Four New Species of the Genus *Tricentrus* STÅL (Membracidae: Tricentrini) from East Bengal with Reference to their Phylogeny and Zoogeography and Notes on two already described Species[1])

NIKHAT YASMEEN and IMTIAZ AHMAD[2])

Abstract

Four new species of the genus *Tricentrus* STÅL from various localities of east Bengal and northern Assam (former east Pakistan) are described with special reference to the characters of their frontoclypeus and male genitalia. The new species are compared with already described south-east asiatic species of their group and their phylogeny and zoogeography are briefly discussed. *T. brunneus* (FUNKHOUSER) 1927 comb. nov. and *T. brevispinis* FUNKHOUSER 1938, junior homonyms of *T. brunneus* FUNKHOUESR 1918 and *T. brevispinis* (FUNKHOUSER) 1920 comb. nov. respectively are also renamed alongwith their taxonomic notes.

Introduction

During a revision of the genus *Tricentrus* STÅL from Pakistan and east Bengal including part of northern Assam (former east Pakistan), the present authors encountered several specimens, all from the latter areas representing a single median lobe of frontoclypeus with its apex continuous with the lower margins of vertex having lateral lobes entirely fused with the former. These, appear to be the smallest of all the *Tricentrus* species the authors have encountered. All these specimens show extreme degree of sexual dimorphism with regard to suprahumeral horns, which are never developed in males but which in females, vary from being entirely absent to completely developed condition (Figs. 3, 7, 8, 11, 18, 21, 28, 31).

FUNKHOUSER (1927 a) described *Tricentrus latus* from a single female collected on Gunung (mountain) singgalang in Sumatra with „clypeus continuing the inferior margins of cheeks". He described it as „short (5.0 mm), broad species with wide flattend suprahumerals". He related it with *T. selenus* BUCKTON but obviously it was erroneous for in *T. selenus* BUCKTON the lateral lobes of the frontoclypeus are obliquely or horizontally continuous with but distinct from the lower margins of vertex and the median lobe extends distinctly more than half its length below the latter.

In the same year the above author described another species *brunneus* (presently renamed as *T. funkhouseri nom. nov.)* from Luzon, Philippine having no suprahumeral horns, under then a valid genus *Centrotoscelus* FUNKHOUSER with „clypeus continuing the inferior margins of the cheeks". FUNKHOUSER (1920) in *T. borneensis* (under *Centrotoscelus* FUNKHOUSER) although described the clypeus „longer than wide, much deflexed" but referring to inferior margins of genae, he noted „weekly sinuate, reflexed, sloping downward from eyes to margins of clypeus".

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[2]) Adress of the authors: Department of Zoology, University of Karachi, Karachi, Pakistan.

KATO (1960) referring to his new species *Tricentrus dubius* noted „The generic position of this species appears to be between *Tricentrus* and *Gargara* but some male individuals appear to be *Gargara* species. In the male of *Tricentrus akonis* (MATSUAMARA) from Formosa the suprahumeral horns are absent while the females of *Gargara femellacornis* KATO from Japan and *G. pseudocornis* FUNKHOUSER from China have small suprahumeral horns". AHMAD (1972) and AHMAD and YASMEEN (1974 and in manuscript) have analysed this sexual dimorphism in detail and have shown the above condition in several other species of the genus *Tricentrus* STÅL from Pakistan but none having a single median lobe of frontoclypeus continuing with lower margins of vertex.

There is no doubt that the present specimens, representing four distinct species share similar form of frontoclypeus and other characters as noted above but their male genitalia in general characters (i. e. having short, stubbed subgenital plate, parameres smoothly curved towards the base with sharp apices and aedeagus with acute apex) agree with those of other species of *Tricentrus* STÅL (AHMAD 1972, AHMAD and YASMEEN 1974 and in manuscript).

The present authors agree with FUNKHOUSER (1951) who held, „we can find no constant character which would warrant the splitting off of the other genera from this large genus or even the erection of sub-genera". It is presently conceived that the character of frontoclypeus having margins continuing with lower margins of vertex which is shared by all the present species and which separates the present group from the rest of the species of the genus *Tricentrus* STÅL represent an evolutionary phase out of many other phases, the species of *Tricentrus* STÅL have under gone and that all these phases represent continuous sequence of evolutionary adaptations (AHMAD 1972 and present section of „Phylogeny and Zoogeography") probably parallel to those in the species of *Coccosterphus* STÅL (GODING 1934). Contarary to CAPENER (1962) who under-rated the importance of male genitalia below tribal levels and in agreement with CALDWELL (1949), DENNIS (1952, 1960), AHMAD (1972, STRÜMPEL 1972 a, b, and 1973), AHMAD and YASMEEN (1973, 1974 and in manuscript) and AHMAD and ABRAR (1974) the male genitalia provided consistent taxonomical differences in the present species with only a little variation within one taxon (Figs. 12, 13, 14, 15, 16, 17, 22, 23, 24, 25, 26, 27).

The measurements of holotype in millimeters is invariably given with range of variation of each character. The measurement ranges given in the technical descriptions of all the species are the maximum and minimum lenghts and widths unless otherwise stated. The lenght is considered as the largest distance from the front of head to the tips of tegmina and width as the greatest width of the body which is usually found between tips of humeral angles when suprahumeral horns are not so well developed as to extend beyond humeral angles. The frontal view of insect is drawn by focussing the frontal aspect of the head showing part of metopidium. For the study of male genitalia, the abdomen was removed in warm 10 % caustic potash (KOH) solution and after it was washed in acidifield water was studied in glycerine. Following DENNIS (1952), the variation found in the genitalia is presently given within different populations of the same taxon.

