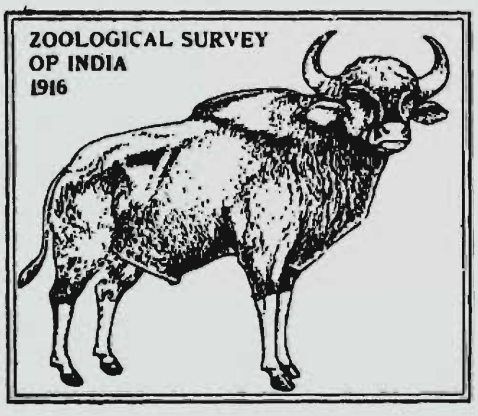
TECHNICAL MONOGRAPH No. 14

GRASSHOPPER FAUNA OF WEST BENGAL, INDIA (ORTHOPTERA : ACRIDIDAE)

by

H. K. BHOWMIK



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(Orthoptera : Acrididae)

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H. K. Bhowmik

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Introduction

The members of the family Acrididae are commonly known as short-horned grasshoppers and locusts (migratory ones). The size of the insects varies from small to large (15 mm to 70 mm). These insects are usually found on grounds in all sorts of shrubs, herbs, vegetations and agricultural fields. Some of them are semiaquatic and live near the edge of water sources and casually go to water (viz., *Oxya* spp., *Gesonula* spp. etc.) Majority of these insects are terrestrial and some show phototaxism and can be collected by light traps.

Grasshoppers pass through 4 to 7 nymphal stages before reaching the adult stages. The gravid female lays eggs in the ground in egg pods. After the incubation period, which varies depending on various ecological factors, the nymphs come out from the egg-pods, feed on nearby vegetation and grow and develop. The males usually die after copulation while the ovipositing females may either die immediately after oviposition or after sometime later. The number of eggs per pod and the total number of eggs laid by a single female may be as high as 90-98 and 299 respectively. There is seasonal fluctuation of acridid population : the warmer months are considered most favourable for population growth. Since grasshoppers are mainly phytophagous and depend largely on vegetation for food, some of them have gained considerable economic importance as pests, and many have been branded as enemies to mankind, though in most cases wrongly and on assumption as there is no or little qualitative and quantitative informations for majority of species (for more informations vide 'Bionomic').

Grasshoppers that develop seasonal and occasional behaviour of mass migration are called 'locusts'. The reasons for this migration though not obvious, are apparently owing to stress and strain of field ecological factors of unexplainable nature. Fortunately, in the fauna of West Bengal, there is no species of locust.

In distribution the Acrididae is almost cosmopolitan, being absent only from truly polar areas and some few small groups of islands of oceanic origin. Members of the family range well into the colder areas of the world, and numerous species are known only from alpine conditions at high elevations on some of the great mountain masses of the world, as the Himalayas, the Altai, the Caucasus, the Alps, the Rocky Mountains, the Sierra Neveda and the Andes. Very few species are of global distribution as distribution of these insects are limited owing to severe inhibiting ecological factors or tropisms. Three special types of vegetations foster grasshopper populations

well. These are the humid grass or savanna country, semi-arid grass plains, steppes or mountains, and tropical lowland rain-forest, the undergrowth of which latter often harbours an acridid fauna of remarkable diversity. Some insular areas, as the Sunda Islands and New Guinea have exceedingly rich and varied acridid faunas, as rich in fact as African and Australian continental areas.

In West Bengal, Acrididae are found in all ecosystems, from plain, agricultural lands in lower Bengal to the semi-arid land in Purulia and Bankura districts up to snow-clad Himalayan ranges. Altogether 11 subfamilies, 44 genera and 56 species and subspecies of grasshoppers are known from West Bengal, though Indian fauna* comprises of 13 subfamilies, 129 genera and 256 species or subspecies while in the world fauna, considerably over 1, 000 genera belong to the family, and it embraces in the neighbourhood of 10,000 known species.

Though much works have been done on this fauna in other parts of the world, very little is known on systematics of West Bengal Acrididae, inspite of their easy availability and abundance. Stray contributions on the taxonomy of West Bengal acridids have been done by Walker (1870, 1871), Stal (1860, 1873), Saussure (1884, 1888), Navas (1904 & 1905), Bolivar (1902, 1909, 1914, 1917), Uvarov (1927, 1942) and more recently by Tandon (1975), Bhowmik (1984) and Bhowmik and Halder (1983, 1984).

The only consolidated source of information is available in Kirby's (1914) posthumous publication of "*Fauna of British India including Ceylon and Burma, Orthoptera, London, Vol. I*". which is now considered out dated for any practical utility (Bhowmik, 1985).

The author who is contributing to the systematics of Indian Orthoptera, for the last 25 years, presents here a consolidated report on acridid fauna of the state of West Bengal, in the light of latest trend in taxonomical work of this group.

The classification of the subfamilies of the family Acrididae is a subject of much controversy and experts often differ in their opinion (Bhowmik, 1985). However, the classification followed here is after Uvarov (1966) for the subfamilies, Acridinae, Gomphocerinae and Oedipodinae ; and, Dirsh (1965) for the remaining subfamilies.

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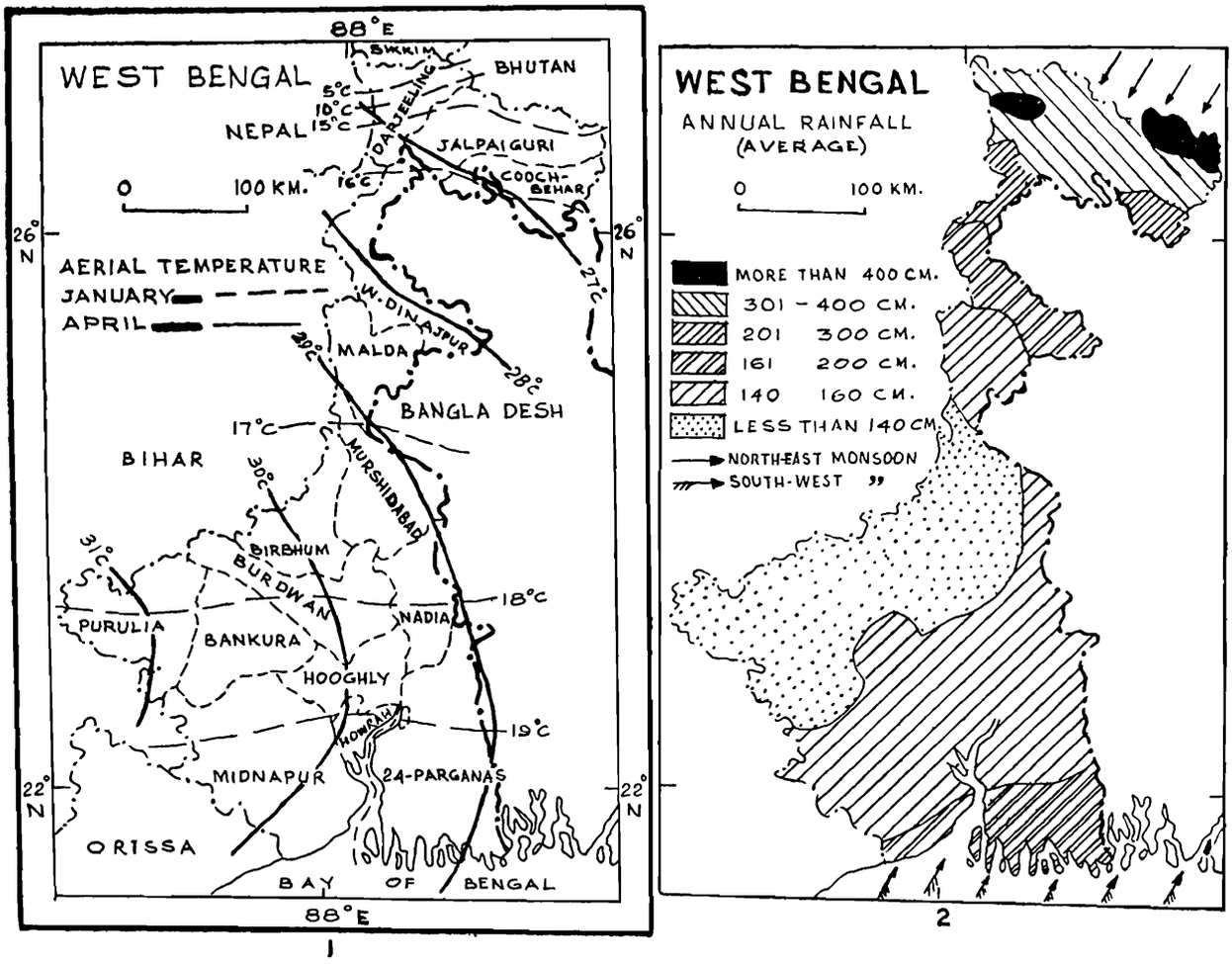
*The approximate strength of genera and species of Indian sub-families is as follows :— (no. of genera within brackets). Acridinae (15) 33 ; Truxalinae (1) 3 ; Gomphocerinae (16) 37 ; Oedipodinae (21) 43 ; Romaleinae (3) 6 ; Hemiacridinae (9) 20 ; Oxyinae (3) 11 ; Coptacridinae (6) 11 ; Tropidopolinae (7) 7 ; Calliptaminae (5) 12 ; Eyprepocnemidinae (10) 20 ; Catantopinae (26) 44 ; Cyrtacanthacridinae (7) 9.

GEOGRAPHICAL POSITION OF WEST BENGAL

(Figs. 1-4)

West Bengal has a unique geographical position and is situated in the north eastern part of India, between 21.31′ and 27.14′ north latitude and 85.51′ and 89.53′ east longitude with Himalayan ranges on the north, Bay of Bengal on the south, Bangladesh and Assam on the east and Nepal, Bihar and Orissa on the west and the tropic of cancer running across the middle. The state covers an area of 87, 882 sq. km. The state represents the western past of the great Brahmaputra-Gangetic delta. The altitude of the state varies from sea level to above 7000 cm. The aerial temperature of the state ranges between 5°C to 19°C (in the winter) and 27°C to 31°C (in the summer) (Fig. 1) and an avarage rainfall of 140 cm to more than 400 cm (Fig. 2). The nature of soil is of different types in different part of the state (Fig. 3) and according to the natural vegetation, the state can be broadly



Figures 1-4, maps of—

Fig. 1. Annual acrial temperature during winter (January) (broken lienes) and mid summer (April) (continuous lines) over the districts of West Bengal.

Fig. 2. Average annual rainfall in West Bengal.

divided into 4 natutal units (Fig. 4).—Himalayan and Sub-himalayan unit, consisting of Alpine, Dry temperate, Wet temperate and sub-tropical pine forest, moist temperate and tropical wet semi-evergreen forests ; Gangetic alluvial unit comprising of moist tropical ; laterite or semi-desertic unit consists of dry tropical or moist deciduous sal forests ; and Coastal swampy unit which is moist tropical, and consists of magroove vegetation (beach—and tidal forests).

The Himalayas have, as a whole, its enormous influence on the prevailing climate of the state and the varied vegetation, which again depends greatly upon the altitude, temperature, rainfall and soil type, makes an impact on the faunal composition of grasshoppers.

Treatment

The present work gives a consolidated faunal information of the family Acrididae (Orthoptera) known to occur in the state of West Bengal, India. It includes all the species and subspecies so far known or recorded in

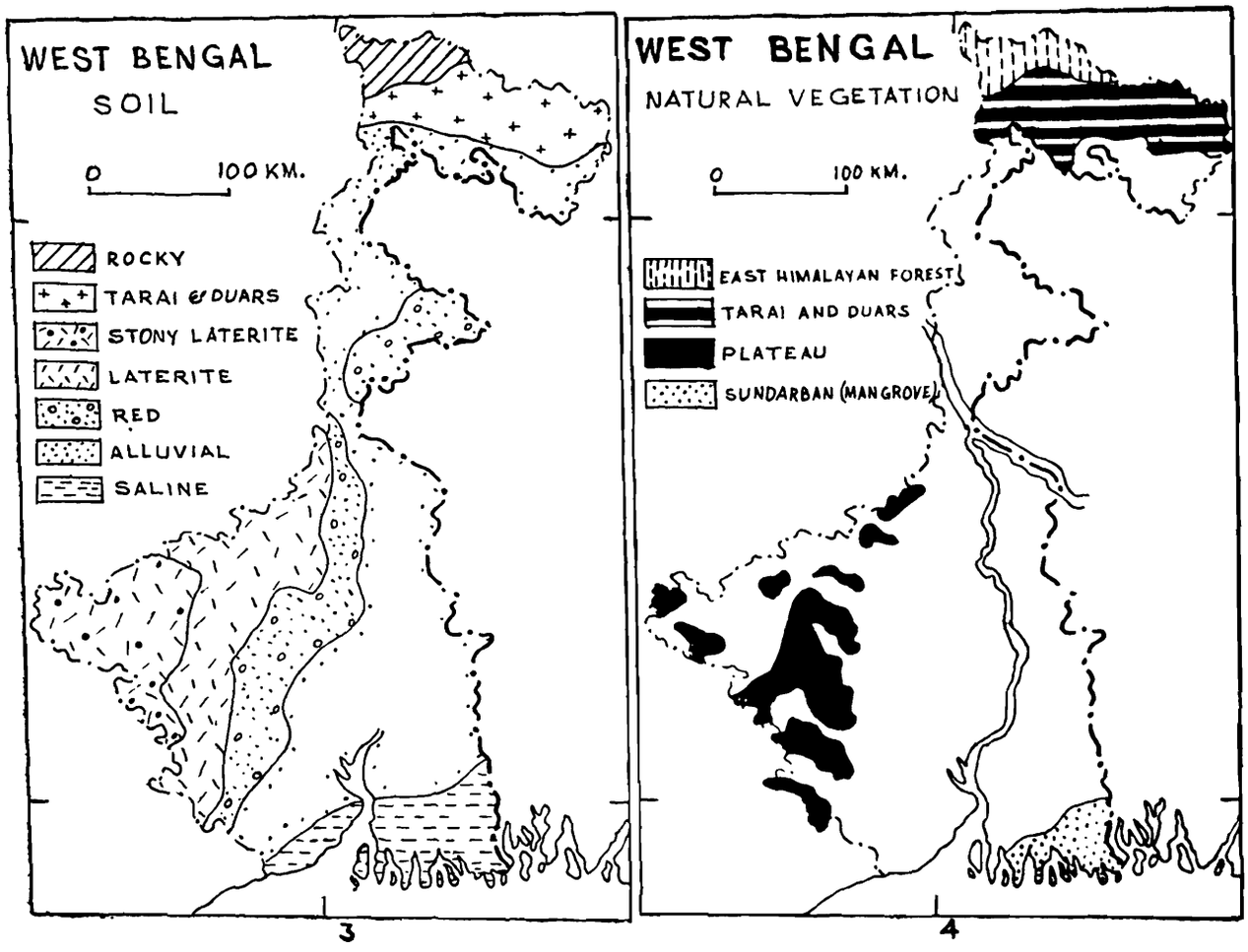


Fig. 3. Broad nature of soil in West Bengal.

Fig. 4. Natural vegetation in West Bengal.

literature from this state, the number so far ranges to 11 subfamilies, 44 genera and 56 species and subspecies. For all the genera, generic synonyms, junior homonyms and deliberate variations in spelling are listed under the valid generic name. Each genus and generic synonym(s) include a reference to the original description. Generic characters and the citation of the type-species for all valid generic names are included and broad distributional range of the genus are recorded.

Similar treatment to that of the genera has been given for all species and subspecies as well. This work further includes all authentic and important bibliographical papers on the taxonomy of the species. The descrition of the species, in light of modern taxonomic trend, illustrations and detailed measurements have also been provided and data have been furnished in respect to the zoogeographical distribution. Under the headings "diagnostic features" the affinity of the species and under "remarks" general information on the taxonomic category including its ecological notes, have been given.

Keys have been furnished for subfamilies, genera and species (and subspecies), wherever there is more than one form of a taxon.

A short review of the bionomic studies of Indian species, with relevant references of international works, has been given with a view to trigger off the necessary impetus of studies in this field of the West Bengal acridid fauna. A short discussion of economic importance has also been included to draw the attention necessary for detalied study of this group in relation to agriculture.

MATERIAL AND METHOD

The materials were collected from the districts of the state of West Bengal. In order to have a comprehensive collection of the acridid fauna, several surveys were conducted in different seasons. The eastern Himalaya covering the districts of Darjeeling and Jalpaiguri which have unique eco-systems were intensively surveyed. Besides, the national collections of the ZSI were also studied.

In certain cases, the material for the recorded species from West Bengal was not available for study ; in such cases, if the material was available from other states of India was also taken into consideration.

Some of the species were confirmed by Dr. Jago of London.

Grasshoppers are usually collected by sweeping on low vegetation with a handnet or by manually or disturbing leaves etc. Few of the larger insects were picked up directly with a pointed forcep and also by light traps.

The mateial was fixed by Potassium cyanide, and were usually preserved dry, for temporary storage in the field they were kept in paper packets with

a strips of cello-cotton. The insects were dried in blotting paper by exposing them to open air from time to time before temporary storage to prevant the growth of mould or fungus. Sometimes insects were directly preserved in Ethyl alcohol (90%) in the field. Such collections were rewashed in Ethyl alcohol before permanent storage.

For study, the insects were preserved dry after relaxation and pinned, labelled and stored in the collection boxes with insecticides to protect against the attack of harmful organisms.

The male genitalia figured in this study were dissected out and treated in the following manner :—

The male genitalia were studied from dried specimens. For permanent mounts of the genitalia, the abdominal tips of male specimens were disscted out and stored overnight in 10% KOH solution, then cleared with fine needles under a dissecting binocular. The separated parts were rinsed several times in water and stored in alcohol with a label of the specimen from which they had been removed.

Whenever necessary for study, the dissected genitalia were placed on grooved slides. This technique was found satisfactory as it facilitated the study of genitalia from different angels for better understanding of the articulation of the component parts.

Measurements

All measurements in millimetres of length are given from the tip to the end of the parts concerned. The figures indicate the range of measurements and are based on a random choice of specimens that were found in the available material. All the figures were drawn under camera lucida at a magnification of x 10.8, x 18, x 24, x 32 or x 56.

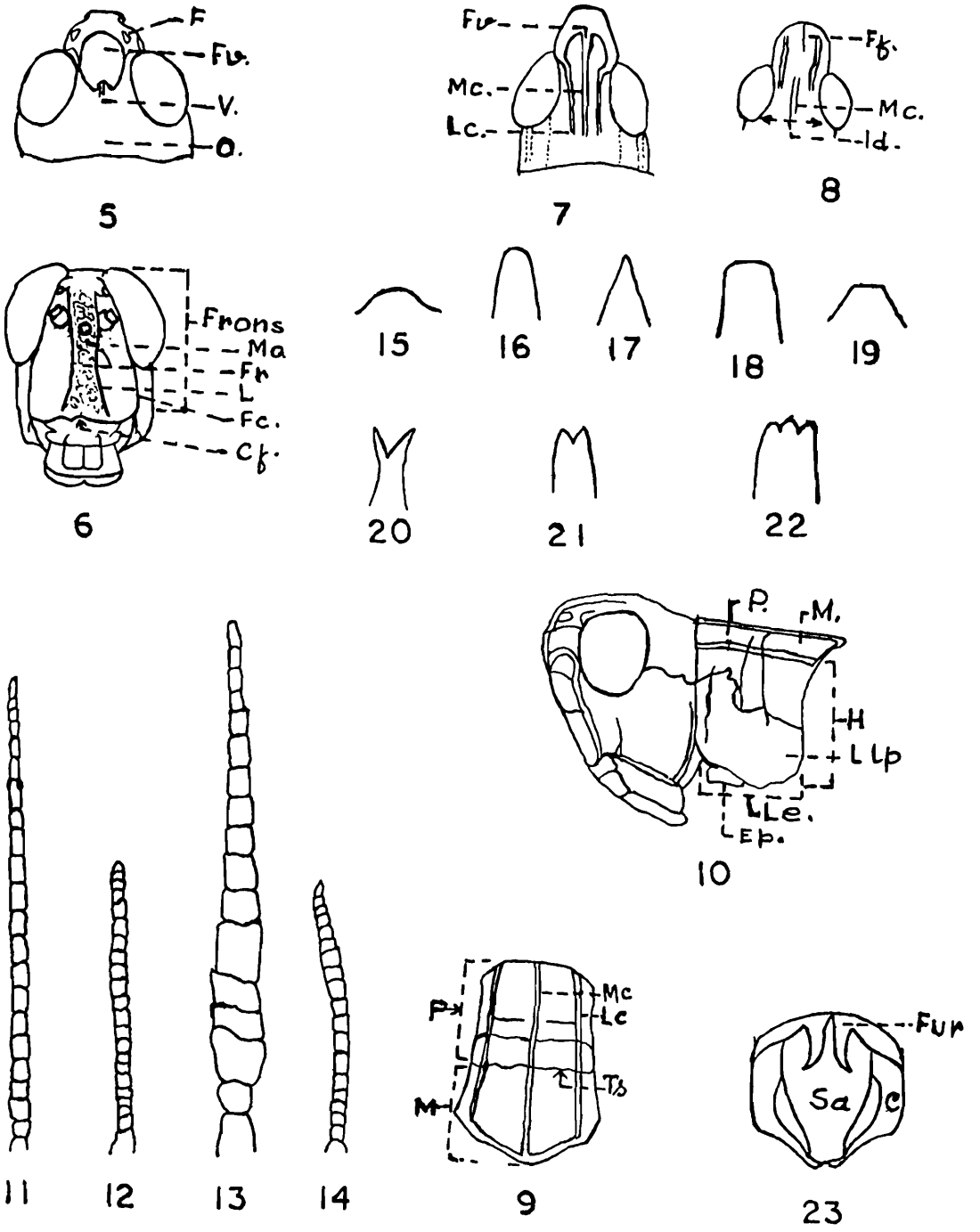
Specimens which were up-to 18-19 mm are termed as "small" ; 18-35 mm as "medium" and the rest having longer measurements as "large".

Terminology of the morphology utilized for taxonomic studies in acridids

(Figs. 5-30)

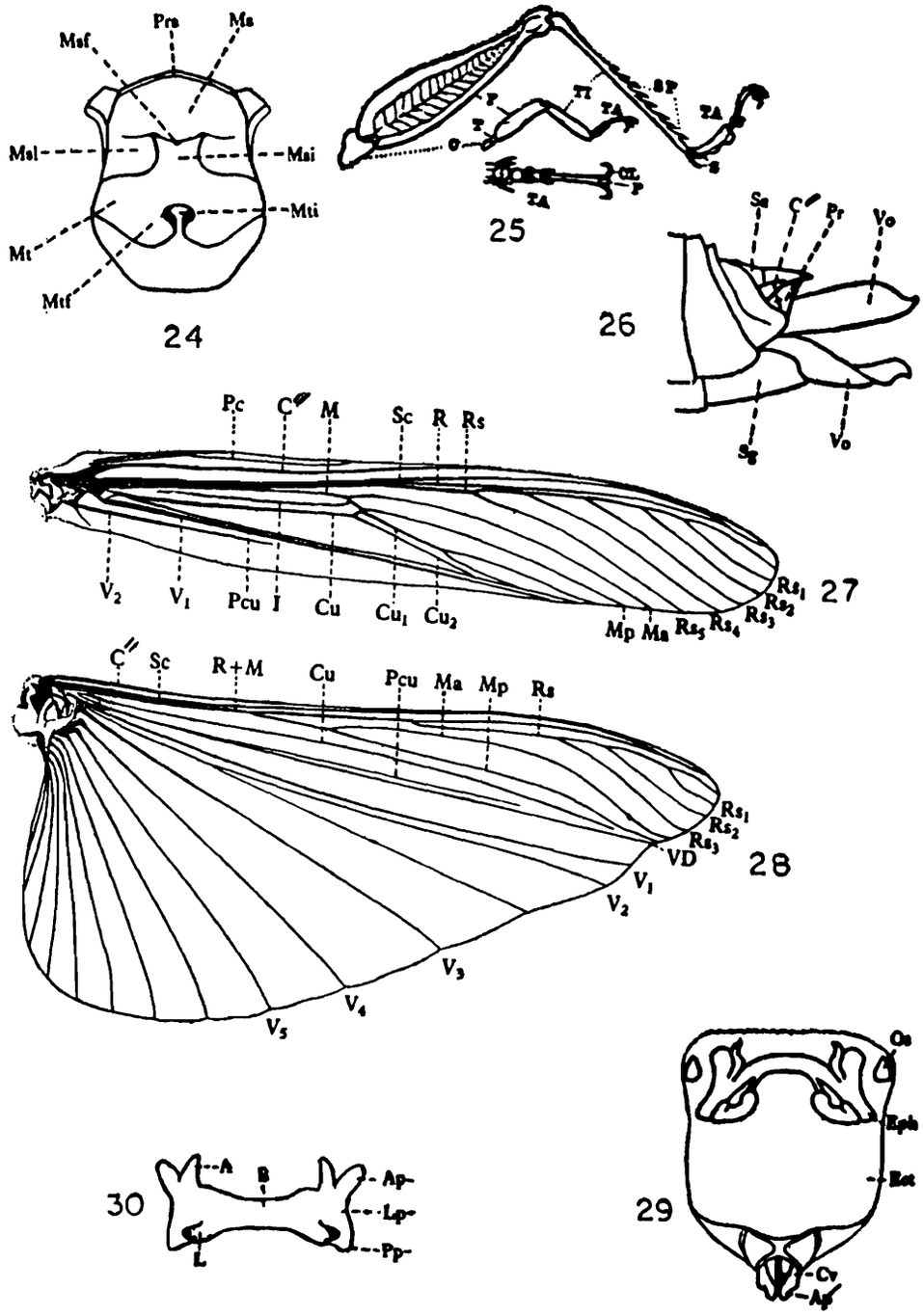
Head : Usually short, broad, more or less oval in shape, rarely conical (eg. *Acrida* spp.). Occiput and vertex constituting the posterior head, usually rounded and wide but rarely flat or depressed.

Posterior part of the head partially covered by the pronotal margin is called the *occiput* and the culminating part is the *vertex*. The margins of vertex are often well raised and sharp, but may be fairly broad which often bear regular depressions, called *foveolae* or *tempora* or *lateral foveae*. This



Figs. 5-23. (diagrammatic) : Morphrloty of grasshoppers. 5-8. Head—5. dorsul view ; 6. front aspect ; 7. dorsal aspect showing fastigium of vertex ; 8. same as 7 ; 9. Pronotum, dorsal aspect showing sulcation ; 10. Lateral aspect of head and pronotum ; 11-14. Antenna—11. filiform ; 12. thick filiform or rod-like ; 13. ensiform ; 14. clavate ; 15-22. Prosternal tubercle or spine—15. Tubercle ; 16. Cylindrical ; 17. Cubical ; 18. Spathulate ; 19. Pyramidal ; 20. Bifurcate ; 21. Bilobate ; 22. Trilobate ; 23. Male abdominal tip from dorsal aspect.

(Letterings : Fv. fastigiam of vertex ; F. fastigial foveolae ; Ff. fastigial furrow ; V. vertex ; O. occiput ; Mc. median carinula of fastigium ; Lc. lateral carinulae of fastigium ; Id. interocular distance ; Mo. median ocellus at frontal ridge ; Fr. frontal ridge ; L. lateral carinula of frontal ridge : Fc. facial carina ; Cf. clypeo-frontal suture ; P. prozona (of pronotum) ; M. metazona ; Mc. median carina (of pronotal disc) ; Lc. lateral carina ; Ts. transverse sulci (of pronotal disc) ; Llp. lateral pronotal lobe ; Le. length of pronotal lobe ; H. height of pronotal lobe ; Ep. episternum ; Fur. furcula ; Sa. supra-anal plate of male ; C. cercus of male).



Figs. 24-30. (diagrammatic) : Morphology of grasshoppers (continued). 24. Mesc- and metasternum ; 25. Posterior leg ; 26. Abdominal tip of female ; 27. Tegmen ; 28. Wing ; 29. Male phallic complex ; 30. Epiphallus.

(Letterings—Prs. prosternum ; Ms. mesosternum ; Msf. mesosternal furcal suture ; Msl. mesosternal lobe ; Msi. mesosternal interspace ; Mt. metasternum ; Mtf. metasteranal furcal suture ; Mte. metasternal interspace ; C. coxa ; T. trochanter ; F. femur, T. tibia ; TA. tarsus (3 segmented) ; SP. tibial spines ; S. tibial spurs ; CL. claw. P. pad ; Sa. Supra-anal plate ; C. cercus ; Pr. paraproct ; Sg. subgenital plate ; Vo. valves of ovipositor ; Pc. pre-costal vein ; C. costal ; Sc. subcostal ; R. radial ; Rs. radial sectors (R_1, R_2 etc) ; M. medial ; Ma. media anterior ; Mp. media posterior ; Cu. cubital ; Cu_1. cubital anterior ; Cu_2. cubital posterior ; I. intercalated vein ; Pcu. post. cubital vein ; V. vanal vein (V_1, V_2 etc.) ; VD. dividing vein ; Os. oval sclerites ; Eph. epiphallus ; Ect. ectophallic sheath ; Cv. cingular valve ; Ap. anterior process ; Ap. apical valve of penis ; B. bridge of epiphallus ; A. ancora (e) ; pp. posterior process of epiphallus ; L. lophus ; Lp. lateral process.

foveola is usually a triangular space and is exactly situated, on each side, above the antennal socket and between the eyes and the fastigium. It is well developed in the subfamilies Gomphocerinae and Oedipodinae and insignificant in other subfamilies. Its position and variable shape etc. have great systematic value.

The vertex is often produced between and beyond the antennae and this prolongation is called the *fastigium of vertex.* Its margin is usually raised and is called lateral carinula (e) often divided by a median carinula and rarely demarketed from the apex of vertex by a transverse fissure. The fastigium may be concave, shallow or depressed or weakly indented. The detailed size and shape of this structure is largely used in generic and specific levels.

Frontal ridge : The anterior surface of the head is called the front, which is either vertical or oblique in profile. The *frontal ridge* is the central part of the face, along the front. It is generally raised, and bounded by a carinula, called as bounding carinula. These carinulae are often curved outwards above each eye and below the *antennae*, they may either run parallel as far as the clypeus or may become obsolete below the level of the antennae or may diverge, leaving a more or less triangular space. The middle of the ridge may be punctured or smooth, deep or shallowly grooved or flattened.

The extremity of fastigium of vertex may be sloping into the frontal ridge, as is usual for the species of the subfamily Oedipodinae, or is separated from it by a transverse carina (eg. most subfamilies).

Under each eye there is frequently another straight or curved carina, the *lateral* or *facial carina.*

Eyes : The size, shape and proximity of eyes are also useful in systematic studies of grasshoppers. More frequently they are separated by a space, the interocular distance, as great or greater than their diameter ; they may be rounded, oval, elongate and may be projecting and sometimes raised above the level of the rest of the head.

Antenna : The antenna consists of a distinct separated joints or segments. The first segment, or *scape*, is generally stouter and longer than the second, the *pedicel* or the ring joint, which is often more or less globular. The remaining joints form the *flagellum.* It is usually *filiform* (i. e., fine, round and equally broad throughout) but more rarely may be *ensiform* (i. e., flattened, the individual joint being wider than their length) or some joints filiform and some segments ensiform or depressed and compressed or some of the terminal joints are expanded or even form a club (eg. *Gomphocerus*). Accordingly antennae are called *filiform*, *ensiform*, *clavate*, *serrated*, *phylliform* and *pectinate* etc.

The antenna is comparatively short ; but always longer than the length of anterior femur, and sometimes may be as long as the body-length. The number of segments usually varies from 18 to 30.

Pronotum : It is a roof-shaped plate, covering the whole prothorax from above. The shape and detailed structure of the pronotum is of great importance in the systematic of acridids.

It is generally as broad as the head and its anterior margin slightly overlaps it. It is of variable shape but generally truncated or rounded or angular behind (but not projected over the abdomen). Its disc is usually flattened with a median carina and two lateral carinae. In other cases the pronotum is cylindrical and arched above (eg. *Chondracris rosea*), when the lateral and often the median carinae are absent. The dorsum of pronotum is crossed by one or two or three or four transverse depressions or grooves called '*sulcus*', the position and extent of which are also important in classification. The third sulcus divides the pronotal disc into two parts : the anterior portion of it is termed as *prozona*, while the posterior portion is known as *metazona*. The lateral lobes of pronotum are also indented by these sulci, often of varying degree and intensity. The texture of inferior (lateral) margin of the lobes and their curvatures at anterior and posterior angles also are of some help in some cases.

Pro-, *Meso-*, and *Metasternum* : The lower surface of the prothorax is called the *prosternum* (which is inbetween the bases of the anterior legs). It is smooth in Acridinae, Truxalinae, Gomphocerinae and Oedipodinae except in some genus (eg. *Gelastorrhinus*) of Acridinae where it is collar-like or slightly toothed. In the remaining subfamilies it is with a raised *spine* or *tubercle* of different shapes, namely, *cylindrical*, *conical*, *spathulate*, *bifurcate*, *bi-or trilobate* etc.

The *mesosternum* and *metasternum* have on each side of the posterior margin, lobes with *interspace* inbetween, the shape and extent of which are of great importance in subfamily, generic and specific levels.

Posterior leg : Out of the three pairs of legs, the posterior ones provide characters for classification. The *trochanters* are very small and practically fused with the *coxae*. The *femora*, on the country, are very large and stout. They are usually swollen at base, sometimes they are less prominently deflexed. Sometimes the distal half is *filiform* and as such can easily be distinguished from the basal half. Its detailed structure (Dirsh, 1965), such as, shape and extent of upper and lower *basal lobes*, toothed or smooth *upper carina*, and of upper and *lower lobes of hind 'knees'* (which are usually rounded but may be angular or spine-like in many cases) provide good criterion for taxonomic studies.

The posterior *tibiae* are also sometimes thickened and lamellated (eg. *Oxya* spp., *Gesonula* spp., *Hygracris* spp.) in hydrophillic species. They are always provided with two rows of usual rigid acute *spines* on the upper surface and two pairs of spines at the extremity called *spurs*. In the genus *Brachycrotaphus*, the inner tibial spines are flattened, blade-like. Likewise, the size and shape of apical spurs are also variable and used in classification, for example, in *Heteropternis*, the internal spurs are greatly unequal, the lower one much longer than the other, abruptly hooked at apex, very acute. The presence or absence of external apical spur is another important character.

Tegmina and wings : A good and sound understanding of venations and other structural peculiarities of tegmina and wings are essential for systematic studies of grasshoppers. The terminology used here is after Ragge (1955).

In most cases the costal area is normal, but in the genera of Gomphocerinae, in particular, it is expanded of different grade and extent. For example, in *Chorthipus*, it is a small projection ; in *Leva*, it is expanded to the extremity, in *Stenobothrus* at or beyond midpoint of tegmen etc. In Oedipodinae the medial vein is very well developed and almost always provided with a serrated *intercalated vein* and in many species some portion of tegmen (sing.) is modified as *stridulatory veins*. Presence of a row of *bristles* or *spines* at anterior margin of tegmen in some species of *Oxya* is an aid in identifying species. Modifications of costal, subcostal, radial areas and fusions of veins in different ways occur. Maximum medification is meet with in the genus *Brachycrotaphus*.

The wings are less complicated in comparison with tegmina but having similar venation. They are most frequently hyaline but may be coloured at bases. Majority of Oedipodine species are having bands in wings, hence they are called band-wings.

Abdomen and genitalia : The abdominal segments except the terminal ones, which are modified into external genital parts, hardly provide any character of taxonomic value. The abdominal *tergites* of males in the genus *Phonogaster* Henry, 1940, however, are expanded as lateral ridges to act as stridulatory organ.

The abdomen consists of 11 segments of which tergite 9 and 10 are dorsally very short in both the sexes. The last externally visible *sternite* is 8 in the female and 9 in the males which are transformed as *sub-genital* plate.

Furcula : The posterior margin of tergite 10 is more or less incurved ; sometimes it is incised in the middle and the incision may divide it into

two lateral parts, which sometimes bear on their inner corners small projections forming a *furcula*. This structure is not often noticeable externally.

Supra-anal plate : Tergite 11 is *epiproct* or more commonly known as *Supra-anal plate*. In males, it is a very variable structure ; may be triangular or semi elliptical, rectangular, pentagonal etc. and its surface which is usually uneven, very often may be with a furrow, or ridge medially and tubercles (eg. *Oxya* spp.) on the sides. In females it is usually a simple structure.

Cereus : It is situated in the membrane between *paraprocts* (below) and supra-anal plate (above). It is again a very variable structure, specially in males, like prosternal spines and used largely in systematics.

In females, it is always a simple structure.

Subgenital plate : In males, it is the apical portion of 11th sternite, which envelops the *phallic complex*. In its simple form, it is navicular with rounded apex, but more often may be conical, projecting and exhibiting lot of variations in its detailed structural pattern.

In females this structure is the 8th sternite and is simple in its form. But provides clues for taxonomical studies. The shape of its visible ventral surface may be flat or concave, with two longitudinal ridges which may be toothed or not ; and its apex more often is rounded, but may also be bi-or trilobate or spined.

Ovipositor : It is the last segment, in females bearing two upper and two lower *values* which are often dentate, and differ considerably in size and shape, in relation to egg laying habits.

Epiphallus (Figs. 29, 30) : The phallic complex of males is a very stable character for separating most of the subfamilies, as worked out by Dirsh (1956). For detailed study the same auther (op. cit) may be consulted.

Since the structure of epiphallus, particulary of its dorsal view, is the most significant part, for separating species, the same has been chiefly figured and described, whenever felt necessary.

It is usually a sclerotised plate, the main body is called the *bridge* of the *epiphallus* (B), with two projections at its antero-lateral directions, called *ancorae* (A.). At its postero-lateral margin, there are also two *lobes*, on each side, called *lophi*. The size and extent of the epiphallus, as a whole, as well as its component parts are always greatly variable and specific.

Presence or absence and or number of ancorae (sometimes only one eg. *Oedaleus*) and that of lophi are often genus-specific.

BIONOMICS

The grasshoppers and locusts pass through three stages in their life, viz. egg, hopper (or instar) and adult. They are promiscuous and copulation

with several individuals of the opposite sex in its life time is a common affair. The mature male abruptly mounts the female but copulation takes place only if the female is in a receptive phase and mood. There seems to be no observable courtship.

(a) Pre-copulation period

The time taken from the last moulting (eclosion) to reach sexual maturity is called the pre-copulation period and is variable from species to species. For example, *Atractomorpha crenulata* takes 4 days for males and 13 days for females after last moult ; *S.p. prasiniferum* males copulate with the females at an average of 3.5 days after emergence whereas *Parahieroglyphus bilineatus* takes 6 to 8 days for males and 10 to 15 days for females.

The pre-copulation period is also variable depending on the season of its occurrence. In *A. crenulata* it is 10-13 days in September, 9 days in March, 7 days in April, 5 days in May, 4 days in July, 5 days in August and 9 days in October (Agarwal, 1955).

(b) Copulation

(Plate II & III, figs. 227-228)

There are three modes of copulation found in short horned grasshoppers (Katiyar, 1960). In mode (I) the male rides on the back of the female head to head. In mode (II), the male positions on the side of the female, and in the (III) mode, the male neither rides on back of the female nor lies at her side, but hangs positively, attached to the abdomen during coitus (Katiyar 1952, 1956). In addition to these 3 modes, there is another intermediate mode, "dorso-lateral" mode as observed in *Phlaeoba panteli*.

The normal mode of copulation is by riding (mode 1). In this method the excited males clasp the female from the back ; sometimes two or three males compete for successful riding on the back of a female for coitus but finally one male succeeds riding on it, head to head, and the terminal ends of the two partners abdomens inter-lock with each other, the male abdomen curving down to either right or left of the female.

Though in some cases, it was observed that the copulating partners go on feeding during copulation and in some cases the male usually remains on the back of the female even after coitus is over and while the latter is in the act of oviposition, my findings are different.

In the field in respect to *Phlaeoba antennata* at Jalpaiguri, *Cyrtacanthacris tatarica* at Chilka Lake and *Paraconophyma scabra* at Simla Hills, it was observed that the copulating pairs were completely engrossed in the act, the insects were motionless and unconcerned about the surroundings even when

they were disturbed and held on the palm for 55-, 40-and 35 minutes respectively. The last named pair of insects (*P. scabra*) were interlocked and even when they were placed in killing jars, they were unable to release themselves (Pl. II, fig. 227-photo in situ position).

The duration of completion in *A. crenulata* varies from 19 minutes to 5.48 hours. In *Acrida exaltata* the time varies from 3 to 14 hours (Bhowmik and Halder, Ms) ; in *S.p. prasiniferum* 8 to 49 hours (Iqbal and Aziz, 1974). *Hieroglyphus nigrorepletus* takes 4-42 hrs (Pradhan and Peswani, 1962).

The season of copulation and that of oviposition are closely interrelated and will be discussed under 'oviposition'.

(c) Oviposition

(Figs. 31-32)

After successful copulation, oviposition takes place, however, it does not occur immediately. The time taken from copulation to oviposition may be called pre-oviposition or post-copulatory period which is variable from species to species and also in the same species, depending on season. In *A. crenulata*, it is 15 to 16 days in September, 13 to 14 days in March, 11 to 12 days in April, 10 to 11 days in May, 9 days in July, 6 days in August and 10 days in October ; while *P. bilineatus* females take 9 to 12 days to oviposit after copulation.

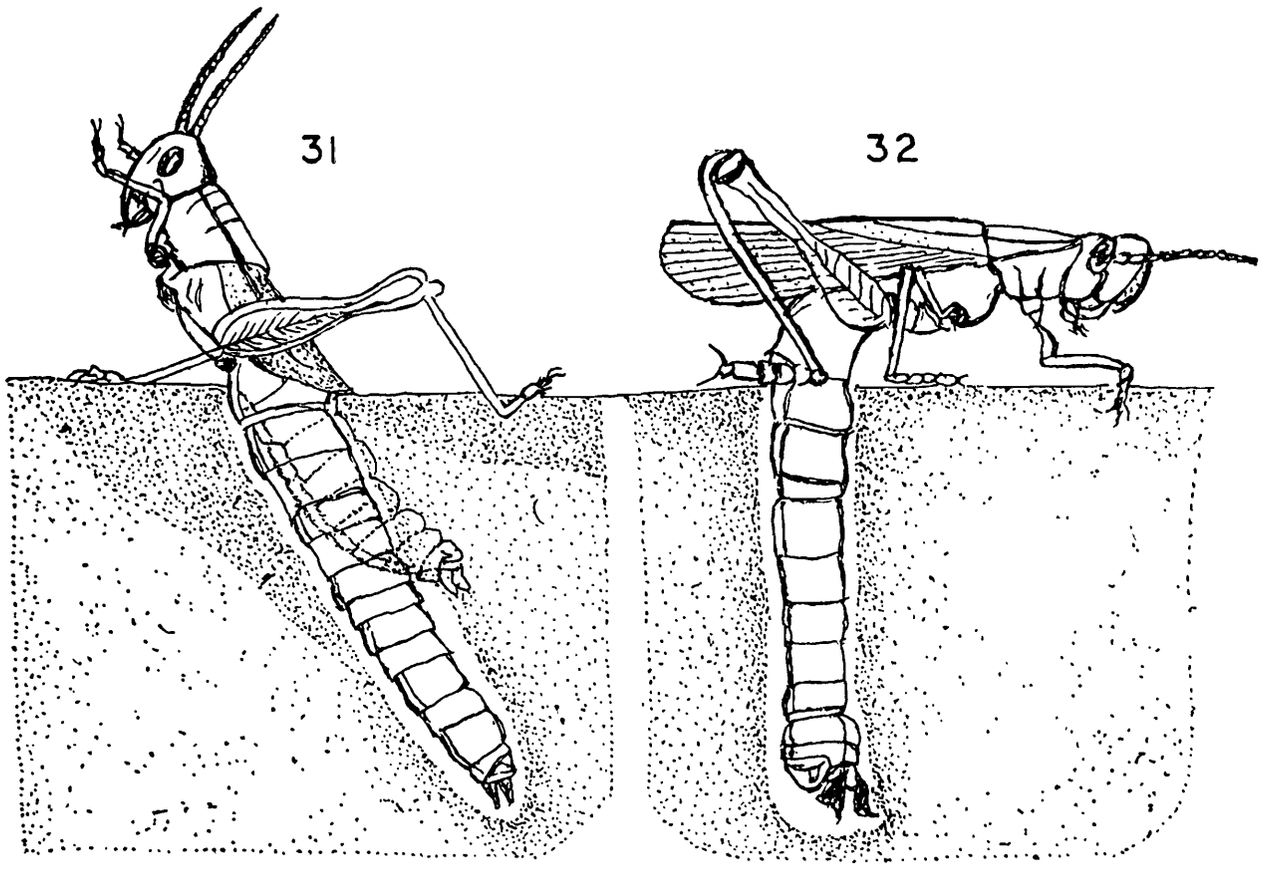
Normally the pre-winter copulating females take longer time to lay eggs than the pre-monsoon or monsoon ones.

The period of pre-oviposition which usually lasts to 3-16 days in species having one breeding season, the gravid females start laying eggs in soil thereafter.

The period of copulation and oviposition are variable phenomena from species to species. Usually in species having one breeding season copulation takes place at the end of rainy season and oviposition occurs at the onset of winter : normally in September—October ; the peak period lasting between 2nd and 3rd week of September to 1st week of October.

The species having two breeding seasons, namely, *Oedaleus abruptus*, the eggs are laid from November to April. The earlier hatchings attain maturity during June—July and lay eggs, giving a second generation of adults in August—September (Ahmed et al., 1973). In species having three or more breeding seasons, the act of copulation, oviposition, and hatching take place round the year, and a population of both adults and nymphs are found during severe winter and in rainy season of the same year.

The period of oviposition and hatching depend on seasons also, namely *Aiolopus thalassinus* oviposits late in October, December, January to March



Figs. 31-32. Oviposition in grasshoppers.

Fig. 31. Extension of abdomen of female *Parahieroglyphus bilineatus* Bolivar during oviposition ;

Fig. 32. Extension of abdomen of femal *Choroedocus* sp. during egg-laying.

in Transval, whereas this species does it in Cape Peninsula in April to May (Chester, 1938). The difference is attributed to seasonal differences.

The act of oviposition in *Acrida exaltata* lasts normally about 3 to 4 hours or slightly more ; however in few cases half an hour to one hour may be required (Bhowmik and Halder, Ms) ; in *P. bilineatus*, it lasts usually 2 to 3.5 hours, although in a few cases it may be only 1.5 hours ; in *S. p. prasineferum*, the duration is 2 to 4 hours ; while in *H. nigroreptelus* it is 2.30 hrs. In species where the females oviposit more than once, the duration of oviposition decreases with subsequent ovipositions. For example, in *A. punctatus* (Katiyar, 1955) the time taken is as follows—

	From		to	
	Hours	Minutes	Hours	minutes
1st egg laying	2	42	4	8
2nd egg laying	2	5	2	42
3rd egg laying	1	20	1	50

About 3 to 16 days after copulation, the females begin to look 'lazy' and were notced to make holes in the soil with the help of their ovipositors.

After making a few trials the final hole for egg-laying is made. If the breeding ground is unsuitable they try more than twenty times for suitable place as recorded in the laboratory in *A. exaltata* (Bhowmik and Halder, Ms).

During oviposition the abdomen of the female is extended slowly and it almost doubles its normal length (figs. 31-32). Almost all females insert the abdomens slowly into the moist or dry soil, at an angle of 10° to 65° with the body above the surface of the ground.

The deposition of eggs and their orientation in the egg-pod are almost same, although having fine differences in detail. Before depositing the eggs, the female deposits a frothy substance at the bottom of the hole, extrudes the eggs one by one after a little pause between two successive eggs, through the tips of the dorsal valvulae of the ovipositor. With all the eggs passing out, the female plugs the egg-pod either by making a fragile, frothy cap above the eggs (in most cases) or with a hard cap above the eggs, with some cement-material that is deposited above the cap. The female withdraws the abdomen from the hole after this and scraps the surface around the hole with its posterior legs.

Eggs are laid, in most cases, under the soil in egg-pods at a depth varying from 2.5 to 12.5 cm and 3.2 to 7.21 cms below sandy loam. The depth may vary in individual case depending on the length of abdomen of the female, and texture of the soil including its moisture contents.

In selecting the site the females are guided by two principles : safety and security of the egg-pods and readily available ample supply of green vegetation for the developing instars.

In most of the species the period of oviposition occurs during September to October when the fields are either waterlogged, innundated or flooded. The females choose sites along the sides of trodden paths, embarkments of agricultural fields or nearby high lands, along cart-routes, bank of rivers, along dense bushes of foothills, in high grass-lands but not in the middle of the fields, and in some cases in gardens and nurseries etc.

However, the grasshoppers exhibit strong preference for soil conditions ; some prefering xerophilic (dry) soil for oviposition, some mesophilic (soil without abundance of moisture although top layer being moist), or some hygrophilic (moist) soil. If a gravid female fails to find out a suitable site, it either drops its egg-pod on the soil-surface, grass-leaves, on glass jar wall (eg. *Acrida*) or in extreme cases stops taking food and ultimately dies.

In extraordinary circumstances, as exhibited by the female of *Gesonula punctifrons* (Stal), an aquatic acridid, egg-laying takes place on the succulent stem of the *Colocasia* (Sembu) plants growing along the field bunds. A round black hole of about 4 mm in diametre is made on the stem. The females of

the species belonging to the genus *Oxya* oviposit usually in dry soils and in flooded fields, to cement egg-masses between grass stems, in leaf axils or on stones, one or two inches above the water-level (Uvarov, 1928). *S. p. prasiniferum* lays eggs in damp soil or on the leaves floating over still water (Iqbal and Aziz, 1974).

(d) **Fecundity**

The female grasshoppers are usually prolific breeders. A female may lay eggs once (eg. *Acridia*), twice, thrice (*A. punctatus*) or even up to 5 times (e. g. *P. bilineatus*) in its life time (Katiyar, 1956). The number of eggs in each egg-pod varies from female to female, depending on climatic factors and supply of food ; and in addition, geographical variation also contributes to the number of eggs per pod for the same species (Phipps 1970). For instance, *Hieroglyphus banian*, in the insectory, gives about 4 egg-pods per female, and the number in each pod varies from 29-49 ; while in Assam each female of the same species lays 50-60 eggs altogether (Chowdhury and Majid, 1954) and 68-90 eggs (average 81) in Uttar Pradesh (Gupta and Saxena 1963). Pickford (1960) working with the species, *Melanoplus bilituratus* in the western Canada, found that fecundity was invariably higher where hatching took place early in the season ; grasshoppers in one case of the earlier-hatched group produced 22.7 egg-pods per female, a recorded case of egg production. This high fecundity was party due to the greater adult longevity and to a higher rate of oviposition. The same author further maintained that the rate of oviposition, in terms of egg production per female per day, was highest about mid summer (3.4 to 5.3 eggs per female per day) when temperatures were at their maximum. The decline to the rate of oviposition (1.7 to 2.6 eggs per female per day) towards the end of the season was attributed mainly to declining temperatures and not to the old age of the females.

Parker (1930) recovered 6 to 8 egg pods per female of *M. bilituratus* reared at temperatures ranging from 27°c to 37°c, but only 0.4 egg-pods per female at 22°c.

The effects of different food plants (Pickford, 1958, 1962) climates (Pickford, 1966) temperature and moisture (Khan, 1974 ; MeCarthy, 1956) are immense on fecundity rate and which by fostering readily availably luxuriant growth of vegetation for the newly hatched nymphs control fecundity and ultimately check grasshopper population.

The minimum of egg production was perhaps records in *Gesonula punctifrons* where the number is 8 to 12. *Acrida exaltata* provides one egg-pod in its life with 47-66 eggs, only in one case it was 12 egg (temperature minimum 20°c to 23°c to maximum 24°c to 26°c). The female of *A. crenulata*

lays 3 to 5 egg-pods, each egg-pod containing minimum 64 eggs (average 21.3 per pod) in September and maximum 136 eggs (ave. 27.5 per pod) in April. In *Schistocercus gregaria*, the average number of eggs per pod was found to be 54 in Rajasthan desert (Singh and Singh, 1978). The females of *S. p. prasiniferum* lay about 6.40 ± 0.393 egg-pods per female, the average no. of eggs is about 8 per pod and the average total being 51 ± 2.704 eggs. In *Hieroglyphus concolor* each egg pod contains 62-84 eggs (Katiyar 1960) to 123 (Gupta and Saxena, 1963).

Again, the egg-number decreases with subsequent oviposition by the same females as for-

Laying	1st	2nd	3rd	4th	5th	Max. nos. Total eggs	Average per pod
P. bilineatus	38-40	34-38	32-36	30-35	28-33	182	33.1
A. punctatus	96-120	90-98	78-81	—	—	299	98

(e) Incubation and hatching

Species having several breeding cycles in annual life cycle have, as a rule, shorter period of incubation as the hatching has to be completed in short intervals. The shortest period of incubation (10 days) is perhaps exhibited by *S. gregaria* (Singh and Singh, 1978) in natural condition. In *Gestrimargus africanus* having 2 or more cycles, the incubation period is only 22-24 days (Deseamps, 1965), while in *S. p. prasiniferus*, it ranges from 20-22 days. Similarly, in *A. exaltata*, with 2 annual cycles has 23-27 days incubation period. For species having one annual cycle, the period is moderately long while for bi-annual and multiple year life cycle, it is considerably long. For example, *Arphia conspersa* Scudder, a Oedipodine from Inaho, having a two year life cycle, over winters as a partially grown up nymphs or as an egg the first winter and a partially grown nymph the second winter (Pickford, 1953). Kreasky (1960) noticed in *Melanoplus alpinus* Scudder, a species of high elevations, having a multiple year life cycle requiring 3 years developmental period in Montana. Besides, the incubation period also varies, in the same species, according to season and is longest in November (pre-winter) and shortest in July and August (during monsoon).

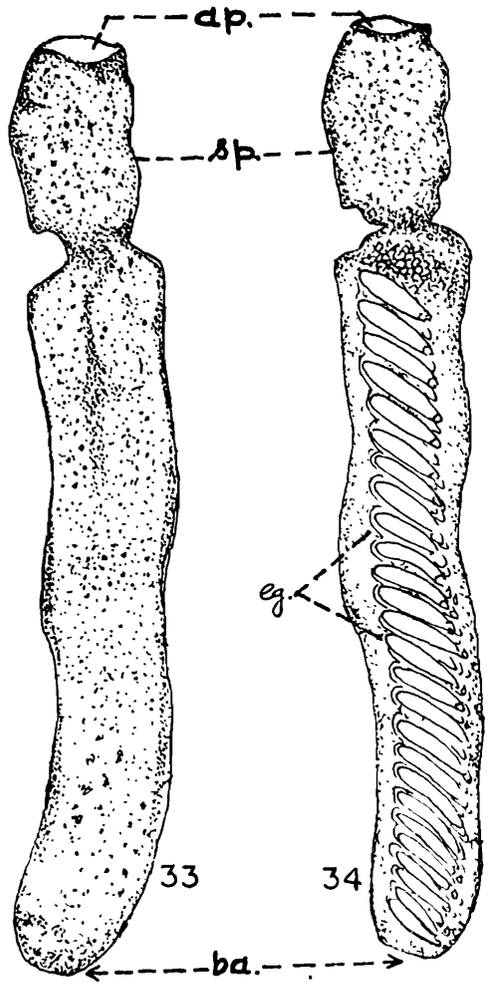
At the time of hatching, the egg-chorion becomes "dry" and splits longitudinally.

In the insectory all egg-pods desired and kept for hatching should be kept moistened, by applying water occasionally on the soil containing the pods. As viability and development of eggs depend on the moist condition of egg-pods enviroment.

(f) Structure of egg-pods and eggs

(Figs. 33-34)

A egg-pod may be like a bag, pot or pill or capsule. It is almost straight and cylindrical and has a flat or concave anterior end ; in the middle of this end is a depressed or concave area known as "Cap" of egg-pod. The posterior end may be rounded or tapering.

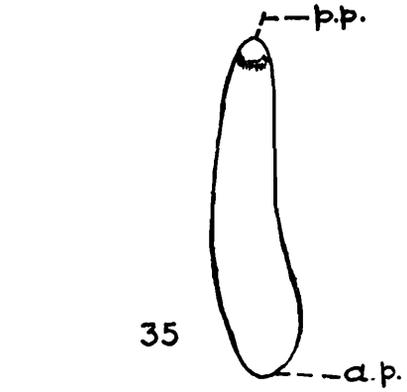


Figs. 33-36. Egg-pods, egg and egg-chorion of *Gastrimargus africanus africanus* (Thunberg). Fig. 33. Entire egg-pod ; Fig. 34. same, after removal of wall (party) showing arrangement of eggs.

