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of *L. reponens* (Walker) and *L. substitutus* Walker and description of
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Revision of Sandal's tree hoppers of the *Leptocentrus taurus* (F.)
species group (Homoptera, Membracidae, Centrotinae):
Re-description of *L. reponens* (WALKER) and *L. substitutus* WALKER
and description of four new species from the Indo-Pakistan
subcontinent

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Tree hoppers of the *Leptocentrus taurus* (F.) group, including *L. reponens* (WALKER) and *L. substitutus* WALKER, which attack Sandal (*Santalum album*) and other plants of economic importance in the Indo-Pakistan subcontinent, are described along with four new species from the above areas, with special reference to lateral lobes of frontoclypeus extending more than one-third but not more than half the length below lower margin of vertex and male and female genitalia. A key to the treated taxa is given, apomorphies are recognized and cladistic relationships are briefly discussed.

Keywords: *Leptocentrus taurus* species group, descriptions, new species, Pakistan.

INTRODUCTION

Tree hoppers of the *Leptocentrus taurus* (F.) and *L. pakistanensis* sp.n. subgroups of the *L. taurus* group attack the medicinal plant Sandal (*Santalum album*) (FUNKHOUSER, 1933) and other plants of economic importance in the Indo-Pakistan subcontinent (NAIR, 1976). MOHAMMAD & AHMAD (1989, 1994) have already treated four species, i.e. *L. neoalbonotatus* along with its biology and three species of the *L. taurifrons* (WALKER) subgroup, all belonging to the *L. taurus* group. That the lateral lobes of frontoclypeus are extended more than one-third but not more than half the length below the lower margin of the vertex was not mentioned to date in the genus *Leptocentrus* STÅL (MOHAMMAD & AHMAD, 1990). In this paper, we discuss the apomorphies of the above mentioned characters as well as the cladistic relationships.

METHODS

For the examination of various traits of head, thorax and abdomen, including their appendages, the specimens were relaxed partially following the technique of AHMAD (1986). Various components of the genitalia were studied following the technique of the present authors (1990).

The following abbreviations are used for the museums: Natural History Museum, University of Karachi (NHMUK), Museum of Natural History, London (BMNH), Natural History Museum, Basel, Switzerland (NHM) and entomological collection of the first author (AHMAD's Coll.).

Key to the species of the Leptocentrus taurus (F.) group from the Indo-Pakistan subcontinent

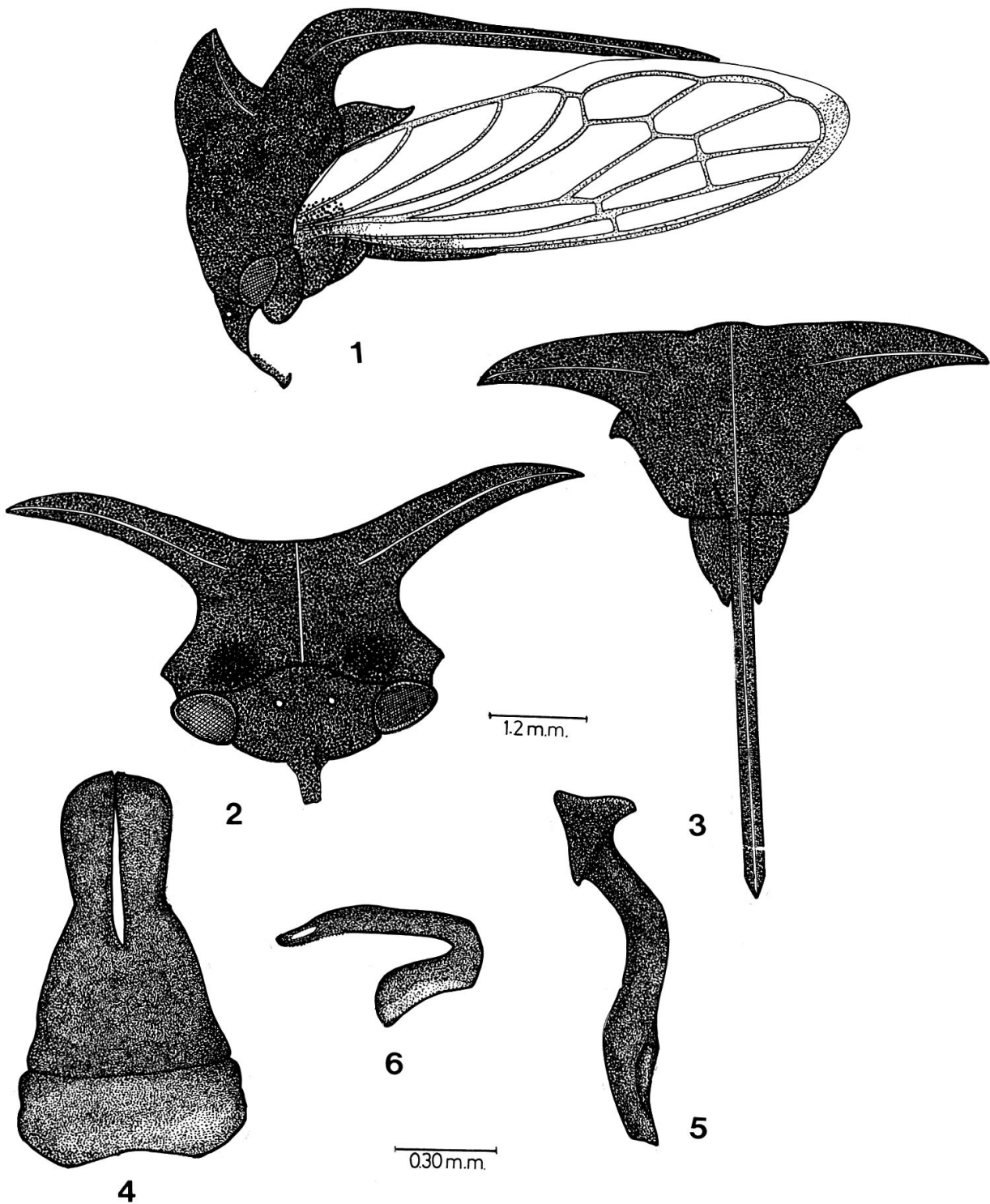
1. Lateral lobes of frontoclypeus extended below 1/3 length of median lobe: *L. leucaspis* (WALKER) group
 - Lateral lobes of frontoclypeus extended below distinctly more than one-third length of median lobe but never more than half length of median lobe: *L. taurus* (F.) group 2
2. Posterior process distant from scutellum and margins of tegmina from base to apex: *L. taurifrons* (WALKER) subgroup
 - Posterior process distant from scutellum, but apex touching margins of tegmina 3
3. Posterior process with a distinct knob at base *L. nordicornis* sp.n.
 - Posterior process without a knob at base 4
4. Posterior process slightly convex at base 5
 - Posterior process strongly convex at base 7
5. Suprahumerals horns remarkably short, intervening space slightly less than twice length of suprahumeral horns *neoalbonotatus* MOHAMMAD & AHMAD
 - Suprahumerals horns only slightly shorter, as long as or much longer than their intervening space 6
6. Suprahumerals horns only slightly shorter or as long as their intervening space; tegmina very slightly longer than abdomen; second gonapophyses with inner margins having prominent, uniform serrations throughout, with less prominent median tooth *horizontatus* sp.n.
 - Suprahumerals horns much longer than their intervening space; tegmina much longer than abdomen; second gonapophyses with inner margin having partly uniform and partly irregular serrations, median tooth absent *pakistanensis* sp.n.
7. Suprahumerals horns strongly oblique, their apices directed downward; tip of frontoclypeus broadly round; body uniformly black *bengalensis* sp.n.
 - Suprahumerals horns horizontal or subhorizontal, apices directed posterio-laterad; tip of frontoclypeus narrowly round; body brown except horns 8
8. Suprahumerals horns much broader above and somewhat foliaceous, tip acute *reponens* (WALKER)
 - Suprahumerals horns not as above 9
9. Suprahumerals horns robust, strongly recurved, apices gradually tapering, subacute; posterior process much arched at base *taurus* (F.)
 - Suprahumerals horns comparatively narrow, less recurved, apices subround; posterior process less arched at base, much smaller in size *substitutus* WALKER

DESCRIPTIONS

Leptocentrus bengalensis sp.n. (Figs 1-6)

Male: Black.