The diagrams are drawn to the given scales. The food plants and the distributional range of each species are invariably given and the localities are also plotted on the map (Fig. 35) alongwith the distribution of *T. latus* FUNKHOUSER, *T. funkhouseri* nom. nov. and *T. borneensis* FUNKHOUSER to illustrate the zoogeography and phylogeny of the present group of species. The place of

deposition of the holotypes, primary types and other identified material is given under each species. The primary types of the new species excluding those in author's collection are deposited at United States National Museum Washington, Hamburg Museum and Zoological Institute, West Germany, and Natural History Museum, Department of Zoology, University of Karachi.

Taxanomic notes together with the original descriptions of two of the FUNKHOUSER's species *T. brunneus* comb. nov. and *T. brevispinis* are also included and these are presently renamed as *T. funkhouseri* and *T. minicornis* respectively.

Key to the species

1. Posterior process more or less distinctly reaching internal angles of tegmina, males always uniformly black, females usually showing development of carinae on pronotum, frontoclypeus extending for about half its length below lower margins of vertex; subgenital plate with outer margins usually uniformly convex with latero-basal angles acute or subacute, parameres with curved portion very slightly oblique having sharply pointed, less defined apices (Figs. 9—18) . . . . . *Tricentrus latiformis* new species.

   Posterior process distinctly falling short off internal angles of tegmina, males usually black, sometimes with median carina of pronotum and humeral angles ferruginous, females showing entirely hornless condition with slight development of carinae on pronotum to having quite developed suprahumeral horns, sometimes, reaching on to humeral angles, frontoclypeus extending for distinctly less than half its lenght below lower margins of vertex; subgenital plate and parameres not as above 2

2. Frontoclypeus extended more downward, distinctly more than a third below lower margins of vertex, posterior process rather shorter with tip stout, falling quite short of internal angles of tegmina; subgenital plate with outer margins straight, parameres with curved portion remarkably elongated having thin and acute apex (Figs. 29—34) . . . . . *Tricentrus sinuaticornis* new species.

   Frontoclypeus extended less downward, about a third below lower margins of vertex, posterior process somewhat longer with tip acute, falling only slightly short off internal angles of tegmina; subgenital plate with outer margin not as above, somewhat concave, parameres with curved portion not as above 3

3. Males always uniformly black, females exhibiting entirely hornless condition to having well developed carinae on pronotum; subgenital plate with outer margins distinctly deeply concave, with distal portion broadly truncated, parameres with acute tips pointing away from the stem (Figs. 1—8) . . . . . *Tricentrus angularis* new species

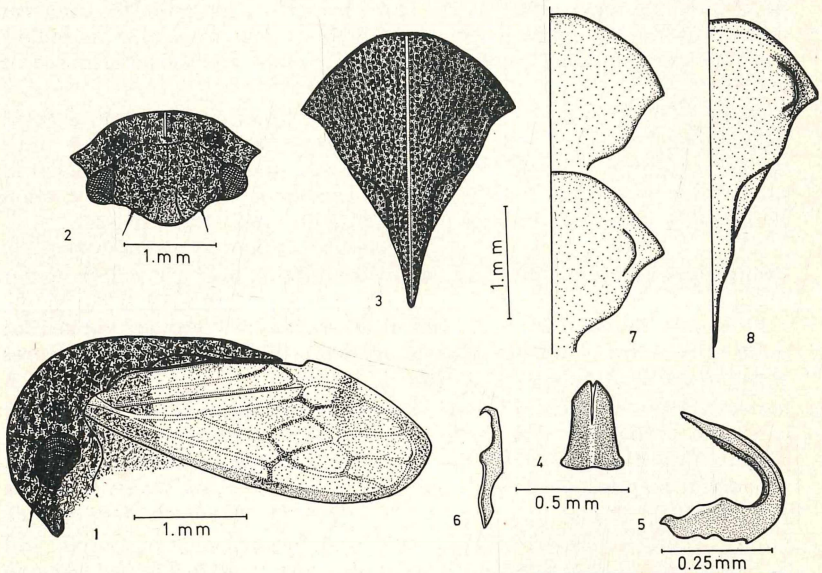
   Males usually black, sometimes with median carina of pronotum and humeral angles ferruginous, females showing well developed carinae on pronotum to quite developed suprahumeral horns almost reaching on to humeral angles; subgenital plate with outer margins only slightly concave with distal portion narrowly truncated, parameres with tips stout, pointing inwardly towards the stem (Figs. 19—28) . . . . . *Tricentrus qadrii* new species,

Tricentrus angularis **new species**

Figs. 1—8

Small, black, punctate, sparingly pubescent; frontoclypeus with lateral lobes entirely fused with median lobe and with the apex continuous with lower margins of vertex; suprahumeral horns entirely absent in males while females varying from entirely hornless to having well developed carinae on pronotum; posterior process short, not reaching internal angles of tegmina.

Male: Head vertical, vertex black, more than three-fourths again as wide as long, finely punctate, covered with golden pubescence; upper margin arcuate and feebly sinuate, lower margins oblique, slightly ridged, sinuate and not extended on frontoclypeus; eyes large, pale brown; ocelli conspicuous, unicolorous and nearer to the eyes than from each other, situated slightly above centro-ocular line; frontoclypeus black, wider than long, extended for distinctly less than half its length below lower margins of vertex, lateral lobes entirely fused with median lobe, their sutures impunctate, tip rounded and continuous with lower margins of vertex. — Pronotum black, punctate, sparingly pubescent, median carina percurrent but fainting anteriorly, metopidium uniformly black; supraocular callosities black, impunctate; suprahumeral horns absent; humeral



TRICENTRUS ANGULARIS, new species (Figs. 1—8)

Fig. 1, entire specimen, lateral view; Fig. 2, frontal view; Fig. 3, male pronotum, dorsal view; Fig. 4, subgenital plate, ventral view; Fig. 5, aedeagus, lateral view; Fig. 6, paramere, lateral view; Figs. 7, 8, female pronotum, dorsal view showing condition of suprahumeral horns.

angles prominent and blunt; posterior process tricarinate, black with median carina ferruginous, short, more or less robust, straight till middle and then sloping towards apex, tip somewhat subacute, depressed and distinctly not reaching internal angles of tegmina; scutellum black, punctate, pubescent, narrowly exposed. — Tegmina pale brown, semihyaline, apical margin and veins of sub-basal area dark brown, base black, thickly punctate, irregularly pilose, five apical and two discoidal cells; hind wings with three apical cells. — Sides of thorax, undersurface of body and abdomen black; legs black with apices of femora, apices of tibia, tarsi and claws ferruginous brown. Length from front of head to tip of tegmina, 3.75 mm; width between tips of humeral angles, 2.0 mm.