The morphology of egg-pod is made of frothy, spongy substance, secreted during oviposition, which hardens on exposure to air. The finer structure of pod is species-specific and is determined by the nature of soil in which it is deposited.

Egg-pods deposited under the xerophilic (dry) soil are simple and short, their outer wall consist of very rough, tough, hard and cemented secreted meterial ; the concave caps are hard, smooth and placed either just above the layers of eggs or at the apex of the pod. In the mesophilic (soil without abundance of moisture although top layer being moist) pods the outer wall

of the pod is not cemented, but is rough, slightly hard and consists of a few layers of dense, laminated, secreted material, with or without a cap at at the top ; the cap, if present, is usually soft and membraneous. In the hygrophilic (with abundant water) pods, the outer wall may be smooth or rough, spongy or frothy, usually fragile ; it is without a cap but the top section is filled with coarsely meshed, spongy secreted material, with septa-or hexagonal empty spaces or cells.



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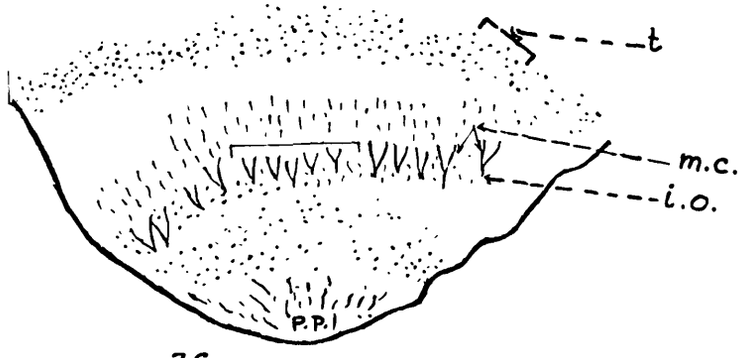

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Figs. 35-36. Egg-pods, egg and egg-chorion of *Gastrimargus africanus africanus* (Thunberg). Fig. 35. A typical egg, lateral ; Fig. 36. Egg-chorion at posterior pole showing the ring of micropylar canals.

(Letterings for figs. 33-36. ap. apex of egg-pod ; ba. base of egg-pod ; sp. spongy secretion at anterior portion of pod ; a. p. anterior pole of egg ; p. p. posterior pole of egg ; t. tubercles or protuberances of endochorion of egg-wall ; m. c. micropylar canals ; i. o. internal opening of micropylar canal)

There are a lot of variations of pods in their external shape than the typical one. They may be curved, with the result that one side is concave, the other side convex (e. g. *Phlaeobs panteli*, *Choroedocus insignis*) ; broad in the middle (e.g. *P. bitineatus*) ; apical end conical or posterior end broadened and rounded ; or constricted at apical end (e. g. *Gastrimargus* sp.) (Figs. 33, 34).

Size of pods are highly variable and is limited by the nature of ground. It may be twice as long as wide (length 1.6-1.7 cms. ; width 0.8-1.0 cms) (e. g. *Hieroglyphus assamacris*) or about 4 times as long as wide (length 1.45-1.85 cms ; width, 0.45.-0.6 cms) (e. g. *Ceracris deplorata*) or 8 times as long as wide (length 2.7-3.8 cms ; width, 0.35-0.5 cms (e. g. *Eyprepocnemis rosea*).

Eggs

(Figs. 35-36)

Eggs are tiny (3.25-4.15×0.85-0.95 mm in *O. abruptus*), cylindrical or sub-cylindrical whitish bodies. The apical end or anterior pole, as it is called, of the egg is round, the posterior one or micropylar pole is rather tapering but is somewhat flat at the extremity. The micropylar rings are distinctly visible, being darker than the rest of the egg surface. The egg-wall or chorion in the micropylar region possesses a series of minute micropylar canals, each having an external and an internal openings and with accompanying roofs of canals (fig. 36). The detailed structure of egg-chorion, its differential sculpturing is species-specific (Katiyar, 1960) and is important in in the systematic studies of Acrididae.

Eggs are arranged differently in the egg-pods ; they may be arranged vertically at right angles or obliquely one above the other and in many other ways but always with the micropylar poles pointing towards the base of the egg-pod.

Size, shape and colouration of eggs always have distinguishing differention ; larger eggs may be up to 8 times bigger than the smaller ones.

(g) Moulting

(Plate II, figs. 225-226)

The freshly hatched nymph is called "vermiform" larva. It is enclosed in a thick membrane, with its head bent downwards and the antennae and legs lying close to the body. On reaching the soil surface, the larva frees itself from the ensheathing membrane. This worm-like larva is very tiny and measures 3.6 mm by 2.0 mm. After some time this larva converts to 1st stage nymph or instar.

The nymphs of short-horned grasshoppers undergo 4 to 7 moults before reaching the adult stage. *Gesonula punctifrons* takes minimum period of nymphal duration and undergoes 4 moults within 22 days, at an interval of about a week (Ayyar & Menon, 1933). There are 5 to 6 stages in *G. africanus* lasting 30-39 days. *Hieroglyphus nigroreptelus* in Benaras takes 3 weeks time for hopper stage (Roonwal, 1945) ; while Grist and Lever (1969) state that nymphal period of the same species is 71 days at 26°c and 35°c, average 32.5 ± 2.5°c. The number of moults and total period taken to complete it

vary from species to species. The females usually require one stage more than the males and generally take 7-16 days longer period than the males (vide below). The duration taken by each successive moults also varies to some extent according to season and availability of food. A day prior to moulting, the nymphs stop taking food and become sluggish.

Duration of nymphal instars (figure in brackets indicates field data) (in days)

Name of spp.	1st	2nd	3rd	4th	5th	6th	Total ♂	Total ♀
A. exaltata	5-9	5-7	6-7	5-6	6-7	8-12	27-35	35-44
S. p. prasiniferum	6.33	7	6.67	6.33	5.58	5.58	37.58	42.25
A. punctatus	10-13	12-13	13-15	12-14	13-16	16-19	80-84	83-91
P bilineatus	11-13	10-14	14-19	12-17	14-18	17-23	78-80	83-88
	(16)	(20)	(15)	(27)	(29)	(22)		
A. crenulata	5-13	5-15	5-12	6-16	7-13	—	31	69

(h) **Nymphs**

All nymphs hatched from an egg-pod do not moult on the same day and there may be a difference of one or two days. The nymphal period is generally longest in pre-winter season (Nov., Dec. and sometimes in January) and shortest during full monsoon (July—August). For example, the nymphal period is longest (31-69 days) during December and January and shortest during July and August (31-39 days) in *A. crenulata*. It is rarely that all the eggs of an egg-pod hatch nor do all the hoppers hatching reach adult stage (see mortality etc.)

The nymphal instars are characterized by having ill—or incomplete development of antennae, and of tegmina and of genitalia. Nymphs more or less resemble their parents except incompleteness of characters noted, and body colouration and size. Colouration often differs markedly from adults. Sexes are not recognizable before 2nd stage and clearly distinguishable during 3rd stage. At 5th stage, the nymphs usually have the tegmina somewhat developed but with the anal area up. In the successive stage, the position of tegmine rotates up to 90°C (Roonwal, 1946). This directional rotation of tegminal axis brings costal area up and anal area down. This down position of costal portion of tegmina at 5th stage differentiates the nymph from a brachypterous (semi-apterous) species (where the tegmen with costal area up, anal area down).

Further study of morphology of nymphal stages of the species having economic importance are needed since fragmentary information are available on this aspect.

B. Breeding cycles

Short horned grasshoppers may have one, two or three annual breeding seasons. The large species have only one breeding cycle e. g. *Hieroglyphus banian*, *H. nigrorepletus*, *P. bilineatus* etc, with a greater interval between breeding seasons. Phipps (1970) showed that the number of cycle (s) depends chiefly on the size (weight of the gravid females). Out of 17 small species (weight under 500 gms) he found 2 species were with one cycle, 8 with 2 cycles and 7 showed continuous breeding. 3 median sized species (500 to 1000 gms) have only one annual cycle, while out of 13 large species (over 1000 gms) 12 were with one cycle, only one large species, *Eyprepocnemis plorans*, showed continuous breeding. With species having one cycle, in most cases, egg laying period extends from the beginning to the end of the rainy season and in other species, it starts at the beginning of the next dry season. In small species oviposition begins a few weeks before the onset of the next rainy season.

In larger species eggs are laid early to counteract the dry as well as the wet season. Large eggs may be up to 8 times the volume of smaller ones. The development of large eggs requires more absorption of water than smaller eggs before development begins. This requirement of water may account for the restriction to one breeding season by large species in a year with having one rainy season in the place of its occurrence.

The geographical pattern of the environment also changes the breeding behaviour of a species. For example, in *Gastrimargus africanus* (Sauss.), there are normally 2 cycles in arid zones (Descamps, 1953), but there are 3 in Madagascar (Descamps and Wintrebert, 1956) and continuous breeding in Ghana (Chapman, 1962).

Size (wt. of ovaries) as pointed out by Pickford (1960) does not indicate the exact stage of breeding cycle of the hopper ; there are cases of overlapping eg.—*Oedaleus abruptus* has at least 2 annual cycles with eggs overwintering from November to April (Ahmed et al, 1973), whereas in *O. senegalensis*, almost of same size as previous one, passes through 3 cycles (Launois, 1979) in Africa. *Spathosternum prasiniferum prasiniferum*, a small species, however, breed throughout the year (Iqbal and Aziz, 1974).

C. Fertility, mortality and longevity

All the eggs laid are neither hatched as nymphs nor all the nymphs grown reach into adult stages. The rate of fertility of survival rate is inversely proportionnal to mortality and other ecological factors remaining the same, the rate of mortality chiefly depends on climatic condition.

Singh and Singh (1978) working with *S. gregaria* in Rajasthan desert, under natural field conditions, at minimum 73.6°F to maximum 106.3°F temperature, and relavive humidity 49%-89% and rainfall 0.22-0.85 inches, found that there is only 9-10% mortality in egg stage, whereas in the laboratory it ranged between 10%-60% (Husain and Ahmed, 1936) under different conditions of temperature and humidity etc (at 30°c with 100% humidity, 40-90% hoppers hatched out). In *S. gregaria*, with a constant temperature of 20°c-21°c, 75-83% of eggs hatched. In *Spathosternum prasiniferum* the fertility rate of eggs were calculated to be 91.76 ± 1.062% (i. e., about 8-9% mortality) at constant temperature of 33°c ± 1°c and 70% ± 5% P. H., with 12 hrs. alteration of light and darkness. Agarwal (1955) showed that only about 53.6-66.6% of nymphs attain maturity in *A. crenulata*.

The longevity of grasshoppers, from hatching, is fairly good. In the insectory, *A. exaltata* lived up to minimum 34 days to maximum 64 days : two females lived as long as 129 days. Longevity is in *P. bilineatus* male 32-43 days, females 58-64 days ; while in *A. crenulata* male and female live 25-36 days and 30-68 days respectively. Unlike other cases, the males of *S. P. prasiniferum* survive more than females (as about 40 days to 29 days on an average) (Iqbal and Aziz, 1974).

From the above data it is clear that the males and the females show marked difference in longevity, the females live long and the difference of 10-32 days have been recorded.

Males normally die after copulation or a few days afterwards. Females may die either immediately after oviposition as found in *A. miliaris* Linn. or later as in *A. exaltata* (Bhowmik and Halder, Ms).

The survival rate of grasshoppers was found greater, from hatching to the newly emerged adult stages, among those hatched on the earlier days of the season and tended to decrease progressively, as hatching occurred later in the season, indicating that drier and warmer conditions foster grasshopper population. Field cage experiments in which *M. bilituratus* was reared from hatching domostrated that those hatched in May showed population increases up to 10 times than those hatched 7 to 9 weeks later in July. However, the most vulnerable stage in the whole life cycle appeared to be the very early nymphal stage.

Adult survival during the first 2 months following the last moult did not appear to be influenced by the date of hatching ; during this period the mortality rate was lower than that during any other stage ; besides, the adults are able to withstand heavy rains or extended periods of cool weather.

D. Seasonal occurrence, abundance, and population fluctuation in acridid community in West Bengal

(Figs. 212-215)

Population dynamics of 14 species of short horned grasshoppers from Shibpur Botanical Garden (termed locality A) and Sankril (locality B) in the

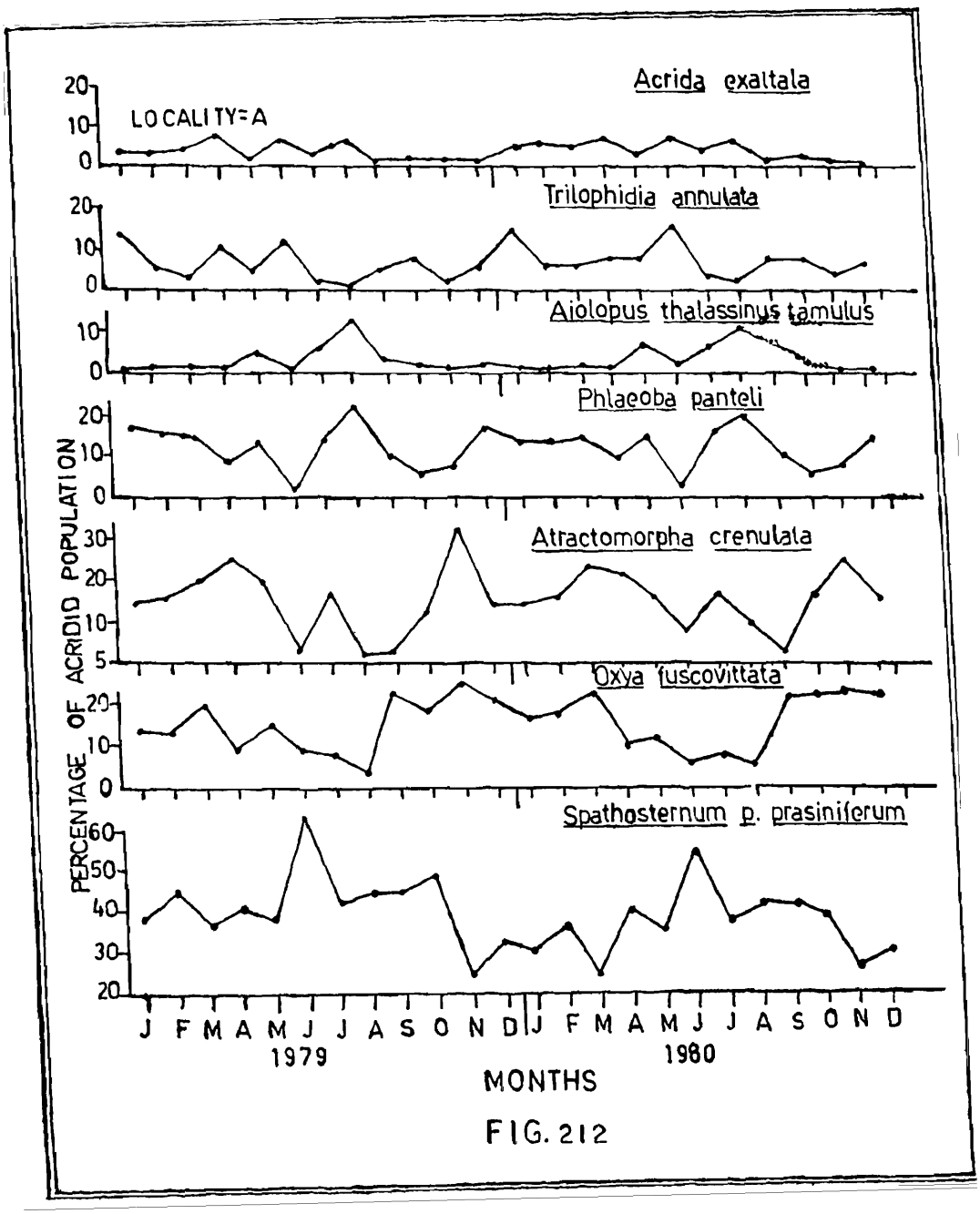


FIG. 212

Figs. 212-215. Graphs of—

Fig. 212. Seasonal abundance of some species of grasshoppers from Loc. A. for the years 1979 and 1980.

district Howrah, West Bengal, were observed for two consequtive years (1979 & 1980). Ecological factors (both abiotic and biotic) differed in the localities. Study of seasonal occurrence and abundance revealed that *S. p.*

prasiniferum is widely distributed and it occupied the top place than other species ; and *O. fuscovittata*, *A. crenulata*, *P. panteli*, *A. t. tamulus*, *T annulata* and *A. exaltata* occupied 2nd, 3rd, 4th, 5th, 6th, 7th position respectively (figs. 212). The distribution of other species are irregular and insignificant. There are 3 peaks of population, the main peak is in Sept.-Oct., the median peak is found in July and the minor and additional one is found in February

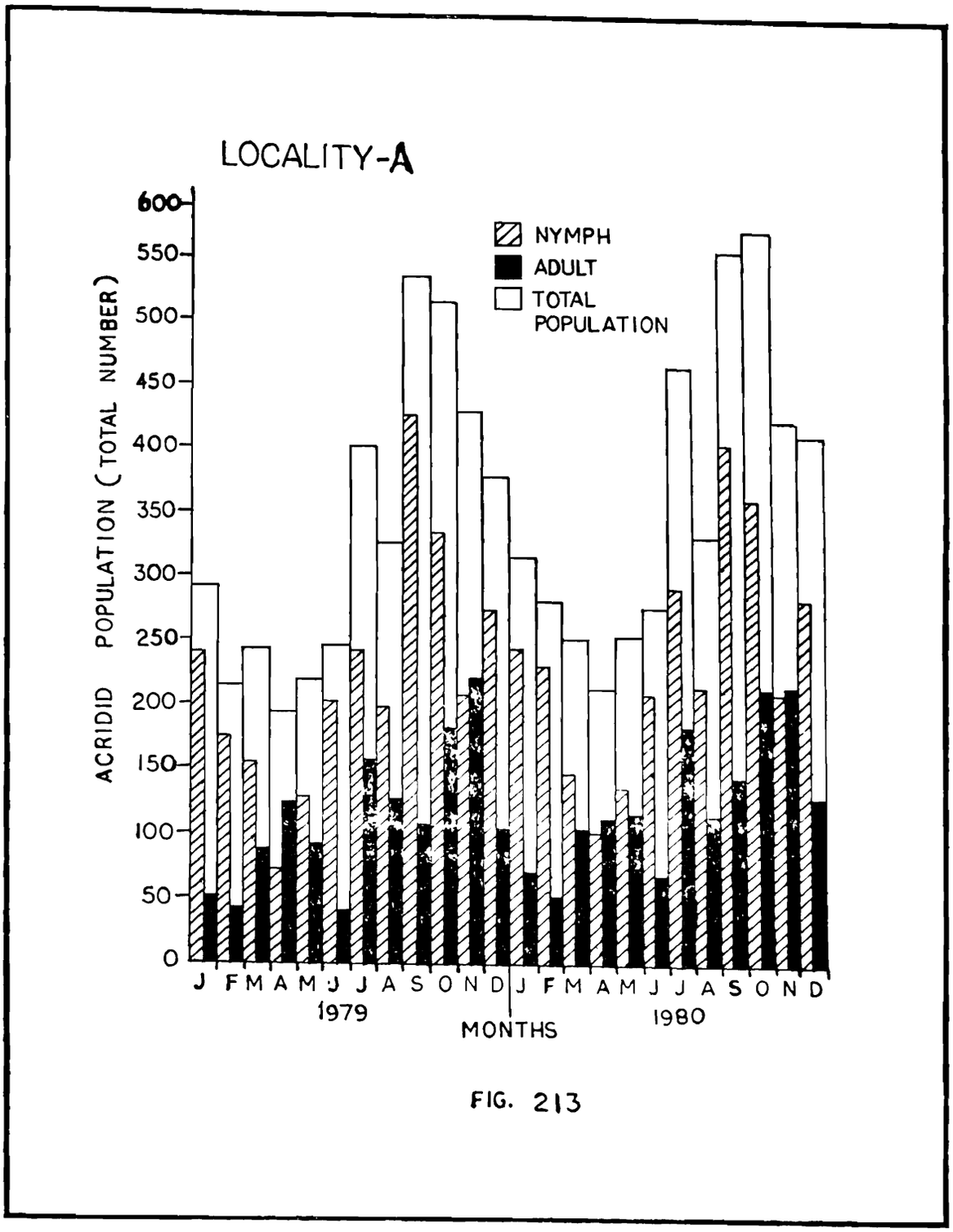


FIG. 213

Fig. 213. Seasonal fluctuation of population of nymphs and adults from Loc. A.

(for. loc. B). Density was least in May. Nymphal population was maximum in August-September for loc. A, February/March for loc. B, while the minimum density was found in April/May (figs. 213-214). In terms of temperature, humidity and rainfall, only humidity is found to be statistically significant in regulating these fluctuations in loc. A. (Figs. 215). Population estimates for sex ratio revealed dominance of males (58.76%) over females (41.24%).

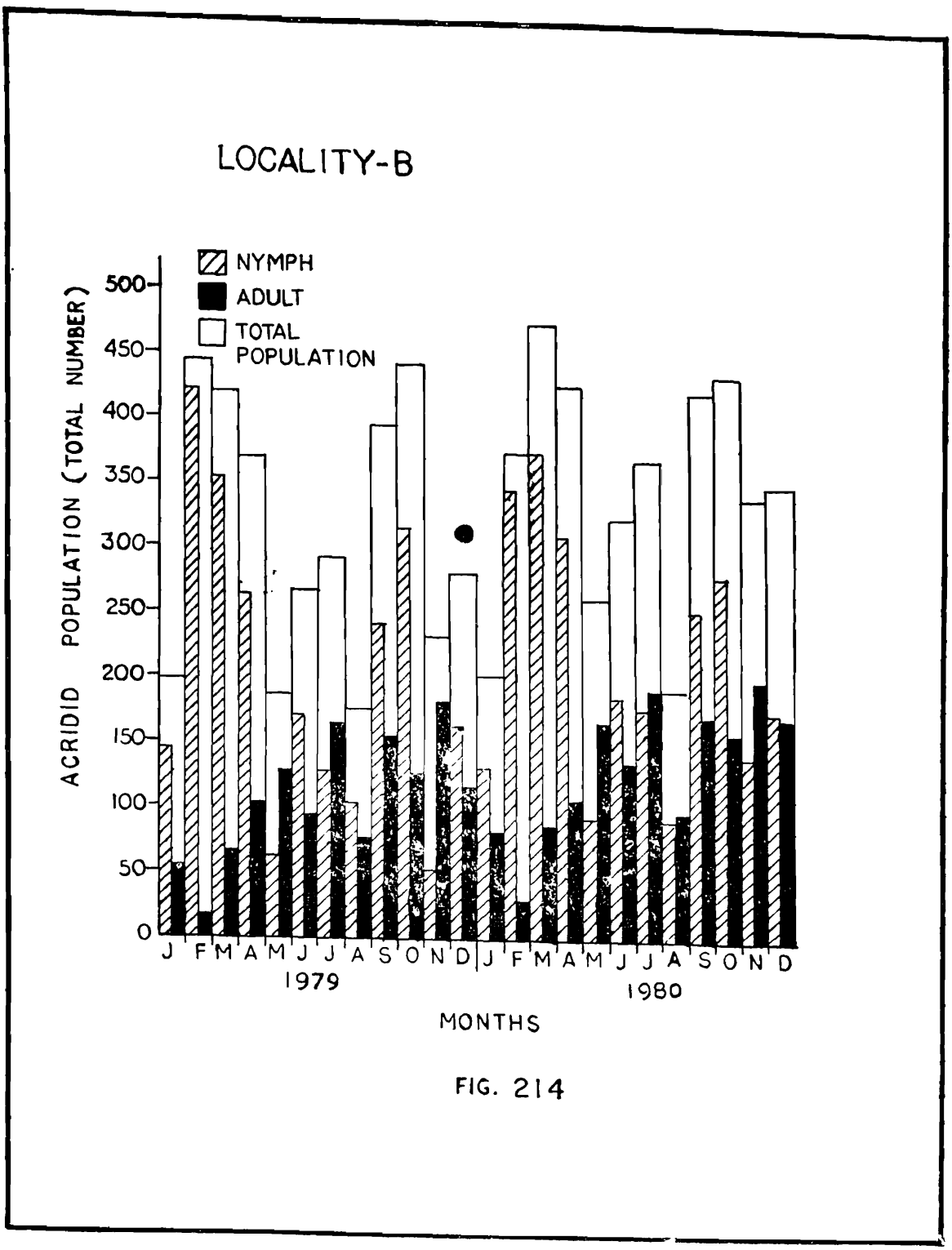


FIG. 214

Fig. 214. Same, from Loc. B.

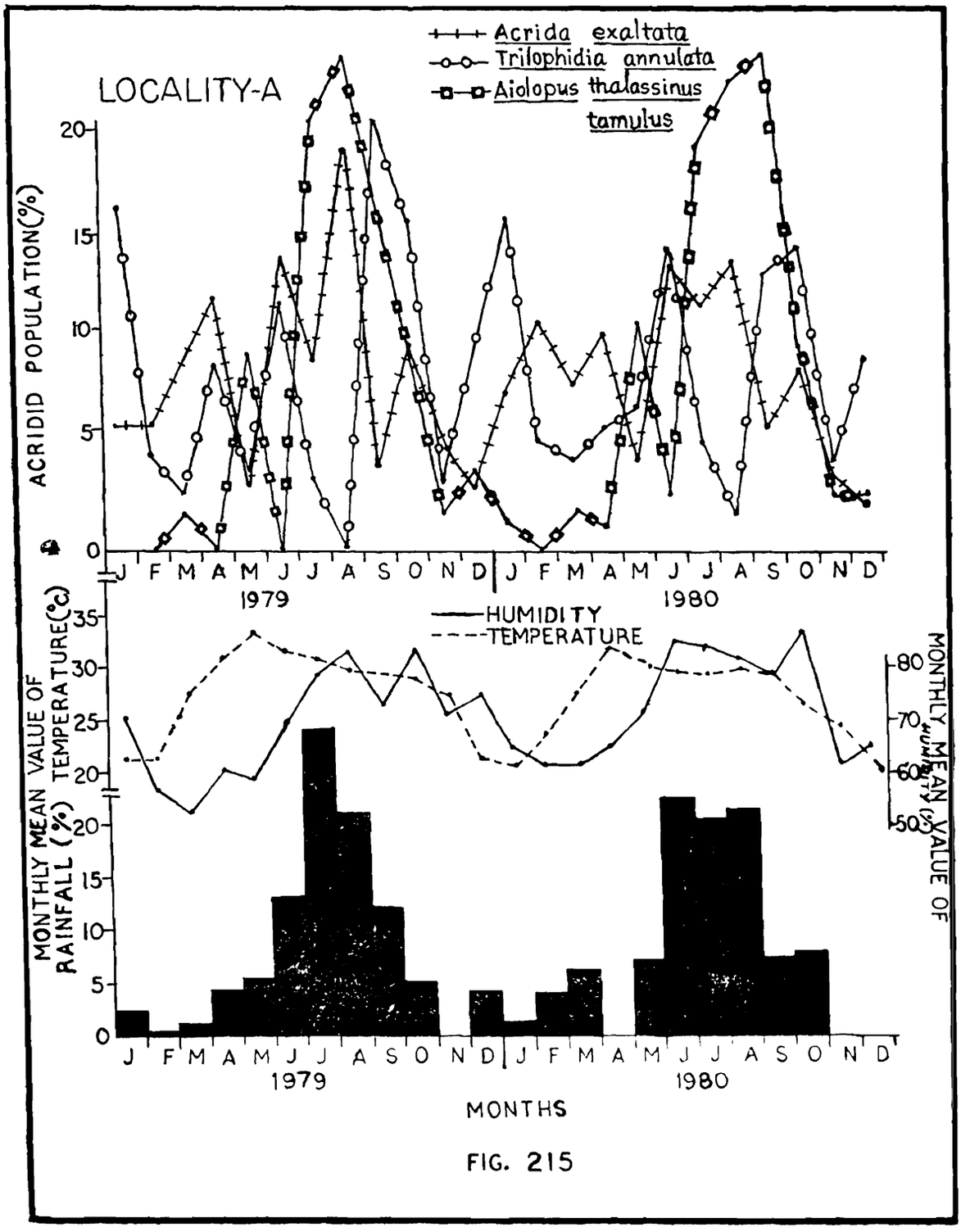


Fig. 215. Percentage of population and monthly mean value of three abiotic factors—rainfall, temperature and humidity from Loc. A.

E. Food and habitat

Grasshoppers are chiefly phytophagous insects although pollen, fungi and arthropod also constitute their food. But all grasshoppers do not invade the same type of habitat and although some can adjust to different habitats also

they usually prefer to live in a particular habitat. Phipps (1970) classified the hoppers habitats into 5 principle categories—Thicket, Wood Land, Long grass, Short grass and cultivation and found that Hemiacridinae, Acridinae and Truxaline (also Gomphocerinae) are restricted to grasses and cultivation ; Catantopinae are mainly thicket species, with a number of species prefering grasses while the remaining sufamilies are rather generally distributed, as shown below in details—

(No. of spp. of) Subfamilies grouped according to habitat (Phipps, 1970).

	Thicket	Woodland	Long grass	Short grass	Cultivation
Hemiacridinae	0	0	3	1	0
Oxyinae	4	0	2	1	0
Coptacridinae	0	0	2	0	0
Calliptaminae	0	0	0	0	1
Eyprepocnemidinae	3	0	3	0	0
Catantopinae	11	2	5	1	1
Cyrtacanthacridinate	1	1	1	1	0
Acridinae	0	0	17	7	9
Truxalinae	0	0	10	1	1

The bandwings (Oedipodinae) usually frequent bare patches in tall grassland, open woodland, forest clearings and also old cultivations, grazing fields ; some of them are found around paddy fields and on shrubs.

Food preference of Acridinae and Truxalinae (including Gomphocerinae) are predominatly graminivorus, while Coptacridinae, Catantopinae and Cyrtacanthacridinae etc. are forbivorous or mixed feeders, as noted below—

(No. of spp.) Subfamilies grouped together according to food preference (Phipps, 1970)

	Forbs	Grassess	Mixed foods
Coptacridinae	2	0	0
Catantopinae	7	0	6
Cyrtacanthacridinae	3	1	0
Tropidopolidinae	1	2	0
Oxyinae	0	1	1
Eyprepocnemidinae	0	1	3
Acridinae	0	22	4
Truxalinae	0	3	1

Food habits vary between habitats and often between age groups. Hoppers do not take food immediately before and after moulting nor do the fliers. Immediately after the final stage is reached they start feeding

but voracious feeding takes place after sometime with a sharp decline again in advanced age (Singh, 1957). Usually in a given habitat, some plants are more favoured than others and this selection-preference does not necessarily depend on abundance.

Grasshopper population is a product of the plant community. The plant community is again determined by various physical features, e.g., soil type, moisture, exposure and climate, and by the biotic forces of competition. The grasshopper community evolves in response to the same biotic forces as govern the plant community, but additionally responds to the vegetation. The environment—ecological requirements of most hoppers, especially of the most common species, are fairly broad and can be fulfilled in several communities.

It was seen that habitat alterations and disturbances have profound effects on hopper composition (Scoggan and Brusven, 1973). According to them, bandwing (Oedipodinae) species are "pioneers", favoured by unsuitable soils and early and immediate seral vegetation ; spurthroats (Catantopinae) prefer intermediate seral conditions with moderately stable soils and having a mixture of grasses and forbs ; stantface (Acridinae, Gomphocerinae) species prefer stable grassy areas.

F. Economic importonce of grasshoppers

Grasshoppers have because of their main dependance on vegetation and of agricultural plantations for subsistence, drawn the attention of economic entomologists. They have become and are becoming of more and more seriously concern due to unusual distrbances in their natural habitats by foresters and agriculturalists by reclaiming and clearing off lands. Recently Bhowmik and Halder (1984) have reported the species *Cyrtacanthacris tatarica*, a species of thicket and woodland, becoming a pest on crops in Naxalbari, Darjeeling, as a result of encroachments on its natural habitat.

Similarly, the species of *Gastrimargus* are inhabitants of the tropical grassland ecosystems. There are now indications that with the continuing destruction of rain forests, and its replacement by vegetation types suitable for *Gastrimargus* spp., favoured by overgrazing which provide bare ground for laying, long and short grasses for feeding and roosting, some of the species, viz., *G. marmoratus*, move from the wild vegetation into the rice, maize or other crop plantation.

The members of the genus *Hieroglyphus* are pests on rice plantation. *H. oryzivorus* is a serious rice-pest in Tamil Nadu, it also infests jowar and sugar-cane plantations. The most important major pest of rice is *H. banian*, almost throughout rice-yielding zones of India. But there is no proper quantitative studies of this pest to assess the exact amount of damage caused.

Bhatia and Mathur (1964) reported that in 1960, in Andhra Pradesh, 4,085 acres of rice was attacked, while in 1961, in Madhya Pradesh, 1,300 acres of rice and 1,000 acres of jowar were affected. Chowdhory and Majid (1954) reported that this pest of rice from Assam, where it destroyed the leaves and the soft stem. Coleman and Kannan (1911) reported that the leaves of rice are eaten and the stalks cut through so that the ears fall. Some authors (Sengupta and Behura, 1960) estimated 25 to 95% rice loss in different parts of India by this pest—an estimate seems highly exaggerated and needs to be rechecked. Sugar cane and maize are also appreciably damaged, in South-east Asia, by this pest (Roffey 1964, 1965).

Next in order, but perhaps equal to or more serious than *H. banian*, is *H. nigrorepletus*, which is again an important pest of rice, sugar cane, hemp, maize and sorghum in the Indo-Pakistan (Gouri and Ahmed, 1960). Bhatia (1950, 1951) stated that it was a serious pest in Ajmer-Mewara, infesting 50% Jowar, 25% Bajra, 20% sesamum and 5% cotton. It is recorded as a serious pest of maize, jowar, and bajra in Tamil Nadu, Bombay, Madhya Pradesh, Bihar, Uttar Pradesh, Rajasthan, Andhra, Orissa, Delhi (Bhatia, Singh and Ahluwalia, 1965). In 1945, in Orissa, there was a remarkable outbreak of this species, damaging 25% of crops (Sengupta and Behura, 1960). It is a major, active pest in Rajasthan, during July to October. In severely infested fields, the crop is totally destroyed. They feed on leaves in nurseries and finally reach the transplanted fields (Khan, Vyasa and Vaish, 1963).

Oedaleus abruptus, a small to median sized band winged common grasshopper, is reported to be a pest on a variety of agricultural crops. Ballard (1921) reported damage to *Eleusine*, while Chopard and Chaterjee (1937) reported damages on *Pinus* and *Shorea* seedlings and sandal. It is also found infesting on maize and rice, in South-east Asia (Roffey, op. cit.) and is also reported to feed on wheat, bajra, jowar, grain pea, groundnut and other crops (Khan and Aziz, 1974).

Similarly the members of the genus *Oxya* are mostly found closely related to agricultural crops, chiefly sugar canes, rice and jute, throughout India as well as far east countries.

The species of the genus *Gastrimargus* are sometimes injurious to pasture in Africa, Asia and Australia. There are no published reports of damage from India. From Africa Descamp (1954) reported that *G. africanus* is a pest to maize and millet, on sorghum (Joyce, 1952), tobacco (Zacher, 1921) and other plants. *G. marmorata*, a species from South-east Asia, Assam to W. Guinea, damages maize, rice, sorghum, citrus, sugar canes, cocoa and oil palm (Roffey, 1979).

Iqbal and Aziz (1974) considered *Spathosternum p. prasiniferum*, as a major pest of crops in U. P. and Punjab feeding on a variety of agricultural crops : wheat, rice, sorghum, sugar cane etc. and on a few garden plants and weeds ; while Bhowmik and Halder (Ms.) noticed *Acrida exaltata* as a pest on rice and jute in West Bengal and Bangladesh.

Coates (1893) recorded *Aiolopus simulatis* causing serious damage to summer rain crops, specially millet, in upper Sind, while Barlow (1900) recorded it damaging young wheat seedlings in Ahmednagar district, Gujarat. The author noticed *A. thalassinus tamulus* in rice field in lower Bengal and Purulia and Bankura districts in West Bengal. It is a serious pest of rice in West Bengal and in many rice-yielding zones of India.

Although there are references on the extent of damage caused by grasshoppers, there exists less quantitative and statistical informations on the quantum of damage caused by these insects on agriculture, forestry and in rangeland management. On these lines further investigations should be undertaken.

Systematic Account

Order : ORTHOPTERA

Suborder : CAELIFERA

Superfamily : Acridoidea

Family Acrididae

The family Acrididae can well be characterized and distinguished from its allied families by the combination of the following morphological characters—

Antennae, usually composed of 18 to 30 segments, longer than fore femora but almost always shorter than length of body ; pronotum of varying shape but usually not flattened dorsally nor extended backwards to cover abdomen ; tarsi of all legs composed of 3 joints, proximal one called metatarsus with 3 pads or pulvilli on its ventral surface : tarsal claws with a definite pad or arolium between them ; prosternum mostly armed, only in a few subfamilies unarmed ; pleuro-sternal suture of mesothorax and metathorax subobsolete or obsolete ; foveolae of vertex ventro-lateral to fastigium, never contiguous or superior.

The species of the family Acrididae may be confused to those of the families, Eumasticidae and Pyrgomorphidae, to which it bears close resemblance but can be distinguished by careful examinations of morphological features.

In Eumasticidae, the antennae are usually shorter than fore femora (exception being seen in *Gomphomastacini*, where it may be as long as body) ;

pronotum may be flattened dorsally and may be produced a little over abdomen ; prosternum generally unarmed and pleuro-sternal suture of meso- and metathorax produced (not subobsolete or obsolete as in Acrididae).

The most distinguishing feature of the family Pyrgomorphidae and which differentiates it at once from the family Acrididae is that its possession of a vertical cleft or fastigial furrow, of fastigium, at its cephalic end, distinct but closed division of which extends caudad over a considerable part of fastigial dorsum, and is also evident for some distance ventrad of immediate fastigio-facial angle ; besides, foveolae of vertex relatively large, superior i. e., on dorsal surface of rostrum nearly horizontal, narrowly separated medielly by vertical fissation of fastigium and forming lateral borders of latter as seen from dorsum (fig. 190, dark line represents the vertical claft). This feature is unique and remarkable.

Key to subfamilies

1.	Prosternal process usually absent ; if present ; than antenna ensiform and body strongly elongate ...	... 2
—	Prosternal process always present ; antenna and body variable ...	... 4
2.	Stridulatory file on inner side of posterior femur absent ...	... 3
—	Stridulatory file present, in form of a series of peg like hairs, along inner lower side of posterior femur (fig. 64) ...	Gomphocerinae (sensu Uvarov, 1966)
3.	Head with a more acute profile. Face usually retreating and angulate, rarely subvertical and generally angulate at fastigiofacial angle, fastigium usually but little declivent ; eyes generally longer than infraocular area of genae ; tegmen without intercalary vein (if present, weak, irregular and not serrated even in male). ...	*Acridinae* (sensu Uvarov, 1966)
—	Head with a rounded profile. Face almost vertical, rarely oblique and generally broadly rounding over fastigo-facial angle into fastigial profile ; fastigium usually strongly declivent ; eyes shorter than infra ocular portion of genae ; tegmen always with an intercalary vein in medial area (mostly well developed). ...	*Oedipodinae* (sensu Uvarov, 1966)
4.	Radial area of tegmen with a series of regular, parallel stridulatory veinlets (Pl. I, figs. 216-217) ; tympanum present ; if apterous, then body compressed and tympanum absent. ...	*Hemiacridinae* (sensu, Dirsh, 1965)
—	Stridulatory veinlets of radial area of tegmen absent ; if apterous, then tympanum (at least rudimentary) present ...	... 5

5. Lower external lobe of posterior knee with spine-like apex ... *Oxyinae* (sensu Dirsh, 1965)

— Lower external lobe of posterior knee with apex rounded, angular or subacute, but not spine-like 6

6. Last abdominal tergite in male usually with well developed furcula (fig. 150) ; supra-anal plate mostly attenuate or trilobate apex ; subgenital plate with transverse fold (figs. 140, 145) .. *Coptacridinae* (sensu Dirsh, 1965)

— Last abdominal tergite in male without well developed furcula ; supra-anal plate variable ; subgenital plate without transverse fold 7

7. Mesosternal interspace closed (figs. 159, 161) ... *Tropidopolinae* (sensu Dirsh, 1965)

— Mesosternal interspace mostly open 8

8. Mesosternal lobes almost rectangular (fig. 164) ... *Cyrtacanthacridinae* (sensu Dirsh, 1965)

— Mesosternal lobes rounded or obtuse-angular or acute-angular, but not rectangular (fig. 171) 9

9. Male cerci pincers-like, strong, regularly incurved (fig. 169) ; epiphallus discoidal, without lophi ... *Calliptaminae* (sensu Dirsh, 1965)

— Male cerci variable, but not pincers-like ; epiphallus not divided or if divided, then with rather small loliform lophi 10

10. Disc of pronotum flat or weakly tectiform, with median and lateral carinae, linear (lateral carinae sometimes obliterated) ; male cerci with strongly compressed, lobiform or subacute, down-curved apex (figs. 200, 203) ... *Eyprepocnemidinae* (sensu Dirsh, 1965)

— Disc of pronotum of variable shape ; lateral carinae, if present, not linear ; male cerci variable but not with strongly compressed, lobiform or subacute, downcurved apex (figs. 176, 182, 187) ... *Catantopinae* (sens Dirsh, 1965)

I. Subfamiiy Acridinae

Key to genera

1. Apex of tegmen acute or subacute ; "knee" lobes of posterior femur acute-pointed ; head elongated (Posternal process absent ; medial area of wing widened, forming speculum ; tegmina with dense reticulation) ... *Acrida* (Linnaeus)

— Apex of tegmen round or obtuse ; "knee" lobes of posterior femur with rounded apex ; head small 2

2.	Antenna ensiform, at least on basal half ...	... 3
—	Antenna filiform (lateral carinae of pronotum diverging in metazonal area ; fastigium rather deeply concave and without median carinula ; antennae much longer than head and pronotum taken together) ...	*Ceracris* Walker
3.	Lateral carinae of pronotum linear, continuous ; fastigium of vertex shallowly concave and often with a strong median dividing carinula ; posterior femora thickened at bases ; length of antennae less than following genus ...	*Phlaeoba* Stal
—	Lateral carinae of pronotum diverging in metazonal area ; fastigium moderately concave and with or without indistinct median carinula ; posterior femora rather slender and antennae longer than preceeding genus ...	*Holopercna* Karsch

Genus (1) **Acrida** Linnaeus

1758. *Gryllus* (*Acrida*) Linne, *Syst. nat., 10th ed* : 427.

1775. *Truxalis* (*Partim*) Fabricius, *Syst. Ent.*, 279.

1954. *Acrida* Dirsh, *Bull. Soc. Fouad. ler. Entom.*, 38 : 107.

Type species : *Gryllus* (*Acrida*) *turritus* Linnaeus, 1758.

Large insects (♂ 40.4-57.8, ♀ 57.8-106.2) with strongly elongate body, almost stick-like. Antenna ensiform, gradually tapering towards apex, longer or subequal to head and pronotum taken together. Head strongly elongate, acutely conical ; fastigium of vertex strongly elongate, with parabolic or obtuse-angular apex ; fastigial foveolae absent ; frons distinctly or slightly incurved. Pronotum long, dorsum of disc flat or weakly tectiform, with sharp median carina, cut only by the posterior sulcus ; lateral carinae low, but very distinct, straight or slightly incurved or slightly excurved or divergent in metazona, latter (metazona) with posterior margin obtuse or acute-angular. Mesosternal interspace usually longer than broad. Tegmina and wings well developed with acute apices ; tegmen with dense reticulation ; costal and sometimes subcostal veins finely serrated ; medial area of wing widened, lustrous, forming speculum, without any pattern (Fig. 39). Posterior femur long, strongly narrowed ; lobes of posterior knee with acute apices, upper inner lobe a little longer than external one. Male cercus narrow-conical, with obtuse apex ; supra-anal plate triangular, simple ; sub-genital plate elongate, acutely conical or short, with uper projection ; epiphallus with rather wide bridge, large ancorae and small, bilobate lophi. Female supra-anal plate obtusangulate ; subgenital plate weakly trilobate or almost truncate ; ovipositor short, robust, with wide, slightly curved valves.

Distribution : Africa ; Australia ; The Austrasian Archipelago. Japan ; Southern part of Asia ; Southern part of Europe.

2 species occur in India.

1. **Acrida exaltata** (Walker)

(Figs. 37-42, Plate III, fiig. 229)

1859. *Truxalis exaltata* Walker, *Ann. Mag. nat. Hist.*, **4** (3) : 222.

1893. *Truxalis bravicollis* Bolivar, *Feuille Jeunes Nat.*, **27** : 162, no. 8.

1902. *Acrida lugubris* Burr, *Trans. R. ent. Soc. Lona.*, **2** ; 170, p. 13.

1936. *Acrida curta* Uvarov, *Linn. Journ. Zool.*, **39** : 536.

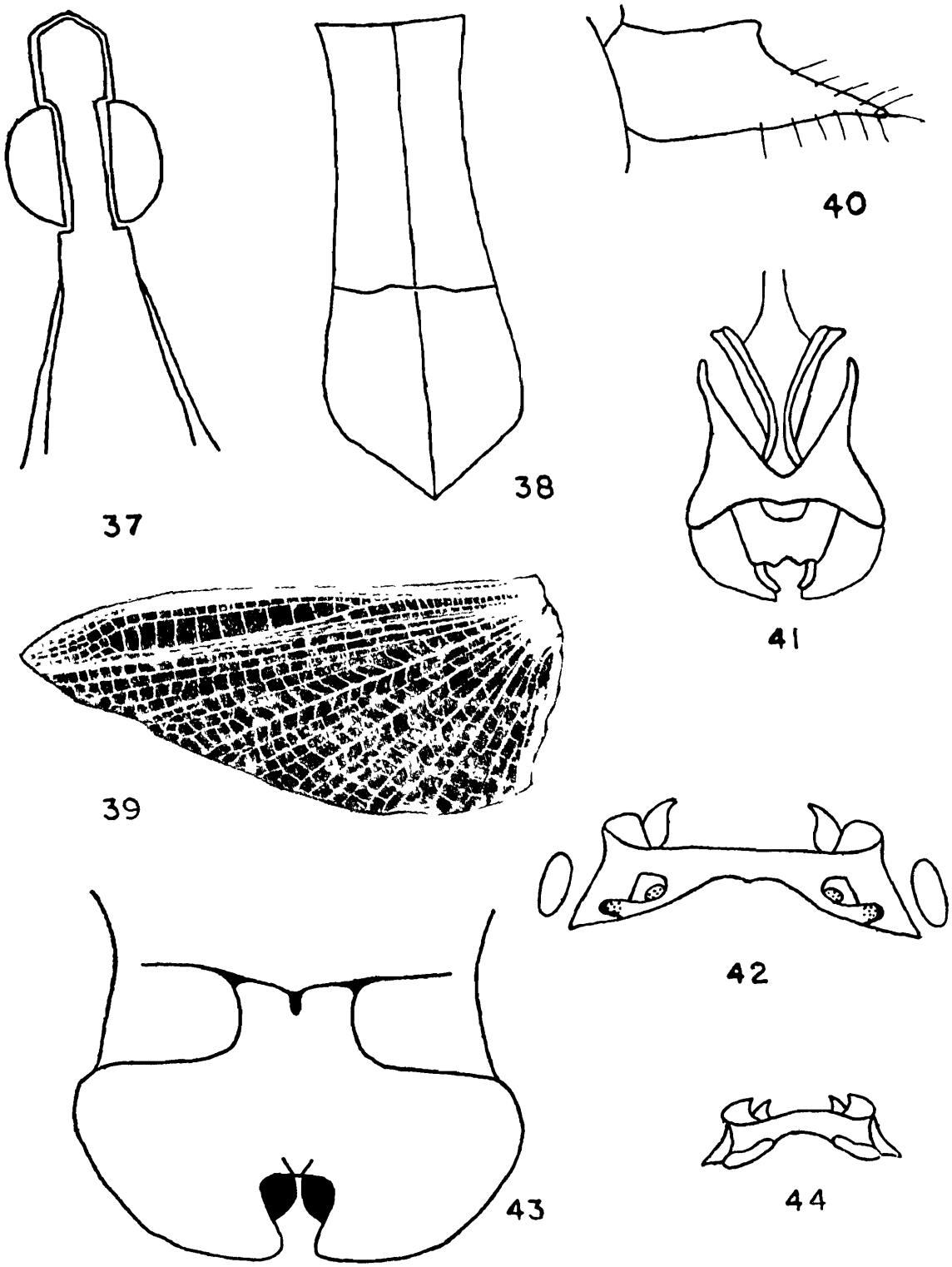
1914. *Acrida exaltata* : Kirby, *Fauna British India, Orth.*, **1** : 99, fig. 80.

Distribution : BANGLADESH ; INDIA (ASSAM ; BIHAR ; H. P. ; ORISSA ; WEST BENGAL) ; PAKISTAN ; SRI LANKA ; AFGANISTAN ; S. E. TIBET ; S. E. PERSIA and ARABIA (YEMEN).

Material : 3 ♀ ; F. R. H. Campus, Naxalbari, Darjeeling ; 13,19.6.79 ; *P. Halder* coll. 1 ♂, 8 ♀ ; (1 nymph ;) Tukriajhar, Naxalbari, Darjeeling ; 18.6.79 ; *P. Halder* coll. 2 ♂, 1 ♀ ; Bhimrajjoth, Darjealing ; 20.6.79 ; *P. Halder* coll. 1 ♂, 1 ♀, (1 nymph) ; F. R. H. Campus, Mongpong, Darjeeling ; 18.3.74 ; *H. K. Bhowuik* coll. 1 ♀ ; Sevok, Darjeeling ; 24.2.74 ; *H. K. Bhowmik* coll. 1 ♂ ; Mirik, Darjeeling 26,6.79 ; *P. Halder* coll. 1 ♂ ; Rydak, Jalpaiguri ; 9.9.1975 ; *H. K. Bhowmik* coll. 1 ♂ ; Garia, 24-Parganas ; 4.12.74 ; *P. Halder* coll. 1 ♂, 1 ♀ ; Kamarchak, 24-Parganas ; 16.8.74 ; *P. Halder* coll. 2 nymphs, Sankrail, Howrah ; 8.7.80 ; *P. Halder* coll.

Description : Males : Medium size. Antennae placed at near apex of head, ensiform at basal half, gradually tapering twoards apex, subequal to head and pronotum taken together. Head very long, sloping upwards ; fastigium of vertix long, shallowly concave, broadly truncate at apex (Fig. 37) ; eyes long, oval, projecting ; frontal ridge narrowed in between antennae, gradually widening, from below median ocellus parallel-sided or slightly divergent downwards. Face strongly oblique. Pronotum tricarinate, with disc weakly tectiform, finely pitted, lateral carinae almost parallel-sided in prozona, slightly divergent at posterior end, but in metazona it is distinctly divergent and a little excurved ; median carina crossed at middle by one sulcus, posterior margin of metazona acute-angular (Fig. 38). Tegmen long, narrow ; costal and subcostal areas hardly expanded and irregularly reticulated ; apex acute pointed. Wing with apex acute, medial area widened, lustrous, froming speculum, traversed by 9 to 13 transverse veinlets (Fig. 39). Posterior femur long, stick-like, knee lobes acute (spine-like) ; post-tibia slender with 26 to 27 small spines. Supra-anal plate tongue-shaped with a

broad median sulcation ; subgenital plate short, acutely conical (Fig. 40) ; cercus narrow, conical, with obtuse apex. Epiphallus with broad bridge, ancorae large, lophi small and bilobate (Figs. 41-42).



Acrida exaltata, male

Figs. 37-44. Head showing fastigium of vertex X 11. 38. Pronotum X 11. 39. Wing showing speculum X I. 5. 40. Subgenital plate, lateral view X 11. 41. Genitalia, dorsol view X 11. 42. Epiphallus, dorsal view X 18. *Phlaeoba antennata*, male 43. Meso- and metanota X 11. 44. Epiphallus, dorsal view X 56.

Females : (Plate III, fig. 229) : Very similar to males but larger in size. Supra-anal plate obtusangular ; sub-genital plate weakly trilobate ; valves of ovipositor short, strong, and slightly curved.

Colouration : Perfectly green in life. Dried specimens appear yellowish, varied with testaceous of various grades and shapes. Wing cells may be tinged with fuscous. Sometimes there are linear, whitish, short streaks along medial veins.

Measurements : Body ♂ 26-35, ♀ 44-58 ; antenna ♂ 10-11, ♀ 13-15 ; head ♂ 6-7, ♀ 8.2-10.5 ; maximum width of head ♂ 1.8-2.2, ♀ , 3-4 ; maximum width of face ♂ .1.9-2.2, ♀ 3-4 ; minimum width of interocular distance ♂ .5-.8, ♀ 1-1.2 ; width of frontal ridge at median ocellus ♂ .3-.4, ♀ .5-.6 ; pronotum ♂ 4.8-5.8, ♀ 7-9.8 ; prozona ♂ 2.5-3, ♀ 3-5 ; metazona ♂ 2-2.8, ♀ 4-5 ; maximum width of pronotum ♂ 2.8-3, ♀ 4-5.5.5 ; minimum width of pronotum ♂ 1.8-2, ♀ 2.5-4 ; tegmen ♂ 24.6-30, ♀ 37.5-45.8 ; maximum width of tegmen ♂ 2.8-3, ♀ 4.2-5 ; post. femur ♂ 18-20, ♀ 25.4-32.5 ; maximum depth of post. femur ♂ 1.4-2, ♀ 2.3-2.8 ; post. tibia ♂ 17.6-19, ♀ 24.5-31.

Diagnostic features : The species is unique by its larger body size, shape of pronotum and frontal ridge and male genitalia. The only other Indian species, *A. indica* Dirsh, 1954, is yet very poorly known to scientists and distinguishable from the present species by its smaller size.

Remarks : The species is one of the commonest grasshoppers of India and available both in open grasslands including agricultural fields as well as in moist, deep tropical woods. The study of the biology by Bhowmik and Halder (Ms) indicates that it is available round the year in West Bengal and has, at least, two generations annually. Dirsh (1954) has revised the genus.

Genus (2) **Phlaeoba** Stal

1860. *Phlaeoba* Stal, *Eugenie's Resa, Orth.*, **3** : 360.

1909. *Kirbyella* Bolivar, *Bol. Soc. esp. Hist. nat.*, **9** : 289.

Type-species : *Gomphocerus* (*Phlaeoba*) *rusticus* Stal, 1860.

Moderately large insects with well developed tegmina and wings. Antenna ensiform, with basal half widened and flattened, generally longer than head and pronotum taken together. Head not elongate, as wide as and shorter than pronotum ; fastigium of vertex produced beyond eyes, broad or narrow, shallowly concave, more or less rounded at extremity, its lateral carinulae run within inner margin of each eye, often continued on head and usually a median carinula divides fastigium which continues on vertex as well ; fastigial foveolae obsolete ; frons somewhat oblique. Pronotum flat,

tricarinate ; lateral carinae always linear, continuous ; disc always crossed by more than one sulcus. Tegmina and wings longer than abdomen and never with acute apices but always more or less rounded off ; tegmina with dense reticulation, intercalary vein absent ; subconstal area of male not dilated, opaque, reticulated. Posterior femur moderately stout, gradually narrowing at apex, knee lobes rounded. Male subgenital plate rounded or acutely pointed at apex. Epiphallus with broad bridge, large ancorae and a somewhat spindle-shaped lophus on each half.

Distribution : Oriental region.

8 species including 5 endemic ones occur in India.

Key to species

Antennae longer than head and pronotum taken together, generally tipped with yellowish-white segments ; frontal carinulae unicolourous ; pronotum smooth ; knees of posterior femora and bases of posterior tibiae blackish ; posterior tibiae sorbid blue or red ; male sub-genital plate with rounded apex ...	*antennata* Brunner
Antennae shorter or at best, equal to head and pronotum together, tipped with brownish segments ; frontal carinulae spotted with black ; head and pronotum rugose, callosities irregular but prominently striated ; posterior femora and post. tibiae unicolourous (pale) ; male subgenital plate with acutely pointed apex ...	*panteli* Bolivar

2. **Phlaeoba antennata** Brunner

(Figs. 43-44, Plate III, fig. 230)

1893. *Phlaeoba antennata* Brunner, *Annli. Mus. civ. Stor. nat. Giacomo Doria* **33** : 125, pl. v, fig. 49 ; Kirby, 1914. *Fauna British India, Orth.*, **1** : 103, figs. 84-85.

Distribution : Assam ; W. Bengal ; Borneo ; Burma ; Malay Peninsula ; Sumatra ; Sylhet.

