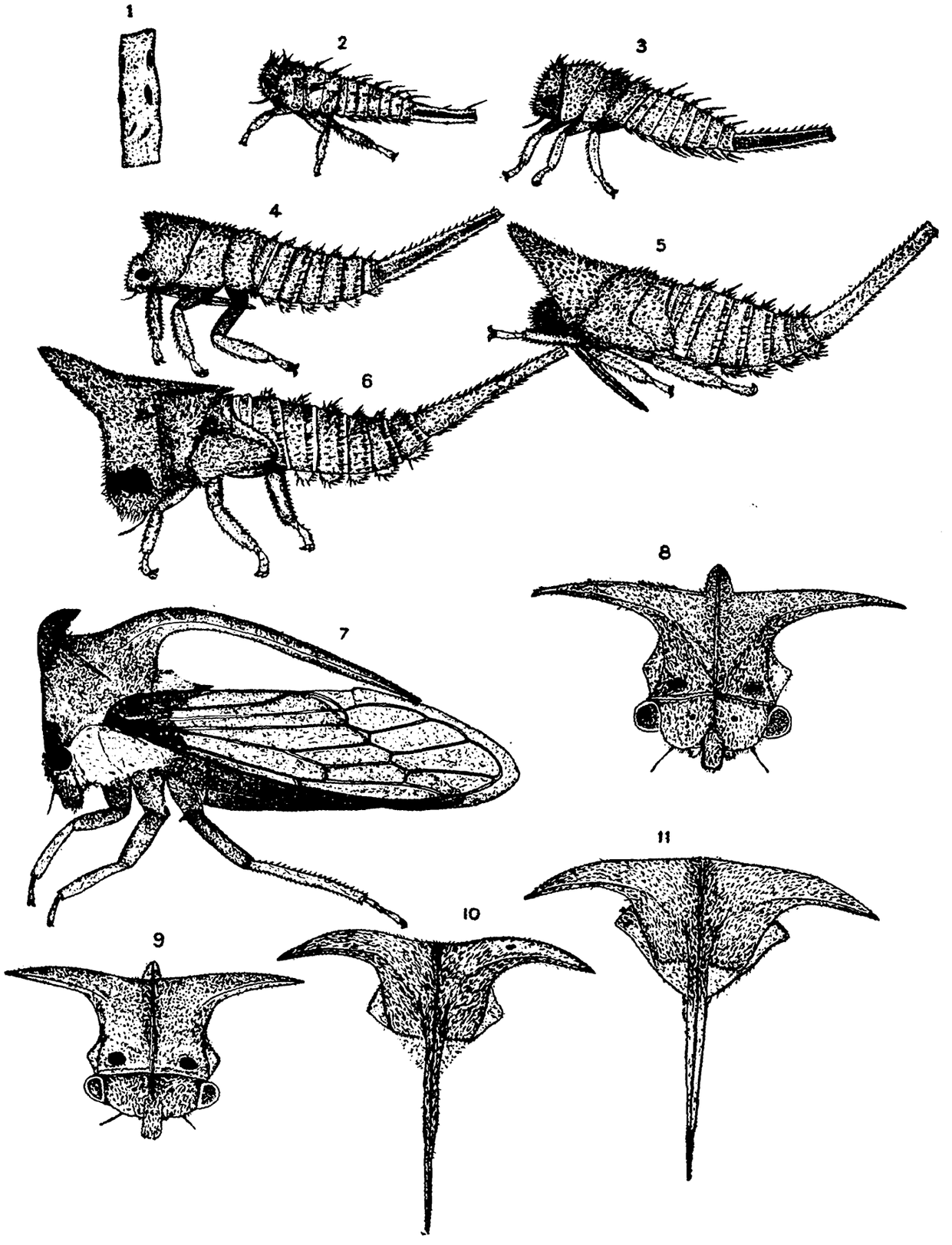
Material studied: 85 females, 50 males and numerous nymphs, Madras, on various dates during the years 1965-68.

Leptocentrus nigra n.sp.

(Text-fig. 15)

Female.—General colour black; head declivous, nearly three times as wide as long, fuscous, somewhat densely pilose with long golden hairs; vertex shallowly arcuate and sinuate at upper margin, lower margins downwardly sloping; frontoclypeus concolorous with vertex, densely pilose, extending more than two-thirds of its length beyond lower margins of vertex, basal lobes prominent, fringed with long golden yellow pilosity; eyes large, globate, reddish brown, moderately projecting laterad; ocelli jet black, a little raised, located above centro-ocular line; closer to eyes than to each other; pronotum jet black, finely punctate, with long suberect golden yellow hairs; lateral and ventral areas of sternum cretaceously sericeous; metopidium slightly higher than wide, vertical, slightly convex; supraocular callosities conspicuous, jet black, bare, somewhat oval, humeral angles prominent and blunt; suprahumeral horns black, about one and a half times longer than width between their bases, as seen from front broad, subparallel, as seen in lateral aspect a little projecting forwards just beyond middle, then obliquely curved backwards and acuminate; as viewed from above somewhat flat, basal one-third gently curved forwards and then laterad, tip sharp; posterior process stout, black, rising obliquely from disc, achieving its greatest height above middle of scutellum, then extending backwards in an almost declivous manner, apical fourth acuminate, impinging on inner margins of tegmina, reaching the extremity of 5th apical cell, distinctly tricarinate, lateral carinae extending upto middle of disc, ventrally posterior face of pronotum vertically raised up, then curving caudad into base of posterior process, median, carina strongly percurrent, finely continued through metopidium, scutellum as wide as long, basal half cretaceously sericeous, apex narrowly emarginate; tegmina 3.5 times as long as wide, shining bronzy ochraceous, extreme base smoky hyaline, distal half of costal margin, tip of 1st apical cell and the adjacent area of apical limbus shaded with black; abdominal undersurface black; legs black upto distal ends of tibiae, tarsi brown.

Measurements.—Length from frontal margin to tips of tegmina 7.7 mm., to tip of posterior process 6.4 mm., width across tips of suprahumerals 6.0 mm., at humeral angles 2.7 mm., at eyes 2.5 mm.



Text-fig. 15. *Leptocentrus nigra* n. sp.

1. Twig with egg-slits. 2. First instar nymph. 3. Second instar. 4. Third instar. 5. Fourth instar. 6. Fifth instar. 7. Adult female. 8. Frontal view of female. 9. Frontal view of male. 10. Dorsal view of pronotum and scutellum of male. 11. Dorsal view of pronotum and scutellum of female.

Male.—Similar to female, but smaller; genitalia similar to *taurus.*

Measurements.—Length from frontal margin to tips of tegmina 7.0 mm., to tip of posterior process 5.9 mm., width across tips of suprahumerals 5.2 mm., at humeral angles 2.5 mm., at eyes 2.3 mm.

Fifth instar nymph.—Closely resembling that of *taurus,* differing in the relative length of anal tube to abdomen and also in the nature of pronotal processes. General colour green; head much inclined backwards, rostral tip extending to 2nd abdominal segment; head densely pilose with long tuberculate bristles, base of vertex nearly truncate; eyes reddish brown; ocelli closer to eyes and located on the centro-ocular line; thorax with metopidium vertical, sprinkled with small tuberculate spines; anterior process of pronotum gradually tapering to an acute tip, directed forwards and upwards; posterior process extending over the entire length of mesonotum, tip acute; suprahumeral buds small, concolorous with metopidium; abdominal segments somewhat attenuated; dorsal tuberculate spines suberect, lateral lamellae crescentic, each lamella bordered with 7 to 9 slender spines; anal tube shorter than the combined length of abdominal segments 1-8.

L. nigra comes nearest to *taurus* from which it differs in the jet black colour, denser pilosity, in the nature of the metopidium which is higher than wide, the strongly abruptly elevated base of posterior process which never extends beyond the 5th apical cell of tegmina.

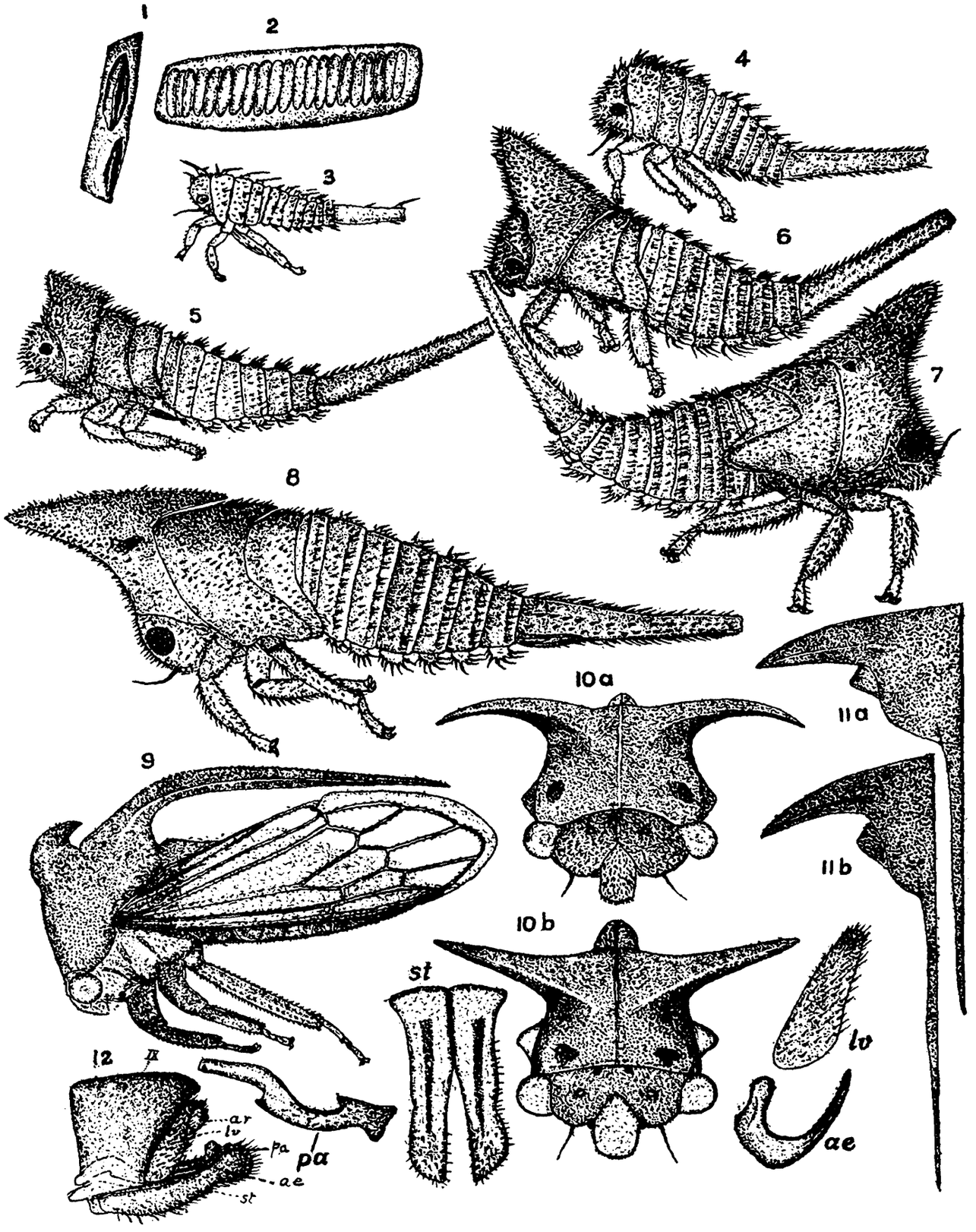
Host plant.—Phyllanthus sp.

Holotype female; 15 female, 6 male paratypes, 10 nepionotypes, Madras, 10.v.1968.

Leptocentrus bauhiniae n.sp.

(Text-fig. 16)

Female.—General colour dark brown. Head nearly thrice as wide as long, vertex arcuate, declivous, finely punctate, black, with more or less closely arranged suberect yellowish hairs; eyes reddish brown with shades of black at centre, ocelli located above centro-ocular line, closer to eyes than to each other; frontoclypeus declivous, with yellow pilosity, extending nearly two-thirds of its length below lower margins of vertex, tip rounded, basal lobes not prominent. Pronotum black, finely punctate, with more or less recumbent yellowish pilosity, metopidium vertical, wider than high, supraocular callosities bare, distinct, humeral angles prominent, tips blunt; suprahumeral horns black, sparsely pilose, strongly quadricarinate, carinae jet black as viewed in lateral aspect slightly projecting forward, as viewed in front, extending outwards and gently curved backwards, as viewed from above, much broader with acute tips. Posterior process punctate at base, black, rising well above disc., gradually sloping backwards achieving its maximum height above posterior end of scutellum, somewhat straight upto half of its length, then slightly declivous, apical fourth tapering, reaching almost the extremity of 4th apical cell of tegmina but never impinging on inner angles of the same, tip sharp; median carina percurrent, continued through metopidium as a fine streak; tegmina three times as long



Text-fig. 16. *Leptocentrus bauhiniae* n. sp.

1. Egg-slits on host stem. 2. Egg slit cut open. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar, male. 8. Fifth instar, female. 9. Adult female. 10a, Frontal view of female. 10b, Frontal view of male. 11a. Dorsal aspect (left half) of pronotum of male. 11b. Dorsal aspect (left half) of pronotum of male. 12. Male genitalia, lateral view,

as broad, shining, pale bronzy ochraceous, apex of costal margin smoky black, base somewhat black, coriaceous and punctate; scutellum nearly as long as broad at base, white tomentose at basal half; coxae, trochanters and proximal three-fourths of femora black, rest of femora and tibiae castaneous, tarsi yellowish brown; abdomen black, sparsely pilose.

Measurements.—Length from frontal margin to tips of tegmina 6.2 mm., to tip of posterior process 5.75 mm., width across tips of suprahumerals 5.0 mm., at humeral angles 2.6 mm., at eyes 2.5 mm.

Male.—Similar to female but slightly smaller; genitalia similar to *taurus*, but with lateral valves narrowly rounded at base, widest at one-third the distance from base, process short, not conspicuously demarcated from main body, fringed with short hairs; sternal plates forked slightly more than half of its length, forked ends divergent.

Measurements.—Length from frontal margin to tips of tegmina 6.0 mm., to tip of posterior process 5.5 mm., width across tips of suprahumerals 4.5 mm., at humeral angles 2.4 mm., at eyes 2.2 mm.

Fifth instar nymph.—Similar to that of *bajulans* in the general coloration but differing in the relative lengths of pronotal processes, very small suprahumeral buds and suberect abdominal dorsal tuberculate spines which are not adpressed to body. Head sparsely pilose with short bristles, vertex slightly sinuate, eyes prominently reddish brown; ocelli closer to eyes and located along the centro-ocular line; metopidium obliquely extending forwards and produced as anterior crest which is nearly horizontal and slightly inclined downwards; pronotal posterior process less than half as long as anterior process; suprahumeral buds very small and inconspicuous, dorsal tuberculate spines of abdomen prominent, suberect, inclined backwards; lateral lamellae typical to genus, semicircular, 8 or 9 spines bordering each lamella, subspines inconspicuous; anal tube as long as rest of abdomen; genitalic rudiments prominent, sternal plate black.

Sexual dimorphism is found in the 5th instar nymphs of this species. While the above description applies to the female, the male differs in the peculiar disposition of the pronotal anterior process which is obliquely directed upwards and forwards, the suprahumeral buds very inconspicuous, the abdominal tip raised upwards and the genital rudiments distinct from those of female.

Host plant.—Bauhinia tomentosa.

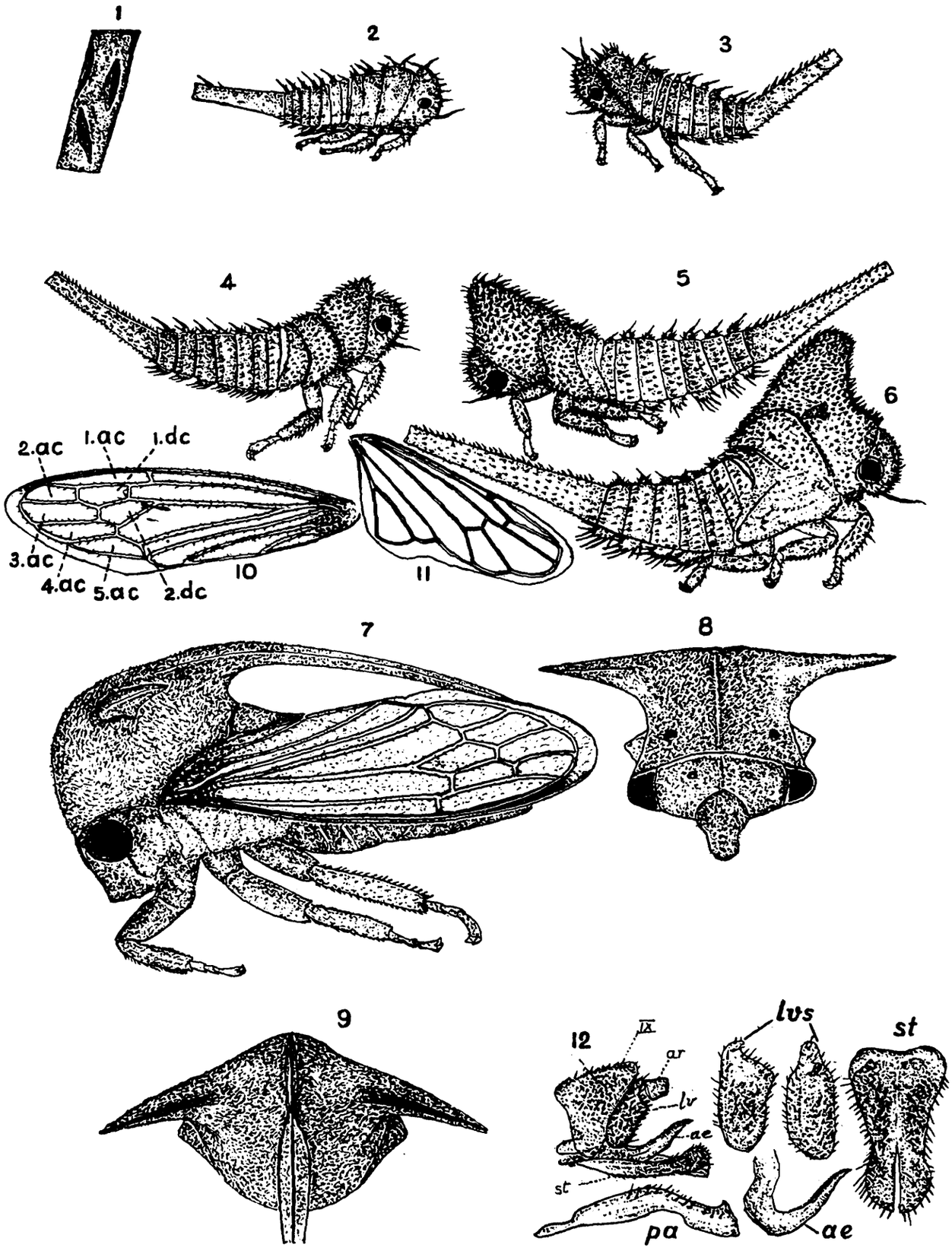
Holotype female; allotype male, paratype 75 females, 35 males, 20 nepionotypes, Madras, August to November, 1968.

The species is nearest to *taurus*, but differing in the nature of the posterior process the distal fourth of which is straight and acuminate, its tip never impinging on the inner angles of tegmina.

Leptocentrus moringae n.sp.

(Text-fig. 17)

Female.—General colour greyish brown; head declivous, nearly 3 times broader than long, vertex broadly convex at base, greyish white,



Text-fig. 17. *Leptocentrus moringae* n. sp.

1. Egg slits on host stem. 2. First instar. 3. Second instar. 4. Third instar. 5. Fourth instar. 6. Fifth instar. 7. Adult female. 8. Frontal view. 9. Dorsal view of pronotum. 10. Tegmina. 11. Hind wing. 12. Male genitalia, lateral view.

with scattered pilosity; eyes scarlet brown, globose, projecting slightly laterad, ocelli black, nearer to eyes than to each other and located distinctly above the centro-ocular line; frontoclypeus densely pilose, extending over two-thirds of its length beyond lower margins of vertex, basal lobes inconspicuous, whitish tomentose, free end broadly rounded; pronotum greyish dorsally; lateral areas of sternum and basal half of scutellum cretaceously sericeous; metopidium slightly broader than high, greyish with sparsely distributed hairs, convex and slightly obumbrant; supraocular callosities not prominent; humeral angles moderate, broadly conical, tips subacute; suprahumerals shorter than width between their bases, as seen in front slender, horizontal, directed outwards, gradually tapering, tips acute, carinae chestnut brown, as seen from above gradually arched backwards beyond middle, viewed from lateral aspect distal one-third of suprahumerals directed backwards, lateral carinae fine; posterior pronotal process slender, tricarinate, slightly raised from disc and obliquely arched to the tip, apex acute, impinging on inner tegminal margins, reaching upto the 4th apical cell; tegmina nearly 3 times longer than wide, hyaline except at apical fourth of costal margin which is fuscous, basal part somewhat darker and coriaceous; abdomen greyish above, lower surface sparingly cretaceously sericeous; ovipositor dark brown; tibiae reddish brown, tarsi light yellow.

Measurements.—Length from frontal margin to tips of tegmina 6.5 mm., to tip of posterior process 5.6 mm., length of suprahumeral 1.5 mm., width across tips of suprahumerals 4.5 mm., at humeral angles 2.5 mm., at eyes 2.4 mm.

Male.—Similar to female. Length from frontal margin to tips of tegmina 6.2 mm., to tip of posterior process 5.3 mm., length of horn 1.4 mm., width across tips of suprahumerals 4.5 mm., at humeral angles 2.4 mm., at eyes 2.2 mm.

Fifth nymphal instar.—Resembling *major* in the shape of the pronotal crest, but differing in the smaller size and much longer anal tube. General colour deep green; head obliquely directed caudad; vertex strongly sinuous with much reduced cranial tubercules; base of tuberculate spines dark-brown; spines on upper margin of vertex closely arranged; eyes reddish brown; ocelli dull white, inconspicuous, equidistant to each other and from eyes, located on the centro-ocular line; frontoclypeus extending a little below the lower margins of vertex; antennae as long as width of frontoclypeus; pronotum, with metopidium as high as long, slightly receding in front and curving forwards and upwards to form the anterior extension of pronotal crest, ending in a broadly rounded tip with thickly arranged spines; pronotal posterior process half as long as anterior process, extending over three-fourths of the length of mesonotum; suprahumeral buds moderate, dark brown at base; mesonotal process extending backwards over the entire length of metanotum; wing pads green with brown dots, faintly revealing the imaginal veins, costal angles not distinct; abdominal segments 1-8 somewhat telescoped, slightly exceeding two-thirds of the length of anal tube; dorsal tubercles dark-brown, longer spines suberect, smaller ones adpressed to body; lateral lamellae with 7 or 8 slender spines; anal tube very long, much longer than rest of abdomen.

Host plant.—Moringa moringa.

Holotype female; 32 female and 19 males paratypes, 20 nepionotypes, Madras, 20.x.1967.

This species is allied to *obortus* Distant in the nature of suprahumerals which are horizontal, obliquely narrowed with tips acute and carinate, the black costal area and the white tomentose lateral areas of sternum, but differing in the coloration of body, in the suprahumerals which are never directed upwards, and the cretaceously sericeous nature of the abdominal sternites.

Key to species of **Leptocentrus** Stål *based on Fifth instar nymphs*

1 (9) Anterior process of pronotum broadly rounded with obtuse tip.

2 (7) Length of abdominal segments 1-8 equal or almost equal to length of anal tube.

3 (6) Body light reddish brown; anal tube as long as the rest of abdomen.

4 (5) Pronotal anterior process shorter than posterior process; tibiae banded. .. ..*rhizophagus* n.sp.

5 (4) Pronotal anterior process as long as or longer than posterior process; tibiae not banded.. .*mangiferae* n.sp.

6 (3) Body pale brown; pronotal anterior process one and a half times as long as posterior process.. .*major* n.sp.

7 (8) Length of abdominal segments 1-8 greater than length of anal tube; anterior pronotal process two and a half times as long as posterior process; tuberculated spines on abdominal lateral lamellae slender with tendency for branching.. .*leucaspis* Walker.

8 (7) Length of abdominal segments 1-8 less than length of anal tube; anterior pronotal process twice as long as posterior process; tegminal venation distinct.. .*moringae* n.sp.

9 (1) Anterior process of pronotum gradually tapering to an acute or subacute tip.

10(15) Length of abdominal segments 1-8 equal or almost equal to length of anal tube.

11(14) Body coloured leafy green; moderately hairy; dorsal tuberculated spines of abdomen inclined backwards, often adpressed to the body.

12(13) Pronotal anterior process twice as long as posterior process; suprahumeral buds well developed; dorsal tuberculated spines of abdomen adpressed to body.. ...*bajulans* Dist.

13(12) Pronotal anterior process more than twice as long as posterior process; suprahumeral buds short and inconspicuous; dorsal tuberculate spines of abdomen inclined backwards. .*bauhiniae* n.sp.

14(11) Body coloured light reddish brown; densely hairy; dorsal tuberculate spines of thorax and abdomen long and erect or suberect; pronotal anterior process nearly six times as long as posterior process, tip acute; spines on abdominal lateral lamellae slender and curved backwards.. .*varicornis* n.sp.

15(16) Length of abdominal segments 1-8 distinctly longer than anal tube; pronotal anterior process nearly one and a third times as long as posterior process. *nigra* n.sp.

16(15) Length of abdominal segments 1-8 about three-fourths the length of anal tube; pronotal anterior process nearly 3 times as long as posterior process. *taurus* Fabr.

Genus **Telingana** Distant

(Type of the genus *Leptobelus curvispinus* Stla)

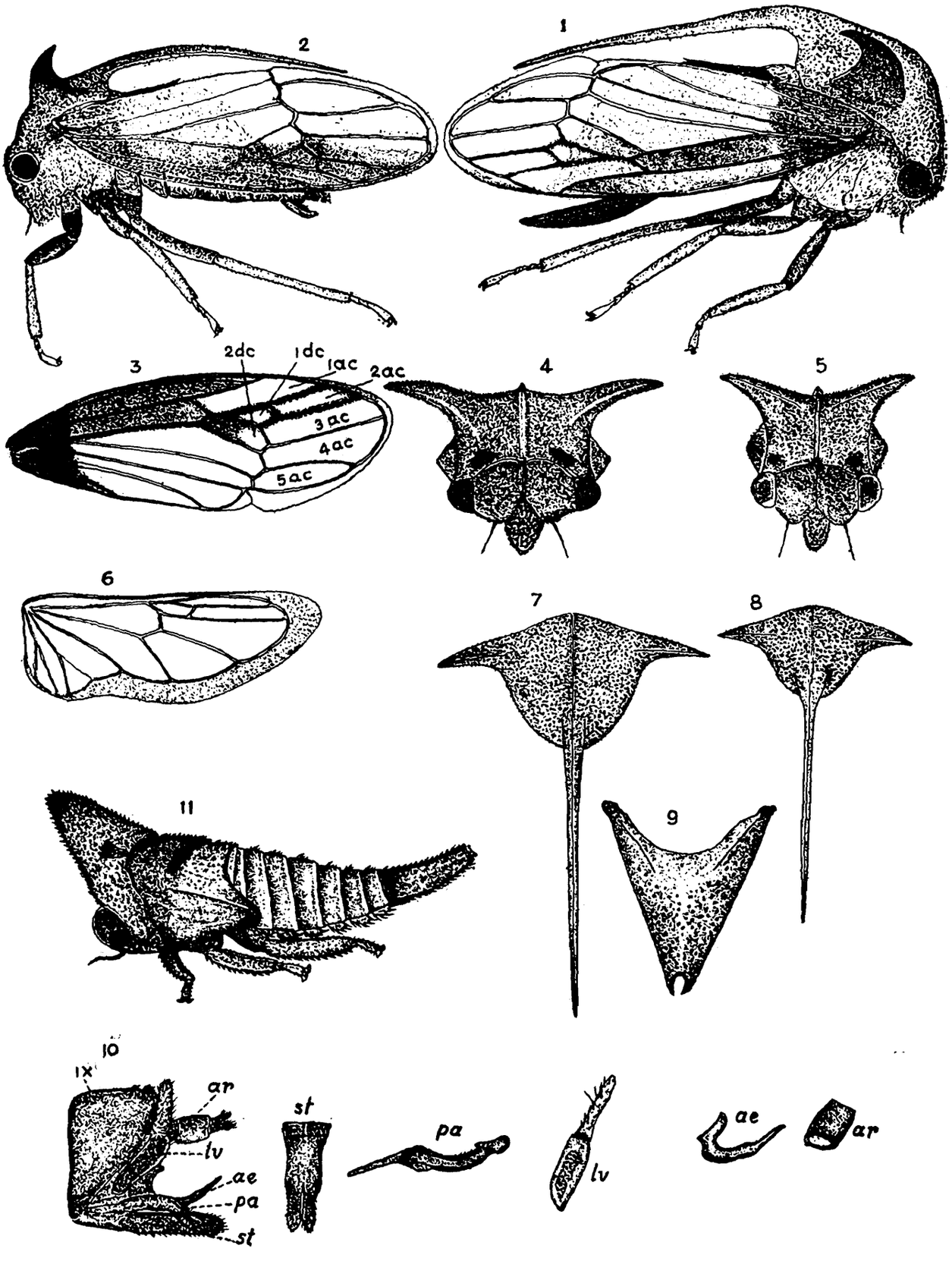
1869. *Leptobelus* Stål, *Ofv. Vet. Ak. Forh.* 284.
1908. *Telingana* Distant, *Fauna Brit. India*, **4**: 17.