Male genitalia: Subgenital plate somewhat less elongated, narrowing at apex, more than half as wide again at base as at the apex, the former distinctly emarginate, latero-basal angles rounded, lobe-like, outer margin obliquely truncate (Fig. 4); parameres elongated with curved portion oblique, head gradually tapering with tip prominently elongated and turned outward, inner margins of distal and proximal portions convexly sinuate, median lobe rounded (Fig. 6); aedeagus not recurved at base but slightly turned upward acute or lobelike, inner transverse projection broad or through a small median emargination appearing bilobed, rounded at apex, transverse outer line strongly sinuate or plainly emarginate, dentines on the inner margin hardly conspicuous, transverse portion distinctly shorter than the curved portion (Fig. 5).

Sexual dimorphism and general variations: Females differing from males in being larger in size (4.2—4.4 × 2.04—2.2 mm), usually ferruginous with only head and anterior portion of metopidium black and exhibiting entirely hornless condition to forms having well developed carina on pronotum. (Fig. 7, 8). Males vary in size being 3.7—4,0 × 1.9—2.0, sometimes in colour pattern of tegmina.

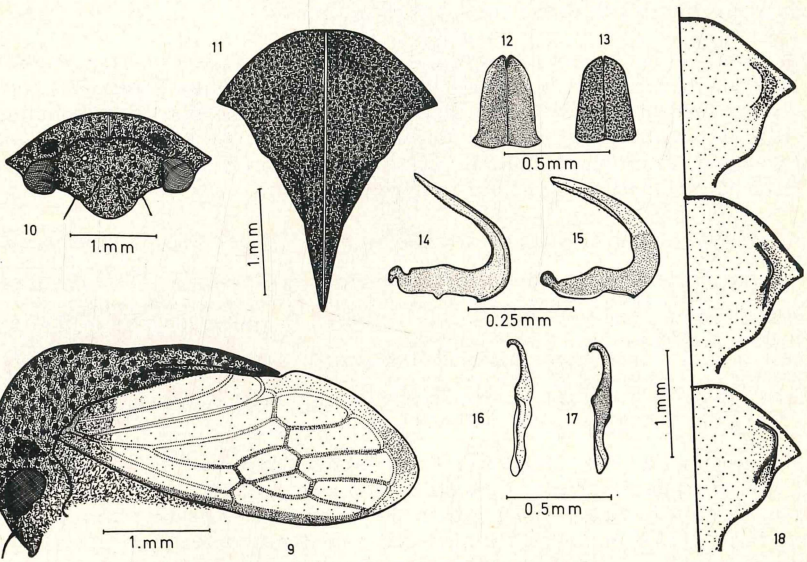
Material examined: Holotype: ♂, East Bengal: Sreemangal; on *Mikania scadens;* 28—3—1970; leg. I. Ahmad, in Natural History Museum, Department of Zoology-Entomology, University of Karachi. — Paratypes: 3 ♂, 4 ♀, East Bengal: Sreemangal, Kaptai; on *Mikania scadens,* grass; 6—2—1969, 23, 28—3—1970; leg. M. U. Shadab, I. Ahmad; in author's coll. at U. S. N. M., Hamburg Museum and above museum. — Other material: 15 ♂, 4 ♀, East Bengal: Sreemangal, Rajshahi, Rangamati, Sylhet, Jessore, Cox's Bazar, Chittagong; on *Mikania scadens,* grass; 22—1—1969, 9—2—1969, 4, 9—3—1969, 22—24, 27, 28, 29—3—1970; leg. I. Ahmad, M. U. Shadab, Q. A. Abbasi, Farid Ahmed; in the above museums and in author's coll.

Comparative note: This species appears to be related to *T. qadrii* sp. n. *T. sinuaticornis* sp. n. and also probably to *T. funkhouseri* nom. nov. in having a short rather slender posterior process which never reaches internal angles of tegmina and a median frontoclypeal lobe which extends only a third its length below lower margins of vertex. However it could easily be separated from *T. sinuaticornis* in having slightly longer and acutely pointed posterior process and from both *T. qadrii* sp. n. and *T. funkhouseri* nom. nov. in having parameres with acute apices which point away from the stem (Fig. 6) and other characters noted in the key.

Tricentrus latiformis **new species**
Figs. 9—18

Small, black, punctate, pubescent; frontoclypeus with lateral lobes entirely fused with median lobe and with the apex continuous with lower margins of vertex; suprahumeral horns absent in males while females showing slight development of carinae on pronotum to quite developed suprahumeral horns usually not extending beyound humeral angles; posterior process more or less distinctly reaching internal angles of tegmina.