Material : 1 ♂ ; Suklapara, Jalpaiguri ; 29.8.1975 ; *H. K. Bhowmik* coll. 2♂, 1♀ ; Panitanki, Naxalbari, Darjeeling ; 17.6.1979 ; *P. Halder* coll. 1♂, 1♀ ; Bamanpokri, Darjeeling ; 22.8.1975 ; *H. K. Bhowmik* coll. 1♂, 5♀ ; Naxalbari, Darjeeling ; 13.9.1974 ; *H. K. Bhowmik* and *P. Halder* coll. 1♂, 1♀ ; Nilpara, Jalpaiguri ; 2.9.1975 ; *H. K. Bhowmik* coll. 1♀ ; Kamkalitala, Bolpur, Birbhum ; 17.12.1981 ; *S. Sen* coll.

Description : Males (plate III, fig. 230) : Medium size. Antenna ensiform in basal half, apical half with elongated segments ; longer than head and pronotum together. Fastigium of vertex produced beyond eyes, broad, shallowly concave, rounded at apex, with a weak median carinula which contiuues over vertex, and, with a semilunar furrow in middle. Foveolae

obsolete. Frons strongly oblique, rugose. Frontal ridge sulcate with distinct bounding carinulae, a little dilated just below fastigial end, then approximating but paralled-sided up to median ocellus, afterwards divergent towards clypeus. Pronotum smoothly punctured, tricarinate, lateral carinae perfectly linear, dorsal ; disc traversed by 2nd and 3rd sulci but crossed by 3rd one behind middle ; metazona slightly more than half of prozona ; with its posterior margin weakly obtuse angular ; lateral lobe vertical in position, divided by 2nd sulcus almost into two halves, with small scattered warts. Meso- and metasternal lobes as shown in (fig. 43). Tegmen long, narrow, with apex obliquely rounded. Posterior femur stout, elongate, with an apical filiform area (about one-third of its length), with knee lobes rounded ; post. tibia a little shorter than post. femur, with 11 internal and 10 external spines. Supra-anal plate tongue-shaped, with a wide, moderately concave medial sulcation ; subgenital plate navicular, with rounded apex ; cercus conical, slender, with subacute apex. Epiphallus as figured (44).

Females : Very similar to males except a little larger in size. Valves of ovipositor moderately curved.

Colouration : General colouration olive-brown varied with testaceous. A broad yellowish band runs from fastigium to over vertex, dorsum of pronotum and continues up to anal area of tegmen in males ; in females this band not distinguishable. Antenna brown with apical segment yellowish-white which is a unique identifying feature. Tegmen subhyaline, with close reticulations, brown. Wings bluish hyaline basad, and infuscated towards tips. Posterior femur uniformly testaceous except knee which is dark. Base of post. tibia dark, rest sorbid blue (mostly in males) or testaceous (mostly in females).

Measurements : Body ♂ 21-24, ♀ 31.5-34.2 ; antenna ♂ 11-14, ♀ 12-15. 5 ; head ♂ 3-4.2, ♀ 4.1-5.5 ; maximum width of head ♂ 1.8-2.1, ♀ 2.6-3.2 ; maximum width of face ♂ 2.5-2.8, ♀ 3-3.8 ; minimum width of interocular distance ♂ .9-1.2, ♀ 1.4-1.8 ; pronotum ♂ 4.8-5.1, ♀ 6.8-7.2 ; prozona ♂ 2.8-3.2, ♀ 4-4.5 ; metazona ♂ 1.8-2.2, ♀ 2.6-3 ; maximum width of pronotum ♂ 2.4-2.8, ♀ 2.8-3.4 ; minimum width of pronotum ♂ 2-2.3, ♀ 2.7-3 ; tegmen ♂ 27-28.5 ; maximum width of tegmen ♂ 2.8-3.2, ♀ 4-4.8 ; post. femur ♂ 14-15, ♀ 17-21 ; maximum depth of post. femur ♂ 3.4-3.8, ♀ 4.2-4.8 ; post. tibia ♂ 12.2-13.8, ♀ 15-17.

Diagnostic features : The species is at once distinguishable from all other species of the genus by its yellowish-white tips of antennae which it always moves. The colouration of posterior legs is also remarkable.

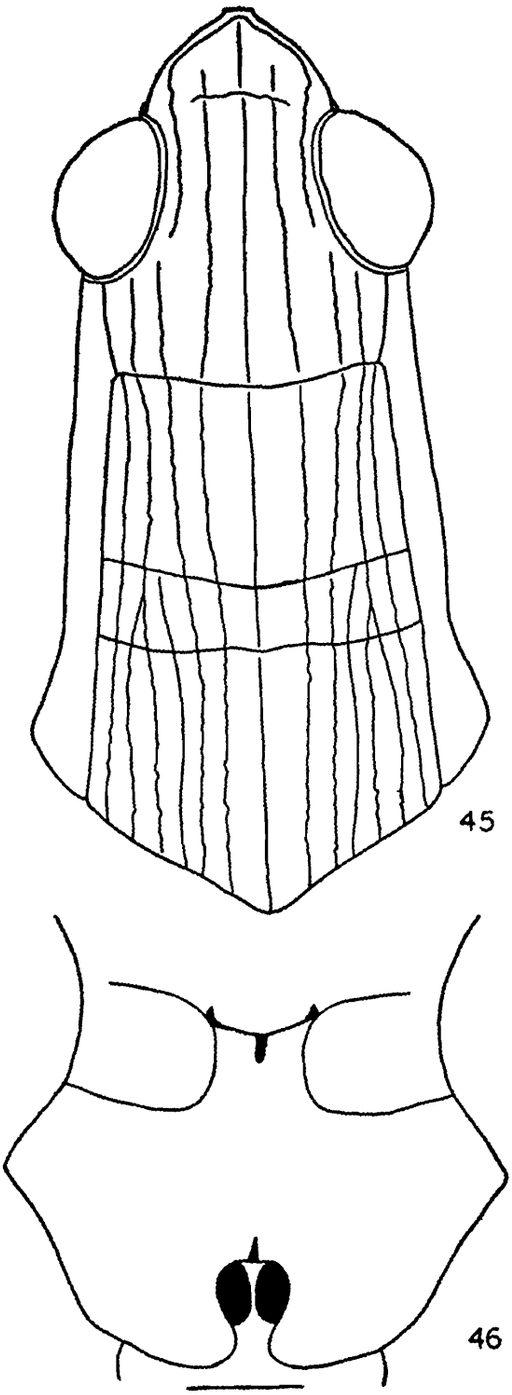
Remarks : The species is found in huge numbers in tea plantations in the foothills of Darjeeling district and adjoining forests. September-October is the breeding session as many were found in pairs in the field.

3. **Phlaeoba panteli** Bolivar

(Figs. 45-49)

1902. *Phlaeoba panteli* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 589 ; Kirby, 1914. *Fauna British India, Orth.*, **1** : 104-105, Fig. 87.

1910. *Phlaeoba walhousei* Kirby, *Syn. Cat. Orth.*, **3** : 138.

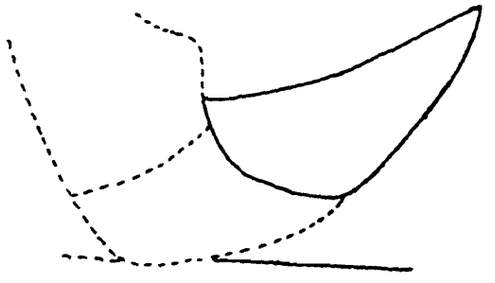


Phlaeoba panteli, male

Fig. 45. Head and pronotum showing longitudinal ridges X 11.
Fig. 46. Meso- and metasternal lobes X 56.

Distribution : Afganistan ; Bihar ; Tamil Nadu ; West Bengal.

Material : 1 ♂ ; Gurubathan, Darjeeling ; 4.3.1974 ; *H. K. Bhowmik* coll. 1 ♂, 1 ♀ ; Bejoynagar Tea Estate, Darjeeling ; 19.6.1979 ; *P. Halder* coll. 3♂, 3♀ ; Naxalbari, Darjeeling ; 17.9.1974 ; *P. Halder* coll. 2♂, 4♀ ;



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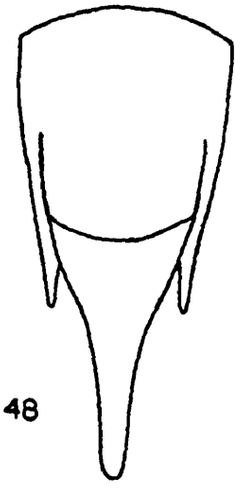

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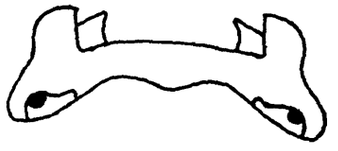

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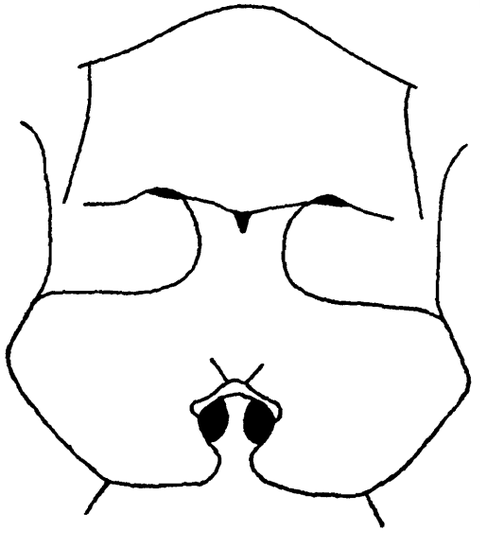

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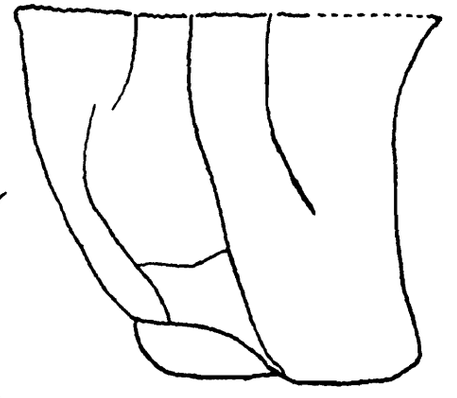

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Phlaeoba panteli, male

Fig. 47. Subgenital plate, lateral view X 11.
Fig. 48. ibid., ventral view X 11.
Fig. 49. Epiphallus X 11.

Ceracris nigricornis laeta, male

Fig. 50. Meso-and metasternal lobes X 11.
Fig. 51. Pronotum, lateral view X 11.

Chunabati, Darjeeling ; 8-10.3.1974 ; *H. K. Bhowmik* coll. 1♂, 2♀ ; Saurini Lower Basti, Mirik, Darjeeling ; 23.7.1979 ; *P. Halder* coll. 2♀ ; Sumsing, Darjeeling ; 6.3.1974 ; *H. K. Bhowmik* coll. 1 ♂, 3♀ ; Mohar Tea Estate,

Sukna, Darjeeling ; 16.11.1974 ; *H. K. Bhowmik* coll. 1 ♀ ; Sukna, Darjeeling ; 13.11.1974 ; *H. K. Bhowmik* coll. 1 ♂ ; Near Mirik Lake, Darjeeling ; *P. Halder* coll. 2 ♀ ; Sundarinala, Jamduar, Darjeeling ; 2.11.1973 ; *H. K. Bhowmik* coll. 2 ♂ ; Sevok, Darjeeling ; 22, 24.11.1974 ; *H. K. Bhowmik* coll. 1 ♂, 1 ♀ ; Mongpo, Darjeeling ; 18.3.1974 ; *H. K. Bhowmik* coll. 1 ♂ ; Rydak, Jalpaiguri ; 9.9.1975 ; *H. K. Bhowmik* coll. 2 ♂, 9 ♀ ; Botanical Garden, Howrah ; 23.5.1978, 29.3.1978, 7.9.1978, 29.3.1979, 16.5.1980 ; *P. Halder* coll. 3 ♂ ; Andul, Howrah, 12.9.1978 ; *P Halder* coll. 2 ♂ ; Singur, Hooghly ; 30.6.1978 ; *P. Halder* coll. 2 ♀ ; Garia, 24-Parganas ; 13.7.1974 ; 4.8.1974 ; *P. Halder* coll.

Description : Males : Medium size. Antenna narrowly ensiform at basal part, as long as head and pronotum taken together. Fastigium of vertex broad, shallowly concave, with a strong median carinula which extends over head and pronotum. Head with distinct, almost linear striated callosities like pronotum (fig. 45). Pronotum tricarinate, rugulose and with irregular striated callosities ; all three sulci indented on disc but 2nd and 3rd only cross it. Meso-and metasternal lobes as shown in fig. 46. Tegmen long, narrow, with apex obliquely rounded. Posterior femur slender, with apical filiform portion ; post. tibia with 12 internal and 11 external spines. Supra-anal plate triangular ; subgenital plate with acute apex (figs. 47-48), cercus small, conical and with subacute apex. Epiphallus as figured (49).

Females : Similar to males but larger in size. Supra-anal plate tongue-shaped with a median depression ; sub-genital plate with posterior margin a little produced in medial apex ; valves of ovipositor moderately curved.

Colouration : General colouration ferrugious brown with scattered black dots. Antenna uniformly brown. Carinulae of frontal ridge and lateral carinae adorned with black dots. Posterior femur also with very small black dots. Posterior femur and post. tibia unicolourous, testaceous, only spines tipped with black. Wing bluish hyaline, not infuscated at apex.

Measurements : Body ♂ 19-25, ♀ 25-41 ; antenna ♂ 7.5-10.9, ♀ 7.5-12-5 ; head ♂ 3-3.8, ♀ 3.2-6.5 ; maximum width of head ♂ 1.9-2.5, ♀ 2.6-4 ; maximum width of face ♂ 2-2.9, ♀ 3.2-4.5 ; minimum width of face ♂ 2-2.9, ♀ 3.2-4.5 ; minimum width of interocular distance ♂ 1-1.7, ♀ 1.3-2.6 ; frontal ridge at median ocellus 0.2-.5, 0.4-.7 ; pronotum ♂ 3.2-4.8, ♀ 4.6-7.8 ; prozona ♂ 2-3, ♀ 2.7-4.6 ; metazona ♂ 1.2-1.8, ♀ 1.8-3.6 ; maximum width of pronotum ♂ 2.4-3, ♀ 3.2-4.8 ; minimum width of pronotum ♂ 1.6-2.2, ♀ 2.5-3.5 ; tegmen ♂ 16.9-21.6, ♀ 22-36, maximum width of tegmen ♂ 2.6-3.3, ♀ 3.2-5 ; post. femur ♂ 11.5-14.5, ♀ 14-24 ; maximum depth of post. femur ♂ 2.9-3.8, ♀ 3.5-5.2 ; post. tibia ♂ 9.6-12.5, ♀ 12.6-21.6.

Diagnostic features : The species resembles *P. antennata* in colouration of wings (being bluish in both species) but can be easily distinguished by the

characters given in the key, of which the irregular striated callosities of head and pronotum are the most unique feature. Besides, the meso.—and metasternal lobes, subgenital plate and epiphallus are also notable.

Remarks : So far the species was known to be distributed in Madura (type locality : Tamil Nadu) and Pusa (Bihar). It is, however, abundant in the 'Duars' and 'Tarai' of West Bengal. Cejchan (1969) recorded it from Afganisthan.

Genus (3) **Ceracris** Walker

1870. *Ceracris* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 721, 790.

1909. *Kuthya* Bolivar, *Bol. Soc. esp. Hist. nat.*, **9** : 291.

1921. *Geea* Caudell, *Proc. ent. Soc. Wash.*, **23** : 29.

Type species : *Ceracris nigricornis* Walker, 1870.

Moderately medium to small insects (18-22). Antenna filiform, much longer than head and pronotum together. Head in front as wide as pronotum ; fastigium of vertex horizontal, concave, produced beyond eyes, slightly curving outwards in front of eyes, and then obtusely rectangular in front ; face moderately oblique. Pronotum rugose-punctate, tricarinate, carinae low, lateral carinae distinctly divergent in metazona ; disc crossed by 3 sulci. Abdomen with a strong median carina. Tegmina and wings well developed ; tegmen with a slight costal enlargement, its spex rounded. Posterior femora rather slender ; 'knee' lobes rounded.

Distribution : Burma ; China ; India ; Taiwan.

4 species including one endemic occur in India.

4. **Ceracris nigricornis laeta** (Bolivar)

(Figs. 50-53, Plate III, figs. 231)

1870. *Ceracris nigricornis* Walker, *Cat. Derm. Br. Mus.*, **4** : 791.

1893. *Duronia versicolor* Brunner, *Annli Mus. Civ. stor. nat. Giacomo Doria Genova*, **13** (33) : 126.

1914. *Kuthya laeta* Bolivar, *Trab. Mus. nac. Cienc. nat. Madr.* (*Zool*), **20** : 79.

1915. *Parapleurus armillatus* Karny, *Suppl. Ent.*, **4** : 83.

1921. *Geea conspicus* Caudell, *Proc. ent. Soc. Wash.*, **23** : 30.

1925. *Ceracris nigricornis* laeta (Bolivar), Uvarov, *Ent. Mitt.*, **14** : 14.

Distribution : India (Sikkim ; West Bengal) ; South China & Taiwan.

Material : 1 ♀ ; Bamanpokri, Darjeeling ; 22.8.1975 ; *H. K. Bhowmik* coll. 4 ♀ ; Mirik, Darjeeling ; 17.9.1974 ; *H. K. Bhowmik* coll. 1 ♂ ; Adalpur, Sukna, Darjeeling ; 15.2.1974 ; *H. K. Bhowmik* coll. 2 nymphs, Thorbu Tea Estate, Mirik, Darjeeling ; 24.6.1979 ; *P. Halder* coll. 3 ♂ (and 1 nymph) ; Saurini Lower Basti, Darjeeling ; 22, 23, 25.6.1979 ; *P. Halder* coll. (Also 1 ♀ ; Khanikhola, Rangpo, Sikkim ; 6.7.1979 ; *P. Halder* coll.).

Description : Males : Medium size. Antenna filiform, much longer than head and pronotum taken together. Fastigium of vertex concave, slightly converging towards in front of eyes, then divergent in middle and broadly rounded in front ; frontal ridge sulcate, almost parallel-sided, only slightly divergent towards clypeus, impress-punctate. Face moderately oblique. Pronotum at prozonal area rugose, at metazona coarsely punctate ; tricarinate, median carina weak but clear and linear, lateral carinae linear at prozona, divergent at metazona and only perceptible by pigments ; indented by 3 sulci but distinctly crossed by posterior one only ; posterior margin of metazona obtuse-angular ; metazona a little more longer than half of prozona ; lateral lobes as figured (51). Tegmen longer than abdomen, apex rounded. Mesosternal lobes wider than long, their inner margins rounded ; interspaces narrower ; metasternal lobes separated by a very narrow interspace (fig. 50). Posterior femur elongate, almost sub-equal to post. tibia which is with 10 to 11 external and 11 to 12 internal spines. Supra-anal plate tongue-shaped, with a very wide longitudinal groove ; sub-genital plate rounded at apex ; cercus conical, apex obtuse-angular ; epiphallus as figured (53).

Females (Pl. III, fig. 231) : Very similar to males except slightly larger in size. Lateral carinae of pronotum more or less prominent at prozona and also may be perceptible at metazona though obliterated in posterior end or may be obliterated (though perceptible by pigmentations) in metazona. Supra-anal plate tongue-shaped, heavily built, apex very broadly rounded or truncate, with a median transverse cut-mark in middle ; subgenital plate flat, with posterior margin at medial apex biconcave in nature.

Nymphs : The collection contains 6 nymphs (♂ 17.2 mm, ♀ 24.0 mm), which are almost identical to adults except for incomplete tegmina and genital parts. Lateral carinae in metazona clear ; posterior femora olive-greenish without any spot or dot ; posterior knee brownish ; posterior tibia beyond basal pale ring brownish ; antennae brownish but not reaching normal size. Tegmina (7-7 mm) brownish with curved venation. Supra-anal plate tongue-shaped ; cercus conical. Valves of ovipositor not formed.

Colouration ; General colouration testaceous-brown. Antenna brownish, sometimes with apical segments dark. A dark band runs from behind eyes and extends over pronotum, along lateral side of lateral carinae. Tegmina with brownish reticulation. Wings hyaline. Posterior femur with a yellowish ring near extremity, knee dark. Post. tibia dark at base, followed by a yellow and a black ring, remaining portion yellowish with black-tipped spines.

Measurements : Body ♂ 22-24.5, ♀ 25-36 ; antenna ♂ 15.4-15.8, ♀ 12-16 ; head ♂ 3.6-4, ♀ 3.8-5.8 ; maximum width of head ♂ 2.2-2.8, ♀ 3-4 ;

maximum width of face ♂ 2.8-3.2, ♀ 3.6-5 ; minimum width of interocular distance ♂ .9-1.2, ♀ 1.2-1.8 ; frontal ridge at median ocellus ♂ .3-.5, ♀ .4-.7 ; pronotum ♂ 4-4.8, ♀ 5-7 ; prozona ♂ 2.2-2.6, ♀ 3-3.6 ; metazona ♂ 1.8-2.2, ♂ 2.4-3.4 ; maximum width of pronotum ♂ 2.8-3.5, ♀ 3.8-4 ; minimum width of pronotum ♂ 2.1-2.7, ♀ 2.7-3 ; tegmen ♂ 17-23.6, ♀ 22-29 ; post. femur ♀ 12.6-15, ♀ 16.5-21 ; maximum depth of post. femur ♂ 2.8-3.8, ♀ 3.8-5 ; post. tibia ♂ 11-12.5, ♀ 14-19.

Diagnostic features : The subspecies can be distinguished from the other one, *C. C. nigricornis*, by its bigger size and to some extent, by body colourations (testaceous brown vs. dark olive-green in the latter). Besides, its restricted distributional range (S. China ; Taiwan and West Bengal—Darjeeling) compared with the other subspecies (N. E. India ; Central Himalayas and Himachal Pradesh) is also remarkable.

Remarks : It is yet a little known subspecies. Uvarov (*op. cit.*) while revising the genus divided Walkerian species, *C. nigricornis*, into 2 subspecies, chiefly basing on relative size. Biology and habits of both the subspecies yet remain unexplored.

Genus (4) **Holopercna** Karsch

1891. *Holopercna* Karsch, *Berl. ent. Z.*, **36** (1) ; 176.

1909. *Sjoestedtia* Bolivar, *Bol. Soc. esp. Hist. nat.*, **9** : 291.

1940. *Sikkimiana* Uvarov, *Ann. Mag. nat. Hist.*, **6** (11) : 375.

Type species : *Holopercna gerstaeckeri* (Bolivar, 1890).

Medium size. Integument rugose and pitted. Antenna longer than head and pronotum, ensiform with basal third compressed and widened and apical two-thirds cylindrical. Head conical ; fastigium of vertex angular, concave in middle, with lateral carinulae ; fastigial foveolae absent ; frons oblique, slightly projecting in apical third, and slightly incurved ; frontal ridge narrow, slightly sulcate, slightly expanded in between antennae, below narrowed and gradually widening downwards. Pronotum slightly constricted in middle ; median carina distinct ; lateral carinae weak, in prozona almost parallel, in metazona divergent and partly obliterated ; dorsum crossed by 3 sulci ; metazona shorter than prozona, its posterior margin obtuse angular. Metasternal interspace open. Tegmina and wings fully developed, far exceeding end of abdomen ; membrane of tegmina parchment-like. Posterior femur slender, far exceeding end of abdomen ; lobes of hind knee of equal length ; inner spurs of post. tibia much longer than external ones. Male supra-anal plate elongate angular. Cercus elongate, conical, slightly incurved, with obtuse apex. Subgenital plate short, subconical, with obtuse apex. Epiphallus with narrow bridge, well developed ancorae and small, tubercle-like lophi. Ovipositor long, with moderate slender, curved valves.

Distribution : Central Africa (Ghana ; Nigeria ; Fermalo Po ; Cameroons ; Gabon ; Belgium Congo) and India (the western and the eastern Himalayas).

2 endemic species occur in India.

5. **Holopercna darjeelingensis** (Bolivar)

(Figs. 54-58, Plate IV, fig. 232)

1914. *Sjoestedtia darjeelingensis* Bolivar, *Trab. Mus. Cienc. nat. Madr., Madrid,* **20** : 77.

1983. *Sikkimiana darjeelingensis* : Bhowmik and Halder. *Rec. Zool. Surv. India,* **81** : 169-170, fig. 11.

1984. *Holopercna darjeelingensis* : Jago, *Trans. Amer. Ent. Soc.,* **109** : 78.

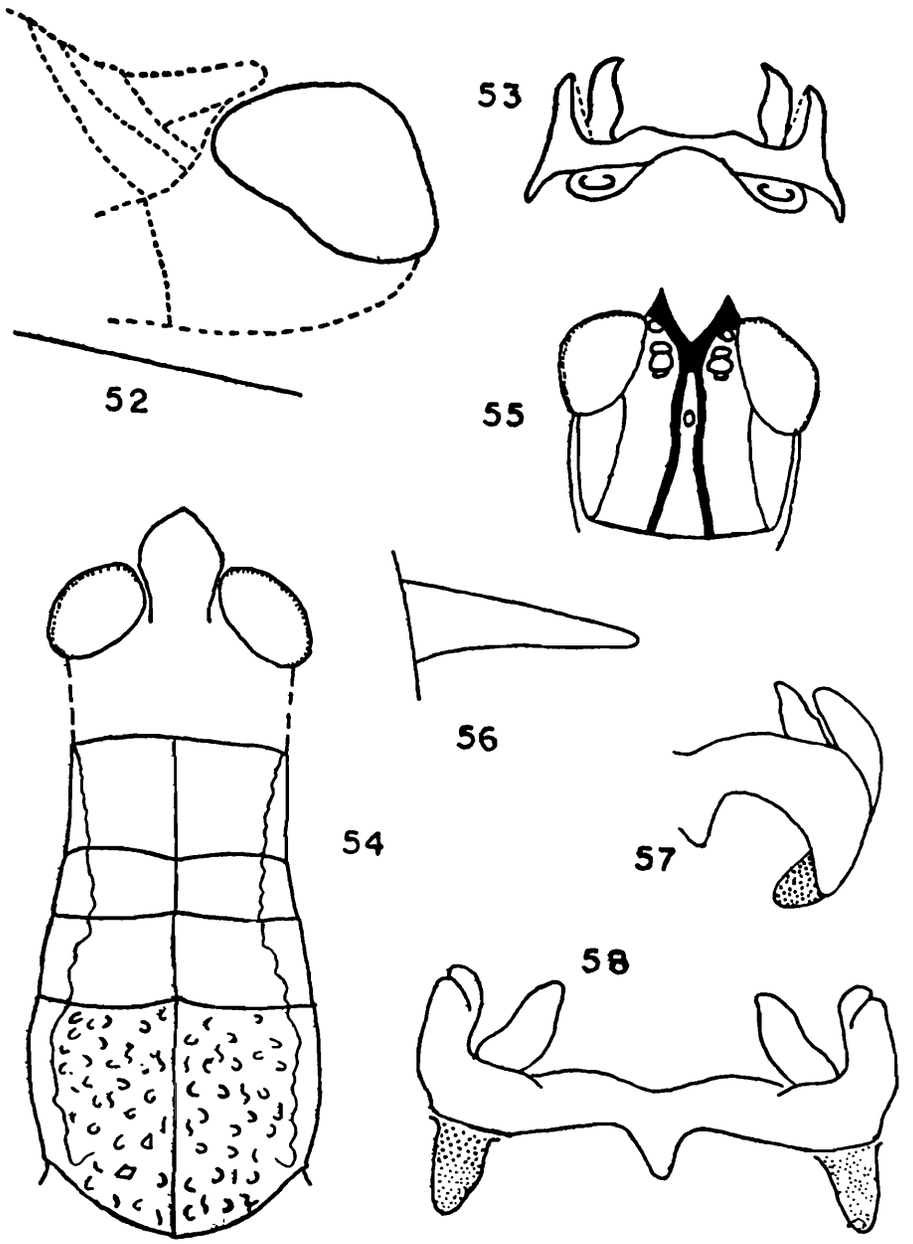
Distribution : Assam ; Darjeeling ; Himachal Pradesh (Mandi) ; Sikkim ; Uttar Pradesh (Kumaon).

Material : 10 ♂, 1 ♀ ; Drang, Mandi, Himachal Pradesh ; 21.9.80. 2 ♂ ; Mandi Riverside, Mandi ; 28.9.80. 2 ♂ ; Pandoh, Mandi ; 18.9.80 (All by *H. K. Bhowmik* coll.).

Description : Males (Pl. IV, fig. 232) : Medium size. Antenna much longer than head and pronotum taken together, of different shape, 1st and 2nd segments rounded, 3rd and 4th ensiform, 5th to 8th segments depressed, remaining 14 to 15 segments cylindrical of which first 10 segments about 3 times longer than their width. Fastigium of vertex concave, apex angular, lateral carinulae distinct and broadly angular in middle ; foveolae absent. Frontal ridge sulcate, expanded between antennae, below narrowing up to median ocellus, then gradually divergent towards clypeous (fig. 55). Pronotum moderately constricted in prozonal area, rugose-punctate ; tricarinate, median carina distinct, linear, lateral carinae slightly convergent up to 2nd sulcus, parallel-sided between 2nd and 3rd sulci ; divergent in metazona but obliterated at posterior end ; all 3 sulci distinctly cut median carina : metazona shorter than prozona, its posterior border widely rounded (fig. 54). Tegmen long, narrow, parchment-like, surpassing abdomen by about its one-third length ; apex obliquely rounded. Posterior femur elongate, slender, dentate, upper carina having a terminal spine ; lower lobe of hind knee angular ; post. tibia slightly shorter than post. femur, with 10 external and 11 internal spines. Supra-anal plate elongate, angular, with a median transverse cut in middle and a medial longitudinal sulcation extending at and about up to median transverse cut ; subgenital plate short, subconical, with obtuse apex ; cercus (fig. 56) long, slender, conical, slightly incurved and with apex obtuse. Epiphallus rounded, with a median projection at posterior margin ; ancorae prominent, projected and inclined inwards ; outer lophi stout, straightly directed towards ventral side ; inner lophi undeveloped (figs. 57-58).

Females : Very similar to males except larger in size. Valves of ovipositor long, moderately curved.

Colouration : General colouration brown, mottled with dark and yellowish spaces and stripes. Antenna pale yellowish. Eyes brownish. From behind each eye, a dark-brown band runs over along lateral edge of lateral pronotal carinae. Face with two oblique yellowish bands—1st one along clypeus and



Ceracris nigricornis laeta, male

Fig. 52. Sub-genital plate, lateral view X 11.
Fig. 53. Epiphallus, dorsal view X 18.

H. darjeelingensis, male

Fig. 54. Head and pronotum, dorsal view X 11.
Fig. 55. Front view of frontal ridge X 13
Fig. 56. Cercus, lateral view X 6.
Fig. 57. Epiphallus, right half, dorsal X 40
Fig. 58. ibid., entire, ventral X 40

extends above in middle of pronotal lateral lobes, 2nd one along mandibular area and also extends up to lower margin of lateral lobes. Episternum III with a yellowish stripe. Tegmen brownish, cells subhyaline, tinted with brown ; a narrow pale yellowish streak runs below radial vein—a unique design. Wing bluish at basal half ; apical half hyaline. Posterior femur with whitish-yellow surfaces ; with dark spots on carinae and carinulae, as of carinulae of face ; lower inner surface olive-green or dark-brown. Post. tibia black at base, followed by a yellow and black ring, remaining area pale yellowish with black-tipped spines.

Measurements : Body ♂ 29-32, ♀ 41-42 ; antenna ♂ 16-17, ♀ 14-17 ; head ♂ 4-4.5, ♀ 5.2-5.8 ; maximum width of head ♂ 2.5-3.5, ♂ 4-4.2 ; maximum width of face (at clypeus point) ♂ 4-4.25, ♀ 5-5.5 ; minimum width of interocular distance ♂ 1-1.25, ♀ 1.5-1.7 ; pronotum ♂ 5-5.5, ♀ 7.1-7.3 ; prozona ♂ 2.5-3, ♀ 3.5-3.6 ; metazona ♂ 2.5-2.75, ♀ 3.6-3.7 ; maximum width of pronotum ♂ 3.6-4, ♀ 5-6.5 ; minimum width of pronotum ♂ 2-2.3, ♀ 3-5.5 ; tegmen ♂ 31-33, ♀ 39-41 ; post. femur ♂ 17-18, ♀ 22-22.5 ; maximum depth of post. femur ♂ 3.5-3.8, ♀ 4-4.5 ; post. tibia ♂ 15-15.5, ♀ 20-21.

Diagnostic features : The species is differentiated by the following features :

General colouration brown mottled with dark and yellow spots and stripes ; wings bluish at bases ; carinulae of frontal ridge and of post. femur marked with dark spots ; fastigium of vertex short and moderately produced.

Remarks : Lately Jago (1983) has synonymised the genus *Sikkimiana* Uvarov, 1940, with the present African genus. It is interesting to note that this Himalayan species is identical to a species from the Central Africa.

Biology of this species is totally unknown.

The members of this genus may be confused with that of *Ceracris* Walker, 1870. In the latter genus, the antennae are filiform, lateral carinae of pronotum parallel-sided up to 3rd sulcus, and though all the three transverse sulci are indented on disc but only the posterior one clearly cross the median carina, whereas in the present genus, the antennae are somewhat ensiform (of different shapes) and never filiform, lateral carinae of pronotum not truely parallel sided up to prozona, it's a little convergent up to 2nd sulcus, then parallel-sided or a little divergent (in females), and finally all the three transverse sulci distinctly cross the median carina. Besides, the lower lobes of hind knees are somewhat angular in the present genus but in *Ceracris*, it is rounded. These external characters clearly differentiate the members of both the genera.

II. Subfamily GOMPHOCERINAE

Key to genera

Lateral pronotal carinae clear to obscure, entire or may be missing between sulci 2 and 3 or may be sharply constricted medially ; it may be straight or with light outward convexity in metazona, but in prozona showing gently inward convexity. Fastigium with truncate apex, with a basal furrow. Vertex may be tricarinate, smooth to rugose. Foveolae weakly concave, with rugose surface and indistinct edges. Frontal ridge inconspicuously concave to flat or lightly convex below ocellus. Medium sized species with rugosed body ... *Dnopherula* Karsch

Lateral pronotal carinae markedly convergent just anterior to 4th transverse sulcus, and diverging forward abruptly just anterior to 2nd sulcus. Narrowest part of pronotal disc at level of 2nd and 3rd transverse sulci. Fastigium with acute apex ; no transverse furrow. Vertex with clear traces of 3 parallel, regular or irregular, rugose or smooth carinulae, sometimes with median carina stronger than lateral ones. Foveolae large, widely trapezoidal, sharply marginated, lateroanteriorly directed and with a complete lower delineating carinula. Frontal ridge slightly sulcated ; lateral carinulae obtuse. Small slender species with finely dotted, almost smooth body ... *Leva* Bolivar

Genus (5) *Dnopherula Karsch

1896. *Dnopherula* Karsch, *Ent. Zeit. Stettin.* **57** : 259.

1902. *Aulacobothrus* Bolivar, *Annls. soc. ent. Fr.*, **70** : 57.

1909. *Ticra* Bolivar, *Bol. Soc. esp. Hist. nat.*, **9** : 294.

1909. *Phorenula* Bolivar, idem., : 296.

1909. *Berengueria* Bolivar, idem, : 296.

1953. *Luenia* Uvarov, *Campanhia de Diamantes de Angola, publ. Cult.*, **21** : 171.

Type species : *Dnopherula callosa* Karsch, 1896.

Small with rugosed integument. Antenna filiform. Head subconical ; fastigium longer than its width, almost trapezoidal, with truncate apex, in middle with concavity, with a transverse basal furrow and sharp marginal carinulae merging with carinulae of vertex ; fastigial foveolae hardly visible from above, weakly concave, with rugose surface and indistinct edges. Face oblique, slightly excurved ; frontal ridge 2 or 3 times as wide as antennal

*No key of the species is given as no material of the last two species was available for study.

scape, very slightly concave to flat or lightly convex below level of ocellus, without lateral carinulae. Dorsum of pronotum flattened, slightly constricted ; median carina sharp, linear ; lateral carinae angularly incurved, sometimes irregular or may be missing in parts of prozona or lateral carinae sharply constricted medially ; prozona with transverse rugosities ; dorsum crossed by 3 sulci, only posterior one crosses median carina. Tegmina and wings well developed ; cu_1 field may show definite traces of resonator formation to virtually none ; marginal speculum is twice, to less than twice, depth of interspace between costa and subcosta at level of precostal lobe (costa (C) under 2/3 length of subcosta (Sc) because expansion of inter C and Sc tegminal cells is greater, eg. in *Aulacobothrus*). Cerci narrow, acutely conical. Epiphallus with narrow bridge, slender ancorae and trilobate lophi.

Distribution : Cosmopolitan.

11 species including 8 endemic ones occur in India.

The following species of the genus belong to the subgenus *Aulacobothrus* (Bolivar, 1902) (Jago, 1971). The members of this subgenus are characterised by having the pronotum without an angular constriction of prozonal carina, lateral carinae in this region being lightly incurved (present or absent between sulci 2 and 3) ; narrowest part of prozona at level of sulcus 2 ; front edge of prozona fractionally narrower than back edge ; ratio of prozonal narrowest width to length is between 1. O-1. 4.

Majority of Indian species belong to this subgenus.

6. **Dnopherula (Aulacobothrus) luteipes** (Walker)

(Figs. 59-61, Plate IV, figs. 233-234)

1871. *Stenobothrus luteipes* Walker, *Cat. Derm. Salt. Br. Mus.*, **5** : 82.

1914. *Stenobothrus* (?) *luteipes* : Kirby, *Fauna British India, Vol.* **1** : 121.

1902. *Aulacobothrus taeniatus* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 600.

1914. *Stauroderus bicolor* Kr. (nec Carpenter) : Kirby, *Fauna British India, Vol.* **1** : 127, fig. 93.

1921. *Aulacobothrus luteipes* : Uvarov, *Ann. Mag. nat. Hist.*, **7** (9) : 482.

1971. *Dnopherula* (*Aulacobothrus*) *luteipes* : Jago, *Proc. Acad. Sci. nat. Philad.*, **123** (8) : 243.

Distribution : All over India. (Also Burma ; China ; Europe ; Japan ; N. America).

Material : 2 ♂, 2 ♀ ; Mukutmanipur, Bankura ; 22.9.1983.

(Also 1 ♂ ; Andherikhola, Rangpo, Sikkim ; 5.7.1979 ; *P Halder* coll. 20 ♂, 20 ♀ ; Simla & Manali, Himachal Pradesh ; September, 1980 ; *H. K. Bhowmik* coll.)

Description : Males (Pl. IV, fig. 233) : Small size, with body finely pitted. Antenna filiform, longer than head and pronotum taken together. Fastigium

of vertex almost trapezoidal, with truncate apex, concave, and with transverse basal furrow, lateral carinae sharp, merging with carinulae of vertex ; median carinula beginning behind basal furrow and continuing backward over vertex (fig. 59) ; fastigial foveolae not visible from above, on profile, rhomboidal in outline, broader in front, weakly concave, with rugose surface and indistinct edges. Frontal ridge almost flat to a little sulcate below middle ocellus, parallel-sided, impress-punctate, about 2 times wider than antennal scape. Pronotal disc flattened, tricarinate, with lateral carinae constricted medially, so that they are on dorsum, incurved, narrowest part being between 2nd and 3rd sulci, from 3rd sulcus again divergent ; median carina linear, cut by posterior sulcus only ; posterior margin of metazona obtuse angular (fig. 60). Tegmen as long as tip of posterior femur, costal area ends beyond middle of tegmen, highly expanded with more than 12 oblique veinlets ; subcostal area less developed, less than half of costal area. Post. femur stout, smooth, its knee lobes rounded. Post. tibia slightly shorter than post. femur, with 11 external and 12 internal spines. Supra-anal plate triangular ; subgenital plate navicular ; cercus narrow, acutely conical. Epiphallus as figured (61).

Females (Pl. IV, fig. 234) : Very similar but larger in size. Median carinula of fastigium detectable from extreme anterior margin. Frontal ridge distinctly flat above median ocellus. Lateral carinae of pronotum almost parallel-sided up to prozona. Precostal area of tegmen rather noticeably developed than males, but its costal area less clearly reticulated. Valves of ovipositors moderately curved.

Colouration : General colouration yellowish testaceous, varied with brown. Antenna testaceous. Eye brownish. A broad brownish band runs from behind eyes, over superior margin of lateral pronotal lobes along lateral carinae. A pale yellowish linear stripe usually runs starting from fastigium over vertex and continuing up to end of metazona. Tegmen hyaline with brownish veinlets, basal third a little opaque. Wing hyaline, a little clouded at tip. All legs testaceous except knees of post. femora and bases of post. tibiae which are dark and post. tibiae reddish with black-tipped spines. Post. tibia pilose, with silky pubescence.

Measurements : Body ♂ 14-18, ♀ 21-23 ; antenna ♂ 8-9, ♀ 8-9.5 ; pronotum ♂ 3.5-4, ♀ 4.74-5 ; tegmen ♂ 11.5-12, ♀ 17-18 ; post. femur ♂ 8.5-9, ♀ 14-15 ; post. tibia ♂ 8-8.5, ♀ 11.5-12.

Diagnostic features : The species is unique in the colour pattern. The pale colour stripe of head and pronotum which is almost always clearly demonstrable, besides, the post. ocular brownish bands extending up to posterior margin of lateral lobes, uniform testaceous colouration of legs, with blackish post. femoral knee and reddish post. tibia are very characteristic and make its identification easy.

Remarks : It is the most abundant species of the genus found in India and an inhabitant of open fields including agricultural fields. As per as colouration is concerned, the species is variable to some extent. In specimens from Himachal Pradesh, the dorsal pale stripe of head and pronotum is less distinct as the distinctiveness of the stripe rests on the constract made by the lateral dark brownish bands, but in these specimens this band is not so dark. Due to this variability, the previous works were deceived and designated it under separate species.

7. **Dnopherula (Aulacobothrus) physopoda** Navas (Comb. Nov.)

1904. *Scyllina physopoda* Navas, *Bol. Sci. Argon*, **3** : 133.

1914. *Aulacobothrus physopoda* : Kirby, *Fauna British India, Orth.*, **1** : 125.

This species was described on a single male specimen from Kurseong (Darjeeling) and since its description in 1904, it was never again reported from anywhere. The type is deposited neither in ZSI nor in *Br. Mus.*, nor in Wien, Austria (Jago and Kaltenback-personal communication). Following description is after Kirby (*op. cit.*).

Description : Male : Ferruginous brown. Head shorter than pronotum, with a longitudinal line on head ; fastigium of vertex moderately sloping ; frons very oblique, and frontal ridge sulcated, carinula distinctly diverging from base to tip ; eye large, much larger than lower part of cheeks, oval, moderately approximating on vertex ; behind eye a brown band continued behind with a lateral band on pronotum. Pronotum with metazona shorter than prozona, front margin obtusely angulated, a middle carina continuous with line on vertex ; lateral lobes longer than broad, with front and hind margins straight and parallel, outer margin oblique, and convex beyond middle. Tegmina longer than abdomen, narrow, rounded at tips, with front and inner margins nearly parallel, very broadly sinuous, spurious nervures indistinct, with no intercalated nervure ; but in middle of medial area, at two-thirds from base, an adventitious intercalated nervure formed by a sinuous confluence of nervures. Wings hyaline, with brownish black nervures. Four front femora thickened, curved above ; hind femora compressed, longer than abdomen, but shorter than tegmina, and with small genicular lobes ; hind tibiae with a terminal spine, inner spurs unequal, inner one almost twice as long as outer.

Measurements : Length 13 ; pronotum 3 ; antenna 4 ; tegmen 10.4 ; post. femur 8.

8. **Dnopherula (Aulacobothrus) rubripes** Navas (Comb. Nov.)

1905. *Scyllina rubripes* Navas, *Bol. Sci. Argon*, **4** : 53.

1914. *Aulacobothrus rubripes* : Kirby, *Fauna British India, Vol.* **1** : 126.

Like the preceeding species, this species was also described on a single female specimen from Kurseong (Darjeeling) and since then it remains unrecorded and unknown to the scientists. Its type depository is similarly also not known. It may be the female counterpart of the preceeding species. Following description is after Kirby (op. cit.).

Description : Females : Ochraceous brown, with hind tibiae bright red. Head ochraceous, finely dotted with brown ; fastigium of vertex moderately sloping, temples distinctly margined above ; frontal ridge sulcated in middle ; lateral carinae sinuated ; eyes pyriform, oceli brownish black. Antennae filiform, yellowish at bases and blackish at tips. Pronotum with prozona shorter than metazona, carinated in middle, carina only intersetced by typical sulcus ; front margin straight, hind margin produced into an acute angle ; lateral lobes transverse, with front and hind margins parallel, nearly straight, oblique externally, sinuated, with disc thickly infuscated in metazona on hind margin ; meso-and metasternal lobes not contiguous. Abdomen pale beneath, unspotted. Tegmina and wings longer than abdomen, former brown, with small distinct subhyaline ochreous spots, and a large irregular one, and white transverse nervures beyond middle ; before middle closely reticulated ; intercalated nervure in middle of medial area not extending to base. Wings hyaline, sulphureous from base as far as one-fourth in front and as far as anal margin behind ; first three lobes infuscated at tips. Four front legs with numerous, and hind legs blotched with brown ; hind femur longer than abdomen, with lower sulcus wholly bright red ; hind tibia shorter than femora, bright red, with base narrowly brown ; spines brownish, inner spurs unequal, outer ones nearly twice as long as inner ; 9 short spines on outer and 10 on inner margin, red, tipped with black ; tarsi pale brown.

Measurements : Length 23 ; pronotum 5 ; tegmen 25 ; post. femur 14.

Genus (6) **Leva** Bolivar

1909. *Leva* Bolivar, *Bol. Soc. esp. Hist. nat.*, **9** : 295.

1926. *Stenohippus* Uvarov, *Trans. ent. Soc. Lond.*, (1925) : 423.

Type species : *Gymnobothrus indicus* Bolivar, 1909.

Small slender species, with finely pitted integument ; almost smooth body. Antenna filiform. Head subconical ; fastigium elongate-angular with acute apex, concave with well developed lateral carinae ; fastigial foveolae not visible from above, large, latero-anteriorly directed, with a complete lower delineating carinula. Face oblique ; frontal ridge shallowly sulcate, with obtuse lateral carinulae. Pronotum subcylindrical, slightly constricted, tricarinate, lateral carinae angularly incurved, often interrupted between 1st

and 3rd transverse sulci ; 3 sulci of which only posterior one cuts median carina, metazona as long as prozona, its posterior margin obtuse angular. Tegmina and wings well developed. Cerci short, narrow, conical.

Distribution : Africa (South of Sahara) ; South West Asia.

5 species occur in India of which 3 are endemic.

9. **Leva indica** (Bolivar)

(Figs. 62-64, Plate IV, fig. 235)

1909. *Gymnobothrus indicus* Bolivar, *Bol. Soc. esp. Hist. nat.*, 9 : 295, pl. 9, fig. 31.

1921. *Leva indica* : Uvarov, *Ann. Mag. nat. Hist.*, 7 (9) : 485.

Distribution : Pusa (Bihar) ; Kulti and Kharagpur (W. B.) ; Central India ; Tripurah ; Coimbatore and Koiloasi (Tamil Nadu). Sri Lanka.

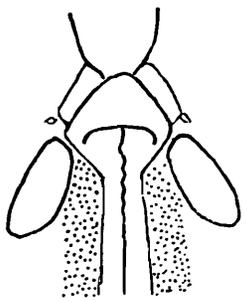
Material : 1 ♀ ; Mukutmanipur, Bankura ; 23.9.81 ; 4 ♀ ; Baram, Purulia ; 12-15.9.81.

(Also 6♂, 7 ♀ (and 3 ♀ advance nymphs) ; Agartala, Tripura ; 7-26.2.83 ; *A. K. Sanyal* coll. 1♂ ; Coimbatore, Tamil Nadu ; 15.4.37 (on loan from B. M.).

Description : Males (Pl. IV, fig. 235) : Small size. Integument finely pitted. Antenna filiform, basal segments slightly depressed, longer than head and pronotum taken together. Fastigium of vertex long, angular with acute apex, concave with strong lateral carinae (fig. 62) ; foveolae not visible from above, on profile, large, latero-anterioly directed, with a complete lower delineating carinula. Frontal ridge almost parallel-sided, a little divergent towards clypeus, sulcate with bounding carinulae well marked, impress-punctate ; lateral carinae strong, slightly curved. Pronotum subcylindrical, slightly compressed laterally in prozonal area, tricarinate, lateral carinae divergent at cephalic border, than angularly incurved behind, narrowest between 2nd and 3rd sulci, again dominantly divergent in metazona ; median carina moderately marked, linear, cut by 3rd sulcus in middle ; posterior margin of metazona obtuse-angular. Tegmen surpasses tip of abdomen ; costal area expanded at base and continued behind up to middle ; subcostal area broad, dilated beyond middle, with about twelve oblique veinlets. Posterior femur stout, with pegs inside (fig. 64) ; knee lobes somewhat rounded, lower one shorter than upper one ; post. tibia with 10 to 11 spines on both edges. Supra-anal plate tongue-shaped, with a median longitudinal groove ; subgenital plate navicular ; cercus short, narrow, conical.

Females : Very similar to males. Frontal ridge seems more divergent downwards than males. Valves of ovipositor moderately curved.

Colouration : General colouration testaceous varied with brown. Fastigial foveolae filled with black or brown. Apical segments of antennae dark. Pronotum pale on dorsum. A broad brown hand runs behind each eye and continues along superior half of lateral pronotal lobes, giving it a design



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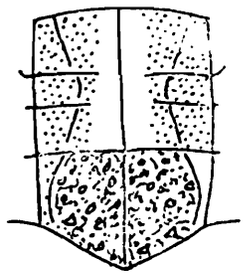

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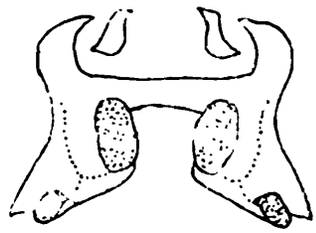

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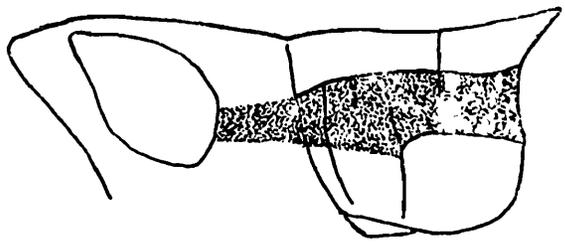
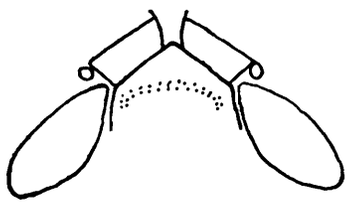


63



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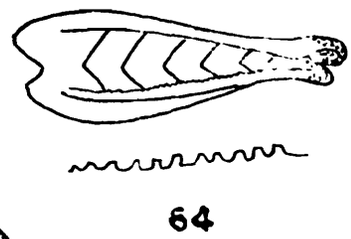

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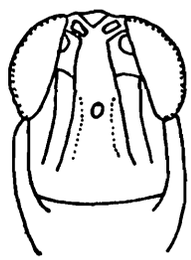


65

D. (*Aulacobothrus*) *luteipes*

Fig. 59. Fastigium of vertex, with carinula and showing foveolae from side view X 11.

Fig. 60. Pronotal disc showing sulcation X 11.

Fig. 61. Epiphallus, dorsal view X 18.

Leva indica

Fig. 62. Fastigium of vertex from side view X 11.

Fig. 63. Side view of head and pronotum showing post-ocular band X 11.

Fig. 64. Post. femur, inside view, showing location of series of stridulatory pegs, with much enlarged view below X 3.

Aiolopus thalassinus tamulus

Fig. 65. Face, front view, showing frontal ridge etc X 5.

(fig. 63) ; lower half of lateral lobes pale yellowish, thus constrasting with superior half. Tegmen subhyaline, with a yellow subcostal line ; middle radial area with six brownish spots. Wing hyaline, apex slightly clouded at tip. Posterior femur with four oblique brownish bands, often obsolete on external surface ; knee dark ; lower carina of outer area marked with five blackish dots. Post. tibia dark at base, rest very pale yellowish, with spines tipped with black.

Measurements : Body ♂ 12-12.5, ♀ 16.5-17 ; antenna ♂ 4.75-5, ♀ 6-6.5 ; pronotum ♂ 2-2.5, ♀ 2.75-3 ; tegmen ♂ 9.5-10.75, ♀ 13-14 ; post. femur ♂ 7-7.5, ♀ 10-10.25 ; post. tibia ♂ 6-6.75, ♀ 8-8.5.

Diagnostic features : This small, slender species is very unique in having particular pattern of colour design. The post-ocular band extending on superior margin of lateral lobes is very characteristic, contrasting it from the pale colouration of pronotal disc and of lower border of lateral lobes. Besides, the brownish spots of radial area of tegmina and the oblique stripes on inner surface of posterior femur and dark spots along its outer carinae at once help its spot identification.

Remarks : This is the most abundant species of the genus found in India. It is an inhabitant of open fields. The species have at least 2 generations in a year as is evidenced from the fact that a larger of adults with 3 advance nymphs were available in February, during winter, in Tripura.

III. Subfamily OEDIPODINAE

Key to Genera

1.	Median carina of pronotum complete or cut by one sulcus ...	...	2
—	Dorsum of pronotum or its median carina at least crossed by two sulci ...	...	8
2.	Transverse veins in apical part of tegmina erect, cells being square or oblong ...	...	3
—	Transverse veins of apical part of tegmina oblique and arranged zig-zag (cells being arranged in oblique quadrilaterals) ...	*Pternoscirta* Saussure	
3.	Wings without well-marked bands ...	...	4
—	Wings usually with black fasciae ...	...	7
4.	Tegmina relatively broad, with square or oblong cells ; robust habitus ...	*Chloebora* Saussure	
—	Tegmina narrow, with square or elongate cells ...	...	5

5. Internal spur of posterior tibiae greatly unequal, lower one much longer than other, abruptly hooked at apex, very acute ... *Heteropternis* Stal

— Internal spurs of posterior tibiae equal, normal 6

6. Head and pronotum granulose, latter bituberculate medially in front: posterior margin of metazona rectangular with tip rounded off; intercalary vein weakly serrated ... *Dittopternis* Saussure

— Head and pronotum not granulated; posterior margin of metazona obtuse-angular; intercalary vein strongly serrated and extending to distal apex of medial area ... *Aiolopus* Fieber

7. Pronotal X-marking always with anterior and posterior arms separate; posterior arms straight, not converging; posterior margin of metazona usually rounded to rectangular, never acutangular (except in a few cases) ... *Oedaleus* Fieber

— Pronotal X-marking with anterior and posterior arms continuous; posterior arms generally curved and with convergent apices; posterior margin of metazona rectangular to acutangular, never rounded ... *Gastrimargus* Saussure

8. Pronotum without very distinct crest 9

— Pronotum with well-marked crest; median carina of pronotum strongly raised in prozona, forming two-tooth-like projections (upper carina of posterior femur not excised. Antenna slightly thickened in apical part) ... *Trilophidia* Stal

9. Tegmina of male rather short and dilated; apical third strongly curved backwards; antenna acuminate at apex ... *Meristopteryx* Saussure

— Tegmina normal; antennae filiform 10

10. Pronotum short (as long as or shorter than its width), broadly rounded behind or very slightly angular, strongly tuberculate and sculptured, its lateral carinae irregular and tuberculate; frontal ridge strongly constricted at apex ... *Acrotylus* Feiber

— Pronotum never shorter than its width, distinctly angular behind, generally not tuberculate and usually not sculptured (except some callous species which are roughly designed); frontal ridge not constricted at apex 11

11. Pronotum with tubercles ; metazona strongly rugose, its length about double of prozona ; very wide sternum, width of mesosternal interspace being more than 3 times, in females, than its length ; very wide posterior femur (about 3 times longer than its maximum depth), with its upper carina expanded ; robust habitus ... *Chondronotus* Uvarov

— Pronotum without tubercles ; metazona moderately rugose, its length never double of prozona ; mesosternal interspace shorter compared with preceeding genus ; posterior femur never so wide (its length about 4 times than its maximum depth) nor expanded on its upper carina ; less robust habitus ... *Sphingonotus* Fieber

Genus (7) **Aiolopus** Fieber

1853. *Aiolopus* Fieber, *Lotos*, **3** : 100.

1853. *Epacromin* Fischer, *Orth. Eur.*, : 296, 360.

1910. *Aeolopus* (sic) Kirby, *Syn. Cat. Orth.*, **3** : 120.

1966. *Aeoloptilus* Bei-Bienko, *Zool. Zh.*, **45** : 1793.