Head (Fig. 2): Black; upper margin of vertex arcuate and sinuate, lower margin subround and truncate; eyes pale; ocelli pale, equidistant; frontoclypeus with apex broad, tip broadly round; lateral lobes indistinct, reaching less than 1/2 length of clypeus below lower margin of vertex.



Figs 1-6. *Leptocentrus bengalensis* sp.n. – 1. Entire male, lateral view; 2. Head, anterior view; 3. Pronotum, dorsal view; 4. Male subgenital plate, ventral view; 5. Paramere, inner view; 6. Aedeagus, lateral view.

Thorax and appendages (Fig. 3) : Pronotum dark ochraceous; humeral angles short, acute; suprahumeral horns moderately oblique, tip subacute, directed laterad, not recurved, length of horns twice length of intervening space; posterior process strongly convex, elevate at base then straight, apex impinging on tegmina, passing beyond clavus; scutellum black, tegmina light yellow, veins indistinct; legs with femur black, tibia and tarsi light ochraceous.

Measurements: Total length from front of head to tip of tegmina 5.6 mm; width between humeral angles 2.0 mm; length of suprahumeral horns 1.6 mm; distance between intervening space 1.1 mm; interocellar distance 0.4 mm; distance between eyes and ocelli 0.4 mm.

Male genitalia: Subgenital plate (Fig. 4) of moderate length, much constricted a little before apex, apically narrow, outer margin strongly sinuate, apex obliquely subround, basal angle subacute; paramere (Fig. 5) with head having anterior and outer apical lobe or process subacute, inner process acute, stem medially curved with outer margin basally oblique and inner margin sinuate and round; aedeagus (Fig. 6) with curved portion almost $\frac{1}{2}$ length of transverse portion, latter with outer and inner margins normal, with tip round.

Female genitalia: Not available.

Material examined: Holotype ♂, Bangladesh: Jessore, on (Assati) grass 14.1.1969, leg. M.U. SHADAB; in NHMUK.

Comparative note: This species is closely related to *L. pakistanensis* in having suprahumeral horns much longer than their intervening space and humeral angles acute, but could easily be separated from it by having strongly convex posterior process and lower margin of vertex subround and truncate as compared to slightly convex posterior process at base and lower margin of vertex round and strongly recurved in *L. pakistanensis*.

Leptocentrus horizontatus sp.n. (Figs 7-13)

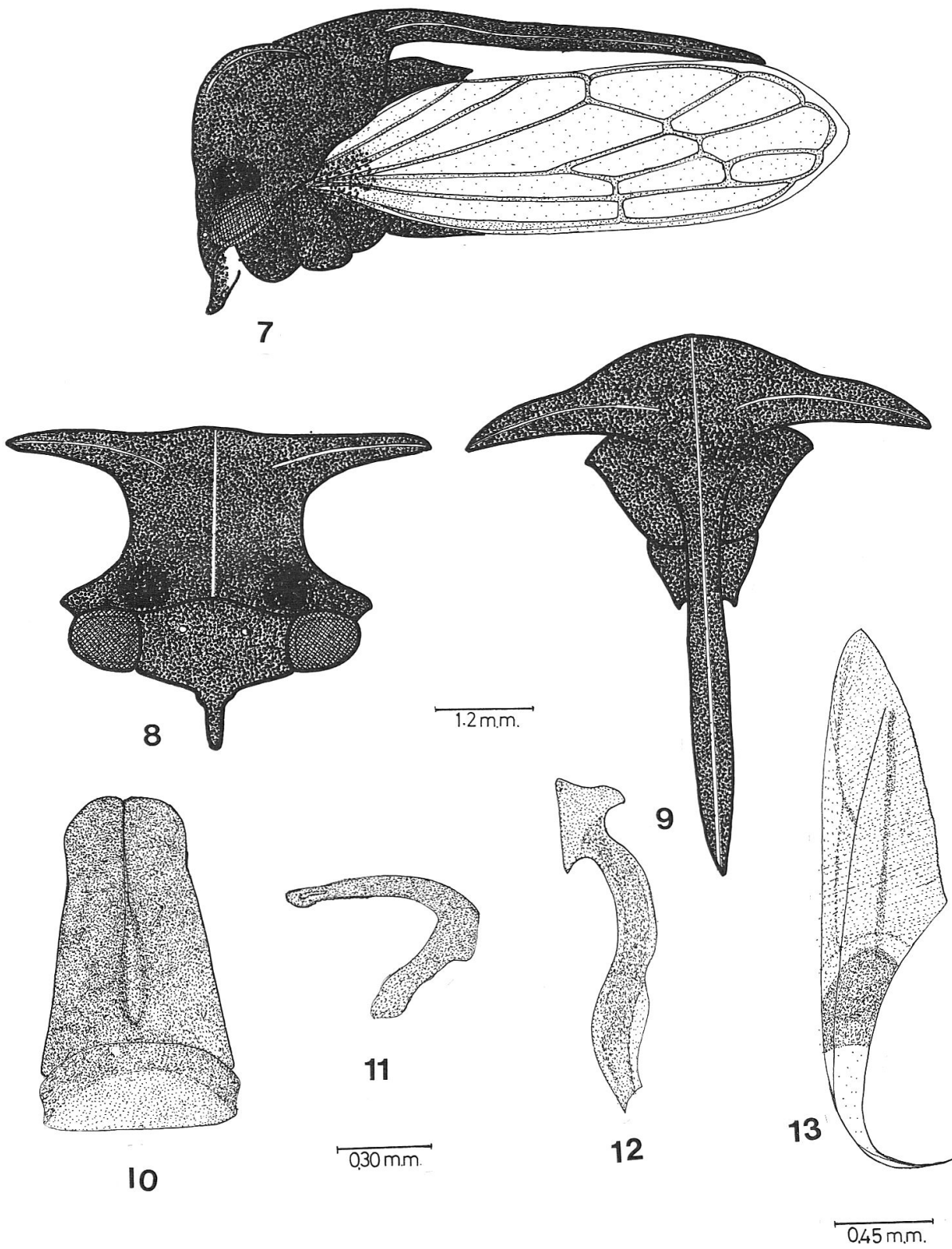
Male: Ferruginous.