Male: Head vertical, vertex black, three fourths again as wide as long, finely punctate, sparingly pubescent; upper margin arcuate and feebly sinuate; lower margins oblique slightly ridged, sinuate and not extended on frontoclypeus; eyes large, dark brown; ocelli conspicuous, unicolorous and nearer to the eyes than from each other, situated slightly above centro-ocular line; frontoclypeus black, wider than long, extending for about half its length below lower margins of vertex, lateral lobes entirely fused with median lobe, their sutures rather obscure, tip rounded and continuous with lower margins of vertex. — Pronotum black, punctate, sparingly pubescent, median carina percurrent but fainting anteriorly; metopidium uniformly black, supra-ocular callosities black and impunctate; suprahumeral horns absent; humeral angles prominent and blunt; posterior process black, tricarinate, short, robust, almost straight



TRICENTRUS LATIFORMIS new species (Figs. 9—18)
Fig. 9, entire specimen, lateral view; Fig. 10, frontal view; Fig. 11, male pronotum, dorsal view; Figs. 12, 13, subgenital plates, ventral view; Figs. 14, 15, aedeagei, lateral view; Figs. 16, 17, parameres, lateral view; Fig. 18, female pronotum, dorsal view, showing condition of suprahumeral horns.

but only sloping towards the apex, tip subacute and more or less distinctly reaching internal angles of tegmina; scutellum black, punctate, coarsely pubescent and narrowly exposed. — Tegmina hyaline, veins to discoidal and apical cells dark brown, a large black spot on apical margins of tegmina, base dark brownish black, punctate and coarsely pubescent, five apical and two discoidal cells; hind wings with three apical cells. — Sides of thorax, undersurface of the body and abdomen black. Legs with femur except apices black, the latter, tibiae and tarsi dark ferruginous. Length from front of head to tips of tegmina, 3.9 mm; width between tips of humeral angles 2.1 mm.

Male genitalia: Subgenital plate slightly elongated, abruptly narrowing at apex, more than two thirds wide again at base as at the apex, the former distinctly or slightly notched in the middle, latero-basal angles acute or sometimes subacute, outer margins except at base straight or slightly convexly straight (Fig. 12); parameres elongated, curved portion very slightly oblique, transverse portion almost inconspicuous, head short, abruptly narrowing to subacute tip, distal portion smoothly emarginate, middle lobe smoothly rounded or slightly obliquely pronounced, proximal portion with outer margins markedly sinuate (Fig. 16); aedeagus slightly recurved at base, inner transverse projection not well marked with inner margin sharply truncated curving smoothly, transverse outer line only slightly projected in the middle, dentines on the inner margin somewhat more prominent at apex, transverse portion subequal to curved portion (Fig. 14).

Sexual dimorphism and general variations: Females differ from males in being larger in size (4.12—4.3 × 2.08—2.15 mm), in being usually ferruginous with head and anterior portion of metopidium black, in gradual development of suprahumeral horns ranging from slight carinae on pronotum to quite developed horns but usually not extending beyond humeral angles. Among the series of females, two specimens exhibit similar colouration as that of male i. e. uniformly black, but due to scarcity of collection, these are included as examples of variations of present species. Among male usually the size vary being 3.68—4.0 × 1.9—2.1 mm, & shape of male genitalia as given in Fig. 13, 15, 17.

A unique male appears quite different among the series of the present species for its elevated apex of posterior process. This character in some cases has been found specific separating two different taxons. However, because of a single specimen available at hand, the range of variation of this character cannot be ascertained presently. Further material is awaited for the correct determination of this unique male specimen.

Material examined: Holotype, ♂, East Bengal: Mymensingh; on wild bush; 30—1—1969; leg. M. U. Shadab, in Natural History Museum, Department of Zoology-Entomology, University of Karachi. Paratypes 5 ♂, 3 ♀, East Bengal: Sreemangal; on *Mikania scadens;* 28—3—1970; leg. I. Ahmad in authors collection in U. S. N. M., Hamburg Museum and in the above museum. — Other material: 30 ♂, 14 ♀, East Bengal: Sreemangal, Khulna, Sylhet, Rangamati, Jessore, Kaptai, Ishurdi; on *Amaranthus viridus, Mikania scadens,* grass; 20—1, 6—2, 8—3—1969, 21, 22, 23, 24, 27, 28—3—1970; leg. I. Ahmad, Farid Ahmad, M. U. Shadab, Q. A. Abbasi; in the above museums and in authors collection.

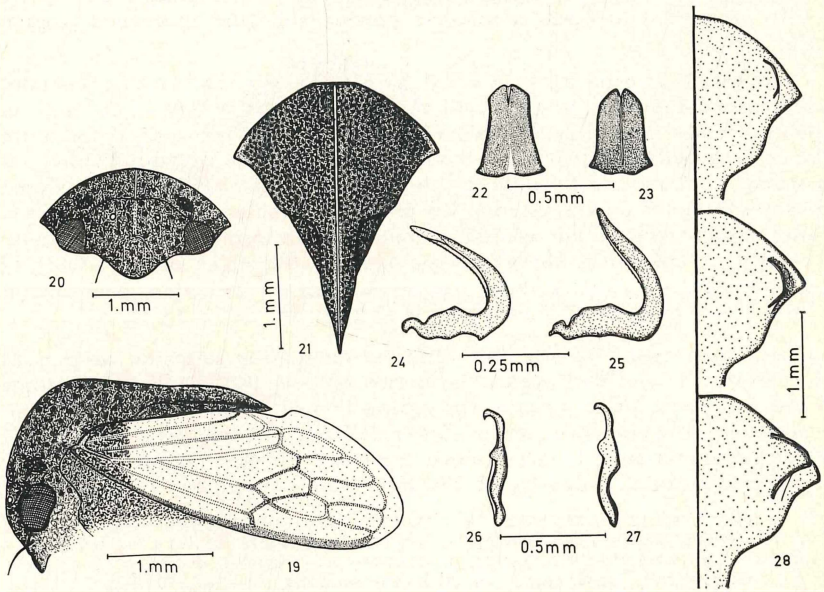
Comparative note: This species appears to be related to *T. latus* FUNKHOUSER and *T. borneensis* FUNKHOUSER comb. nov. in having a comparatively longer posterior process which more or less distinctly reaches on to the internal angles of tegmina and a median frontoclypeal lobe which extends about half its length below lower margins of vertex. However it could easily be separated from either of these by its parameres having sharply pointed less defined apices (Figs. 16, 17) and its characteristic subgenital plates having more or less convex outer margins (Fig. 12, 13).