Type species : *Gryllus thalassinus* Fabricius, 1781.

Medium size, with body finely or coarsely pitted. Antenna filiform. Fastigium of vertex pentagonal, slightly longer than wide, moderately concave with well defined margins, forward angle acute or broadly rounded ; foveolae trapezoid or rectangular ; frons oblique ; frontal ridge slightly convex or flat or weakly convave near ocellus, if latter, ill-developed marginal carinulae present. Pronotum weakly tectiform or slightly saddle-shaped, constricted at prozona and sometimes constricted medially ; 3 transverse sulci but only posterior one crosses linear median carina ; lateral carinae absent or weakly present in prozona only ; metazona longer than prozona, its posterior margin obtuse-angular. Mesosternal interspace as wide as or wider than long. Tegmina and wings fully developed, former long, obtusely rounded at apices, with strongly serrated intercalary vein extending to distal apex of medial area ; costal area expanded at base and traversed by an acessory nerve ; wings ample, rather shorter than tegmina, subhyaline. Posterior femur with apical lobes rounded ; posterior tibia not expanded and its apical spurs unspecialized. Male supra-anal plate rounded triangular, with moderately long, subangular apex ; cercus narrow, conical with subobtuse apex ; subgenital plate short, subangular with rounded apex ; epiphallus with moderately narrow bridge, ancorae curved and with simple bilobed lophi. Lower valve (curved) of ovipositor with small externo-ventral teeth.

Distribution : Africa ; Asia including India ; Australia ; Europe ; Malayan Archipelago.

3 species occur in India.

10. **Aiolopus thalassinus tamulus** (Fabricius)
(Fig. 65, Plate IV, fig. 236)

1798. *Gryllus tamulus* Fabricius, *Ent. Syst. Suppl.*, : 195.

1838. *Gomphocerus tricoloripes* Burmeister, *Handb. Ent.*, **2** : 649.

1888. *Epacromia rufostriatus* Kirby, *Proc. zool. Soc. Lond.*, : 550.

1968. *Aiolopus thalassinus* tamulus : Hollis, *Bull. Br. Mus. nat. Hist.* (*Ent.*), **22** (1) : 347-350, fig. 22, 23, 84, 92-96.

Distribution : Andaman Is. ; Australia ; Borneo ; Brunei ; Burma ; China ; East Pakistan ; Hainan ; Japan ; Java ; Malaya ; Mariana ; New Guinea ; Nicobar Is. ; Singapore ; Sri Lanka ; Sumatra and Taiwan. In India it is very common.

Material : 4 ♂, 1 ♀ ; Naxalbari Forest Rest House Campus, Darjeeling ; 17-19.6.1979 ; *P. Halder* coll. 3 ♂, 14 ♀ ; Tukriajhar, Darjeeling ; 17.6. 1979 ; *P. Halder* coll. 1 ♀ ; Panitanki, Darjeeling ; 18.6.1979 ; *P. Halder* coll. 1 ♂, 2 ♀ ; Bijoynagar Tea Estate, Darjeeling ; 19.6.1979 ; *P. Halder* coll. 1 ♂, 2 ♀ ; Bamanpokri, Darjeeling ; 21-22.8.1975 ; *H. K. Bhowmik* coll. 1 ♀ ; Sukiapokri, Masadara, Darjeeling ; 30.6.1979 ; *P. Halder* and party coll. 1 ♂, 2 ♀ ; Mirik, Lake area, Darjeeling ; 23-25.6.1979 ; *P. Halder* coll. 2 ♂ ; Thorbu Tea Estate, Mirik, Darjeeling ; 24.6.1979 ; *P. Halder* coll. 1 ♂, 4 ♀ ; Suklapara, Jalpaiguri ; 29.8.1975 ; *H. K. Bhowmik* coll. 1 ♀ ; Bhutanghat, Jalpaiguri ; 7.9.1975 ; *H. K. Bhowmik* coll. 1 ♂ ; Sahapur, Maldah ; 17.9. 1975 ; *H. K. Bhowmik* coll. 6 ♂, 8 ♀ ; Sankrail, Howrah ; 8.8.1980 ; *P. Halder* coll. 1 ♀ ; Botanical Garden, Howrah ; 16.5.1980 ; *P. Halder* coll. 4 ♂, 2 ♀ ; Chandan Nagar, Hooghly ; 8.9.1978 ; *P. Halder* coll. 1 ♂, 1 ♀ ; Sirkabad, Purulia ; 14.9.1981 ; *H. K. Bhowmik* coll.

Description : Males : Medium size. Antenna as long as head and pronotum. Fastigium of vertex with forward angle more acute ; fastigial foveolae narrowly trapezoid, about twice as long as wide, narrowing more strongly anteriorly. Frontal ridge almost flat and gradually narrowing and almost angular towards fastigial end, sparsely punctured (fig. 65). Pronotum somewhat saddle-shaded and with median prozonal constriction, posterior margin of pronotum rounded. Phallic complex with valves of penis expanded laterally and not recurved. Tegmen longer, ratio of length of tegmen over length of pronotum 4.7-5.5. Posterior femur narrow, ratio of length to depth 4.0 or more ; post. tibia slighter shorter than post. femur in length, with 10 external and 11 internal spines.

Females (Pl. IV, fig. 236) : Longer than males. Frontal ridge a little more punctured than males, weakly sulcate, gradually narrowing towards fastigial end but not so angular as males.

Colouration : General colouration yellowish varied with greenish. Ochraceous or greenish stripe along costal area of tegmen complete. Outer

surface of post. femur unicolourous, without any oblique fascia or marking. Post. tibia usually with red colouration in apical fourth and broadly separated from black band by a wide bluish grey band (about double in length than reddish apex).

Measurements : Body ♂ 15-21.6, ♀ 21-27 ; antenna ♂ 6.5-7, ♀ 7.8-9 ; head ♂ 2.2-3.1, ♀ 2.9-3.9 ; maximum width of head ♂ 1.8-2.2, ♀ 2-3.5 ; minimum width of interocular distance ♂ .6-1.2, ♀ .9-1.4 ; width of frontal ridge at median ocellus ♂ .5-1.4, ♀ .5-1.2 ; pronotum ♂ 3-4, ♀ 3.8-4.9 ; prozona ♂ 1-1.5, ♀ 1.2-2 ; metazona ♂ 1.9-2.8, ♀ 2.5-3.4 ; maximum width of pronotum ♂ 2.9-4, ♀ 3.6-4.5 ; tegmen ♂ 16-22, ♀ 20.6-27.5 ; posterior femur ♂ 9.5-13, ♀ 11.6-14.6 ; maximum depth of post. femur ♂ 2.8-3.6, ♀ 3-4.1 ; post. tibia ♂ 8-10.5, ♀ 9.2-12.2.

Diagnostic features : This subspecies is distinctly recognizable by the shape of its fastigium, gradually narrowing frontal ridge and colouration of post. tibia, though it exhibits high transition in regard to its size and colouration.

Remarks : The subspecies is very abundant in West Bengal. It is one of the serious pests of our agricultural fields, specially of paddy fields. Hundreds of them are noticable from the seedling stage to ripening stage of paddy.

Genus (8) **Dittopternis** Saussure

1884. *Dittopternis* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, 28 (9) : 52, 125.

Type species : *Dittopternis ceylonica* Saussure, 1884.

Medium size, with integument granulosed. Antenna filiform, longer than head and pronotum taken together. Head broad, globular, granulated ; fastigium pentagonal, longer than broad, truncated in front, lateral carinulae not extending behind eyes ; frontal ridge widely sulcate, somewhat parallel-sided, continuous. Pronotum granulose, with median bituberculate structure infront, somewhat constricted in prozona, crossed by posterior sulcus before middle ; anterior border of pronotal disc truncate, posterior margin rectangular, with tip rounded off ; lateral pronotal lobe nearly square, margins slightly sinuated. Tegmen long, narrow, densely reticulate, opaque over little more than proximal half, apical half membranous and subhyaline ; intercalary vein weakly serrated. Wing hyaline, often coloured but without definite bands. Posterior femur denticulated. Male cercus conical ; epiphallus with narrow bridge, long and narrow ancorae and somewhat bilobate lophi.

Distribution : Australia ; India ; Sri Lanka ; S. Africa.

2 species occur in India.

11. **Dittopternis venusta** (Walker)

(Figs. 66-69, Plate IV, fig. 237)

1870. *Oedipoda venusta* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 740.

1888. *Dittopternis venusta* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **30** (1) : 44.

Distribution : Darjeeling ; Annamalai, Shevaroys and South of Pollachi (Tamil Nadu) ; Karnatak.

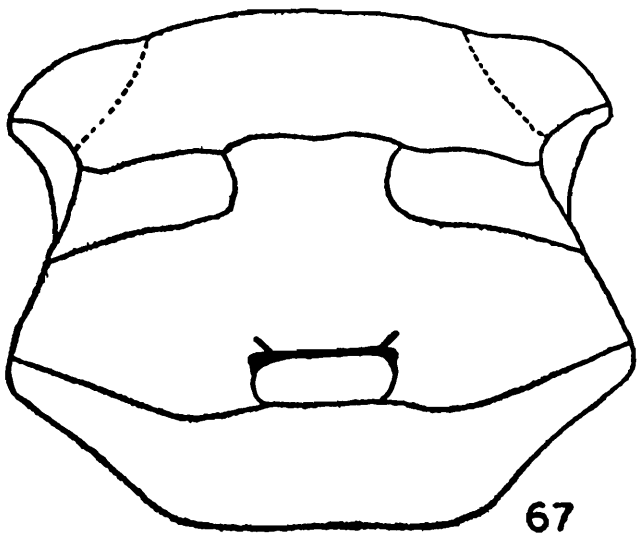
Material : 2 ♀ ; Tukriajhar, Darjeeling ; 18.6.1979 ; *P. Halder* coll. 1 ♀ ; Panitanki, Darjeeling ; 17.6.1979 ; *P. Halder* coll. 2 ♀ ; Bamanpokri, Darjeeling ; 21.8.1975 ; *H. K. Bhowmik* coll. 1 ♀ (dry) and 8 ♀ (wet) ; Bhutanghat, Jalpaiguri ; 7.9.1975 ; *H. K. Bhowmik* coll. 2 ♂, 2 ♀ (dry) and 3 ♀ (wet) ; Rydak, Jalpaiguri ; 10.9.1975 ; *H. K. Bhowmik* coll. 1 ♀ ; Jayanti, Jalpaiguri ; 4.9.1975 ; *H. K. Bhowmik* coll.

Description : Males : Small size with body pilose and head and pronotum granulated. Antenna filiform, longer than head and pronotum. Fastigium of vertex five sided, moderately concave, gradually narrowing towards but ultimately terminating in a transverse carina ; foveolae small, triangular ; frontal ridge moderately sulcate, almost parallel-sided, slightly divergent towards clypeus. Eye rounded, projected, with wide interocular distance which is more than one and a half times wider than frontal ridge in between antennae. Pronotum moderately granulated, laterally compressed at prozonal area, with a strong median carina, crossed by posterior sulcus before middle ; metazona divergent in middle, with lateral "shoulders" and obtusely angular at medial posterior margin ; lateral lobes with posterior edge straight, posterior angle rounded. Tegmen long, narrow, apex obliquely rounded ; intercalated vein incompletely developed ; radial veins with irregular cells at centre and regular, square-shaped cells apically. Meso-and metasternal lobes punctured ; mesosternal interspace as wide as or slightly wider than one of its lobes which are broader than long ; metasternal lobes separated by an elliptical suture. Posterior femur stout, dentate, slightly longer than post. tibia, latter with 8 external and 11 internal spines. Supra-anal plate tongue-shaped ; subgenital plate navicular ; cercus short, conical, apex acute and slightly incurved.

Females (Pl. IV, fig. 237) : Very similar to males except slightly larger in size. Valves of ovipositor slightly curved. Pronotal lobe, meso-and metasternal lobes and terminal spine of post. femur as shown in figs. (66-67 and 69).

Colouration : General colouration dark-brown varied with yellow. Tegmen with basal half brown, with a large yellow blotch at one fourth of length of extending half across, and smaller yellowish spots along costa and middle ; apical half subhyaline, with cells tinted with brown. Wing hyaline,

bright yellow at base, remaining portion suffused with brown. Inner surface of post. femur with two bands (fig. 68), basal one long and extends at both ends up to outer upper carinula, second one completely separate and ring like ; knee dark. Base of post. tibia dark, followed by light yellow and black rings and then blue.



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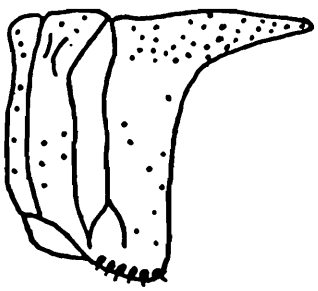

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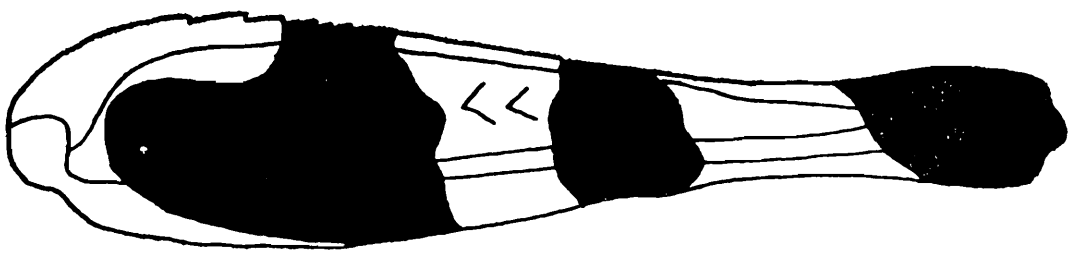

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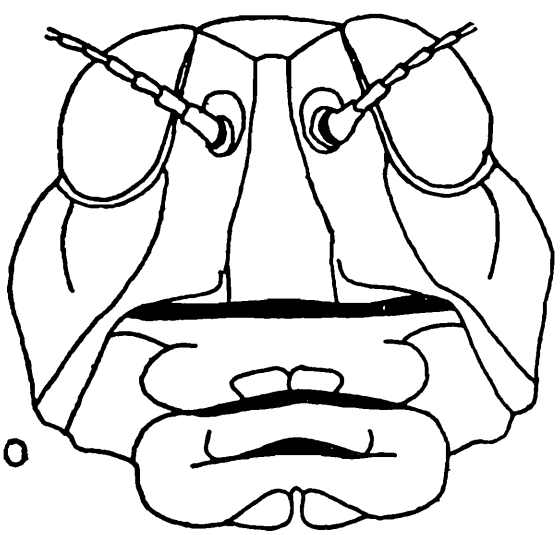

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Dittopternis venusta

Fig. 66. Pronotal lobe, female, lateral view X 11.
Fig. 67. Meso-and metasternal lobes, female, X 11.
Fig. 68. Inner side of post. femur, male, showing colour band X 11.
Fig. 69. Terminal spine of post. femur, female, dorsal view X 11.

Heteropternis respondens

Fig. 70. Face, female, frontal view X 11.

Measurements : Body ♂ 18.5-19, ♀ 27-29 ; antenna ♂ 12.5-13, ♀ 13-14 ; head ♂ 2.8-3, ♀ 3-3.5 ; maximum width of head ♂ 2-2.2, ♀ 2.5-2.8 ; maximum width of face ♂ 2.1-2.3, ♀ 3.4-3.5 ; minimum width of interocular distance ♀ 1-1.1, ♀ 1.5-1.8 ; width of frontal ridge at median ocellus ♀ .4-.5, ♀ .9-1 ; pronotum ♂ 4.5-4.8, ♀ 5.5-5.8 ; prozona ♂ 1.8-1.9, ♀ ♀ 2.1-2.3 ; metazona ♂ 2.7-2.9, ♀ 3.2-3.6 ; maximum width of pronotum ♂ 3.7-3.8, ♀ 4-4.5 ; maximum width of pronotum ♂ 2.2-2.4, ♀ 3-3.8 ; tegmen ♂ 18.3-19, ♀ 24-27 ; post. femur ♂ 11.3-11.5, ♀ 14.5-16 ; maximum width of post. femur ♂ 4-4.1, ♀ 4-4.6 ; post. tibia ♂ 10-10.1, ♀ 11.5-13.

Diagnostic features : The species is separable by its rectangular shape of lateral pronotal lobes at posterior angle and by its male genitalia.

Remarks : It is yet a very little known species. The specimens before me differ from its earlier description by not having vertex with "four diverging rows of pale granules running backwards from between the eyes". The species bears a close resembles to the species of the genus *Pternoscirta* but is distinguishable by its frontal ridge which is not constricted at fastigial end (vs. constricted in the latter genus).

Genus (9) **Heteropternis** Stal

1873. *Heteropternis* Stal, *Recens. Orth.* **1** : 127, 128.

1908. *Thaleius* Finot, *Paris Bull. Soc. ent.*, **77** : 1.

Type species : *Acrydium respondes* (Walker, 1859).

Rather slender insects. Head smooth or granulated. Antenna filiform, as long as or longer than head and pronotum taken together. Fastigium of vertex angular, with fine lateral carinulae, flat or slightly concave ; frons vertical, a little excurved. Frontal ridge sulcate, constricted at apex and gradually widening downwards. Pronotum slightly tectiform, rugose, with sharp median carina and indistinct lateral carinae ; only posterior sulcus crosses pronotum before middle ; posterior margin of metazona acutangular. Tegmina and wings developed or shortened ; tegmen with basal half opaque, transverse veins on apical half erect, cells square, intercalary vein finely serrated ; wing hyaline, more or less clouded but with no well marked fascia. Internal spur of posterior tibia greatly unequal, lower one much longer than other, abruptly hooked at apex, very acute. Male supra-anal plate elongate and angular ; cercus narrow, conical, a little incurved and with obtuse apex ; epiphallus with short bridge, small ancorae and bilobate lophi.

Distribution : Africa and Oriental regions.

Only 1 common species occurs in India.

12. **Heteropternis respondens** (Walker)

(Figs. 70-76, Plate V, fig. 238)

1859. *Acrydium respondens* Walker, *Ann. Mag. nat. Hist.*, **4** (3) : 228.

1873. *Heteropternis pyrrhoscelis* Stal, *Recens. Orth.*, **1** : 1.8.

1914. *Heteropternis respondens* : Kirby, *Fauna British India, Orth.*, **1** : 141, fig. 101.

Distribution : Burma ; China ; Far east Islands ; India ; Java ; Malacca ; Nepal ; Sri Lanka ; Sumatra.

Material : 1 ♂ ; Sukna, Darjeeling ; 13.11.1974 ; *H. K. Bhowmik* coll. 1 ♀ ; Sevok, Darjeeling ; 22.11.1974 ; *H. K. Bhowmik* coll. 1 ♀ ; Bamanpukri, Darjeeling ; 21-22.8.1975 ; *H. K. Bhowmik* coll. 2 ♂ ; Jayanti, Jalpaiguri ; 4.9.1975 ; 1 ♀ ; Rangpo, Sikkim ; *P. Halder* coll.

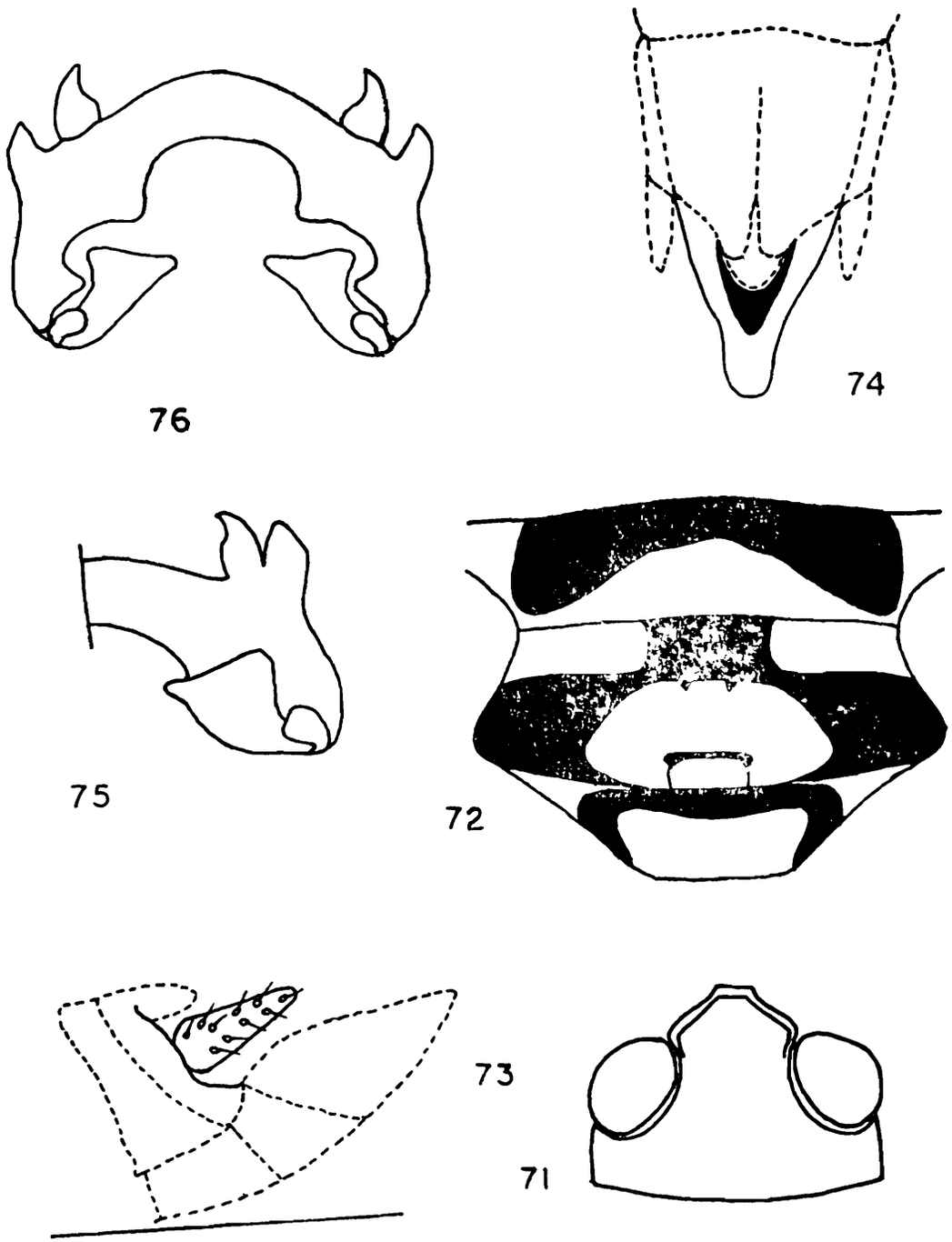
Description : Males : Medium size. Antenna filiform, much longer than head and pronotum. Head smooth ; fastigium of vertex broad posteriorly, gradually narrowed and truncate in front, moderately concave. Frontal ridge moderately sulcate, upper half almost parallel-sided, lower half diverging towards clypeus, weakly punctured ; lateral carinulae distinctly curved in middle. Pronotum laterally compressed at prozona, which is much shorter than metazona, median carina distinct, only cut by posterior sulcus ; no lateral carinae, though lateral sides of metazona clearly edged ; posterior border of metazona rectangular, with tip rounded off ; lateral lobes higher than long, space behind 3rd sulcus coarsely rugose and with rounded posterior angle. Tegmen long, narrow, basal half entirely opaque, apical half somewat subhyaline, radial veins erect, with elongate cells , intercalary vein prominent. Posterior femur stout, without denticles, slightly longer than post. tibia, latter with 9 external and 11 internal spines, internal apical spurs greatly unequal, inner one much longer than outer one, both of them curved and hooked apically. Cercus conical, with apex subacute (fig. 73), subgenital plate navicular, with conical apex (fig. 74). Epiphallus as figured (75-76).

Female (Pl. V, fig. 238) : Very similar to males but larger. Frontal ridge comparatively more narrowed and angular at fastigial end (Fig. 70). Fastigium of vertex with more sharp carinae (fig. 71). Supra-anal plate tongue-shaped, with a median wide depression ; subgenital plate flat, with broadly rounded posterior margin. Valves of ovipositor weakly curved.

Colouration : General colouration rufo-testaceous, varied with black. Antenna brown, with more than apical third black. Pronotum velvety, with darker and paler areas ; lateral lobes marked with a big black spot. Maxillary and labial palpi yellowish-white. Sternal region designed with black (fig. 72). Tegmen opaque at base, with large subhyaline spots and blotches along costal and in apical areas. Wing yellowish basad and clouded towards

outside. Posterior femur rufous, irregularly spotted and mottled with dark-black ; post. tibia slightly dark basad, remaining portion including metatarsus etc. red ; spines tipped with black. Body pilose.

Measurements : Body ♂ 19-21, ♀ 24-25 ; antenna ♂ 9.5-11, ♀ 10.5-11 ; head ♂ 2.5-2.7, ♀ 2.9-3.1 ; maximum width of head ♂ 2-2.2, ♀ 2.6-2.7 ;



Heteropternis respondens

Fig. 71. Fastigium of vertex, female, dorsal view X 11.
Fig. 72. Meso- and metasternal lobes, female X 11.
Fig. 73. Cercus, male, lateral view X 11.
Fig. 74. Sub-genital plate, male, ventral view X 11.
Fig. 75. Epiphallus, right half, dorsal view X 25
Fig. 76. ibid., entire, view X 25.

maximum width of face ♂ 2.5-2.7, ♀ 3.2-3.3 ; minimum width of interocular distance ♂ 1-1.2, ♀ 1.3-1.4 ; width of frontal ridge at median ocellus ♂ .5-.6, ♀ .7 ; pronotum ♂ 4-4.1, ♀ 5 ; prozona ♂ 1.4-1.5, ♀ 1.7-1.8 ; metazona ♂ 2.3-2.6 ; ♀ 3.2-3.3 ; maximum width pronotum ♂ 3-3.2, ♀ 4.1-4.2 ; minimum width of pronotum ♂ 2.5-2.6, ♀ 3-3.2 ; tegmen ♂ 17-19.5, ♀ 24-24.5 ; maximum width of tegmen ♂ 3-3.8, ♀ 4.2-4.3 ; post. femur ♂ 10.5-12, ♀ 13-14 ; maximum depth of post. femur ♂ 2.8-3.1, ♀ 4.2-4.5 ; post. tibia ♂ 8-9, ♀ 10.2-11.

Diagnostic features : This is the only one valid species of the genus represented in Indian fauna. Its nongranulated head and pronotum, and red post. tibia with unequal internal spurs at once distinguish it from the species of the genus *Dittopternis* Saussure to which it bears close resemblance.

Remarks : It is a common species of the subfamily in India, found in tropical, moist grassy habitat.

Genus (10) **Oedaleus** Fieber

1853. *Oedaleus* Fieber, *Lotos*, **3** : 126 ; Ritchie, 1981. *Bull. Br. Mus. nat. Hist.* (*Ent.*), **42** (3) : 86.

Small to medium size. Antenna mainly filiform, as long as or longer than head and pronotum. Fastigium of vertex flat or slightly concave, apex truncate, with obtuse lateral carinulae, variable in emphasis, with or without median longitudinal carinula. Frontal rideg sulcate with marginal carinulae diverging ventrally. Pronotum from high tectiform to saddle-shaped, constricted anterior to and at junction of prozona and metazona ; median carina linear, crossed by only posterior sulcus ; posterior margin of metazona usually rounded to rectangular. Tegmina and wings usually fully develope ; intercalary vein of medial area well developed and serrate, at least in males, continuing to distal apex of medial area. Exterior ventral 'knee' lobe of post. femur acutely rounded. Male supra-anal plate shield-shaped, rounded triangular ; male cercus conical, subacute ; epiphallus bridge-shaped with well developed ancorae and large, bilobate lophi. Female ovipositor short, moderately curved.

Pronotum with variable dorsal light markings in form of an X, which is always with anterior and posterior arms separate, posterior arms straight, not converging.

Distribution : Cosmopolitan but largely in Africa.

3 species occur in India.

13. **Oedaleus abruptus** (Thunberg)

(Fig. 77, Plate V, figs. 239-240)

1815. *Gryllus abruptus* Thunberg, *Mem. Acad. Sci. St.—Petersb.* **5** : 233.

1873. *Pachytylus* (*Oedaleus*) *abruptus* : Stal, *Recens Orth.*, **1** : 127.

1834. *Oedaleus* (*Oedaleus*) *abruptus* : Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) : 110, 117.

Distribution : Bangladesh ; Burma ; China ; E. Nepal ; India (West Bengal) ; Pakistan ; Sri Lanka and Thailand.

Material : 3 ♂, 8 ♀ ; Panitanki Darjeeling ; 17.6.79 ; *P. Halder* coll. 2 ♀ ; F. R. H. Campus, Naxalbari, Darjeeling ; 18.6.79 ; *P. Halder* coll. 1 ♀ ; Tukriajhar, Darjeeling ; 18.6.79 ; *P. Halder* coll. 1 ♂, 1 ♀ ; Lish forest, Darjeeling ; 13.3.74 ; *H. K. Bhowmik* coll. 1 ♂ ; Bhutanghat, Jalpaiguri ; 5.9.75 ; *H. K. Bhowmik* coll. 1 ♂, 1 ♀ ; Suklapara, Jalapiguri ; 30.8.75 ; *H. K. Bhowmik* coll. 1 ♀ ; Falakata, Cooch Behar ; 14.9.75 ; *H. K. Bhowmik* coll. 2 ♀ ; Sahapur, Maldah ; 17-18.9.75 ; *H. K. Bhowmik* coll. 2 ♂, 5 ♀ ; Arsha, Purulia ; 11-12.9.81 ; *H. K. Bhowmik* coll. 2 ♂, 2 ♀ ; Mukutmonipur, Bankura ; 21.9.81 ; *H. K. Bhowmik* coll.

Description : Males (Pl. V, fig. 239) : Usually small species. Integument finely rugulose and pitted. Antenna about one and one-third times as long as head and pronotum together. Fastigium of vertex longer than wide, concave, narrowing to two-fifths of maximum width anteriorly, with distinct lateral carinulae and with a weak median carinula continued behind over vertex ; frons in profile slightly convex ; frontal ridge constricted just below median ocellus, becoming obsolescent ventrally. Pronotum low tectiform ; median carina low arcuate, not intersected by posterior sulcus ; hind margin rounded obtusangular, metazona longer than prozona. Tegmen surpassing folded posterior knees by about one-third of posterior femoral length, with numerous long fine hairs on subcostal and radial veins, intercalary vein continues along posterior medium and of cubitus vein up to end of post. cubital vein. Mesosternal lobe very short, much wider than long, interspace wider ; metasternal area short and separated by an elliptical furcal structure (fig. 77). Posterior tibia with 13 inner and 12 outer spines ; inner apical spurs one and four-fifths as long as outer ; apical tarsal segment twice of claw length ; arolium three-fifths length of claw ; outer surface of ventral inner apical spur with row of conical sensilla, more marked than in other species. Cercus four-fifths times as long as its basal width. Epiphallus rectangular with narrow bridge ; inner lobes of lophi two and a half times as wide as outer lobes ; outer lobes outwardly protruding, pointed ; anterior projections rounded acutangular ; posterior projections acutangular.

Females (Pl. V, fig. 240) : Very similar to males except slightly larger in size. Valves of ovipositor moderately curved ; lower valves more strongly curved.

Colouration : General colouration variable : fresh specimens green in appearance. Preserved specimen brown, with light brown or green markings on vertex, frons, genae, pronotum and dorsal surface of folded tegmina and posterior femora. Tegmen infuscate in basal half with three or four pale transverse bands, variable in emphasis, extending from costal margin to first radial vein or as far as first cubitus ; first and second bands dividing basal half of wing equally into three parts, band three situated distal to junction of Culb, band four situated about two-thirds along from base, frequently obsolete ; apical third of tegmen clear with variable brown blotches. Posterior wing fascia widely interrupted between first radial and second anal veins, reaching or almost reaching hind margin, basal area pale yellow. Posterior femora with two indistinct dark transverse bands on external upper marginal and medial areas, sometimes obsolete ; internal surface mottled ; ventral surface straw-coloured ; posterior knees dark brown ; post. tibiae straw-coloured with dark basal ring and thicker subbasal pale ring, spines black-tipped.

Measurements : Body ♂ 12.5-17, ♀ 18.5-21.5 ; antenna ♂ 8-9, ♀ 8-10 ; head ♂ 2-2.6, ♀ 2.7-3 ; maximum width of head ♂ 1.4-1.8, ♀ 2-2.3 ; maximum width of face ♂ 1.8-2.3, ♀ 2.8-3 ; minimum width of interocular distance ♂ .6-.9, ♀ 1-1.2 ; pronotum ♂ 2.9-3.3, ♀ 3.8-4.2 ; prozona ♂ 1.3-1.5, ♀ 1.5-1.8 ; metazona ♂ 1.5-1.9, ♀ 2.2-2.5 ; maximum width of pronotum ♂ 2.4-3, ♀ 3.2-3.6 ; minimum width of pronotum ♂ 1.4-1.8, ♀ 2.2-2.5 ; tegmen ♂ 14-16.5, ♂ 20-22 ; maximum width of tegmen ♂ 2.8-3.2, ♀ 3.2-3.8 ; post. femur ♂ 9-11, ♀ 11.8-13 ; maximum depth of post. femur ♂ 1.8-2.5, ♀ 3-3.4 ; post. tibia ♂ 7.5-9, ♀ 10-11.

Diagnostic features : This species is distinguished from all other species of the genus by the shape of its wing band, the anterior termination of which is flattened and just surpassing 2nd anal vein, and posterior two thirds of which being parallel to posterior margin of wing. This character again brings it close to *O. australis* Saussure. But the distribution pattern of the latter is quite far apart (i. e. SE New Guinea, Australia and Tasmania) and so, at the present stage of out knowledge, there is no chance of overlapping.

Remarks : The species is distributed in North-west and North India, Madhya pradesh, Tamil Nadu and Eastern India. Recently I have collected a good lot from Andhra Pradesh and Orissa. In West Bengal as well as North-east Andhra Pradesh I found it an abundant species, available in open-grass-fields. In Calcutta, it is caught at light. Ritchie (1981) has revised the genus and the species in detail.

Genus (11) **Gastrimargus** Saussure

1884. *Gastrimargus* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, 28 (9) : 109.

Type-species : *Gryllus virescens* Thunberg, 1815.

Medium size. Antenna filiform, a little shorter or slightly longer than head and pronotum taken together. Fastigium of vertex concave, flat or convex ; raised marginal carinulae distinct or indistinct, medial carinula present or absent ; fastigium narrowing to about half maximum width anteriorly. Frontal ridge with variable sulcation, smooth, sometimes widening at median ocellus. Pronotum low to high tectiform with median carina from weakly to high blade-like, sometimes without intersection by posterior sulcus ; posterior margin of metazona rectangular to acutangular. Tegmina and wings fully developed or slightly abbreviated, usually of variable length ; intercalary vein usually well developed and serrate, at least, in males. Inner apical spurs about 1.5 times longer than outer spurs. Male supra-anal plate shield-shaped, rounded triangular ; cercus subconical to finger-shaped. Pronotum with cruciform markings with anterior and posterior arms continuous ; posterior arms usually curved and with slightly convergent apices.

Distribution : Old World but chiefly in Africa.

3 species are known from India.

14. **Gastrimargus africanus africanus** (Saussure)

(Figs. 78-82, Plate V, fig. 241)

1888. *Oedaleus* (*Gastrimargus*) *marmoratus var. africanus* Saussure, *Mem. Soc. Phys. nat. Hist. Geneve*, **30** (1) : 39.

1910. *Gastrimargus africanus* : Kirby, *Syn. Cat. Orth.*, **3** : 227.

1928. *Gastrimargus africanus var. zebrata* Sjostedt, *Svenska Akad. Handl.* (3) **6** No. 1 : 41.

1928. *Gastrimargus africanus var. orientalis* Sjostedt, *Svenska Akad. Handl.* (3) **6**, No. 1 : 11, 41, tab. 8, figs. 6, 7.

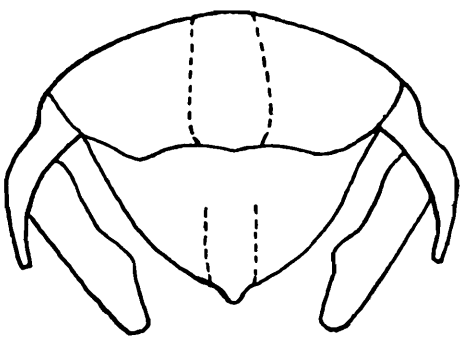
1982. *Gastrimargus africanus africanus* : Ritchie, *Bull. Br. Mus. nat. Hist.* (*Ent.*), **44** (4) : 248-250, figs.

Distribution : Africa ; Arabia ; Burma ; India ; Nepal ; Pakistan ; Srilanka ; Thailand and Tibet.

Material : 1♂, 3♀ ; Tukriajhar, Naxalbari, Darjeeling ; 18.6.1979 ; *P. Halder* coll. 1♂ ; Panitanki, Darjeeling 17.6.1979 ; *P. Halder* coll. 2♂, 1♀ ; Bhutanghat, Jalpaiguri ; 6.9.1975 ; *H. K. Bhowmik* and *P. Halder* coll.

Description : Males : Medium size. Fastigium of vertex concave, with a median carinula continuing over vertex. Frontal ridge sulcate except along median ocellus, parallel-sided, densely punctured. Pronotum moderately tectiform, weakly intersected by posterior sulcus, smooth ; prozona a little

shorter than metazona, posterior margin of metazona acutangular. Mesosternal lobes wider than long, their inner posterior angle being obliquely round. Tegmen longer, surfassing hind knee by one-third to one-half of post. femoral length. Posterior tibia with 12 external and 11 to 12 internal spines. Cercus



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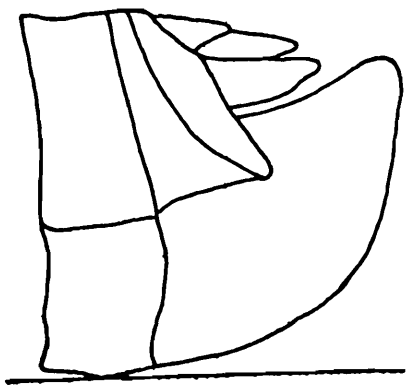

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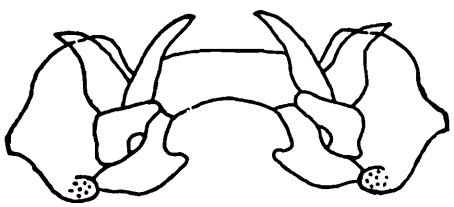

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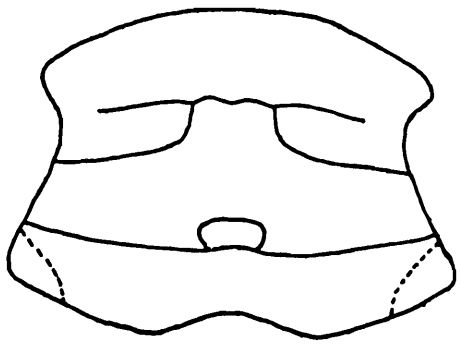

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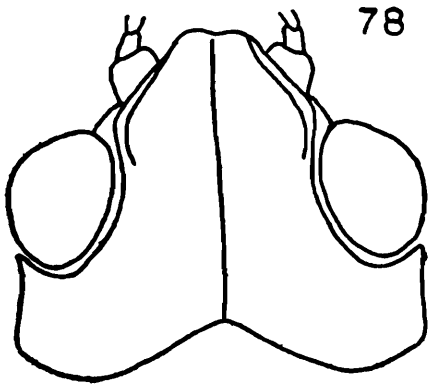

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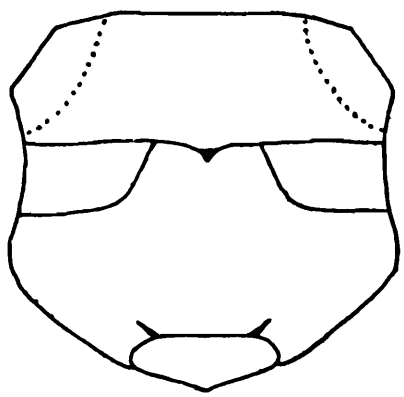


Oedaleus abruptus

Fig. 77. Meso- and metasternal lobes, male, ventral view X 11.

Gastrimargus africanus africanus

Fig. 78. Head, female, with fastigium of vertex X 11.
Fig. 79. Meso- and metasternal lobes, female, ventral view X 11.
Fig. 80. Supra-anal plate, male, dorsal view X 18.
Fig. 81. Sub-genital plate, male, lateral view X 11.
Fig. 82. Epiphallus, ventral view X 18.

conical, as long as supra-anal plate. Supra-anal plate, subgenital plate and epiphallus as shown in figures (80-82).

Females (Pl. V, fig. 241) : Larger in size and resemble males in appearence. Head and meso- and metasternal lobes as shown in figures (78-79).

Colouration : General colouration green with brownish markings. Metazona of pronotum with X-marking is usually effaced and without pale striae. Tegmen with basal pale transverse bands. Wing with complete fascia ; basal area bright yellow ; apex infumate. Posterior femur with three dark oblique transverse bands externally ; internal surface with two basal bands forming black zone in medial area, apical band separate ; intero-ventral carinula and ventral surface suffused with blue-grey or blue black. Posterior tibia basally brownish, subbasally straw, apical region reddish.

Measurements : Body ♂ 24.5-25.6, ♀ 32-38 ; antenna ♂ 12.5-13, ♀ 12.5-14 ; head ♂ 3-3·1, ♀ 3.5-4.1 ; maximum width of head ♂ 2.6-2.7, ♀ 3.4-3.8 ; maximum width of face ♂ 3.2-3.5, ♀ 4.6-5.2 ; minimum width of interocular distance ♂ 1.4-1.6, ♀ 2-2.2 ; pronotum ♂ 6-6.8, ♀ 8.3-8.8 ; prozona ♂ 3-3.2, ♀ 3.9-4.2 ; metazona ♂ 3-3.6, ♀ 4.2-4.6 ; minimum width of pronotum ♂ 3.6-3.8, ♀ 4.2-5 ; tegmen ♂ 27-28.5, ♀ 35.5-39.5 ; maximum width of tegmen ♂ 5.2-5.5, ♀ 6.5-7.8 ; post. femur ♂ 14-15.8, ♀ 19.5-22.5 ; maximum depth of post. femur ♂ 3.8-4.2, ♀ 4.8-5.6 ; post. tibia ♂ 12-13.8, ♀ 17-20.

Diagnostic features : The subspecies is distinguishable by its longer tegmina (ratio of length of tegmen to length of pronotum is 3.9 in ♂, 3.8 in ♀) and by the effaced cruciform marking on pronotum. It differentiates itself from the other abundant Indian subspecies, *G. a. sulphureus* Bei-Bienko, 1951, by its rather longer tegmina, bright yellow colouration of wings and weaker ventral process of aedeagus in lateral view.

Remarks : This subspecies is abundantly available in its distributional range and, now-a-days, in the agricultural fields.

Genus (12) **Acrotylus** Fieber

1853. *Acrotylus* Fieber, *Lotos*, **3** : 125.

Type-species : *Gryllus insubricus* Scopoli, 1786.

Rather small insects (18-25 mm), with rugose integument. Antenna filiform. Fastigium of vertex triangular, deeply concave, with high lateral carinulae ; fastigial foveolae sometimes indistinct ; frons vertical ; frontal ridge rather broadly sulcate, strongly constricted at apex and slightly divergent at posterior extremity. Pronotum short, saddle-shaped, strongly tuberculate and sculptured, more or less constricted in prozona, with well developed median and irregular tuberculates, lateral carinae sometimes absent in metazona ; 2 sulci cross median carina ; posterior margin of metazona

usually rounded. Intercalary vein of medial area well developed and strongly serrate ; membrane semi-transparent ; costa expanded near base and costal area almost equally divided longitudinally by intercalated vein ; wing hyaline, generally red or yellow basad, with a dark curved central band. Lower lobes of posterior knee rounded ; inner pair of spurs of posterior tibia longer than external ones.

Distribution : Entire Old World.

India contains 2 species.

15. **Acrotylus humbertianus** Saussure

(Figs. 83-85, Plate V, figs. 242-243)

1884. *Acrotylus humbertianus* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) : 189.

1870. *Oedipoda inficita*, var. B. Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 742.

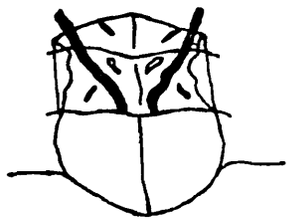
Distribution : Afganisthan ; India ; Sri Lanka.

Material : 1 ♀ ; Sevok, Darjeeling ; 22.11.1974 ; *H. K. Bhowmik* coll. 1 ♂, 2 ♀ ; Mongpong, Darjeeling ; 15.11.1974 ; *H. K. Bhowmik* coll. Also 1 ♂ ; Raimona forest, Goalpara dist., Assam ; 27.1.1973 ; *H. K. Bhowmik* coll. 1 ♂, 1 ♀ ; Ajodhya hill, Purulia ; 15.9.81 ; *H. K. Bhowmik* coll, 1 ♂ ; Anjoda, Araku, A. P. ; 6.9.83 ; *H. K. Bhowmik* coll. 1 ♂, 2 ♀ ; Bobbili, A. P.; 14-15.9.83 ; *H. K. Bhowmik* coll. 3 ♂, 5 ♀ ; Hoshiarpur, Punjab ; 3-8.10.82 ; *H. K. Bhowmik* coll.

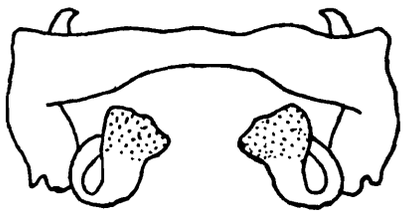
Description : Males : Small size with body pilose. Antenna filiform, longer than head and pronotum taken together. Fastigium of vertex with strong lateral carinulae ; deeply concave, reclinate with frontal ridge, latter sulcate, strongly narrowing at fastigial end and diverging from below median ocellus ; lateral carinulae curved. Vertex smooth ; eye prominent, raised above level of head, rounded, interocular distance wide. Pronotum smooth (fig. 83) ; without tubercles, constricted both laterally and dorsally at prozonal portion ; only a weak median carina visible, lateral carinae not detectable ; metazona longer than prozona, with lateral 'shoulders,' broadly rounded at posterior margin ; lateral lobes higher than its length, posterior margin straight, posterior angle broadly round, anterior angle also rounded but a little oblique. Tegmen long, surpassing posterior femur by half of femoral length. Posterior femur moderately stout, without denticles ; knee lobes rounded ; posterior tibia slightly shorter than femora, with 8 external and 11 internal spines. Supra-anal plate rounded triangular, with a well developed lateral basal fold ; subgenital plate navicular ; cercus short. conical, apex obtusely angular, incurved. Epiphallus as shown in figs. 84-85.

Females (Pl. V, figs. 242-243) : Very similar to males except larger in size. Supra-anal plate rounded triangular with a median shallow depression ;

subgenital plate almost flat, with rounded posterior margin. Valves of ovipositor moderately curved.



83



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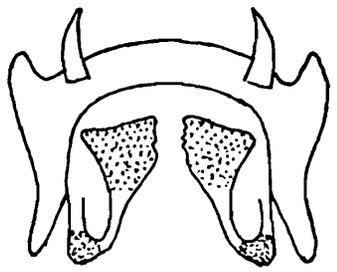

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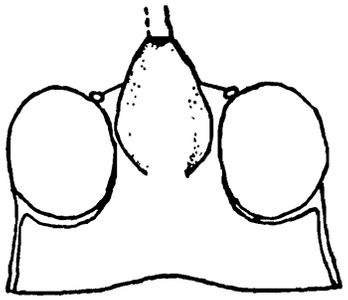

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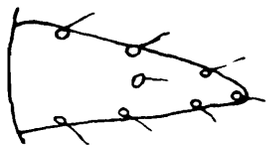

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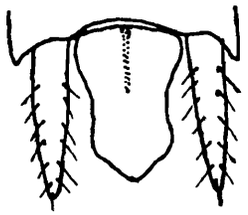

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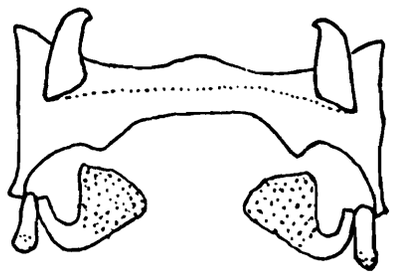


Acrotylus humbertianus, male

Fig. 83. Pronotal disc, dorsal view X 5.
Fig. 84. Epiphallus, ventral view X 28.
Fig. 85. Ibid., dorsal view X 28.

Trilophidia annulata, male

Fig. 86. Inner side of post. femur, showing colour band X 5.

Pternoscirta bimaculata, male

Fig. 87. Head, showing fastigium of vertex X 11.
Fig. 88. Cercus, lateral view X 11.
Fig. 89. Abdominal tip with supra-anal plate and cerci, dorsal view X 5.
Fig. 90. Epiphallus, ventral view X 28.

Colouration : General colour varied with brown to grey-brown ; light yellow beneath. Prozona with two fuscous fasciae. Tegmina with two oblique white fasciae ; apical portion subhyaline, radial veins somewhat tinted with fuscous, posterior intercalated space with a line of dark-brown spots. Wing yellow basad, bordered in central part, in radial area, with a slightly cresent brown band ; remaining area hyaline. Posterior femur trifasciate, ill defined one at base, 2nd one from upper external carina to inside and apical one ring-like ; posterior knee specially inside of it and base of posterior tibia and tips of ovipositai valves blackish. Base of posterior tibia adorned with a very light yellowish ring, then bluish, its apex and metatarsus light rose. External carinae of post. femur and of frontal ridge alternated with brownish and yellowish spots.

Measurements : Body ♂ 13.5-14, ♀ 20-21 ; antenna ♂ 5-5.6, ♀ 7-8 ; pronotum ♂ 2.25-2.5 ; ♀ 3.25-3.5 ; tegmen ♂ 18-19, ♀ 22-23 ; post. femur ♂ 8-8.5, ♀ 10-11 ; depth of post. femur ♂ 2-2.25, ♀ 2.25-2.5 ; post. tibia ♂ 7-7.5, ♀ 9.5-10.

Diagnostic features : This species is distinguishable by the basal colouration (yellow) of its wings and its spotless costal margin, whereas in the other Indian species, *A. inficita*, it is rose-red and costal margin and apex of wings with brown spots. Besides, the length of the posterior femur and of post. tibia, which is subequal, differentiates it from the other species (vs. post. tibia much shorter than post. femur).

Remarks : The species is found, more or less, throughout India, though the taxonomic account of the species is yet inadequately known. It is, however, abundantly found in Hoshiarpur (Punjab) during September, in sand-dune habitat, in close association with *Pusana laevia* Uvarov (Bhowmik and Rui, 1982 (1964).

16. **Acrotylus insubricus inficita** (Walker)

1870. *Oedipoda inficita* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 742.

1888. *Acrotylus patruelis* var. *inficita* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **30** (1) : 68.

1914. ***Acrotylus inficita*** : Kirby, *Fauna British India*, Vol. 1 : 152.

1933. ***Acrotylus insubricus inficitus*** : Uvarov, *Proc. zool. Soc. London* 1933 : 267.

Distribution : Afganistan ; Africa ; Central Asia ; India (North Bengal) ; Sri Lanka and USSR.

Description : Females : The species chiefly differs from the preceeding species by it colouration.

General colouration brown ; testaceous beneath. Antenna blackish apically. On each side of median carina of pronotum, there is a black subquadrate patch, bordered with testaceous. Abdomen testaceous. Two black patches on inner side of posterior femur ; posterior knee black ; posterior tibia much shorter than femur, yellow, with black tipped spines. Basal half of tegmen light brown, with a broad costal stripe and a middle stripe of darker brownish spots and dots ; there is a triangular testaceous spot in front margin about one-third from base. Wing bright reddish-rose basad, with a rather broad, lunate brown spot on disc and a few small brown spots along costal margin and two at apex.

Measurements : Body 23 ; tegmen 22.

Diagnostic features : The species, *A. inficita*, differs from *A. humbertianus* Sauss. by the features referred to in the diagnostic features discussed for the latter species.

Remarks : The species, *A. inficita*, has a number of subspecies in African fauna. The present subspecies is only recorded from India proper. But it seems to be a very rare subspecies. Zoological Survey of India has only 2 examples in spirit (from Chilka) which are much decoloured and have not been taken cognisance in its description as colouration, specially of wing, is the main distinguishing feature.

Genus (13) **Meristopteryx** Saussure

1888. *Meristopteryx* Saussure, *Mem. Soc. Phys. Hist. nat., Geneve*, **30** (1) : 20, 52.

Type species : *Oedipoda rotundata* Walker, 1870.

Size small. Antenna filiform, rather thickened in middle and pointed at tip. Eye rounded, large, and prominent ; within each eye a carina runs from vertex, nearly straight, but rather irregular below, and curving a little outwards end of clypeus ; on vertex two other carinae curve inwards to form scutellum of vertex, and sulcation of frontal ridge, which is divided by a transverse carina in its narrowest part above antennae ; occiput rugose. Pronotum strongly crested, with three sulci very strongly marked, first and last intersecting median carina ; lateral carinae slightly marked ; hind border obtusely rounded ; deflexed lobes nearly square, but hinder angle rounded off. Tegmen narrow at base, much widened before extremity, with costa arched ; costal area very broad, with several intercalated nervures ; wing short and broadly subhyaline, with clouded border, widely meshed on front half, very closely on hinder half. Hind femora moderately stout, somewhat constricted before extremity.

Distribution : India. A monotypic genus.

17. **Meristopteryx rotundata** Walker

1870. *Odipoda rotundata* Walker, *Cat. Derm. Salt. Br. Mus.* **4** : 743.

1888. *Mecistopteryx rotundata* Saussure, *Mem. Soc. Phys. Hist. nat., Geneve*, **30** (1) : 53, pl. ii, fig. 3.

Distribution : 'North Bengal.'

Description : Male : Head and pronotum brown, antennae reddish, paler towards base beneath, abdomen blackish. Tegmina light brown for two-thirds of their length, with whitish sub-hyaline marks ; a streak below median nervure near base ; a large blotch extending nearly across wing from costa and an irregular band beyond, spreading out half-way to base above submedian nervure, and below it along inner margin nearly to base ; outer third of tegmina subhyaline, indistinctly clouded, and with some darker spots along costa. Wing bluish hyaline, with border clouded, upper half almost as widely meshed as in American Tryxaline genus *Hyalopteryx*, and hinder half very closely reticulated with pale nervures, almost as in the Neuropterous genus *Neurothemis*. Hind femora yellowish, inner and lower surface black, with three yellowish bands, first incomplete above, before extremity ; knees wholly black above ; hind tibiae black, with a white streak towards base, and two broad white bands, eight rather irregular black spines on each side ; and tarsi whitish.

Measurements : Length 15 ; post. femur 9 ; expanse of tegmen 32.

Diagnostic features : This species of the monotypical genus is a unique Indian species, having a short, dilated male tegmen, with its apical third curving backwards. But unfortunately the species is never recorded again since its publication. The species is only represented by a unique male holotype, deposited in *Br. Mus. (Nat. Hist.)*. The above description is after Kirby (1914).

Genus (14) **Trilophidia** Stal

1873. *Trilophidia* Stal, *Recens. Orth.*, 1 : 117, 131 ; Hollis, 1965. *Trans. R. ent. Soc., Lond.*, **117** (8) : 245-262.

Type-species : *Oedipoda cristella* Stal, 1860.

Small size (12-22), with integument strongly rugose, tuberculate and pubescent. Antenna filiform on basal two-thirds, slighted inflated on apical third. Head subconical ; fastigium of vertex angular, apex truncate, concave, with sinuous lateral carinae ; foveolae present ; frons slightly oblique ; frontal ridge sulcate, with obtuse, almost parallel lateral carinulae. Pronotum tectiform, slighily constricted in prozona, strongly tuberculate ; median carina in prozona forming two tooth-like projections ; lateral carinae irregular, forming small tooth-like lateral tubercles in front of deeply incised anterior

sulci, strongly divergent and somewhat weak in metazona ; posterior sulcus cuts median carina before its middle ; metazona slightly inflated, with posterior margin being rectangular and apex obtuse. Tegmina and wings perfectly developed ; tegmen with strong intercalary vein, slightly sinuous, finely serrate ; membrane parchment-like ; wing long, with basal disc often coloured. Posterior femora with inner side banded. Epiphallus with narrow bridge, ancorae small and articulated, lophi weakly bilobate.

Distribution : Ethiopian and Oriental regions.

1 widely distributed species occurs in India.

18. **Trilophidia annulata** (Thunberg)

(Fig. 86, Plate VI, fig. 244)

1815. *Gryllus annulatus* Thunberg, *Mem. Acad. Sci. St.- Petersb.*, **5** : 234.