Head vertical, two and a half to three times wider than long, upper margin of vertex slightly arcuate; eyes subglobate; ocelli closer to eyes than to each other and located on or above c-o-line; frontoclypeus extending two-thirds to three-fourths of its length below lower margins of vertex, tip broadly rounded, frontoclypeal lobes entirely fused; disc of pronotum not or slightly elevated; metopidium one and a half to two times wider than high; humeral angles prominent and blunt; suprahumeral horns variable; posterior process slender, tricarinate, emerging from posterior half of pronotum, moderately arcuate, distant from scutellum and tegmina, extending beyond apex of clavus, usually impinging on tegminal inner margins; scutellum much longer than broad, apex deeply excavated, tip acute; tegmina three times longer than wide, without pterostigma, with five apical cells, the first apical cell three to five times longer than broad; hind wings with four apical cells. Male genitalia almost similar to that of *Leptocentrus*, but differing in the lateral valves with the process very long and unchitinised.

Telingana nigroalata n.sp.

(Text-fig. 18)

Female.—General colour pitch black; head vertical, about 2.3 times as wide as long, black, lightly shaded to dark brown on genae, finely punctate with very short adpressed silvery white hairs; upper margin of vertex sinuate and weakly concave, lower margins broadly rounded at lateral angles; eyes black or dark brown, subglobate, ocelli black, somewhat elevated, slightly closer to eyes than to each other and located well above centro-ocular line; frontoclypeus nearlyr homboidal with two-thirds of its length extending below lower margins of vertex, lateral lobes entirely fused, tip obtusely rounded, fringed with pale white hairs. Pronotum shining black with shades of dark brown, thickly coarsely punctate, with rather sparse short adpressed silvery white hairs; metopidium almost vertical, twice as high as wide; supraocular callosities conspicuous, pitch black, bare; humeral angles concolorous with disc, tips blunt; disc convex at middle, distinctly punctate and sparsely hairy; suprahumeral horns shorter than intervening space, as seen from above slender, curved, weakly carinate just behind middle, apices acute, as viewed in front slender, long, gently recurved with strong carinae, as viewed laterally slightly directed upwards, then outwards with acute tips curved backwards; posterior process slender, curved and slightly elevated at base, remote from scutellum, declivous, slightly sinuate at middle, apex nearly acute, almost touching tegmina near posterior angle of inner margin but not impinging on them, tricarinate, dorsal carina strongly percurrent through pronotum. Tegmina 3 times longer than wide, with apical area shining ochraceous, subapical area somewhat stramineous, basal sixth black and coriaceous, the whole of costal



Text-fig. 18. *Telinguna nigroalata* n. sp.

1. Adult female. 2. Adult male. 3. Tegmina of female. 4. Frontal view of female. 5. Frontal view of male. 6. Hind wing. 7. Dorsal view of pronotum of female. 8. Dorsal view of pronotum of male. 9. Scutellum. 10. Male terminalia, lateral view.

margin, subcostal and basal areas, half of 2nd discoidal cell, and claval area jet black and strongly punctate, veins pale brown with the exception of R1, R2+3, R4+5, rs and 3rd anal cell which are black and finely punctate; hind wings with four apical cells; scutellum black except at bases, longer than wide, tip deeply excavated, lateral areas coarsely punctate; lateral margins of pronotum, sternum and dorsolateral areas of scutellum cretaceously sericeous; legs with coxae, trochanters, and femora jet black, tibiae of first and second pairs of legs more or less dark ochraceous, posterior tibiae very light brown, tarsi of all legs light brown. Abdomen black, ovipositor dark reddish brown.

Measurements.—Length from frontal margin to tips of tegmina 6.75 mm., to tip of posterior process 5.50 mm., width across tips of suprahumeral horns 3.9 mm., at humeral angles 2.5 mm., at eyes 2.0 mm.

Male.—Smaller; similar to female in general colour; suprahumeral horns shorter, directed more prominently upwards, slightly recurved with tips turned backwards; metopidium one and a half times as high as wide; posterior process not sinuate, obliquely directed backwards; its tip reaching the middle of fifth apical cell of tegmina; coloration of legs as in female.

Measurements.—Length from anterior pronotal margin to tips of tegmina 5.9 mm., to tip of posterior process 4.9 mm., width across tips of suprahumeral horns 2.7 mm., at humeral angles 2.3 mm., at eyes 1.75 mm.

Fifth instar nymph.—General coloration light green with shades of grey; legs with tibiae greyish brown; head inclined backwards, rostrum reaching metasternite; cranial tubercules obsolete; eyes prominent, black, ocelli obscure; length of thorax more or less equal to abdomen excluding anal tube; pronotal anterior process obliquely directed forwards, tip blunt, tuberculate spines on pronotal crest very short; posterior process short, about one-fifth as long as anterior process; suprahumeral buds prominent, dark brown, mesonotal process extending over basal half of metanotum; wing pads well developed reaching upto third abdominal segment, costal angles well demarcated; abdominal dorsal tubercles with their spines much reduced; latero-dorsal tubercles turned caudad; anal tube about one-fifth of the total body length and almost equal to the combined length of the four preceding segments.

Host plants.—*Agapanthus umbellatus.*

Holotype female; 205 female and 25 male paratypes, many nymphal instars, Kodaikanal, Madras, 16.vi.1968.

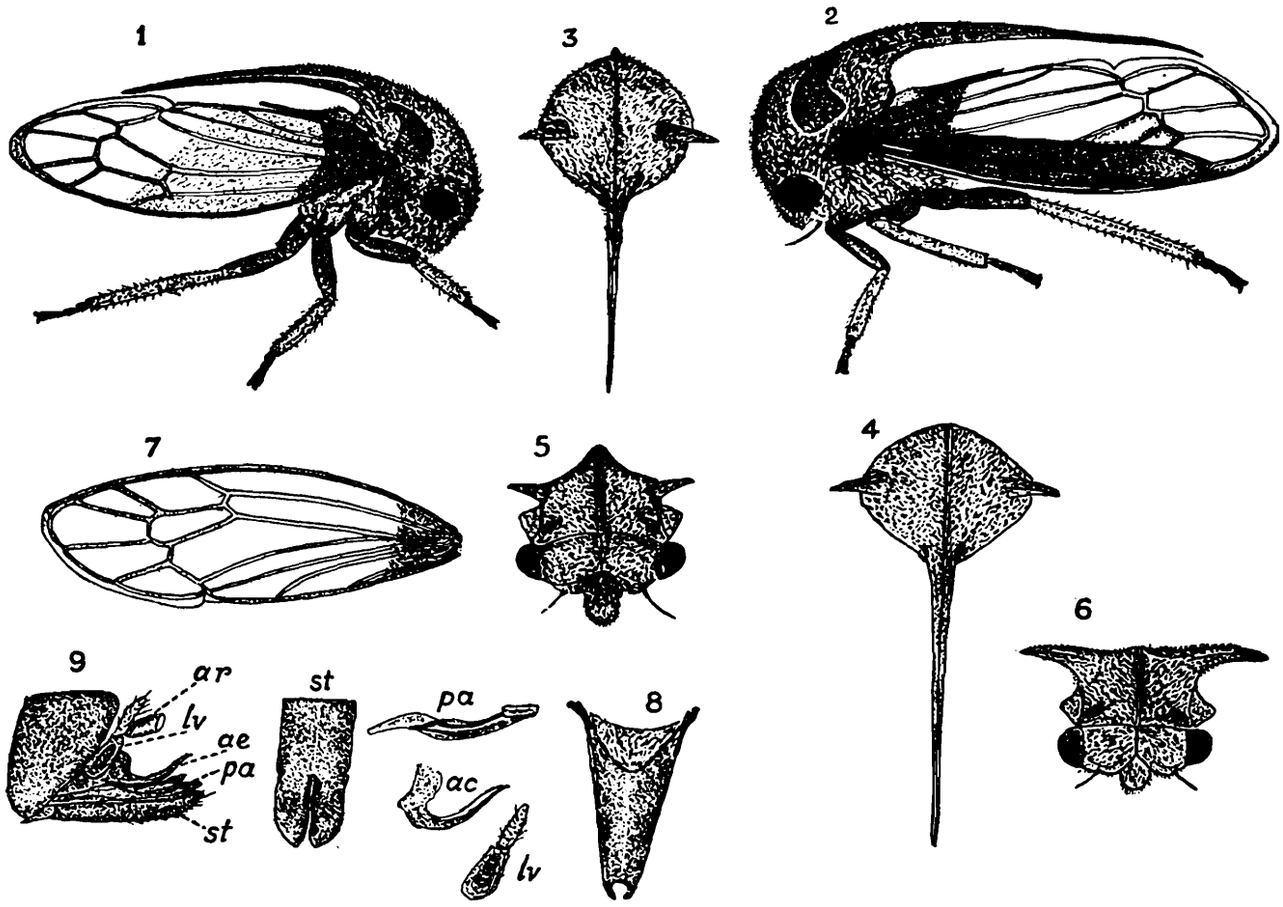
This species is very close to *curvispina* (Stål), differing in the tegminal coloration and the black finely punctate nature of R1, R2+3, R4+5 and 2nd discoidal cell.

Telingana consobrina Distant

(Text-fig. 19)

1916. Distant, *Fauna Brit. India, Append.* **6:** 152.

Distant's (1916) description and figures agree well to the males of this strikingly dimorphic species, the females closely resembling *T. nigroalata.* A more detailed description is given below.



Text-fig. 19. *Telingana consobrina* Distant

1. Adult male. 2. Adult female. 3. Dorsal view of pronotum of male. 4. Dorsal view of pronotum of female. 5. Frontal view of male. 6. Frontal of female. 7. Tegmina of male. 8. Scutellum of female. 9. Male terminalia, lateral view.

Male.—General colour black. Head nearly vertical, about thrice as wide as long, finely punctate, with short silvery hairs; upper margin of vertex sinuate, lower margins broadly rounded; eyes dark brown, ocelli shining white, nearer to eyes than from each other, located above c-o-line, frontoclypeus parallel sided, with two-thirds of its length extending below lower margins of vertex, lateral lobes entirely fused, tip broadly rounded. Pronotum black, often shaded to dark brown, coarsely punctate with sparsely distributed short whitish hairs; metopidium wider than high; strongly convex and obliquely extending backwards; humeral angles short, blunt, never projecting laterad beyond eyes; suprahumeral horns arising from about middle of disc, shorter than width between their bases, viewed from above short, slender, directed outwards and a little backwards, viewed from front much narrower, tips acute, directed slightly upwards. Posterior process obliquely raised from disc, very slender, tricarinate, tip acuminate impinging on tegmina, reaching the middle of 5th apical cell of tegmina, median carina strongly percurrent throughout metopidium, Tegmina hyaline, three times longer than wide, basal sixth coriaceous and ochraceous, veins reddish brown, apical veins darker, five apical cells and one dis-

coidal cell, first apical cell three times longer than wide, apical limbus narrow. Scutellum nearly one and three-fourths as long as wide, coarsely punctate; lateral areas of pronotum, sternum and basal lateral parts of scutellum cretaceously sericeous. Abdomen black beneath, dark ochraceous brown above.

Measurements.—Length from frontal margin to tips of tegmina 4.8 mm., to tip of posterior process 3.6 mm., width across tips of suprahumeral horns 2.0 mm., at humeral angles 1.7 mm., at eyes 1.8 mm.

Female.—General colour black; head about 2.5 times wider than long, punctate with silvery pilosity, base of vertex sinuate, lower margins very slightly rounded, eyes dark brown; ocelli black, closer to eyes than to each other and located slightly above centro-ocular line; frontoclypeus slightly convex, about two-thirds of its length extending below lower margins of vertex, lateral lobes fused, tip obtusely rounded, fringed with short whitish hairs. Pronotum black, shining, closely punctate, hairy; metopidium nearly vertical, supraocular callosities small but distinct, humeral angles short, not extending beyond eyes laterally, tips subacute; suprahumeral horns seen from above slender, shorter than the space between bases, directed outwards and backwards, apices acute; posterior process arising from hind end of disc, slightly sinuate beyond middle, turned downwards, passing over the entire length of 5th apical cell of tegmina. Tegmina shining ochraceous, a little more than three times longer than wide, basal fourth jet black and finely punctate, whole of costal margin, subcostal, basal and claval areas, basal three-fourths of 1st apical cell and veins bordering 1st discoidal cell jet black and finely punctate, 1st discoidal cell petiolate, 1st apical cell about three and a half times longer than wide; lateral areas of pronotum and sternum cretaceously sericeous. Legs fuscous upto base of tibiae, rest ochraceous; hind tibiae light brown. Abdomen black beneath, shaded to dark brown dorsally.

Measurements.—Length from frontal margin to tips of tegmina 6.4 mm., to tip of posterior process 5.3 mm., width across tips of suprahumeral horns 2.9 mm., at humeral angles 2.5 mm., at eyes 1.8 mm.

Fifth instar nymph.—Similar to the 5th instar of *nigroalata*, but smaller. General colour deep green; cranial tubercules distinct, small; ocelli invisible; tip of rostrum extending upto 2nd abdominal segment; thoracic tubercles short, each terminating in a stout spine; pronotal anterior process directed forwards, its tip broadly rounded; suprahumeral buds distinct; posterior process extending over basal of metanotum; costal angles of wing pads not distinctly demarcated; abdominal dorsal tubercles and lateral lamellae similar to those of *nigroalata*. Anal tube one-fifth of the total length of body.

The fifth instar of *consobrina* differs from that of *nigroalata* chiefly in the much reduced pronotal posterior process and in the nature of costal angles of tegminal wing pads which are not distinctly demarcated.

Host plant.—*Aspidium* sp.

Material studied: 10 females, 3 males and 12 nymphs, Kodaikanal, Madras, 16.vi.1967.

Genus **Otinotus** Buckton

(Type of genus *Otinotus ammon* Buckton)

1903. *Otinotus* Buckton, *Mon. Memb.*, 232, 269.

1927. *Convector* Fuankhouser, *Gen. Cat. Hom. Fasc.* 1: 348.

Head wider than long, upper margin of vertex shallowly arcuate and weakly sinuate, lower margins slightly oblique to frontoclypeus and weakly rounded or sinuate; ocelli nearly equidistant from each other and from eyes and located on the centro-ocular line or slightly above it; frontoclypeus about twice as long as wide, its lobes short; pronotum moderately high metopidium convex, humeral angles prominent; median carina percurrent; suprahumeral horns short or long, spatulate or subtriangular, tips acute or obliquely truncate, tricarinate or quadricarinate; posterior process emerging dorsally horizontally from behind disc and ventrally from posterior margin, tricarinate, weakly undulate and contiguous with or very close to scutellum and tegmina; scutellum triangular, wider than long, tip concavely emarginate; tegmina about three times as long as wide, without pterostigma, with five apical and two discoidal cells, the first apical cell four to eight times as long as its greatest width; hind wings with 4 apical cells.

Key to species

1(4) Suprahumerals unicarinate above, tips acute; tegmina not pubescent, second discoidal cell slightly longer than first discodial cell; male genitalia, with process of lateral valve rudimentary; ocelli located above c-o-l.

2(3) Piceous brown; suprahumerals directed obliquely forward; tegmina pale testaceous hyaline, base without a white spot, first apical cell 7 times longer than wide; tip of posterior process extending far beyond fifth apical cell. .*oneratus* (Walker).

3(2) Castaneous brown; suprahumerals subhorizontal, tegmina shining ochraceous, base enclosing a large white spot, first apical cell four and half times as long as wide; tip of posterior process never extending beyond fifth apical cell. .*mimicus* Distant.

4(1) Suprahumerals bicarinate above, tips obliquely truncate; tegmina ferruginous, pubescent, second discoidal cell twice or more as long as 1st discoidal cell; malegenitalia, with process of lateral valve long and prominent; ocelli located on c-o-l.

5(6) Suprahumerals subhorizontal, as long as space between bases..*indicatus* (Melichar).

6(5) Suprahumerals directed obliquely forward, slightly longer than space between bases. ... ..*obliquus* n.sp.

Otinotus oneratus (Walker)

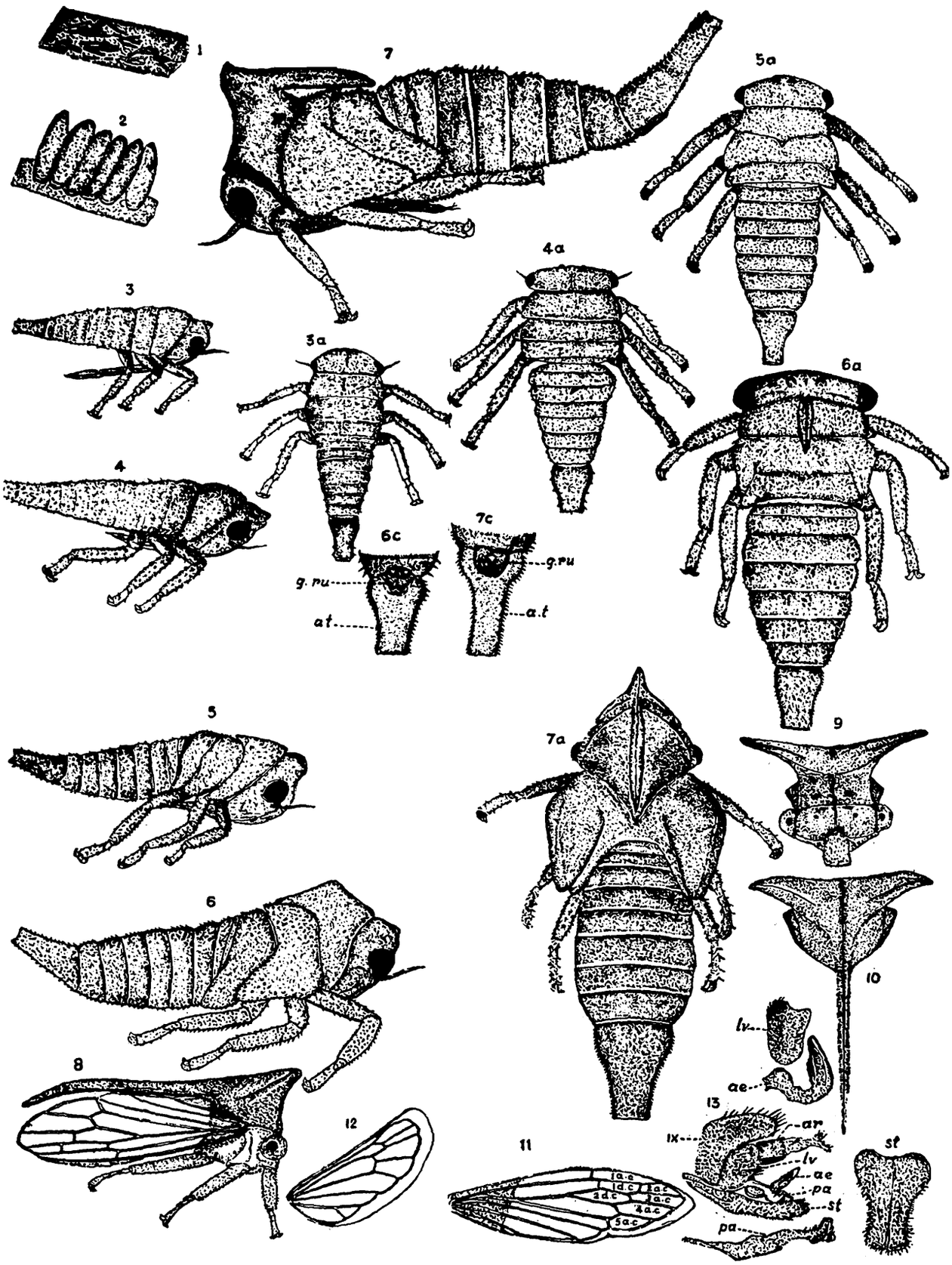
(Text-fig. 20)

1858. *Centrotus oneratus* Walker, *Ins. Saund. Hom.*: 78.

1869. *Centrotypus oneratus:* Stål, *Ofv. Vry.-Ak. Forh.*: 256.

1903. *Oxyrhachis lignicola* Buckton, *Monogr. Membr.*: 261.

1908. *Otinotus oneratus:* Distant, *Fauna Brit. India*, **4**: 40.



Text-fig. 20. *Otinotus oneratus* (Walker)

1. Egg masses on host stem. 2. An egg mass. 3. First instar nymph, lateral view. 3a. First instar nymph, dorsal view. 4. Second instar, lateral view. 4a. Second instar, dorsal view. 5. Third instar, lateral view. 5a. Third instar, dorsal view. 6. Fourth instar, lateral view. 6a. Fourth instar, dorsal view. 7. Fifth instar, lateral view. 7a. Fifth instar, dorsal view. 8. Adult female. 9. Frontal view of female. 10. Dorsal view of pronotum. 11. Tegmina. 12. Hind wing. 13. Male terminalia, lateral view.

Female.—General colour castaneous brown, varying to brownish ochraceous in some specimens; head finely punctate, greyish pilose, nearly thrice as wide across extremities of eyes as length of vertex; vertex nearly twice as wide as long, base of vertex shallowly arcuate, lower margins oblique to frontoclypeus; eyes hemispherical, reddish brown; ocelli a little elevated, almost equidistant from each other and from eyes and located just above centro-ocular line; frontoclypeus twice as long as wide, sides parallel, distal half projecting beyond lower margins of vertex, tip truncate, longly pilose, basal lobes small, indistinct; pronotum dark brown, with short adpressed hairs; metopidium slightly convex, twice as wide as high, humeral angles broadly conical, tips obtuse, posterior angles rounded; supraocular callosities black, bare; suprahumeral horns longer than space between bases, viewed from above centrally carinate, flattened, basal areas of horns darker, thickly pilose, viewed from front appearing slender, gradually narrowing from base to apex, turned outwards and obliquely forwards, tips slightly recurved; posterior process slender, gradually narrowing from base to apex, turned outwards arising from posterior margin of disc, tricarinate, weakly sinuate, almost contiguous with scutellum and impinging on inner margins of tegmina, in some specimens posterior half slightly elevated over tegmina, apex sharp and extending beyond fifth apical cell of tegmina; dorsal carina of posterior process strongly percurrent through metopidium, lateral carinae weak; tegmina thrice as long as wide, pale semi-hyaline, basal sixth opaque and punctate, first apical cell seven times longer than its greatest width, second discoidal cell slightly longer than first discoidal cell; hind wings with four apical cells; scutellum slightly broader than wide, tip emarginate, apices acute; lateral areas of scutellum and sternum cretaceously sericeous; abdomen dark brown; legs dark brown upto distal half of femora, tibiae light brown, tarsi pale white.

Measurements.—Length from frontal margin to tips of tegmina 5.5-7.0 mm., to tip of posterior process 5.0-6.3 mm., width across tips of suprahumerals 2.9-3.5 mm., at humeral angles 2.2-2.4 mm., at eyes 2.0-2.2 mm.

Male.—Smaller; general coloration greyish brown; suprahumeral horns longer, more divergent, apical region more strongly recurved, tips acute; abdomen slender and gradually tapering; genitalia, with sternal plate forked at distal half, lobes distinct, base nearly twice as broad as tip; aedeagus U-shaped, tip obtusely rounded, inner margin strongly serrate, the teeth arranged in 4 rows; lateral valves oblong, about 1.75 times longer than broad, process reduced to a short strongly chitinised stump; parameres similar to those of *Leptocentrus*.

Fifth instar nymph.—Body laterally compressed; general coloration reddish-brown, but variable, rarely light green; head concealed from above by pronotal process, twice as wide as long, base of vertex sinuate, cranial tubercules obsolete; ocelli closer to eyes than to each other and located slightly above centro-ocular line; rostral tip extending a little beyond middle of metathorax; metopidium receding, then curving forwards into the pronotal crest; pronotal posterior process tricarinate, emerging from base of crest; and extending over three-fourths the length of mesonotum, median carina percurrent through anterior process

which is short, about one-fourth as long as posterior process; suprahumeral buds marked off as rounded prominences; mesonotum subquadrate, wing pads extending backwards upto the posterior margin of 2nd abdominal segment; costal angles obtuse; abdominal tergites sparsely hairy, anal segment about one-fourth as long as body, with closely set bristles; genital rudiments distinct in both sexes.

Host plants.—*Prosopis spicigera, Acacia arabica, Cestrum diurnum, Zizyphus jujuba, Bauhinia variegata, B. purpurea, Erythrina indica, Capparis sepiaria, Cassia angustifolia, Cassia fistula, Cassia marginata, Caesalpinia pulcherrima, C. coriaria, Peltophorum* sp., *Psidium guajava, Tamarindus indicus, Pongamia glabra, Butea frondosa, Enterolobium saman, Pithecolobium dulce, Aegle marmelos, Feronia elephantum, Morinda tinctoria, M. citrifolia, Moringa moringa, Thespesia populneu, Sesbania grandiflora, Lagerstroemia flosreginae, Terminalia catappa, Lawsonia alba, Crotalaria* sp., *Solanum torvum, Casuarina equisetifolia,* Prop roots of *Fiscus bengalensis.*

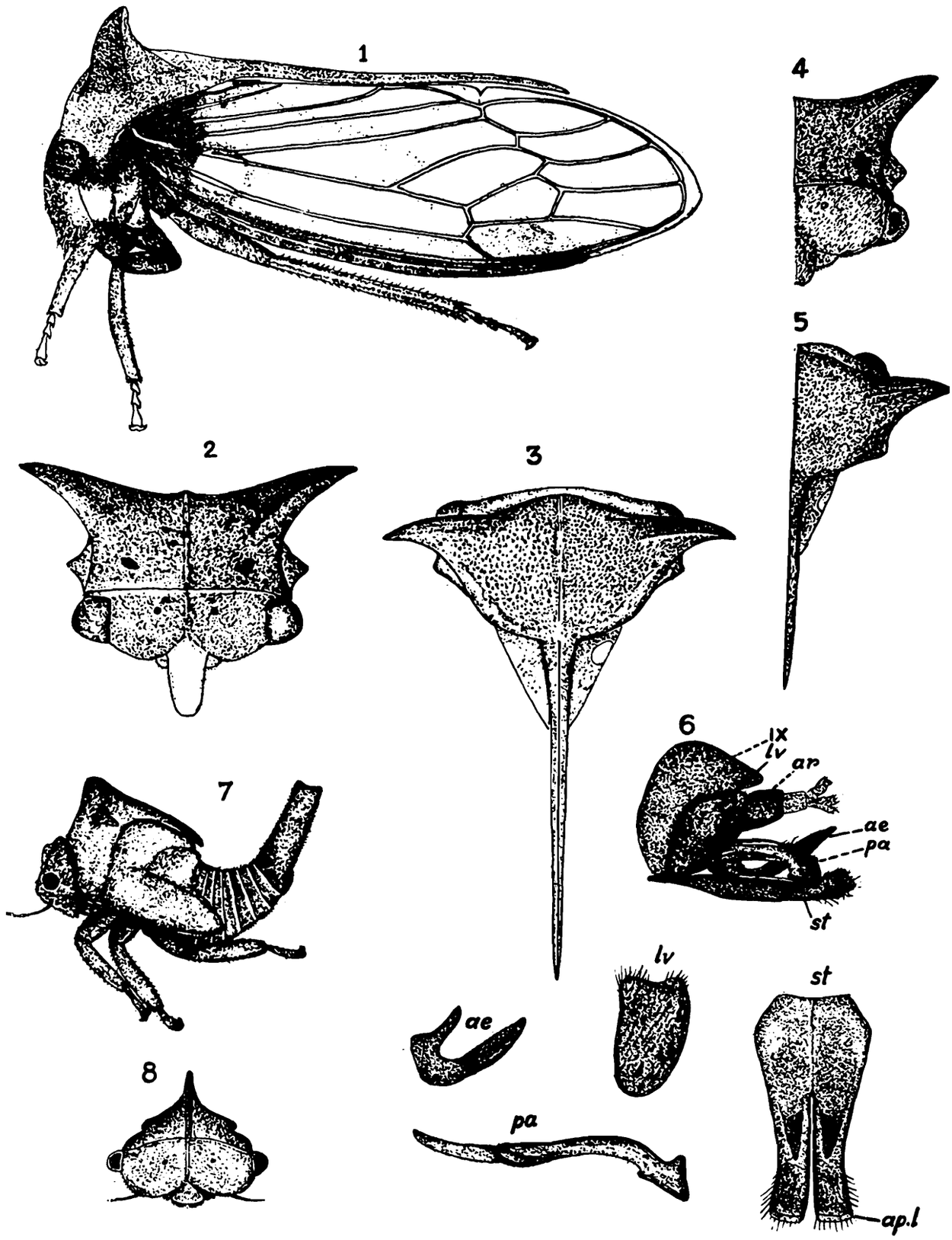
Material studied.—170 females, 80 males and numerous nymphs of all stages, Madras, different dates during the years 1964-67.