Head (Fig. 8): Dark ferruginous red; upper margin of vertex deeply arcuate and sinuate; lower margin subround and slightly recurved; eyes ochraceous; ocelli pale yellow, usually nearer to eyes than from each other; frontoclypeus with apex normal, tip subround and slightly recurved; lateral lobes of frontoclypeus extending less than $\frac{1}{2}$ length below lower margin of vertex.

Thorax and appendages (Fig. 9): Pronotum usually ferruginous; humeral angles short and subround; suprahumeral horns horizontal, recurved, tip subacute, length of horns slightly longer than length of intervening space; posterior process impinging on tegmina, without knob and slightly convex at base; apex impinging on tegmina, passing beyond clavus; scutellum ferruginous with sides ochraceous; tegmina pale yellow, veins dark brown, with femur dark ferruginous, tibia and tarsi pale ochraceous.

Measurements: Total length from front of head to tip of tegmina 5.8-6.3 mm; width between humeral angles 2.2-2.4 mm; length of suprahumeral horns 1.5-1.7 mm; distance between intervening space 1.5-1.7 mm; interocellar distance 0.3-0.4 mm; distance between eyes and ocelli 0.45-0.5 mm.

Male genitalia: Subgenital plate (Fig. 10) elongate, outer lateral margin strongly oblique, slightly sinuate before apex, inner margin shallowly straight, apices round, basal angles subacute; paramere (Fig. 12) slightly curved, head with inner



Figs 7-13. *Leptocentrus horizontatus* sp.n. – 7. Entire male, lateral view; 8. Head, anterior view; 9. Pronotum, dorsal view; 10. Male subgenital plate, ventral view; 11. Aedeagus, lateral view; 12. Paramere, inner view; 13. Second gonapophyses, ventral view.

and outer lateral processes acute, anterior process subacute, distal portion with outer and inner margins obliquely straight, proximal portion with outer margin subround, inner margin deeply curved; aedeagus (Fig. 11) curved, transverse arm with outer and inner margins smooth, depressed at apex with tip recurved and subround, inner margin with dentation.

Female genitalia: Second gonapophyses (Fig. 13) with apical portion slightly narrower than proximal portion, with inner margin having prominent uniform serrations, median tooth less prominent.

Material examined: Holotype ♂, Pakistan: Sind; Hyderabad, on *Medicago sativa* (L.), 8.12.1978, leg. N.A. RANA, in NHMUK. Paratypes: 20 ♂♂, 20 ♀♀, Pakistan: Sind; Hyderabad, Thatta, Kohsar farm, Bella, (Punjab); Changamanga, Rawalpindi, Whah, on *Withenia somnifera* (L.), Wild bush, *Amarathus viridis* L. *Medicago sativa* L., on 18.6.1969, 27.2.1972, 19.6.1976, 6.2., 28.5.1977, leg. I. AHMAD, S. KAMALUDDIN, A.A. KHAN, N.A. RANA and M. RAHIM, in NHMUK, BMNH, NHM and in AHMAD's Coll. Other specimens: 200 ♂♂, 300 ♀♀, Pakistan: Sind; Hyderabad, Sukkar, Kotri, Thatta, Thatta farm, Talhar, Sakrand, Tandojam, Malir, Gullamullah; Punjab; Sargodah, Zero point, Wah, Changamanga, on *Rumex hastatus* D. DON. and *Medicago sativa* L., 13.4.1959, 2.7.1967, 9.1., 19.11.1968, 23.3., 26.7.1969, 27.4.1972, 9.3., 15.12.1974, 9.1., 1.2., 3.7.1975, 4.2., 6.2., 14.10.1977, 30.3., 12.4.1978, leg. I. AHMAD, A.A. KHAN, M. RAHIM, S. SHAUKAT, F. AHMAD, N. YASMEEN, N.A. RANA and A. KHAN, in the above mentioned museums and in AHMAD's Coll.

Comparative note: This species is closely related to *L. pakistanensis* and *L. neoalbonotatus* in having posterior process slightly convex at base but could be separated from it by having suprahumeral horns about equal length of intervening space as compared to much shorter and much longer suprahumeral horns with respect to intervening space in *L. pakistanensis* and *L. neoalbonotatus*, respectively.

Leptocentrus neoalbonotatus MOHAMMAD & AHMAD

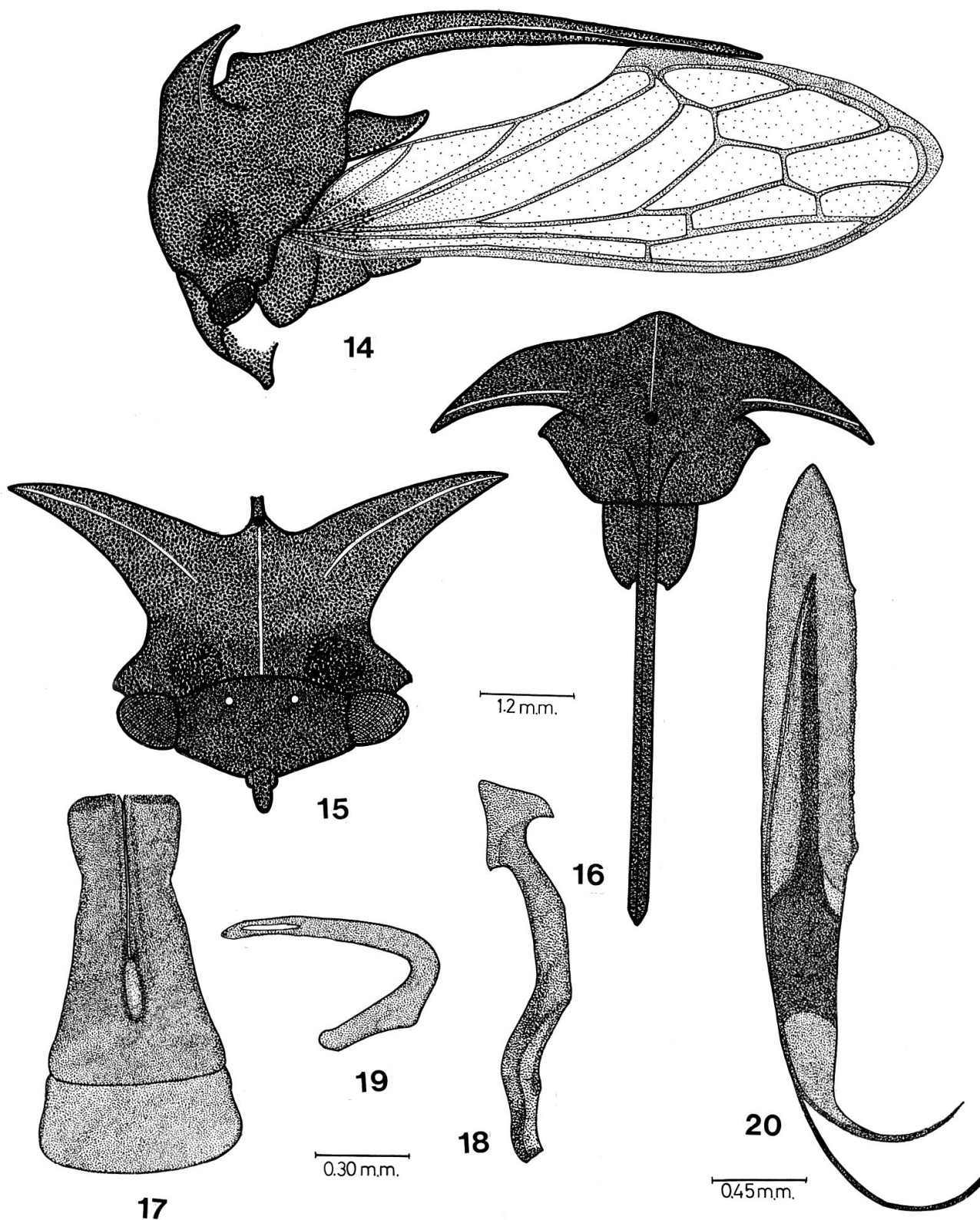
Leptocentrus neoalbonotatus MOHAMMAD & AHMAD, 1989: 67 (detailed description and biology given).