Tricentrus qadrii **new species**

(Figs. 19—28)

Small, usually black, sometimes with median carina of pronotum and humeral angles ferruginous, punctate, pubescent; frontoclypeus with lateral lobes entirely fused with median lobe and with the apex continuous with lower margins of vertex; suprahumeral horns entirely absent in males while females showing well developed carinae on pronotum to having quite developed horns almost reaching on to humeral angles; posterior process short, not quite reaching internal angles of tegmina.

Male: Head vertical, vertex black, more than three-fourths again as wide as long; finely punctate; sparingly pubescent; upper margin



TRICENTRUS QADRII new species (Figs. 19—28)

Fig. 19, entire specimen, lateral view; Fig. 20, frontal view; Fig. 21, male pronotum, dorsal view; Figs. 22, 23, subgenital plate, ventral view; Figs. 24, 25, aedeagus, lateral view; Figs. 26, 27, parameres, lateral view; Fig. 28, female pronotum, dorsal view, showing condition of suprahumeral horns.

arcuate and feebly sinuate, lower margins oblique, very slightly ridged, sinuate and not extended on frontoclypeus; eyes large, pale brown; ocelli conspicuous, unicolorous and nearer to the eyes than from each other, situated slightly above centro-ocular line; frontoclypeus black, wider than long, extending for distinctly less than half its length below lower margins of vertex; lateral lobes entirely fused with median lobe, their sutures impunctate, tip subrounded and continuous with lower margins of vertex. — Pronotum black, punctate, sparingly pubescent, median carina percurrent but fainting anteriorly; metopidium uniformly black; supra-ocular callosities black, impunctate, suprahumeral horns absent; humeral angles prominent, blunt, ferruginous; posterior process black with median carina ferruginous, tricarinate, short, robust, straight, sloping at apical portion, tip depressed, subacute, not reaching internal angles of tegmina; scutellum black, punctate, pubescent, well exposed. — Tegmina pale, semihyaline, veins brown, that of subbasal area dark brown, base dark ferruginous brown, thickly punctate, irregularly pilose, five apical and two discoidal cells; hind wings with three apical cells. — Sides of thorax, undersurface of body and abdomen black; legs with femora except apices black, the latter, tibiae and tarsi dark ferruginous brown. Length from front of head to tips of tegmina 3.85 mm; width between tips of humeral angles 2.1 mm.

Male genitalia: Subgenital plate elongated, narrowing at apex, about half again as wide at base as at the apex, the former slightly notched in the middle, latero-basal angles acute, outer margins sinuate, convex in the middle, emarginated at base and near apex (Fig. 22); parameres elongated, curved portion obliquely transverse, remarkably prominent or relatively smaller, gradually tapering at head, inner margins of distal and proximal portion smoothly emarginate, middle lobe less obliquely truncate (Fig. 26); aedeagus slightly recurved at base, in some recurved portion less prominent, inner transverse projection triangular, transverse outer line less sinuate, dentines in the inner margin hardly conspicuous, transverse portion subequal to curved portion (Fig. 24).

Sexual dimorphism and general variations: Females differ from males in being larger in size (4.1—4.4 × 2.0—2.24 mm), usually ferruginous to brown with head and anterior portion of metopidium black and exhibiting entirely hornless condition to forms having quite developed suprahumeral horns almost reaching on to humeral angles. Males vary in size being 3.64—4.0 × 1.8—2.1, in colour pattern of tegmina and shape of male genitalia as given in Figs. 23, 25, 27.

Material examined: Holotype: ♂, East Bengal, Ishurdi; on grass; 20—1—1969; leg. M. U. Shadab; in Natural History Museum, Department of Zoology-Entomology, University of Karachi. — Paratypes: 5 ♂, 3 ♀, East Bengal: Sreemangal, Ishurdi; on *Mikania scadens, Amaranthus viridis,* grass; 20—1, 6—3—1969, 27—3—1970; leg. I. Ahmad, Farid Ahmad M. U. Shadab; in author's collection, in U. S. N. M., Hamburg Mus. and above museum. — Other material: 26 ♂, 10 ♀, East Bengal; Sreemangal, Jessore, Rangamati, Kaptai; on *Mikania scadens, Amaranthus viridis,* wild bush, grass; 6, 25—2, 5, 6—3—1969, 22, 24, 27, 29—3—1970, leg. I. Ahmad, Farid Ahmad; in the above museums and in the author's coll.

Comparative note: This species appears to be related to *T. angularis* sp. n. *T. sinuaticornis* sp. n. and also probably to *T. Funkhouseri* nom. nov. in having a short, rather slender posterior process which never reaches internal angles of tegmina and a median frontoclypeal lobe which extends only a third its length below lower margins of vertex. It, however appears unique in having parameres with head region highly developed and prominent (Figs. 26, 27) and other characters as listed in the key.

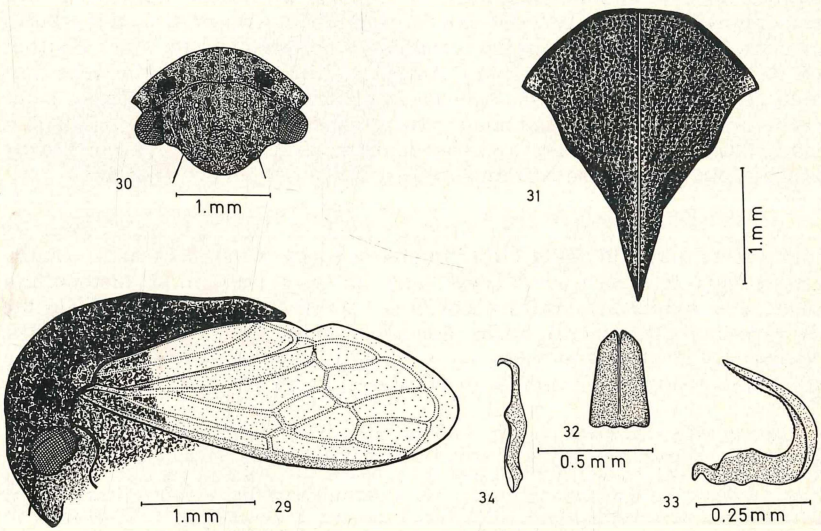
The species is hereby named in honour of late Professor M. A. H. Qadri, ex-Chairman and ex-Dean, Faculty of Science, University of Karachi in an effort to recognize his contribution in systematic Entomology. Professor Qadri expired on 6th December, 1974.