Otinotus mimicus Distant

(Text-fig. 21)

1916. *Otinotus mimicus* Distant, *Fauna Brit. India, Append.* **6**: 159.

Female.—General coloration dark reddish brown; head dark brown, slightly declivous, about 3.5 times wider than long, very finely punctate with short adpressed shining white hairs, upper margin almost planate, lower margins obliquely sloping to frontoclypeus; eyes dull white, subglobate, ocelli pale white, almost equidistant from each other and from eyes, and located slightly above centro-ocular line; frontoclypeus extending about three-fourths its length below lower margins of vertex, distinctly lobate at base, tip broadly rounded and sparsely pilose with short adpressed silvery hairs; median carina moderately percurrent; metopidium nearly twice as wide as high, frontal margin not obumbrant; supraocular callosities impunctate, rather inconspicuous; humeral angles prominent with tips blunt; suprahumeral horns short and stout, much shorter than space between their bases, seen from front directed outwards and slightly upwards, terminal region curving a little backwards, anterior carina strongly backwardly curved, apex sharply acute, seen from above dorsal carina weak; posterior process slender, arising from posterior margin of pronotum, slightly raised above base of scutellum, directed backwards, sinuate, apically acuminate, contiguous with inner margins of tegmina, tip sharp and extending along approximately two-thirds of the length of fifth apical cell; scutellum triangular, dark reddish brown with a prominent white spot in each basal angle, wider than long, tip emarginate, apices acute; tegmina nearly three times as long as wide, pale shining ochraceous, basal region dark brown, coriaceous and punctate enclosing a large white spot, veins yellowish brown, apical limbus narrow, first apical cell about 4.5 times longer than wide; hind wings with four apical cells; lateral areas of sternum with confluent white spots; legs dark brown, tibiae yellowish brown, tarsi with black dots,



Text-fig. 21. *Otinotus mimicus* Distant

1. Adult female. 2. Frontal view of female. 3. Dorsal view of pronotum and scutellum of female. 4. Frontal view of male (right half). 5. Dorsal view and scutellum of male (right half). 6. Male genitalia, lateral view. 7. Fifth instar. 8. Frontal view of fifth instar.

Measurements.—Length from frontal margin to tips of tegmina 8.0 mm., to tip of posterior process 6.2 mm., width across tips of suprahumeral horns 4.0 mm., across humeral angles 3.0 mm., across eyes 2.6 mm.

Male.—Smaller than female; suprahumerals shorter, about half as long as distance between their bases, tips less recurved; frontoclypeus with its distal half extending below lower margins of vertex; genitalia similar to *oneratus*.

Measurements.—Length from frontal margin to tips of tegmina 5.6 mm., to tip of posterior process 4.4 mm., width across tips of suprahumeral horns 2.8 mm., across humeral angles 2.4 mm., across eyes 2.3 mm.

Fifth nymphal instar.—General colour leafy green, pale white ventrally; head more than twice as broad as long, base of vertex planate, cranial tubercules short and blunt, each terminating in a slender bristle; frontoclypeus slightly extending beyond lower margins of vertex, its free end truncate, lobes on either side of clypeus distinct; eyes dark reddish brown, semiglobate; ocelli succineous, slightly closer to eyes than to each other and located on the centro-ocular line; length of thorax greater than the combined length of abdominal segments 1-8; metopidium convex, vertical; anterior process of dorsal crest inconspicuous; pronotal posterior process slender, tricarinate, contiguous with mesonotum, reaching just the posterior margin of metanotum, suprahumeral buds prominent with acute tips; wing pads large, extending upto the 4th abdominal segment; costal angles inconspicuous, a row of stout bristles on the costal margin; abdominal segments strongly telescoped; anal tube longer than rest of abdomen, strongly raised up; genital rudiments very distinct.

Host plant.—*Artocarpus integrifolia.*

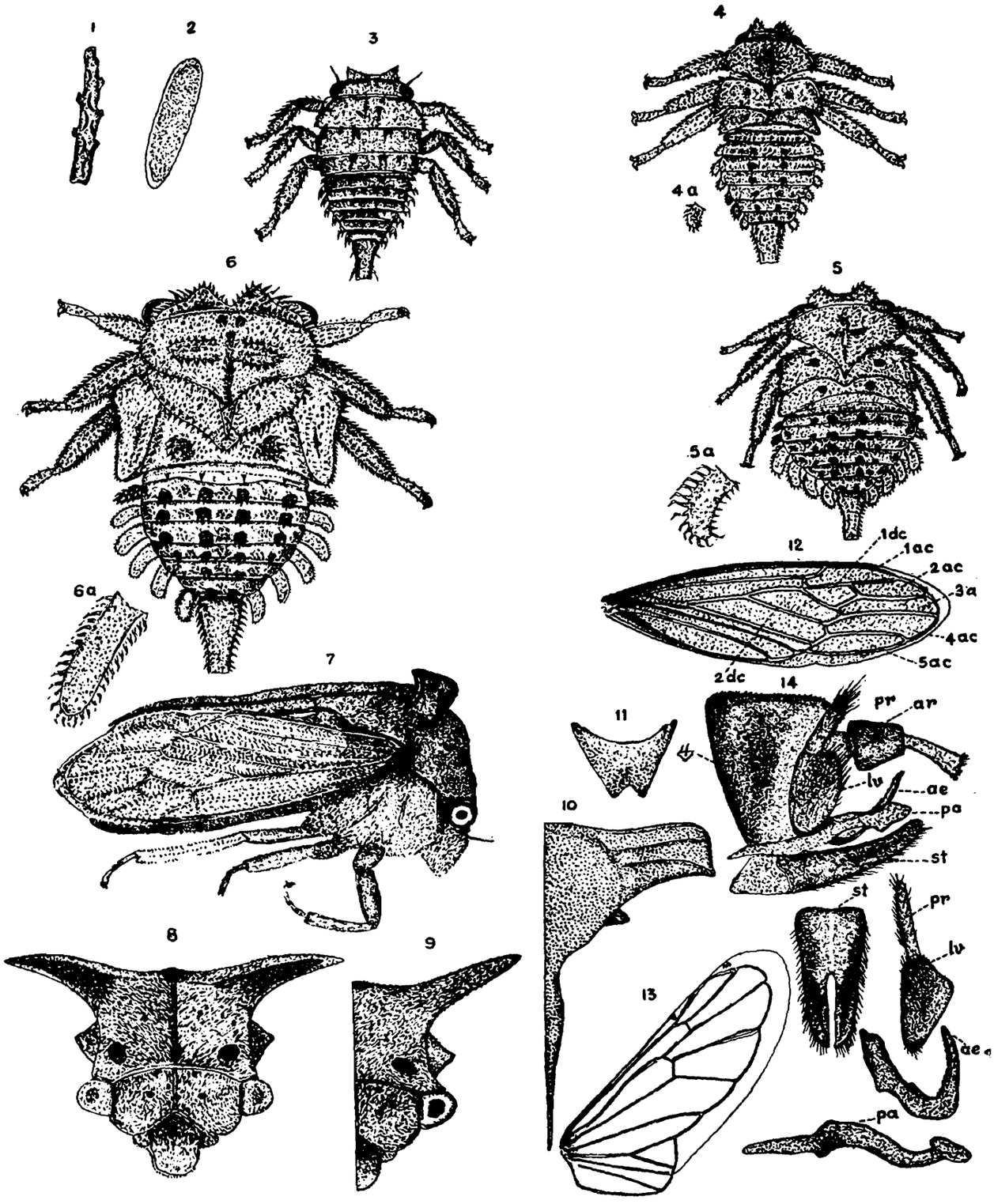
Material studied.—10 females, 6 males and 35 nymphal instars, Madras, 30.viii.1968.

Otinotus indicatus (Melichar) comb. nov.

(Text-fig. 22)

1903. *Centrotus indicatus* Melichar, *Hom. Faun. Ceylon,*: 111.

Female.—General colour dark reddish brown; head thickly ochraceously pilose, thrice as wide as long; upper margin of vertex shallowly arcuate, lower margins obliquely sloping to frontoclypeus; eyes hemispherical, somewhat elongately globate, reddish brown; ocelli black, closer to eyes than to each other and located on the centro-ocular line; cranial callosities a little elevated; frontoclypeus ochraceously pilose with long sparse hairs, slightly longer than broad, extending about three-fourths its length below lower margins of vertex, tip broadly rounded, basal lobes prominent; pronotum reddish brown, coarsely punctate, sparsely pilose; metopidium vertical, slightly convex, nearly twice as wide as high, supra-ocular callosities prominent, humeral angles broadly conical, posterior angles rounded; suprahumeral horns chest-



Text-fig. 22. *Otinotus indicatus* (Melichar) comb. nov.

1. Egg-slits on host stem. 2. An egg. 3. First instar. 4. Second instar. 4a. Abdominal lateral lamella of second instar. 5. Fourth instar. 5a. Lateral lamella of Fourth instar. 6. Fifth instar. 6a. Lateral lamella of fifth instar. 7. Adult female. 8. Frontal view of female. 9. Frontal view of male. 10. Dorsal view of pronotum of male (left half). 11. Scutellum. 12. Tegmina. 13. Hind wing. 14. Male terminalia, lateral view.

nut brown, as long as space between their bases, as viewed from lateral aspect obliquely raised upwards and outwards with apices obliquely truncate, as viewed from above somewhat broad and bicarinate, as viewed from the front much narrower with their apices nearly acute; posterior process tricarinate, slightly elevated from base of scutellum, then sinuate, contiguous with inner margins of tegmina, apical region acuminate, apex passing over three-fourths of the length of fifth apical cell, dorsal carination percurrent through metopidium, lateral carinae weak; tegmina ferruginous, pubescent, thrice as long as wide, basal sixth punctate, dark brown and opaque, veins reddish brown, first apical cell about four times as long as broad, second discoidal cell much smaller than first discoidal cell; hind wings with four apical cells; scutellum broader than long; lateral areas of sternum and a spot on each side of base of scutellum greyish ochraceous; abdomen black, without distinguishing characters.

Measurements.—Length from frontal margin to tips of tegmina 6.0-7.0, mm., to tip of posterior process 5.0-5.8 mm., width across tips of suprahumerals 5.0-5.5 mm., at humeral angles 2.75-3.25 mm., at eyes 2.5-3.0 mm.

Male.—Similar to female. Genitalia with sternal plate, black distal half divided, pubescent, lobes inconspicuous; lateral valves wedge-shaped, punctate, processes very prominent, as long as or slightly longer than main body; aedeagus U-shaped, finely serrate on inner margin; parameres as in *Leptocentrus.*

Measurements.—Length from frontal margin to tips of tegmina 5.7 mm., to tip of posterior process 4.8-5.6 mm., width across tips of suprahumerals 4.7-5.25 mm., at humeral angles 2.5-3.0 mm., at eyes 2.5-3.0 mm.

Fifth nymphal instar.—General colour greyish dorsally, light green ventrally; head about twice as wide as long, cranial tubercules very conspicuous, 0.3 mm. long and 1 mm. wide at base, bordered by small tuberculate spines; tip subacute; eyes nearly reniform, projecting outwards and backwards, dark brown; ocelli nearer to eyes than from each other and located on the c-o-line; upper margin of vertex strongly sinuate, emarginate, set with tuberculate spines, lower margins obliquely sloping to frontoclypeus; rostrum 1.5 mm. long. extending upto the middle of 2nd abdominal segment; thorax as wide as long, metopidium nearly vertical, median carina of dorsal process percurrent and bearing closely set spines; a prominent lateral tuberculated ridge on either side of median carina; pronotal posterior process extending over a little more than half the length of mesonotum, tip bluntly acute; suprahumeral buds black, spinous; mesonotal process reaching three-fourths of length of metanotum; lateral tubercles large,bearing clusters of spines on meso- and metathoracic tergites; wing pads greyish brown, costal angles prominent; tibiae more or less flattened, fringed with bent bristles. Abdomen nearly one and a half times longer than thorax, attaining its maximum width at 4th abdominal segment; anal tube stout, short, one-fifth as long as body, abdominal segments 3-7 with ferruginuus dorsal and dorso-lateral tubercles; each dorsal tubercle tipped with 3 short stout spines, each dorso-lateral tubercle tipped with

one or two spines; 8th abdominal segment with a single pair of tubercles; lateral lamellae of 3rd segment dark brown, smaller than those of 4th segment; lamellae of segments 5 to 8 uniform, light yellowish, flattened and gently curved, each lamella measuring 0.75 mm. long, bordered with 22-27 bent spines mounted on short tubercles; smaller spines scattered over lamellae; extreme bases of lateral lamellae with a cluster of microsetae.

Host plants.—*Thespesia populnea, Syzygium jambolanum, Tecoma stans.*

Material studied.—68 females, 24 males, 18 nymphal instars., Madras, 20.xii.1966.

Otinotus obliquus n.sp.

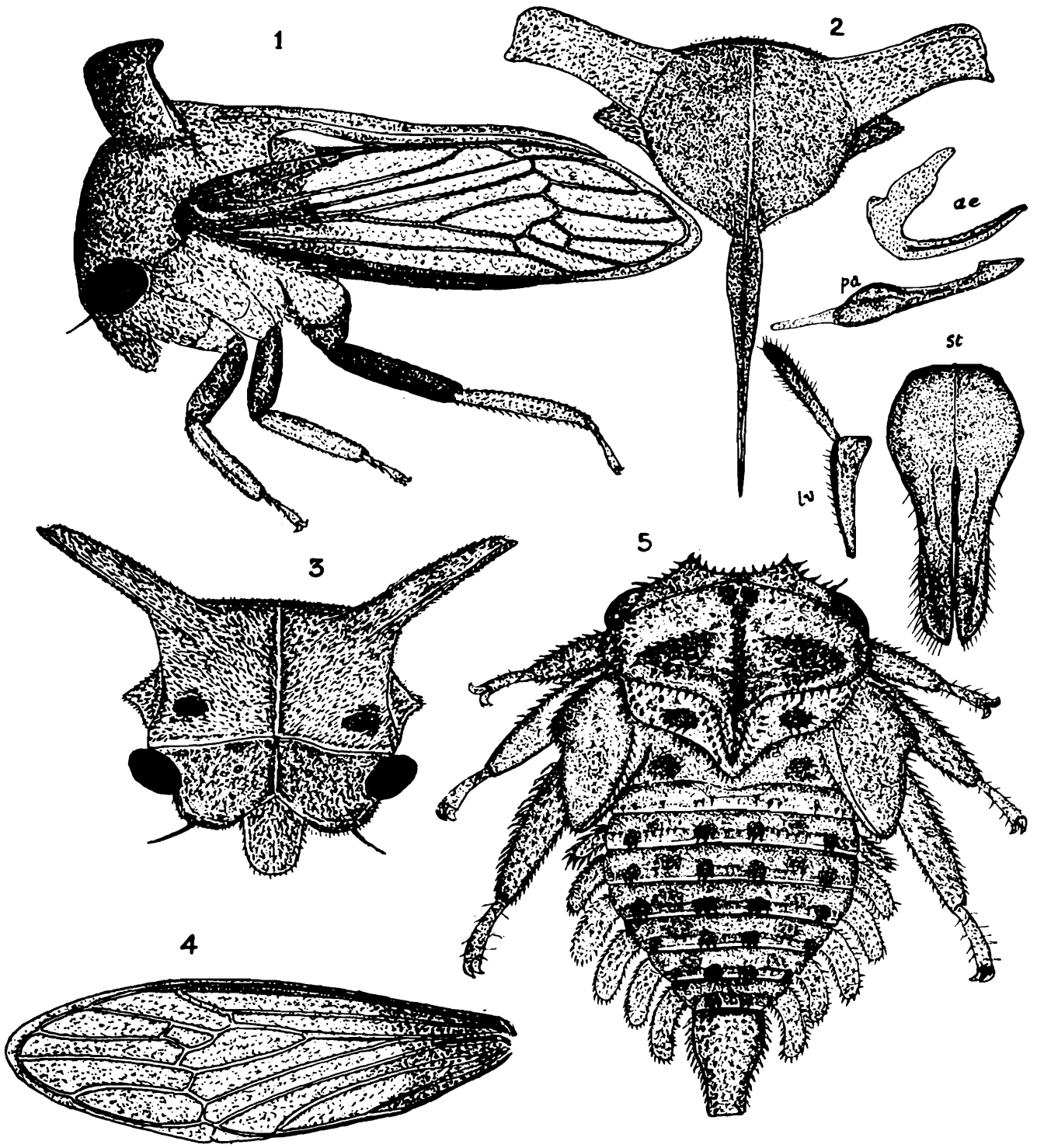
(Text-fig. 23)

Female.—General colour dark brown; head three times wider than long, finely punctate, with long greyish white hairs; upper margin of vertex moderately arcuate and sinuate, lower margins gradually sloping to frontoclypeus; eyes dark brown, ovate, obliquely directed laterad; ocelli small, slightly closer to eyes than to each other and situated on centro-ocular line; frontoclypeus slightly longer than wide at base with three-fourths of its length extending downwards below lower margins of vertex, longly pilose, tip broadly rounded; pronotum finely punctate with short adpressed hairs; metopidium convex in front, vertical, one and a half times as wide as high; supraocular callosities conspicuous; humeral angles prominent, densely hairy, tips subacute; suprahumeral horns dark reddish brown, slightly longer than space between bases, as viewed from lateral aspect obliquely directed upwards and forwards, tips strongly recurved and obliquely truncate, as seen from above much flattened and weakly bicarinate, as viewed from the front much narrower with anterior carinae closer to posterior margin, apices somewhat subacute; posterior process slender, emerging from posterior region of disc, distinctly separated at base from scutellum, then contiguous with inner margins of tegmina, moderately sinuate towards middle, apex passing over half the length of fifth apical cell, tip acute, lateral carinae weak, dorsal carina strongly percurrent through metopidium; tegmina three times as long as wide, dark reddish brown, wrinkled, pubescent, costal margin dark brown, veins castaneous, basal region dark brown and punctate, first apical cell four and a half times longer than its greatest width, second discoidal cell about one-third as long as first discoidal cell, apical limbus narrow; hind wings with 4 apical cells; scutellum triangular, as wide as long; lateral areas of sternum greyish ochraceous; legs black as far as femora, tibiae castaneous, tarsi light brown.

Measurements.—Length from frontal margin to tips of tegmina 8 mm., to tip of posterior process 7.0 mm., width across tips of suprahumeral horns 7.0 mm., at humeral angles 3.4 mm., at eyes 3.2 mm.

Male.—Similar to female, slightly smaller; genitalia similar to *indicatus*, but lateral valves much narrow.

Measurements.—Length from frontal margins to tips of tegmina 7.0 mm., to tip of posterior process 5.6 mm., width across tips of suprahumeral horns 5.3 mm., at humeral angles 3.2 mm., at eyes 3.0 mm.



Text-fig. 23. *Otinotus obliquus* n.sp.

1. Female, adult. 2. Dorsal view of pronotum. 3. Frontal view of female. 4. Tegmina. 5. Fifth instar, dorsal view. st, sternal plate ; pa, paramere ; ae, aedeagus ; lv, lateral valve

Fifth nymphal instar.—General coloration brown with shades of green; closely resembling the fifth instar nymph of *indicatus*, but slightly larger size; tegminal wing pads much broader, abdominal lateral lamellae larger, with the bordering spines shorter and more numerous.

Measurements.—Length from frontal margin to tip of anal tube 6.6 mm., length of anal tube 1.2 mm., length of thorax 2.7 mm., length of abdomen including anal tube 3.9 mm., width of abdomen across 4th segment 2.9 mm., width of thorax 2.7 mm., width of head across eyes 2.6 mm., length 1.5 mm., length of rostrum 1.6 mm., length of tegminal wing pad 1.7 mm., width 0.8 mm., length of lateral lamella 0.9 mm.

Host plants —Trewis nudiflora, Phyllanthus sp., *Premna latifolia.*

Holotype female; 4 female and 11 male paratypes, 6 nepionotypes, Madras, 10.ix.1967.

The species is nearest to *indicatus* from which it differs in the more obliquely forwardly directed suprahumerals which are longer than the width between their bases.

Key to species of **Otinotus** Buckton *based on Fifth instar nymph*

1(4) Body devoid of tuberculate spines and lamellae.

2(3) Reddish brown or shining black; suprahumeral buds short, with tips broadly rounded; wing pads extending upto 2nd abdominal segment; abdominal segments not telescoped; anal tube about one-fourth as long as body, not raised up. .*oneratus* (Walker).

3(2) Leafy green; suprahumeral buds prominent with tips acute; wing pads extending upto 4th abdominal segment; abdominal segments strongly telescoped; anal tube slightly more than one-third as long as body, strongly raised up..... .*mimicus* Distant.

4(1) Body equipped with well developed tuberculate spines and long, frondulose lamellae bearing bent spines.

5(6) General coloration greyish; wing pads somewhat narrow; anal tube about one-fourth as long as body.. . .*indicatus* (Melichar).

6(5) General coloration brown with shades of green; wing pads broad; anal tube about one-sixth as long as body.. . . .*obliquus* n.sp.

Tribe **Centrotini** Goding, 1892

The *Centrotini* is separated from the *Leptocentrini* by the presence of three apical cells in the hind wing; a distinct pterostigma may be present or absent; the fronto-clypeal lobes are either partially or completely fused to the frontoclypeus on their inner margins and are not prominent; the scutellum is normal and exposed.

Genus **Tricentrus** Stål

(Type of genus *Tricentrus convergens* Walker)

1866. *Tricentrus* Stal, *Hem. Afr.* **4:** 89.

1905. *Taloipa* Buckton, *Trans. Linn. Soc. London, Zool.* (2) **9:** 334.

1912. *Centrotus* Matsumura, *Annot. Zool. Japan,* **8:** 90.

Small to moderately large; body robust, ovate or oblong-ovate; head about three times wider than long, obliquely directed backwards,

upper margin of vertex shallowly arcuate and sinuate; lower margins gradually sloping to frontoclypeus; eyes subglobate; ocelli nearer to eyes than to each other and situated above centro-ocular line; frontoclypeus oval or subovate, frontoclypeal lobes almost fused and inconspicuous; rostrum stout, reaching middle of hind coxae, mandibular stylets recurved at tip. Pronotum with posterior process longer than broad; metopidium vertical or sloping; humeral angles prominent, tips subacute or blunt; suprahumeral horns moderately long or short, aborted or totally absent; posterior process moderately short, contiguous with scutellum, tip not reaching or slightly passing apex of clavus, tricarinate, dorsal carina percurrent, often obsolete anteriorly; tegmina about thrice as long as wide, with or without a distinct pterostigma, with five apical cells and two discoidal cells, apical limbus moderately broad; hind wings with three apical cells; scutellum as wide as long, concavely emarginate, apices acute; hind trochanters elevated into a disc inwardly, armed with spines. Male genitalia, with sternal plate cleaved to about one-third its length from apex; lateral valves triangular, processes short, nodular, weakly chitinised, fringed with long slender bristles; aedeagus U-shaped with inner margin finely serrate; parameres straight, weakly chitinised, apex recurved, tip acute.

Key to South Indian species of **Tricentrus**

1(8) Suprahumerals present.

2(5) Suprahumerals projecting forward, about three-fourths as long as width between bases; apex of posterior process impinging on tegmina.

3(4) Dark purplish; apices of suprahumerals subacute; posterior process unicarinate, its basal half normal, apical half straight; tegmina purplish brown, veins fringed with long hairs; lateral areas of sternum white tomentose.. .*purpureus* n.sp.

4(3) Brown; apices of suprahumerals sub-obliquely truncate, posterior process tricarinate, its basal half heavy, laminate, apical half attenuate, slightly arched; tegmina pale bronzy brown; lateral area of sternum pale brown. .*congestus* (Walk,).

5(2) Suprahumerals not projecting forward, about one-third as long as width between bases; apex of posterior process not impinging on tegmina.

6(7) Moderately large brown species; pronotum pilose; suprahumerals variable; apex of posterior process brown, projecting backwards behind clavus; tegmina pale bronzy brown, base opaque, followed by a broad yellow patch. *pilosus* n.sp.

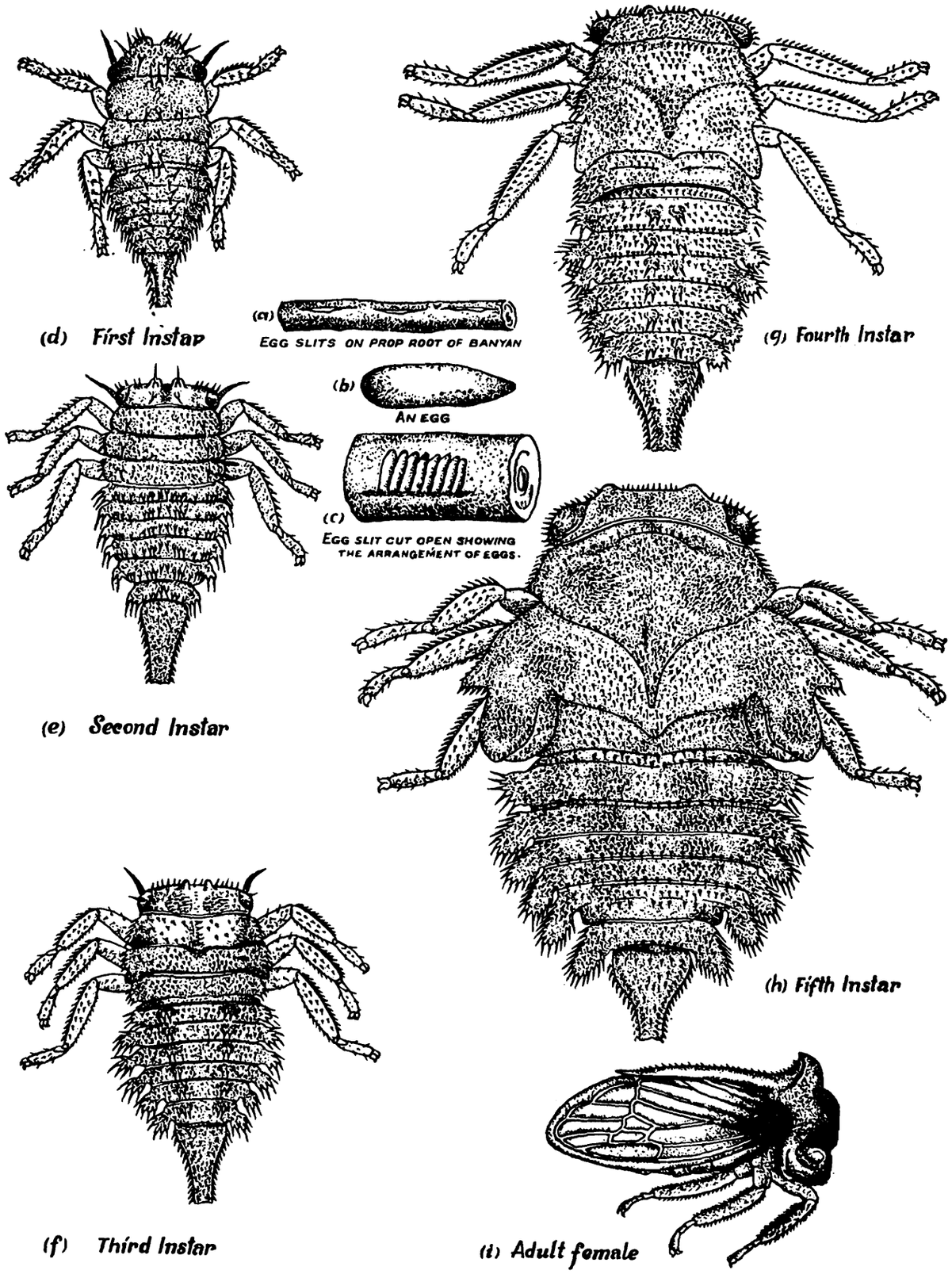
7(6) Small, black species; pronotum finely pilose; suprahumerals not variable; apex of posterior process black, extreme tip upcurved; tegmina dull bronzy subhyaline, base black, yellow patch inconspicuous in some, or absent.. .*albomaculatus* Distant.

8(1) Suprahumerals absent; pronotum dark brown, finely punctate.. *decornis* n.sp.