Leptocentrus nordicornis sp.n. (Figs 14-20)

Male: Black.

Head (Fig. 15): Black or dark ferruginous; upper margin of vertex arcuate and less sinuate; lower margin obliquely truncate and recurved; eyes pale with black tinge; ocelli pale ochraceous, nearly equidistant; frontoclypeus with apex usually narrow and tip subround; lateral lobes prominent, slightly protruding, extending less than $\frac{1}{2}$ length of clypeus below lower margin of vertex.

Thorax and appendages (Fig. 16): Pronotum black; metopidium convex; humeral angles broad, triangular, somewhat pointed; suprahumeral horns oblique, length of horns greater than intervening space, tip usually subacute; posterior process distinctly knobbed at base, strongly convex at base then straight, sometimes sinuate, apex passing beyond posterior margin of inner angle of tegmina; scutellum black with apex dark ferruginous; tegmina pale ochraceous, apical margin dark ochraceous; veins prominent; sides of thorax and abdomen beneath black; legs with femur black, tibia and tarsi ochraceous.



Figs 14-20. *Leptocentrus nordicornis* sp.n. – 14. Entire male, lateral view; 15. Head, anterior view; 16. Pronotum, dorsal view; 17. Male subgenital plate, ventral view; 18. Paramere, inner view; 19. Aedeagus, lateral view; 20. Second gonapophyses, ventral view.

Measurements: Total length from front of head to tip of tegmina 6.7-7.2 mm; width between humeral angles 2.4-2.7 mm; length of suprahumeral horns 1.6-1.8 mm; distance between intervening space 0.8-1.3 mm; interocellar distance 0.5 mm; distance between eyes and ocelli 0.45 mm.

Male genitalia: Subgenital plate (Fig. 17) elongate, outer lateral margins sinuate, apex broad, truncate, apices medially raised, basal angles subround; paramere (Fig. 18) with head having outer and inner lateral processes acute, anteriorly subacute, distal portion with outer and inner margins obliquely straight, inner margin deeply concave, proximal portion with outer and inner margins deeply curved and sinuate; aedeagus (Fig. 19) comma-like, transverse arm with outer and inner margins almost straight, slightly tapered at apex with subacute tip, inner serrations not so prominent.

Female genitalia: Second gonapophyses (Fig. 20) long, of uniform width throughout and slightly tapered apically, inner margin with distinct uniform serrations with a distinct tooth.

Material examined: Holotype ♂, Pakistan: NWFP; Behren, on *Rumex hastatus* D. DON., 9.7.1975, leg. A. KHAN, in NHMUK. Paratypes: 3 ♀ ♀, Pakistan: Sind; Malir, NWFP; Behren, on *Medicago sativa* L., *Rumex hastatus* D. DON., 18.5.1969, 9.7.1975, leg. F. AHMAD and A. KHAN, in NHMUK and in AHMAD's Coll.

Comparative note: This species is isolated in the entire group by having a distinct knob at the base of posterior process.

Leptocentrus pakistanensis sp.n. (Figs 21-27)

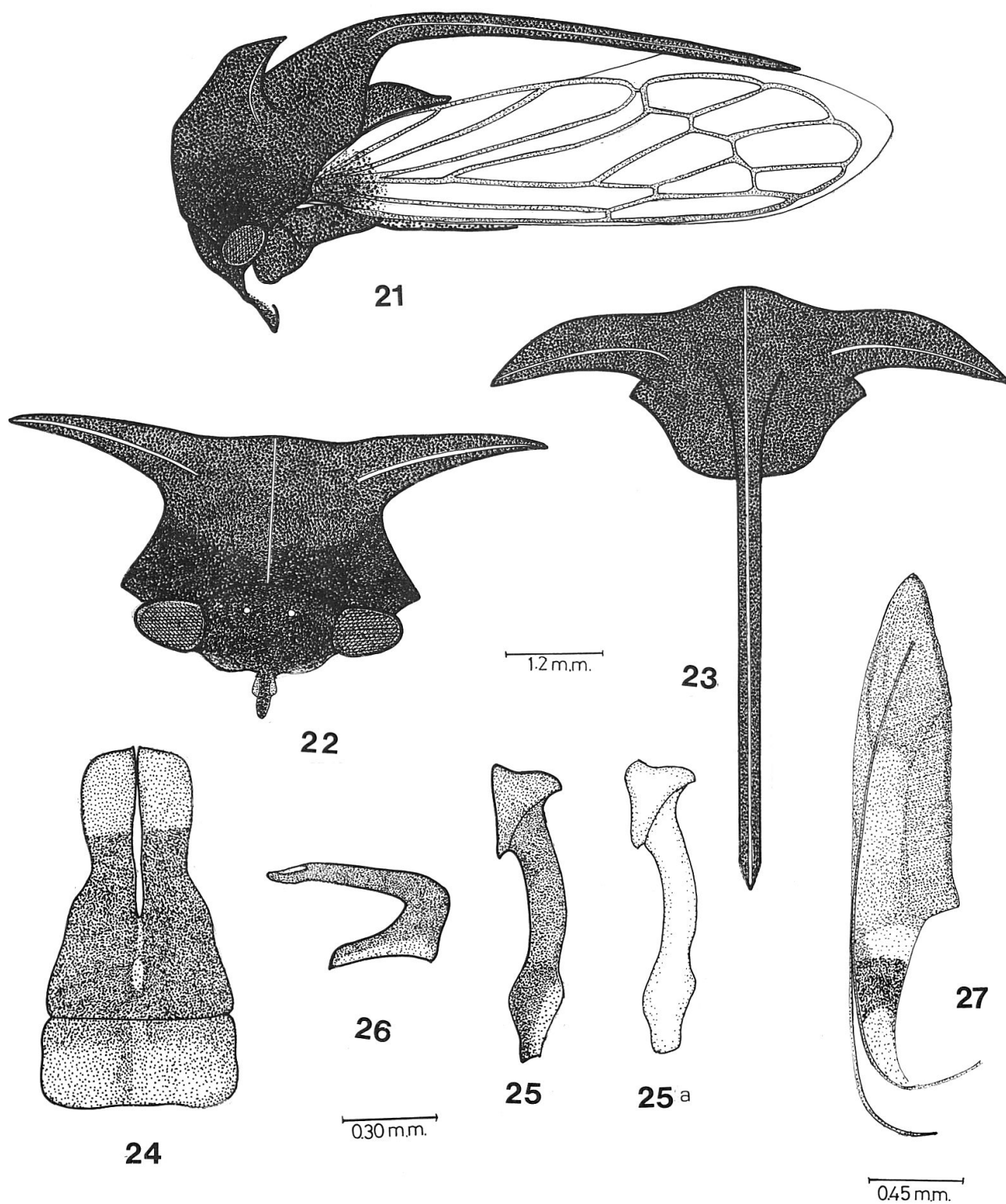
Male: Bright ferruginous.