1815. *Gryllus bidens* Thunberg, *Mem. Acad. Sci. St.- Petersb.*, **5** : 235.

1882. *Acriditum* (*Oedipoda*) *vulneratum* de Haan, *Bijd. Temminck* : 163, taf. 21, fig. 13 : (Stal, 1873. *Recens. Orth.*, **1** : 132).

1860. *Oedipoda cristella* Stal, *Eugenie's Resa, Orth.*, **3** : 344.

1870. *Epacromia aspera* Walkea, *Cat. Derm. Salt. Br. Mus.*, **4** : 775.

1870. *Epacromia turpis* Walker, ibid., **4** : 775.

1870. *Epacromia nigricans* Walker, ibid., **4** : 776.

1884. *Trilophidia annulata* var. ceylonica Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) : 158.

1888. *Trilophidia annulata* var. *japonica*, Saussure, ibid., **30** (1) : 54.

1888. *Trilophidia annulata* var. *mongolica* Saussure, ibid., **30** (1) : 54.

1965. *Trilophidia annulata* : Hollis, *Trans. R. ent. Soc. Lond.*, **117** (8) : 251-253, figs. 2-8, 12-17-19, 26.

Distribution : China ; India ; Japan ; Korea ; Mongolia ; North Bornea ; Pakistan.

Material : 5♂, 7♀ ; Bamanpokri, Darjeeling ; 21-22.8.75 ; *H. K. Bhowmik* coll. 2♂, 3♀ ; Tukriajhar, Darjeeling ; 18.6.79 ; *P. Halder* coll. 1♀ ; Bhimrajgoth, Darjeeling ; 20.6.79 ; *P. Halder* coll. 2♂ ; Bijoynagar Tea Estate, Darjeeling ; 19.6.79 ; *P. Halder* coll. 1♀ ; Mirik, Darjeeling ; 17.9.74 ; *H. K. Bhowmik* coll. 2♂, 1♀ ; Mohar Tea Estate, Sukna, Darjeeling ; 16.11.74 ; *H. K. Bhowmik* coll. 1♂ ; Sevok, Darjeeling ; 22.11.74 ; *H. K. Bhowmik* coll. 3♂ ; Mongpong, Darjeeling ; 17.3.74 ; *H. K. Bhowmik* coll. 1♂, 2♀ ; Chunabati, Darjeeling ; 9.3.1974 ; *H. K. Bhowmik* coll. 2♀ ; Samsing, Murti Rivulet, Darjeeling ; 6.3.74 ; *H. K. Bhowmik* coll. 1♂, 2♀ ; Nilpara, Jalpaiguri ; 28.9.75 ; *H. K. Bhowmik* coll. 2♂, 2♀ ; Rydak forest, Jalpaiguri ; 10.9.75 ; *H. K. Bhowmik* coll.

Description : Males (Pl. VI, fig. 244) : Antenna 19-21 segmented, of variable shape, sometimes apex with inflated segments. Fastigium of vertex elongate- trapezoid, lateral carinae high, wavy ; foveola irregularly oval, wide, deep ; vertex behind eyes with a pair of tubercles. Frontal ridge sulcate, slightly widening between antennae. Pronotum with well marked crest ; median carina of pronotum strongly raised in prozona, forming two tooth like projections ; three lateral projections (dentates) on each side of median projections which decrease in size posteriorly ; lateral lobes also with scattered small tubercles. Tegmen long, surpassing tip of abdomen. Posterior femur stout. Epiphallus with large articulated ancorae and large bilobed lophi, posterior lobe strongly bent up at right angles.

Females : Very similar to males except larger in size. Apex of subgenital plate obtuse-angular.

Colouration : General colouration brown to dark grey, with blackish spots. Antennae often ringed with light and dark brown. Tegmina with 2 to 3 darker bands. Wing yellow-green, yellow or hyaline basad ; brownish apicad. Inner side of post. femur characterized by having one long and wide black band, with posterior projection at basal two-thirds ; rarely, there are two separate bands, posterior one being smaller (fig. 86). Posterior tibia black with two wide ochraceous rings ; spines tipped with black.

Measurements : Body ♂ 12.5-15.5, ♀ 16-22 ; antenna ♂ 6-7, ♀ 6.5-7.5 ; head ♂ 2-2.2, ♀ 2.3-3 ; maximum width of head ♂ 1.6-1.8, ♀ 2-2.5 ; minimum width of interocular distance ♂ .7-.8, ♀ 1-1.2 ; pronotum ♂ 3-3.6, ♀ 3.7-4.5 ; prozona ♂ 1.2-1.4, ♀ 1.6-2 ; metazona ♂ 1.7-2, ♀ 2.1-2.6 ; maximum width of pronotum ♂ 2.3-2.6, ♀ 3.1-3.3 ; minimum width of pronotum ♂ 2-2.1, ♀ 2-2.4 ; tegmen ♂ 15-17, ♀ 17-21.5 ; maximum width of tegmen ♂ 2.6-3.2 ; post. femur ♂ 7.5-8.2, ♀ 8.5-11.5 ; maximum depth of post. femur ♂ 2.5-3.2, ♀ 3.2-3.8 ; post. tibia ♂ 6.2-6.5, ♀ 7.5-8.8.

Diagnostic features : In India the genus is represented by this species only. So its geographical isolation along with the colouration of inner surface of posterior femur and unique form of the lophi of the epiphallus easily identify the species.

Remarks : The species is one the commonest grasshoppers found in India in bare grassy fields throughout the year.

It is variable in size (specimens from lower Bengal being smaller than North Bengal) and general colouration. Wing colouration of specimens from western part of its range more prominent yellowish than central ones (yellowish-green), whereas the specimens from eastern region having almost hyaline base of wings.

The species is unique in Indian fauna in possessing the dentates and projections on pronotum and on median carinae respectively.

Genus (15) **Chloebora** Saussure

1884. *Chloebora* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) : 54, 132.

Type-species : *Chloebora grossa* Saussure, 1884.

Body stout. Antennae filiform, moderately thick, as long as head and pronotum together in female, and rather longer in male. Vertex sloping into clypeus, with scarcely an indication of division ; frontal ridge not expanded between antennae ; face quadricarinate, central pair commencing on inner side of upper surface of eyes, curving inwards within antennae, and then running downwards, but not quite extending to end of clypeus ; outer carinae running from eyes opposite antennae, and curving forwards and then backwards to outer lower corner of clypeus. Pronotum with a strongly-raised median carina, not divided by slightly indicated sulci, with hinder extremity subtriangular and obtusely truncate at end ; lateral lobes higher than long, with front and hind borders nearly parallel and lower margin convex. Tegmen long, nearly parallel-sided, slightly expanded on costa near base, opaque and very thickly reticulated to beyond middle, distal portion somewhat irregular and densely reticulate. Wing ample, rather shorter than tegmina, opaque at base and hyaline on margin. Posterior femur thick, moderately long, very slightly serrulate on upper carinae ; posterior tibiae spinose, pubescent. Mesosternal lobes separated by a wide oval space between narrow curved foveolae at extremity of mesosternum.

Distribution : Africa and India Africa and India.

3 species are known from India.

19. **Chloebora grossa** Saussure

1884. *Chloebora grossa* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) : 132 (♀).

1884. *Chloebora bramina* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) 132, (♂).

1932. *Scintharista punjabi* Willemse, *Natuurh Maandbl.* V. **21** : 105, fig. 2 (♀).

Distribution : India : Punjab (Dhar) ; H. P. (Simla) ; U. P. (Dehra Dun-Kalsi) ; W. Bengal (Phoolseing, Darjeeling) ; N. W. Province (Pakistan).

Description : Males : Thick, rufo-testaceous, dotted with black. Head with front rather angulate, facial ridge sulcate at ocellus and punctate at vertex ; scutellum of vertex truncate in front and shortly carinate behind ; tempora trigonal. Pronotum punctate and slightly granulated, crest compressed, nearly straight, rectangularly produced behind. Tegmen brown, with two narrow pale fasciae, basal half coriaceous beyond middle, with irregular polygonal reticulations, apical half spotted or tessellated with grey. Wing sulphur-yellow, with a rather broad transverse brown band, extending to crenate hind margin ; tip brown. Hind tibia red, with a pale ring at the base. (after Saussure (op. cit.).

Females : Yellowish grey ; head large, rather smooth, especially at sides, which are ashy ; face vertical, slightly arched ; vertex broad between eyes, carinulate at base of its scutellum, which is smooth, broad, rather short, and broadly truncate in front ; frontal ridge punctate, rugulose, subparallel-sided, and slightly narrowed by vertex ; tempora trigonal and lanceolate. Pronotum above indistinctly tuberculate in front and middle of central area, obtusely angulated anteriorly, behind bluntly rectangular ; median crest continuous, subarcuate (seen laterally), tectiform in front area, very slightly intersected by principal sulcus ; lateral lobes between sulci smooth, weakly punctured, but elsewhere thickly ; lower margin arched, front margin oblique or slightly sinuated. Tegmen extending as far as middle tibiae, coriaceous and mottled with black towards base, with apical third hyaline and reticulated ; cubital area much broader than medial area, with an incomplete arched intercalated vein. Wing yellow at base, hyaline beyond, with a narrow brown marginal border. Posterior legs long ; post. femur obsoletely banded with brown, carinae dotted with black, lower margin arched, upper very finely serrulate and basal half dilated ; posterior tibia red, with a pale ring at base ; arolia small, membranous ; posterior tibia with 10 spines in outer row- 5 large and 5 rudimentary (after Willemse (op. cit).

Measurements : body ♂ 23, ♀ 42 ; tegmen ♂ 25, ♀ 38 ; post. femur ♀ 20.5-24.

Diagnostic features : The species exhibits strong sexual dimorphism. The females are much larger and more robust than the males and have beautiful basally violaceous wings with a relatively narrow fascia not, or scarcely, touching the outer margin, while the males are small, slender, with the wings basally light primrose-yellow, bearing a wide fascia touching the margin ; the apex of wing is hyaline in female and infumate in male.

Remarks : Among Indian genera the present genus bears close resemblance to that of *Scintharista* Saussure, 1884. In both the genera, the frontal ridge is parallel-sided (not expanded between antennae). However, the former can be differentiated from the latter (*Scintharista*) by its robust habitus and somewhat irregular and dense reticulation of distal portion of tegmina (vs. less stout habitus, and a normal venation of tegmina in *Scintharista*).

The species is very rare and no material was available for this study. ZSI has only one specimen (damaged), without locality level.

Genus (16) **Pternoscirtus** Saussure

1884. *Pternoscirtus* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve,* 28 (9) : 52, 127.

1873. *Prionida* Stal (nec Leach), *Recens. Orth.* **1** : 116, 127.

1884. *Conipoda* Saussure, ibid., **28** (9) : 192.

Type-species : *Oedipoda saturata* Walker, 1870.

Head short, somewhat rugose ; carinulae of frontal ridge not very prominent, strongly approximating between antennae. Tegmen brown, varied with paler markings on basal half, then with a large subhyaline patch, and more or less varied with brown and subhyaline beyond, cells being arranged in oblique quadrilaterals, angulated towards each other at longitudinal veinlets ; wing often coloured at base, with no central black band ; hyaline beyond middle, with tip dusky. Legs and under surface pilose.

Distribution : The oriental region.

2 widely distributed and common species occur in India.

Key to species

Wing yellow at base ; size smaller (16-23) ; fastigium of vertex terminates in a transverse carina ...	*bimaculata* Thunberg
Wing red at base ; size rather larger (22-31) ; fastigium of vertex open at extremity ...	*cinctifemur* Walker

20. **Pternoscirta bimaculata** (Thunberg)

(Figs. 87-90, Plate VI, fig. 245)

1815. *Gryllus bimaculatus* Thunberg, *Mem. Acad. Sci. St. Petersb.* 5 : 239.

1870. *Epacromia turbata* Walker, *Cat. Derm. Salt. Br. Mus.*, 4 : 776.

1914. *Pternoscirta bimaculata* : Kirby, *Fauna British India*, Vol. 1 : 136, fig. 98, a.

Distribution : India (West Bengal : Bankura & Purulia dists.) ; Sri Lanka.

Material : 1 ♂ (and 2 nymphs) ; Mukutmanipur, Bankura ; 22.9.81. 1 ♂ ; Ajodhya Hill, Purulia ; 15.9.81 (All by *H. K. Bhowmik* coll.). (Also 1 ♂, 2 ♀ ; Araku Valley, Andhra Pradesh ; 6-7.9.83 ; *H. K. Bhowmik* coll.).

Description : Males (Pl. VI, fig. 245) : Small size. Head and pronotum slightly granulate. Antenna much longer than head and pronotum taken together ; filiform, with first six segments smaller, of equal length and breadth, remaining segments elongate, roughly 3 times longer than width. Fastigium of vertex about twice longer than width, deep, concave, with distinct lateral carinae, gradually narrowing towards but terminating in a transverse carina (Fig. 87). Frontal ridge sulcate, narrowed towards fastigial transverse carina but gradually divergent towards clypeus. Cheeks weakly granulate. Eye round, projecting, with wide interocular distance. Vertex smooth. Prozonal portion laterally compressed ; median carina strong, crossed by only posterior sulcus before middle ; metazona longer than prozona, with posterior margin rectangular, tip rounded off ; lateral lobes at prozonal area with a few scattered small granules, its posterior edge

almost straight with rounded angles which is slightly projected ; anterior angle slightly oblique. Mesosternal lobes about double width than length, its interspace very wide. Metasternal lobes contiguous. Tegmen narrow, longer than tip of post. femur, basal half opaque, apical half subhyaline, with zig-zag cells, apex obliquely rounded ; intercalary vein moderately developed. Posterior femur stout, with denticles ; knee lobes rounded ; post. tibia slightly shorter than post. femur, with 11 internal and 9 external spines ; internal spurs almost subequal, longer than external ones. Supra-anal plate rounded triangular ; subgenital plate navicular, with subacute tip (fig. 89) ; cercus short, conical, apex subacute (fig. 88). Epiphallus as shown in figure (90).

Females : Larger than males. Supra-anal plate tongue-shaped ; subgenital plate flat, posterior margin slightly rounded ; valves of ovipositor small, curved.

Female nymphs (9.5-16.5) almost unmistakably resemble the adults except their colour slightly more reddish, possess more granules on body-parts, and tegmina ; genital parts yet incomplete.

Colouration : Grey-brownish. Behind each eye a blackish-brown band runs backwards over lateral lobe up to 3rd sulcus and then a little extended laterally making a L-shaped design. Tegmen opaque at basal half, apical half for most part tinted with brown, varied with hyaline areas, with two transverse whitist bands. Wing subhyaline, base yellowish, costal beyond middle brown, marginal half clouded with brown, with anal portion dark (but does not form a regular band). Posterior femur yellowish brown, with black denticles and two brownish bands which are more patterned on inner side ; post. knee dark. Posterior tibia dark at base, followed by a light yellowish and black ring ; remaining portion blue, with black-tipped spines ; tarsus and claw light yellowish. Abdomen light yellowish with median carina designed with large black spots. Carinulae of frontal ridge, of facial carinae and carinae of post. femur marked with black spots.

Measurements : Body ♂ 16.5-16.75, ♀ 22-23 ; antenna ♂ 11.5-12, ♀ 12-12.5 ; prozona ♂ 1.5-1.75, ♀ 1.75-2 ; metazona ♂ 3-3.25, ♀ 3-3.5 ; tegmen ♂ 18.5-19, ♀ 21-22 ; wing ♂ 17-17.5, ♀ 20-21 ; post. femur ♂ 11-11.5, ♀ 11.5-12 ; post. tibia ♂ 9.25-9.5, ♀ 10-11.

Diagnostic features : The species is distinguished by having a transverse carina of fastigium of vertex and its tegmen having a row of brown spots near front margin in apical half. The highly irregular cells of tegmina and the smaller size of the species also differentiate it from its nearest relatives.

Remarks : The species was described and recorded from Sri Lanka. Only recently Bhowmik (1984) recorded it from West Bengal, India, for the first time. It must be a very rare species.

The availability of 2 nymphs, one of them is a 4th stage instar, in the middle of September, indicates that the species breeds immediately after monsoon (i.e. during August).

21. **Pternoscirta cinctifemur** (Walker)

1859. *Acridium cinctifemur* Walker, *Ann. Mag. nat. Hist.*, **4** (3) : 223.

1870. *Oedipoda saturata* Walker, *Cat. Derm. Salt. Br. Mus.* **4** : 740.

1888. *Pternoscirta saturata* : Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **30** (1) : 36.

1884. *Pternoscirta humbertiana* Saussure, ibid., **28** (9) : 127.

1914. *Pternoscirta cinctifemur* : Kirby, *Fauna British India, Orth.*, **1** : 134, fig. 97.

Distribution : E. Nepal ; India : Meghalaya (Khasi Hill) ; W. B. (Kurseong) ; Tamil Nadu (Shevaroys, Nilgiri, Lower Palni) ; Sri Lanka.

Material : No material from West Bengal was available. 1 ♀ from Dehra Dun was studied.

Description : Female : Head and pronotum granulated. Pronotum slightly produced and obtusely rounded behind, crossed by 3rd sulcus behind middle. Tegmen narrow, costa slightly expanded and with rounded tip ; transverse veins on apical part oblique, often arranged zig-zag at basal region. Posterior femur stout ; posterior tibia with 9 or 10 black spines. Valves of ovipositer short, slightly curved.

Colouration : Head and pronotum brown, mottled with pale markings ; abdomen shining black ; pronotum and abdomen with a continuous median carina. Tegmina brown with two pale spaces, one just beyond costal expansion, 2nd one, paler and just beyond middle ; basal area speckled with grey ; outer area brown, varied with subhyaline spaces, often forming short transverse lines. Wing red on basal half, then clouded hyaline, darkest towards margins, tending to become brownish towards apex, sometimes forming two irregular spots. Posterior femur buff or bluish grey outside, with black spots, banded with black above ; inner side with two pale bands before knees. Posterior tibia black, banded with yellow at base and then blue ; posterior tarsus yellow.

Measurements : Body 31 ; antenna 9 ; prozona 2.75 ; metazona 4 ; tegmen 40 ; wing 28 ; post. femur 16 ; post. tibia 14.

Diagnostic features : The species is distinguishable by the characters noted in the key.

Remarks : Though the species is rather common in India compared with the preceeding species, in West Bengal, it seems extremely rare.

Genus (17) **Sphingonotus** Fieber

1852. *Sphingonotus* Fieber, *Kelch, Orth. Oberschles* : 2.

1853. *Sphinctonotus* Fischer, *Orth. Eur.* : 52, 297.

Type-species : *Gryllus locusta coerulans* (Linnaeus, 1767).

Medium size (18-35), slender insects ; colour grey, pale heneath. Antenna filiform, usually longer than head and pronotum taked together. Fastigium of vertex reclinate, concave, with lateral and sometimes with median carinulae ; fastigial foveolae present ; frons vertical, straight ; frontal ridge shallowly sulcate. Pronotum slightly saddle-shaped, constricted in prozona, with linear median but without lateral carinae ; median carina obliterated in between sulci ; metazona longer than prozona, its posterior margin obtuse-angular, with obtuse to almost rounded apex. Tegmina and wings fully developed ; tegmen at basal third opaque, strongly serrated intercalary vein in medial area, membrane on apical half transparent or semi-transparent, densely reticulated ; wing bluish hyaline or brightly coloured, with a curved black band. Male supra-anal plate with angular and sometimes attenuate apex ; cercus slightly incurved, with obtuse or rounded apex ; epiphallus with narrow bridge, large ancorae and bilobate lophi. Lower valve of ovipositor with external, lateral projection.

Distribution : Cosmopolitan but mostly in Palaearctic region.

7 species including 1 endemic form occur in India.

22. **Sphingonotus longipennis** Saussure

(Figs. 91-96, Plate VI, fig. 246)

1884. *Sphingonotus longipennis* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) : 197, 203.

1884. *Sphingonotus indus* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **28** (9) : 204.

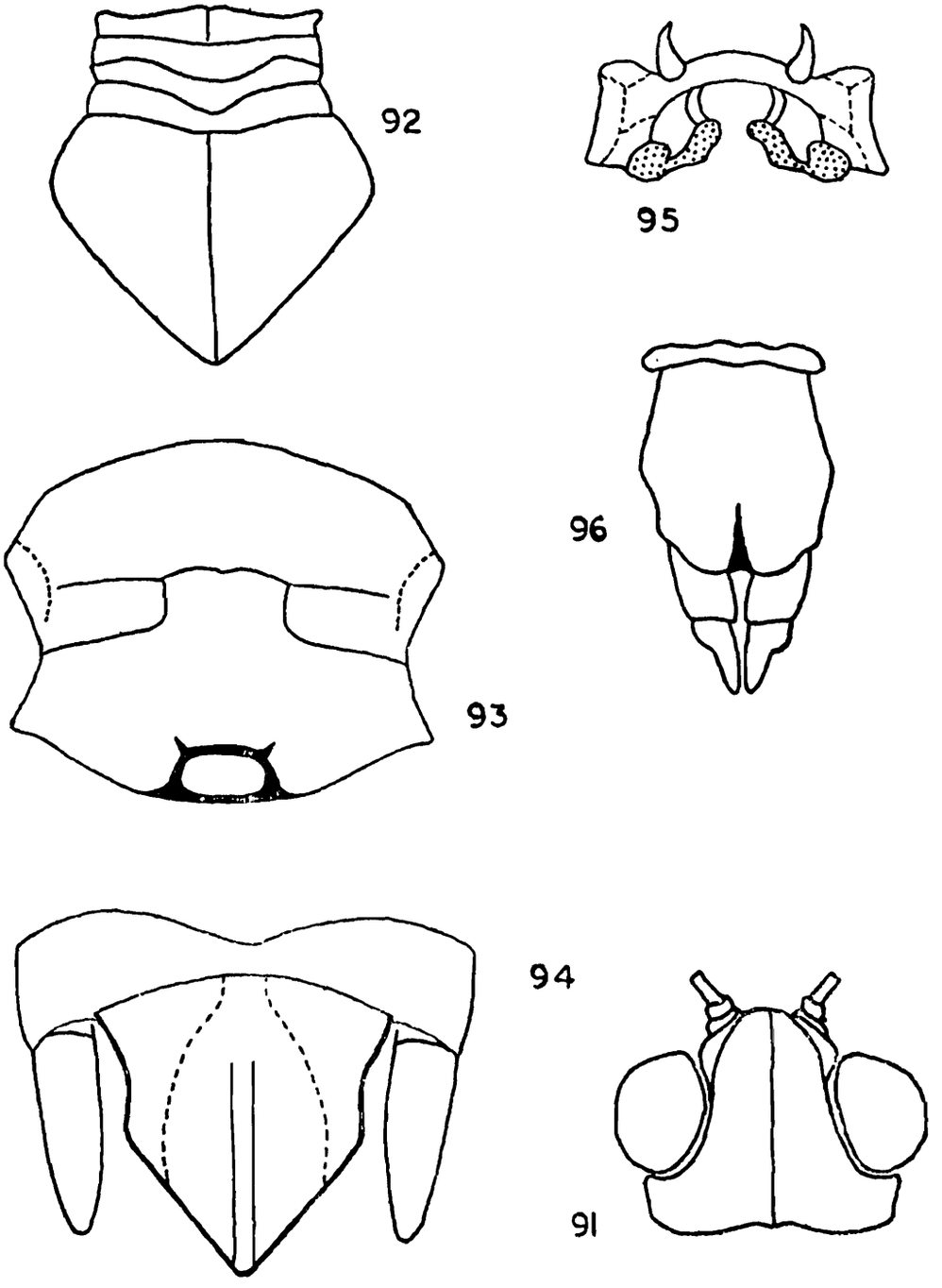
Distribution : Bangladesh ; India : West Bengal (Jalpaiguri) ; Kashmir. Nepal (Bey-Bienko, 1968).

Material : 1♂, 3♀ ; Rydak River bed, Bhutanghat, Jalpaiguri dist. ; 5.9.1975 ; *H. K. Bhowmik* and *P Halder* coll.

(Also 2♂, 2♀ ; Bhadarwar, Doda dist., Kashmir ; 21.9.1976 ; *H. K. Bhowmik* coll.)

Description : Males (Pl. VI, fig. 246) : Medium size (25-26). Head rounded (fig. 91) ; interocular distance distinctly wider than width of frontal ridge ; eye prominent, lateral and raised above level of head ; fastigium sloping with a medial longitudinal carinula, continuing behind over head ; frontal ridge almost parallel-sided but clearly divergent below median ocellus and almost effaced before clypeal end. Antenna filiform with elongated segments,

longer than head and pronotum taken together. Pronotum with a weak median carina, obsolete in between sulci ; prozonal part of pronotum compressed and constricted, roughly half of metazona, latter coarsely punctured and distinctly divergent in middle (fig. 92) and with rectangular posterior margin ; pronotal lateral lobes higher than long, with broadly rounded posterior angle, slightly oblique at anterior angle. Mesosternal interspace



Sphingonotus longipennis, male

Fig. 91. Head showing fastigium, dorsal X 11.
Fig. 92. Pronotal disc, dorsal X 11.
Fig. 93. Meso- and metasternal lobes X 11.
Fig. 94. Supra-anal plate dorsal X 11.
Fig. 95. Epiphallus, dorsal X 28.
Fig. 96. Sub-genital plate and ovipositor, female, ventral X 11.

wider than its length, and almost equal to width of one of its lobes in width ; inner posterior margin of lobes rounded (fig. 93). Metasternum wide apart from mesosternum, its lobes being separated from each other by a smaller interspace (fig. 93). Tympanum open. Supra-anal plate with subacute apex and with a median longitudinal groove (fig. 94). Cercus short, conical, with obtusely angular apex ; subgenital plate navicular, apex truncate, and with a medial longitudinal ridge at posterior part ; epiphallus as figured (fig. 95). Tegmen long, surpassing posterior femur by its equal length, obliquely rounded apically, intercalary vein moderately developed. Posterior femur stout, without denticles, as long as post. tibia, latter with 8 to 10 external and 11 internal spines.

Females : Quite similar to males except larger in size. Supra-anal plate with angular apex, with a longitudinal groove and a transverse sulcus in middle ; subgenital plate with a weak medial ridge throughout over visible part and its posterior margin divided into 2 rounded, bilobate structures (fig. 96). Posterior tibia with 8 to 11 external and 11 internal spines. Valves of ovipositors short, slightly curved (fig. 96).

Colouration : General colouration greyish-brown. Head, sides of pronotum, meso-and metasternal portions and post. femora sometimes whitish. Tegmen opaque at basal third, thickly reticulated, brownish, followed by a wide transverse pale band and an ill defined transverse, brown band ; apical half hyaline and with square, elongate and irregular cells. Wing blue basad, bordered by a broad, curved semi-lunar dark brownish fascia, gradually narrowing at anal end, from middle of costal region to anal area but not extending to hind margin ; beyond this fascia, wing hyaline. Posterior femur whitish or with varying colouration but always with an illdefined oblique blackish band before apex on both surfaces ; knee blackish. Post. tibia alternated with bluish and yellowish areas. Tips of spines and ovipositol valves dark.

Measurements : Body ♂ 25-26, ♀ 32-34 ; antenna ♂ 11-12, ♀ 13-14 ; head ♂ 3.2-3.3, ♀ 3.5-3.8 ; maximum width of head ♂ 2.5-2.6, ♀ 3-3.1 ; maximum width of face ♂ 3.3-3.5, ♀ 4-4.2 ; minimum width of interocular distance ♂ 1-1.2, ♀ 1.5-1.6 ; pronotum ♂ 5.4-5.6, ♀ 6.2-6.6 ; prozona ♂ 2-2.1, ♀ 2.1-2.2 ; metazona ♂ 3.4-3.5, ♀ 4.1-4.4 ; maximum width of pronotum ♂ 4.2-4.5, ♀ 5-5.5 ; minimum width of pronotum ♂ 3-3.2, ♀ 3.8-4.2 ; tegmen ♂ 27.5-28.5, ♀ 34-35 ; maximum width of tegmen ♂ 5-5.5, ♀ 6-6.5 ; post. femur ♂ 12.5-13, ♀ 15-16 ; maximum depth of post. femur ♂ 3.3-3.6, ♀ 4.6-4.8 ; post. tibia ♂ 10-10.5, ♀ 12-12.4.

Diagnostic features : The species is unique in having the bluish base of wings and bilobate apical margin of female subgenital plate. The shape of its fasciae on wings is also distinguishable.

Remarks : The species was previously known from Assam (Darang), Sylhet (now Bangladesh), Himachal Pradesh, Punjab, the Himalayas (Rungeet Valley (ca. 300-350 m), Darjeeling dist. and Eastern Nepal. The members of this species are always found on sunny open rocky beds of hill streams and can rightly be called as "Rocky riverbed grasshoppers".

(18) **Chondronotulus** Uvarov

1956. *Chondronotulus* Uvarov, *Ent. Mon. Mag.*, **92** : 217-218.

Type-species : *Sphingonotus bengalensis* Saussure, 1883.

Differs from *Sphingonotus* by more robusr habitus (though the size is below the average for that genus) ; very wide sternum, width of mesosternal interspace in females being more than three times its length ; very rugose pronotum, with metazona elongate and angular behind ; strongly coriaceous tegmina especially in basal parts ; and very broad posterior femur (its length not more than three times its maximum depth), with upper carina particularly expanded and suddenly depressed near apex.

In the structure of the head, with its very strongly sloping vertex, *Chondronotulus* approaches some species of *Sphingonotus* of the callous group. This resemblance is strengthened by the similarly rough sculpturing of the pronotum, but the shape of its metazona, the structure of sternum and of the post. femur, as well as the general robustness of build supply very distinctive characters that should be given generic value. As far as the general appearance goes, the relation of *Chondronotulus* to *Sphingonotus* is of the same kind as of *Tmetonota* to *Trilophidia*. Besides, the colour pattern of the wing is very distinguishable.

Distribution : India. A monotypical genus.

23. **Chondronotulus bengalensis** (Saussure)

1870. *Oedipoda balteata* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 376.

1888. *Sphingonotus bengalensis* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **30** : 77, 80.

1914. *Sphingonotus bengalensis* : Kirby, *Fauna British India, Orth.*, **1** : 154, 156.

1956. *Chondronotulus bengalensis* : Uvarov, *Ent. Mon. Mag.*, **92** : 218.

Distribution : Jabalpur (M. P.) ; North Bengal ; Poona (Maharashtra).

Description : Female : Antenna slender, somewhat longer than head and pronotum together. Head distinctly raised above pronotum and rugose. Face somewhat flattened, almost vertical, rugose and tuberculate. Frontal ridge broad, low, weakly concave ; margins distinctly raised in upper two-thirds, approximated under ocellus and obsolescent some distance from clypeus. Lateral facial keels irregular, strongly divergent below. Vertex very broad and strongly sloping ; fastigium practically vertical, rugose,

scarcely marginated ; foveolae almost on same plane with fastigium, wide, scarcely concave, rugose. Eye broadly oval ; vertical diameter subequal to subocular distance. Pronotum constricted in prozona ; anterior margin strongly crenate, with a bilobate projection in middle ; furrows deep, but made less distinct by coarse tubercles and rugosities of surface. Median carina in shape of a low and broad swelling in front of first sulcus ; absent between first and second sulci ; replaced by a pair of distinct submedian tubercles between second and third sulci ; scarcely perceptible in metazona which is practically flat and strongly rugose ; length of metazona more than double of prozona ; lateral lobe much deeper than long ; lower margin rounded and sinuate ; lower posterior angle broadly rounded ; posterior margin broadly crenate. Last sternite of abdomen shallowly triemarginate, Valves of ovipositor short and blunt ; basal part of lower valve weakly convex, slightly uneven ; its tooth obtuse, small. Tegmen distinctly narrowed in apical part. Venation dense, anastomosing, even beyond discoidal area, while basal third is strongly coriaceous, with raised veins and with some broad rounded pits. Intercalary vein thick, gently sinuate, but strongly approaching discoidal vein at apex (after Uvarov (op. cit.).

Male : Distinctly smaller than female. Head more raised above pronotum. Second branch of medial vein with two branches. Post. tibia dirty bluish.

Colouration : Colouration brown. Tegmen in basal third chocolate-brown, colour becoming more saturated distally ; rest is light-brown, with two darker postmedian fasciae and a few small spots in apical part. Wing very faintly bluish ; dark fascia in shape of a narrow triangular spot, with apex directed towards anal margin but widely distant from it, base of triangle touches first false radial vein (vena radiata spuria prima' of Saussure). Posterior femur on inside dark chocolate-brown, becoming black towards apex, with a narrow preapical light fascia ; tibia dirty-yellowish, with base black.

Measurements : Body ♂ 16, ♀ 22 ; pronotum ♂ 4, ♀ 5.5 ; tegmen ♂ 17, ♀ 23 ; post. femur ♂ 8.5, ♀ 10.5.

Diagnostic features : This unique species is the only representative of the monotypical genus—as yet an indigenous Indian genus.

Remarks : The female holotype from North Bengal which is deposited in *Br. Mus. (Nat. Hist.)*, is the only representative of this species. Uvarov (op. cit.) had also recorded two male specimens from Poona and Jabalpur and suggested that probably this species has fairly a wide distribution in Central India.

IV. Subfamily **Hemiacridinae**

Key to Genera

1. Mesosternal lobes contiguous (meeting in a straight line) ; posterior femur much shorter than abdomen ; thorax with white lateral stripe ... *Leptacris* Walker

— Mesosternal lobes more or less separated ; posterior femur not shorter than abdomen ; thorax with no lateral stripe 2

2. Tegmina with a patch of densely placed transverse veinlets between radial and medial areas ; tegmina and wings fully developed ; apex of male cercus spine-like ; size small 3

— Tegmina without patches of veinlets ; tegmina and wings chiefly shortened (though developed in some species) ; apex of male cercus usually bilobate, bifurcate or trilobate (though in some cases conical but not spine-like) ; usually large 4

3. Prosternal process spathulate ; fastigium of vertex not much produced before eyes, parabolic or obtuse-angular ; interocular distance rather wide ; pronotum distinctly tricarinate ; posterior tibia not modified for swimming ... *Spathosternum* Krauss

— Prosternal process conical ; fastigium of vertex elongate, projecting far in front of eyes ; interocular distance narrow ; pronotum not exactly tricarinate, its median carina obsolete or only represented in metazona only, lateral carinae represented by pigments only ; posterior tibia dorso-ventrally flattened on apical half for swimming ... *Gesonula* Uvarov

4. Male supra-anal plate narrower than long, with sides excurved towards apex. Male cercus of medium size, simple, slightly curved and gradually narrowing to apex, bifurcate, or bilobate ... *Hieroglyphus* Krauss

— Male supra-anal plate broader than long, with straight sides narrowing to acute angular apex or trilobate at apex, with very small middle lobe. Male cercus very large, trilobate, with very large expanded middle lobe. ... *Parahieroglyphus* Carl

Genus (19) **Gesonula** Uvarov

1878. *Gesonia* Stal, *Bih. svensk. Vet. Akad. Handl., Stockholm*, 5 (4) : 1-100.

1940. *Gesonula* Uvarov, *Ann. Mag. nat. Hist.*, 6 (11) : 174.

Type-species : *Acridium* (*Oxya*) *punctifrons* Stal, 1861.

Small (15-25), with finely rugose integument. Antenna filiform, slightly thickened towards apical portion, longer than head and pronotum taken

together. Head conical ; fastigium of vertex remarkedly produced beyond eyes, longer than wide, slightly depressed, more or less acute-pointed at apex or slightly obtusely rounded ; frontal ridge shallowly sulcate, parallel sided (a little constricted at apex, just below edge of produced fastigium). Eye large, prominent, lateral, and approximating ; interocular distance shorter than breadth of inner antennal frontal ridge. Pronotum flat, median carina obsolete or insignificantly detectable in metazona ; lateral carinae indistinct, represented by pigments only ; dorsum crossed by 3 sulci ; metazona shorter than prozona, its posterior margin truncatedly rounded. Prosternal process conical and inclined backwards. Tegmina and wings fully developed, former with close transverse veinlets between radial and medial areas. Posterior femur slender, lower "knee lobe" with an acute spine ; posterior tibia with an external spine, apical half of which dorso-ventrally flattened for swimming. Male supra-anal plate somewhat tongue-shaped, with a median, wide longitudinal groove throughout ; cerci simple, apices spine-like, incurved.

Distribution : India ; Japan and Pakistan.

Only 1 species available in India.

24. **Gesonula punctifrons** (Stal)

(Figs. 99-104, Plate VI, fig. 248)

1861. *Acridium* (*Oxya*) *punctifrons* Stal, *Zool. Ins*, **10** : 336.

1870. *Heteracris tenuis* Walker, *Cat. Derm. Salt. Br. Mus.* **4** : 647.

1870. *Oxya punctifrons* : Walker, ibid., **4** : 669.

1878. *Gesonia punctifrons* : Stal, *Bih. svensk. Vet. Akad. Handl., Stockholm*, **5** (4) ; 47.

1910. *Racilia okinawensis* Matsumara, : 3.

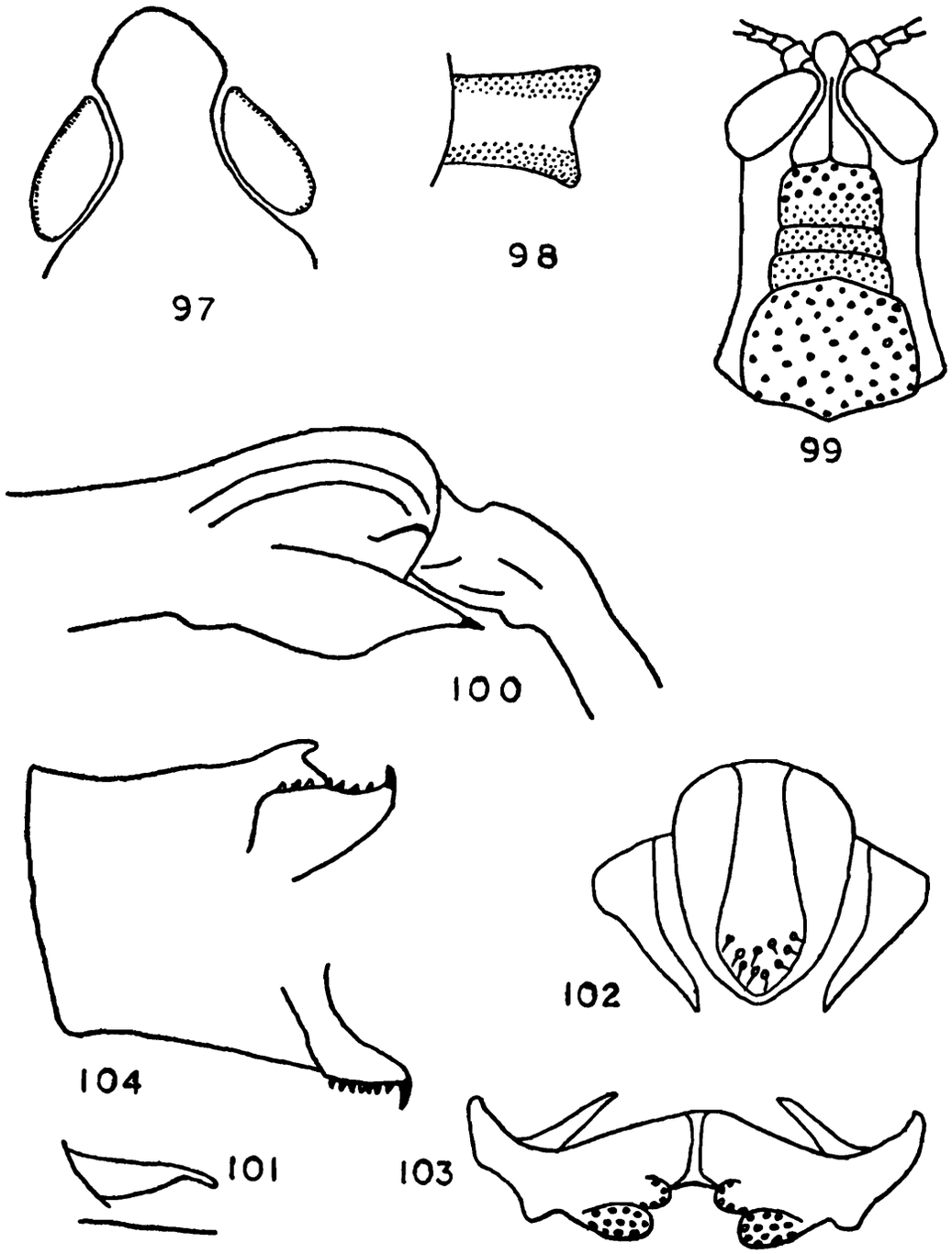
1951. *Gesonula punctifrons* : Mistschenko, : 172.

Distribution : India : West Bengal (Darjeeling ; Howrah and Hooghly) and Japan.

Material : 1♂, 1♀ ; Naxalbari F. R. H. Compound, Darjeeling ; 18.6. 1979 ; *P. Halder* coll. 1♂ ; Raimona Forest, Darjeeling ; 27.1.1973 ; *H. K. Bhowmik* coll. 1♀ ; Sunderinala, Jamduar, Darjeeling ; 2.2.1973 ; *H. K. Bhowmik* coll. 2♂, 4♀ ; Bally, Howrah ; Feb. 1978 ; *P. Halder* coll. 1♂, 2♀ ; Chandannagar, Hooghly ; 8.9.1978 ; *P Halder* coll.

Description : Males ; Body slender, subcylindrical. Fastigium of vertex produced in front of eyes, elongate-rounded, almost flat, very shallowly concave, remarkably constricted between eyes ; from junction of constriction a median carinula continues behind over middle of occiput (fig. 99) ; foveolae invisible from above. Antenna filiform, a little longer than head

and pronotum taken together. Frons angularly oblique ; frontal ridge sulcate from apex up to clypeus, carinulae slightly convergent below ; facial carinulae prominent, linear. Face coarsely rugose. Pronotum coarsely punctured ;



Spathosternum prasiniferum prasiniferum, male

Fig. 97. Head, showing fastigium of vertex X 11.
Fig. 98. Prosternal spine, dorsal view X 11.

Gesonula punctiform, male

Fig. 99. Head and pronotum, dorsal X 11.
Fig. 100. Hind femoral spine, lateral X 11.
Fig. 101. Anal cercus, lateral X 11.
Fig. 102. Supra-anal plate, dorsal X 11.
Fig. 103. Epiphallus, dorsal X 28.
Fig. 104. Valves of ovipositor X 11.

all 3 sulci prominent ; prozona longer than metazona, latter being distinctly wider. Prosternal tubercle short, conical at apex ; mesosternal interspace narrower than one of its lobes, latter with rounded internal margin ; metasternal lobes separated. Posterior femur with upper basal lobe rounded, lower lobe of hind knee distinctly spine-like (fig. 100). Posterior tibia modified for swimming ; posterior metatarsi brownish ; basal segment wide and well developed. Cercus as long as subgenital plate, apically spine-like and down curved (fig. 101). Supra-anal plate medially with a distinct groove. (fig. 102). Tegmen much longer than abdomen and posterior femora ; apex clearly round ; basal half closely reticulated. Epiphallus as figured (fig. 103).

Females (Pl. VI, fig. 248) : Fairly similar to males. Cerci shorter than those of males ; supra-anal plate with lesser sulcation ; valves of ovipositor short with margins indentated and apically hook-like (fig. 104).

Colouration : Greenish-yellow, shiny. Eyes brownish. Ocelli rufous. A wide, prominent, linear brownish band runs from each eye along superior margin of pronotal lateral lobe and continues up to end of episternum. Legs as body colour, only posterior knee brownish ; base of posterior tibia rufous. Tegmen brownish basad, subhyaline apicad ; anal area greenish-yellow as body colour. Wings hyaline.

Measurements : Body ♂ 17.5-18.8, ♀ 19.8-22.2 ; head ♂ 2.5-3, ♀ 2.9-3.1 ; maximum width of head ♂ 1.2-1.6, ♀ 1.8-2 ; pronotum ♂ 4-4.8, ♀ 4.5-5 ; maximum width of pronotum ♂ 2.9-3.5, ♀ 3-3.5 ; minimum width of prozona ♂ 2.2-2.6, ♀ 2.3-2.9 ; metazona ♂ 2-2.3, ♀ 2.5-2.9 ; tegmen ♂ 18.5-19, ♀ 19.5-21.5 ; maximum width of tegmen ♂ 2.8-3, ♀ 3.3-3.8 ; post. femur ♂ 10.5-11, ♀ 11-12 ; post. tibia ♂ 7.8-8.8 ; ♀ 8.5-9.5.

Diagnostic features : The species is unique in having the characteristic colour band of head and pronotum ; male supra-anal plate with a wide groove throughout and denticulated ovipositai valves of females.

Remarks : The species is very commonly noticed frequenting the water hyacinth, often found in the neighbourhood of canals, ditches etc. or ponds, willingly entering water and leading almost an aquatic life like the species of the genus *Oxya* Serville for which their posterior tibiae are modified.

Genus (20) **Spathosternum** Krauss

1877. *Spathosternum* Krauss, *Sber. Akad. Wiss. Wien*, **76** (1) : 44.

Type-species : *Tristria nigrotaeniata* Stal, 1876.

Small (14-22), with finely rugose or smooth integument. Antenna filiform, thick, hardly longer than head and pronotum taken together. Head conical ; fastigium of vertex parabolic or obtuse-angular ; frons strongly oblique ; frontal ridge narrow and deeply sulcate throughout. Pronotum tricarinate,

flat, crossed by 3 sulci ; metazona shorter than prozona, its posterior margin excurved. Prosternal process large, strongly compressed, antero-posteriorly spathulate, inclined backwards. Mesosternal interspace strongly constricted ; metasternal lobes contiguous. Tegmen and wing fully developed or shortened, former being narrow, rounded at apex, with close transverse parallel-sided stridulatory veinlets between radial and medial area (Pl. I, figs. 216-217). Posterior tibia with an external apical spine. Male supra-anal plate long, angular. Cercus simple, conical, sometimes slightly incurved. Subgenital plate short, subconical, with obtuse apex. Epiphallus with undivided bridge, short ancorae and lobiform lophi.

Distribution : India ; Thailand and West Africa.

3 species occur in India of which 2 are endemic.

25. **Spathosternum prasiniferum prasiniferum** (Walker)

(Figs. 97-98, Plate 1, 216-217, Plate VI, figs. 246-247)

1871. *Heteracris* (?) *prasinifera* Walker, *Cat. Derm. Salt. Br. Mus.*, **5** : 65.

1871. ? *Calopternus caliginosus* Walker, ibid., **5** : 69.

1871. *Stenobothrus strigulatus* Walker, ibid., **5** : 82.

1871. *Stenobothrus simplex* Walker, ibid., **5** : 82.

1871. *Stenobothrus rectus* Walker, ibid., **5** : 83.

1878. *Spathosternum venulosum* Stal, *Bih. svensk. Akad. Handl.* **5** (4) : 97.

1910. *Spathosternum caliginosum* : Kirby, *Syn. Cat. Orth.* **3** : 400.

1910. *Oxya prasinifera* : Kirby, ibid., **3** : 394.

1910. *Phlaeoba simplex* : Kirby, ibid., **3** : 138.

1910. *Roduina recta* : Kirby, ibid., **3** : 140.

1914. *Gymnobothrus* (?) *simplex* : Kirby, *Fauna British India, Orth.*, **1** : 114.

1914. *Spathosternum prasiniferum* : Kirby, ibid., **1** : 208, fig. 121.

1936. *Spathosternum prasiniferum prasiniferum* : Tinkham, *Lingn. Sci. Journ., Canton*, **15** : 51.

Distribution : Throughout India.

Material : 1♂ ; Mohar Tea Estate, Sukna, Darjeeling ; 16.11.1974 ; *H. K. Bhowmik* coll. 2♂, 1♀ ; Tindaria, Darjeeling, 18.11.1974 ; *H. K. Bhowmik* coll. 6♂, 2♀ ; Sevok, Darjeeling, 22, 23.11.1974 ; *H. K. Bhowmik* coll. 2♂ ; Gurubathan, Darjeeling ; 4.3.1974 ; *H. K. Bhowmik* coll. 2♂, 4♀ ; Samsingh Forest, Darjeeling, 6.3.1974 ; *H. K. Bhowmik* coll. 3♂, 2♀ ; Mongpong, Ram Dong, Darjeeling, 17.3.1974 ; *H. K. Bhowmik* coll. 2♂, 3♀ ; Chunabati, Darjeeling, 9, 10.3.1974 ; *H. K. Bhowmik* coll. 3♂, 4♀ ; Naxalbari, Darjeeling, 11, 13.9.1974, 18, 20.6.1979, *H. K. Bhowmik* and *P Halder* coll. 1♂, 2♀ ; Panitanki, Darjeeling, 17.7.1979 ; *P. Halder* and party coll. 1♀ ; Ramthi forest, Darjeeling ; 2.3.1974 ; *H. K. Bhowmik* coll. 1♂, 1♀ ;

Bamanpokri, Darjeeling ; 22.8.1975 ; *H. K. Bhowmik* coll. 2♂, (1♂ nymph) ; Mirik, Darjeeling, 17.9.1974 ; *H. K. Bhowmik* and *P. Halder* coll. 1♀ ; Rydak, Jalpaiguri ; 9.9.1975 ; *H. K. Bhowmik* coll. 1♀ ; Suklapara, Jalpaiguri ; 27.8.1975 ; *H. K. Bhowmik* coll. 11♂, 9♀ (2 nymphs) ; Botanical Garden, Howrah ; different dates ; *P. Halder* coll. 1♂, 3♀ ; Argori, Andul, Howrah ; 11.7.1978 ; *P. Halder* coll. 6♂, 5♀, (3 nymphs) ; Garia, 24-Parganas ; different dates ; *P. Halder* coll. 3♂, 2♀ ; Kamarchak, 24-Parganas, 16.8.1974 ; *P. Halder* coll. 2♂ ; Raghunathpur, 24-Parganas, 17.8.1974 ; *P Halder* coll. 1♂ ; Kankalitala, Bolpur, Birbhum ; 17.12.1981 ; S. Sen and party coll.

Description : Males (Pl. VI, fig. 246) : Head convex and level, parallel-sided. Fastigium of vertex almost parabolic, with lateral carinulae slightly raised and having a distinct median carinula which continues behind over vertex (fig. 97) ; frontal ridge narrow, depressed, parallel-sided and sulcate throughout. Antenna 21 segmented, filiform, shorter than head and pronotum taken together. Prosternal spine dorso-ventrally depressed, more so in medial portion, spathulate and concave at posterior margin (fig. 98). Pronotum tricarinate, almost parallel-sided, crossed indistinctly by usual 3 sulci ; prozona longer than metazona. Tegmen with transverse stridulatory veinlets between radial and medial areas (Pl. 1, fig. 216). Posterior tibia long, slender, hardly dilated, with 9 or 10 spines, besides, apical one. Epiphallus as for the genus.

Females (Pl. VI, fig. 247) : Very similar to males but larger. Fastigium of vertex pronouncedly convex, so that lateral and median carinulae, seen in males, obsolete. Ovipositor short, moderately robust, with valves incurved ; lower valves armed with a small tooth beyond middle.

Colouration : Variable in colouration. Rufo-testaceous or green in fresh material. A broad characteristic blackish or dark green stripe runs behind lower part of eyes and along lateral carinae of pronotum. Tegmina light brown basad and subhyaline beyond ; central area may be with a linear black streak, sometimes almost obsolete in males, sometimes well marked in females, entire, but more frequently with white transverse markings ; inner margin reddish or obscure in males, usually greenish in females. Wings hyaline, often clouded towards apices. Legs rufo-testaceous ; posterior femur somewhat greenish in females, often with a dark longitudinal band on external surface ; post. tibia sometimes green.

Measurements : Body ♂ 14-16.5, ♀ 19-22 ; antenna ♂ 3.8-4.2, ♀ 3.8-4.8 ; head ♂ 2-2.5, ♀ 2.8-3.2 ; pronotum ♂ 2.8-3, ♀ 3.4-4 ; prozona ♂ 1.5-1.6, ♀ 1.7-1.9 ; metazona ♀ 1.3-1.5, ♀ 1.7-2.1 ; maximum width of pronotum ♂ 1.6-2, ♀ 2.4-2.6 ; minimum width of pronotum ♂ 1.2-1.4, ♀ 1.8-2.1 ; tegmen ♂

11-14, ♀ 14-17 ; post. femur ♂ 8-9, ♀ 9.5-10.5 ; maximum depth of post. femur ♂ 1.8-2, ♀ 2.3-2.6 ; post. tibia ♂ 5.5-7, ♂ 7.8-9.

Diagnostic features : The subspecies is unique in having convex and levelled head and parallel-sided pronotum ; its usual greenish colouration in live and characteristic post-ocular band on head and pronotum and its central dark colour streak on tegmina are also notable. Besides, the texture of its prosternal spine and epiphallus are also distinctive in nature.

Remarks : It is a very common Indian subspecies found in all sorts of open fields. It breeds and is found in West Bengal all round the year.

Genus (21) **Leptacris** Walker

1870. *Leptacris* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** ; 676.

1902. *Capellea* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 616.

Type-species : *Leptacris filiformis* Walker, 1870.

Size large ; body very long and slender, nearly cylindrical. Fastigium of vertex rather short and broad, nearly horizontal in males, in females sloping to apex, which is obtusely rounded in front and tricarinate from eyes, behind which lateral carinae are obsolete, but median one, though not conspicuous, is continued over pronotum ; head nearly as long as pronotum ; frontal ridge oblique, sulcate, carinulae diverging downwards, and hardly reaching extremity of clypeus, coarsely punctured ; facial carinulae running from base of antennae obliquely backwards. Antennae inserted near eyes. Pronotum thickly punctured, slightly rounded in front and behind, posterior sulcus placed beyond middle ; lower border of pronotal lobes nearly straight and bordered with a silvery white band running from antennae, posterior margin slightly sloping. Front and middle legs very short, front femora thickened and punctured ; posterior legs long and slender ; posterior tibia armed with 20 or 21 spines, and with an outer apical spine. Tegmina and wings well developed, but shorter than abdomen. Prosternal spine small, slender, compressed, obtuse but not expanded at tip. Mesosternal and metasternal sutures straight in both sexes. Male with subgenital plate long, strongly compressed ; female with upper appendages pubescent, crenulated above, and lower ones with a strong tooth below basad.

Distribution : China ; India ; Pakistan ; Sri Lanka.

4 species are available in India of which 2 are endemic forms.

26. **Leptacris vittata** (Fabricius)

(Plate VII, figs. 249-250)

1787. *Truxalis vittatus* Fabricius, *Man. Ins.*, : 231.

1798. *Gryllus vittatus* : Denovan, *Epi. hist. lus. China, London* : pt. 10, fig. 2.

1838. *Truxalis (Mesops) vittatus* : Westwood, *Nat. Hist. Ins. China, London*, **23** : pt. 10, fig. 2.

1870. *Opomala convergens* Walker, *Cat. Derm. Br. Mus.*, **3** : 511.

1873. *Ischnacrida vittata* : Stal, *Recens. Orth.*, **1** : 87.

1910. *Ischnacrida convergens* : Kirby, *Syn. Cat. Orth.* **3** : 405.

1953. *Leptacris vittata* : Willemse, *Wessens, Ergehn der Sumba Exped. des. Museums fur volker. Kunde und des Naturh. Museums in Basel*, : 93.

Distribution : Previously known from China ; Indonesia ; India (North Bengal) ; Pakistan and Sri Lanka, the species is recorded here for the first time from A. P.

Material : 1 ♂ ; Foochow, China ; 1930-37 ; M. S. Yang coll. determined by Uvarov, 1939 (B. M.). 1 ♀ (nymph) ; Parvatipuram, Vizianagaram, A. P. ; 20.9.83.

Description : Male (Pl. VII, figs. 249-250) : Body slender. Antenna 24-segmented of which basal 12 segments distinctly ensiform ; then gradually narrowed and finally pointed at apex. Fastigium of vertex produced in front of eyes, horizontal, elongate, subconical at apex, lateral carinae prominent, almost parallel but end before eyes ; median one inconspicuous and continues over pronotum ; foveolae large, triangular and visible from above. Pronotum cylindrical with an indistinct linear median carina, cut by three indistinct transverse sulci ; disc densely rugose ; metazona about half length of prozona. Tegmen longer than posterior femora ; subcostal area with about sixteen oblique distinct veinlets. Prosternum smooth. Cercus very small, conical. Supra-anal plate somewhat tongue-shaped with a median prominent longitudinal groove and sinuate on each side near apex. Subgenital plate very long, slender and pointed, as long as head and pronotum.

The nymph (39 mm) at hand has the unique white bands from below eyes. Fastigium of vertex very similar to adult. Pronotal disc convex and with dense punctuations. Antenna (8 mm) 24 segmented with basal 12 segments more or less ensiform. Wing pads and genitalia ill developed.