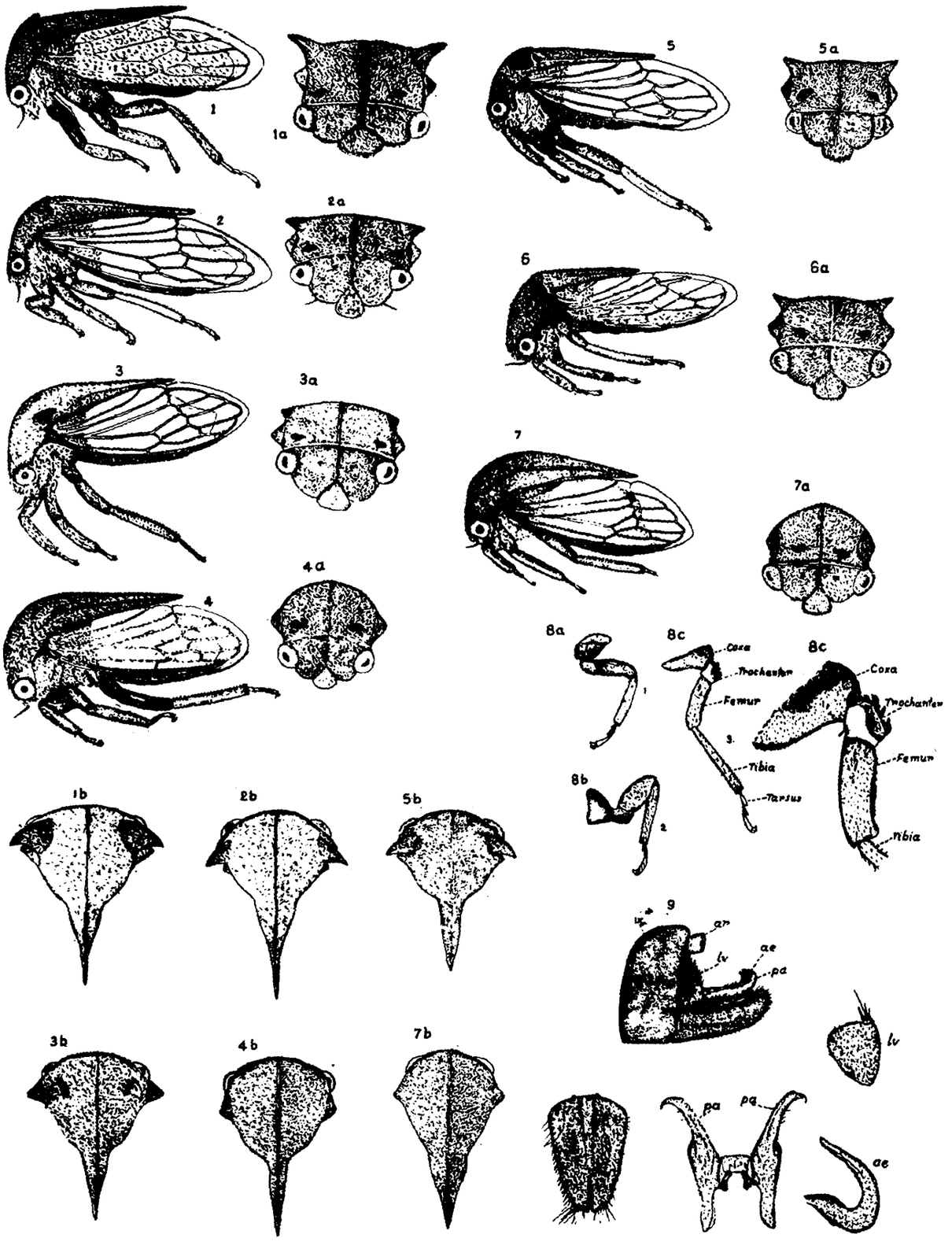
Tricentrus pilosus n.sp.

(Text-figs. 24 & 25)

Female.—General coloration brown; head nearly thrice as wide as long, obliquely directed backwards, longly pilose with silvery hairs;



Text-fig. 24. *Tricentrus pilosus* n. sp.



Text-fig. 25. *Polymorphic forms in Tricentrus pilosus* n. sp.

1. Female with normal horns; 1a. Its frontal view; 1b. 2. Female with reduced horns; 2a. Its frontal view; 2b. 3. Female with aborted horns; 3a. Its frontal view; 3b. 4. Female with no horns; 4a. Its frontal view; 4b. 5. Male with reduced horns; 5a. Its frontal view; 5b. 6. Male with aborted horns; 6a. Its frontal view; 7. Male with no horns; 7a. Its frontal view; 7b. 8a. Foreleg; 8b. Middle leg; 8c. Hind leg showing spines. 9. Male genitalia, lateral view. lv, lateral valve; pa, ae, aedeagus.

upper margin of vertex slightly arcuate, sinuate; eyes dark brown, subglobate projecting outwards, with a central black spot. ocelli black, a little closer to eyes than to each other and located slightly above centro-ocular line; frontoclypeus longly sparsely pilose, subovate, extending about one-third its length below lower margins of vertex, tip broadly rounded and slightly convex. Pronotum light brown laterally, darker ventrally, finely punctate and densely pilose near bases of horns; metopidium almost vertical, wider than high, frontal margin less pilose not obumbrant, supraocular callosities black, punctate, prominent; humeral angles light brown, tips subacute with posterior margins rounded at lateral angles; suprahumeral horns about one-third as long as width between bases, obliquely directed upwards and outwards, then turned backwards, tips subacute, carinae weakly developed; posterior process stout, central and lateral carinations fine, central carination percurrent, extending through metopidium, sprinkled with shining silvery hairs, tip black, directed somewhat upwards, just reaching anal angle of tegmina, extreme tip not impining on tegmina; tegmina about three times as long as wide, hyaline, basal sixth coriaceous, punctate, dark brown, veins reddish brown, apical limbus normal; legs with trochanters and basal three-fourths of femora black, rest light reddish brown, hind trochanters prominently toothed on the dilated internal surface, inner margin of mid- and hind femora corrugated; abdomen dark brown, pubescent ventrally, ovipositor darker.

Measurements.—Length from frontal margin to tips of tegmina 6.0 mm., to tip of posterior process 4.2 mm., width across tips of suprahumerals 3.6 mm., at humeral angles 2.9 mm., at eyes 3.0 mm.

Male.—Similar to female, but slightly smaller and darker; suprahumeral horns shorter. Genitalia, with sternal plate black, turned upwards, split extending upto one-fourth the length of plate, lower surface pubescent; lateral valves broadly triangular, process of lateral valve bearing very long bristles; parameres with tips recurved, bearing a small subapical process visible from caudal aspect; connecting plate quadrangular, aedeagus finely serrate on inner margin.

Measurements.—Length from frontal margin to tips of tegmina 5.1 mm., to tip of posterior process 3.6 mm., width across tips of suprahumerals 2.4 mm., at humeral angles 2.5 mm., at eyes 2.5 mm.

This species is noted for its polymorphism with reference to the degree of development of suprahumeral horns. Females include four different types : 1. those with horns of normal size as described above; 2. those with short horns; 3. those with much aborted horns and 4. those with no horns. Males include three types: 1. those with short horns comparable to the females of the second type; 2. those with aborted horns, and 3. those with no horns (vide Table 1). Very rarely males with shorter posterior process not reaching the inner angle of tegmina are encountered. But for the presence of intergrading forms, extremes might be regarded as different species.

An analysis of the frequencies of occurrence of the above types of *Tricentrus pilosus* was made out of 5 samples of collections totalling 430. The results which are tabulated (Table 2) indicate that individuals

without horns form the majority, while females with normal horns constitute about one-fifth of the total number. Forms with short suprahumerals comprise about one-third, while aborted condition of suprahumerals is found to be very rare. It is noteworthy that in no male the suprahumerals are found to develop to the normal size.

TABLE 1

	Females				Males		
	I With normal horns	II With short horns	III With aborted horns	IV With no horns	I With short horns	II With aborted horns	III With no horns
Length from frontal margin to tips of tegmina in mm.	6.0	6.1	5.6	5.75	5.1	5.2	5.0
Length from frontal margin to tip of posterior process in mm.	4.2	4.4	3.9	3.75	3.1	3.5	3.6
Width across tips of suprahumeral horns in mm.	3.25	2.75	2.2	—	2.3	2.0	—
Width of disc across bases of suprahumeral horns in mm.	1.75	1.75	1.7	—	1.5	1.5	—
Width at humeral angles in mm.	3.0	2.8	2.7	2.65	2.3	2.4	2.6
Width across eyes in mm.	2.9	2.75	2.6	2.7	2.3	2.35	2.65
Length of suprahumeral horn in mm.	0.75	0.50	0.20	—	0.50	0.2	—

TABLE 2

Collection Number	Total number in each collection	Females				Males		
		With normal horns	With reduced horns	With aborted horns	With no horns	With short horns	With aborted horns	With no horns
1	85	15	16	4	15	8	1	26
2	87	19	20	5	18	10	—	15
3	85	15	17	3	10	14	2	24
4	83	20	18	5	10	8	3	19
5	90	19	18	4	9	13	—	27
Total	430	88	89	21	62	53	6	111
Percentage		20.5	20.7	5	14.4	12.3	1.4	26
Standard error of percentage		1.97%	1.95%	1.05%	1.69%	1.58%	0.57%	2.11%

Fifth instar nymph.—Body dorso-ventrally compressed. densely bristled; general coloration light reddish brown; head about 2.5 times as wide as long, cranial tubercles persistent as small conical projections, vertex truncate at base; eyes reniform, pale white; ocelli conspicuous, nearer to eyes than to each other and located on the centro-ocular line; frontoclypeal tip slightly extending beyond lower margins of vertex; rostrum reaching the hind coxae. Thorax slightly exceeding the length of abdomen excluding anal tube; metopidium sparsely spinose, sloping backwards from its base to disc; lateral angles of pronotum broadly rounded, posterior process gradually tapering to an acute point, extending over three-fourths of length of mesotergite; median carina of posterior process percurrent, beset with short spines, mesonotum about two-thirds of length of protergum, mesonotal process short, tip obtuse; metanotum narrow, sparingly spinose; tegminal wing pads very prominent extending upto 2nd abdominal segment, costal angles projecting out as conical extensions; legs pinkish brown on tibiae which are flat, fringed with long slender tuberculate spines arranged in rows, tarsi yellowish, sparsely setose, trochanters not armed with teeth. Abdominal tergites very broad, dorsal tubercles replaced by two groups of small spines; lateral lamellae of 3rd segment dark brown, shorter than the succeeding ones, bearing only 6 or 7 stiff spines, those of succeeding segments more than twice as long as wide, inclined backwards and bordered with 14-20 long slender spines on tubercles besides minute subspines scattered over lamellae; external genital rudiments extending as far back as middle of anal tube on the ventral aspect; anal tube about one-sixth of length of body, width at base nearly equal to its length.

Host plants.—Prop roots of *Ficus bengalensis, Thespesia populnea.*

Holotype female, 88 female and 54 male paratypes, 45 nepionotypes, Madras, on various dates during July, 1966.

The species is nearest to *subangulatus* Distant in the robust slightly apically projecting posterior process, but differing in the coloration of body and tegminal veins, and also in the extremely variable suprahumeral horns.

Tricentrus purpureus n.sp.

(Text-fig. 26, part)

Female.—General coloration purplish brown; head greyish, speckled with dark spots, about two and a half times as wide as long, densely pilose, with long golden hairs; base slightly convex at junction with metopidium; frontoclypeus extending about half of its length below lower margins of vertex, tip broadly rounded, thickly pilose with short golden hairs; eyes dark brown, ocelli black, located just above centro-ocular line, slightly closer to eyes than to each other; pronotum dark brown dorsally, cretaceously sericeous laterally; metopidium vertical, not sloping, greyish brown, densely pubescent, twice as wide as high; supraocular callosities very conspicuous, margins shaded with black; tips of humeral angles blunt; suprahumeral horns stout, about three-fourths as long as space between bases, longly pilose, pilosity denser at basal one-fourth, projecting obliquely forwards and slightly inclined outwards, tips black, broadly rounded and turned backwards, apices

subacute, tricarinate, dorsal carina weak; posterior process robust, short, unicarinate, apical half straight, tip acute, dark brown, just reaching the posterior angle of the inner margin of tegmina; dorsal carina percurrent extending through metopidium; legs densely pilose, distal end of femur and whole of tibia purplish brown, tarsi light brown, rest black; hind trochanter raised into a disc bearing 5 large teeth in a row besides smaller ones. Tegmina purplish brown, fringed with long hairs, basal portion dark brown and punctate followed by an yellow round fascia, apical limbus broad; abdomen robust, uniformly black.

Measurements.—Length from frontal margin to tips of tegmina 5.3 mm., to tip of posterior process 3.5 mm., to tip of abdomen 4.9 mm., width across tips of horns 2.7 mm., at humeral angles 2.0 mm., at eyes 1.9 mm.

Male.—General coloration of body similar to that of female; slightly smaller; differing from female chiefly in the nature of suprahumerals which are smaller, slightly projecting forwards, more divergent, turned outwards and slightly upwards, tip acutely turned backwards; dorsal carina weak; abdomen slender, extending upto one-third distance of 3rd apical cell of tegmina.

Measurements.—Length from frontal margin to tips of tegmina 5.0 mm., to tip of posterior process 3.5 mm., to tip of abdomen 4.2 mm., width across tips of horns 3.0 mm., at humeral angles 2.0 mm., at eyes 1.8 mm.

Fifth instar nymph.—Body dorso-ventrally flattened as in *pilosus;* general coloration brown; head two times wider than long, inclined backwards; cranial tubercules prominent, broadly conical; eyes subglobate, dark brown; ocelli as close from each other as from eyes and located on the centro-ocular line; thorax sprinkled with sparse tuberculate spines; metopidium gradually sloping from base; posterior process tapering, tip acute, beset with short spines; suprahumeral buds absent; mesonotal process dark brown, densely spinose, obtuse, a row of spines on the distal half of each abdominal segment from 3 to 8; abdominal lateral lamellae of segments 4 to 8 nearly uniform, about twice as long as broad, directed backwards and bordered with 17-22 long, slender, pointed spines; anal tube one-fifth of the total length of body, more than twice as long as its width at base.

Host plant.—*Polygonum* sp.

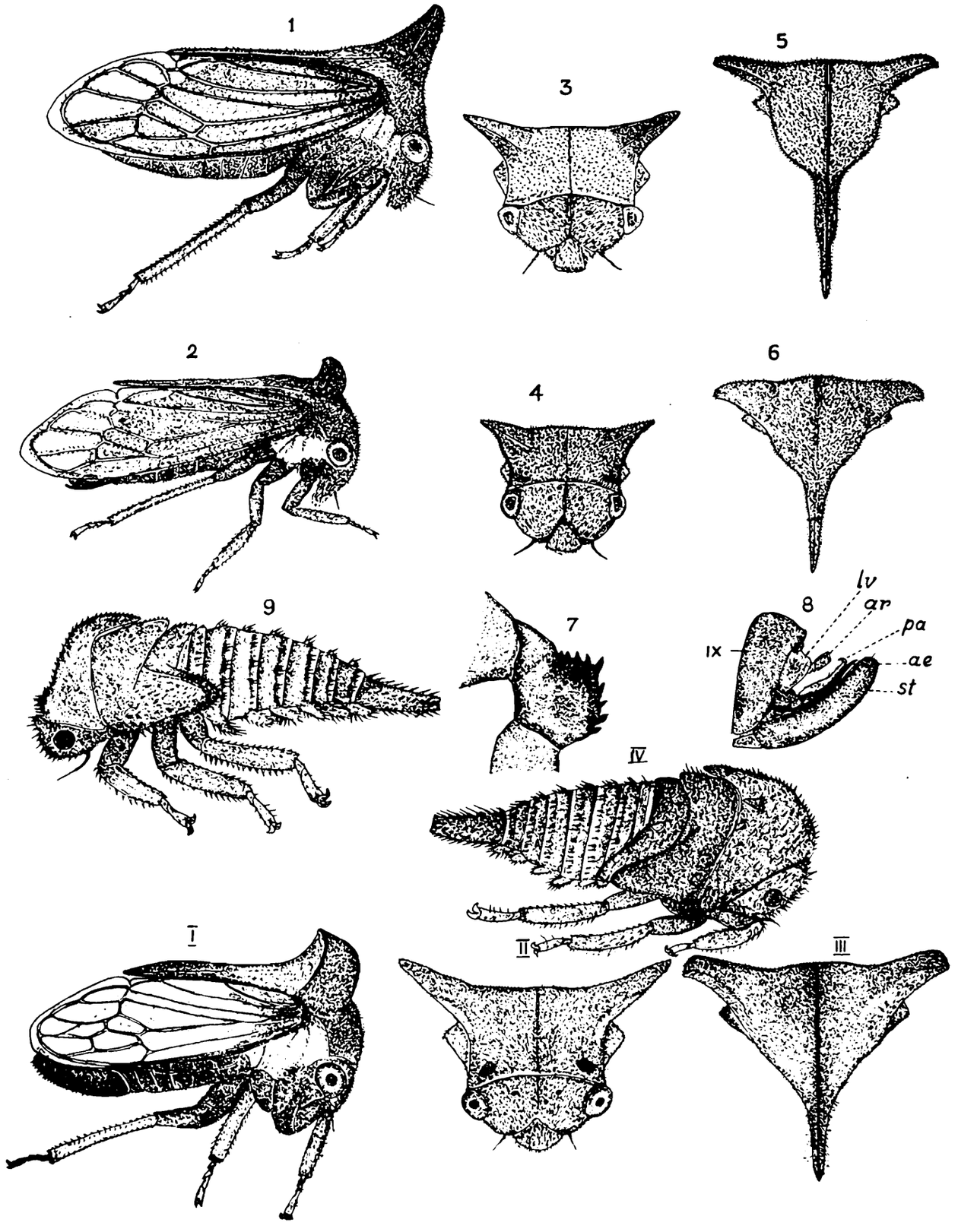
Holotype female; 15 female, 9 male paratypes, 8 nepionotypes, Kodaikanal, Madras, 30.ix.1968.

This species is nearest to *congestus* (Walker) in the backwardly projecting suprahumerals which are about three-fourths as long as width between their bases, and the apex of posterior process impinging on tegmina, but differs in the dark purplish colour, apices of suprahumerals subacute, and in the cretaceously sericeous lateral areas of sternum.

Tricentrus congestus (Walker)

(Text-fig. 26, part)

1870. *Centrotus congestus* Walker, *J. Linn. Soc. Lond. Proc.* **10:** 187.
1908. *Tricentrus congestus:* Distant, *Fauna Brit. India.* **4:** 34.
1934. *Otaris congestus:* Goding, *N. Y. Ent. Soc. Jl.* **42:** 480.



Text-fig. 26. *Tricentrus purpureus* n. sp.

1. Adult female. 2. Adult male. 3. Frontal view of female. 4. Frontal view of male. 5. Dorsal view of female pronotum. 6. Dorsal view of male pronotum. 7. Hind trochanter showing spines. 8. Male genitalia. 9. Fifth instar.

Tricentrus congestus (Walker)

I. Adult female. II. Frontal view. III. Dorsal view of pronotum. IV. Fifth instar.

Female.—General coloration brown; head thickly ochraceously pilose, about three times wider across extremities of eyes than length of vertex; vertex about twice as wide as long; upper margin of vertex very shallowly arcuate, lower margins gradually sloping to frontoclypeus; eyes hemispherical, dull succineous; ocelli slightly nearer to eyes than to each other and situated above centro-ocular line; frontoclypeus extending below lower margins of vertex, extended area semicircular, longly pilose, frontoclypeal lobes almost entirely fused; pronotum dark brown, finely punctate, thickly pilose, with short greyish hairs; metopidium convex, two-thirds as high as wide, densely pilose, ochraceous; supraocular callosities prominent, black and punctate; humeral angles large, sparsely pilose, tips blunt; suprahumeral horns robust, obliquely projecting forwards, about three-fourths as long as width between bases, viewed from lateral aspects, lateral carinae strong, reddish brown, viewed from above moderately broad, obliquely ascendant, posterior carinae obscure behind middle, apices subobliquely truncate, seen from the front much narrower, apices subacute; posterior process robust, tricarinate, basal half heavy, contiguous with scutellum, laminate, apical half attenuate, slightly arched, apex impinging on tegmina, dorsal carination percurrent through metopidium, lateral carinae weak; tegmina pale bronzy brown, nearly thrice as long as wide, veins strong, castaneous, first apical cell nearly five times longer than its greatest width, apical limbus moderately broad; hind wings with three apical cells; lateral areas of sternum pale brown; legs black upto tibiae, tibiae reddish brown, tarsi light brown.

Measurements.—Length from frontal margin to tips of tegmina 5.3 mm., to tip of posterior process 3.7 mm., width across tips of suprahumerals 4.3 mm., at humeral angles 2.8 mm., at eyes 2.4 mm.

Male.—Similar to female, slightly pubescent, humeral angles less prominent, posterior process straight.

Measurements.—Length from frontal margin to tips of tegmina 5.0 mm., to tip of posterior process 3.6 mm., width across tips of suprahumerals 4.0 mm., at humeral angles 2.6 mm., at eyes 2.3 mm.

Fifth instar nymph.—Body robust, dorso-ventrally compressed; general coloration grey, with black spots sprinkled over body; head nearly thrice as wide as long, cranial tubercules reduced; short stout spines scattered all over vertex; eyes light black; ocelli nearer to each other than from eyes and located a little above centro-ocular line; rostral tip extending to hind coxae; thorax greyish, densely pilose, bases of tubercles black; suprahumeral buds very small; metopidium convex in front, concealing head from above; disc with closely set spines; pronotal posterior process extending over three-fourths of the length of mesonotum, mesonotal process much reduced; abdomen sparsely spinose; dorsal tuberculate spines more or less inclined back and adpressed to body; lateral lamellae nearly twice as long as wide, each bordered with 14-18 slender spines; anal tube black at basal one-fourth, genitalic rudiments dark brown.

Host plant.—*Vernonia cinerea.*

Material studied.—12 females, 4 males and many nymphal instars, Madras, 10.v.1966.

Tricentrus albomaculatus Distant

(Text-fig. 27)

1908. *Tricentrus albomaculatus* Distant, *Fauna Brit. India.* **4**: 56.

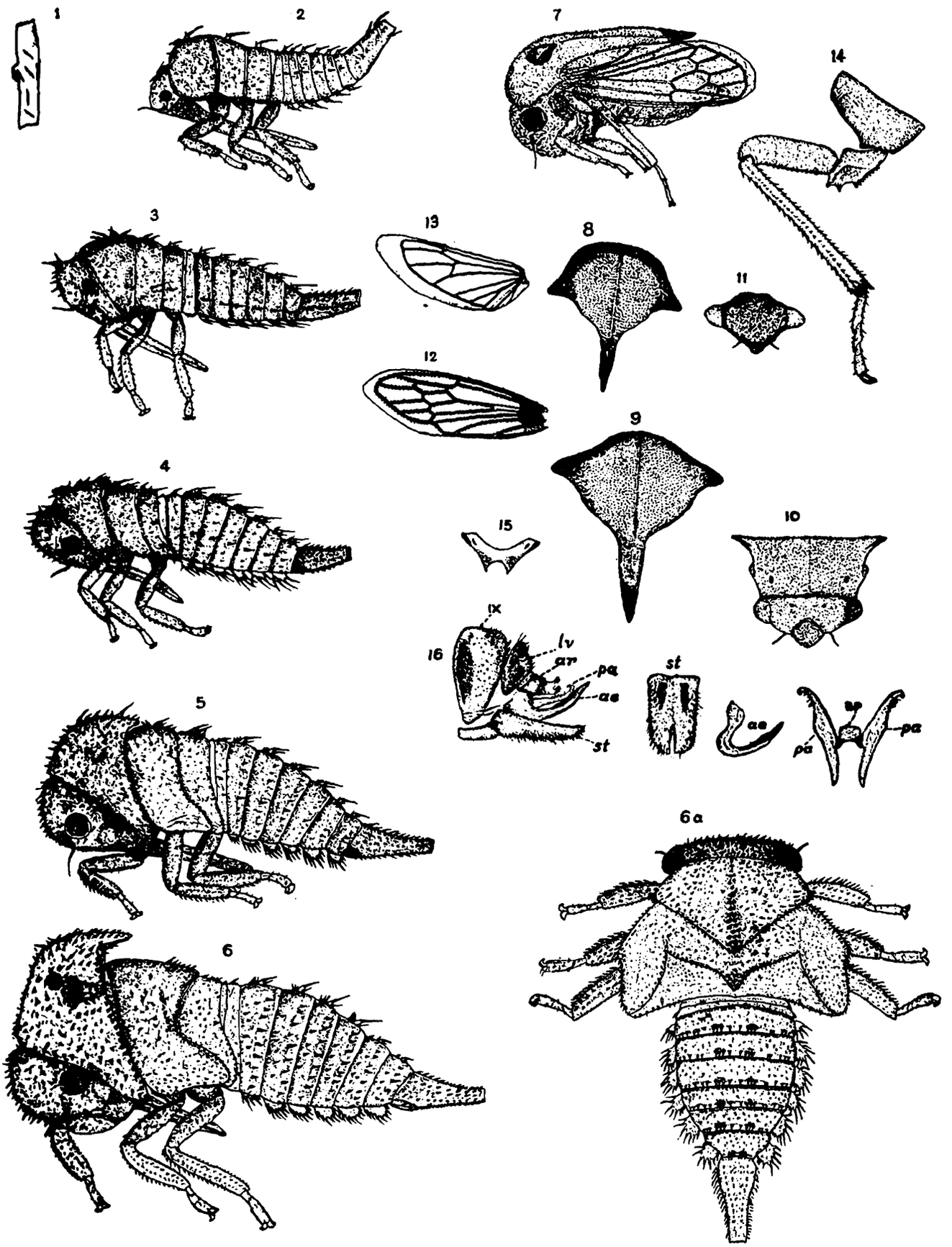
Female.—General coloration black; head thrice as wide as long, finely pilose, with silvery hairs; base of vertex shallowly emarginate; eyes reddish brown, hemispherical; ocelli minute, closer to eyes than to each other and situated above centro-ocular line; frontoclypeus ovate, sparsely pilose, distal half extending below lower margins of vertex, tip broadly rounded, frontoclypeal lobes fused to inner margins of vertex; pronotum black, often shaded with greyish brown, finely punctate, with adpressed silvery hairs; metopidium nearly vertical, slightly obumbrant; supraocular callosities inconspicuous; humeral angles short, not prominent, tips blunt; suprahumeral horns short, black, about one-third as long as space between bases, as seen from sides directed upwards and recurved, as seen from above somewhat broad, apically recurved, anterior margins rounded, apices subacute, dorso-posterior carinae slightly behind middle, as seen from front much narrower and obliquely upcurved; posterior process robust, contiguous with scutellum and inner angles of tegmina, apex reaching posterior angle of inner margin of tegmina, tip acute, black, distinctly upcurved, dorsal carination obscurely percurrent through metopidium; tegmina about thrice as long as wide, dull bronzy, subhyaline, basal sixth black, coriaceous and coarsely punctate, first apical cell about 5 times longer than wide; hind wings with 3 apical cells; scutellum broader than long; lateral areas of pronotum and sternum white tomentose; legs with hind trochanters armed with spines on inner surface.

Measurements.—Length from frontal margin to tips of tegmina 3.8 mm., to tip of posterior process 3.0 mm., width across tips of suprahumerals 2.6 mm., at humeral angles 1.9 mm., at eyes 1.7 mm.

Male.—General colour jet black, much smaller than female; suprahumerals arising from posterior lateral margins of pronotum; genitalia similar to *pilosus.*

Measurements. - Length from frontal margin to tips of tegmina 2.9 mm., to tip of posterior process 2.3 mm., width across tips of suprahumerals 2.0 mm., at humeral angles 1.5 mm., at eyes 1.4 mm.

Fifth instar nymph.—General coloration pale green; base of suprahumeral buds, costal margins of tegminal pads, bases of abdominal dorsal tubercles and distal half of anal tube with shades of black; head nearly twice as broad as long, directed backwards with rostral tip just passing beyond hind coxae; vertex of head truncate; eyes subglobate, ocelli minute, nearer to eyes than to each other, and located above c-o-line; frontoclypeal tip on a line with lower margins of vertex; thorax sparsely spinose on lateral areas; metopidium nearly vertical; posterior process extending over disc; suprahumeral buds very prominent with subacute tip; mesonotal process blunt with closely set spines; legs with coxae, trochanters, and distal half of femora black, tibiae yellowish brown, tarsi pale white. Abdominal segments 3-8 sparsely hairy, dorsal tubercles terminating in suberect spines, a transverse row of short spines towards posterior border of each segment; lateral lamellae nearly similar



Text-fig. 27. *Tricentrus albomaculatus* Distant

1. Egg slits on host stem. 2. First instar. 3. Second instar. 4. Third instar. 5. Fourth instar. 6. Fifth instar. 7. Adult female. 8. Pronotum of male, dorsal view. 9. Pronotum of female, dorsal view. 10. Frontal view of female. 11. Head, frontal elevation. 12. Tegmina. 13. Hind wing. 14. Hind leg. 15. Scutellum. 16. Male genitalia, lateral view.

to those of *Leptocentrus* in shape, each lamella fringed with 7 long spines and 2 short spines at posterior surface; anal tube about one-sixth of total length of body.

Host plant.—*Datura fastuosa.*

Material studied.—75 females, 48 males, and numerous nymphal instars, Madras, —.xii.1966.

Tricentrus decornis n.sp.