Head (Fig. 22): Dark ferruginous; upper margin of vertex arcuate and sinuate; lower margin distinctly round, strongly recurved; eyes yellowish; ocelli light, nearly equidistant; frontoclypeus longer than broad, apex narrowly subround, tip slightly medially depressed; lateral lobes prominent, extending less than $\frac{1}{2}$ length of frontoclypeus below lower margin of vertex.

Thorax and appendages (Fig. 23): Pronotum dark ferruginous; humeral angles prominent, sharp, acute; suprahumeral horns subhorizontal, length 1.5x greater than intervening space, recurved with tip acute; posterior process slightly convex at base, then substraight; scutellum ferruginous with sides and apex light ochraceous; tegmina opaque with veins dark, apical costal margin dark brown; thorax and abdomen beneath dark ferruginous; legs with femur ferruginous, tibia and tarsi light ochraceous.

Measurements: Total length from front of head to tip of tegmina 5.8-7.2 mm; width between humeral angles 2.3-2.6 mm; suprahumeral horns 1.6-1.8 mm; distance between intervening space 0.9-1.2 mm; interocellar distance 0.4-0.5 mm; distance between eyes and ocelli 0.35-0.4 mm.

Male genitalia: Subgenital plate (Fig. 24) comparatively short, outer margin weakly sinuate, much constricted a little before apex, latter broader with subround margin, inferior margin of apex sinuate, inner margin slightly sinuate, medially depressed, basal angles subround; paramere (Fig. 25) with head having only inner angle acute, outer and anterior almost subacute, stem with distal portion somewhat swollen, proximal portion with outer and inner margins concave; aedeagus (Fig. 26) not recurved at base, curved portion slightly more than $\frac{1}{2}$ length of transverse portion, latter with outer margin weakly sinuate, inner almost straight, with apex tapered and tip round.



Figs 21-27. *Leptocentrus pakistanensis* sp.n. – 21. Entire male, lateral view; 22. Head, anterior view; 23. Pronotum, dorsal view; 24. Male subgenital plate, ventral view; 25. Paramere, inner view; 25a. Showing variation in parameral head, 26. Aedeagus, lateral view; 27. Second gonapophyses; ventral view.

Female genitalia: Second gonapophyses (Fig. 27) with blade having proximal portion slightly broader than apical portion, inner apical margin with uniform serrations in lower $\frac{1}{2}$ portion and apical $\frac{1}{2}$ with irregular serrations, median tooth absent.

General variations: Entire head and pronotum partly black, eyes with dark brown patches and also showing slight variation in the shape of parameral head as shown in Fig. 25a.

Material examined: Holotype ♂, Pakistan: Punjab; Shahdra, on *Withenia somnifera* (L.) DUNAL, 20.12.1973, leg. A. KHAN, in NHMUK. Paratypes: 7 ♂♂, 10 ♀♀, Pakistan: Punjab; Shahdra, Cheechawatni, NWFP: Peshawar, on *Withenia somnifera* (L.) DUNAL, *Medicago sativa* (L.), *Acacia nilotica* (L.), *Tamarix* spp., 9.6., 14.6.1970, 20.12.1973, 11.12.1976, leg. H. REHMAN, A.A. KHAN, I. AHMAD and A. KHAN, in NHMUK, BMNH, NHM and in AHMAD's Coll. Other specimens: 20 ♂♂, 60 ♀♀, Pakistan: Punjab; Mian Chunnun, Shahdra, Cheechawatni, Multan, NWFP; Peshawar, on *Tamarix* spp., *Medicago sativa* (L.), *Acacia nilotica* (L.), wild bush, *Withenia somnifera* (L.) DUNAL and *Dalbergia sissoo* (ROXB.), 9.6., 14.6.1970, 28.3., 20.12.1973, 11.12.1976, 23.3.1978, leg. I. AHMAD, A.A. KHAN, A. KHAN and M. RAHIM, in NHMUK and in AHMAD's collection.

Comparative note: This species is closely related to *L. taurus* (F.) in having a similar ferruginous body and in the shape of the suprahumeral horns but could easily be separated from it by having a round and strongly recurved lower margin of the vertex as compared to the obliquely straight and slightly recurved lower margin of the vertex in *L. taurus* and by other characters noted in the descriptions.

Leptocentrus reponens (WALKER) (Figs 28-34)

Centrotus reponens WALKER, 1851: 604.

Leptocentrus reponens: ATKINSON, 1885: 86; DISTANT, 1908: 30; FUNKHOUSER, 1915: 368; 1927: 113; 1951: 228; GODING, 1939: 340; METCALF & WADE, 1965: 122; AHMAD *et al.*, 1978: 23; AHMAD, 1979: 9, 21; 1980: 141.

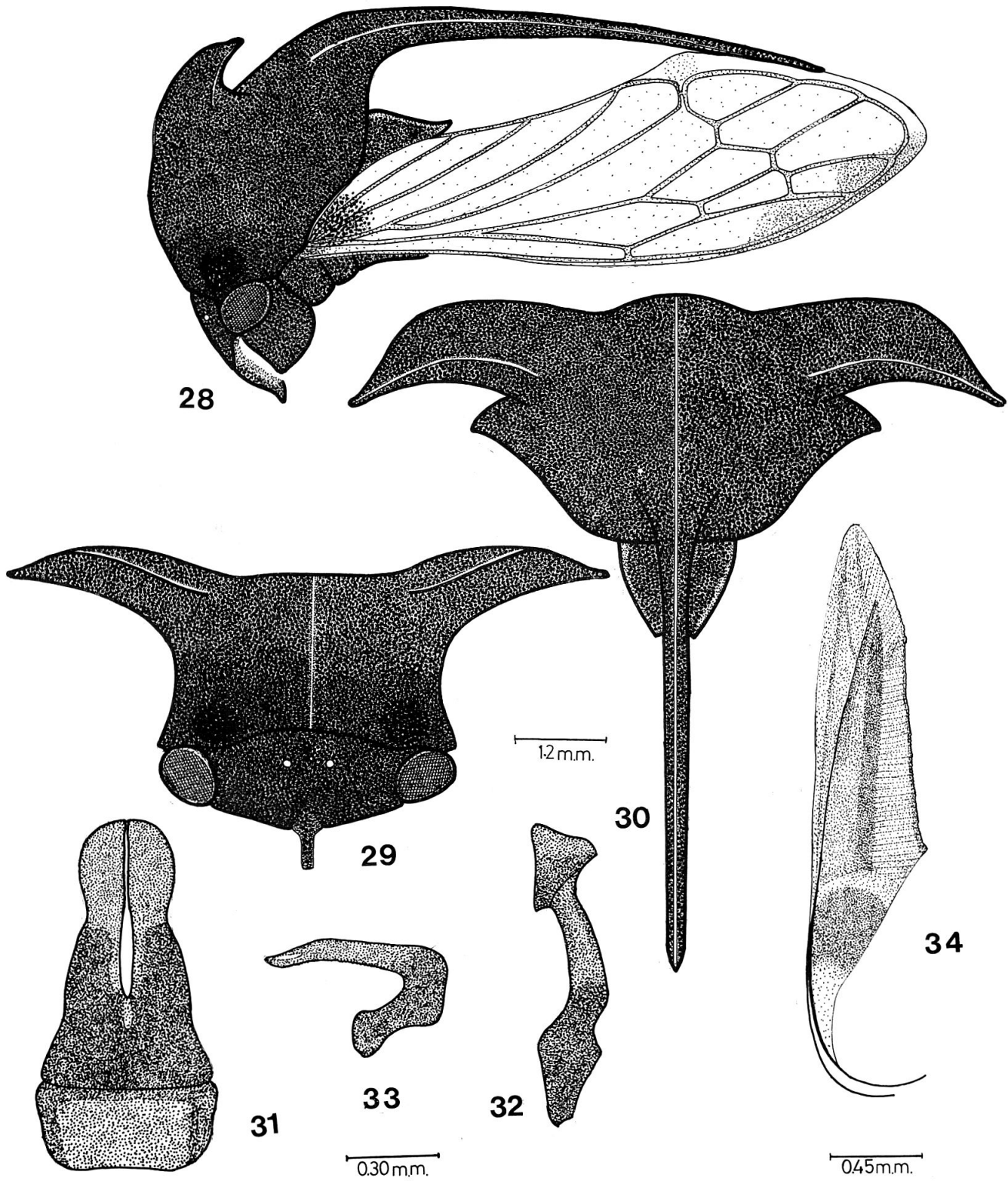
Male: Black.