Colouration : Colouration yellow-brownish. Pronotum above with indistinct whitish longitudinal lines. A silvery white stripe runs from behind antennae below eyes along lower border of pronotal lobes and continues up to posterior femora. Inner side of posterior femur with a short black longitudinal line at base and another black mark at base of knee. Tibial spines black. Tegmina and wings subhyaline, latter pinkish basad.

Measurements : Body 51.0 ; antenna 10.0 ; head 6.25 ; prozona 4.0 ; metazona 2.0 ; tegmen 27.0 ; post. femur 15.0 ; post. tibia 13.5 ; subgenital plate 9.0 (measured one ♂).

Diagnostic features : The species is unique in possessing wings with pinkish bases and male with subgenital plate longer than pronotum. It

differs from *L. fusca* (Karny, 1907) chiefly by its having an unspotted wings (which is stained with pink basally) and elongate fastigium of vertex ; from *L. maxima* (Karny, 1907) by its ensiform antennae (vs. filiform), elongate and subconical fastigium (vs. triangular), and smaller size (vs. 62-82) ; from *L. filiformis* Walker, 1870, by its colouration (vs. pale olivaceous red) and projected fastigium ; from *L. greeni* Kirby, 1914, by its thickly rugosed pronotum (vs. moderately rugosed), colouration of wings (vs. hyaline) and smaller size (vs. 70).

Remarks : No material was available from West Bengal. Dr. Jago has kindly sent me one male specimen from China on loan. The species must be considered to be a rare one and inadequately known from India. The availability of a nymph from A. P. is very interesting.

Genus (22) **Hieroglyphus** Krauss

1877. *Hieroglyphus* Krauss, *Sber. Akad. Wiss. Wien.* **76** : 41 ; Mason, 1973. *Bull. Br. Mus. nat. Hist.* (*Ent.*), **28** (7) : 512.

1932. *Miramia* Uvarov, *Trudy Zool. Inst. Leningr.*, **1** : 224.

Type-species : *Hieroglyphus daganensis* Krauss, 1877.

Medium to large size. Body finely rugose. Antenna filiform. Fastigium of vertex shallowly depressed in front of a bow-shaped transverse furrow, broader than long, apex obtuse angular. Frontal ridge with moderately deep or shallow sulcus, parallel-sided or widening towards base and narrowing towards apex. Pronotum cylindrical, median carina weak, linear or obliterated behind 1st sulcus or in metazona ; 3 or 4 broad or narrow sulci ; lateral carinae absent. Prosternal spine conical or bifurcate. Tegmina and wings developed or shortened. Supra-anal plate longer than its width, narrowing towards apex ; apex long, subacute ; elongate ridges present with shallow median sulcus. Cercus simple or bifurcate, subacute pointed or obtuse apex. Epiphallus large, bridge undivided. Lower valves of ovipositor with a pair of strong or weak teeth. Female subgenital plate with median lobe only or trilobate with median lobe much longer than lateral ones.

Distribution : Africa ; China ; Oriental regions ; Russia.

6 species occur in India having only 1 endemic species.

Key to species

1. Male cercus with apex simple, oblique on upper margin 2

— Male cercus with apex bifurcate, relatively slender, with upper branch of fork recurved anteriorly towards head and lower branch elongate and acute. (Lower valves of ovipositor long and slender with external lateral projection well defined and acute) ... *banian* Fabricius

2. 1st and 3rd sulci on sides of pronotum not joined by black band, or, if joined, then also with irregular stripes connecting all sulci on dorsum. Posterior margin of pronotum obtuse angular. Male cercus with elongate acute apex, straight or downcurved apicad ... *nigrorepletus* Bolivar

— 1st and 3rd sulci on sides of pronotum joined by black band, without irregular stripes connecting all sulci on dorsum. Posterior margin of pronotum rounded. Male cercus upcurved apicad (epiphallus with an extra smaller lobe facing towards centre of bridge) ... *oryzivorus* Carl

27. **Hieroglyphus banian** (Fabricius)

(Fig. 109-112)

1798. *Gryllus banian* Fabricius, *Ent. Syst. Supple.* : 194.

1839. *Acridium furcifer* Serville, *Hist. nat. Ins.*, : 677.

1922. *Hieroglyphus banian* var. *elongata* Uvarov, *Bull. ent. Res.*, **13** : 238.

1973. *Hieroglyphus banian* : Mason, *Bull. Br. Mus. nat. Hist.* (*Ent.*) **28** (7) : 540-541.

Distribution : India and other Oriental countries.

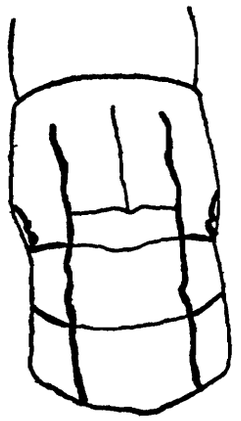
Material : 4♂, 1♀ ; Araku Valley, Andhra Pradesh ; Sept. 1983 ; *H. K. Bhowmik* coll. 11♂, 10♀ ; Mandi, Himachal Pradesh ; 18.9.80 ; *H. K. Bhowmik* coll.

Description : Males : Medium size. Fastigium of vertex as broad as long, with an elongate depression in middle. Frontal ridge sulcate. Median carina of pronotal disc weak but entire ; crossed by 3 sulci, 1st sulcus present only laterally, second medially, 3rd and posterior one entire ; 2nd and 3rd sulci slightly wavy ; posterior margin of metazona (which is smaller than prozona) obtuse angular (fig, 109). Tegmina and wings as long as or longer or shorter than abdomen. Supra-anal plate longer than wide in apical area, with 2 ridge-like elevations, median sulcus obsolete at centre but basally present (fig. 111). Cercus slender, bifurcate with upper branch incurved and recurved (fig. 110). Epiphallus large, bridge-shaped, undivided ; ancorae with acute apices ; lophi large with two inner lobes, outer edges sinuate.

Females : Larger than males. Subgenital plate simple, with acute median lobe. Lower valves of ovipositor narrow, long, with 2 well defined teeth on each side (fig. 112).

Colouration : Green or yellowish brown, with yellowish brown patches. Antenna brown with yellow stripes. All sulci on pronotum black. Posterior femur greenish buff ; knee with black patches on both sides ; base of tibia black, rest bluish grey.

Measurements : Body ♂ 30-31, ♀ 44-45 ; antenna ♂ 14-17, ♀ 13-16 ; head ♂ 3.4-3.5, ♀ 5.5-6 ; maximum with of head ♂ 3-3.2, ♀ 5-6.5 ; minimum width of interocular distancg ♂ 1-1.2, ♀ 3-4 ; pronotum ♂ 5.5-5.7, ♀ 8-11.5 ; prozona ♂ 3.5-3.6, ♀ 5-6.5 ; metazona ♂ 2-2.2, ♀ 3-5 ; maximum width of



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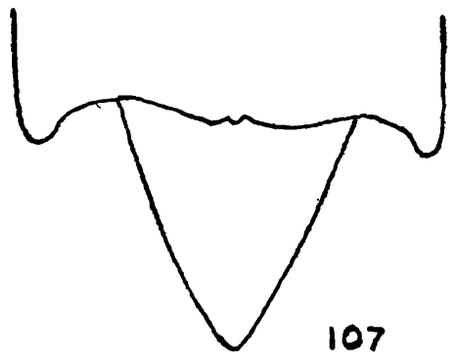

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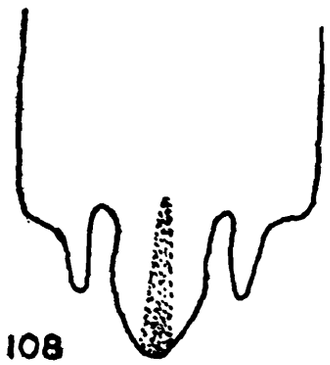

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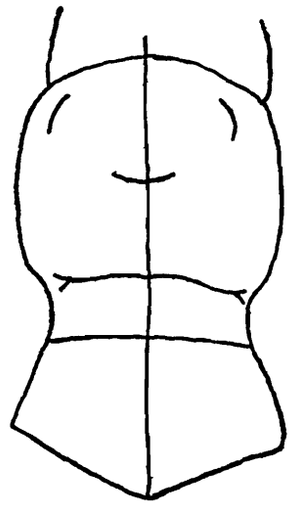

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Parahieroglyphus bilineata

Fig. 105. Pronotal disc, male. showing colour bands X 11.
Fig. 106. Cercus, male, lateral view X 11.
Fig. 107. Supra-anal plate, male, dorsal view X 11.
Fig. 108. Sub-genital plate, female, ventral view X 11.

Hieroglyphus banian

Fig. 109. Pronotal disc, male, showing colour bands X 11.
Fig. 110. Cercus, male, lateral view X 11.

pronotum ♂ 4-4.5, ♀ 5.5-8 ; minimum width of pronotum ♂ 3.5-4, ♀ 5-7 ; tegmen ♂ 22-23, ♂ 29-30 ; post. femur ♂ 17-17.7, ♀ 22-24 ; maximum depth of post. femur ♂ 3.5-4.8, ♀ 4-5 ; post. tibia ♂ 14-15, ♀ 20-22.

Diagnostic features : It is a variable species exhibiting lot of transitional features. But the general shape of male cercus (bifurcate), genitalia and the dental projection of female ovipositai valves distinguish the species at once.

Remarks : A widespread species of the genus in India and often confused earlier with other species of the genus. Much biological works have been conducted on this species, being a serious pest on rich and other agricultural crops.

28. **Hieroglyphus nigrorepletus** Bolivar

(Figs. 113-116, Plate VII, fig. 251)

1912. *Hieroglyphus nigrorepletus* Bolivar, *Trab. Mus. nac. Cienc. nat. Madr.*, no. **6** : 56.

1914. *Hieroglyphus bettoni* Kirby, *Fauna British India*, **1** : 203.

1916. *Hieroglyphus vastator* Carl, *Revue suisse zool.*, **24** : 481.

Distribution : India (Assam ; Kashmir ; Karnataka ; Maharastra ; Orissa ; Punjab ; Uttar Pradesh ; West Bengal) and Pakistan.

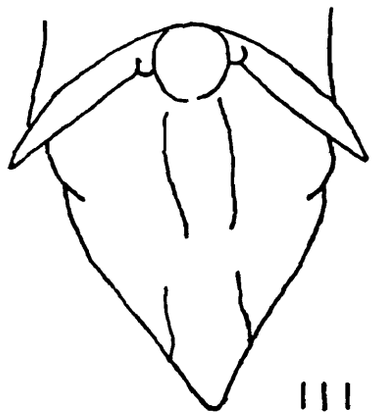
Material : 1 ♂, 1 ♀ ; Pinjore, Kalka, Haryana ; 1.10.82 ; *H. K. Bhowmik* coll. 2 ♀ ; Balugaon, Puri, Orissa ; 30.9.83 ; *H. K. Bhowmik* coll.

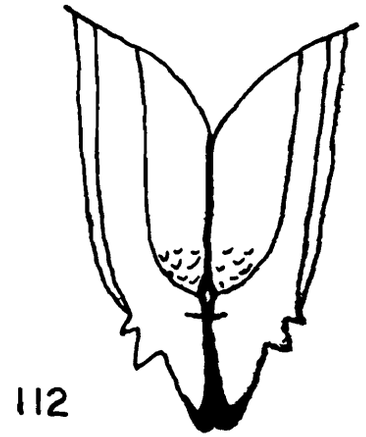
Description : Male (Pl. VII, fig. 251) : Large and robust. Fastigium of vertex one and a half times as broad as long. Frontal ridge parallel-sided. Pronotum with only a weak median carina ; posterior margin of metazona obtuse angular. Tegmina and wings longer than abdomen or may be brachypterous. Supar-anal plate angular, with subacute apex. Cercus simple, elongate, slightly incurved, apex oblique on dorsum, acute (fig. 114). Epiphallus very large, with large robust lophi ; ancorae small, directed inwards.

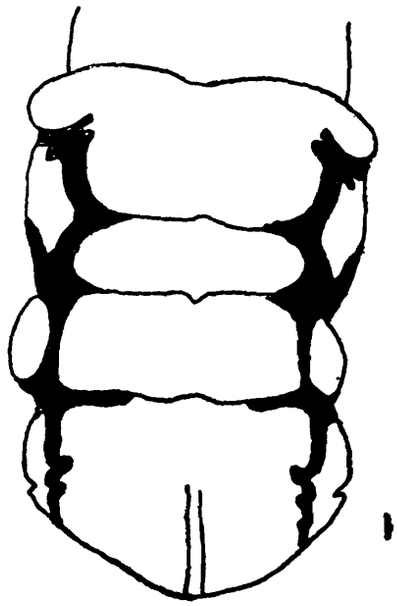
Females : A little larger. Fastigium of vertex two and a half times as broad as long. Subgenital plate with very acute median lobe (fig. 115). Lower valve of ovipositer as shown in figure (116).

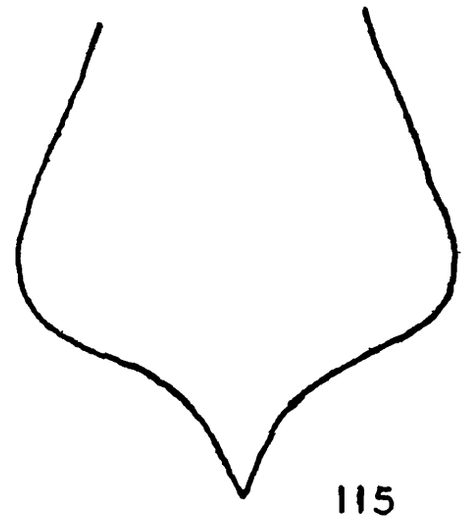
Colouration : Buff with yellowish buff patches. 1st, 3rd and 3th sulci of pronotum with wide black bands on lateral lobes, 3rd sulcus joins 1st one laterally ; band on 2nd sulcus broad, parallel-sided and connects all sulci on dorsum (fig. 113). Other minor colouration as for the genus.

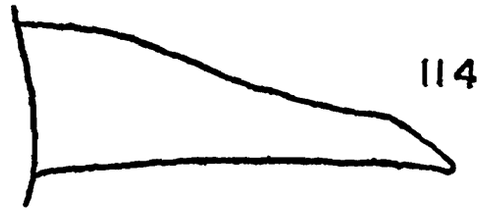
Measurements : Body ♂ 33, ♀ 39-44 ; antenna ♂ 15, ♀ 15-16 ; prozona ♂ 5, ♀ 5.25-6 ; metazona ♂ 3.5, ♀ 4-5 ; maximum depth of metazona ♂ 6,

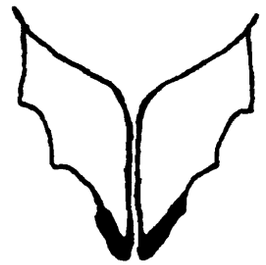












Hieroglyphus banian

Fig. 111. Supra-anal plate, male, dorsal view X 11.

Fig. 112. Lower valve of ovipositor showing dentation X 11.

Hieroglyphus nigroreptelus

Fig. 113. Pronotal disc, male, showing colour pattern X 11.

Fig. 114. Cercus, male, lateral view X 11.

Fig. 115. Sub-genital plate, female, ventral view X 11.

Fig. 116. Lower valve of ovipositor showing dentation X 11.

♀ 6.25-7 ; tegmen (brachy.) ♂ 13, ♀ (brachy.) 12-14 ; post. femur ♂ 18.5, ♀ 20-23 ; post. tibia ♂ 17, ♀ 18-20 ; cercus ♂ 3.5, ♀ 1.25-1.5.

Diagnostic features : The species has characteristic colour markings (on pronotum) and particular shape of the male cercus—which distinguish it from all allied species.

Remarks : The species varies greatly in body size and in form of tegmina —brachypterous forms being very frequent. Its degree of colouration also variable.

29. **Hieroglyphus oryzivorus** Carl

1916. *Hieroglyphus oryzivorus* Carl, *Revue suisse Zool.*, **24** : 480.

Distribution : Known from Southern and Western India including Orissa and West Bengal ; and also from Pakistan.

Description : Male : Moderately slender. Frontal ridge divergent downwards and with moderately shallow sulcus. Posterior sulcus on pronotum bow-shaped at centre ; posterior margin of metazona rounded. Both macropterous and brachypterous forms available. Cercus simple, short, upcurved and incurved, with apex subacute. Epiphallus with lobe of lophi rounded and with a second lobe facing inwards, ancorae small.

Female : Larger. Fastigium of vertex wider (3 times). Subgenital plate trilobate with outer lobes rounded and small, much shorter than median lobe, median lobe pointed. Valves of ovipositer very short, robust ; external lateral projection of lower valve small, obtuse.

Colouration : Pale green or buff with yellowish brown patches. Sulci on pronotum with wide black bands laterally, 2nd sulcus with only small black patches each end, 3rd sulcus joins 1st laterally. Dorsum of pronotum pale green with narrow, pale brown sulci.

Measurements : Body ♂ 35-35.4, ♀ 42.7-63.3 ; pronotum ♂ 5.4-7.1, ♀ 7.6-10.2 ; tegmen ♂ (macrop.) 20.5-23.7, ♀ (macrop) 33.5, (brachyp) 17.6-28.4 ; post. femur ♂ 15.7-18.9, ♀ 19.6-28.3.

Diagnostic features : The species is very close to *H. daganensis* Krauss, 1877, from Africa, but can be differentiated by its smaller size, short ♂ cercus, elongate and narrow valves of cingulum (vs. shorter and thicker) and an extra lobe on the lophi of epiphallus (vs. absent).

Remarks : Though the species was described from 2 females from Murshidabad (West Bengal), it has never again been recorded from the state. The above description is after Mason (1973), who has lately revised the genus.

Genus (23) **Parahieroglyphus** Carl

1912. *Hierocerxy* Bolivar, *Trab. Mus. nac. Cienc. nat., Madr.* no. **6** : 59.

1916. *Parahieroglyphus* Carl, *Revue suisse Zool.*, **24** : 461.

1923. *Hierocericina* Bolivar, *Boln. R. Soc. esp. Hist. nat.*, **23** : 76.

Type species : *Parahieroglyphus bilineatus* Carl, 1916.

Body finely rugose. Antenna filiform, longer than head and pronotum. Fastigium of vertex with depression in front of transverse furrow, apex obtuse angular. Frontal ridge sulcate and parallel-sided. Pronotum flat, median carina weak, linear, crossed by 3 narrow, shallow sulci ; lateral carinae absent. Prosternal spine conical. Tegmina and wings shortened, not exceeding 3rd tergite. Male supra-anal plate short, triangular, slightly broader than long, with 3 or 5 shallow callosities, apex subacute. Male cercus very large, apex trilobate, upper and middle lobes much larger than lower one. Epiphallus divided, thick, robust, broader in apical part than basally, ancorae moderately large, lophi curved inwards and upwards. Female subgenital plate trilobate.

Distribution : Two species are known from India.

30. **Parahieroglyphus bilineatus** (Bolivar)

(Figs. 105-108, Plate VII, fig. 252)

1912. *Hieroceryx bilineatus* Bolivar, *Trab. Mus. nac. Cienc. nat., Madr.* no. **6** : 60.

1914. *Hieroglyphus bilineatus* Kirby, *Fauna British India*, **1** : 202.

1916. *Parahieroglyphus bilineatus* Carl, *Revue suisse Zool.*, **24** : 483.

Distribution : India (West Bengal ; Maharashtra ; Himachal Pradesh (Simla) ; 'Indies Orient' ; Himalaya).

Material : 1♂, 1♀ ; Pinjore, Kalka, Haryana ; 1.10.82 ; *H. K. Bhowmik* coll. (in rice field).

Description : Male (Pl. VII, fig. 252) : Medium size. Frons in profile straight, inclined backwards. Frontal ridge parallel-sided or may diverge just below median ocellus. Cercus very large, divided into 3 lobes : upper lobe subacute, almost subequal to middle one which is expanded laterally apicad, lower lobe narrow, long and upcurved (fig. 106). Genitalia as described for the genus. Supra-anal plate triangular (fig. 107). Tegmen shortened or may extend up to last abdominal tergite.

Female : Very similar to male except larger in size. Fastigium of vertex may be 3 times as broad as long. Mesosternal interspace may rarely slightly open. Subgenital plate trilobate, lateral lobes straight, shorter and narrower than middle lobe ; middle lobe with a median shallow depression apicad (fig. 108).

Colouration : Body colouration buff with black markings. Pronotal disc with 2 narrow black linear stripes, on either side of lateral carinae, which are continued backwards along post-cubital vein of tegmina ; 2nd sulcus black on lobes with band forming an L-shape directed towards head (fig. 105). Edges of upper and middle lobes of male cercus black. Posterior knee with black patches on both sides. Posterior tibia bluish grey with black base ; spines tipped with black. Last abdominal tergite brownish at central-margin.

Measurements : Body ♂ 22, ♀ 42 ; antenna ♂ 9, ♀ (broken) ; prozona ♂ 3.75, ♀ 5 ; metazona ♂ 2, ♀ 3 ; maximum depth of metazona ♂ 3, ♀ 5 ; tegmen ♂ 7.25, ♀ 10.5 ; post. femur ♂ 12, ♀ 19.5 ; post. tibia ♂ 10.5, ♀ 17.

Diagnostic features : The species is very characteristic with straight frons, on profile, and the unique shape of its male cercus. Its female trilobate subgenital plate is also unique, but since the ♀ of the other species, *P. colemani* (Bolivar, 1912) is unknown, it is not definite at this stage how far it should be viewed.

Remarks : Kirby's (1914) syntypes of both sexes from 'Bengal' being lost, there is no more record of the species being available from the state. Mason (1973) has given revisional characters for its identity.

V. Subfamily OXYINAE

Genus (24) **Oxya** Serville

1831. *Oxya* Serville, *Annls. Sci. nat.*, **22** : 286 ; Hollis, 1971. *Bull. Br. Mus. nat. Hist.* (*Ent.*), **26** (7) : 272-274.

Type species : *Oxya hyla* Serville, 1831.

Small to medium size (15-38), usually with integument finely rugose and shiny. Fastigium of vertex short, with widely rounded or obtuse apex, shallowly concave and without median longitudinal carinula. Frons oblique, straight or weakly convex ; frontal ridge sulcate thoroughly with distinct carinulae. Pronotum subcylindrical, with usually flattened dorsum, median carina weak, lateral carinae absent ; disc crossed by 3 fine sulci. Prosternal spine conical, with rounded or subacute apex, often slightly inclined backwards and may be with weakly flattened posterior surface. Mesosternal interspace much narrower than long. Tegmen developed or shortened (never lobiform and without parallel transverse veinlets), anterior margin, in females, may be densely, weakly or not at all spined ; wings usually with dense hairs on dorsal surface of basal parts of anal veins. Upper 'knee' lobes of posterior femur rounded, lower one extended into a spine-like projection ; posterior tibia expanded on apical two-thirds, with acute dorso-lateral margins and with

external apical spine. Male supra-anal plate rounded triangular, with rounded or angular apex or weakly trilobate, and may be or without basilateral folds and subapico-lateral tubercles ; cercus variable, conical or compressed with rounded, acute, truncate or bifid apex ; epiphallus usually with narrow divided bridge, ancorae usually absent (may be present in some species), with two pairs of lophi, an outer hook-like pair and an inner, short, tooth-like pair. Apical margin of female subgenital plate with apical and-or subapical teeth or tubercles, ventral surface often with longitudinal ridge and/or furrow ; valves of ovipositor may be with hook-like marginal spines ; inner ventral margin of posterior ventral basivalvular sclerite may have (a) one or two large, tooth-like spines or (b) a row of small spinelets or (c) may be completely unarmed.

Distribution : Africa ; Asia ; Australia.

8 species occur in India of which 2 are endemic forms.

Key to species and subspecies

1.	♂ Supra-anal plate with a tubercle on each side of a median apical process ...		
	♀ Anterior margin of tegmen with a row of short bristles from costal budge almost to apex of tegmen ; valves of ovipositor with rather long teeth, apical ones curved ...	...	2
—	♂ Supra-anal plate without lateral tubercle ...		
	♀ Anterior margin of tegmen weakly or not at all with spines or bristles ; valves of ovipositor with short denticles ...	...	3
2.	♂ Cercus laterally compressed, parallel-sided throughout, apex bifurcate ...		
	♀ Subgenital plate, on ventrum, very flat and without lateral ridge ; anterior edge of tegmen with a few small bristles ...	*fuscovittata* (Marschall)	
—	♂ Cercus conical, or if compressed then narrowing towards apex, which is obtuse or truncate (never bifurcate) ...		
	♀ Subgenital plate, on ventrum, markedly concave, bordered posteriorly by two longitudinal, toothed, lateral ridges ...	*hyla hyla* Serville	
3.	♂ Cercus with subacute apex ; supra-anal plate without any fold on lateral, apical margin ...		
	♀ Posterior ventral basivalvular sclerite of ovipositor without any spine on its lower inner margin ; posterior margin of subgenital plate with unarmed lateral ridges ...	*velox* (Fabricius)	

— ♂ Cercus with subacute or truncate apex, supra-anal plate with basilateral folds ...

♀ Posterior ventral basivalvular sclerites having one or two tooth-like spines on its inner ventral margin ; lateral longitudinal ridges of ovipositor with two teeth at apices ... *japonica japonica* (Blanchard)

31. **Oxya velox** (Fabricius)

(Figs. 117-121)

1787. *Gryllus velox* Fabricius, *Mant. Ins.*, **1** : 239.

1836. *Gryllus squalidus* Marschall, *Ann. Wien. Mus., Vienna*, **1** (2) : 213, pl. 18, fig. 5.

1870. *Heteracris apta* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** ; 66.

1910. *Oxya velox* : Kirby, 1910. *Syn. Cat. Orth.*, **3** : 393 (partim) ; Kirby, 1914. *Fauna British India, Orth.*, **1** : 199, fig. 116 (Partim) ; Hollis, 1971. *Bull. Br. Mus. nat. Hist. (Ent.)*, **25** (7) : 297-300.

1925. *Oxya squalida* : Willemse, *Tijdschr. Ent.*, **68** : 58, fig. 65.

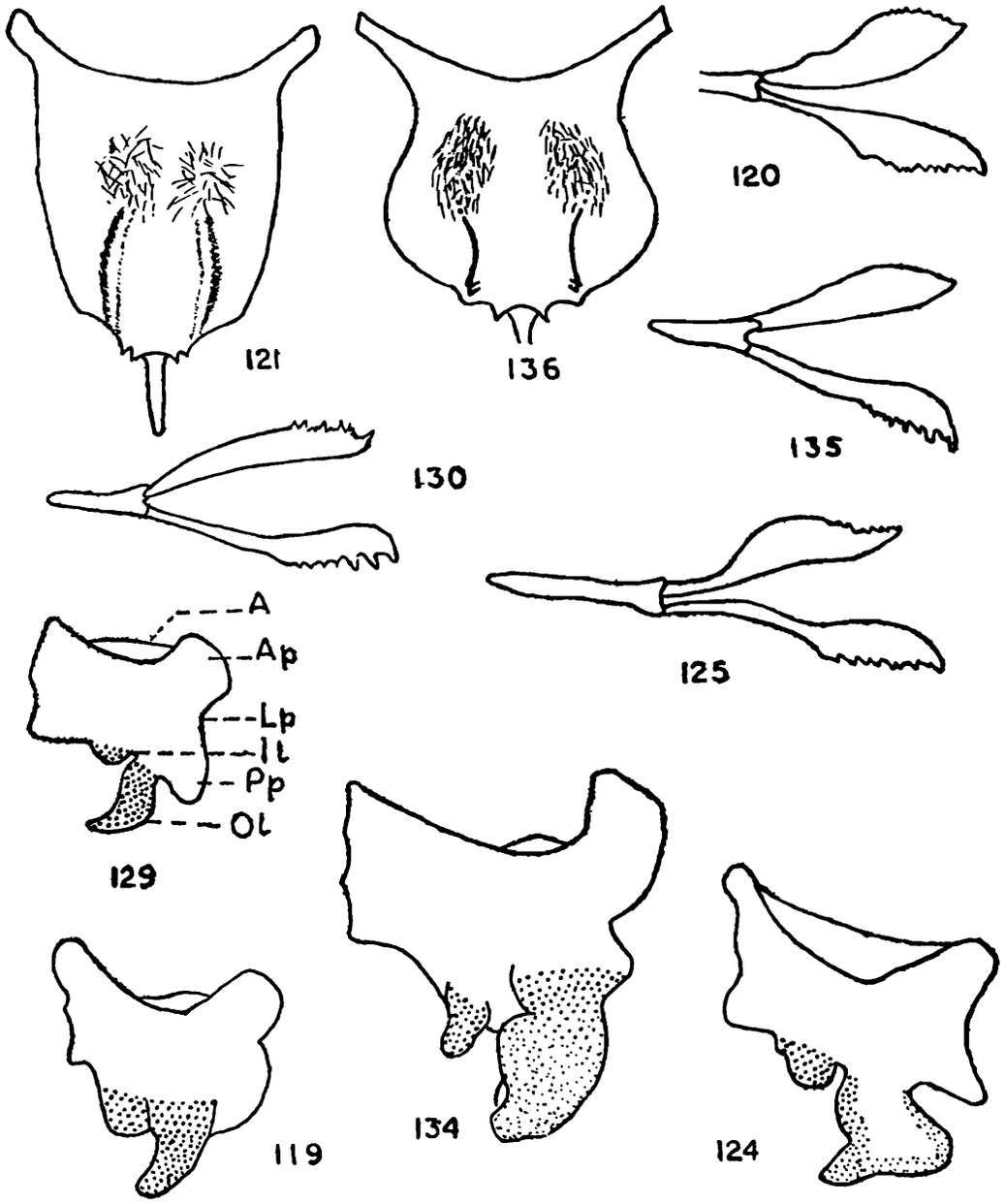
Distribution : Bangladesh ; Burma ; China ; India ; Thiland ; Pakistan.

Material : 1 ♀ ; Naxalbari, Darjeeling ; 18.6.1979 ; *P. Halder* and party coll. 2 ♀ nymphs ; Bamanpokri, Darjeeling ; 21-22.8.1979 ; *H. K. Bhowmik* coll. 1 ♀ ; Nilpara, Jalpaiguri ; 2.9.1975 ; *H. K. Bhowmik* coll. 5 ♀ ; Sankrail, Howrah ; 20.5.1980 ; *P. Halder* coll. 1 ♀ ; Botanical Garden, Howrah ; 16.5.1980 ; *P. Halder* coll. 4 ♀ ; Garia, 24- Parganas ; July-August, 1974 ; *P. Halder* coll. 2 ♀ ; Kamarchak, 24- Parganas ; 16.8.1974 ; *P. Halder* coll. 1 ♀ ; Hatgacha, 24- Parganas ; 7.6.1974 ; *P. Halder* coll. 2 ♂ ; Narandrapur, 24- Parganas ; 3.7.1974 ; *P. Halder* coll. 1 ♀ ; Kankalitala, Bolpur, Birbhum ; 17.12.1981 ; *S. Sen* and party coll.

Description : Males : Antenna as long as head and pronotum taken together. Interocular distance as wide as or slightly wider than frontal ridge near median ocellus. Prozona longer than metazona, latter with posterior margin widely obtuse-angular. Tegmen longer than post. femur by one fourth of its length. Supra-anal plate with triangular apex, without lateral tubercle (fig. 118.). Cercus short, conical, with subacute apex (fig. 117). Subgenital plate pilose. Epiphallus with hook-like outer lophi and large, tooth-like inner lophi (fig. 119). In phallic structure, valvular plate of cingulum very large. Posterior tibia modified for swimming, with 8 external and 9 internal yellowish black tipped spines.

Female : Larger and more robust than males. Interocular distance wider than frontal ridge near median ocellus. Anterior margin of tegmen very weakly spined. Valves of ovipositor with very inconspicuous (specially, on upper valves) tooth-like spines (fig. 120) ; posterior ventral basivalvular sclerite obtusely rounded on inner ventral margin, smooth. Subgenital

plate, on ventrum, with a wide but longitudinal apical concavity, bordered by lateral ridges which is without spine ; medial pair of marginal spines widely spaced (fig. 121).



Oxya velox

Fig. 119. Epiphallus, dorsal view X 18.
Fig. 120. Valves of ovipositor, lateral view X 11.
Fig. 121. Subgenital plate, female, ventral view X 11.

Oxya fuscovittata

Fig. 124. Epiphallus, dorsal view X 18.
Fig. 125. Valves of ovipositor, lateral view X 11.

Oxya hyla hyla

Fig. 129. Epiphallus, dorsal view X 18.
Fig. 130. Valves of ovipositor, lateral view X 11.

Oxya japonica japonica

Fig. 134. Epiphallus, dorsal view X 18.
Fig. 135. Valves of ovipositos, lateral view X 11.
Fig. 136. Subgenital plate, ♀, ventral view X 11.

Colouration : General colouration greenish (in fresh specimens) and yellowish (in preserved material) varied with brown. Eyes and abdomen more or less dark brownish. Tegmen except anal region brownish. Wing hyaline. Post. ocular brownish bands along superior margin of lateral lobes and continuing up to episterna prominent.

Measurements : Body ♂ 23-24, ♀ 25-34 ; antenna ♂ 8.5-9, ♀ 8-9 ; head ♂ 3.1-3.2, ♀ 3.6-4.5 ; maximum width of head ♂ 2.2-2.4, ♀ 3.1-4.3 ; minimum width of interocular distance ♂ .6, ♀ .8-1.3 ; pronotum ♂ 4.9-5.1, ♀ 5.8-7.3 ; prozona ♂ 2.7-2.8, ♀ 3.3-4.3 ; metazona ♂ 2.2-2.3, ♀ 2.4-3 ; tegmen ♂ 22-23.5, ♀ 20-25 ; post. femur ♂ 13-14, ♀ 15-18.5 ; maximum depth of post. femur ♂ 2.8-3.1, ♀ 3.3-4 ; post. tibia ♂ 10.5-11, ♀ 12-15.5.

Diagnostic features : The species is distinguishable in male by extraordinarily developed valvular plate of cingulum (Hollis, 1971) and in females in the form of detailed shape of subgenital plate and unarmed nature of posterior ventral basivalvular sclerite of the ovipositor.

In field, it is, however, very difficult to distinguish it from *O. hyla hyla* in general appearance.

Remarks : It is yet an inadequately known species. In India, it is recorded yet from only a few places. From south, central and Western India it seems to be unreported till date.

32. **Oxya fuscovittata** (Marschall)

(Figs. 122-126, Plate VII, figs. 253-254)

1836. *Gryllus fuscovittatus* Marschall, *Ann. Wien. Mus. Vienna*, **1** (2) : 211. pl. 18, fig. 3.

1912. *Oxya truanica* Uvarov, *Trudy russk. ent. Obshch.*, **40** : 28.

1925. *Oxya uvarovi* Willemse, *Tijdschr. Ent.*, **68** : 25, figs. 18, 19.

1925. *Oxya uvarovi* Willemse, ibid., **68** : 27, figs. 23. 25.

1925. *Oxya uvarovi f. brachyptera* Willemse, ibid., **68** : 29.

1926. *Oxya fuscovittata* : Uvarov, *Bull. ent. Res.*, **17** : 46.

Distribution : Afganisthan ; India ; West Pakistan ; USSR (Southwest).

Material : 1♂, 1♀ ; Naxalbari, Darjeeling ; 17-20.6.1979 ; *P Halder* & party coll. 1♂ ; Tukriajhar, Darjeeling ; 18.6.1979 ; *P. Halder* & party coll. 1♂, Bijoynagar Tea Estate, Darjeeling ; 19.6.1979 ; *P. Halder* & party coll. 1♂ ; Suklapara, Jalpaiguri, 29.8.1975 ; *H. K. Bhowmik* coll. 2♂ ; Sankrail, Howrah ; 20.5.1980 ; *P. Halder* coll. 1♂ ; Argori, Andul, Howrah ; 11.7. 1978 ; *P. Halder* coll. 1♀ ; Singur, Hooghly ; *P. Halder* coll. 4♂ ; Garia, 24-Parganas ; 1974 ; *P. Halder* coll. 2♀ ; Raghunathpur, 24-Parganas ; 17.7.1974 ; *P. Halder* coll.

Description : Males : Antenna as long as or slightly longer than head and pronotum. Interocular distance slightly narrower than frontal ridge at

median ocellus. Pronotum parallel-sided. Tegmina and wings fully developed. Supra-anal plate with subapical lateral tubercles more pronounced and posterior lobe a little developed (fig. 123). Cercus strongly compressed, laterally flattened and almost parallel-sided throughout, apex somewhat bifid in nature (fig. 122). Epiphallus with narrow bridge, without ancorae, and with boot-shaped outer lophi and tooth-like inner lophi (fig. 124).

Females (Pl. VII, figs. 253-254) : Larger. Anterior margin of tegmen weakly spined. Valves of ovipositor with tooth-like marginal spines (fig. 125) ; posterior basivalvular sclerite with small spines on inner ventral margin. Subgenital plate with very broadly flattened ventral surface, without lateral longitudinal ridge ; posterior margin emarginate medially, straight or with two very small medial spines (fig. 126).

Colouration : General colouration green in fresh specimens and yellowish in preserved specimens, with brownish bands, starting from each eye along superior margin of lateral lobe and continued up to episternum.

Measurements : Body ♂ 19.5-24, ♀ 25-30 ; antenna ♂ 8-9, ♀ 7.5-8 ; head ♂ 2.6-3.4, ♀ 3.5-4.1 ; maximum width of head ♂ 1.9-2.5, ♀ 3-3.7 ; minimum width of interocular distance ♂ .3-.5, ♀ .7-1 ; width of frontal ridge at median ocellus ♂ .5-.6, ♀ .6-.8 ; pronotum ♂ 3.8-4.5, ♀ 4.9-6 ; prozona ♂ 2.3-2.7, ♀ 2.8-3.2 ; metazona ♂ 1.5-1.8, ♀ 2.1-2.8 ; tegmen ♂ 14.5-17, ♀ 25-28 ; post. femur ♂ 10.5-12, ♀ 14-17 ; maximum depth of post. femur ♂ 2.3-3, ♀ 2.8-3.3 ; post. tibia ♂ 8-10, ♀ 12-14.

Diagnostic features : The species is distinguished by its broad, compressed and apically somewhat bifid male cercus ; and the short, tooth-like spines on the ovipositol valves of females and absence of lateral longitudinal ridges of subgenital plate on ventral side.

Remarks : In general appearance, in form of male supra-anal plate and to some extent to cercus and phallic complex and in the female tegmen, subgenital plate and ovipositor, the species is very close to *O. hyla hyla* but can be separated by the careful study of the diagnostic features noted above. For more detailed morphology reference may be made to Hollis (1971) who has revised the genus in modern trend. It is one of the commonest species of the genus in India, but not so common as *velox* or *hyla*.

33. **Oxya hyla hyla** Serville
(Figs. 127-131)

1831. *Oxya hyla* Serville, *Annls. Sci. nat.*, **22** : 287.

1871. *Oxya serrulata* Krauss, *Zool. jb. Syst.*, **5** (1890) ; 662.

1925. *Oxya acuminata* Willemse, *Tidjschr. Ent.*, **68** ; 42.

1925. *Oxya multidentata* Willemse, ibid., **68** ; 44.

1925. *Oxya ebneri* Willemse, ibid., **68** ; 46.

1870. *Heteracris viridivitta* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** ; 662.

1870. *Heteracris humeralis* Walker, ibid., **4** ; 662.

1971. *Oxya hyla hyla* : Hollis, *Bull. Br. Mus. nat. Hist.* (*Ent.*), **26** (7) ; 282-283, figs.

Description : Africa (South of Sahara) ; India and Sri Lanka.

Material : 1 ♂ ; Garia, 24-Parganas ; 24.1.75 ; *P. Halder* coll. 1 ♀ ; Sankrail, Howrah ; 20.5.80 ; *P. Halder* coll. 1 ♂ ; Rydak, Jalpaiguri, 10.9.75 ; *H. K. Bhowmik* coll.

Also 7 ♂, 10 ♀ ; Mandi Riverside, Himachal Pradesh ; 23-25.9.81 ; *H. K. Bhowmik* coll.

Description : Males : Body finely rugulose, shiny. Antenna longer than head and pronotum. Supra-anal plate trapezoidal with triangular apical projection, at base of which, on dorsum, on both sides, there is a small tubercle (fig. 128). Cercus conical, or may be compressed laterally with subacute or truncate apex (but never bifid) (fig. 127). Epiphallus with narrow bridge, without ancorae, with curved hook-like outer lophi and usually well developed tooth-like inner lophi (fig. 129).

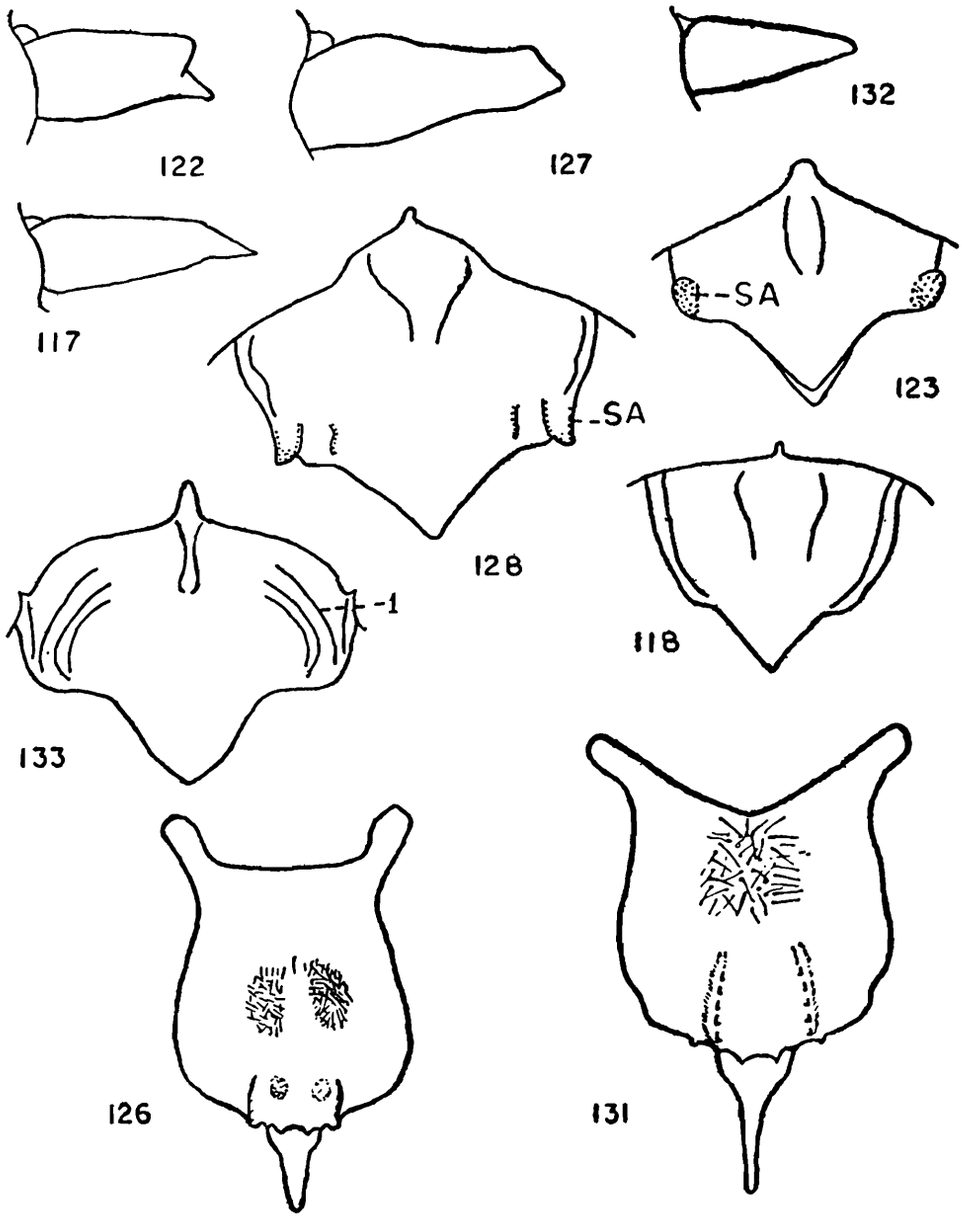
Females : Larger than males. Anterior margin of tegmen with a dense row of short bristles. Valves of ovipositor with hook-like marginal spines (fig. 130) ; inner ventral margin of posterior ventral basivalvular sclerite with small spinelets. Subgenital plate with a pair of median spines on posterior margin, on ventral surface, with a median linear concavity, bordered on each side by a longitudinal ridge bearing spines (fig. 131).

Colouration : Almost identical to *Oxya fuscovittata*.

Measurements : Body ♂ 23-24, ♀ 28-30 ; antenna ♂ 10-10.5, ♀ 8.5-9 ; head ♂ 3.25-3.5, ♀ 3.75-3.8 ; max. depth of head ♂ 3.25-3.5, ♀ 4-4.2 (Ratio L/W ♂ 1, ♀ .937) ; tegmen ♂ 20.5-21, ♀ 22-23 ; post. femur ♂ 13-13.5, ♀ 15-15.5 ; post. tibia ♂ 10.5-11, ♀ 12-12.5.

Diagnostic features : The subspecies may be recognised by sub-apico lateral tubercle on male supra-anal plate and in female by a dense row of short bristles on anterior margin of tegmen from costal bulge to almost to apex and by denticles on lateral ridges of subgenital plate, on ventrum.

But these distinguishing characters are not unique and may likely to be confused with the characters of *O. fuscovittata* to which it bears strong resemblance. In *O. fuscovittata*, the sub-apico lateral tubercles of male supra-anal plate more pronounced, the cercus laterally compressed, never narrowing at apex, bifurcate and, in female, anterior edge of tegmen weakly spined, the subgenital plate on ventral surface flat ; without lateral longitudinal ridge. These contrasting characters should be clearly understood and analysed before specific identification.



Oxya velox

Fig. 117. Cercus, male, lateral view X 11.

Fig. 118. Supra-anal plate, male, dorsal view X 11.

Oxya fuscovittata

Fig. 122. Cercus, male, lateral view X 11.

Fig. 123. Supra-anal plate, male, dorsal view (SA—Subapical lateral tubercles) X 11.

Fig. 126. Subgenital plate, female, ventral view X 11.

Oxya hyla hyla

Fig. 127. Cercus, male, lateral view X 11.

Fig. 128. Supra-anal plate, male, dorsal view X 11.

Fig. 131. Subgenital plate, ♀, ventral view X 11.

Oxya japonica japonica

Fig. 132. Cercus, ♂, lateral view X 11.

Fig. 133. Supra-anal plate, ♂, dorsal view (1-lateral folds) X 11.

Remarks : It is a highly variable subspecies as regards its size and appearance. The length of tegmen, shape of male cercus and dentation on lateral ridges of subgenital plate are also variable.

34. **Oxya japonica japonica** (Thunberg)

(Figs. 132-136)

1824. *Gryllus japonicus* Thunberg, *Mem. Acad. Sci. St. Petersb.*, **9** : 429.

1870. *Acridium sinense* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 628.

1870. *Heteracris straminea* Walker, ibid., **4** : 666.

1870. *Heteracris simplex* Walker, ibid., **4** : 669.

1877. *Oxya lobata* Stal, *Ofvers. Vetensk. Akad. Forh. Stockh.*, **34** : 53.

1925. *Oxya asinensis* Willemse, *Tijdschr. Ent.*, **68** : 32, figs. 29, 30.

1925. *Oxya rufostriata* Willemse, ibid., **68** : 33, figs. 31.

1925. *Oxya sinensis f. robusta* Willemse, ibid., **68** : 52.

1971. *Oxya japonica japonica* : Hollis, 1971. *Bull. Br. Mus. nat. Hist.* (*Ent.*), **26** (7) : 302-307, figs. 117-121, 123-138, 138.

Distribution : Oriental region as a whole.

Material : 4♂, 2♀ ; Mirik (ca. 1668 m), Darjeeling ; 17.9.74 ; *H. K. Bhowmik & P. Halder* coll.

Description : Males : Body rugulose, shiny. Antenna longer than head and pronotum taken together. Interocular distance almost as wide as frontal ridge at median ocellus. Prozona slightly less than double length of metazona ; posterior margin of metazona almost rounded. Tegmen exceeds posterior femur ; no bristle on anterior margin. Posterior femur slender ; tibia pilose, with 9 internal and 7 to 8 external brownish black-tipped spines. Supra-anal plate triangular, apex rounded, with well developed apical folds (fig. 133). Cercus conical, with subacute apex (fig. 132). Epiphallus characterized with hook-like outer lophi and short, slender inner lophi (fig. 134).

Females : Larger and more robust, otherwise very similar to males. Interocular distance about one and a half times wider than frontal ridge at median ocellus. Anterior margin of tegmen very weakly spined (sometimes very difficult to detect). Valves of ovipositor with tooth-like spines (fig. 135) ; posterior ventral basivalvular sclerite with a large spine on its inner ventral margin. Subgenital plate on its ventral surface with a median linear concavity posteriorly, with a distinct longitudinal border on either side having one or two spines apicad ; median pair of marginal spines distinct, set well apart (fig. 136).

Colouration : General colouration almost uniformly brownish. Tegmina and posterior femora yellowish. Wings hyaline. Eyes dark. Posterior

femoral knees deep brown. Remaining body parts brownish ; head and face almost rufous, shiny.

Measurements : Body ♂ 20.5-22, ♀ 27-28 ; antenna ♂ 7.5-9, ♂ 9, head ♂ 2.7-2.9, ♀ 3.1-3.5 ; maximum width of head ♂ 1.8-2, ♀ 3.2-3.6 ; minimum width of interocular distance ♀ .4-.5, ♂ .8-1 ; frontal ridge at median ocellus ♂ .5-.6, ♀ .8 ; pronotum ♀ 4.1-4.4, ♂ 5.7-5.9 ; prozona ♂ 2.3-2.5, ♂ 3-3.1 ; metazona ♂ 1.8-2, ♀ 4-4.4 ; tegmen ♂ 18-19.5, ♀ 23.5-24 ; maximum width of tegmen ♂ 2.4-2.7, ♀ 3.4-3.6 ; post. femur ♂ 12-13, ♀ 16-17 ; maximum depth of post. femur ♂ 2.5-2.8, ♀ 3.4-3.5 ; post. tibia ♀ 10-11, ♀ 14-14.5.

Diagnostic features : This subspecies may be distinguished in the male by the basal folds of supra-anal plate and the slender inner lophi of the epiphallus ; in the female, in the form of its subgenital plate and spined posterior ventral basivalvular sclerite.

Remarks : This nominate subspecies shows strong affinity to the other subspecies, *O. j. vitticollis* (Blanchard, 1853) which is mostly distributed in Australia etc. In the latter, the male cercus is almost bifid in nature and its female subgenital plate having a row of spines along the entire (posterior) length (vs. only one or two apical ones in *O. j. japonica*) of lateral ridges on ventral surface and, the close approximation of well developed medial pair of spines on posterior margin.

This nominate subspecies exhibits variability in respect to size, relative length of tegmen and in the form of male cercus, while its distinguishing characters mentioned above remain constant.

The post-ocular brownish bands running along the superior margins of lateral lobes, which are usually always a characteristic of the species of this genus, are lacking or obliterated, at least, in the specimens before me.

VI. Subfamily COPTACRIDINAE

Key to genera

1. Tegmen fully developed, as long as or longer than abdomen, never lateral or lobiform 2
— Tegmen shortened, not exceeding first abdominal segment, always lateral and lobiform ... *Circocephalus* Willemse
2. Frontal ridge scarcely or only moderately narrowed at apex (distinctly widened between antennae and wider than vertex between eyes) ; median carina of pronotum low, linear, interrupted by 3 transverse sulci ; no transverse carina between eyes ... *Eucoptacra* Bolivar
— Frontal ridge narrowed almost to a point apically ; median carina well raised, interrupted by posterior transverse sulcus only ; vertex with a transverse carina between eyes ... *Epistaurus* Bolivar

Genus (25) **Eucoptacra** Bolivar

1902. *Eucoptacra* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 623, 625.

1912. *Coptacroides* Bolivar, *Trab. Mus. nat. Cienc. nat. Madr., Madrid* no. **6** : 62.

Type species : *Acridium* (*Catantops* ?) *praemorsum* Stal, 1860.

Medium sized (27-33) insects, with integument finely rugose. Antenna filiform, usually longer than head and pronotum, slightly flattened basally. Fastigium of vertex narrow, concave in middle, sloping, with sharp lateral carinulae ; frons straight, almost vertical, slightly inclined backwards ; frontal ridge wide, flat, expanded between antennae, narrowed apically. Pronotum weakly tectiform with linear median carina, cut by 3 sulci, posterior margin of metazona angular. Prosternal spine obtusely conical. Tegmen fully developed or shortened, with obliquely truncate apex. Male supra-anal plate with strongly attenuate apical part and truncate apex ; cercus compressed and widened basad, with apex of variable shape ; epiphallus with small ancorae and wide, lobiform lophi.

Distribution : Australian and Oriental regions.

2 species occur in India of which 1 is endemic.

35. **Eucoptacra praemorsa** (Stal)

(Figs. 137-141)

1860. *Acridium* (*Catantops* ?) *praemorsum* Stal, *Eugenie's Resa, Orth.*, **3** : 330.

1870. *Catantops* ? *praemorsus* : Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 638.

1873. *Coptacra praemorsa* : Stal, *Recens Orth.*, **1** : 58.

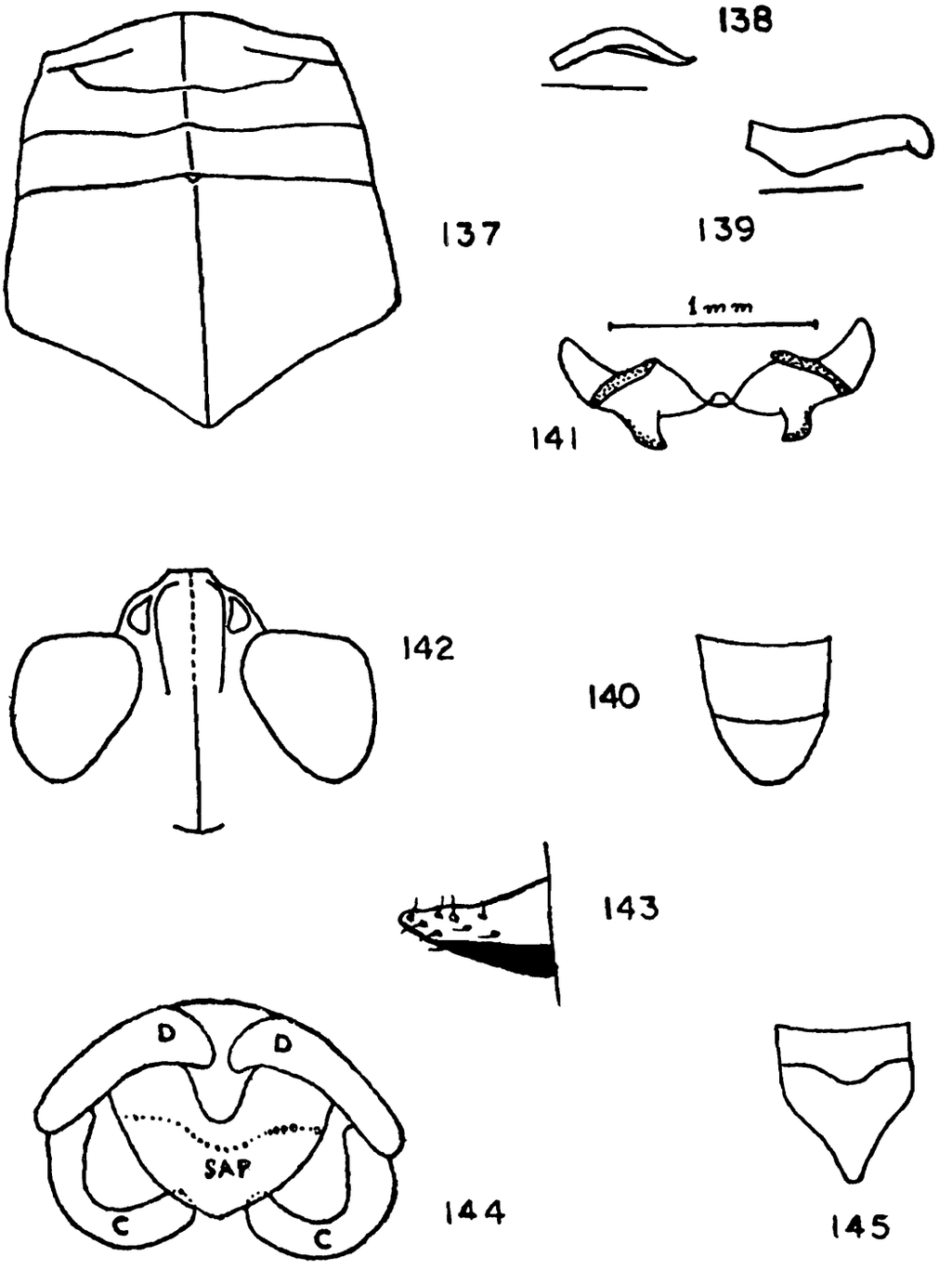
1902. *Eucoptacra praemorsa* : Bolivar, *Annls. Soc. ent. Fr.*, **70** : 623.