(Text-fig. 28)

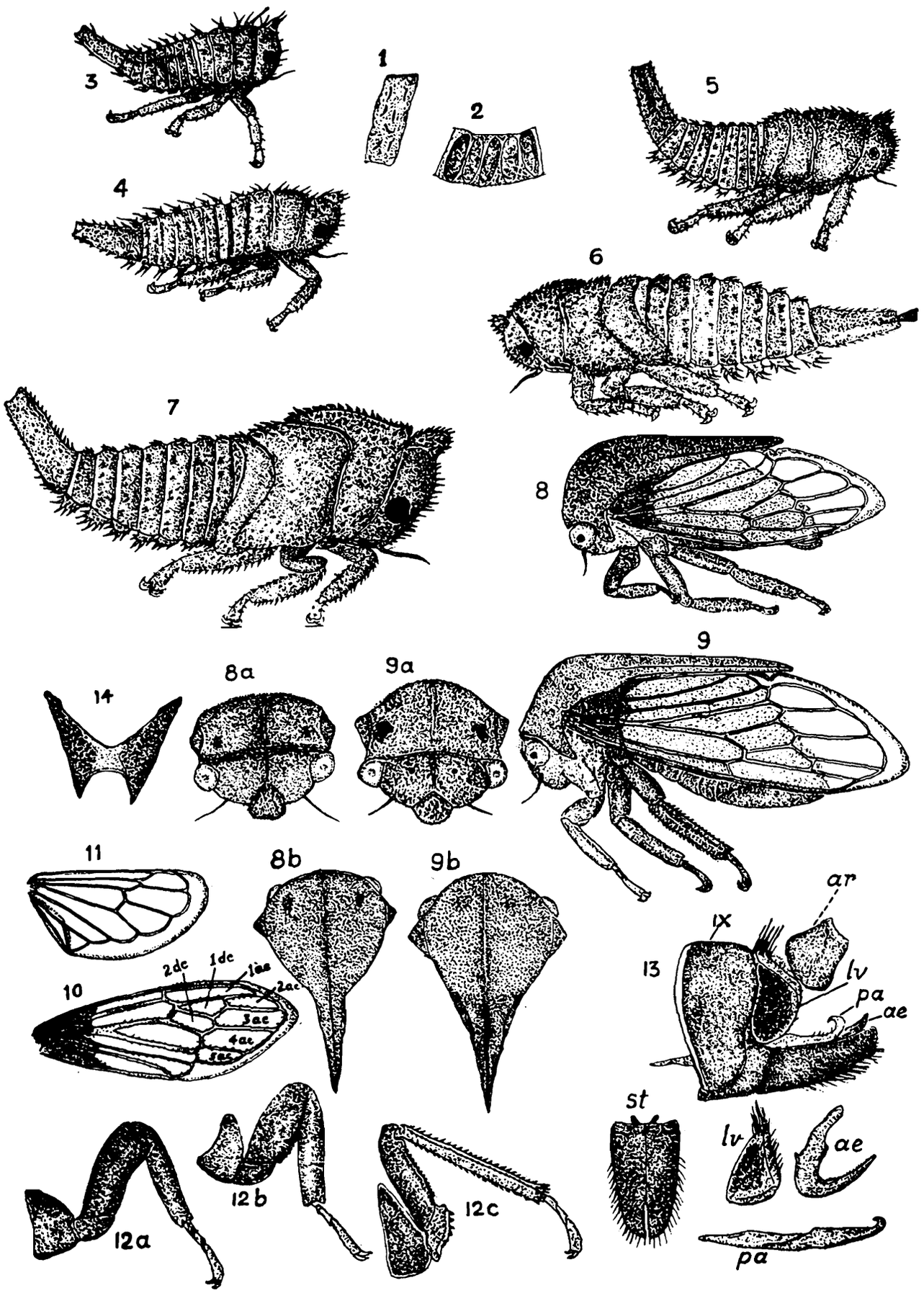
Female.—General coloration of body reddish brown; head nearly one and three-fourths as wide as long; base slightly arcuate and sinuate, distinctly punctate with sparsely scattered short golden hairs; frontoclypeus dark brown, extending a little more than half its length beyond head, sparsely pilose, free end broadest, truncate, margins black. Eyes globate, projecting out, dull white, ocelli silvery white, slightly closer to eyes than to each other and situated above centro-ocular line. Thorax reddish brown, lateral parts cretaceously sericeous, metopidium gradually sloping back, closely punctate, not pilose, supraocular callosities prominent, impunctate, concolorous with metopidium; supra-humeral horns absent; humeral angles dark brown, broadly conical with acute tips; posterior process robust, slightly sinuate, tip acute, extending just beyond the posterior angles of the inner margins of tegmina, lateral carinae black, median carina percurrent, continued over metopidium; scutellum light brown, punctate, one and a half times as wide as length at base; legs reddish brown except coxa and trochanter which are dark brown; hind trochanter set with 4 prominent teeth besides smaller teeth on inner edge of disc; hind femur corrugated on inner edge; tegmina three times longer than wide, pale brown, reflecting the dark abdomen, base dark, punctate, veins stout, dark brown, apical limbus broad.

Measurements.—Length from frontal margin to tips of tegmina 5 mm., to tip of posterior process 3.6 mm , scutellum width at base 1.4 mm., length 0.9 mm., width across humeral angles 2.1 mm., at eyes 2.0 mm., length of tegmina 4.1 mm , width 1.3 mm.

Male.—Similar to female but smaller; general coloration of body dark brown.

Measurements.—Length from frontal margin to tips of tegmina 4.25 mm., to tip of posterior process 3.2 mm., width across humeral angles 1.7 mm., at eyes 1.7 mm., width of scutellum at base 1.2 mm., length 0.8 mm.

Fifth nymphal instar.—General colour dark brown; head declivous; cranial tubercles persistent and very large; eyes reddish brown; vertex with a row of tuberculate spines turned forwards, lower margins broadly rounded; clypeal tip broadly rounded extending a little beyond lower margins of vertex; ocelli conspicuous, closer to eyes and situated above centro-ocular line; pronotal posterior process arched above, contiguous with mesonotum, extending over the length of mesonotum, dorsal carina



Text-fig. 28. *Tricentrus decornis* n. sp.

1. Egg slits on host stem. 2. An egg slit exposed to show the arrangement of eggs. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar. 8. Adult male. 8a. Frontal view of male. 8b. Pronotum of male, dorsal view. 9. Adult female. 9a. Frontal view of female. 9b. Pronotum of female, dorsal view. 10. Tegmina. 11. Hind wing. 12-a, b, c. legs. 13. Male genitalia. 14. Scutellum.

continued forwards upto anterior border of disc and beset with closely arranged tuberculate spines; suprahumeral buds absent; lateral parts of pronotum sparsely spinose; mesonotal process broadly triangular, fringed with short spines; wing pads of moderate size, costal margins fringed with stiff spines, costal angles not sharply demarcated. Abdomen nearly twice as long as anal tube; dorsal tuberculate spines adpressed to body; base of tubercles black; lateral lamellae short, semicircular, each lamella bearing 5 short spines, besides short subspines scattered on lamellae.

Host plants.—Eugenia caryophyllata, Lagerstroemia sp., *Cryptostegia* sp.

Holotype female; 18 female and 11 male paratypes, 20 nepionotypes, Madras, 3.iii.1967.

This species differs from all other known members of the genus in the complete absence of suprahumeral horns.

Key to species of **Tricentrus** Stål *based upon Fifth nymphal instar*

1(6) Body dorso-ventrally compressed; abdominal lateral lamellae long, bordered by many long spines.

2(5) Cranial tubercules persistent but reduced.

3(4) Suprahumeral buds present or absent; lateral lamellae of abdominal segments 5-8 more than twice as long as wide; coloration of body reddish brown. *pilosus* n.sp.

4(3) Suprahumeral buds always present; lateral lamellae of abdominal segments 5-8 less than twice as long as wide; coloration of body brown.. .*congestus* (Walker).

5(2) Cranial tubercules prominent; suprahumeral buds absent; lateral lamellae of abdominal segments 5-8 nearly thrice as long as wide; coloration of body brown.. .*purpureus* n.sp.

6(1) Body laterally compressed; abdominal lateral lamellae short, bordered with a few short spines.

7(8) Cranial tubercules obsolete; suprahumeral buds present; lateral lamellae bearing 7-9 spines.. .. . *albomaculatus* Dist.

8(7) Cranial tubercules very large; suprahumeral buds absent; lateral lamellae bearing 5 short spines. .*decornis* n.sp.

Tribe **Gargarini** Distant

This tribe is characterised by the partially concealed scutellum exposed laterally and at basal angles and weakly chitinised in the middle, the broad close-fitting posterior process, absence of suprahumeral horns and the hind wings with 3 apical cells. It is distinguished from the closely related tribe, *Coccosterphini*, by the absence of tubercles on veins.

Genus **Gargara** Amyot & Serville

(Type of the genus *Cicada genistae* Fabr.)

1843. *Gargara* Amyot & Serville, *Hemip.:* 537.

1903. *Maerops* Buckton, *Mon. Memb.:* 268.

Small to moderately large; head two and a half to three times wider across extremities of eyes than length of vertex; vertex nearly one and a half times wider than long; eyes subglobate; ocelli slightly closer to eyes than to each other and situated on or above centro-ocular line; frontoclypeus extending from one-third to half its length below lower margins of vertex, its lobes partially or entirely fused, tip broadly rounded or truncate; pronotum rather low, metopidium convex and backwardly sloping, disc slightly convex, suprahumerals absent, humeral angles moderate, tips blunt, posterior angles rounded; posterior process broadly triangular, closely fitting against scutellum and contiguous with tegmina, tip reaching apex of clavus or anal angles of tegmina, ventrally basally shallow; scutellum wider than long, triangular, deeply excavated at tip, incompletely chitinised in middle which is concealed by posterior process; tegmina two and a half times longer than wide, membrane a little chitinised at R1 and rs forming an incipient pterostigma in some species, five apical cells and two discoidal cells; hind wings with 3 apical cells. Male genitalia, with lateral valves broadly triangular and parameres with recurved tips and strikingly resembling those of the genus *Tricentrus*; split of sternal plate extending from one-third to one half of its length from apex.

Key to South Indian species of **Gargara**

1(4) Posterior process just reaching apex of clavus; tip of frontoclypeus broadly rounded; 1st apical cell of tegmina 5 or 6 times longer than wide.

2(3) Light brown, moderately large pronotum thickly ochraceously pilose; ocelli located on centro-ocular line; tegmina greyish, semi-opaque, 1st discoidal cell not pedicellate; tarsi light brown.. .*mixta* (Buckton).

3(2) Black; small; pronotum sparsely pilose; ocelli located above centro-ocular line; apical sixth of tegmina brown, with a sub-apical brown band, 1st discoidal cell pedicellate tarsi; pale white.. .*albitarsis* n.sp.

4(1) Posterior process extending beyond apex of clavus; tip of frotnoclypeus truncate or broadly rounded.

5(8) Tegmina slightly chitinous at R1 and rs forming an incipient pterostigma.

6(7) Black, moderately large; pronotum finely, palely pilose; posterior process slightly sinuous; tegmina subhyaline, broadly black at apical limbus and apical area of costal margin, 1st apical cell six times longer than wide, 1st discoidal cell pedicellate. ..*extrema* Distant.

7(6) Brown, smaller, pronotum coarsely ochraceously pilose; posterior process straight; tegmina hyaline, not fuscous, 1st apical cell about five times longer than wide, 1st discoidal cell not pedicellate.. *malabarica* n.sp.

8(5) Tegmina devoid of an incipient pterostigma.

9(10) Very small, black; tegmina hyaline, devoid of spots or patches; 1st apical cell about three times longer than wide, 1st discoidal cell pedicellate, very much smaller than 2nd discoidal cell.. .*madrasensis* n.sp.

10(9) Moderately large, reddish brown; tegmina with reddish brown patches near end of clavus, apical area of costal cell about five times longer than wide, 1st discoidal cell not pedicellate, about as large as 2nd discoidal cell.. .*rustica* n.sp.

Gargara mixta (Buckton)

(Text-fig. 29)

1903. *Maerops mixta* Buckton, *Mon. Memb.*: 257.
1903. *Gargara variegata* Melichar, *Hom. Faun. Ceylon,*: 122.
1908. *Gargara mixta;* Distant, *Fauna Brit. India* **4**: 65.

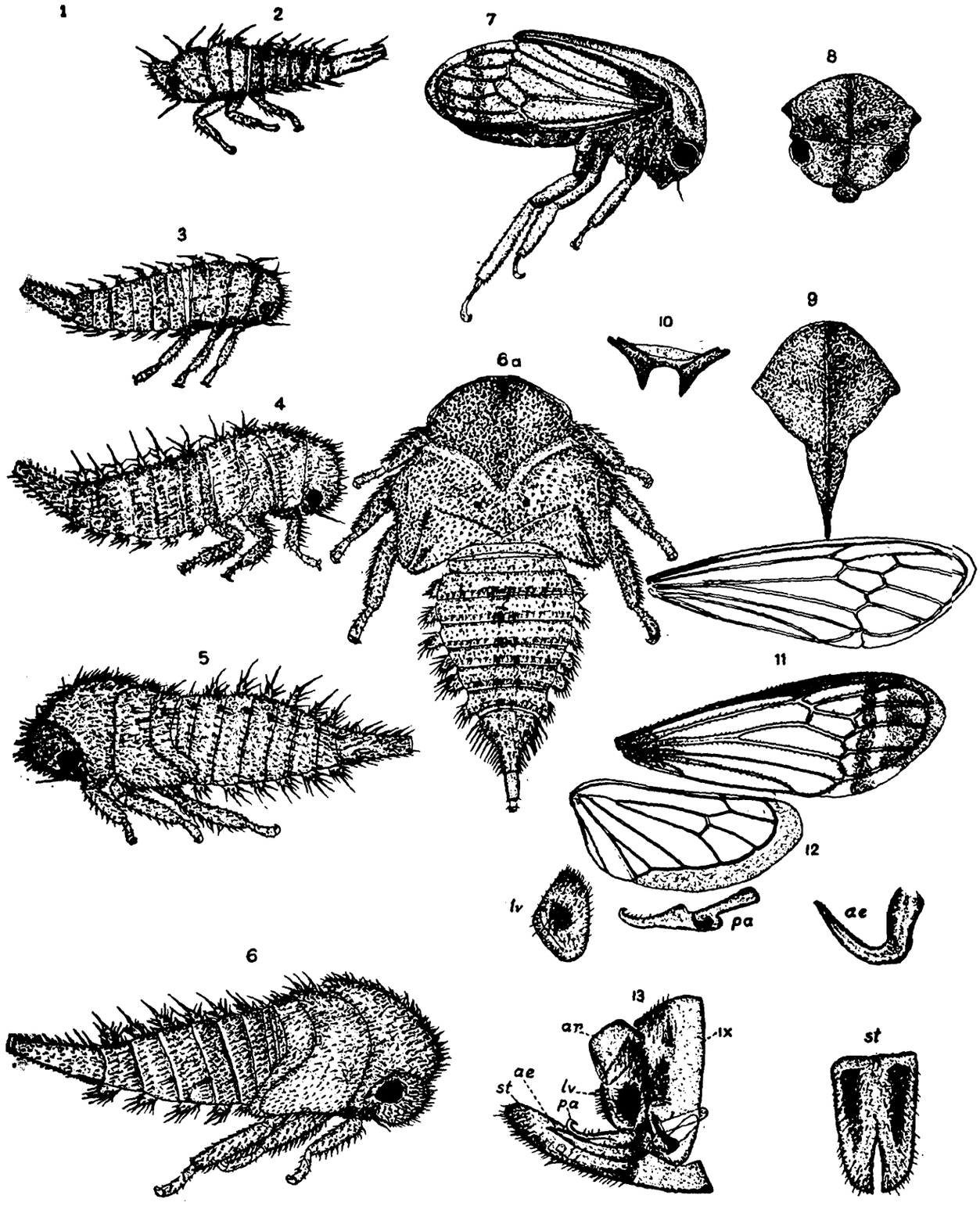
Female.—General colour light brown; head two and a half times wider across extremities of eyes than length of vertex; vertex one and a half times as wide as long, finely punctate with adpressed golden pilosity; base of vertex nearly planate; eyes reddish brown, subhemispherical; ocelli slightly nearer to eyes than to each other and situated on centro-ocular line; frontoclypeus greyish brown, extending to half of its length below lower margins of vertex, tip broadly rounded, frontoclypeal lobes entirely fused, pronotum thickly ochraceously pilose; metopidium 1.75 times as broad as high, convex, backwardly sloping, disc convex; humeral angles short, tips blunt, posterior angles rounded; posterior process broadly triangular, thickly palely pilose, contiguous with scutellum and tegminal inner margins, apex gradually tapering to an acute tip just reaching apex of clavus, dorsal carination finely continued through metopidium; scutellum twice as broad as long, deeply excavated at tip, strongly chitinised at lateral areas, tips acute; tegmina three times longer than broad, more or less speckled with fuscous, greyish semiopaque, base and costal area ochraceous, 1st apical cell nearly 6 times longer than wide, 1st discoidal cell not pedicellate, about as long as 2nd discoidal cell; hind wings with 3 apical cells; legs shaded with black upto basal half of femora, tibiae reddish brown, tarsi light brown; body beneath dark brown.

Measurements.—Length from frontal margin to tips of tegmina 6.0 mm., to tip of posterior process 4.3 mm., width across humeral angles 2.6 mm., at eyes 2.0 mm.

Male.—Smaller than female; pronotum jet black; tip of posterior process black; tegmina hyaline, basal sixth black, punctate, costal margin shaded with black, apical sixth including apical limbus black; a subapical narrow black band.

Measurements.—Length from frontal margin to tips of tegmina 4.5 mm., to tip of posterior process 3.3 mm., width across tips of humeral angles 2.3 mm., at eyes 1.8 mm.

Fifth instar nymph.—General coloration pale green with castaneous patches sprinkled over tergites; head turned backwards; vertex about twice as wide as long, planate at base, thickly pilose with tuberculate hairs, lower margins broadly rounded; frontoclypeus densely bristled, never extending beyond the level of lower margins of vertex; ocelli faintly visible, closer to eyes than to each other and located above the c-o-line; tip of rostrum extending to metathorax; thorax triangular in a cross section, metopidium convex and backwardly sloping to disc, pronotal posterior process bluntly acute, extending over half the length of mesonotum; supra-ocular callosities obscure; mesonotum with a pair of stout lateral tubercles; mesonotal process produced over base of metanotum



Text-fig. 29. *Gargara mixta* (Buckton)

1. Egg-slits on host stem. 2. First instar. 3. Second instar. 4. Third instar. 5. Fourth instar. 6. Fifth instar. 7. Adult male. 8. Frontal view. 9. Dorsal view of pronotum. 10. Scutellum. 11. Tegmina of male. 11a. Tegmina of female. 12. Hind wing. 13. Male terminalia, lateral view,

which is concave at posterior margin; tegminal wing pads well developed, costal angles broadly rounded and confluent with costal margin; abdomen narrowest at the level of 2nd segment; dorsal tubercles long, twig-like with tuberculate vertical spines, bristles arranged in a characteristically spiral fashion dorso-lateral tubercles and a row of weak tuberculate hairs on posterior margins of abdominal segments giving a highly bristly appearance to the nymph; lateral lamellae long and somewhat tapering, each with 8 or 9 long slender tuberculate bristles arranged in a regular manner; anal tube nearly one-fifth as long as body and fringed with two dorsal and two dorsolateral rows of closely arranged long tuberculate spines; spines at the base of anal tube more than half as long as the tube; anal tube one-fifth of total length of body.

Host plants.—*Lagerstroemia* sp., *Syzygium jambolanum.*

Material studied.—38 females, 8 males and many nymphal instars, Madras, 14.x.1967.

Gargara albitarsis n.sp.

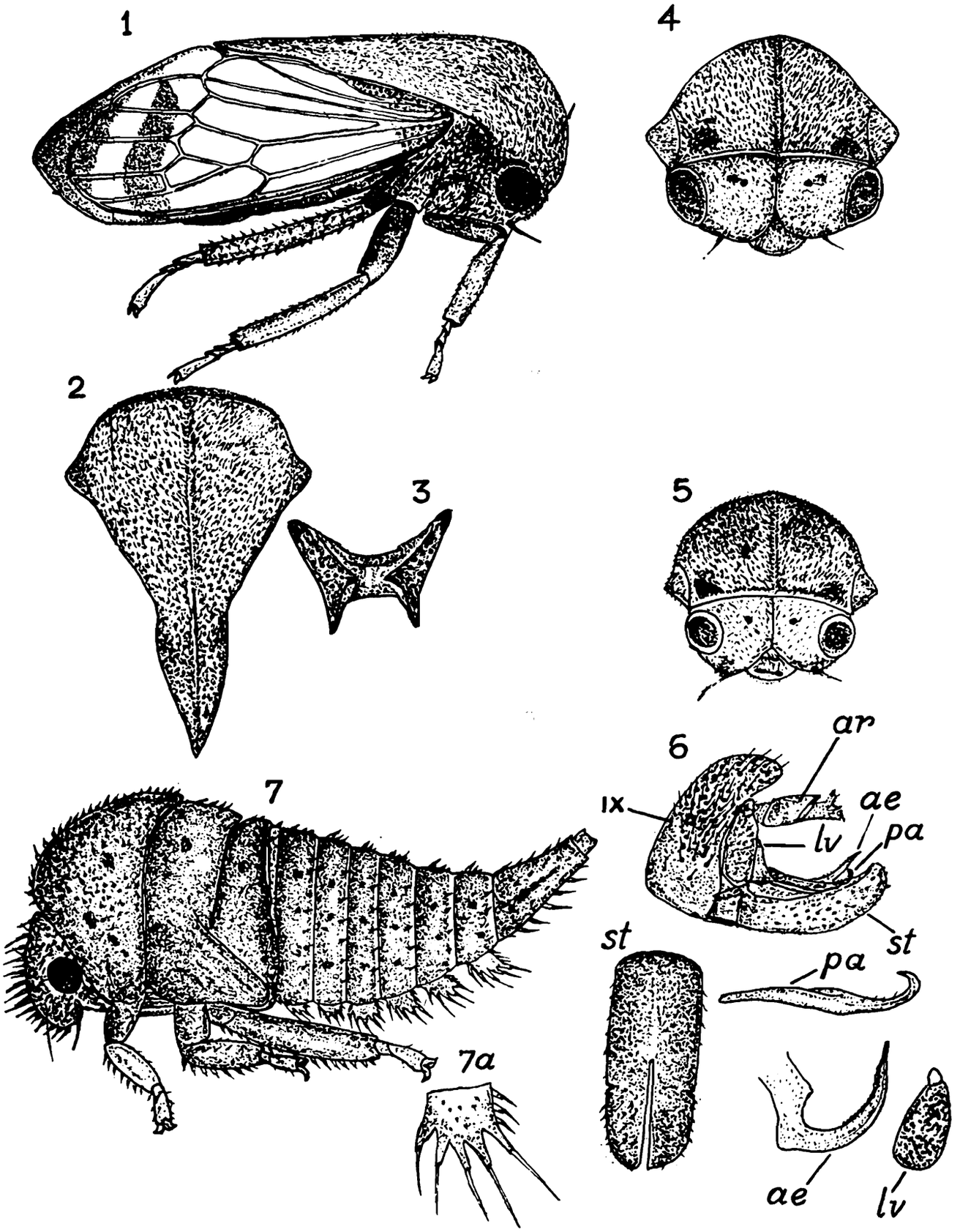
(Text-fig. 30)

Female.—General colour dark brown, shaded to black on dorso-lateral areas of metopidium, lateral carinae and apical fourth of pronotal posterior process; head nearly 2.5 times wider than long; vertex finely punctate, with short yellow hairs, nearly thrice as wide as long, upper margin nearly planate and weakly sinuate, lower margins gradually sloping down to frontoclypeus; eyes dull red, ocelli shining white, closer to eyes than from each other and located above centro-ocular line; a small rounded spot near each ocellus; frontoclypeus dark reddish brown extending slightly below lower margins of vertex, lateral lobes completely fused, tip broadly rounded and hairy. Pronotum ferruginous, strongly punctate, with short adpressed pale yellow hairs; metopidium strongly convex at base and then vertical, gradually sloping backwards to disc; supraocular callosities conspicuous, humeral angles concolorous with disc; posterior process straight, tip acuminate, jet black, reaching anal angles of tegmina, 2.3 times longer than wide, basal sixth of tegmina and three-fourth of costal margin castaneous and punctate; apical limbus broad, with a black or reddish brown fascia extending into the apical cells, a subapical transverse fascia across apical cells; veins light brown; legs with coxae and basal half of trochanters jet black, rest dark brown except tarsi which are pale white or yellowish white; abdominal undersurface pubescent.

Measurements.—Length from frontal margin to tips of tegmina 4.25 mm., to tip of posteiror process 3.0 mm., length of tegmina 3.4 mm., width across tips of humeral angles 2.1 mm., at eyes 1.9 mm.

Male.—Differing from female in being smaller and darker; metopidium less convex, abdominal sternites more pubescent.

Measurements.—Length from frontal margin to tips of tegmina 3.75 mm., to tip of posterior process 2.7 mm., length of tegmina 3.0 mm., width across tips of humeral angles 1.9 mm., at eyes 1.6 mm.



Text-fig. 30. *Gargara albitarsis* n. sp.

1. Adult female. 2. Dorsal view of pronotum. 3. Scutellum. 4. Frontal view of female. 5. Frontal view of male. 6. Male genitalia. 7. Fifth instar, 7a, Abdominal lateral lamella of fifth instar.

Fifth nymphal instar.—General colour deep green; reddish brown patches scattered over; body laterally compressed; head directed downwards, thrice as wide as long; vertex planate, base truncate, clypeus densely pilose; ocelli indistinct; metopidium convex in front, sloping backwards and fringed with short tuberculate spines; pronotal posterior process very short, just overlapping the base of mesonotum; tip broadly rounded; mesonotum about two times longer than metanotum; wing pads moderately developed extending upto 2nd abdominal segment, costal angles not demarcated; legs light reddish brown, except tarsi which are pale white; abdomen excluding anal tube as long as thorax, tuberculate spines arranged in a row near the posterior margin of each segment; dorsal tuberculate spines inconspicuous and adpressed to body; lateral lamellae on segments 3-8 short and broad, resembling those of *Coccosterphus*, each lamella bearing 5 slender pointed spines on tubercles, besides 2 or 3 short spines towards posterior margin; anal tube one-fifth of body length, fringed with rows of spines, each row consisting of 5 or 6 short tuberculate spines.

Host plant.—Tecoma grandiflora

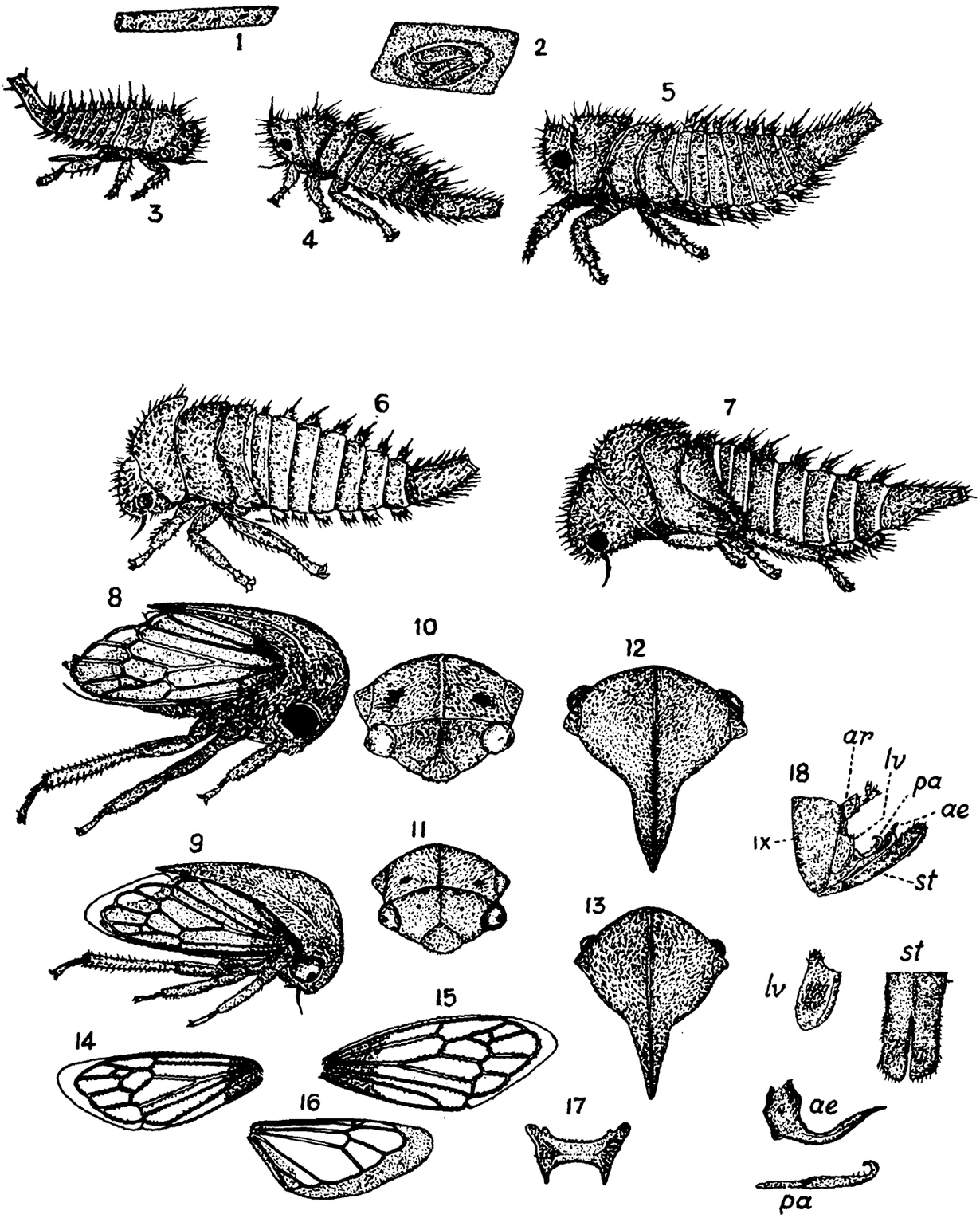
Holotype female; 4 female, 3 male paratypes, 10 nepionotypes, Madras, 2.i.1967.