Head (Fig. 29): Black; upper margin of vertex arcuate and sinuate; lower margin obliquely straight and strongly recurved; eyes dark brown; ocelli pale or light brown, nearer to eyes than to each other; frontoclypeus slightly longer than broad with tip narrowly round and recurved; lateral lobes somewhat subround extending less than $\frac{1}{2}$ length below lower margin of vertex.

Thorax and appendages (Fig. 30): Pronotum dark brown; humeral angles much broader and triangular; suprahumeral horns subhorizontal, much broader, recurved, foliaceous, convex at their anterior margin, tip acute and strongly recurved; posterior process convexly elevate at base then substraight; scutellum dark brown with sides and apical margin light yellow; tegmina light ochraceous, with veins light; thorax and abdomen beneath dark ferruginous; legs with femur ochraceous, tibia and tarsi light ochraceous.

Measurements: Total length from front of head to tip of tegmina 6.6-6.7 mm; width between humeral angles 2.6-2.7 mm; length of suprahumeral horns 2.1-2.4 mm; distance between intervening space 1.2-1.3 mm; interocellar distance 0.5-0.6 mm; distance between eyes and ocelli 0.4-0.5 mm.

Male genitalia: Subgenital plate (Fig. 31) of moderate length, outer margin sinuate, apical lobe narrow, basal angles subround; paramere (Fig. 32) with head



Figs 28-34. *Leptocentrus reponens* (WALKER). – 28. Entire male, lateral view; 29. Head, anterior view; 30. Pronotum, dorsal view; 31. Male subgenital plate, ventral view; 32. Paramere, inner view; 33. Aedeagus, lateral view; 34. Second gonapophyses; ventral view.

having outer process subround, inner acute, anterior and apical subacute, distal portion with outer margin obliquely straight, then sinuate, inner margin deeply concave, proximal portion with outer margin deeply sinuate, inner margin smoothly convex; aedeagus (Fig. 33) slightly recurved at base, curved portion almost $\frac{1}{2}$ length of transverse portion, latter with outer margin sinuate, inner margin smooth, apex medially depressed with round tip.

Female genitalia: Second gonapophyses (Fig. 34) with comparatively short and broad blade, serrations minute and uniform, median tooth not so developed.

Material examined: Lectotype ♀ with labels. "Type" and "Tenasserim 44, 24 and 14". "*Centrotus*" in BMNH. Other specimens: 1 ♂, 3 ♀♀, Bangladesh: Sirimangal, Chittagong, Comilla, Khulnaghat, on road side plants, 21.3., 24.3.1970, leg. I. AHMAD and Q.A. ABBASI, in NHMUK and in AHMAD's Coll.

Comparative note: This species is closely related to its closest ally *L. taurus* in colour and general body shape, lower margin of vertex obliquely straight and recurved, suprahumeral horns subhorizontal and longer than their intervening space, but could easily be separated from it by having the suprahumeral horns much broader above and foliaceously convex at their anterior margins, as compared to *L. taurus* having the suprahumeral horns comparatively narrow and the anterior margin not convex.

Leptocentrus substitutus WALKER (Figs 35-41)

Leptocentrus substitutus WALKER, 1851: 605; ATKINSON, 1885: 87; DISTANT, 1908: 29; OSHANIN, 1912: 99; BERGROTH, 1915: 179; FUNKHOUSER, 1927: 428; 1929: 470; 1951: 229; MATHUR, 1953: 154; GODING, 1939: 340, 342; DE MOTSCHULSKY, 1863: 96; KIRBY, 1891: 165; JACOBI, 1905: 445; METCALF & WADE, 1965: 124; AHMAD *et al.*, 1978: 24; AHMAD, 1979: 9, 21.

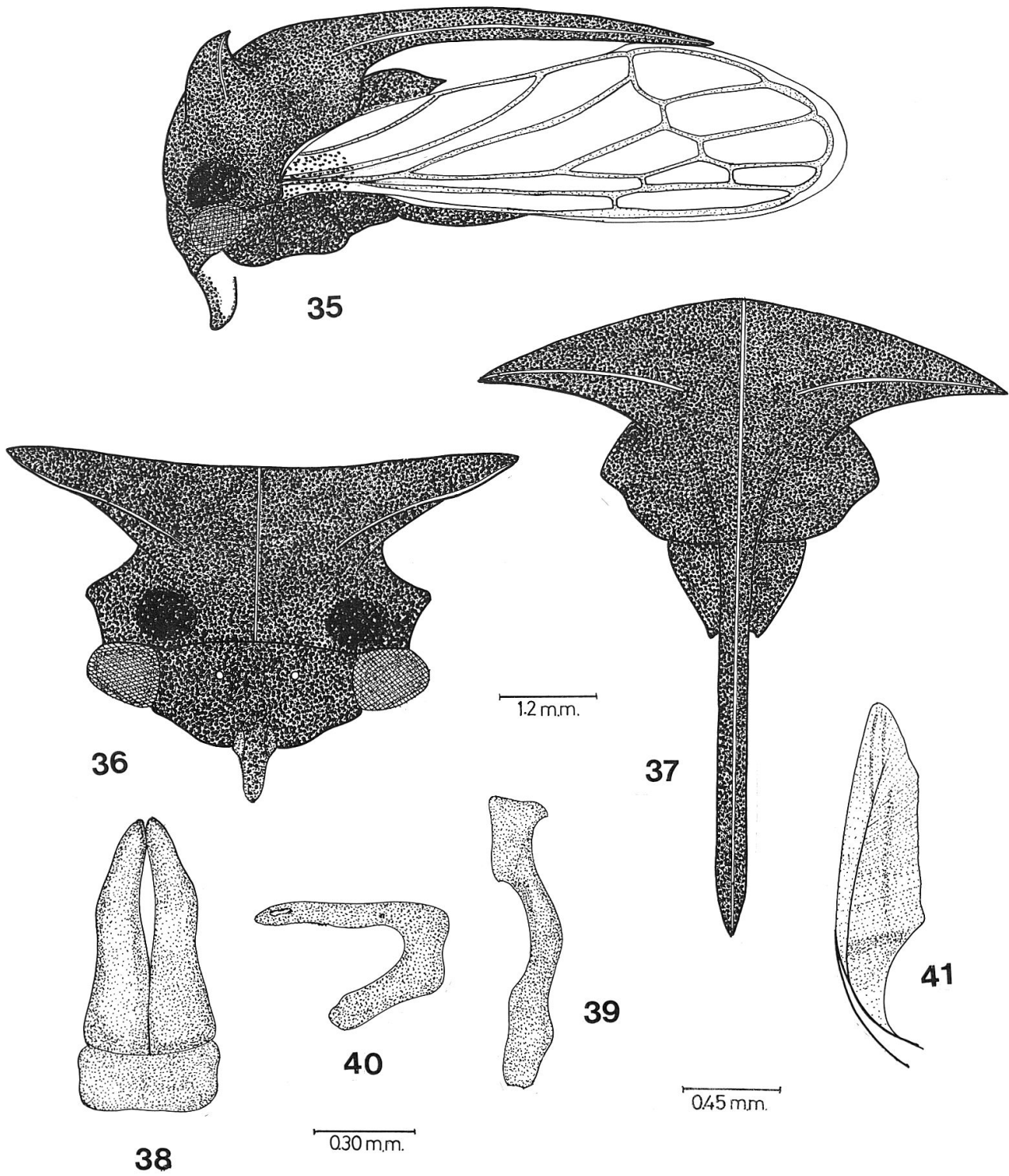
Male: Ferruginous.