Distribution : Burma ; China ; India (Sikkim ; Tamil Nadu ; West Bengal) ; Tenasserim.

Material : 1 ♂ ; Sevok, Darjeeling ; 22.7.74 ; *H. K. Bhowmik* coll. 1 ♀ ; Tukriaghar, Darjeeling, 18.6.79 ; *P. Halder* coll. 2 ♂, 2 ♀ ; Mukutmonipur, Bankura, W. B. ; 22.9.81 ; *H. K. Bhowmik* coll.

Also 1 ♀ ; P. W. D. Bunglow, Rangpo, Sikkim ; 2.7.79 ; *P. Halder* and party coll. ; 1 ♀ ; Khanikhola, Rangpo, Sikkim ; 6.7.79 ; *P. Halder* and party coll. ; 1 ♀ ; Andberikhola, Rangpo, Sikkim, 5.7.79 ; *P. Halder* and party coll.

Description : Males : Antenna filiform, decidedly longer than head and pronotum taken together, with segments on distal half gradually widened. Frontal ridge convex, expanded maximally between antennae ; finely punctured. Median carina of pronotum distinctly cut by 3 sulci, 3rd sulcus, restricted not only to dorsum but also extending to lateral lobes as other sulci. Metazona longer than prozona. Lateral field of pronotum being almost as long as high. Prosternal tubercle short and cylindrical ; mesosternal



Eucoptacra praemorsa

Fig. 137. Pronotal disc, female, dorsal view X 11.
Fig. 138. Anal cercus, male, dorsal view X 11.
Fig. 139. Same, lateral view X 11.
Fig. 140. Sub-genital plate male, ventral view, showing transverse fold X 5.
Fig. 141. Epiphallus, dorsal view X 32.

Circocephalus indica, male

Fig. 142. Fastigium of vertex, dorsal view X 5.
Fig. 143. Prosternal spine, lateral view X 5.
Fig. 144. Appendix of last abdominal ternite, dorsal (D—dentates of last abdominal segment ; SAP—Supra-anal plate ; C—Cerci) X 5.

Epistaurus sinetyi

Fig. 145. Sub-genital plate, female, ventral view skowing transverse fold X 5.

interspace a little narrower than width of one of its lobes, with rounded inner margins, slightly more approximating in upper region than posterior region ; metasternal lobes separate. Tegmen with a little expanded costal area ; opaque up to middle ; cells of radial sector and medial region elongate, reticulation on basal half very dense ; apex truncate. Posterior femur rather robust, with a distinct attenuated apical portion which is about one third of entire length of femur ; all carinulae with dark spots. Posterior tibia with 11 internal and 9 external spines. Cercus slightly compressed, incurved so as to meet its counterpart in middle (figs. 138-139). Subgenital plate with transverse fold (fig. 140). Epiphallus as figured (141).

Females : Similar to males except for its slightly larger size and curved valves of ovipositor and short, conical cerci.

Colouration ; General colouration brownish testaceous. Tegmina from beyond middle subhyaline with oblique, obsolete transverse dusky markings. Wing pale brownish hyaline, greenish towards base and clouded at apex. Posterior femur with a black spot before apical area on upper inside, lower outer portion brown, carina marked with dark-brown, inner surface of it, and posterior tibia and tarsus red.

Measurements : Body ♂ 18.5, ♀ 23-24 ; head ♂ 1.8, ♀ 2-2.1-2.8 ; maximum width of head ♂ 1.7, ♀ 2-2-2.1 ; pronotal length ♂ 4.2, ♀ 5-5.6-5.8 ; maximum width of pronotum ♂ 3, ♀ 4-4.1-4.6 ; minimum width of pronotum ♂ 2, ♀ 3-3.2-3.5 ; prozona ♂ 2.2, ♀ 2-2.5-2.7 ; metazona ♂ 2.3, ♀ 3-3.1-3.5 ; tegmen ♂ 19, ♀ 21.5-22.1-23.5 ; maximum width of tegmen ♂ 3.1, ♀ 4.1-4.5-4.6 ; post. femur ♂ 12.5, ♀ 13-14.1-14.5 ; post. tibia ♂ 10, ♀ 11-11.1-12.

Diagnostic features : The species is a typical one of the genus and is easily distinguished from all other species of the genus by its greenish basal area of wings, male cerci and genitalia and the dark spots on carinulae of posterior femora.

Remarks : It is one of the little known species in India and recorded here for the first time from North-east India (Sikkim ; West Bengal).

Genus (26) **Epistaurus** Bolivar

1889. *Epistaurus* Bolivar, *J. Sci. Acad. Lisboa, Lisb.*, 1 (2) : 164.

Type species : *Epistaurus crucigerus* Bolivar, 1889.

Very allied to *Eucoptacra* from which it differs in the following characters : frontal ridge narrow, round, arched at base, widened between antennae, gradually narrowed at apex ; between fastigium of vertex and occiput a deep transverse depression, with a transverse carina occurs ; pronotum tectiform

and crossed by posterior sulcus only ; male supra-anal plate less attenuate and not truncate at apex ; cercus gradually conical apically with acute or subacute and downcurved apex ; epiphallus with large ancorae and large, lobiform lophi.

Distribution : Africa ; Burma ; India.

Only 1 species occurs in India.

36. **Epistaurus sinetyi** Bolivar

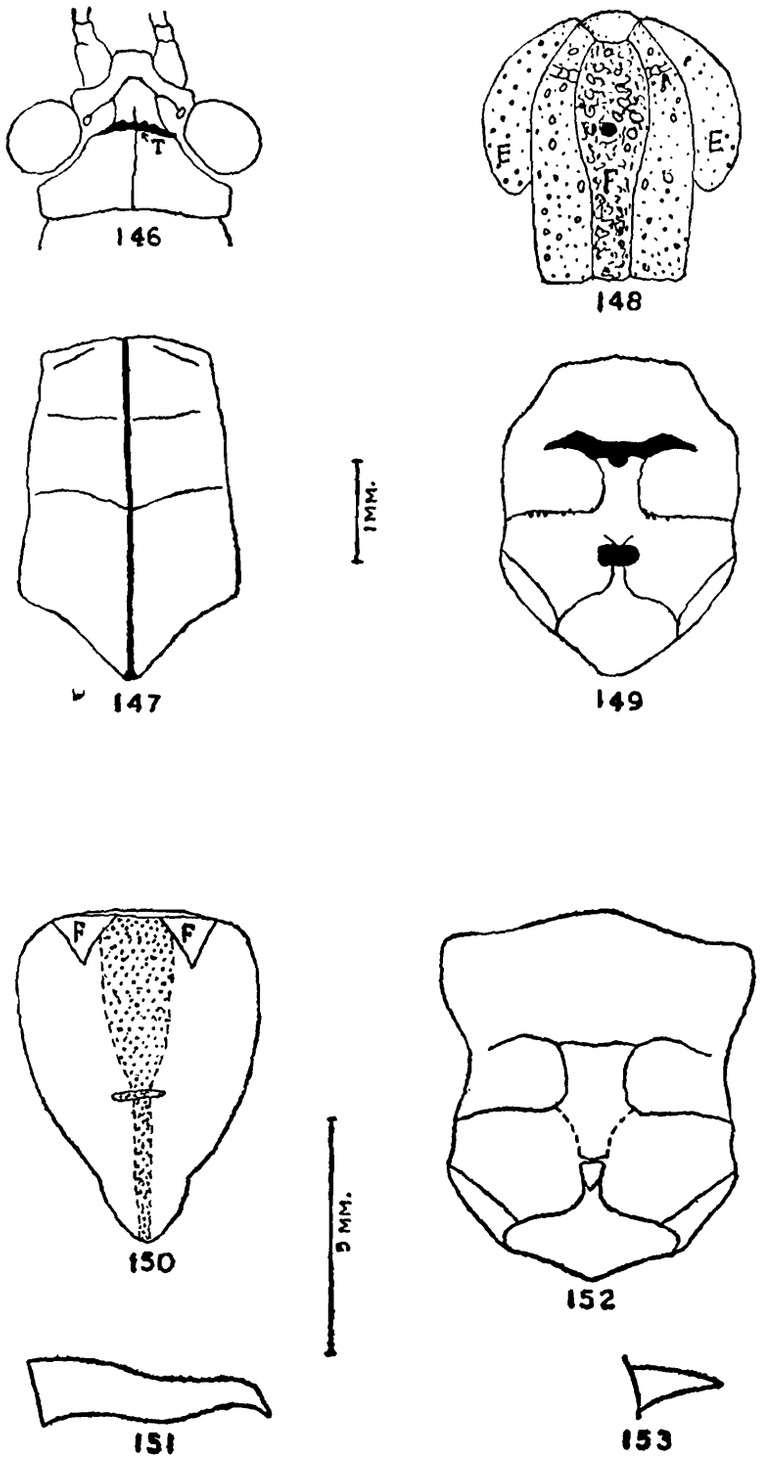
(Figs. 145-153, Plate VII, fig. 255)

1902. *Epistaurus sinetyi* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 623.

Distribution : Tamil Nadu (Trichinopoly) (type locality) ; West Bengal. Sri Lanka.

Material : W. B. : 1♂ ; Andul, Howrah ; 12.9.78. 1♀ ; Botanical Garden, Howrah ; 14. 3. 80. 2♂, 3♀ ; Mukutmanipur, Bankura ; 22-23.9.81.

Description : Males : Size small (Pl. VII, fig. 255). Body pilose. Head very small, less than half length of pronotum ; occiput very small ; fastigium of vertex extended before eyes, longitudinally tricarinate with truncate apex, median carinula continued behind over occiput and pronotal median carina ; fastigium limited posteriorly by a transverse carina between eyes (fig. 146) ; latter, lateral, projecting, approximating in middle and raised above level of head and pronotum. Frontal ridge narrowest beyond fastigial end, widest in between antennae, more than double width of fastigial width and then gradually converged towards clypeus ; finely but closely punctured, in profile, not so convex as in spp. of *Eucoptacra*, shallowly sulcate, carinulae being somewhat prominent (fig. 148). Antenna filiform, 20 to 21 segmented, longer than head and pronotum taken together ; scape largest, 2nd to 7th segments narrowest, then gradually thickened. Pronotum tectiform due to well marked median carina, interrupted by posterior transverse sulcus only, punctured ; prozona longer than metazona, latter with posterior margin angular (fig. 147). Prosternal tubercle short, pyramidal (apex spine-like) ; mesoternal lobes with rounded inner margins ; metasternal lobes separated (fig. 149). Tegmen a little longer than abdomen, opaque throughout, more so in basal half with thick reticulation. Wing as long as tegmen. Posterior femur stout with filiform apical portion. Posterior tibia with 10 to 11 internal and 9 to 10 external spines. Tympanum closed. Abdomen carinated medially. Supra-anal plate more or less tongue-shaped, with apex broadly angulate, shallowly sulcate in basal half and with furcula (F) (fig. 150) ; subgenital plate navicular, with rounded apex ; cercus longer than supra-anal plate, conical, incurved and acute at apex (fig. 151).



Epistaurus sinetyi

Fig. 146. Head, ♂, dorsal view showing transverse cerina (T.) in between eyes.

Fig. 147. Pronotal disc, ♂ dorsal view.

Fig. 148. Face, frontal view (E—eye ; F—frontal ridge ; A—antenna).

Fig. 149. Meso- and metasternal lobes, ♂, ventral view

Fig. 150. Supra-anal plate, ♀, showing (F) furcula

Fig. 151. Anal cercus, ♂, lateral view (Figs. 150 and 151 same scale).

Fig. 152. Meso- and metasternal lobes, ♀, ventral view

Fig. 153. Anal Cercus, lateral, ♀, lateral view (Figs. 146-149 and 152, 153 same scale).

Females : Very similar to males except differing in the following minor features :-Size a little longer. Posterior tibia with 10 internal and 9 external spines. Meso-and metasternal plates somewhat different (fig. 152). Valves of ovipositor coarsely impress-punctate ; anal cercus short, compressed basad and acute apicad (fig. 153).

Colouration : General colouration dark-brown. Antennae brownish, apical segments darkened. Tegmen dark-brownish with spots which are hardly detectable. Wing vermillion-red basad with margins infuscate. Posterior femur yellowish, in males, trifasciate. Posterior tibia brownish basad, followed by a pale ill defined yellowish ring, thereafter reddish ; spines black tipped. Posterior metatarsus dark-brown. Abdomen brown to dark-brownish ; only a few scattered spots visible in females, in males, not neticeable.

The colouration of the specimens at hand differs in two points from that of the description of types which are stated to be "Pale reddish and wings yellowish hyaline".

Measurements : Body ♂ 13.0-13.5, ♀ 15.0-17.5 ; head ♂ 1.0-1.5, ♀ 2.0-2.2 ; antenna ♂ 7.0-7.5, ♀ 6.5-7.0 ; prozona ♂ 2.0-2.2, ♀ 2.5-2.7 ; metazona ♂ 1.5-1.7, ♀ 1.75-1.9 ; tegmen ♂ 11.0-11.2, ♀ 13.0-13.2 ; post. femur ♂ 9.0-9.2 ; ♀ 10.0-10.2 ; post. tibia ♂ 8.0-8.5, ♀ 9.25-9.5.

Diagnostic features : The species resembles that of other oriental species, *E. aberrans* Brunner, 1893, known so far from Burma, in having vertex longitudinally carinated, with a very unique transverse carina between eyes ; frontal ridge round, arched basad, widest between antennae, shallowly sulcate ; tectiform median carina of pronotum traversed by posterior sulcus only and fully developed tegmen with truncate apex.

Unique in form of red abdomen with spots on either side of median line, trifasciated posterior femora, male with tongue-shaped supra-anal plate, with apex broadly angulate and with conical and incurved anal cerci. In *aberrans* abdomen brown, post. femora indistinctly bifasciated, male supra-anal plate quadrate and cerci curved, deflexed and pointed at apices.

Colouration of wing (red) different from that of *aberrans* (yellowish).

Remarks : It is yet a little known species and reported so far to occur in isolated areas such as Tamil Nadu, Sri Lanka and West Bengal. Dr. Jago has kindly confirmed the identification of the species.

Genus (27) **Circocephalus** Willemse

1928. *Circocephalus* Willemse, *Zool. Meded. Leiden*, **11** : 1.

Type species : *Ciroocephalus micropterum* (de Haan, 1842).

Small to medium sized insects. Antenna filiform, almost equal in length of head and pronotum taken together. Fastigium of vertex elongate, extending in front of eyes. Upper part of frontal ridge arched forwards and projected over lower part of face. Eye big, projecting. Pronotum somewhat narrowed in front, elongate, slightly tectiform dorsally due to prominent medium carina which runs through entire length. Prosternal tubercle conical ; mesosternal lobes with rounded inner angles. Tegmina shortened, not exceeding first abdominal segment, always lateral and lobiform.

Distribution : India and Java.

Only 1 endemic species occurs in India.

37. **Circocephalus indica** Bhowmik and Halder

(Figs. 142-144, Plate XII, figs. 281-282)

1982. *Circocephalus indica* Bhowmik and Halder, *Geobis new Reports*, **1** : 8-10, 5 figs.

Distribution : West Bengal (India).

Material : 1 ♂, Jayanti, Jalpaiguri, Tarai, West Bengal ; 4.9.1975. *H. K. Bhowmik* coll. 1 ♂ ; Naxalbari, Darjeeling, Duars, W. B. ; 13.9.1975 ; *P. Halder* coll. ; Bhutanghat, Jalpaiguri, W. B. 6.9.1975 ; *H. K. Bhowmik* coll. 5 ♀ ; Rydak, Jalpaiguri Tarai, W. B. ; 12.9.1975 ; *H. K. Bhowmik* coll.

Description : Males (Pl. XII, fig. 281) : Elongate. Dark to dark brown varied with testaceous ; rugose-punctate. Head a little longer than half of pronotum ; dark-brown ; fastigium of vertex elongate, extending in front of eyes, deeply concave, reclinate in front margin, lateral carinulae prominent but somewhat sinuous, with a median thin, linear carinula which extends behind to head and in continuation with median carina of pronotum (fig. 142) ; foveolae visible from above, concave, almost triangular. Frontal ridge arched above (just after fastigial margin), a little sulcate, with two clear black transverse bands, one in between antennae, another a little below first one, remaining portion of ridge almost flat, oblique (because frons is also oblique), carinulae weak but somewhat divergent towards clypeus, suture punctured ; lateral carinae prominent, linear and with scattered dark spots ; facial region yellowish, though mandibles etc. a little dark. Eye very big, roundish, projected beyond level of head and pronotum, approximating, separated by lateral carinulae of fastigium ; behind each eye there is a wide dark band which runs beyond and up to superior margin of lateral pronotal lobes. Antenna filiform, with elongated segments, 3rd and 4th segments somewhat depressed, larger than 2nd segment, followed by 2 to 3 smaller segments, remaining segments elongate, rounded, followed by conical apical segments, colouration dark to brown except apical 3 to 4 segments which are pale yellowish. Pronotum elongate, coarsely punctured all over, slightly

tectiform due to prominent median carina, which is cut by 3 usual sulci, lateral carinae perceptible being represented by pigments only, almost linear, very inconspicuously divergent in posterior area of metazona, latter about half of prozona (as long as pronotal disc anterior to 1st sulcus) and with truncate but a little wavy posterior border ; lateral lobes with a very wide oblique dark band in middle which is more conspicuous between 2nd and 3rd lateral sutures, lower broader yellowish. Prosternal tubercle (fig. 143) conical, slightly bent ; mesosternal lobes with rounded postero-internal angles, interspace as wide as one of its lobes ; metasternal lobes separate ; pro-, meso- and metasterna greenish yellow with black areas. Tegmen as long as 1st abdominal segment, punctured, costal half dark, anal half brownish. Abdomen with a median carina, punctured above, with 2 lateral yellowish, more or less uniform, dark bands which run along middle ; last abdominal segment with a pair of dentates in middle of supra-anal plate ; latter, somewhat tongue-shaped, broadly angular at apex and with a suture where abdominal dentates cover it (fig. 144). Cercus a little compressed, constricted in middle, incurved, apical region more or less dilated with a depression on it and upturned (fig. 154). Both anterior and middle femora round ; posterior femora robust, testaceous, with 2 dark transverse bands, hinder one largest and expanded below, incomplete, this band extends from lower external carinula to lower inner carinula, outer one ring-like, complete ; upper carinae dentate ; knee dark ; lower marginal lobe and inside reddish. Posterior tibia multicoloured, base dark followed by a pale yellow ring, this in turn followed by a long black ring ; apex bright red ; 9 internal and 8 external spines ; in black ring area, spines black, in red area, red with black tipped.

Females (Pl. XII, fig. 282) : Very similar to males except more robust in size and differ in some minor details. Fastigium appears a little less concave. 3rd to 10th antennal segments somewhat depressed. Impression of lateral pronotal carinae somewhat divergent posteriorly. 9 internal and 7 external tibial spines. Cercus short, conical. Valves of ovipositor typical. Colouration of body slightly more blackish, indistinct ; abdominal band less prominent (degree of colouration varies due to state of preservation).

Measurements : Body ♂ 22-23, ♀ 28.1-29.1-31 ; head ♂ 3-3.2, ♀ 3.15-3.75-3.9 ; maximum width of head ♂ 2.8-3, ♀ 2.9-3-3.1 ; antenna ♂ 7.0 (tip broken), ♀ 10.9-11.1-12 ; pronotum ♂ 5.2-5.5, ♀ 6-6.2-7 ; maximum width of pronotum ♂ 2.25-2.5, ♀ 4.1-4.5-4.7 ; prozona ♂ 3.1-3.3, ♀ 4-4.3-4.6 ; metazona ♂ 2.1-2.25, ♀ 2-2.1-2.5 ; tegmen ♂ 4-4.2, ♀ 4.5-5.6 ; post. femur ♂ 12-13, ♀ 16-16.45-17 ; post. tibia ♂ 10-10.5, ♀ 13-14-14.8.

Remarks : The species described above is the first record of the genus from India. Dr. N. D. Jago, PSO I/c Acridid Taxonomy of Centre for

Overseas Pest Research, London, has kindly confirmed it as a new species of *Circocephalus*. He has, however, expressed some doubt about the generic identity of the species saying that specimens sent to him "match no BM material and are certainly in a genus related to *Trulia*. The species is thus new but its generic identity is open to some doubt". Thus the species described occupies, perhaps, an intermediate position between *Circocephalus* Willemse, 1928 and *Trulia* Stal, 1873, and so, in the present state of our knowledge, the species fits in with no species of either genus. The description and illustrations given, it is hoped, will help the experts, in future, to settle its status finally while revising the genera. The new species, however, unique by having an elongated appearance, wavy lateral carinulae of fastigium and arched frontal ridge.

The species seems to be abundant throughout the 'Duars' and 'Tarai' of the eastern Himalayas (lat. 26°N to 27°N and long 88°E to 90°E, elevation 75 metre to 300 metre). The climate of the area is tropical (temperature above 27°C in summer) associated with heavy annual rainfall (avarage 300 cm to 400 cm). The forest is dense with evergreen trees and tea plantations.

VII. Subfamily TROPIDOPOLINAE

Key to genera

Size medium. Fastigium of vertex parabolic, convex ; frontal ridge almost flat. Prosternal spine strongly widened, with lateral margins raised, producing a wide groove between them, on dorsum, inclined backwards, touching mesonotum ; mesosternal lobes contiguous only in anterior third only. Wing rounded at apex, shorter than abdomen ...	*Tristria* Stal
Size moderately stout. Fastigium of vertex obtuse angular ; frontal ridge somewhat sulcate, gradually narrowed towards apex. Prosternal spine conical, compressed laterally, inclined but not touching mesonotum ; mesosternal lobes meeting in a straight line. Wing acute at apex, longer than abdomen ...	*Oxyrrhepes* Stal

Genus (28) **Tristria** Stal

1873. *Tristria* Stal, *Recens. Orth.*, **1** : 80.

1907. *Metapula* Giglio-Tos, *Boll. Musei Zool. Anat. Camp. R. Univ. Tornio*, **22** : 1.

1921. *Tapinophyma* Uvarov, *Ann. Mag. nat. Hist.*, **7** (9) : 496.

Type species : *Tristria lacerta* Stal, 1873.

Size medium (23-42), with integument finely rugulose. Antenna shorter than head and pronotum taken together, thick filiform, compressed on basal

half. Head conical, with rounded apex ; frons strongly oblique ; frontal ridge flat, narrowing towards apex or with parallel margin ; fastigium of vertex parabolic, convex, with a median carinula ; interocular distance wide. Pronotum with flattened dorsum, tricarinate, cut by 3 sulci ; metazona much shorter than prozona, its posterior margin excurved and broadly rounded. Prosternal process curved backwards, almost square in cross section, strongly widened apically, with square, flat or slightly concave apical surface ; mesosternal lobes contiguous for short or longer distance. Tegmen fully developed or shortened. Last abdominal tergite of males with or without a triangular projection on posterior margin on either side. Male cercus with acute or subacute apex, conical or with apical part compressed, incurved and down curved. Subgenital plate acutely conical or somewhat compressed. Subgenital plate of female with or without a triangular projection on posterior margin on either side of egg guide.

Distribution : Africa ; China ; India ; Java ; Sri Lanka ; Thailand.

Only 1 species in India.

38. **Tristria pulvinata** (Uvarov)

(Figs. 154-159, Plate VIII, fig. 256)

1921. *Tapinophyma pulvinata* Uvarov, *Ann. Mag. nat. Hist.*, **7** (9) : 497.

1929. *Tristria pulvinata* : Uvarov, *Revue suisse Zool.*, **36** : 559.

Distribution : India (Assam ; Bihar ; Karnatak ; Maharastra ; Tamil Nadu ; Uttar Pradesh ; West Bengal) and Sri Lanka.

Material : 3 ♂, 4 ♀ ; Botanical Garden, Howrah, 16.5.80 ; *P. Halder* coll.

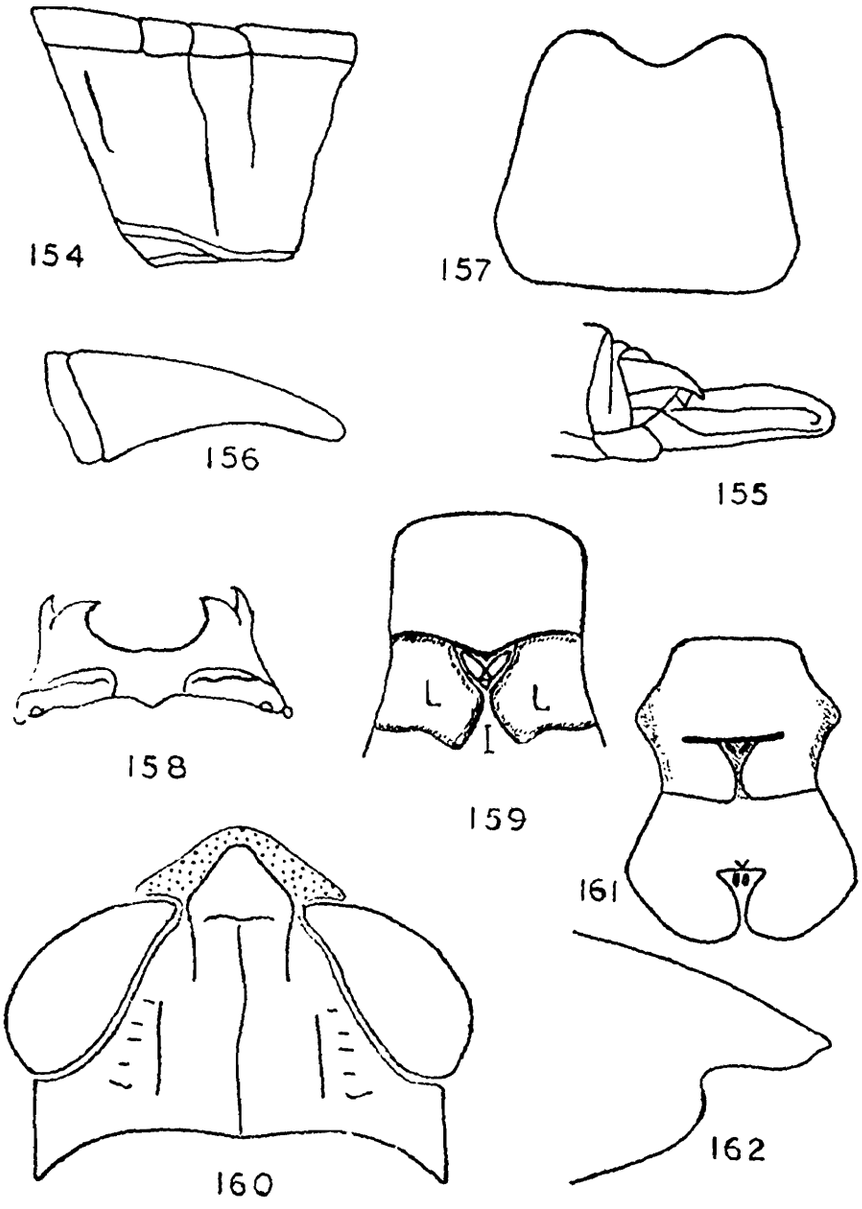
(Also 1 ♂; Jamduar, Goalpara Dist., Assam ; 11.3.1957 ; *B.K. Tikader* coll.

Description : Males (Pl. VIII, fig. 256) : Antenna filiform. Fastigium of vertex parabolic, moderately narrow. Mesosternal lobes contiguous in anterior third only. Prosternal tubercle as figured (157). Tegmina and wings fully developed, extending up to apex of subgenital plate or shorter. Tympanum prominent, close. Last abdominal tergite with a triangular projection on posterior margin on either side of mid line ; cercus subconical in basal two-thirds, apical third compressed, incurved and directed slightly downwards (fig. 156). Supra-anal plate rather wide, gradually tapering to an angular apex, sulcated on basal half ; subgenital plate on ventral view almost linear, strongly produced, upturned, tapering, strongly compressed laterally to form a dorsal ridge, apex round. Epiphallus as figured (158). Posterior femur narrow ; post. tibia with 11 internal and 14 external spines.

Females : Essentially very similar to males except a little larger in size. Mesosternal lobes very close (fig. 159).

Colouration : General colouration uniformly olive-brown.

Measurements : Body ♂ 25-25.5, ♀ 37-40.5 ; head ♂ 4-4.5, ♀ 5-5.5 ; maximum width of head ♂ 2-2.4, ♀ 3-3.4 ; antenna, ♂ 6.5-7, ♀ 8-8.5 ; pronotum ♂ 4-5, ♀ 6-6.8 ; maximum width of pronotum ♂ 2.8-3, ♀ 3.8-4 ; minimum



Tristria pulvinata

Fig. 154. Pronotal lobe, male, side view X 11.
Fig. 155. Abdominal tip, male, lateral view X 5.
Fig. 156. Cercus, male, lateral view X 11.
Fig. 157. Prosternal tubercle, male, dorsal view X 11.
Fig. 158. Epiphallus, dorsal view X 18.
Fig. 159. Mesosternal lobes, female X 5. Note closeness of lobes, almost contiguous.

Oxyrrhepes obtusa, female

Fig. 160. Head, showing festigium of vertex, dorsal view X 11.
Fig. 161. Meso- and metasternal lobes, ventral view X 5.
Fig. 162. Apex of tegmen X 5.

width of pronotum ♂ 2.5-2.8, ♀ 3-3.5 ; prozona ♂ 2.5-3, ♀ 4-4.4 ; metazona ♂ 1.6-2, ♀ 2-2.5 ; tegmen ♂ 15-17, ♀ 23-25 ; post. femur ♂ 13-14, ♀ 19-20 ; post. tibia ♂ 10-11, ♀ 15-16.5.

Diagnostic features : According to Hollis's (1970) revisional works this species belongs to pisciforma group for having curved and flattened male cercus, triangular projections on posterior margin of last abdominal tergite in male (fig. 155), angular projections on posterior margin of female subgenital plate and almost regular ventral margin of episternum. The species is very close to the only other oriental species of the genus, *T. pisciforme* (Serville, 1839), but differs cheifly in having almost linear shape of male subgenital plate (on ventral view) (vs triangular shape of the latter).

Remarks : The species is abundant in plain grasslands. It is a tropical species. Recently I have collected a good numbers from Botanical garden (Howrah) with nymphal stages and from Viziagaram, Andhra Pradesh.

Genus (29) **Oxyrrhepes** Stal

1873. *Oxyrrhepes* Stal, *Ofvers Vetensk. Akad. Forh., Stochh., Stochholm,* **30** (4) : 40, 53.

Type species : *Opsomala lineatitarsis* Stal, 1860.

Size moderately stout. Antenna filiform, set between eyes or scarcely in front of them. Fastigium of vertex short, sloping, rectangular or obtuse at apex. Frontal ridge sulcate, narrower above, but not compressed. Pronotum depressed above between carinae ; punctured ; metazona obtusely angulated behind. Prosternal spine conical or compressed ; mesosternal lobes meeting almost in a straight line (fig. 161). Posterior femur reaching apex of abdomen ; posterior tibia with about 12 spines on each superior margin, in addition to, apical spine. Tegmen and wing fully developed ; former hyaline, opaque and densely reticulated basad, hardly expanded on costa. Wing hyaline, pointed, twice as long as broad. Male subgenital plate not compressed.

Distribution : Ethiopian and Oriental countries.

Only 1 species occurs in India.

39. **Oxyrrhepes obtusa** (de Haan)

(Figs. 160-162, Plate VIII, figs. 257-258)

1842. *Acridium* (*Oxya*) *obtusum* de Haan, *Temminck Verhandel Orth.,* **16** : 155.

1860. *Opsomala lineatitarsis* Stal, *Eugenic's Resa,* **3** : 324.

1870. *Acridium extensum* Walker, *Cat. Derm. Salt. Br. Mus.,* **3** : 586.

1870. *Oxya obtusa* : Walker, ibid., **4** : 647.

1870. *Heteracris strangulata* Walker, ibid., **4** : 665.

1870. *Heteracris antica* Walker, ibid., **4** : 668.

1873. *Oxyrrhepes lineatitarsis* : Stal, *Recens. Orth* , **1** : 73.

1910. *Oxyrrhepes extensa* Kirby, *Syn. Cat. Orth.*, **3** : 402.

1931. *Oxyrrhepes celebesia* Willemse, *Treubia* **12** (suppl) : 197.

1955. *Oxyrrhepes obtusa* : Willemse, *Public. nat. Hist. Gen. Limburg, Reeks.* **8** : 32.

Distribution : Burma ; China ; Far East countries ; India (Arunachal Pradesh ; Karnatak ; Sikkim and West Bengal).

Material : 1 ♀ ; Mohan Tea Estate, Sukna, Darjeeling dist., 16.2.74 ; *H. K. Bhowmik* coll.

(Also **1** ♀ from Amatulla, Kameng, NEFA ; 8.3.1961 ; K. C. J.)

Description : Female (Figs. 259-258) : Body moderately stout. Head as wide as pronotum in front, brown, almost half length of pronotum. Fastigium of vertex separated by an almost straight sulcus, lateral carinulae continued backwards over vertex (fig. 160) ; a median carinula runs through middle of vertex. Frons moderately oblique, punctured ; lateral carinae start behind scape—straight but divergent towards extremity. Pronotum deeply and densely punctured throughout ; prozona (4.4) longer than metazona (4), median carina prominent, cut by all 3 sulci ; lateral carinae linear and indicated by no definite line but by punctuation only, almost obliterated at posterior margin of metazona ; lateral lower margin of lateral lobes almost straight. Prosternum with a prominent and compressed curved spine, inclined towards back ; mesosternal lobes approximating, separated from each other by a broad straight partition line ; metasternal interspace a little wider than preceeding one (fig. 161). Tegmen exceeds abdomen by one sixth of its length, acute at apex (fig. 162) ; wing almost subequal to tegmen, hyaline, slightly clouded towards margins. Anterior and median femora rounded ; posterior femur slender, elongate, as long as tip of abodmen ; lower lobe of knee subacute, more projected than upper one. Posterior tibia with 12 internal and 12 external yellowish spines with black tips. Abdominal dorsum partially damaged ; subgenital plate somewhat trilobed ; ovipositor with curved valves.

Colouration : General colouration brownish varied with yellow. Tegmina yellowish, with brown venations ; wings hyaline with brownish venations.

Measurements : Body 46 ; antenna (broken) ; head 5 ; maximum width of head 5 ; minimum width of interocular distance 2 ; pronotum 8.4 ; prozona 4.4 ; metazona 4 ; tegmen 42 ; maximum width of tegmen 6 ; post. femur 25 ; maximum depth of post. femur 4 ; post. tibia 20.5 (measured one female).

Diagnostic feature : The species is distinguishable by its approximating mesosternal lobes, and insertion of antennae in the proximity of eyes.

Remarks : The species must be a very rare one. Since only the female specimen was available in tea garden at Sukna, at the foothill of Darjeeling-Himalayas, during winter season. In NEFA specimen, there is a distinct dorso-median black line over the 1st and 2nd segments of hind tarsi.

VIII. Subfamily CYRTACANTHACRIDINAE

Key to genera

1.	Tegmen with apex obliquely truncate : apical part with regular oblique (feather-like) reticulation ...	*Pachyacris* Uvarov
—	Tegmen with apex rounded or obliquely rounded ; veinlets in apical part more or less perpendicular to veins ...	... 2
2.	Prosternal spine straight, vertical or only slightly inclined (but never bent) towards mesosternum, but not reaching latter and usually compressed laterally...	*Patanga* Uvarov
—	Prosternal spine curved backwards, angularly bent and touching or almost touching mesosternum, inflated in middle, with acute or subacute conical apex ...	... 3
3.	Pronotum moderately tectiform, slightly constricted, Integument finely rugose or dotted, almost smooth (never tuberculate). Male cercus with subacute apex. Upper carina of externo-median area of posterior femur convex. Wing lemon-yellow. Disc of pronotum smooth and velvety ...	*Cyrtacanthacris* Walker
—	Pronotum strongly tectiform. Integument strongly granulose. Male cercus incurved, at base about half as wide as its length. Upper carina of externo-median area of posterior femur straight or practically so. Wing rose-coloured. Disc of pronotum covered with tubercles and rugosities ...	*Chondracris* Uvarov

Genus (30) **Pachyacris** Uvarov

1923. *Pachyacris* Uvarov, *Ann. Mag. nat. Hist. Lond.*, **11** (9) : 477.

Type species : *Acridium violascens* Walker, 1870.

Fastigium of vertex may be almost flat or distinctly impressed, more or less reclinate. Frontal ridge parallel-sided or slightly dilated above median ocellus. Pronotum with median carina somewhat developed with three distinct transverse sulci. Tegmen with apex obliquely truncate ; apical part with regular oblique (feather like) reticulation. Wing distinctly elongate, coloured.

Distribution : Two species are known in this genus, both from the oriental region.

40. **Pachyacris vinosa** (Walker)

(Fig. 164, Plate VIII, fig. 261)

1870. *Acridium vinosum* Walker, *Cat. Derm. Salt. Br. Mus.*, **3** : 588.

1900. *Cyrtacanthacris wingatei* Kirby, *Ann. Mag. nat. Hist.*, **7** (6) : 881.

1914. *Orthacanthacris vinosa* : Kirby, *Fauna British India, Orth.*, **1** : 288.

1923. *Pachyacris vinosa* : Uvarov, *Ann. Mag. nat. Hist.*, **11** (9) : 478.

Distribution : Burma ; China and India.

Material : H. P. : 1♂, 3♀ ; Pandoh, Mandi dist., 18.9.80. 1♂ ; P. W. D. Rest House, Mandi, 17.9.80. 1♀ ; Mandi 19.9.80. 3♂, 2♀ ; Moreh, Manipur ; 25.11.83. 1♀ ; Temu, Burma ; 24.11.83.

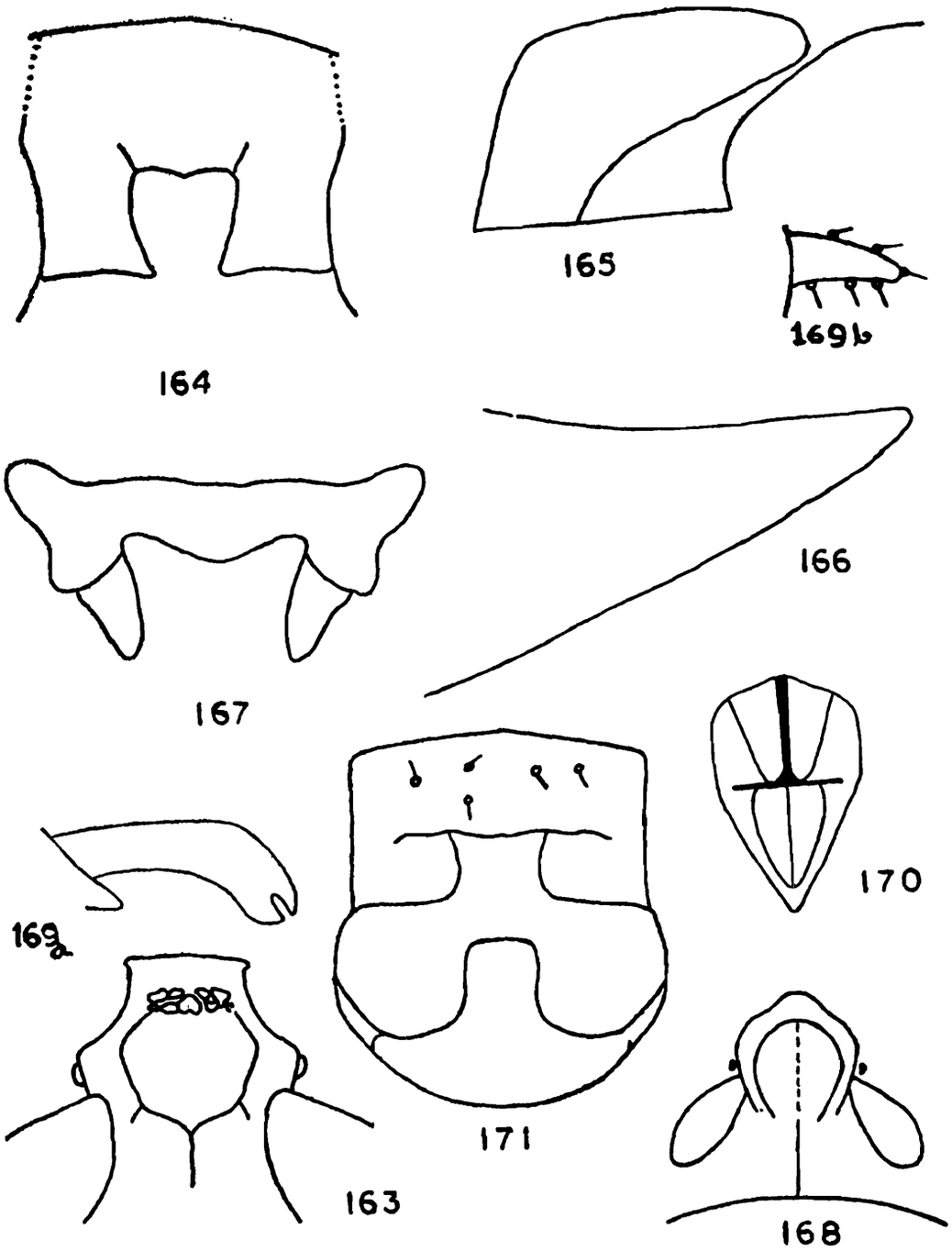
Description : Males : Size moderately large. Antenna filiform, longer than head and pronotum taken together. Fastigium of vertex almost flat, distinctly sloping. Frontal ridge slighly sulcate, thickly punctuated throughout, slightly narrowed at middle ocellus but a little dilated above it. Pronotum densely punctate, with median carina somewhat tectiform, with 3 transverse sulci, prozona subequal to metazona. Prosternal tubercle pyramidal. Mesosternal lobes as figured (164). Tegmen with apex obliquely truncate ; apical part with regular oblique, feather-like reticulation. Posterior femur stout, pilose ; posterior tibia with 11 internal and 7 external spines ; spines yellowish in one side but their tips and backsides black. Subgenital plate compressed, short, acutely pointed. Cercus conical, thin, very acute, spine-like, incurved.

Females (Pl. VIII, figs. 261) : Very similar to males except larger in size. Supra-anal plate transverse, broadly angulated apically ; valves of ovipositor short, curved, lower valves with a pair of ventral projections.

Colouration : Colouration brownish varied with pale yellow (behind eyes and lateral lobes of pronotum). Antenna yellowish. Sometimes posterior margin of head of vermillion colour. Metazona narrowly streaked with yellow on posterior margin. Tegmina subopaque and may be with more numerous darker spots, forming somewhat distinct narrow oblique fasciae in apical areas. Sometimes spots on tegmina may be inconspicuous and obsolete. Wing infumate throughout with rosy base. Posterior femur whitish on both sides and banded with lighter and darker brown bands. Body pilose.

Measurements : Body ♂ 35-36, ♀ 44-46 ; antenna ♂ 13-14, ♀ 19-20 ; prozona ♂ 4.5-4.75, ♀ 6-6.5 ; metazona ♂ 4-5, ♀ 6-6.5 ; tegmen ♂ 33-34, ♀ 48-49 ; post. femur ♂ 19-20, ♀ 26-27 ; post. tibia ♂ 18-19, ♀ 25-26.

Diagnostic features : This species is unique in having almost flat, distinctly reclinate fastigium of vertex ; a little dilated frontal ridge above middle



Patanga japonica

Fig. 163. Fastigium of vertex, female, dorsal view X 11.

Pachyacris vinosa

Fig. 164. Mesosternal lobes, male X 5.

Cyrtacanthacris tatarica, male

Fig. 165. Prosternal tubercle, lateral view X 24.
Fig. 166. Tip of sub-genital plate, lateral view X 11.
Fig. 167. Epiphallus, dorsal view X 28.

Peripolus pedarius

Fig. 168. Fastigium of vertex, female, dorsal view X 5.
Fig. 169a. Cercus, male, lateral view X 5.
Fig. 169b. Same, female, lateral view X 5.
Fig. 170. Supra-anal plate, male, dorsal view X 11.
Fig. 171. Meso- and metasternal lobes, ♀ ventral view X 11.

ocellus ; more or less patterned colouration of apices of tegmina and finally rosy basal halves of wings.

It differs from the only other Indian species, *P. violascens* (Walker, 1870) by the above quoted features. In the latter species fastigium of vertex distinctly impressed, less sloping ; frontal ridge not dilated above ocellus ; tegminal colouration not patterned : it is covered with very small, indistinct, scattered darker spots ; and finally by violasenous basal half of wing.

Remarks : This species is more abundantly found in India (W. B. including North Bengal ; Lushai Hills ; Aijawl ; Kumaon ; Chota Nagpur, H. P.) and Nepal (Monda) than the other species of the genus. Both of them are yet inadequately known and nothing is known about their biology etc. No specimen was available to me from W. B. for the present study. Recently Bhowmik and Halder (1983) has contributed to its morphology, illustrated suitably.

Genus (31) **Patanga** Uvarov

1923. *Patanga* Uvarov, *Ann. Mag. nat. Hist.*, **12** (9) : 364.

Type species : *Gryllus locusta succinctue* Johanson, 1763.

Face vertical or slightly reclinate. Frontal ridge somewhat parallel-sided, sometimes slightly constricted at apex, somewhat impressed below median ocellus. Pronotum distinctly compressed laterally and constricted in prozona, rounded, median carina low and almost obliterate. Prosternal process somewhat compressed laterally, inclined, but not bent towards mesosternum, not nearly reaching latter. Mesosternal lobes with their inner margins more or less concave, so that their interspaces somewhat cordiform. Posterior femur long, slender, with apical part attenuate. Male cercus laterally compressed, long, with apex attenuate, decurved and incurved.

Distribution : China ; India ; Japan ; Pakistan, Sri Lanka and Sumatra.

2 species occur in India.

According to gago (1981 : *Plant Prot. Bull.* **33** (3 & 4) : 39-40) the genus *Patanga* now contains three subgenera.

41. **Patanga (Patanga) japonica** (Bolivar)

(Fig. 163, Plate VIII, figs. 259-260)

1898. *Acridium japonicum* Bolivar, *Annli. Mus. civ. Stor. nat. Giacomo Doria Genova*, **39** : 98.

1914. *Orthacanthacris japonica* : Kirby, *Fauna British India, Orth.* **1** : 229.

1933. *Acridium japonicum* var. *immaculata* Sjostedt, *Art. Zool., Stockholm*, **25**A (3) : 32.

1923. *Patanga japonica* : Uvarov, *Ann. Mag. nat. Hist.*, **12** (9) : 364.

Distribution : China ; India : (Sikkim ; West Bengal) ; Japan ; Pakistan.

Material: 1 ♀ ; Saurini Basti area, Mirik (alt. ca. 1650 m). Darjeeling ; 23.6.1979 ; *P. Halder* coll. 1 ♀ ; Near forest Rest House, Mirik, Darjeeling, 22.6.1979, *P. Halder* coll.

Description : Females (Pl. VIII, figs. 259-260) : Antenna filiform, just as long as head and pronotum taken together (as 15 to 15-16). Fastigium of vertex with somewhat deep concavity, its lateral margins being raised, anterior margin broad and widely blend with frontal ridge (fig. 163). Face vertical. Frontal ridge parallel-sided with raised carinulae, impressed punctate ; facial carinae prominent, linear. Pronotum distinctly compressed laterally, punctate, crossed by 3 sulci ; prozona as long as or shorter than metazona, posterior margin of metazona rounded off in middle. Prosternal spine cylindrical, and with rounded apex, a little inclined. Mososternal interspace as wide as one of its lobes, a little more closer at posterior end, lobes with angular inner ends, somewhat concave at inner margins ; metasternal interspace open with distinct furcal suture (Meso- and metasternal almost identical to *C. tartarica*). Tegmen with coarse and irregular reticulation ; precostal vein not detectable, its place being occupied by coarse reticulation ; costal and medial areas prominent and coarsely reticulate ; apex rounded. Cercus short, conical, spine-like. Supra-anal plate tongue-shaped ; subgenital plate with almost truncated margin. Ovipostital valves moderately curved. Posterior femur long, slender, with apical area moderately filiform, upper carinae with distinct denticles ; posterior tibia with 7 to 8 external and 10 to 11 internal whitish black-tipped spines.

Colouration : General colouration more or less pale varied with greyish and brownish. Antenna pale brownish or darker. A pale yellow stripe runs from fastigium of vertex, along median carina of pronotum and continues to suture of closed tegmina. A broad blue-black stripe below each eye. Tegmen brownish basad, yellowish apicad, with big brownish spots along marginal and radial sectors. Wing rosy basad and distinctly infumate apicad. Denticles of upper carina black and there is a narrow, linear black streak along upper carinula of post. femur for about two-thirds of its length from anterior end—a characteristic identity for the species.

Measurements : Body 50-51 ; head 4-4.2 ; maximum width of head 4.5-5 ; interocular distance 2-2.2 ; antenna 15-15.25 ; pronotum 10-11 ; maximum width of pronotum 8-8.2 ; prozona 5-5.15 ; metazona 5-6 ; tegmen 47-49 ; maximum width of tegmen 8-8.5 ; post. femur 28-29 ; post. tibia 24-25.

Diagnostic features : The colouration of the species is unique which is never greenish (vs *P. succinta* Linnaeus, 1763, where it is mostly greenish). Besides, its smaller size, comparatively shorter prozona, colouration of tegmina and posterior femora easily distitinguish it from the other species.

Remarks : The species is available in high hills of evergreen forests (Kurseong, Dow Hill, E. Himalayas, alt. 1950 m) as well as in hot, tropical forests (Siliguri and Mirik). It is, however, a rare species in Indian fauna.

Genus (32) **Cyrtacanthacris** Walker

1870. *Cyrtacanthacris* Walker, *Cat. Derm. Salt. Br. Mus.*, 3 : 550 ; Uvarov, 1923. *Ann. Mag. nat. Hist.*, **11** (9) : 139.

Type species : *Gryllus locusta tataricus* Linnaeus, 1758.

Large insects with slightly granulated and punctate or dotted bodies. Antenna filiform. Fastigium of vertex angular, with depression in middle ; frontal ridge narrow, almost flat, with slight depression at ocellus, narrower than interocular space. Pronotum moderately tectiform, a little constricted at prozona, with obtuse median carina ; metazona with angular posterior margin. Posternal tubercle large, strongly curved backwards and almost touching mesosternum, compressed at base, widened in middle and gradually tapering to subacute apex. Tegmen and wing developed, former semi-membranous, with dense, irregular venation basad and apical half with regular, elongated cells ; apex rounded and with scattered brownish spots. Male supra-anal plate somewhat trilobate, with angular apical lobe ; cercus compressed, subconical, with subacute apex ; subgenital plate long, acutely conical ; epiphallus without distinct ancorae, and hook-like lobiform lophi. Ovipositor with curved valves, lower one with subacute external, lateral projection.

Distribution : India (common) ; Nepal ; Mediterranean region ; South and Central America ; Sri Lanka ; Western Asia.

Only 1 species occurs in India.

42. **Cyrtacanthacris tatarica** (Linnaeus)

(Figs. 165-167, Plate I, figs. 218-219, Plate IX, figs. 262-263)

1758. *Gryllus Locusta tataricus* Linnaeus, *Syst. Nat.* (10th ed) : 432.

1923. *Cyrtacanthacris tatarica* : Uvarov, *Ann. Mag. nat. Hist.*, **11** (9) : 139.

Distribution : Africa ; Oriental countries. In India, it is widely distributed : Andhra Pradesh (Nagarjun Kunda Dam) ; Orissa (Chilka Lake) ; Tamil Nadu (Nilgiri) ; W. B. (Calcutta and North Bengal).

Material : 4♂, 4♀ ; Bijanbari, Naxalbari, Darjeeling ; 12.9.1974 ; *H. K. Bhowmik* coll. 1♂, 1♀ ; Tukriajhar, Naxalbari, Darjeeling ; 18.6.1978 ; *P. Halder* coll. 1♂, 2♀ ; Mukutmonipur, Bankura ; 23.9.81 ; *H. K. Bhowmik* coll.

Description : Males (Pl. IX, fig. 263) : Size large. Fastigium of vertex rounded, shallowly concave, horizontal and reclinate with frontal ridge which is almost parallel-sided, only slightly constricted below median ocellus, slightly sulcate, smooth ; interocular distance narrow. Pronotum with a distinct median carina which is slightly tectiform on prozonal portion, flat on metazona, latter being widened laterally and broadly angular at posterior margin ; prozona and metazona subequal in length ; punctured throughout specially on lateral lobes and with a few insignificant, scattered yellowish granules on pronotal disc. Prosternal spine bent and almost touches mesosternum (fig. 165). Tegmen 5 times longer than its maximum width and characterised by not having precostal vein, its place being occupied by coarse, strong irregular reticulation (Pl. 1, fig. 218). Supra-anal plate triangular with a deep median groove. Subgenital plate conical (fig. 166). Cercus broad at base, gradually tapering at apex, slightly curved. Epiphallus as typical for the genus ; ancorae slightly indicated, lophi tooth-like (fig. 167). Posterior femur long, stout with dark denticles at upper carina ; posterior tibia with 8 internal and 6 external white red-tipped spines, internal spines more stout than external ones ; spines often dark apically.

Females (Pl. IX, fig. 262) : Similar to males except much robust. Cercus small, conical ; subgenital plate almost with truncated apex. Valves of ovipositor moderately curved. Number of tibial spines sometimes varies from 8 to 11 on internal and 6 to 8 on external sides.

Colouration : General colouration yellow or red. A median pale (yellowish) band runs from fastigium of vertex to pronotum, with a darker border on either side. There is a characteristic whitish patch on either pronotal lobe, on superior part bordered all around with dark colouration. Tegmen subhyaline, covered with irregular transverse brown reticulate spots ; costal margin green in fresh specimens, yellowish in preserved material. Wing hyaline, yellowish basad. Posterior femur testaceous, its inner and outer sides whitist ; dentates on upper carina and a narrow streak along upper and lower carinae on external side, black. Prosternal spine white with greenish tinge.

Measurements : Body ♂ 44-46 ; ♀ 58-60 ; head ♂ 3.15-4.15, ♀ 5-5.1 ; maximum width of head ♂ 3.15-4.2, ♀ 5-5.15 ; interocular distance ♂ 1.85-2, ♀ 2-2.5 ; antenna ♂ 14-17, ♀ 20-21 ; pronotum ♂ 10-11, ♀ 13.65-14 ; maximum width of pronotum ♂ 6.25-7, ♀ 9-10 ; minimum width of pronotum ♂ 4.85-5, ♀ 6-7 ; prozona ♂ 5-5.35, ♀ 6-7 ; metazona ♂ 5-5.65, ♀ 7-7.15 ; tegmen ♂ 39-41, ♀ 51.5-56 ; post. femur ♂ 25-27, ♀ 32-35 ; post. tibia ♂ 22-23, ♀ 29-32.

Diagnostic features : The species is unique in having a bent prosternal spine, touching mesosternum ; besides its conical male cercus, whitish colouration on posterior femora and on lateral lobes of pronotum and reticulated brownish

patches on tegmina (Pl. 1, figs. 218-219) are also remarkable. Besides, shape of its epiphallus is very unique.

Remarks : The species is a very common one in Indian fauna and abundantly found along with *Gastrimargus africanus africanus* both in agricultural fields and in shrubs. In Naxalbari (Dooars, Darjeeling) where it is abundant, was noticed to have caused serious damages to vegetables like Lady's finger and Chillie (Bhowmik and Halder, 1984 b).

Genus (33) **Chondracris** Uvarov

1923. *Chondracris* Uvarov, *Ann. Mag. nat. Hist.*, 9 (12) : 365.

Type species : *Acridium roseum* de Geer, 1773.

Robust insects with granulosed body. Antenna filiform. Fastigium of vertex trapezoidal ; frontal ridge slightly narrowed apicad, flat, with depression at and below ocellus, about half width of interocular distance. Pronotum highly tectiform, granulate, with high median carina ; metazona shorter than prozona, with angular posterior margin. Prosternal spine almost as in *Cyrtacanthacris* but not so approximated with mesosternum ; similarly tegmina which differ from *Cyrtacanthacris* by not having scattered brownish spots or blotches. Male cercus compressed, narrow-triangular, with slightly attenuated, incurved apex ; subgenital plate long, acutely conical ; epiphallus without ancorae and with triangular loliform lophi. Lower valves of ovipositor with angular, external, lateral projection.