Gargara albitarsis is nearest to *mixta* but differs in the much smaller size, black colour, in the position of ocelli which are above centro-ocular line, in the pedicellate 1st discoidal cell and in the pale white tarsi; in the presence of a subapical and an apical transverse fasciae, it resembles the male of *mixta*.

Gargara madrasensis n.sp.

(Text-fig. 31)

Female.—General colour black; head vertical, more than twice as wide as long, finely punctate with dense pale yellowish hairs, vertex weakly convex, upper margin somewhat sinuate, lower margins strongly oblique to frontoclypeus, eyes light brown, subglobate, ocelli black, closer to eyes than to each other and located distinctly above c-o-line; frontoclypeus as wide as one-third width of head, lateral lobes entirely fused, tip broadly rounded, fringed with short golden yellow hairs; rostrum reaching bases of hind coxae. Pronotum light brown, densely pilose; metopidium convexly obumbrant and sloping backwards into disc, finely punctate and clothed with short dense golden pilosity; supra-ocular callosities conspicuous, black, partially hidden by pilosity from surrounding areas; humeral angles concolorous with disc, blunt; posterior process broad at base, about two-thirds as wide as long, emerging from posterior margin of disc, contiguous with scutellum, extending horizontally backwards as far as anal angles of tegmina; median carina fine, percurrent, continued through metopidium without any interruption on disc; scutellum aborted centrally, basal lateral parts exposed, punctate, brown, densely pilose at basal angles; tegmina nearly two and a half times longer than wide, uniformly hyaline except the basal fifth which is dark brown, coriaceous and punctate; veins light brown, margined with sparse pale yellow hairs; apical limbus broadest opposite to



Text-fig. 31. *Gargara madrasensis* n. sp.

1. Twig with egg-slits. 2. Egg-slit exposed to show the arrangement of eggs. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar. 8. Adult female. 9. Adult male. 10. Frontal view of female. 11. Frontal view of male. 12. Dorsal view of pronotum of female. 13. Dorsal view of pronotum of male. 14. Tegmina of male. 15. Tegmina female. 16. Hind wing. 17. Scutellum. 18. Male genitalia, lateral view.

3rd apical cell; 2nd discoidal cell about 2.3 times as long as the 1st discoidal cell which is petiolate; thoracic lateral areas and tergites of abdomen punctate, light brown; ovipositor dark brown; legs light reddish brown.

Measurements.—Length from frontal margin to tips of tegmina 2.75 mm., to tip of posterior process 2.0 mm., width across humeral angles 1.75 mm., across eyes 1.5 mm.

Male.—Smaller; general colour dark brown, more densely pilose, eyes pale white; metopidium sloping backwards; sub-genital plate dark brown.

Measurements.—Length from frontal margin to tips of tegmina 2.3 mm., to tip of posterior process 1.5 mm., width across humeral angles 1.4 mm., at eyes 1.1 mm.

Fifth nymphal instar.—General colour deep green; head directed downwards, two times wider than long; vertex with tuberculate spines directed forwards; ocelli obscure; thorax covered with short spines denser on dorsal region; metopidium sloping backwards; posterior process as long as pronotum, extending over the entire length of mesonotum and terminating in an acute point; wing pads yellowish brown, costal angles not demarcated; abdomen with dorsal tubercles well developed, each tipped by a long tuberculate spine and a cluster of smaller spines emerging from base; lateral regions of abdominal tergites only sparsely and weakly pilose; lateral lamellae short, semicircular, each lamella bearing 5-7 small slender spines on tubercles anal tube a little less than one-fifth the total length of body.

Host plants.—Cestrum diurnum. Caesalpinia pulcherrima, Tecoma stans.

Holotype female; 14 female, 5 male paratypes, 8 nepionotypes, Madras, 1.viii.1967.

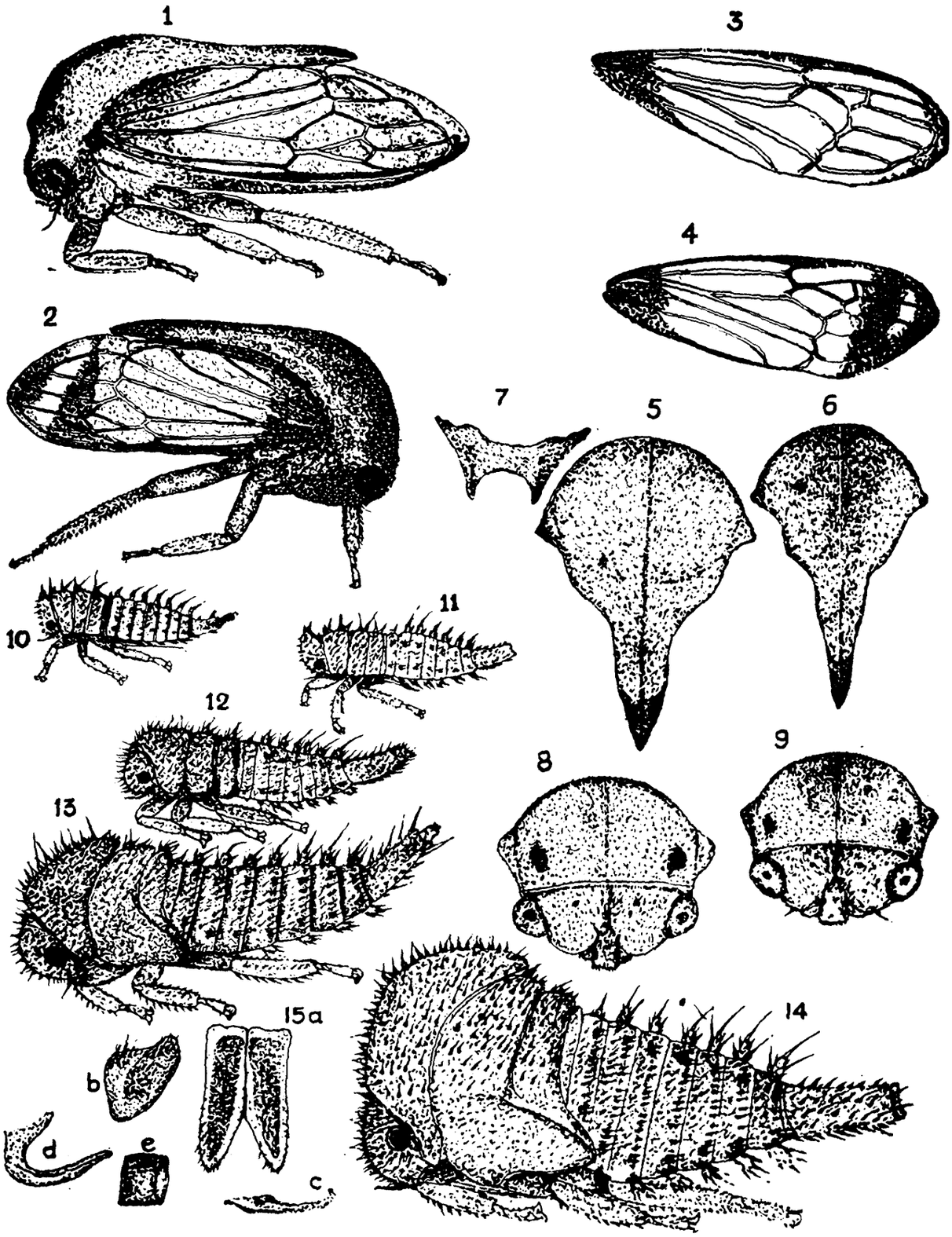
This species comes near *rustica* from which it can be easily distinguished by the much smaller size, black coloration, and the pedicellate first discoidal cell of tegmina which is much smaller than 2nd discoidal cell.

Gargara extrema Distant

(Text-fig. 32)

1916. *Gargara extrema* Distant, *Fauna Brit. India, Append.* **6**: 171.

Female.—General coloration black; head nearly three times wider across extremities of eyes than length of vertex; vertex nearly two times wider than long, finely pilose with silvery hairs; eyes hemispherical, reddish brown; ocelli succineous, a little nearer to eyes than to each other and located above centro-ocular line; frontoclypeus longly sparsely pilose, one-fourth of its length extending below lower margins of vertex, tip truncate; pronotum black, with shades of brown; finely pilose; metopidium about as wide as high, with sparsely adpressed silvery pilosity, convex, slightly sloping; supraocular callosities large, black, impunctate; humeral angles prominent, brown, sparsely hairy, tips nearly



Text-fig. 32. *Gargara extrema* Distant

1. Adult female. 2. Adult male. 3. Tegmina of female. 4. Tegmina of male. 5. Dorsal view of pronotum of female. 6. Dorsal view of pronotum of male. 7. Scutellum. 8. Frontal view of female. 9. Frontal view of male. 10. First instar. 11. Second instar. 12. Third instar. 13. Fourth instar. 14. Fifth instar. 15a, Sternal plate of male genitalia, b, lateral valve; c, paramere; d, aedeagus; e, anal ring.

blunt; posterior process broadly triangular, centrally slightly sinuate, tip black, acute, passing behind apex of clavus and reaching the posterior angle of inner margin of tegmina, dorsal carination strongly percurrent through metopidium; tegmina nearly thrice as long as wide, subhyaline, basal sixth punctate, dark reddish brown, costal margin narrowly black, thickened at R1 forming an incipient pterostigma, apical limbus speckled with black spots, 1st apical cell about six times longer than wide, 1st discoidal cell pedicellate; legs, upto basal half of femora black, tibiae reddish brown, tarsi pale white, with shades of black; body beneath black, with short pale white hairs.

Measurements.—Length from frontal margin to tips of tegmina 6.0 mm., to tip of posterior process 4.3 mm., width across humeral angles 3.0 mm., at eyes 2.4 mm.

Male.—Slightly smaller; general coloration jet black; tegmina with a somewhat narrow apical black band extending over apical limbus and a broad subapical band.

Measurements.—Length from frontal margin to tips of tegmina 5.6 mm., to tip of posterior process 4.2 mm., width across tips of humeral angles 2.7 mm., at eyes 2.2 mm.

Fifth instar nymph.—General coloration deep brown; body robust, highly bristled; head vertical, about 2.5 times wider than long, slightly convex, apex truncate; ocelli obscure; pronotum high, sloping upwards and backwards; metopidium vertical upto three-fourths of its height and then sloping backwards to disc; pronotal process slightly curved behind extending over basal half of mesonotum; tuberculate spines on metopidium directed forwards; spines on lateral aspects of thorax smaller and dense; mesonotum with posterior margin declivous, hardly produced into a process; tegminal wing pads with costal angles distinctly demarcated, fringed with long bristles arranged as in *mixta;* lateral lamellae long, narrow, cylindrical, each lamella fringed with 4 or 5 spines springing from all sides of lamella; anal tube one-fifth the total length of body, with rows of spines which are shorter right from base.

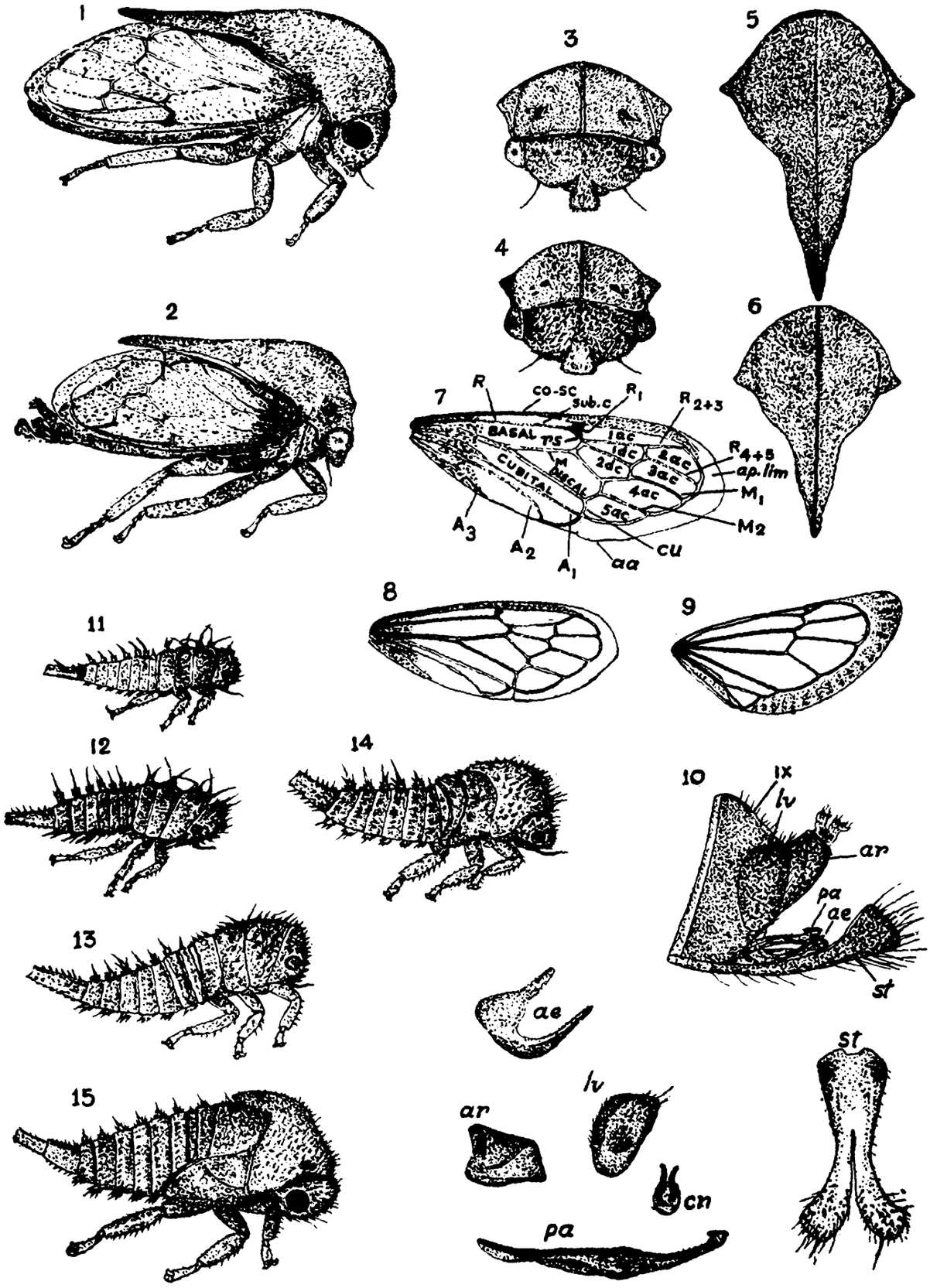
Host plants.—*Solanum melongena*, *Solanum torvum*, *Zizyphus oenoplia*, *Capsicum frutescens.*

Material studied.—40 females, 6 males and numerous nymphal instars, Madras, October to December, 1967.

Gargara malabarica n.sp.

(Text-fig. 33)

Female.—General colour ochraceous brown; head vertical, black with shades of brown, nearly thrice as wide as long; vertex with upper margin nearly planate, finely punctate with short adpressed golden yellow pilosity, lower margins broadly rounded and obliquely continuous to frontoclypeus; eyes dark brown; ocelli dull succineous, a little closer to eyes than to each other and situated slightly above the centro-ocular line; frontoclypeus with half of its length extending below vertex; lateral lobes small, free; tip broad, truncate, fringed with rather long golden pilosity, marginal carinae jet black. Thorax: Pronotum dark



Text-fig 33. *Gargara malabarica* n. sp.

1. Adult female. 2. Adult male. 3. Frontal view of female. 4. Frontal view of male. 5. Dorsal view of pronotum of female. 6. Dorsal view of pronotum of male. 7. Tegmina of female. 8. Tegmina of male. 9. Hind wing. 10. Male genitalia, lateral view. 11. First instar nymph. 12. Second instar. 13. Third instar. 14. Fourth instar. 15. Fifth instar.

brown, shading to jet black on median and lateral carinae and apical fourth of posterior process; metopidium three times as wide as high, covexly sloping backwards into disc; punctate with golden hairs more dense at bases of humeral angles; supra-ocular callosities not prominent; humeral angles prominent, light brown, blunt; posterior process strongly tricarinate, running horizontally backwards as far as the middle of 5th apical cell of tegmina, apical fourth jet black, tip a little curved upwards and acute, median carina finely percurrent on metopidium; scutellum aborted centrally, lateral basal areas exposed, punctate and somewhat tomentose; tegmina about two and two-thirds as long as wide, hyaline, basal fifth reddish brown, leathery and punctate, veins light reddish brown, a distinct reddish brown patch on R1 and rs; a lighter spot at anal angle; 1st apical cell twice as long as 2nd apical cell; lateral areas of thorax densely whitely tomentose; legs reddish brown except coxae which are black. Abdominal tergites dark brown, genital plates densely pubescent.

Measurements.—Length from frontal margin to tips of tegmina 4.5 mm., to tip of posterior process 3.4 mm., width across tips of humeral angles 2.2 mm., at tyes 2.0 mm.

Male.—Smaller, general colour black or almost black; upper margin of vertex arcuate and somewhat sinuate; frontoclypeus with one-third of its length extending beyond vertex, lateral lobes more or less fused to lateral margins of frontoclypeus, tip broader than in female. Thorax: Pronotum black, shaded to brown, finely punctate with closely adpressed pale yellow hairs, tip of posterior process pitch black, bluntly acute, a little decurved and extending as far back as tip of 5th apical cell of tegmina. Tegmina nearly 2.5 times as long as wide. 1st apical cell less than twice as long as 2nd apical; reddish brown patch on R1 and rs less conspicuous than in female; abdominal tergites dark brown with intersegmental membranes lighter, bifid tips of subgenital sternal plate divergent, broad, enlarged and densely pubescent.

Measurements.—Length from frontal margin to tips of tegmina 3.9 mm., to tip of posterior process 2.8 mm., width across tips of humeral angles 1.9 mm., at eyes 1.7 mm.

Nymph.—Fifth instar: Greyish brown; head directed backwards, twice as wide as long, eyes large fuscous; ocelli not visible; pronotum densely pilose dorsally; metopidium somewhat sinuate, sloping backwards to disc; posterior process tapering, extending over three-fourths the length of mesonotum; mesonotal process obscure; metathorax about one-third as long as mesothorax; wing pads large, extending as far as 4th abdominal segment, claval area demarcated from corium, costal margin dark brown, costal angles broadly rounded and not sharply demarcated; abdomen densely hairy; dorsal tubercles as in *rustica;* lateral lamellae, of moderate length, each bearing 5 or 6 thin spines; anal tube one-fifth the total body length, stout and nearly cylindrical, with longitudinal rows of very short tuberculate spines.

Host plant.—Phyllanthus emblica.

Holotype female; 18 female 7 male paratypes, 10 nepionotypes, Walayar, 8.viii.1967; Tambaram, 1.xii.1967.

The species is nearest to *extrema* but differs in the smaller size, in the nature of the pronotum which is coarsely ochraceously pilose, in the straight posterior process, in the hyaline tegmina which is not fuscous, and in the non-pedicellate 1st discoidal cell of tegmina.

Gargara rustica n.sp.

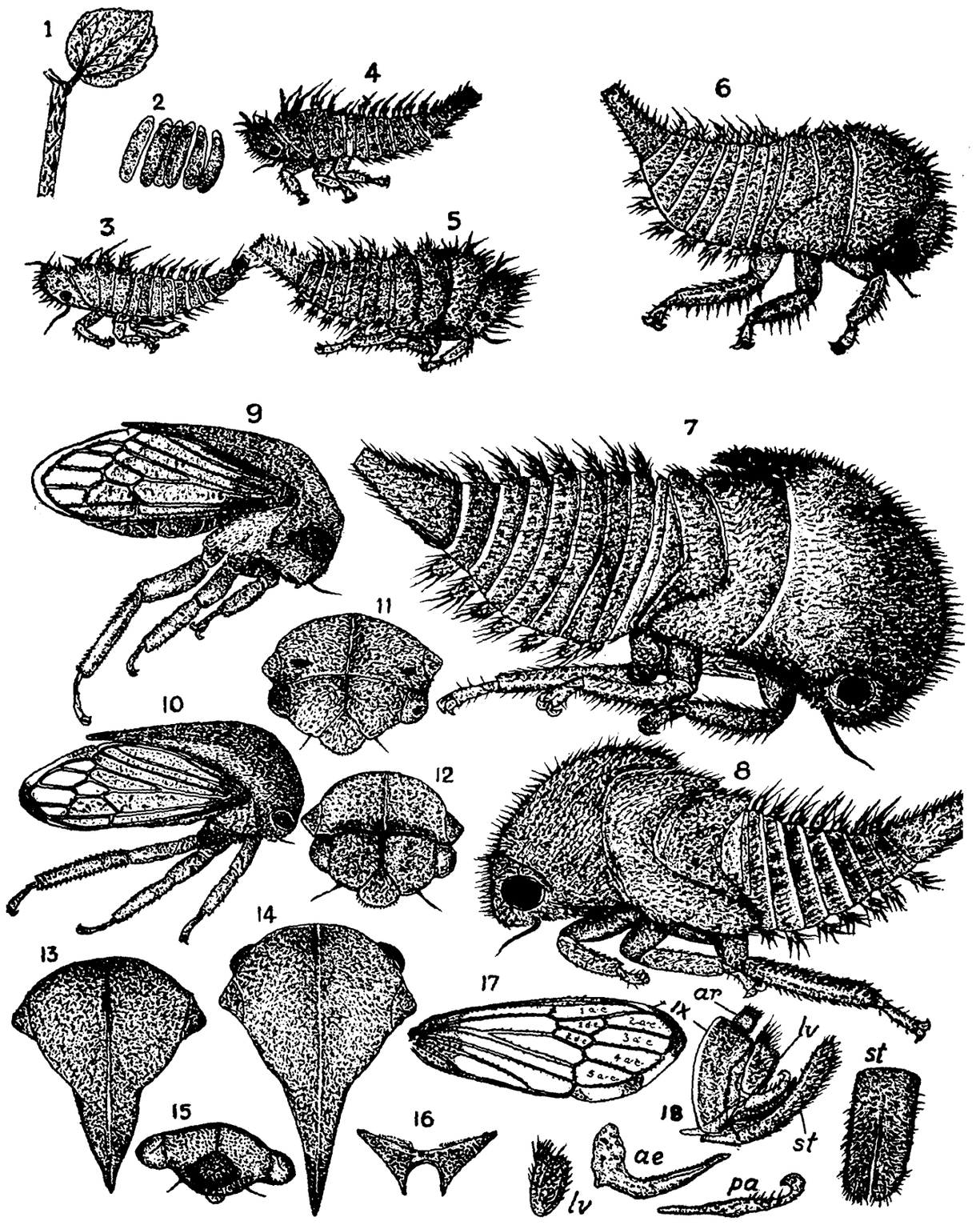
(Text-fig. 34)

Female.—General colour rusty brown; head declivous, about two and a half times wider across extremities of eyes than length of vertex, brown, sprinkled with red spots, densely pilose with golden yellow hairs; vertex about one and three-fourths as wide as long, upper margin planate, lower margins obliquely sloping to frontoclypeus; eyes subglobate, dark brown; ocelli jet black, small, slightly closer to eyes than to each other and located well above c-o-line; frontoclypeus greyish brown, extending about one-third its length below lower margins of vertex, its lobes entirely fused upto tips and together forming a broadly rounded tip fringed with somewhat longer pale yellow hairs; rostrum reaching bases of middle coxae; antennae rusty brown, their length equals half the width of frontoclypeus. Pronotum reddish brown, metopidium convex and sloping backwards, distinctly punctate, with yellow hairs, disc convex, sprinkled with rusty brown spots, humeral angles moderately prominent, light brown, their posterior angles rounded and tips blunt; posterior process arising horizontally from disc, fitting tightly against scutellum and contiguous with tegmina, basally broad and hollow ventrally, tricarinate, median carina finely continued on metopidium, terminal one-fourth of posterior process jet black, tip acute, just passing the anal angles of tegmina; scutellum twice as broad as long, deeply excavated at tip, incompletely chitinised in middle, strongly chitinised and punctate laterally; tegmina hyaline, nearly two and a half times longer than wide, extreme base coriaceous and punctate, veins reddish brown bordered with short hairs, 1st discoidal cell not petiolate, 2nd discoidal cell half as long as 1st apical cell, rusty brown patches on apical limbus opposite to 2nd, 3rd and 5th apical cells and at anal angle; lateral areas of thorax cretaceously sericeous; legs light reddish brown except coxae and trochanters which are black; abdomen dark reddish brown, lateral areas of sternites somewhat whitely tomentose; ovipositor robust, darker.

Measurements.—Length from frontal margin to tips of tegmina 4.0 mm., to tip of posterior process 3.2 mm., width across humeral angles 2.1 mm., at eyes 1.8 mm.

Male.—General colour jet black, smaller than female, eyes pale white with shades of yellow; metopidium, disc and posterior process pitch black with short silvery white adpressed hairs; tegmina subhyaline, sprinkled with rusty spots, veins black.

Measurements.—Length from frontal margin to tips of tegmina 3.3 mm., to tip of posterior process 2.6 mm., width across humeral angles 1.8 mm., at eyes 1.5 mm.



Text-fig. 34. *Gargara rustica* n. sp.

1. Egg-slits on host stem. 2. Eggs. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar of female. 8. Fifth instar of male. 9. Adult female. 10. Adult male. 11. Frontal view of female. 12. Frontal view of male. 13. Dorsal view of pronotum of male. 14. Dorsal view of pronotum of female. 15. Head, frontal elevation. 16. Scutellum. 17. Tegmina. 18. Male terminalia.

Fifth instar.—Strikingly dimorphic. Female larger, pale green, densely hairy; head directed backwards, 2.5 times wider than long, vertex with dense pilosity and long slender tuberculate spines; ocelli not visible; antennae as long as width across frontoclypeus; prothorax longer than pterothorax; metopidium convex, gradually sloping backwards, thickly hairy; posterior process densely pilose, passing over the entire length of mesonotum; tip acute; mesonotal process prominent; wing pads relatively small and narrow, their costal angles not distinctly demarcated; abdominal dorsal tubercles arranged as in *extrema*, but lateral lamellae short, each with 4 or 5 long spines besides smaller ones interspersed; anal tube about one-fifth of total body length, clothed with moderately long tuberculate spines.

Male fifth instar about three-fourths as long as female; head directed downwards, eyes prominent; prothorax shorter than pterothorax; pronotal posterior process some-what broader and blunt, not extending over the entire length of mesonotum; wing pads very large, sprinkled with short hairs, costal angles very distinct; abdominal lateral lamellae with 4 to 6 spines.

Host plant.—Zizyphus jujuba.

Holotype female; 35 female and 13 male paratypes, 21 nepionotypes, Madras, 12.ix.1967.

In this dimorphic species, the male is very near to *robusta* Distant in the general coloration of body and in the spots near the apex of clavus; the female is nearest to *mixta* in the ochraceously pilose pronotum and in the non-pedicellate 1st discoidal cell, but differs in the presence of reddish brown patches in the apical areas of costal margin, apical limbus and near apex of clavus.

Key to species of **Gargara** Amyot and Serville *based upon Fifth instar nymph*

1 (6) Spines on abdominal lamellae regularly arranged along margins.

2 (3) Body large, 4.75-5.25 mm. long; metopidium convex and obumbrant at base and then sloping backwards; pronotal posterior process extending upto one-half the length of mesonotum; lateral lamellae of abdomen long and broad, fringed with 8 or 9 long spines; castaneous patches scattered all over body. .*mixta* Buckton

3 (2) Body small; 2.0-2.75 mm. long; lateral lamellae of abdomen short, fringed with 5-7 moderately long spines.

4 (5) Head thrice as wide as long; pronotal posterior process short, never extending over mesonotum; abdominal dorsal tubercles adpressed to body; reddish brown patches scattered over body. .*albitarsis* n.sp.

5 (4) Head twice as wide as long pronotal posterior process long, extending over the entire length of mesonotum; abdominal dorsal tubercles erect; no red patches scattered over body. .*madrasensis* n.sp.

6 (1) Spines on abdominal lateral lamellae not regularly arranged along margins, but springing from the sides.

7 (8) Body large, 4.0-4.5 mm. long; metopidium vertical upto three-fourths its height and then sloping backwards; pronotal posterior process extending upto one half the length of mesonotum; lateral lamellae of abdomen with 4 or 5 spines, longer thanl amella. .*extrema* Dist.