Head (Fig. 36): Dark ferruginous; upper margin of vertex, deeply arcuate and sinuate; lower margin obliquely round and slightly recurved; eyes dark ochraceous; ocelli pale, ochraceous, nearer to eyes than from each other; frontoclypeus with tip narrowly round and recurved, lateral lobes partially fused, extending less than $\frac{1}{2}$ length of clypeus below lower margin of vertex.

Thorax and appendages (Fig. 37): Pronotum dark ferruginous; humeral angles broad and acute; suprahumeral horns subhorizontal apparently much narrower and less recurved, horns distinctly longer than their intervening space, tip subround; posterior process convex and less arched at base, and apically touching inferior margin of tegmina; scutellum ferruginous, apex pale ochraceous; tegmina pale bronzy, ochraceous, base narrowly opaque; veins very light, abdomen dark ferruginous; legs with femur and tibia bright castaneous, tarsi light ochraceous.

Measurements: Total length from front of head to tip of tegmina 6.2-6.3 mm; distance between humeral angles 2.3-2.4 mm; length of suprahumeral horns 1.7-1.8 mm; distance between intervening space 1.1 mm, interocellar distance 0.5 mm, distance between eyes and ocelli 0.4 mm.

Male genitalia: Subgenital plate (Fig. 38) comparatively long, abruptly tapering apically, outer and inner margins deeply sinuate, inner margin apically obliquely truncate, apices narrow, basal angles prominent and subround; paramere (Fig. 39) obliquely curved, head with apical and inner lateral apices short and blunt, outer lateral apices subacute, distal portion with outer and inner margins deeply smoothly curved, proximal portion almost equal to length of distal portion and comparatively



Figs 35-41. *Leptocentrus substitutus* WALKER. – 35. Entire male, lateral view; 36. Head, anterior view; 37. Pronotum, dorsal view; 38. Male subgenital plate, ventral view; 39. Paramere, inner view; 40. Aedeagus, lateral view; 41. Second gonapophyses, ventral view.

broad; aedeagus (Fig. 40) with curved arm slightly more than $\frac{1}{2}$ length of transverse arm, latter with outer and inner margins slightly sinuate, apex slightly depressed with tip subround.

Female genitalia: Second gonapophyses (Fig. 41) with blade having proximal portion comparatively broader than apical portion, inner margin having minute, indistinct uniform serrations, apical tooth very minute or indistinct.

Material examined: Holotype ♀, with labels; "Type" and "*substitutus*" in BMNH. Other specimens: locality Kushalli, Mysoor Coll. 21, on Sandal, March 1929, collector B. Shashjui RAO, Pres. by Imp. Inst. Eng. B.M. 1935-366, det. FUNKHOUSER. Alagar Kovil, Madwa Dt. S. India 7-III-36. det. R.J. IZZARD 1937, in BMNH.

Comparative note: This species is closely related to *Leptocentrus taurus* (F.) in general body colour and the shape of the frontoclypeus but could easily be separated from it by having the suprahumeral horns comparatively narrow and less arched at base as compared to the robust and strongly recurved suprahumeral horns in *Leptocentrus taurus* and by other characters as noted above.

Leptocentrus taurus (F.) (Figs 42-45)

Membracis taurus FABRICIUS, 1775: 676; TURTON, 1802: 576.

Cicada taurus: GOEZE, 1778: 147; GMELIN, 1789: 2095; DONOVAN, 1820: 2.

Centrotus taurus: FABRICIUS, 1803: 20; GERMAR, 1835: 257; BLANCHARD, 1840: 182, 1850: 182; FAIRMAIRE, 1846: 510.

Leptocentrus taurus: ATKINSON, 1885: 85; MELICHAR, 1903: 116; DISTANT, 1908: 28; METCALF & WADE, 1965: 125; AHMAD *et al.*, 1978: 24; AHMAD, 1979: 9, 21.

Leptobelus scutellaris ATKINSON, 1886: 196.

Leptocentrus gazella BUCKTON, 1903: 268.

Female: Dark ferruginous.