Tricentrus sinuaticornis **new species**

(Figs. 29—34)

Small, black, punctate, pubescent; frontoclypeus with lateral lobes entirely fused with median lobe and continuous with lower margins of vertex; suprahumeral horns absent in males; posterior process short, not reaching internal angles of tegmina.

Male: Head vertical, vertex black, more than three-fourths again as wide as long, finely punctate, pubescent; upper margin arcuate and weakly sinuate; lower margins oblique, weakly ridged, slightly sinuate and extended on frontoclypeus; eyes large, pale; ocelli conspicuous, brown, nearer to the eyes and set wide apart from each other, situated above centro-ocular line; frontoclypeus black, wider than long, extending for



TRICENTRUS SINUATICORNIS, new species (Figs. 29—34)

Fig. 29, entire specimen, lateral view; Fig. 30, frontal view; Fig. 31, male pronotum, dorsal view; Fig. 32, subgenital plate, ventral view; Fig. 33, aedeagus, lateral view; Fig. 34 paramere, lateral view.

distinctly less than half its length below lower margins of vertex, lateral lobes entirely fused with median lobe, their sutures impunctate, tip rounded and continuous with lower margins of vertex. — Pronotum black, punctate, sparingly pubescent, median carina percurrent but somewhat fainting anteriorly; metopidium uniformly black; supra-ocular callosities black, impunctate; suprahumeral horns absent; humeral angles prominent, blunt, ferruginous; posterior process black with median carina ferruginous, tricarinate, short, robust, elevated before base, depressed in the middle, then convexly sloping towards depressed and blunt tip, distinctly not reaching internal angles of tegmina; scutellum black, punctate, pubescent, well exposed. — Tegmina pale, semihyaline, veins castaneous, base black, thickly punctate, irregularly pilose, five apical and two discoidal cells; hind wings with three apical cells. — Sides of thorax, undersurface of body and abdomen black; legs black with apices of femora dark ferruginous.

Length from front of head to tips of tegmina, 3.8 mm; width between tips of humeral angles, 2.05 mm.

Male genitalia: Subgenital plate elongated, abruptly narrowing at apex, distinctly half wide again at the base as at the apex, the former distinctly notched in the middle, latero-basal angles inconspicuous, outer margins slightly convex (Fig. 32) parameres elongated, curved portion usually markedly oblique, remarkably uniformly thin with less distinct but prominent head, latter obscurely but sharply pointed, distal portion smoothly concave, median lobe small, obliquely rounded, proximal portion sinuate (Fig. 34); aedeagus distinctly recurved at base, inner transverse projection well marked with inner margin truncated but with slight notch in the middle, curving smoothly, transverse outer line distinctly sinuate, dentines on the inner margin uniformly marked, transverse portion subequal to curved portion (Fig. 33).

Females unknown.

Material examined: Holotype, ♂, East Bengal: Rajshahi; on grass, 9—2—1969; leg. M. U. Shadab; in Natural History Museum, Department of Zoology-Entomology, University of Karachi. — Paratypes, 2 ♂, East Bengal: Sreemangal; on *Mikania scadens;* 27—3—1970; leg. I. Ahmad; in U. S. N. M. and at Hamburg Mus.

Comparative note: This species is closely related to *T. angularis* sp. n. *T. qadrii* sp. n. and probably to *T. funkhouseri* nom. nov. in having a short posterior process which never reaches internal angles of tegmina. It however appears isolated in having a relatively shorter and more robust posterior process which is sinuate from above and has stout and blunt apex (Fig. 29) together with other characters noted in the key.

Phylogeny and Zoogeography

It is clear from above that the present species together with *T. latus* Funkhouser, *T. funkhouseri* nom. nov. and *T. borneensis* Funkhouser (comb. nov.) form a very closely related group of their own. All these species share a single median frontoclypeal lobe with lateral lobes entirely fused having margin continuous with lower margins of vertex. All represent the smallest, body size within *Tricentrus* species (3.75—5.5 mm). All

these species show remarkable degree of sexual dimorphism with regard to suprahumeral horns which are entirely absent in the males but which in females vary from being entirely absent to a fully developed condition. Males of the above species are usually uniformly black while the females always show patterned condition with pronotum ferruginous and head and anterior portion of metopidium black.

AHMAD (1972) and the present authors (1974 and in manuscript) have shown that the entire fusion of the lateral lobes of the frontoclypeus with the median lobe is an advanced condition and some of the more advanced centrotines such as species of the genera *Sipylus* STÅL, *Cryptaspidia* STÅL and *Gargara* AMYOT et SERVILLE represent this condition, although this character has probably evolved more than once in Mambracidae such as in a rather primitive genus *Coccosterphus* STÅL (GODING, 1934). Similarly the smallest body form also appears to be an advantageous trait and probably has been acquired by some species of the genus *Tricentrus* including those being discussed presently.