8 (7) Body of moderate size, 3.25-3.75 mm.

9(10) Pronotal posterior process extending over the entire length of mesonotum, mesonotal process prominent; wing pads of female short and narrow; lateral lamellae of abdomen short and narrow with 4 or 5 spines. .. .*rustica* n.sp.

10 (9) Pronotal posterior process extending upto three-fourths the length of mesonotum; mesonotal process obscure; abdominal lateral lamellae of moderate size, with 5 or 6 spines. .. .*malabarica* n.sp.

Tribe **Cococosterphini** Distant 1908

The tribe Coccosterphini is very closely related to Gargarini from which it is distinguished by the scutellum which is abortive in the middle. The pronotum is either tuberculate or not. The tegminal veins are coarsely or finely tuberculate; a distinct pterostigma may be present or absent.

Genus **Coccosterphus** Stål 1869

1869. *Coccosterphus* Stål, *Hem. Fabr.*, **8**: 67.

1903. *Phaerotus* Buckton, *Mon. Memb.*: 255.

(Type of the genus *Membracis minutus* Fabr.)

Body small, obovate; head declivous, two and a half to three times as wide as long, width across eyes equal to width of metopidium; eyes somewhat deflexed; ocelli nearer to eyes than to each other and situated on or above centro-ocular line; tip of frontoclypeus on a line with lower margins of vertex or extending below to a variable degree, its lobes entirely fused; pronotum moderately convex, finely or coarsely tuberculate, metopidium about one and a half times as wide as high; suprahumeral horns absent; humeral angles prominent; base of posterior process broadly triangular, depressed from base to middle, closely fitting against scutellum and contiguous with tegminal inner margins, apex laminately convexly raised, reaching apex of clavus; scutellum aborted in the middle, apices spine-like; tegmina with or without a distinct pterostigma, obliquely rounded, apical limbus narrow, base opaque and coriaceous, veins stout, bearing small or large nodulose tubercles, with 5 apical cells and two or three discoidal cells, outer discoidal cell petiolate in some, apical cells often divided by abnormal cross veins; hind wings with three apical cells.

Key to species

1 (4) Tegmina with a distinct pterostigma; tubercles on pronotum and tegminal veins small.

2 (3) Pronotum light brown, with a strong tubercular basal ridge project ing forward, a broader less elevated convex ridge on either side; base of vertex broadly truncate; ocelli located on c-o-l. .. .*paludatus* Distant.

3 (2) Pronotum rusty brown; metopidium with a median and a pair of lateral greyish white streaks; base of vertex strongly arcuate; ocelli located above c-o-l. .*tuberculatus* (Motsch.)

4 (1) Tegmina lacking a pterostigma; tubercles on pronotum and tegminal veins large. .. .*minutus* (Fabricius)

Coccosterphus minutus (Fabricius)

(Text-fig. 35)

1798. *Membracis minuta* Fabricius, *Ent. Syst. Suppl.*: 514.

1803. *Centrotus minutus:* Fabricius, *Syst. Rhyng.*: 22.

1851. *Scaphula* (?) *minuta*: Walker, *List of Hom. Br. Mus.* **2**: 589.

1869. *Coccosterphus minutus:* Stal, *Hom. Fabr.* **8**: 51.

1903. *Scaphula minuta:* Buckton, *Mon. Memb.*: 149.

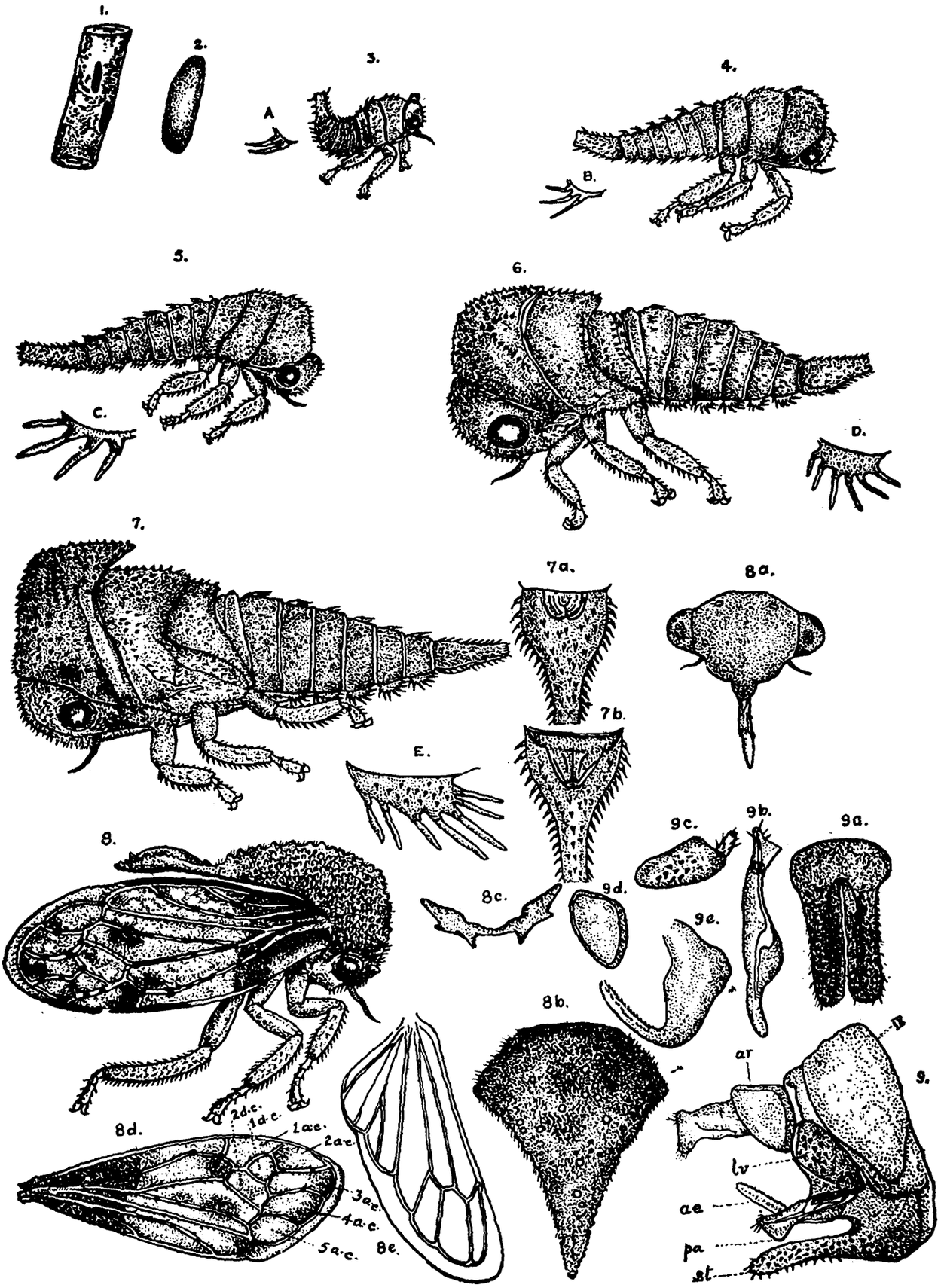
Female.—General colour black; head two and a half times wider than long, sprinkled with granules, sparsely pilose with short adpressed pale white hairs; eyes hemispherical, dull white; ocelli nearer to eyes than to each other and located above centro-ocular line; frontoclypeus nearly oval, about half of its length extending below lower margins of vertex, tip broadly rounded; pronotum black, with large tubercles and granules; metopidium nearly vertical, humeral angles prominent and finely punctate, suprahumeral horns absent; posterior process broadly triangular, slightly elevated behind disc, dorsal carina obsolete anteriorly, interrupted in the median depressed part of posterior process, apical region laminately convexly raised and strongly tuberculate, tip acuminate; tegmina 2.5 times longer than wide, lacking pterostigma, pale greyishly flavescent, basal third coriaceous, punctate and black, veins more or less infuscate, coarsely tuberculous, apical area tinted with reddish brown patches, first apical cell wedge-shaped, twice as long as broad, first discoidal cell stylate; hind wings with 3 apical cells.

Measurements.—Length from frontal margin to tips of tegmina 3.0-3.25 mm., to tip of posterior process 2.2-2.4 mm., width across humeral angles 1.8-2.0 mm., at eyes 1.7-1.8.

Male.—Smaller than female; pronotum and legs black, tegmina as long as abdomen, semilucid yellow with white dots. Genitalia, with sternal plate pitch black, cleaved to about three-fourth of its length from apex; lateral valve wedge-shaped, process very short and unchitinised; aedeagus and parameres as in *tuberculatus*.

Measurements.—Length from frontal margin to tips of tegmina 2.5-2.75 mm., to tip of posterior process 1.8-2.2 mm., width at humeral angles 1.6-1.8 mm., at eyes 1.6 mm.

Fifth instar nymph.—Coloration green; head with closely arranged granules and very short tuberculate spines arranged in a characteristic manner, base of vertex planate, bordered by slender bristles; tip of rostrum extending to basal half of mesothorax; eyes prominent, ocelli inconspicuous; lower margin of frontoclypeus on a line with lower margins of vertex, densely setose; metopidium slightly concave in front, granulose, a transverse keel on either side margined by short closely arranged tubercles; posterior process of pronotum high above mesonotum, passing



Text-fig. 35. *Coccosterphus minutus* (Fabricius)

1. Twig with egg-slits. 2. A single egg. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar. 7a. Rudiments of male genitalia of fifth instar. 7b. Rudiments of female genitalia of fifth instar. 8. Adult female. 8a. Head, frontal elevation. 8b. Pronotum, dorsal view. 8c. Scutellum. 8d. Tegmina. 8e. Hind wing. 9. Male genitalia, lateral view. 9a. Sternal plate. 9b. Paramere. 9c. Lateral valve. 9d. Anal ring. 9e. Aedeagus.

over basal half of the latter and bearing tubercles tipped with short spines; posterior borders of thoracic tergites fringed with rows of fine hairs; mesonotal process tuberculate, slightly overlapping metanotum; wing pads broad, granules scattered throughout, costal angles very well demarcated, bordered with tuberculate spines; abdomen with 9 segments, the first one is very narrow, the last forming the anal tube; dorsal tuberculate spines adpressed to body; lateral lamellae semicircular, with 7 penicillate spines fringing each lamella; anal tube shorter than the combined length of the three preceding segments; genital rudiments distinct in male and female.

Host plants.—*Prosopis spicigera*, *Cestrum diurnum*, *Tecoma stans*, *Vernonia sinerea*, *Acalypha* sp.

Material studied.—105 females, 39 males, and numerous nymphs, Madras, —.xii.1966.

Coccosterphus paludatus Distant

(Text-fig. 36)

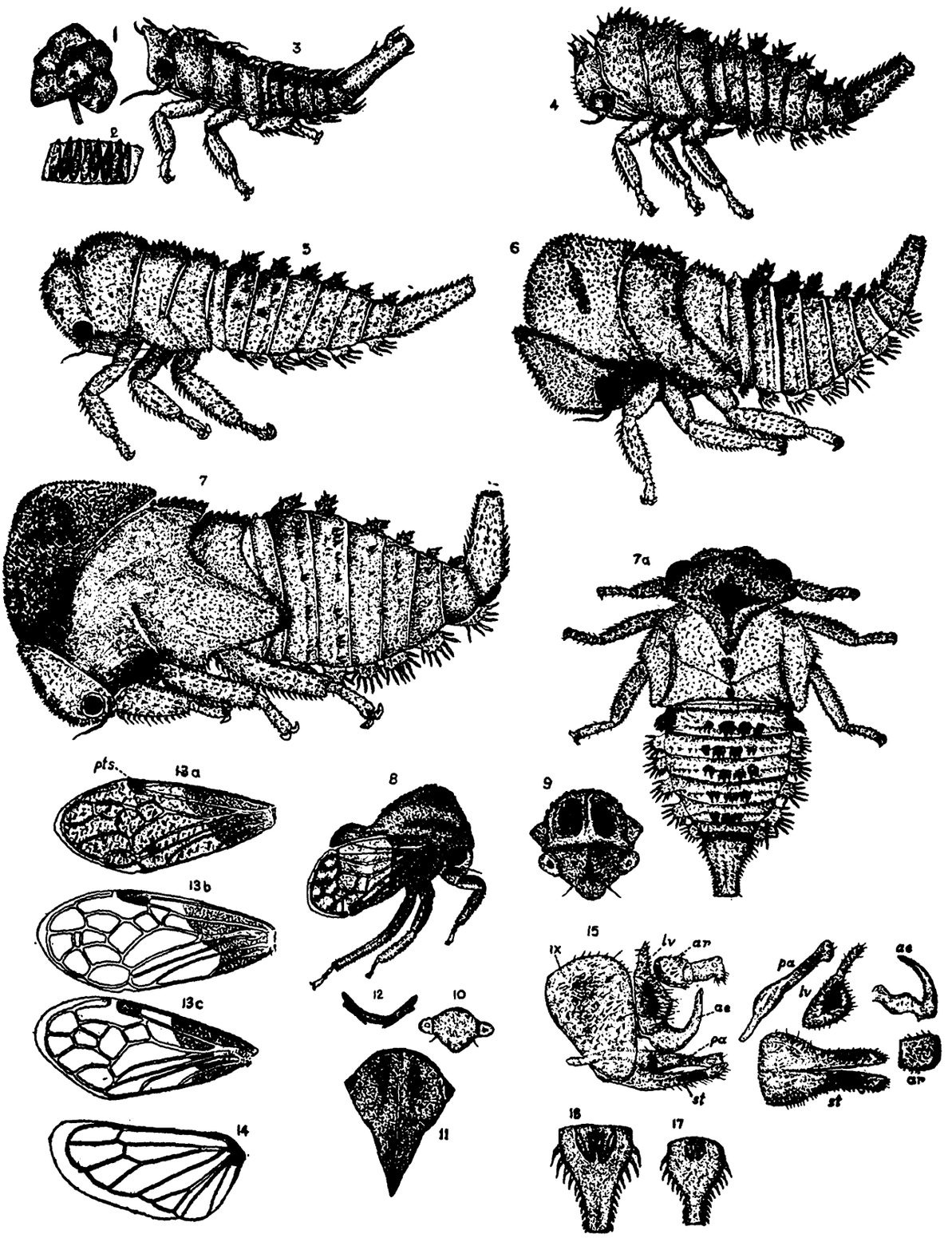
1916. *Coccosterphus paludatus* Distant, *Fauna Brit. India, Append.* **6:** 175.

Female.—General colour light brown; head nearly vertical, two and a half times wider than long, thickly greyishly pilose, base of vertex broadly truncate; eyes hemispherical, pale white; ocelli nearer to eyes than to each other and located on centro-ocular line; frontoclypeus greyish pilose, with its distal half extending below lower margins of vertex, tip broadly rounded, frontoclypeal lobes fused; pronotum light brown, finely tuberculate on median dorsal ridge, with a broad elongate tuberculate ridge on either side; metopidium vertical, with two broad nearly oval ridges one on either side of the median carina which is finely percurrent; suprahumerals absent; humeral angles prominent, thickly pilose; posterior process gradually acuminate, base broadly triangular, concave behind base, apical area black, strongly compressed and convex; scutellum incomplete in the middle; tegmina two and a half times longer than wide, with a distinct pterostigma, greyish white, basal third coriacious and dark brownish ochraceous, followed by a transverse greyish white line, distal half of tegmina with reddish brown patches forming a broad transverse fascia, apical area sprinkled with brown spots, veins reddish brown with small sparse tubercles arranged linearly; legs black upto three-fourths of femora, tibiae ochraceous, tarsi light brown.

Measurements.—Length from frontal margin to tips of tegmina 3.6-4.0 mm., to tip of posterior process 2.7-2.9 mm., width across humeral angles 2.3-2.5 mm., at eyes 1.8-2.0 mm.

Male.—Similar to female. Genitalia, with sternal plate cleaved to two-thirds of its length from apex; lateral valves wedge-shaped, process long and unchitinised; aedeagus *U*-shaped, tip acuminate; tips of parameres slightly expanded; connecting plate rectangular.

Measurements.—Length from frontal margin to tips of tegmina 3.5-3.8 mm., to tip of posterior process 2.6-2.8 mm., width across humeral angles 2.1-2.4 mm., at eyes 1.6-2.0 mm.



Text-fig. 36. *Coccosterphus paludatus* Distant

1. Egg slits on Morinda fruit. 2. Egg slit cut open to show eggs. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar. 7a. Dorsal view of fifth instar. 8. Adult female. 9. Frontal view. 10. Frontal elevation of head. 11. Pronotum, dorsal view. 12. Scutellum. 13a, b, c. Variations in tegminal venation. 14. Hind wing. 15. Male genitalia, lateral view. 16. Rudiments of female genitalia in fifth instar, 17. Rudiments of male genitalia in fifth instar.

Fifth instar nymph.—Strikingly different from that of *minutus;* body nearly cylindrical, heavily chitinised fore-shadowing the shape and colour of adult; general colour brown dorsally, pale green ventrally; head 2.5 times wider than long, base of vertex planate, cranial tubercules persistent; frontoclypeus never extending beyond lower margins of vertex; rostral tip extending upto middle of hind coxae; thorax nearly as long as abdomen; metopidium convex in front, pronotum sprinkled with granules and short spines on tubercles; a longitudinal carina on disc confluent with a pair of lateral ridges, giving a characteristic cruciform structure, covered with dense tuberculate spines; median ridge continued over posterior process which overlaps the basal half of mesonotum; mesonotum with a median ridge; metanotum narrow, bearing a group of spines on a smaller median ridge; wing pads greyish brown, costal angles distinctly demarcated; abdominal dorsal tubercles tooth-like and heavy; lateral lamellae flat, with 6 or 7 penicillate spines; anal tube about one-seventh the length of body.

Host plants.—*Morinda* sp., *Cestrum diurnum*, *Lawsonia alba*, prop roots of *Ficus bengalensis.*

Material studied: 80 females, 19 males and numerous nymphs, Madras, 1.ix.1965.

Coccosterphus tuberculatus (de Motschulsky)

(Text-fig. 37)

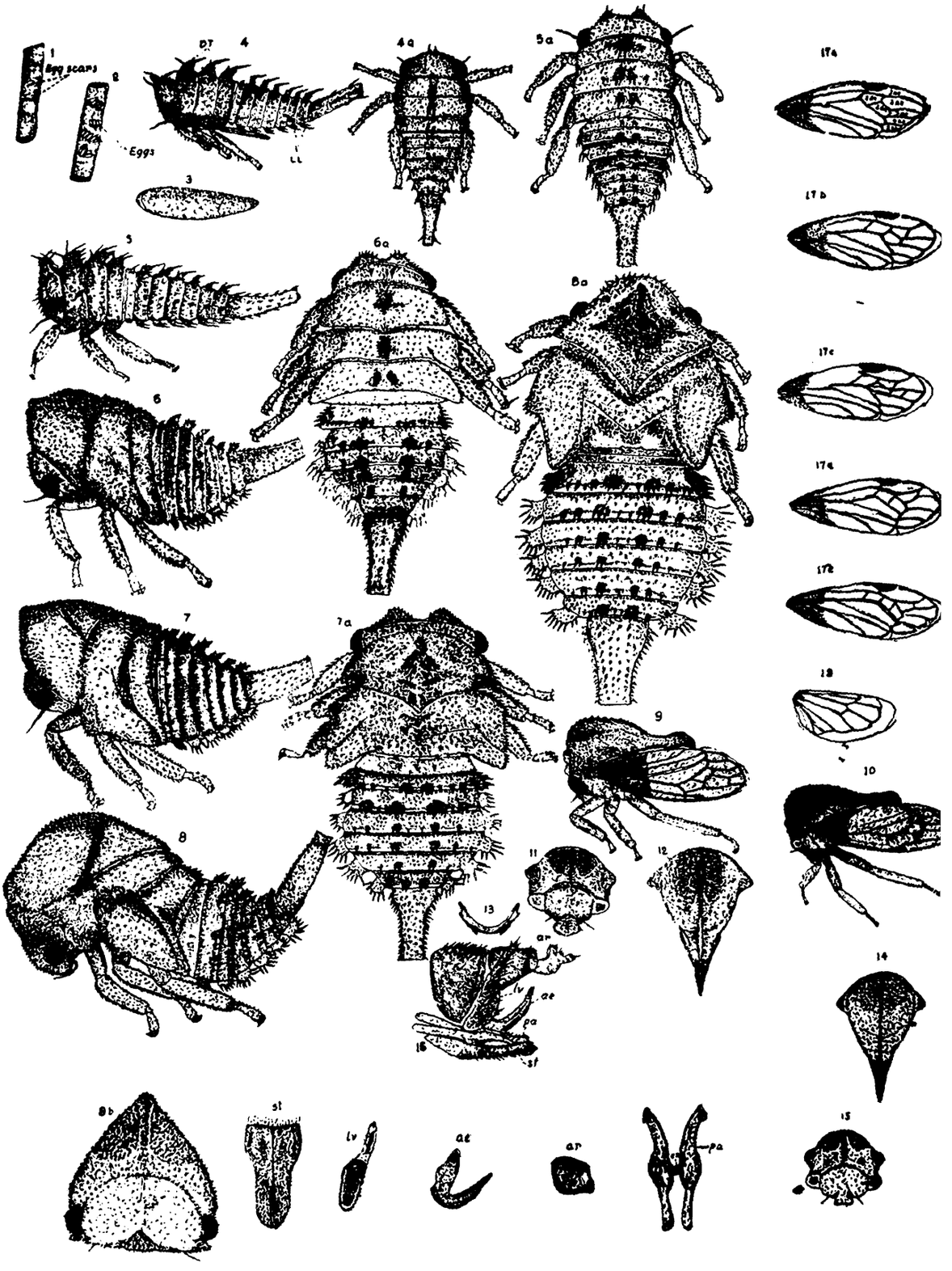
1859. *Anomus tuberculatus* de Motschulsky, *Etud. Ent.* **8**: 109.

1903. *Gargara fasciata* Melichar, *Hom. Faun. Ceylon*, : 122.

1903. *Coccosterphus tuberculatus:* Melichar, *Hom. Faun. Ceylon*, : 121.

Female.—General colour dark brown; head twice as wide as long, rusty brown, sparsely pilose with pale white hairs, base of vertex strongly arcuate and sinuate, eyes prominently projecting laterad; ocelli closer to eyes than to each other and situated slightly above centro-ocular line; frontoclypeus extending three-fourths its length below lower margins of vertex; pronotum rusty brown above, thickly and finely punctate, clothed with short greyish white hairs; metopidium nearly twice as wide as high, with a vertical, median and two lateral greyish white streaks; a pair of broad, oval tuberculate ridges one on either side of median ridge on metopidium; posterior process distinctly keeled dorsally, finely tuberculate, apical area black, strongly compressed and convex, with short tubercles, apex reaching tip of clavus; tegmina about 2.75 times longer than wide, hyaline, with a distinct pterostigma, basal one-third coriaceous and rusty brown, a broad rusty brown transverse fascia beyond middle of tegmina, apical area speckled with reddish brown patches, veins reddish brown, moderately stout, with sparsely arranged tubercles; hind wings with 3 apical cells; legs, with tibiae rusty brown, trochanters and femora black, tarsi yellowish with black spots.

Measurements.—Length from frontal margin to tips of tegmina 3.4-3.8 mm., to tip of posterior process 2.4-2.7 mm., width at humeral angles 1.7-1.9 mm., at eyes 1.7 mm.



Text-fig. 37. *Coccosterphus tuberculatus* (Motsch.)

1. Twig with egg slits. 2. Egg slits exposed. 3. An egg. 4. First instar, lateral view ; 4a. its dorsal view. 5. Second instar, lateral view ; 5a. its dorsal view. 6. Third instar, lateral view ; 6a. its dorsal view. 7. Fourth instar, lateral view ; 7a. its dorsal view. 8. Fifth instar, lateral view ; 8a. its dorsal view. 8b. Frontal view of fifth instar. 9. Adult female. 10. Adult male. 11. Frontal view of female. 12. Pronotum of female, dorsal view. 13. Scutellum. 14. Pronotum of male, dorsal view. 15. Frontal view of male. 16. Male genitalia, lateral view. 17, a-e. Variations in tegminal venation. 18. Hind wing.

Male.—Smaller than female, jet black; genitalia similar to that of *paludatus*.

Measurements. Length from frontal margin to tips of tegmina 3.0-3.5 mm., to tip of posterior process 2.2-2.5 mm., width at humeral angles 1.5-1.7 mm., at eyes 1.5 mm.

Fifth instar nymph.—Similar to *paludatus*, differing only in the colour patterns; general coloration greyish with shades of black; head, pronotum, lateral parts of segments 3 to 6 of abdomen black, dorsal tubercles dark brown, rest of body greyish; lower surface of abdomen pale green; anal tube raised upwards, about one-fifth the length of body.

Host plants.—Phyllanthus emblica, Morinda tinctoria.

Material studied.—85 females, 20 males and many nymphal instars, Madras, 10.i.1966.

Key to species of **Coccosterphus** *based on Fifth instar nymph*

1 (2) Metopidium vertical, dorsal tuberculate spines simple and short; abdominal lateral lamellae small and crescentic bearing 7 penicillate spines; body uniformly green. ..*minutus* Fabr.

2 (1) Metopidium convexly obumbrant; dorsal tubercles of abdominal segments tooth-like, heavy and multispinous; abdominal lateral lamellae larger, flat, each with 6 or 7 short, stout, penicillate spines arranged in a palmate manner.

3 (4) Body yellowish brown.. .. .. .*paludatus* Dist.

4 (3) Body greyish black.. . . .*tuberculatus* (Motsch.)

Genus **Parayasa** Distant

1916. *Parayasa* Distant, *Fauna Brit. India, Append.* **6**: 180.

(Type of genus *Parayasa typica* Distant)

Body small; head 3 times wider across extremities of eyes than length of vertex; eyes subglobate; ocelli about as near to eyes as to each other and situated on centro-ocular line; frontoclypeus extending to one half its length below lower margins of vertex; tips broadly rounded, clypeal lobes fused; pronotum rather low, not tuberculate, metopidium slightly convex; humeral angles prominent with posterior margins rounded; suprahumeral horns absent; posterior process broadly triangular at base, more or less concavely sinuate, closely fitting against scutellum and contiguous with inner margins of tegmina, apical area laminately convex, tip just reaching the apex of 2nd anal cell of tegmina and not reaching the posterior angle of the inner margin of tegmina; scutellum aborted in the middle; tegmina nearly thrice as long as wide, apical limbus narrow, 5 apical cells and 2 discoidal cells, veins finely tuberculous; hind wings with 3 apical cells.

Parayasa maculosa Distant

(Text-fig. 38)

1916. *Parayasa maculosa* Distant, *Fauna Brit. India, Append.* **6**: 127.

Female.—Head brownish ochraceous, thickly pilose, about thrice as wide as long, base of vertex broadly truncate, eyes subglobate, pale white; ocelli equidistant to each other and from eyes and located on centro-ocular line; frontoclypeus sparsely pilose, with half of its length extending below lower margins of vertex; pronotum reddish brown, finely punctate, with short, thickly arranged pale white hairs; metopidium convex in front; posterior process closely fitting against scutellum, nearly straight, tip acute, reaching the 2nd anal cell of tegmina, dorsal carina percurrent through metopidium; tegmina about 3 times longer than wide, basal fourth opaque, dark, thickly punctate, 2nd discoidal cell nearly one and a half times longer than first, first apical cell wedge shaped; scutellum reddish brown, aborted in the middle; legs, with trochanters and femora black, rest light reddish brown.

Measurements.—Length from frontal margin to tips of tegmina 4.0 mm., to tip of posterior process 2.0 mm., width at humeral angles 1.5 mm., at eyes 1.4 mm.