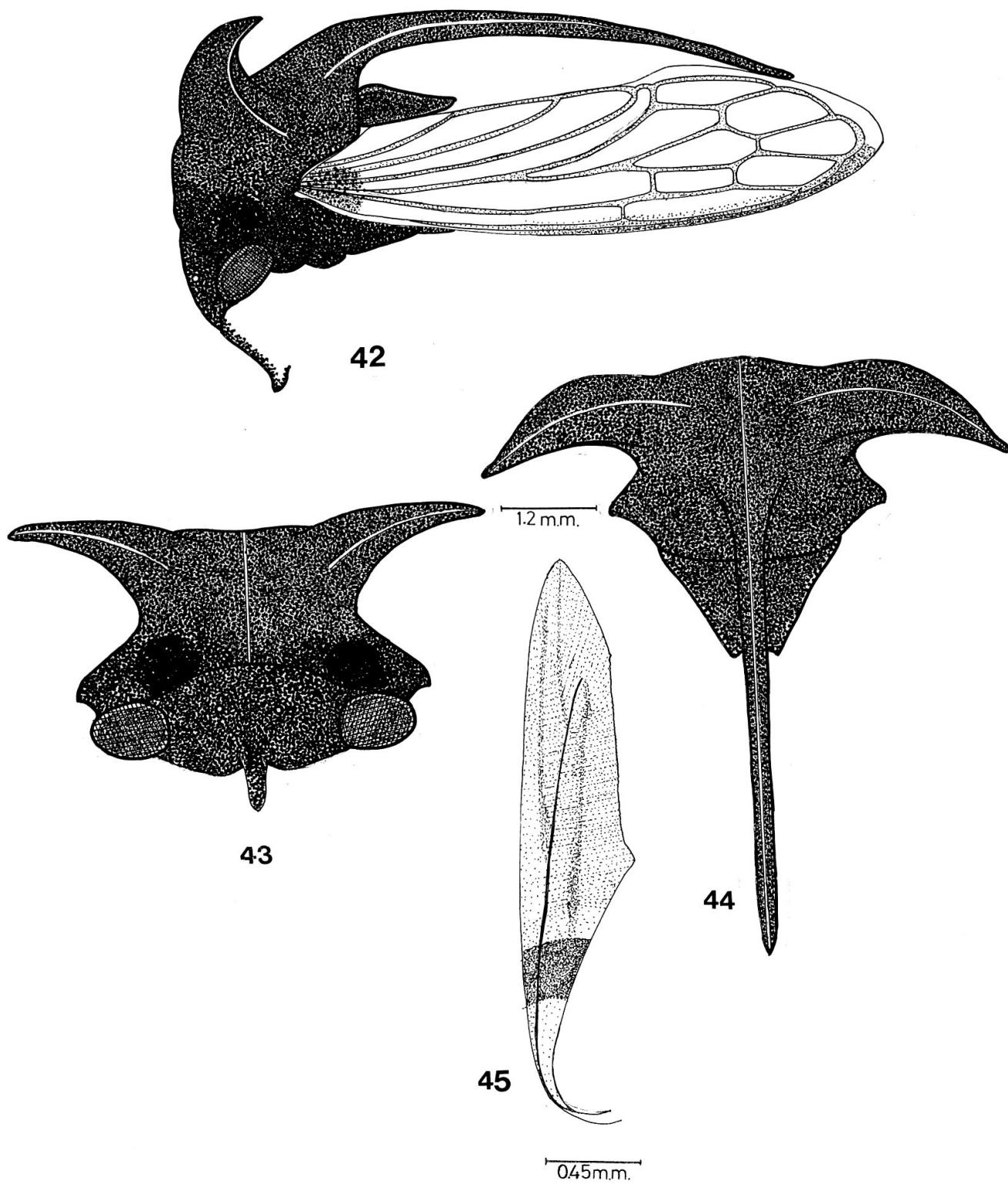
Head (Fig. 43): Black; upper margin of vertex deeply arcuate and sinuate; lower margin obliquely straight and recurved; eyes light ochraceous; ocelli ochraceous, nearly equidistant; frontoclypeus with tip narrowly round and recurved; lateral lobes partially fused, extending less than $\frac{1}{2}$ length of clypeus below lower margin of vertex.

Thorax and appendages (Fig. 44): Pronotum dark ferruginous; humeral angles small and subacute; suprahumeral horns subhorizontal, apparently much narrower and less recurved, length of horns distinctly longer than intervening space, tip subacute; posterior process strongly convex at base and strongly elevate, curved and apically touching inferior margin of tegmina; scutellum dark ferruginous, sides pale ochraceous; tegmina pale bronzy ochraceous, having a narrow pale piceous, submarginal streak, beyond middle of costa; base narrowly opaque and veins dark; abdomen beneath blackish red; legs castaneous, sometimes apices of femora and tarsi piceous.

Measurements: Total length from front of head to tips of tegmina 6.5-6.7 mm; width between humeral angles 2.4-2.5 mm; length of suprahumeral horns 1.6-1.7 mm; distance between intervening space 1.2-1.4 mm; interocellar distance 0.45-0.5 mm; distance between eyes and ocelli 0.45-0.5 mm.

Male genitalia: Not available.

Female genitalia: Second gonapophyses (Fig. 45) with blade having proximal portion comparatively broader than apical portion, inner margin having minute uniform, and distinct serrations with a poorly developed tooth.



Figs 42-45. *Leptocentrus taurus* (F.). – 42. Entire female, lateral view; 43. Head, anterior view; 44. Pronotum, dorsal view; 45. Second gonapophyses, ventral view.

Material examined: Lectotype ♀, with labels "India" and associated with it though not mounted on the same pin "Type" and "*Membracis taurus*, FABR. Entom. P.676.9.", in BMNH. Other specimens: 3 ♀♀, Bangladesh: Srimangal and Jessore, on *Mikania scandens* WIL. grass, 22, 27.3.1970, leg. I. AHMAD, in NHMUK and in AHMAD's Coll.

Comparative note: This species is closely related to its closest ally *L. bengalensis* in having the posterior process strongly convex at base but differs from it by having dark ferruginous brown, horizontal or subhorizontal suprahumeral horns, and the frontoclypeus with the apex narrow and the tip subround as compared to black strongly oblique suprahumeral horns and the apex of the frontoclypeus broad and the tip broadly round in *L. bengalensis*.

CLADISTIC RELATIONSHIPS

The present *L. taurus* group, comprising *L. reponens*, *L. substitutus*, *L. taurus*, four newly described taxa from Pakistan, plus *L. neoalbonotatus* MOHAMMAD & AHMAD, 1989, and *L. bajulans*, *L. impunctus* and *L. taurifrons* (the three latter representing the *L. taurifrons* subgroup re-described recently by MOHAMMAD & AHMAD (1994) from different areas of the Indo-Pakistan subcontinent) could be defined by their synapomorphy of lateral lobes of frontoclypeus extended distinctly more than one-third but less than half length of median lobe below inferior margin of vertex. AHMAD (1987) has already discussed the plesiomorphy of this trait in different centrotine tree hoppers. The above mentioned taxa of the *L. taurus* group appear to show an outgroup relationship with the *L. leucaspis* group (comprising ten species from the Indo-Pakistan subcontinent, with lateral lobes of frontoclypeus extended half or more than half length of median lobe below inferior margin of vertex). The *L. taurifrons* subgroup is defined by the unique synapomorphy of the posterior process, the tips of which appear distant from scutellar and teguminal margins (and certainly not impinging upon). Among *Leptocentrus*, the most common and probably plesiomorphic state shows the tip of posterior process impinging upon scutellum and on teguminal margin. The *L. taurifrons* subgroup appears to represent an outgroup relationship with the two sister subgroups, i.e. *L. taurus* subgroup (comprising *L. bengalensis*, *L. reponens*, *L. substitutus* and *L. taurus*, defined by their synapomorphy of comparatively narrow apical lobe of subgenital plate) and *L. pakistanensis* subgroup (comprising *L. horizontatus*, *L. neoalbonotatus* and *L. pakistanensis*, defined by their posterior process somewhat convex at base). Among the former, *L. substitutus* and *L. taurus* appear most closely related as sister groups (defined by the synapomorphy of their much narrower and less recurved suprahumeral horns), the outgroup of which appears to be represented by *L. reponens* (the above three taxa show the synapomorphy of narrowly round median lobe of frontoclypeus). Among the latter, *L. pakistanensis* and *L. horizontatus* appear most closely related as sister groups (defined by long suprahumeral horns at least longer than their intervening space) of which *L. neoalbonotatus* probably represents the outgroup. *L. nordicornis* appears to show an outgroup relationship with both sister subgroups, i.e. *L. taurus* and *L. pakistanensis* subgroups; all eight taxa representing their synapomorphy of raised posterior process with apex touching the margins of tegmina.

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