The sexual dimorphism with regard to suprahumeral horns appears to be an important feature of most of the members of the family Membracidae (KATO 1960; CAPENER 1962, 1968, AHMAD 1972, AHMAD and YASMEEN, 1974 and in Ms.). FUNKHOUSER (1914) based the description of his new genus *Centrotoscelus* on the presence or absence of these horns and its allocation to a different tribe was also based on this character (FUNKHOUSER 1951). Yet FUNKHOUSER (1927) himself suspected the unreliability of this character while describing his species *pseudocornis* FUNKHOUSER and in erroneously assigning it to *Centrotoscelus*, „This species is most interesting in that it shows a tendency to a transition towards the genus *Tricentrus*. It very closely approaches *Tricentrus brevicornis* described above (No. 26) and might be placed in the same genus as the latter species if the suprahumeral ridges were somewhat more prominent. In general facies, however, *Centrotoscelus pseudocornis* has more affinities towards *Centrotoscelus* than towards *Tricentrus* and must be placed for the present in the former genus. It may be that additional forms from these two genera will show that the presence or absence of suprahumeral horns will not constitute a sufficient generic character as has hitherto been supposed". AHMAD (1972) and the present authors (1974 and in manuscipt) have shown this sexual dimorphism to be of highest degree in those species of *Tricentrus* STÅL the ancesters of which probably also gave rise to some of the more advanced tricentrines such as species of *Sipylus* STÅL or indeed members of the more advanced centrotines at large (e. g. species of *Gargara* AMYOT et SERVILLE and *Cryptaspidia* STÅL).

The above species group the ancestors of which probably also gave rise to the present species, probably evolved by a loss of the separate identity of the lateral lobes. The median lobe is extended for half its length below the lower margins of vertex but with its margins not continuous with the latter. These species represent maximum size variations (some of the largest species of the genus *Tricentrus* STÅL such as *T. aeneus* DISTANT (5.0 mm) and some of the smallest species such as *T. nigra* sp. n. (3.5 mm) are included in this group). In some of these

species, the males show from a smooth pronotal surface to so much fully developed horns which exceed in length in comparison to their intervening space. In some of these species besides black males, patterned males and patterned to almost uniformly black females are also encountered.

The presently included species also appear advanced in exhibiting strikingly similar appearance in body form with consistent differences in their male genitalia especially the parameres, similar to some of the species of the tribes Leptocorisini of the family Alydidae and Stenodemini of the family Miridae of the true bugs group. Heteroptera (AHMAD 1965). This striking similarity in their body form and consistent differences in their male genitalia might be representing their rather recent evolution which was probably based on mechanical isolation preventing gene flow between closely related species in the absence of more recognizable significant differences which help establish ethological isolation between closely related species.

The present species appear to be distributed in the South-east asiatic territories (Fig. 35). The distributional range in the north-east appears to be extending in the northern Assam (Sylhet, former East Pakistan)

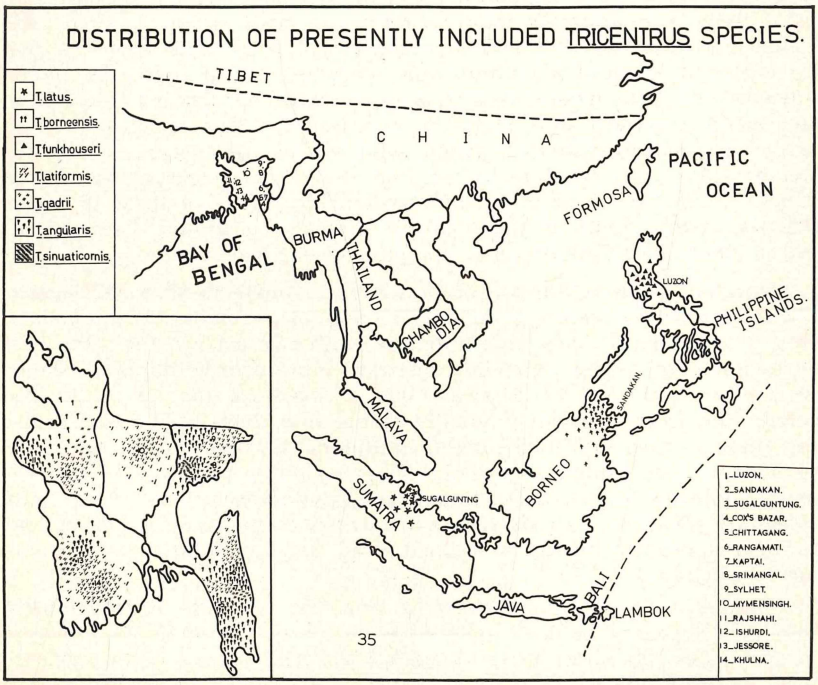


Fig. 35: Map showing distribution of presently included species.

diverging more eastward into Luzon (Philippine Island) on the western side of the Wallace line and in the south-east from Cox's Bazar (former east Pakistan) into Sumatra and Borneo Island (Indonesia).

The present species obviously fall into two groups. The first group which is represented by *Tricentrus latiformis* sp. n. and probably includes *T. latus* FUNKHOUSER and *T. borneensis* FUNKHOUSER comb. nov. exhibits comparatively longer posterior process which always reaches on to internal angles of tegmina. In these the frontoclypial lobe extend more or less half its length below lower margins of vertex.

The females probably show an extreme degree of variation of suprahumeral horns from being entirely hornless to having completely developed horns (both *T. borneensis* FUNKHOUSER) comb. nov. and *T. latus* FUNKHOUSER are described on a single female and probably the hornless condition of the former and the extremely developed broad, flat and stout horns of the later species extending outward and upward, exhibit extreme range of variations). Whereas the males of both FUNKHOUSER's species *T. latus* and *T. borneensis* comb. nov. are unknown, the parameres of the present new species are rather generalized in having extremely less developed oblique portion of the curved part with head region indistinct having sharply pointed apices.

The possession of the above generalized characters of these species show them comparatively more primitive in their group. (AHMAD 1972, AHMAD and YASMEEN 1974 and in manuscript). It is quite probable that the centre of origin of this group was somewhere in the south east indian subcontinent from where these species extended northward into Sylhet and south eastward into Sumatra and Borneo. This conclusion is in agreement with FUNKHOUSER (1940) who in his „Zoogeography of the Membracidae" has concluded, „we find that there seems to be two of these centres (centre of origin of Membracidae). One of these is in the Oriental region which is the home of the more primitive Centrotinae" and in other place, „the first movements were eastward".