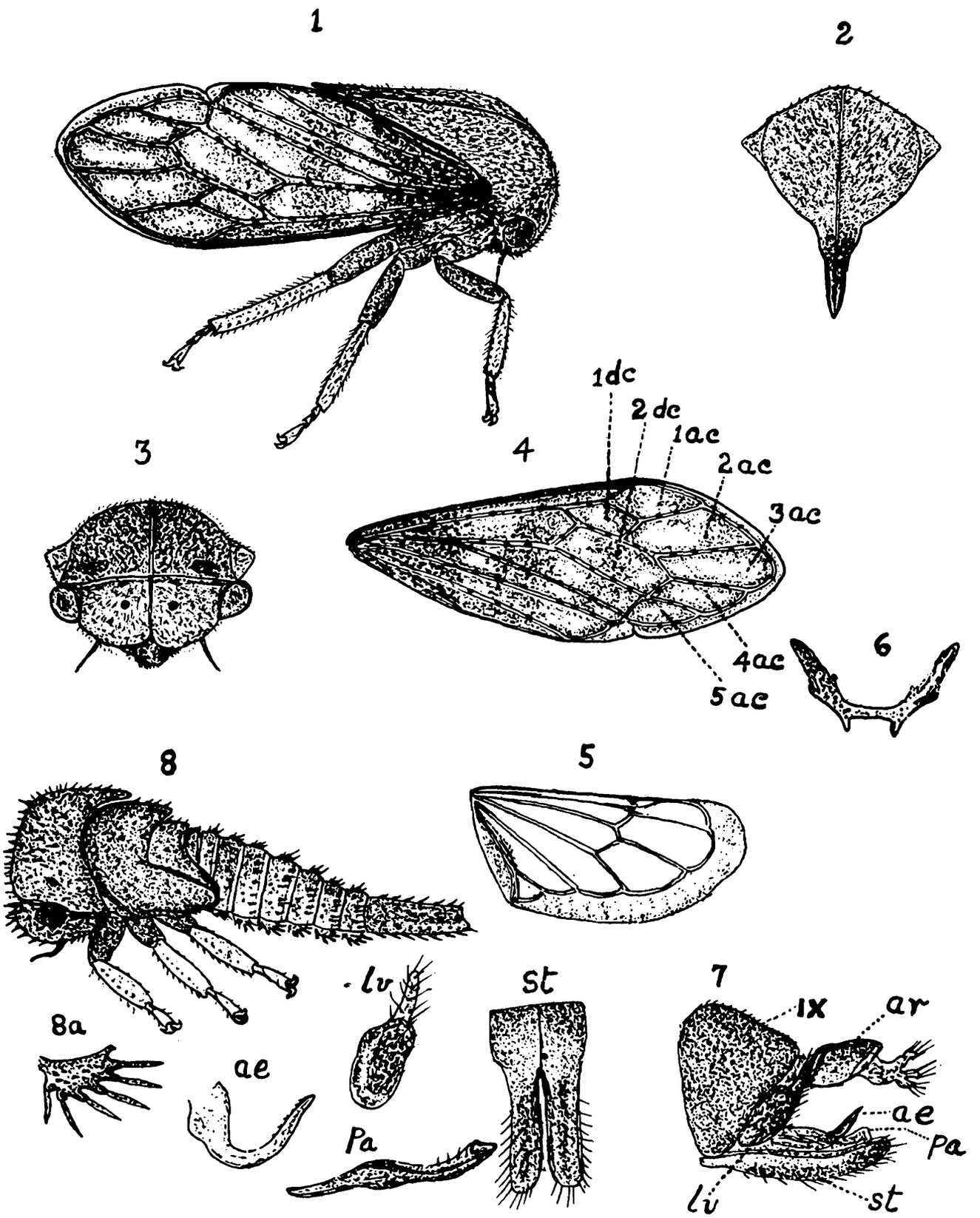
Male.—Similar to female. Genitalia, with sternal plate cleaved to about two-thirds of its length; lateral valves elongate-oval, process about half as long as valve; aedeagus and parameres similar to those of *Coccosterphus.*

Fifth instar nymph.—General colour deep green; body laterally compressed; head directed backwards, rostral tip reaching middle of hind coxae; eyes brown; ocelli inconspicuous; thorax nearly as long as abdomen excluding anal tube; metopidium nearly vertical; posterior process about two-thirds the length of mesonotum; wing pads extending back to 3rd abdominal segment, costal angles distinct; lateral lamellae similar to those of *Coccosterphus*, each lamella bearing 6 penicillate spines.

Material studied.—6 females and 3 males and 6 nymphs, Kodiakanal, 22.vi.1968.

Discussion

The occurrence of considerable intraspecific variation in the Membracidae though generally accepted, has not been emphasised in spite of profound plasticity shown by many species with reference to the pronotal structures and the tegminal characters, which has led to much confusion in the matter of allocating the species to their correct taxa. That the suprahumeral horns are liable to vary considerably within species has been clearly exemplified by *Oxyrhachis tarandus* and *Leptocentrus varicornis* (Text-fig. 2 & 13). Equally significant is the existence of sexual dimorphism, the occurrence of which was not recorded in the past except by Capener (1962, 1968) in the African Oxyrhachinae and Centrotinae. Observations herein presented are in agreement with Capener in that the basic error in the classification was the separation of groups



Text-fig. 38. *Parayasa maculosa* Distant

1. Adult female. 2. Dorsal view of pronotum. 3. Frontal view. 4. Tegmina. 5. Hind wing. 6. Scutellum. 7. Male genitalia, lateral view. 8. Fifth instar. 8a. Lateral lamella of fifth instar.

based on the presence or absence of suprahumeral horns. *Tricentrus purpureus* and *Telingana consobrina* provide typical examples in support of this view since their suprahumeral horns exhibit marked differences in the two sexes. Above all, the discovery of polymorphism with regard to the degree of development of suprahumeral horns in *Tricentrus pilosus* (Text-fig. 24) where both the males and the females exhibit a gradation between individuals with well developed horns and those lacking the horns, is an instance of the extreme lability of these structures and the risks involved in relying too much on them for the determination of the species.

Distant (1908) differentiated *Tricentrus* from *Gargara* by the presence of suprahumeral horns in the former genus, but the apparent weakness of this character is demonstrated by the discovery of *Tricentrus decornis* which lacks the suprahumeral horns in both the sexes and might easily be allocated to the genus *Gargara*, were it not be for the presence of the armed hind trochanters equipped with rows of strong spines on an elevated disc (Text-fig. 28). The spined trochanters were first used by Stal for separating his genera, *Tricentrus* and *Sipylus*. Distant (1908), while (1866) admitting the soundness and reliability of this character, felt that it is "somewhat difficult or obscure character to always distinguish" But as Funkhouser (1917) has stated, Distant's criticism is not valid since the spines on the hind trochanters are plainly visible from a caudal view of the insect. Moreover, removal of one of the hind legs for examining the trochanters will not in any way damage the other useful structures of taxonomic value.

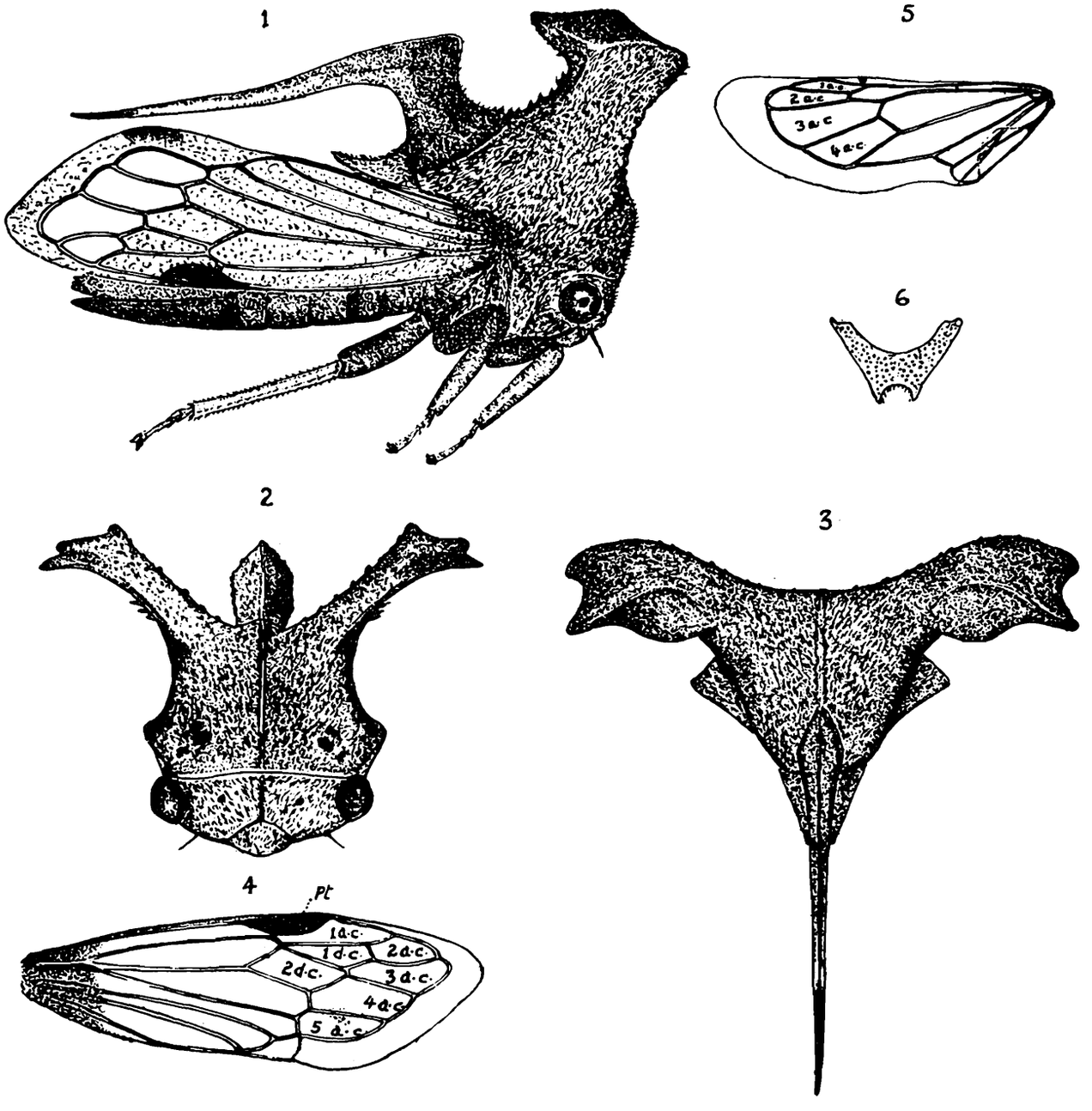
Although of considerable systematic value, the tegmina were not given due importance in the past. Distant (1908) remarked that the number of tegminal apical cells is "an uncertain character owing to the different method of computations used by describers" More recent workers, particularly Evans (1948) and Capener (1968) have stressed the importance of tegminal characters. In all the species studied, the tegmina present 5 apical cells. The relative length and width of the 1st apical cell has proved to be of value at generic level and has been largely used in the present studies in separating genera and species. The 1st and the 2nd discoidal cells are no less important. The former may be stylate in some species and bears a definite relationship in its size to the latter. Sexual dimorphism has been noticed to occur in *Telingana consobrina*, the male tegmina possessing but one discoidal cell (Text-fig. 19). The most striking tegminal character deserving consideration is the presence or absence of a pterostigma. This structure is formed by a chitinised thickening of the tegminal membrane near R1. The tribe Leptocentrini lacks a pterostigma while in the Centrotini it is present in some like *Anchon* and absent in others like *Tricentrus* and *Centrotus*. In the Gargarini an incipient pterostigma has been discovered in *Gargara malabarica* and *G. mixta*, the latter possessing the structure only in the male. In the tribe Coccosterphini, the genus *Coccosterphus* is of particular interest as two of the species, *C. paludatus* Dist. and *C. tuberculatus* (Motsch.) possess a distinct pterostigma while *C. minutus* lacks this structure. According to Capener (personal communication, 1966) the presence or absence of a tegminal pterostigma is a very important character and has been largely used in the separation of African genera. Capener's suggestion of separating *minutus* and

paludatus into two genera finds favour when considered in conjunction with the male genitalia and nymphal characters, which show striking differences to warrant the revision of the genus *Coccosterphus*. In *C. paludatus* and *C. tuberculatus* (Text-figs. 36 & 37) there is also a tendency for the apical cells to get subdivided by abnormal cross veins.

The importance of the hind wings has been recognised by earlier workers in the separation of tribes. In the Leptocentrini and Centrotini the number of apical cells in the hind wings have been found to be 4 and 3 respectively. According to Capener (1968) the number of apical cells in the hind wings of all the tribes of the subfamily Centrotini are remarkably constant. However, many previous workers never made mention in descriptions of species about the number of apical cells in the hind wings which has resulted in confusion. For example, what Distant (1908) thought as *Centrotus indicatus* Melichar has now turned out to be *Otinotus indicatus* (Melichar) in view of the presence of 4 apical cells in the long series of specimens collected from Madras. It may not be out of place to mention here that in the past the genus *Centrotus* has been a clearing house for a wide range of species and to-day most of those originally placed in this genus have been re-allocated to other genera.

Present studies have also shown that intraspecific variations do occur in respect of the number of apical cells in the hind wings. For example, the genus *Anchon* is characterised by three apical cells in the hind wings and as such designated to the tribe Centrotini. However, specimens collected from S. India and identified as *Anchon echinatum* Dist. (Text-fig. 39) and *Anchon ulniforme* Buckton reveal 4 apical cells in the hind wings showing the plasticity of this character previously believed to be rigid.

Funkhouser (1927) and Goding (1931) have called attention to the presence of "mesonotal teeth" as a diagnostic feature of the tribe Coccosterphini; Distant (1908) who erected this tribe also diagnoses it as having the mesonotum armed at the apex with two distinct prolongations, acute or otherwise. However, no such teeth could be distinguished, in any of the species examined. Probably these authors meant the forwardly directed mesopleural processes of Mc Atee and Malloch (1928). Hasenoehrl and Cook (1965) also noted the presence of ventrolateral teeth on the mesothoracic episternum in *Oxyrhachis lefroyi* and *Stictocephala bubalus*. Thus, while no mesonotal teeth appear to be present, mesopleural teeth or processes occur in all membracids and these structures may not be characteristic of Coccosterphini. On a balance of characters that overlap and due to the fluid nature of several characters in the tribe Coccosterphini, Capener (personal communication) remarks that the genus *Coccosterphus* should be placed in the tribe Gargarini and has reiterated the same view in his monographic work on Centrotinae (1968). Though this view finds favour so far as the adult characters are concerned, it appears rather contradictory when the nymphal characters are considered. The abdominal lateral lamellae with their fringing spines in all the species of *Gargara* are so strikingly different from those of *Coccosterphus* that the idea of including the genus *Coccosterphus* in Gargarini has been kept in reserve.



Text-fig. 39. *Anchon echinatum*

1. Adult female. 2. Frontal view. 3. Dorsal view of pronotum and scutellum. 4. Tegmina. 5. Hind wing. 6. Scutellum.

The importance of the genitalia has been stressed by Funkhouser (1917) who states "The male genitalia, while comparatively simple in structure, are extremely interesting and are well deserving of more serious study than has been given to them in the past" He further states in his concluding remarks: "On the whole the male genitalia afford good taxonomic characters. .. The relative position of the plates and the structure of the individual pieces show sufficient variations throughout the family, and are constant enough within a genus, to furnish valuable data at least to supplement the more evident characters of the exoskeleton" Buckton (1903) and Fowler (1897) believed the male genitalia as having very little practical value. Caldwell (1949) who attempted a generic rivision of the American membracids of the

tribe Ceresini pointed out the limitations of the use of genital structure in taxonomy in view of their identical nature in many different genera. Dennis (1960) examined a large number of *Stictocephala bubalus* (F.) with a view to determine the constancy or variability in the genitalia of both sexes of the species and he concludes that except for variations in the anterior arm of the aedeagus of the male and in the second valvula of the female, the uniformity of the genitalia is striking. It may be stated here that while the uniformity of genitalia within the species is certainly advantageous, their similarity in a number of species is disadvantageous in using them as primary diagnosing characters. Capener (1962) dealing with Oxyrhachinae states: "The male genitalia, from which so much was hoped, have proved unsatisfactory, for although on a tribal level they are distinctive, they have proved so similar in general shape and so variable in microscopic details, that they can only be used as subsidiary characters in certain species"

The present studies tend to show the importance of the male genitalia only as subsidiary characters in many of the species in view of their general similarity within the genus. For instance, in all the species of *Leptocentrus* the genitalic structures are remarkably uniform except for their size differences. Of all the genitalic components, the lateral valves with the process attached to them appear to have considerable value since they are distinct in the different genera. In all species of *Oxyrhachis*, the lateral valve is broadly triangular and the tuberculate process is short and roughly globular attached at right angles to the long axis of the valve. In *Leptocentrus* the lateral valves are elongate oval and the process is always short and well chitinised. In *Tricentrus* and *Gargara* the lateral valves are nearly identical being broadly triangular, the process very short and nodular. However, in *Tricentrus* the pilosity on the process is very dense, the hairs as long as the valve, whereas in *Gargara*, the hairs on the process are always short. In *Telingana*, the valves are elongate oval and the process is as long as the valve, while in *Otinotus indicatus* the valves are longly triangular and its process longer than the valve and densely hairy. As stated earlier, the lateral valves of *Coccosterphus paludatus* and *tuberculatus* closely resemble each other, those of *minutus* being very distinct. The aedeagus presents little variation, but differs in the two subfamilies. In Oxyrhachinae the inner surface of the aedeagus is smooth without serrations, the tip blunt and broadly rounded. In Centrotinae the inner surface of this structure is invariably serrated, the teeth being arranged in 3 rows. The parameres in *Oxyrhachis* have rounded tip while in the Centrotinae the tip is shaped like the hood of a snake; however, in all species of *Tricentrus* and *Gargara* examined, the tip of the paramere is characteristically recurved inwards. The sternal plate is invariably bifid, each divided plate terminating in a small apical lobe.

An analysis of the genitalic structures in the species mentioned above indicates a close relation between *Tricentrus* and *Gargara*, rather than *Gargara* and *Coccosterphus; Parayasa* and *Coccosterphus* with the exception of *C. minutus* are very closely related; this fact again indicates the distinctiveness of Coccosterphini and Gargarini. In spite of the usefulness of the male genitalia atleast as subsidiary in the membracid taxonomy, the general paucity of male in collections and the fact that in many

species they are still unknown, precludes the possibility of using their genitalic characters in taxonomy at present.

In the light of the above discussion it is clear that there are so much of overlapping of characters in the different species of adult membracids besides individual variations, added to sexual dimorphism in many instances and much difficulty is experienced to distinguish between closely related species. A knowledge of the nymphal characters will, therefore, help in diagnosing the species especially if one could associate both nymphs and adults so that they can be definitely associated as has been attempted in the present work. That the pronotal structures of the fifth instar nymphs, their dorsal tuberosities and lateral lamellae and the spines borne on them are more or less constant and that they are of considerable value in the determination of species have already been pointed out. Although some earlier workers like Wildermuth (1915) and Haviland (1926) thought that the spines and tuberosities were of a variable nature having little value in taxonomy, Funkhouser (1917) and Yothers (1934) have stressed their importance. The latter author has very accurately figured the tuberosities of all the nymphal instars of *Stictocephala inermis* and pointed out how the arrangement of dorsal spines differed in *Ceresa basalis*. Although the importance of nymphal characters are realised, no attempts were made earlier probably for the simple reason that nymphs were not available for study, as correctly pointed out by Capener (1968): "Nymphs, unfortunately are all too seldom seen in collections and have rarely been associated with definite species" The present studies on nymphs have shown fairly well that it is possible to differentiate closely related species from a consideration of their nymphal differences. For instance, the adults of *Leptocentrus leucaspis* and *L. nigra* are very closely allied but they can be easily separated by examining their nymphs. *Leptocentrus varicornis* is a species exhibiting considerable individual variations in the adult stage, but its nymph with its extraordinarily long pointed pronotal anterior process which is a very stable character, immediately gives the clue about the species. Further, barring a few instances, nymphs never exhibit any sexual dimorphism unlike many adults and this precludes the possibility of any confusion that might arise. Even in the extreme cases of polymorphic species like *Tricentrus pilosus* where the adults exhibit different grades from individuals with well developed horns to those totally lacking the horns, the fifth instar nymphs of all those types are remarkably uniform, at the same time exhibiting characters sufficient enough for distinguishing them from the nymphs of other related species. It was stated in the early part of this chapter that a *Tricentrus* lacking suprahumeral horns is liable to be mistaken for a *Gargara* unless one takes the trouble of examinaing the hind trochanters. But the fifth instar of *Tricentrus* is so strikingly different from the corresponding stage of a *Gargara* that the two can be distinguished most easily even by a casual perusal of their dorsal tubercles and lateral lamellae. It should be emphasized that though the nymphal characters by themselves appear to be distinct enough to identify the species, their form and shape never indicate that of the adult in the species studied here except in two species, *Coccosterphus paludatus* and *C. tuberculatus*, wherein the nearly cylindrical and serrate body of the 5th instar nymph with much shortened anal tube is strongly indicative of the general appearance of the adult.

As stated earlier there appears to be a distinct linear relationship between the anal tube and body in the different stages of nymphs. A study of the relative growth has revealed relationships which, in many cases, appear in conformity with established taxonomic characters of adults.

The number of species based on which the nymphal characters are analysed in the present studies is limited, but all the same they are suggestive of their significance in taxonomy and pave the way for future work on similar lines when more material is available and if new and more reliable characters are discovered they can always be incorporated without difficulty.

TABLE 3

Total length of body and length of anal tube of the nymphal instars (in mm.)
(The figures are mean values of ten individuals at each stage)

	First Instar		Second Instar		Third Instar		Fourth Instar		Fifth Instar	
	Body length	Length of Anal tube	Body length	Length of Anal tube	Body length	Length of Anal tube	Body length	Length of Anal tube	Body length	Length of Anal tube
Oxyrhachis tarandus	1.25	0.34	2.5	0.5	3.25	0.6	4.9	0.8	5.5	0.9
O.rufescens	1.26	0.35	2.2	0.5	3.4	0.7	5.0	1.0	5.8	1.1
O.minusculus	0.8	0.16	1.4	0.28	2.4	0.46	3.3	0.7	4.5	0.88
O. uncatus	1.0	0.20	1.8	0.35	3.0	0.50	4.1	0.7	4.8	0.8
O. krusadiensis	1.0	0.18	1.9	0.35	3.2	0.55	4.1	0.7	5.5	1.0
O. brevicornutus	0.8	0.20	1.4	0.30	2.8	0.50	3.5	0.7	4.8	0.9
Telingana nigroalata	1.8	0.4	3.0	0.6	3.8	0.75	5.5	1.0	6.5	1.3
T. consobrina	1.2	0.3	2.1	0.45	3.0	0.60	4.5	0.9	6.0	1.2
Leptocentrus taurus	1.6	0.45	3.0	0.9	3.7	1.2	7.2	2.5	9.0	3.1
L. rhizophagus	1.3	0.30	2.75	0.5	3.5	0,8	5.5	2.0	9.0	2.6
L. varicornis	1.8	0.60	2.6	0.8	3.9	1.4	5.3	2.2	8.1	3.0
L. leucaspis	1.9	0.40	2.5	1.0	3.8	1.4	7.7	2.6	8.9	3.2
L. moringae	1.3	0.45	2.2	0.8	3.2	1.2	5.2	2.0	7.2	3.0
L. bajulans	1.5	0.53	2.4	0.9	4.0	1.4	7.4	2.7	8.6	3.2
L. nigra	1.6	0.45	2.8	0.95	3.8	1.4	6.0	2.15	8.8	3.1
L. bauhiniae	1.4	0.47	2.7	1.0	3.4	1.3	6.0	2.1	7.8	2.9
L. mangiferae	1.75	0.6	2.75	0.7	3.9	1.7	7.0	2.3	8.1	2.7
L. major	1.9	0.55	3.1	0.9	4.4	1.6	6.9	2.1	9.6	3.5
Otinotus oneratus	1.4	0.3	2.1	0.4	3.3	0.6	4.9	1.0	6.1	1.5
O. mimicus	1.3	0.25	2.2	0.4	3.2	0.7	4.6	0.9	5.3	1.6
O. indicatus	1.2	0.3	2.4	0.48	3.4	0.68	4.5	0.9	6.0	1.4
O. obliquus	1.5	0.3	2.8	0.5	3.6	3.70	5.0	0.8	6.6	1.2
Tricentrus pilosus	1.5	0.3	2.6	0.6	3.2	0.74	4.7	0.9	6.4	1.15
T. albomaculatus	1.25	0.3	2.5	0.5	3.4	0.6	4.1	0.8	5.5	0.9
T. decornis	1.5	0.37	2.2	0.5	2.9	0.7	3.5	0.77	4.1	0.9
T. purpureus	1.4	0.3	2.5	0.52	3.0	0.7	5.5	1.0	6.2	1.2
T. congestus	1.5	0.32	2.6	0.5	3.4	0.7	5.7	0.9	6.5	1.2
Gargara mixta	1.2	0.25	2.1	0.4	2.6	0.6	3.3	0.7	5.0	0.7
G. extrema	1.25	0.25	1.8	0.35	2.5	0.5	3.4	0.7	4.5	0.9
G. malabarica	1.25	0.30	2.0	0.40	2.4	0.5	3.1	0.6	4.0	0.8
G. rustica	1.0	0.25	1.7	0.35	2.5	0.55	2.9	0.61	3.5	0.72
G. albitarsis	0.8	0.2	1.4	0.3	2.0	0.4	2.6	0.5	3.1	0.60
G. madrasensis	0.6	0.15	1.5	0.3	2.1	0.42	2.5	0.5	3.0	0.65
Parayasa maculosa	0.8	0.2	1.6	0.3	2.2	0.45	2.8	0.6	3.2	0.70
Coccosterphus minutus	1.0	0.2	1.7	0.34	2.2	0.44	3.0	0.53	3.2	0.56
C. tuberculatus	1.1	0.26	2.2	0.55	2.9	0.67	3.4	0.8	4.2	0.9
C. paludatus	1.2	0.31	2.0	0.44	2.7	0.45	3.5	0.5	4.0	0.62

TABLE 3A

Growth pattern of anal tube in relation to length of body in membracid nymphs.

Species	Growth ratio (k)	Initial Growth index (b)	r (between log. X and log. Y)	Significance of r. -P-
Oxyrhachis tarandus	0.6509	0.2857	0.4492	>0.1
O. rufescens	0.7648	0.2839	0.9976	<0.001
O. minusculus	1.0020	0.1995	0.9985	<0.001
O. uncatus	0.7829	0.2095	0.9858	>0.001; <0.005
O. krusadiensis	0.9826	0.1807	0.8902	>0.02; <0.05
O. brevicornutus	0.8412	0.2320	0.9948	<0.001
Telingana nigroalata	0.8900	0.2311	0.9953	<0.001
T. consobrina	0.8873	0.2390	0.9912	<0.001
Leptocentrus taurus	1.1267	0.2664	0.9996	<0.001
L. rhizophagus	1.2164	0.1905	0.9730	>0.005; <0.01
L. varicornis	1.1339	0.2972	0.9931	>0.001
L. leucaspis	1.2288	0.2427	0.9641	>0.005; <0.001
L. moringae	1.0982	0.3357	0.9997	<0.001
L. bajulans	1.0146	0.3558	0.9993	<0.001
L. nigra	1.1250	0.2855	0.9957	<0.001
L. bauhiniae	1.0353	0.3456	0.9978	<0.001
L. mangiferae	1.0383	0.3168	0.9617	>0.005; <0.01
L. major	1.1206	0.2679	0.9924	<0.01
Otinotus oneratus	1.0735	0.1897	0.9863	>0.001; <0.005
O. mimicus	1.2289	0.1673	0.9764	>0.001; <0.005
O. indicatus	0.9328	0.2325	0.9862	>0.001; <0.005
O. obliquus	0.9560	0.2675	0.5755	>0.1
Tricentrus pilosus	0.9051	0.2304	0.9820	>0.001; <0.005
T. albomaculatus	0.7616	0.2511	0.9936	<0.001
T. decornis	0.8956	0.2557	0.9955	<0.001
T. purpureus	0.8973	0.2318	0.9913	<0.001
T. congestus	0.8514	0.2281	0.9663	>0.005; <0.01
Gargara mixta	0.7838	0.2370	0.9363	>0.01; <0.02
G. extrema	1.0177	0.1969	0. 999	<0.001
G. malabarica	0.8409	0.2383	0.9921	<0.001
G. rustica	0.8696	0.2403	0.9935	<0.001
G. madrasensis	0.8845	0.2249	0.9941	<0.001
G. albitarsis	0.8035	0.2342	0.9983	<0.001
Parayasa maculosa	0.9130	0.2265	0.9831	>0.001; <0.005
Coccosterphus minutus	0.8809	0.2069	0.9949	<0.001
C. tuberculatus	0.9419	0.2460	0.9955	<0.001
C. paludatus	0.5013	0.2881	0.9392	>0.01; <0.02

Key to lettering of **Text-figures**

A1, A2, A3—Anal veins
aa—anal angle
1 a.c.—first apical cell
2 a.c.—second apical cell
3 a.c.—third apical cell
4 a.c.—fourth apical cell
5 a.c.—fifth apical cell
ae—Aedeagus
an—Anal ring
an.c.—anterior carina
ap.l.—apical lobe of sternal plate
ap.lim.—apical limbus
ca—costal angle
cn—connective
Ms—mesonotum
mt—metanotum
oc—ocellus
P—pronotum
pa—paramere
pp—posterior process
pr.h—pronotal horn
pr.p—propleural process
p.s—posterior surface
pt.s.—pterostigma
p.w—posterior wing pad
R—radius
r—rostrum
sbc—sub-basal cell

c-c-l—centro-ocular line
co-sc—costa-subcosta
cp—cranial process
cu—cubitus
d—disc
1 dc—first discoidal cell
2 dc—second discoidal cell
d.p.c—dorso-posterior carina
f—frontoclypeus
G—gibba
h.f—hamular fold
l.a—lateral angle
l.c.—lateral carina
l.l—lateral lamella
l.s—lateral surface
lv—lateral valve
m—metopidium
M1, M2—media
mc—median carina
sh—suprahumeral horn
sh.b—suprahumeral bud
soc—supraocular callosity
soe—subocular expansion
st—sternal plate
sub.c—subcostal cell
tw—tegminal wing pad
vk—ventral keel

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