The other group which is represented by *T. angularis* sp. n., *T. sinuaticornis* sp. n. and *T. qadrii* sp. n. and probably also includes *T. funkhouseri* nom. nov. appears widely distributed in south east asia, in the north east in the northern Assam, extending eastward into Luzon, Philippine Islands on the western side of WALLACE line. FUNKHOUSER (op. cit.) has also noted, „the forms of Asia gradually merge into those of the east indies and these in turn into those of the Philippines". These species appear to be advanced in having acquired a short posterior process which never reaches internal angles of tegmina, single frontoclypeal lobe usually only extending about a third its length below lower margins of vertex and parameres usually having a defined head and an oblique part in the curved portion.

T. qadrii sp. n., *T. angularis* sp. n. and also probably *T. funkhouseri* nom. nov. appear to be more generalized in comparison to *T. sinuaticornis* sp. n. in still retaining rather elongated posterior process with subacute apex. In this group *T. qadrii* sp. n. appears to be more advanced in having parameres with more distinct head region.

Notes on two already described species of *Tricentrus* Stål

Tricentrus funkhouseri **new name**

1927 *Centrotoscelus brunneus* Funkhouser: 117; Pl. 4, Fig. 21.
1951 *Centrotoscelus brunneus* Funkhouser: 270
1951 *Centrotoscelus brunneus,* Allen: 486
1951 *Centrotoscelus brunneus,* Metcalf & Wade: 363

Funkhouser's original description of *Centrotoscelus brunneus* is as follows: „Long, slender, brown, punctate, pubescent; no suprahumerals; hind trochanters armed with teeth, tegmina brown with internal apical margin hyaline; undersurface and legs brown. — H e a d wider than long, black, densely pubescent with golden hairs; base sinuate; eyes large, brown; ocelli small, pearly, elevated, about equidistant from each other and from the eyes and situated on a line drawn through centers of eyes; clypeus continuing the inferior margins of the cheeks. — P r o n o t u m brown, finely punctate, densely pubescent with golden hairs; metopidium convex, broader than high, an irregular smooth black area on each side at base; humeral angles large, prominent, obtuse, median carina percurrent; scutellum well exposed; posterior process short, heavy, blunt, tectiform, depressed at base, tip darker and not reaching internal angles of tegmina. — T e g m i n a brown, wrinkled, weakly pilose; base brown, opaque, and punctate; veins brown, prominent; internal apical margin bearing two large hyaline spots separated by a narrow brown line; five apical and two discoidal cells. — Sides of thorax, undersurface, and abdomen very dark brown, almost black; legs light brown; hind trochanters bearing teeth.

Length from front of head to tips of tegmina, 5.5 millimeters; width between tips of humeral angles, 2.5 mm.

T y p e , female.

L o c a l i t y , Mount Polis, Ifugao Subprovince, Luzon.

Described from a single specimen, received from Staudinger and A. Bang-Haas and now in my collection. Date and collector unknown."

T a x o n o m i c n o t e : Funkhouser described the species *brunneus* under the genus *Tricentrus* Stål in 1918. Later in 1927 a, he described altogether a different species having the same name under the then a valid genus Centrotoscelus Funkhouser. The present authors (1974) have already synonymized the latter with the former and in presence of a more senior valid species *Tricentrus brunneus* Funkhouser 1918, *Centrotoscelus brunneus* Funkhouser 1927 is renamed here as *Tricentrus funkhouseri* nom. nov.

Tricentrus minicornis **new name**

1938 *Tricentrus brevispinis* Funkhouser: 206; Fig. 8
1951 *Tricentrus brevispinis* Funkhouser 1951: 212, 304
1965 *Tricentrus brevispinis* Metcalf & Wade: 389

Funkhouser's original description of *T. brevispinis* is as follows: „Near *T. capreolus* Walker, but larger, with much smaller suprahumerals and a differently shaped head. Large, light brown, with very minute suprahumerals and a depressed posterior process which just reaches internal angles of tegmina; tegmina light brown, semi-opaque, with base and tip brown. T e c h n i c a l d e s c r i p t i o n : H e a d subqadrate, almost as high as wide, brown, finely punctate, densely pubescent; eyes dark brown, ovate; base highly arcuate and sinuate; ocelli large, pearly, slightly elevated, equidistant from each other and

from the eyes and situated well above a line drawn through centers of eyes; inferior margins of genae sloping; clypeus extending for half its length below inferior margins of genae, tip rounded and pilose. — P r o n o t u m light brown, finely punctate, densely pubescent with short golden hairs; metopidium sloping, wider than high; median carina faintly percurrent; humeral angles large, triangular, blunt, extending outward farther than the suprahumeral horns; suprahumeral horns very short, spine-like, sharp, not more than one fourth as long as the distance between their bases, extending outward and upward; posterior process strong, heavy, tricarinate, tectiform, slightly depressed at tip which extends just to the internal angles of the tegmina; scutellum narrowly exposed on each side. — T e g m i n a brownish, semiopaque, wrinkled, base broadly brown, coraceous and punctate, tip narrowly brown, apical limbus very narrow, five apical and two discoidal cells. — Sides of thorax and undersurface of body dark brown; femora dark brown, tibiae and tarsi light brown.

Lenght from front of head to tips of tegmina 5.7 mm; width between tips of suprahumeral horns 2.8 mm.

T y p e : Female.

T y p e l o c a l i t y : Kwantung, Mei District, South China.
Described from a single female collected by F. K. To on July 19, 1933. Type in the Lignan University coll.

T a x o n o m i c n o t e : FUNKHOUSER in 1920 described the species *brevispinis* under the then a valid genus *Centrotoscelus* FUNKHOUSER. Later in 1938, he described altogether a different species having the same name under the genus *Tricentrus* STÅL. Because of the synonymy of the former genus with the latter, and in presence of a senior now valid species, *T. brevispinis* comb. nov. (FUNKHOUSER 1920), the present species *Tricentrus brevispinis* FUNKHOUSER, 1938 is renamed here as *Tricentrus minicornis* nom. nov.

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