Distribution : A monotypic genus, distributed all over Oriental region.

43. **Chondracris rosea** (de Geer)

1773. *Acrydium roseum* de Geer, *Mem. Ins.*, 3 : 488, pl. 41, fig. 1.

1914. *Cyrtacanthacris rosea* : Kirby, *Fauna British India, Orth.*, 1 : 231.

1923. *Chondracris rosea* : Uvarov, *Ann. Mag. nat. Hist.*, 11 (9) : 139.

Distribution : China ; India (Manipur ; North Bengal) ; Java ; Philippines.

Material : Darjeeling Dist. (Naxalbari ; 1♂, 4♀ ; 12.9.1974 ; Bamanpokri, 4♂, 8♀ ; 21-25.8.75). Jalpaiguri dist. (Bhutanghat ; 1♂ ; 16.9.75 ; Rydak ; 1♂, 2♀ ; 10.9.1975). Cooch Behar dist. (Falacata ; 2♀ ; 14.9.75). (All by *H. K. Bhowmik*.)

Description : Males : Size large ; body granulate. Antenna filiform, much longer than head and pronotum taken together. Fastigium of vertex trapezoidal, hardly depressed, reclinate ; frontal ridge shallowly concave, parallel-sided, with carinulae distinct, moderately punctate. Eye oval, projecting, interocular distance about twice width of frontal ridge. Pronotum highly tectiform, granulate ; median carina forming a strong ridge ; crossed by 3 sulci ; metazona shorter than prozona and with lateral "shoulders", its

posterior margin angular, with tip rounded off. Prosternal spine long, curved, inclined but separate from mesosternum. Tegmen long, procostal area very well developed and closely reticulate, costal area also well developed and closely reticulate, and extends up to about 4th fifth of tegmen ; subcostal area less than half width of costal area, with a series of transverse veinlets. Posterior femur long, slender, dentate ; lower knee lobe triangular-rounded, longer than upper lobe. Posterior tibia with 10 spines on each margin, internal spines longer and stronger than utter ones ; pilose with silky pubescence. Supra-anal plate triangular-rounded, with a medial wide sulcation ; subgenital plate long, conical and with apical half acutely upcurved ; cercus compressed, narrow-triangular, apex attenuate, incurved. Epiphallus without ancorae and with triangular lobiform lophi.

Females : Very similar to males except larger in size. Lower valves of ovipositor with angular, external lateral projection.

Colouration : General colouration green varied with dark-brown. Basal segments of antenna yellowish, apical ones testaceous. Eye brown. Tegmen greenish-yellow. Base of wing reddish, rest hyaline, often with greenish tinge at costal apex. Femora of legs usually greenish, tibiae etc specially of post. tibia red, spines pale yellowish, tipped with black. Medial ridge of pronotum and prosternal spine green, while lateral sides of pronotum as well as abdomen dark-brown.

Measurements : Body ♂ 63-65, ♀ 78-80 ; head ♂ 3.5-3.75, ♀ 5-6 ; maximum width of head ♂ 5-5.2, ♀ 7-7.5 ; interocular distance ♂ 3-3.2, ♀ 4-4.5 ; antenna ♂ 25-26.25, ♀ 28-31 ; pronotum ♂ 16-16.5, ♀ 21-23 ; maximum width of pronotum ♂ 8-8.25, ♀ 11-13 ; minimum width of pronotum ♂ 6-6.1, ♀ 8-9 ; prozona ♂ 8-8.1, ♀ 10-12 ; metazona ♂ 8-8.1, ♀ 10-12 ; tegmen ♂ 54-55, ♀ 70-76 ; maximum width of tegmen ♂ 10-10.25, ♀ 15-16 ; post. femur ♂ 34-35, ♀ 41-44 ; post. tibia ♂ 29-29.2, ♀ 37-40.

Diagnostic features : The species is distinguished by its greenish colouration with red bases of wings and red post. tibiae. The median crest of pronotum distingushes it from all other Indian species. Its prosternal spine and structure of epiphallus bring it closer to *C. tartarica*. But its unspotted, uniform greenish tegmina and less inclined prosternal spine (vs strongly inclined prosternal spine, touching the mesosternum) and pronotal crest differentiate it from that species beyond doubt.

Remarks : The species is generally spread over China, Java, Philippines and India. In North Bengal, it is seen in wild herbs bordering tea and rice fields in the foothills.

In the field, these insects are perfectly green in colour, camauflaging with their environment. They are good fliers and with the slightest disturbance can fly away to about 15 to 20 metres at a stretch exposing their rosy wings.

The species is one of the largest grasshoppers of the oriental region. Tandon (1975) has redescribed the species.

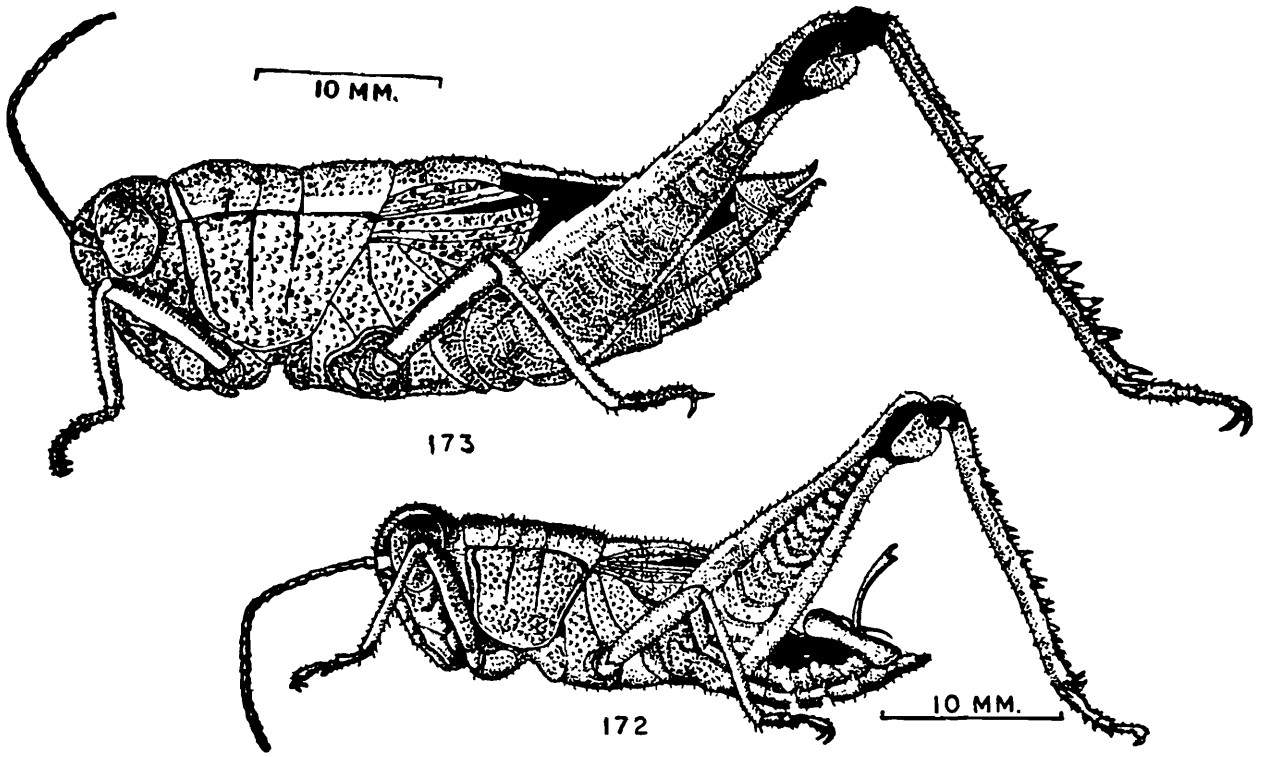
IX. Subfamily CALLIPTAMINAE

Genus (34) **Peripolus** Martinez

1902. *Peripolus* Martinez, *Ann. Soc. esp. Hist. nat., Madrid.*, **30** : 303.

Type species : *Peripolus pedarius* Stal, 1878.

Medium to large insects. Antenna filiform. Fastigium of vertex reclinate, forming an obtuse angle with frontal ridge. Pronotum tricarinate, median carina distinct, lateral carinae diverging behind or parallel-sided ; prozona longer than metazona ; both anterior and posterior margins of pronotum obtusely angulate. Tegmen short, lateral, rudimentary. Prosternal process cylindro-conical ; mesosternal lobe with inner margin obtusely angulate, interspace very narrow behind. Last two abdominal tergites of male fused, inflated and



Peripolus pedarius

Fig. 172. Profile, male

Fig. 173. Profile, female

upcurved. Male cercus large, compressed, incurved, bilobed at apex ; supra-anal plate with three longitudinal and a transverse median furrows. Supra-anal plate of female triangular and with a basal longitudinal groove and with a transverse furrow. Epiphallus plate-like, mostly trapezoidal, with ancorae and without lophi.

Distribution : India and Nepal.

2 species occur in India, with 1 endemic form.

44. **Peripolus pedarius** Stal

(Figs. 168-173, Plate IX, figs. 264-265)

1878. *Calliptamus pedarius* Stal, *Bih. svensk. Vet. Akad. Handl.*, 5 (4) : 75.

1914. *Peripolus pedarius* : Kirby, *Fauna British India, Orth.*, 1 : 261.

Distribution : Assam ; Darjeeling ; Garhwal (U. P.) ; Sikkim.

Material : 3♂ ; Tadah (Alt. c. 1650 m), Darjeeling, W. B. ; 31.7.1959 ; *H. Khajuria* coll. 6♂, 8♀ ; Phaugri Beat House, Mirik (alt. c. 1500m), Darjeeling, W. B. ; 21.6.1979 ; *P. Halder* coll. 7♂, 15♀ ; Singla, Darjeeling, W. B. ; March-April 1979 ; *Kulkarni* coll.

1♂ (type) bearing label as-"Typus/*Caloptenus pedarius* Stal del Stal/Ind. Orient/Br. v. Watt" (Type depository : *Nat. Mus. Wien* (Australia). The type nicely agrees with the specimens at our disposal.

Description : Females (Figs. 168, 169b, 171, 173, Pl. IX, fig. 265) : Stout. Head small ; fastigium of vertex (fig. 168) grooved, almost rounded, sloping, forming an obtuse angle with frontal ridge, from base of occiput a median cerinula extends up to end of fastgium ; foveolae indistinct and not visible from above. Eye prominent, lateral, brownish with dark facets ; interocular distance less than individual diameter of an eye. Lateral ocelli very much approximated to eyes. Frontal ridge prominent, flat, almost parallel-sided. Antenna filiform, longer (19-20 mm) than head and pronotum (16-17 mm) taken together ; scape very robust, almost double of pedical ; length of each middle joints about 3 times their width. Pronotum obtusely angulate both at anterior and posterior margins, intersepted by 3 transverse sulci, posterior sulci present beyond middle ; prozona (7.25-7.75) longer than metazona (5.25-5.75) ; lateral carinae moderately and gradually diverge posteriorly (9 to 9.25 as to 5.5-5.75 at anterior margin) ; median carina more prominent but very moderately tectiform (measured from the margin of lateral inferior border of pronotal lobe to lateral carinae its about 8 whereas median carina about 10) ; lateral lobes densely and coarsely punctuated (whereas in pronotal disc, it's fine and obscure due to velvety colouration) and strongly ascending posteriorly, traversed laterally by 3 distinct sulci almost up to lateral border, 2nd and 3rd sulci in continuation of 2nd and 3rd transverse sulci of disc whereas 1st sulci far in front and border anterior margin of lobe. Episternum prominent, long, roughly angulate. Prosternal tubercle cylindrical, conical. Meso-and metasternal lobes as shown in fig (171). Tegmen short, extends a little longer than 1st abdominal segment, lateral, rudimentary ; veins and veinlets obscure due to dense and very rough rugosities. Posterior leg stout, as long as abdomen ; upper carina of posterior femur serrate, medial area rosy, upper lobe smooth ; posterior tibia (23-24) slightly shorter than posterior femur (26-27), armed with 8 external and

9 internal black tipped spines, internal spines being longer than external ones ; no outer apical spine. Abdomen laterally compressed, with a median carina which is in continuation with median carina of pronotum. Supra-anal plate broadly angulate at apex, with a median groove throughout but more so at basal half and intersepted with a transverse sulcus ; subgenital plate almost flat, a little depressed in middle. Cercus short, slightly smaller than paraproct, broad at base and gradually tapers towards apex. (fig. 169b).

Colouration : Colour brownish mixed with dark in different grades and shapes ; abdomen uniformly dark, shiny. In some examples, a median dark band extends from fastigium to pronotal disc. Pronotal disc more or less velvety. Antenna yellowish brown with apical segments a little darker. Posterior femur characteristically rosy, specially medial area, upper marginal area yellowish green ; cresent areas and bases of posterior tibiae very dark ; remaining posterior tibiae yellowish-brown ; tarsi brownish. Labial and maxillary palpi yellowish.

Pubescence : Whole body covered sparsely with white, small and thin hairs except the valves of ovipositors which display moderately dense silky pubescence.

Males (Figs. 169a, 170, 172, Pl. IX, fig. 264) : Males differ from females in the following features—distinctly smaller. Body rather slender, a little more hairy. Scutellum almost straight, lateral carinae not rounded but gradually diverge towards middle from apex and then converge or run almost straight posteriorly. Lateral carinulae of frontal ridge more clear. In tegmina more pronounced black longitudinal band in medial area. Pronotal disc more depressed, smooth and shiny in colouration. Upper part of last abdominal segment stout. Cercus large, laterally compressed, curved inside and bilobed at apex, with a concavity in between (fig. 169a). Supra-anal plate (fig. 170) with 3 fine longitudinal furrows, forming 2 plates, lateral ones converge in middle of plate in a transverse sulcus ; posterior portion also grooved in middle forming two lobes ; subgenital plate short, navicular, angulate at apex.

Colouration : More patterned than females. In some cases there is a blackish band on vertex separated by median carina, and it extends up to groove of fastigium in front and up to end of pronotal disc behind. A more prominent lateral band on sides of abdomen above, intersepted by a yellowish brown band along median carina. Otherwise the colouration is more or less identical with that of females.

Nymphs : The present collection contains 2 advanced female nymphs (30-31 mm) which are easily distinguishable from their adults. Abdominal segment apically and valves of ovipositor incompletely formed ; rudiments of tegmina and wings present ; tegmen being as long as metathorax, pointed

at apex. Antenna fully formed. Otherwise nymphs are identical with the adults.

Field notes : It is an alpine species, always occuring at an altitude about 1250 m or more. The present series was collected from Phaugri Beat House, Mirik (Darjeeling district, West Bengal) having an altitude of more than 1500 m and 70% humidity in the summer. In Darjeeling, the specimens were found havering over a particular bush with broad leaves, which form their natural diet. The occurrence of two nymphs in the collection is, perhaps, indicative of the starting of a post winter new generation in June.

Measurements : Body ♂ 26-27-30, ♀ 40-41-48 ; head ♂ 3.21-3.75, ♀ 5.25-5.75 ; maximum width of head ♂ 4.1-4.5, ♀ 6.5-7 ; interocular distance ♂ 1.75-2, ♀ 2.5-3 ; maximum length/width of pronotum (lateral carinae) ♂ 6.5-7/4.9-5.25, ♀ 12-13/8.75-9 ; tegmen ♂ 4.5-4.75, ♀ 8.5-8.75 ; post. femur ♂ 16.5-17, ♀ 29-29.5 ; post. tibia ♂ 14.5-15, ♀ 23.5-24.

Remarks : The species was described from the eastern Himalayas (probably from Assam) as *Calliptamus pedarius* Stal, in 1878. It was subsequently transferred to the genus *Peripolus* Martinez (op. cit.) as the type species by Kirby (1910). Till now it is the sole representative of the genus and of the subfamily Calliptaminae in Indian fauna. Uvarov (1927) recorded its occurrence in Sikkim. He (1942) described a species, *P. nepalensis*, from Nepal which, according to him, should have been regarded as diminutive, dark and hairy subspecies of *P. pedarius* inhabiting higher altitude were it not showed appreciable difference in the shape of pronotum.

Recently a good number of examples of the species have been collected from Darjeeling. National collection of the Zoological Survey of India also contains two authentically identified examples from Garhwal and a few examples from Darjeeling.

Its occurrence in Garhwal district (a new record), other than the Eastern Himalaya indicates its probable distribution throughout the Himalayan range.

X. Subfamily CATANTOPINAE

Key to genera

1.	Tegmen lateral, lobiform, shortened, not exceeding first abdominal segment ...	...	5
—	Tegmen and wing well developed, as long as or slightly shorter than abdomen ...	...	2
2.	Pronotum slightly tectiform, asperate ; vertex between eyes wider than frontal ridge. Tegmen usually with a black spot ...		*Gerenia* Stal
—	Pronotum flat or subcylindrical ; vertex between eyes narrower than frontal ridge. Tegmen never with a black spot ...	...	3

3.	Pronotum subcylindrical, slightly narrowing forwards Prosternal tubercle thick, cylindrical or slightly anterio- posteriorly compressed with rounded apex ...	*Catantops* Schaum
—	Pronotum not subcylindrical. Prosternal tubercle not cylindrical and never with rounded apex ...	... 4
4.	Pronotum constricted. Prosternal tubercle conical. ...	*Xenocatantops* Dirsh and Uvarov
—	Pronotum flattened [not constricted]. Prosternal tubercle laterally compressed [very slender habitus] ...	*Stenocatantops* Dirsh and Uvarov
5.	Fastigium of vertex separated from frontal ridge by a distinct transverse carina ; fastigial foveolas absent ; lateral carinae of pronotum obsolete ...	*Mesambria* Stal
—	Fastigium reclinate, sloping towards frontal ridge ; foveolae prominently present ; some sort of lateral carinae of pronotum always present ...	*Paraconophyma* Uvarov

Genus (35) **Mesambria** Stal

1878. *Mesambria* Stal, *Bih. Svensk. Vet. Akad, Handl,* 5 (4) : 28, 72.

Type species : *Mesambria maculipes* Stal, 1878.

Small (13-18). Antenna filiform, often slightly thickened beyond middle, longer than head and pronotum taken together. Vertex sometimes with a median carinula ; fastigium of vertex separated from frontal carina by a distinct ridge, smooth, scarcely closed at extremity, and very slightly carinated. Frontal ridge sulcate, slightly projecting between antennae. Pronotum elongate, rugose ; median carina also extending over abdomen ; lateral carinae obsolete ; metazona much shorter than prozona, with its posterior margin truncated. Tegmen rudimentary, lateral, as long as abdomen. Posterior femur thickened, about as long as abdomen ; posterior tibia without external spine and with 6 to 8 strong spines.

Distribution : India and Sri Lanka. It is a monotypic genus.

45. **Mesambria dubia** (Walker)

(Figs. 174-179, Plate IX, fig. 266)

1870. *Acridium dubium* Walker, *Cat. Derm. Salt. Br. Mus.,* **4** : 632.

1870. *Acridium tarsale* Walker, ibid., **4** : 632.

1878. *Mesambria geniculata* Stal, *Bih. Svensk. Vet. Akad. Handl.,* 5 (4) : 73.

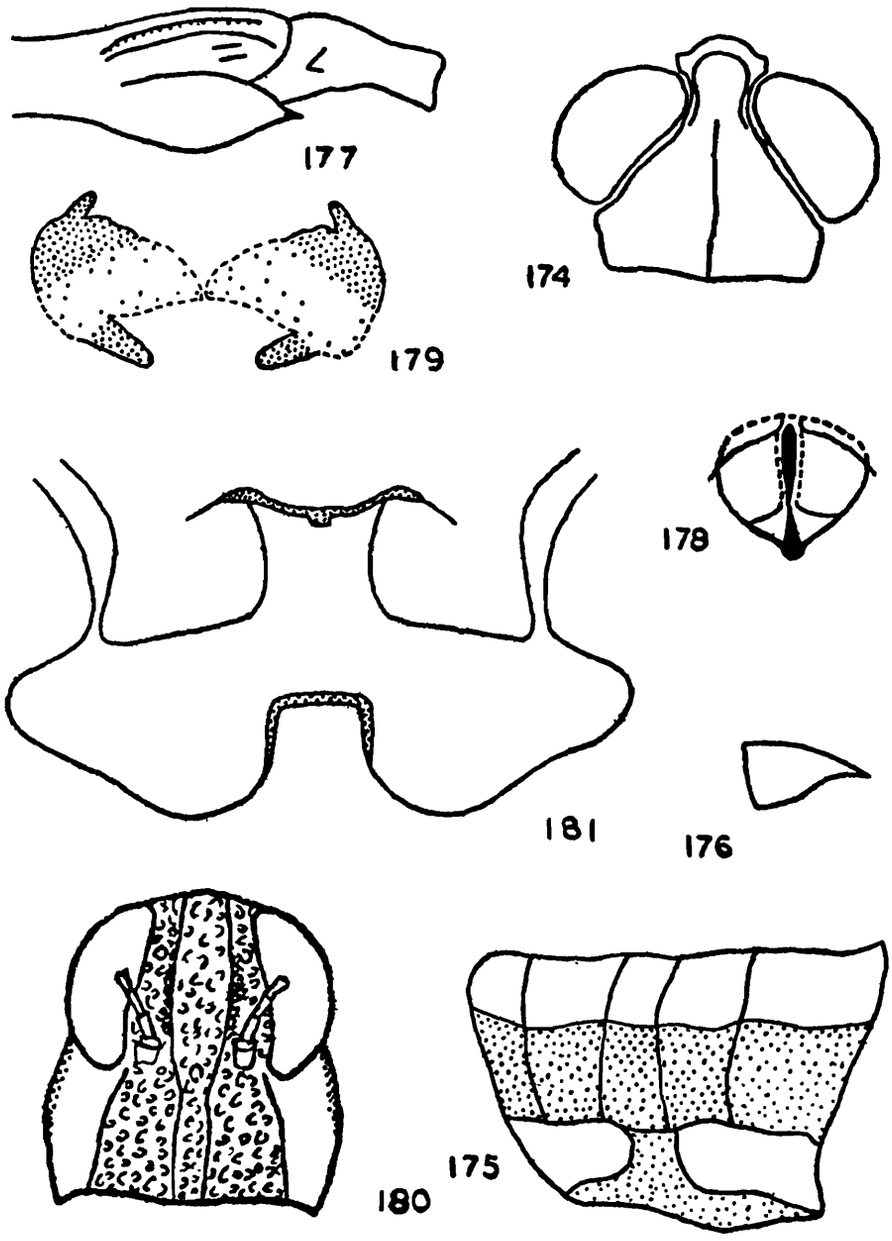
1914. *Mesambria dubia* : Kirby, *Fauna British India, Orth.,* **1** : 221.

Distribution : India (Nagaland ; West Bengal) ; Sri Lanka.

Material : 5♂, 1♀ ; Mirik, Darjeeling, 17.9.1974 ; *H K. Bhowmik* and *P. Halder* coll.

Description : Males (Pl. IX, fig. 266) : Small, slender. Head short ; fastigium of vertex produced beyond eyes, triangular and transverse on

profile, rounded at apex (fig. 174), lateral carinulae prominent and extending between eyes, separated from front by distinct edge ; fovoelae not detectable from above ; frontal ridge distinctly sulcate, narrowed just after separating edge of fastigial border, gradually widened up to middle ocellus, below ocellus constricted, then parallel-sided ; carinulae raised and clear. Antenna not



Mesambria dubia, male

Fig. 174. Fastigium of vertex, dorsal view X 5.
Fig. 175. Lateral pronotal lobe, X 11.
Fig. 176. Anal cercus, lateral view X 5.
Fig. 177. External spine of posterior knee X 11.
Fig. 178. Supra-anal plate, dorsal view X 5.
Fig. 179. Epiphallus, dorsal view X 32.

Gerenia bengalensis, female

Fig. 180. Front view of face showing frontal ridge X 3.5.
Fig. 181. Meso- and metasternal lobes and their interspaces X 11.

so long as noted by Uvarov (op. cit.) but longer than head and pronotum taken together. Eye big, brownish, prominent, lateral and extends beyond level of head and pronotum, from behind each eye a broad brown, shining band runs up to end of head and continues on upper margin of lateral side of pronotal disc to its posterior end and then to sides of abdominal segments. Pronotum almost flat, though a low and week median carina detectable and is cut by usual 3 sulci ; metazona less than half of prozona, posterior margin of former truncate ; lateral lobe as figured (175). Prosternal tubercle very short, conical. Mesosternal lobes with rounded inner margin ; interspace narrower than one of its lobe. Metasternal lobes separate. Abdomen with a distinct median carina, upcurved at apical end. Supra-anal plate wider than long, broadly angular at apex, and with a median longitudinal suture (fig. 178). Cercus thin, basally wide, then tapers apically to a spine like structure, longer than supra-anal plate, a little directed downwards (fig. 176). External apical spine of posterior knee as figured (177). Male epiphallus as figured (179).

Females : Very similar to males. Supra-anal plate roughly conical with a median depression. Valves of ovipositor hooked ; lower valves dentate on lateral edges. Subgenital plate with truncated apex. Cercus short, conical.

Colouration : General colouration mostly dark olive green to testaceous brown. Antenna pale orange-red. A pair of longitudinal dark brown bands run from eyes, through upper-lateral pronotal lobes to tegmina and finally continue at abdominal sides. Legs green-yellowish (in fresh specimens) and testaceous (in dried specimens), only knees of posterior femora dark ; posterior tibia clearly blue in fresh specimens. Lower border of lateral pronotal lobes dark brown which is in continuation with upper band through a medial branch, giving it a design.

Measurements : Body ♂ 13.5-15, ♀ 16-18 ; head ♂ 1.8-2.2, ♀ 2-2.4 ; maximum width of head ♂ 2.2-2.6, ♀ 2.3-2.8 ; antenna ♂ 6-7.5, ♀ (broken) ; pronotum ♂ 3.5-4, ♂ 3.75-4.8 ; maximum width of pronotum ♂ 2,8-3.2, ♀ 3-3.5 ; minimum width of pronotum ♂ 2.5-2.8, ♀ 2.5-3 ; prozona ♂ 2.3-2.9, ♀ 3-3.3 ; metazona ♂ .9-1.2, ♀ 1.1-1.5 ; tegmen ♂ 2-3, ♀ 3-3.5 ; post. femur ♂ 9-10, ♀ 10-11.5 ; post. tibia ♂ 8-9, ♀ 9.5-10.5.

Diagnostic features : This unique species is easily distinguishable by the characteristic shining dark brownish band on head and pronotum ; shorter metazona and design of lateral pronotal lobes and upturned apical abdominal end.

Remarks : This species was described on female from Sri Lanka. Uvarov (1927 b) mentioned of its male counterpart in a few words. The availability of the species at the high altitude of Darjeeling district is a new and interesting record of its zoogeography.

Genus (36) **Paraconophyma** Uvarov

1921. *Paraconophyma* Uvarov, *Ann. Mag. nat. Hist.*, **7** (9) : 497.

Type species : *Paraconophyma polita* Uvarov, 1921.

Head short, thick. Antenna filiform, of medium length. Eye large, oval, prominent laterally. Frontal ridge raised, gradually lowered towards clypeus, somewhat impressed ; lateral carinulae feebly divergent downwards. Fastigium of vertex reclinate, strongly sulcate, elongate, with lateral carinulae extending behind eyes, sloping towards frontal ridge, with apex (seen in profile) widely rounded ; temporal foveolae developed, about as long as broad, more or less distinctly margined. Pronotum rather thick, rugulose ; median carina thick, but low, interrupted by at least one (the hind) transverse sulcus ; prozona more than twice as long as metazona, latter emarginate behind ; lateral carinae very obtuse, reaching at least first sulcus, but often extending to third sulcus ; lateral lobes more or less polished in prozona, except margins which are rugulose, scarcely longer than high, rounded, with lower margin sinuate. Prosternum armed with a short conical spine. Mesosternal lobes and their interspace quadrate in male, transverse in female. Metasternal lobes separate in both sexes, more widely in female. Meso-and metanotum about as thick as pronotum and distinctly thicker than abdominal segments ; whole abdomen more or less rugulose, with a low, median carina running throughout. Tegmen lateral, lanceolate, reaching first abdominal segment. All femora short, thickened. Posterior tibia rounded, gradually thickened apically ; armed with 9 outer and 9 inner spines including the apical ones ; spurs of tibia unequal in length, inner pair being distinctly longer than outer one.

♂. Anal segment emarginate behind, with a pair of more or less prominent teeth. Supra-anal plate trapezoidal, with a median apical tooth, with lateral angles protruding or rounded ; sulcate basally. Cercus feebly compressed, longer than supra-anal plate, strongly narrowed posteriorly and very acutely pointed. Subgenital plate small, vertical, rounded.

♀. Anal segment with a median emargination, but without teeth. Supra-anal plate obtusely triangular, longer than its basal width, distinctly divided into two parts by a transverse sulcus ; surface more or less rugulose. Valve of ovipositor moderately long ; upper pair shorter than lower, which is dentate basally.

The nearest relative of this genus is *Conophyma* Zubowsky, 1898, from which it differs by the presence of rudimentary tegmina, larger eyes, narrower fastigium and fastigial foveolae, and less dilated pectus etc.

Distribution : Restricted yet to India and Nepal.

4 species are yet known in India.

46. **Paraconophyma scabra** (Walker)

(Plate II, fig. 227)

1870. *Catoptenus scaber* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 707.

1914. *Mesambria scabra* : Kirby, *Fauna British India, Orth.*, **1** : 221.

1921. *Paraconophyma scabra* : Uvarov, *Ann. Mag. nat. Hist.*, **7** (9) : 501-502.

Distribution : The species (♀) was described from Burdwan (W. B.) and was later recorded from Mussoorie and Kumaon (U. P.). Lately Bhowmik and Halder (1983) has recorded it from the H. P. and J. & K. where it is rather very common and abundant.

Material : Himachal Pradesh : 20♂, 18♀ ; Glen, Simla, 12.9.80, 1♂ ; Rohtang Jot, Manali, 26.9.80. 2♂, 3♀ ; Kufri, Simla, 15.9.80. 1♀ ; Solan, 13.8.80. 1♀ ; Solan, 9.9.80. 1♂, 1♀ ; Near Water Supply Office, Mandi, 22.9.80.

Description : Males (Pl. II, fig. 227) : Size small. Antenna as long as head and pronotum taken together, filiform. Fastigium of vertex as generic ; a median carinula divides fastigium and continues back over vertex. Foveola a little longer than wide, narrowed anteriorly, shallowly concave, with weak margins. Frontal ridge sulcate, slightly punctured above. Pronotum (as well as abdomen) with a strongly marked median carina, crossed by at least 2 sulci ; lateral carinae developed before 1st sulcus only and distinctly convergent behind ; sometimes they also perceptible at posterior part of pronotum as well, where they are strongly divergent ; metazona less than half of prozona. Prosternal tubercle short, thick, pyramidal ; meso- and metasternal lobes etc. mostly generic in nature. Tegmen narrow, parallel-sided, truncate at extremity, extending to end of 1st abdominal segment. Posterior femur thick, as long as abdomen ; posterior tibia with 7 to 8 external and 8 to 9 internal spines. Male cercus short, conical ; supra-anal plate longitudinally sulcate in middle, with angulated apex and with one lateral, spine-like projection on each side, about two-thirds along its length ; subgenital plate rounded and strongly upcurved.

Females : Very similar to males except larger in size. Supra-anal plate almost tongue-shaped, with a curved transverse sulcus at two-thirds along its length and with a median longitudinal groove in basal half. Ovipositor valves short, curved ; upper pair dentate basally.

Colouration : General colouration dark brown, with blackish markings. A broad and irregular but rather indistinct and ill defined black stripe runs behind eyes over sides of pronotum, and abdomen, and on this, in middle of pronotum stands a very large round depression ; sides and under surface of pronotum and abdomen paler than above. Tegmen blackish on costal half and testaceous behind. Posterior femur with 2 indistinct brown

transverse bands above, and black mottling on lateral areas ; post. knee blackish on sides ; tibia testaceous or may be muddy greenish, with a lighter-coloured subbasal ring.

Colouration of the species is slightly variable depending on localities. Posterior femur in lighter coloured specimens bear in extero-median area two indefinite transverse bands, while in darker specimens they are almost entirely clouded with two round pale spots along lower margin ; upper side with two or three dark transverse fasciae ; inner surface olive-yellow, more or less clouded with blackish. In some specimens from Simla, posterior tibiae and tarsi reddish instead of greenish.

Legs densely pilose, less so on lateral pronotal lobes and ventral parts of body and abdomen.

Measurements : Body ♂ 14-15, ♀ (22.5) 19-20 ; antenna ♂ 7-7.5, ♀ 4-7 ; head ♀ 3-3.2, ♀ 2.2-3 ; minimum width of interocular distance ♂ 1-1.2, ♀ 1-1.1 ; width of frontal ridge at median ocellus ♂ .8-.9, ♀ .8-.9 ; pronotum ♂ 4-4.2, ♀ (4.5) 4.5-5 ; prozona ♂ 3-3.2, ♀ 3-3.5 ; metazona ♂ 1-5, ♂ 1.5-2 ; maximum width of pronotum ♂ 3.5-3.75, ♀ 5-5.5 ; minimum width of pronotum ♂ 2.5-2.8, ♀ 4-4.2 ; tegmen ♂ 3-3.5, ♀ (4) 3.5-4 ; post. femur ♂ 9-10, ♀ 10-11 ; maximum depth of post. femur ♂ 3-3.5, ♀ 3.8-4, post. tibia ♂ 7-7.5, ♀ 8-9. (measurements of type (♀) as given by Uvarov (op. cit.) are given in brackets).

Diagnostic features : This species is remarkably distinguishable from all the remaining 3 species of the genus by its median carina of pronotum being crossed by 2 sulci, lateral carinae developed before 1st sulcus only and and which is distinctly convergent behind. Besides, punctuation of pronotal disc, pleurae, mesonotum, metanotum and abdominal tergites very coarse and strong ; tegmina with upper part rugulose and lower polished ; supra-anal plate of male with posterior angle straight, sharp.

Remarks : From the distribution records of the species, it shows that the species exhibits good ecological tolerance. From the subtropical semi evergreen locality of the type, it is now known in the western Himalayas where it is subjected to severe cold, scantly annual rainfall and winter snow in barren, cold and windy places like Rohtang Jot (alt. above 3965 m.).

During September many pairs were observed in copulation (Pl. II, fig. 227).

Since its description from Burdwan, the species was never again recorded from West Bengal.

Genus (37) **Gerenia** Stal

1878. *Gerenia* Stal, *Bih. Svensk. Vet. Akad. Handl*, 5 (4) : 28, 73.

Type species : *Acridium dorsale* Walker, 1870. (=Gerenia obliquenervis Stal, 1878).

Medium to large insects (23-41 mm). Antenna rather short, filiform. Head broad ; interocular distance wider than width of frontal ridge. Fastigium of vertex short, rounded into frontal ridge, which is almost obsolete below antennae. Face vertical ; frontal ridge scarcely reaching clypeus. Pronotum with median carina tectiform, crossed by usual 3 transverse sulci ; posterior margin of metazona obtusely angulated. Prosternal spine acute apically. Mesosternal lobes with rounded angles. Tegmen and wing well developed, former with shining black spot(s) in radial area. Posterior femur thickened, its carinae denticulate ; post. tibia with 8 to 11 spines.

Distribution : Autralia ; Burma ; India (Southern and Western India and West Bengal) ; Malaya.

3 endemic species occur in India.

47. **Gerenia bengalensis** Bhowmik and Halder

(Figs. 180-181, Plate IX, figs. 267-269)

1983. *Gerenia bengalensis* Bhowmik and Halder, *Rec. zool. Surv. India*, **81** : 23.

Distribution : West Bengal.

Material : 1 ♀ ; Bhutanghat, Jalpaiguri, W. B. ; 7.9.1975 ; *H. K. Bhowmik* coll. 1 ♂ ; Bamanpookri, Darjeeling, W. B. ; 25.8.1975 ; *H. K. Bhowmik* coll.

Description : Female : Size medium but robust in appearance (Pl. IX, figs. 268, 269). Antenna filiform, longer than head and pronotum taken together, first 8 segments brownish, remaining segments dark. Head short, less than half of pronotum ; fastigium very shallowly concave, semi-lunar, transverse, separated from frontal ridge. Vertex of head with an ill-defined median carina. Face vertical, coarsely punctured. Frontal ridge (fig. 180) widened between antennae, gradually tapers towards behind of middle ocellus where it becomes a little constricted and then carinulae more or less parallel and run up to clypeus ; coarsely and densely punctured. Lateral carinae almost straight. Eye brownish, lateral, projected, pointed at apex and approximating ; interocular distance wider than width of frontal ridge. Pronotum longer (8.9 mm) than width (6.5 mm) ; heavily and coarsely punctured all over ; moderately tectiform ; median carina distinct, linear but crossed by three usual transverse sulci ; prozona distinctly longer than metazona, latter with its posterior margin obtusely angulated ; lateral pronotal lobe somewhat depressed, its lower margin straight, a little oblique at anterior angle. Prosternal tubercle straight, conical. Mesosternal interspace (fig. 181) shorter than width of one of its plate, inner margin of which rounded ; metasternal plates clearly separated by a distinct interspace in between. Tegmen coriaceous-like, shorter than abdomen and less than half of total body length ; medial area adorned with an irregular longitudinal black band. Wing hyaline, shorter

than tegmen. Tympanum close. Abdomen with a distinct median, dorsal carina. Supra-anal plate almost tongue-shaped, with a median longitudinal sulcus. Valves of ovipositor curved, margins of upper ones somewhat marginate. Cercus small, conical. Posterior leg (broken); posterior tibia with 10 internal and 8 external spines.

Male: Fairly identical (Pl. IX, fig. 267) with female except that it is much smaller in size. Cercus longer than supra-anal plate, latter similarly with a median longitudinal sulcus. Sub-genital plate hairy, navicular. Both upper and lower basal lobes of posterior femora equal, their upper carinae denticulate. Upper lobe of posterior knee longer than lower one; both of them more or less rounded. Posterior femur with 2 ill-defined dark bands on external face, first one at base, small and incomplete, second one almost fills whole length and extends to inner face; posterior tibia smaller than femora and possesses equal numbers of spines to that of female.

Colouration: General colouration of the types olive green. The most remarkable colouration is the black, shiny mark on the posterior, superior margin of pronotal lateral lobe, the mark gradually tapers and extends up to anterior border. The medial dark band of tegmina is also unique.

Measurements: Body ♂ 22.5, ♀ 33; antenna ♂ 13.5, ♀ 14; minimum interocular distance ♂ 1.5, ♀ 2.2; prozona ♂ 4, ♀ 5.2; metazona ♂ 2.5, ♀ 3.7; tegmen ♂ 9.5, ♀ 16; wing ♂ 6, ♀ 11; post. femur ♂ 15, ♀ 23; post. tibia ♂ 13.5, ♀ 21.

Diagnostic features: The species is very much unique in having a coriaceous, shortened tegmen, with medial area adorned with an irregular longitudinal black band.

Remarks: The species comes close to the other Indian species, *G. pustulipennis* Walker, 1871, described from Bombay, in having black spots in tegmina but differs strongly from all known species of the genus for having the frontal ridge extended up to clypeus, dark band on the lateral pronotal lobe and the unique longitudinal colour band on medial area of tegmina and posterior femora.

Genus (38) **Catantops** Schaum

1853. *Catantops* Schaum, *Ber. Verch. Akad. Wiss. Berlin*, **2** : 779.

Type species: *Catantops melanostictus* Schaum, 1853.

Small to medium sized insects (15-36 mm) with fine rugose or dotted bodies. Antenna filiform, slightly compressed on basal region. Fastigium of vertex trapezoidal apically, with obtuse angles and having concavity in middle; frons oblique, straight or slightly excurved; frontal ridge flat or

slighty depressed, lateral carinulae obsolete. Pronotum subcylindrical, slightly narrowing anteriorly ; without lateral carinae, median carina weak or obliterated ; posterior margin of metazona obtuse-angular. Prosternal spine thick, cylindrical or slightly antero-posteriorly compressed, with rounded apex. Tegmina and wings well developed. No external apical spine in posterior tibia. Epiphallus with large bridge and well developed ancorae which are straight or decurved and with moderately small lobiform lophi. Male cercus blunt, bilaterally flattened, apically hatched-shaped.

Distribution : Africa ; Australia ; Oriental region.

3 species occur in India of which 1 is endemic.

48. **Catantops innotabilis** (Walker)

(Figs. 182-185)

1870. *Acridium innotabile* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 629.

1925. *Catantops innotabilis* : Uvarov, *Orth. Acrid.*, 80.

1927. *Catantops innotabile* : Uvarov, *Rec. Indian Mus.* **29** (4) : 238.

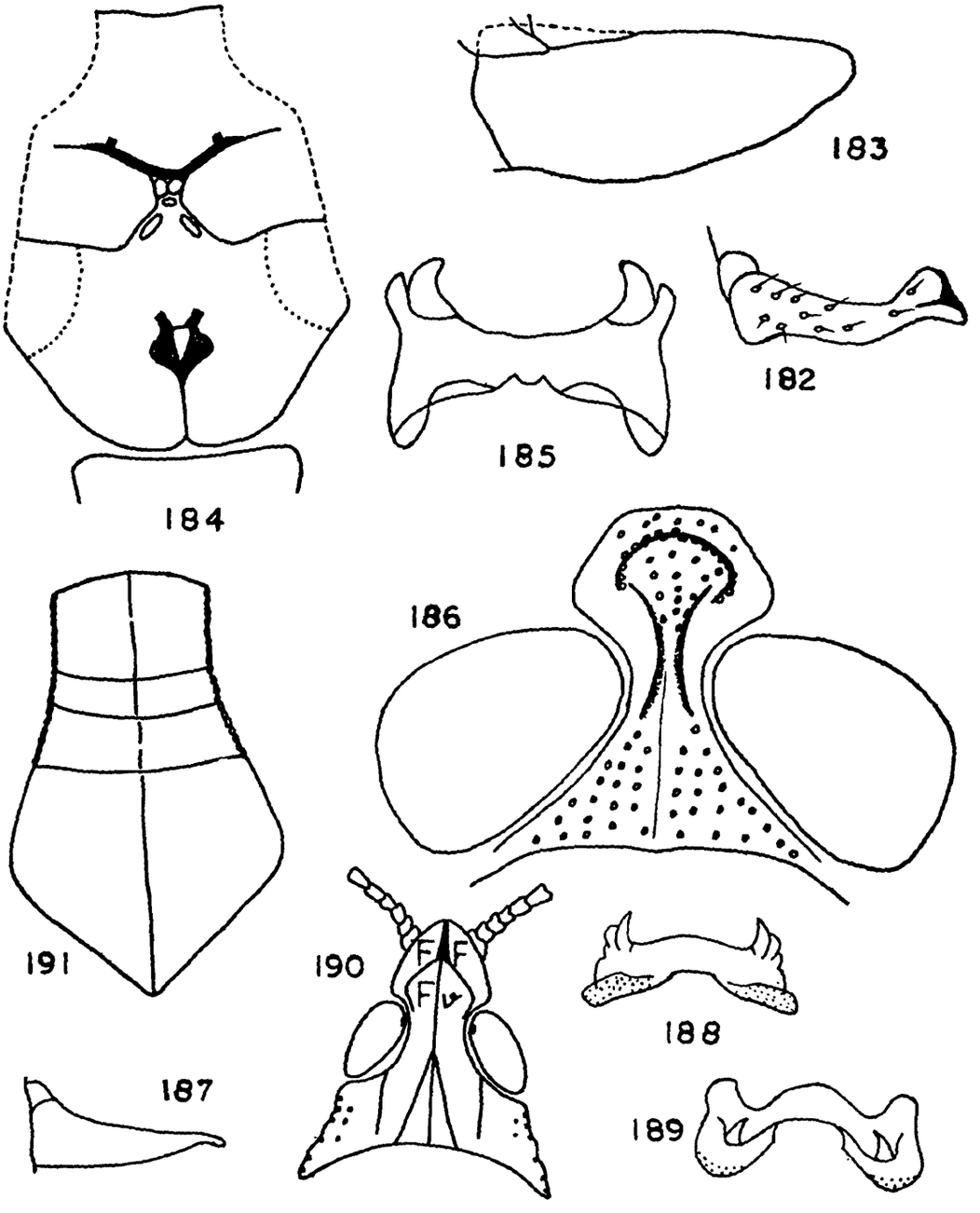
1935. *C. pinguis innotabilis* : Dirsh and Uvarov, *Tijdschr. Ent.*, **96** (3) : 233 ; Dirsh, 1956. *Comp. Diam. Angola. Publ. Cult.* **28** : 150.

Distribution : Afganisthan ; India ; Korea ; Sri Lanka.

Material : 1 ♂, 4 ♀ ; Naxalbari, Darjeeling, 13.9.74 ; *P Halder* coll. 1 ♀ ; Jayanti, Jalpaiguri, 4.9.1975 ; *H. K. Bhowmik* coll. 1 ♀ ; Mirik, Darjeeling, 17.9.1974 ; *H. K. Bhowmik* coll.

Description : Males : Frontal ridge parallel-sided ; impressed in middle, starting from around median ocellus up to clypeus ; faintly punctured ; lateral carinae prominent and almost linear. Eye big, lateral, brown and approximating on dorsum. Prozona a little longer than metazona, latter being divergent posteriorly. Prosternal tubercle thick, obtuse. Tegmen longer than abdomen, finely mottled with brown, radial area with pale spots. Mesosternal lobes separate from each other by a narrow interspace (fig. 184) ; metasternal lobes contiguous. Male cercus slender, slightly compressed, upcurved and expanded at apex (fig. 182). Supra-anal plate triangular with a median longitudinal groove (fig. 183). Subgenital plate navicular, laterally eompressed, pointed at tip. Epiphallus as figured (fig. 185). Posterior femur stout ; posterior tibia with 10 to 11 internal and 9 to 10 external black tipped spines.

Females : Very similar to males except a little larger in size. Cercus short ; conical. Valves of ovipositor moderately curved ; subgenital plate with truncated apex.



Catantops innotabilis

Fig. 182. Anal cercus, male, lateral view X 11.
Fig. 183. Supra-anal plate, male, lateral view X 11.
Fig. 184. Meso- and metasternal lobes, female, ventral view X 5.
Fig. 185. Epiphallus, dorsal view X 32.

Xenocatantops humilis

Fig. 186. Fastigium of vertex, female, dorsal view X 11.
Fig. 187. Anal cercus, male, side view X 11.
Fig. 188. Epiphallus, dorsal X 18.
Fig. 189. Same, ventral X 18.

Atractomorpha crenulata (Pyrgomorphidae)

Fig. 190. Head of a nymph, female X 5, showing foveolae (F) and fastigium of vertex (fv.)

Colouration : General colouration testaceous brown. Lateral pronotal lobes indistinctly brownish. Episternum III with a pale band. Posterior femur with two transverse bands with brown above middle which continue up to medial area of inner side ; in addition, these are one black patch at base and another at apex on inner side. Lower side of post. femur yellowish to ferruginous ; post. tibia reddish. Wing hyaline.

Measurements : Body ♂ 24-27.5, ♀ 31-35.5 ; head ♂ 2-2.2, ♀ 2-3.1 ; antenna ♂ 9-10, ♀ 8-10.5 ; pronotum ♂ 5.5-6, ♀ 7.5-8 ; maximum width of pronotum ♂ 4.5-4.8, ♀ 5.2-5.8 ; prozona ♂ 2.4-2.8, ♀ 3-3.5 ; metazona ♂ 3-3.2, ♀ 4-4.8 ; tegmen ♂ 22-25, ♀ 30-32 ; post. femur ♂ 12-15, ♀ 17-19 ; post. tibia ♂ 10.5-12, ♀ 14.8-16.

Diagnostic features : This species is distinguishable by its parallel-sided frontal ridge (vs. *C. pinguis* Stal, 1860, where it is a little expanded between antennae) and colouration in details specially of wings. However, both the species is unique in having expanded tip of male cerci and same type of genitalia.

Remarks : It is one of the commonest grasshoppers found in all habitats in India.

Jago (1984) raised the status of the subspecies, *C. pinguis innotabilis* and *C. pinguis pinguis*, into distinct and independent species and put them under his newly established genus *Diabolocatantops* (p. 370). I refraim from transferring the species to the new genus as to my mind, the shape of the male cercus and male genitalia (epiphallus) of the present species studied are more alike to *Catantops* than *Diabolocatantops*.

49. **Catantops erubescens** (Walker)

1870. *Caloptenus erubescens* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 703.

1914. *Catantops erubescens* : Kirby, *Fauna British India, Orth.*, 1 : 253-54, fig. 134.

Since its description in 1870, from North Bengal, the species has never again been reported from anywhere. The British Museum has 1 ♂, 1 ♀ syntypes from Bengal. Dr. Jago, in a personal communication, says that these unique examples "Look like *Catantops pinguis* but have bright red inner sides to the hind femur and a black bar along the upper edge of the outer area of the hind femur". The following description is after Kirby (op. cit.).

Description : Reddish brown, finely punctured. Frontal ridge very slightly depressed in male and flattened in female, subparallel-sided ; antenna yellowish, moderately stout, filiform, about as long as head and pronotum taken together. Pronotum with median carina and sulci only slightly marked, posterior sulcus placed just behind middle, posterior border obtusely

rounded ; a blackish stripe runs behind each eye, which is paler and broader on metapleura. Prosternal tubercle thick, obtuse ; abdomen light brown, rather shining. Tegmen subhyaline, brown towards base, and mottled with brown beyond, posterior area pale, perhaps reddish in life, with some scatrered black spots ; wing hyaline, rose-red towards basad. Posterior femur reddish, inclining to yellow outside, with a broad black stripe on outer upper area, obsolete at base and towards extremity ; and another extending from knees below to upper outer carina ; on inner upper surface are several large black spots ; tibia and tarsus red, tibia with 8 or 9 black-tiped spines.

Measurements : Length 28-33 mm ; tegmen 48-60 mm.

Diagnostic features : The species can be isolated at once by its rose-red base of wings and by the black bar of posterior femur. This colour pattern is unique and remarkable in the whole of Indian *Catantops*.

Genus (39) **Xenocatantops** Dirsh and Uvarov

1953. *Xenocatantops* Dirsh and Uvarov, *Tijdschr. Ent.*, **96** (3) : 237 ; Willemse, 1968. *Mon. Ned. Ent. Ver.* **4** : 1-77 ; Jago, 1982. *Trans. Amer. ent. Soc.*, **108** (3) : 449-457.

Type species : *Acridium humile* Serville, 1839.

Very much identical with the genus *Catantops* Schaum, 1853, but differs from it by constricted pronotum and conical prosternal tubercle. Outer surface of posterior femur furnished with large median and apical spots, which often traverse entire outer area on to upper surface of it. Male cercus clearly to weakly bifurcate apically or angularly bent at tip giving impression of bifid nature. Lophi of epiphallus angulate on inner and outer tips, each angle bearing a small outgrowth.

Distribution : Africa ; India ; S. E. Asia.

5 species occur in India including one endemic form.

50. **Xenocatantops humilis** (Serville)

(Figs. 186-189, 192)

1839. *Acridium humile* Serville, *Ins. Orth.* : 662.

1842. *Acridium* (*Oxya*) *humile* : de Haan, *Temminck. Verh. Orth.*, **16** ; 156.

1870. *Caloptenus dominas* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 701, 705, 804.

1870. *Caloptenus signatipes* Walker, ibid., **4** : 706.

1870. *Caloptenus strictus* Walker, ibid., 707.

1910. *Coptacra stricta* : Kirby, *Syn. Cat. Orth.*, **3** : 468.

1910. *Coptacra dominans* : Kirby, ibid., **3** : 468.

1914. *Catantops humilis* : Kirby, *Fauna British India, Orth.*, **1** : 250.

1953. *Xenocatantops humilis humilis* : Dirsh and Uvarov, *Tijdschr. Ent.*, **96** (3) : 237.

1982. *Xenocatantops humilis* : Jago, *Trans. Amer. ent. Soc.*, **108** (3) : 454, figs. 56, 57, 68, 69, 86, 87.

Distribution : A wide spread species occuring in Oriental countries.

Material : 4♂, 4♀ ; Samsing forest, Darjeeling ; March-Aprill, 1974. 2♂, 3♀ ; Adalpur, Sukna, Darjeeling ; 15.2.74. 1♂ ; Nilpara, Jalpaiguri ; 2.9.75. 1♀ ; Jayanti, Jalpaiguri ; 4.9.75. 1♀ ; Andul, Howrah ; 12.9.78. 1♀ ; Botanical Garden, Shibpur, Howrah ; 6.5.78. 1♂ ; Bally, Howrah ; Feb., 1978.

Description : Males : Body finely rugose. Fastigium of vertex produced before eyes with parabolic apex (fig. 186). Frontal ridge moderately sulcate, parallel-sided, with raised carinulae, a little constricted below ocellus and dilated above it. Pronotum with a median weak carina, crossed by 3 sulci ; prozona and metazona subequal. Meso-and metasternal lobes as figured (192). Tegmen long, often with dusky mottling ; wing hyaline. Abdomen with a strong median carina. Supra-anal plate roughly triangular with a median groove extending beyond middle of it. Cercus slender, wide at base, then gradually tapers, laterally compressed, incurved and slightly upturned apically (fig. 187). Subgenital plate navicular, apically acute. Epiphallus as figured (188, 189). Posterior femur stout, ornamented ; posterior tibia with 9 external and 9 to 10 internal black-tipped spines.

Females : Very similar to males except larger in size. Supra-anal plate tongue-shaped with a median depression ; subgenital plate almost with truncate apex. Valves of ovipositor curved, lower valve with a dentate like projection (seen laterally). Cercus short, conical.

Colouration : Yellowish varied with dull brown, with brownish bands. Eyes dull brownish. Each lateral pronotal lobe with a lighter brownish stripe on superior border. Sides of abdominal carina bordered with brownish streaks. Posterior femur with two broad oblique dark brown bands, continued more narrowly on upper and middle of inner surface which in addition have one dark spot basally and one at base of knee. Inside of posterior femur and tibia reddish. A broad lighter oblique band on episternum III.

Measurements : Body ♂ 21-24, ♀ 26-27-32.8 ; head ♂ 2.5-3, ♀ 2.5-3.2 ; antenna ♂ 10-11, ♀ 10.5-12.5 ; pronotum ♂ 5-5.5, ♀ 6-8 ; maximum width of pronotum ♂ 3.4-4, ♀ 4.5-5.8 ; minimum width of pronotum ♂ 2.5-3, ♀ 3.5-4 ; prozona ♂ 2-2.5, ♀ 3-3.6 ; metazona ♂ 2.8-3, ♀ 3.1-4.8 ; tegmen ♂ 19.5-22, ♀ 21-29.5 , post. femur ♂ 12.5-13.5, ♀ 14-18.6 ; post. tibia ♂ 9.6-11, ♀ 11.5-14.8.

Diagnostic features : The species is unique in form of male cercus, dark markings of outer surface of posterior femur, and in having epiphallus with smoothly rounded lophi combined with lophal interspace.

Remarks : The species is one of the commonest grasshoppers of India and is found in shrubs as well as in agricultural fields. Though it has been recorded from all corners of the country including Kurseong (Darjeeling), it is, however, a new record, for other localities of the Himalayan West Bengal.

Genus (40) **Stenocatantops** Dirsh and Uvarov

1953. *Stenocatantops* Dirsh and Uvarov, *Tijdschr. Ent.*, **96** : 237 ; Willemse, 1968. *Mon. Ned. Ent. Ver.*, **4** : 14.

Type species : *Gryllus splendens* Thunberg, 1815.

Identical with *Catantops* Schaum, 1953, but differs from it by the laterally compressed prosternal tubercle, flattened pronotal disc and very slender habitus. Male phallic complex with the aedeagal valves short and surrounded by greatly swollen cup-shaped expansions ; epiphallic lophi divergent laterally, but their ventral edges straight and in line with each other.

Distribution : Australian and Oriental regions.

Only 1 common species in India.

51. **Stenocatantops splendens** (Thunberg)

(Figs. 191, 193-197)

1815. *Gryllus splendens* Thunberg, *Mem. Acad. Sci. St.-Petersb.*, **5** : 236.

1839. *Acridium luteolum* Serville, *Ins. Orth.*, 661.

1842. *Acridium* (*Oxya*) *infuscatum* de Haan, *Temminck. Verh. Orth.*, **16** : 155.

1870. *Cyrtacanthacris nana* Walker, *Cat. Derm. Salt. Br. Mus.*, **3** : 568.

1870. *Cyrtacanthacris ferrina* Walker, ibid., **3** : 568.

1870. *Acridium ceramicum* Walker, ibid., **3** : 591.

1870. *Cyrtacanthacris tenella* Walker, ibid., **4** : 618.

1870. *Acridium corcanum* Walker, ibid., **4** : 629.

1870. *Oxya infuscata* : Walker, ibid., **4** : 647.

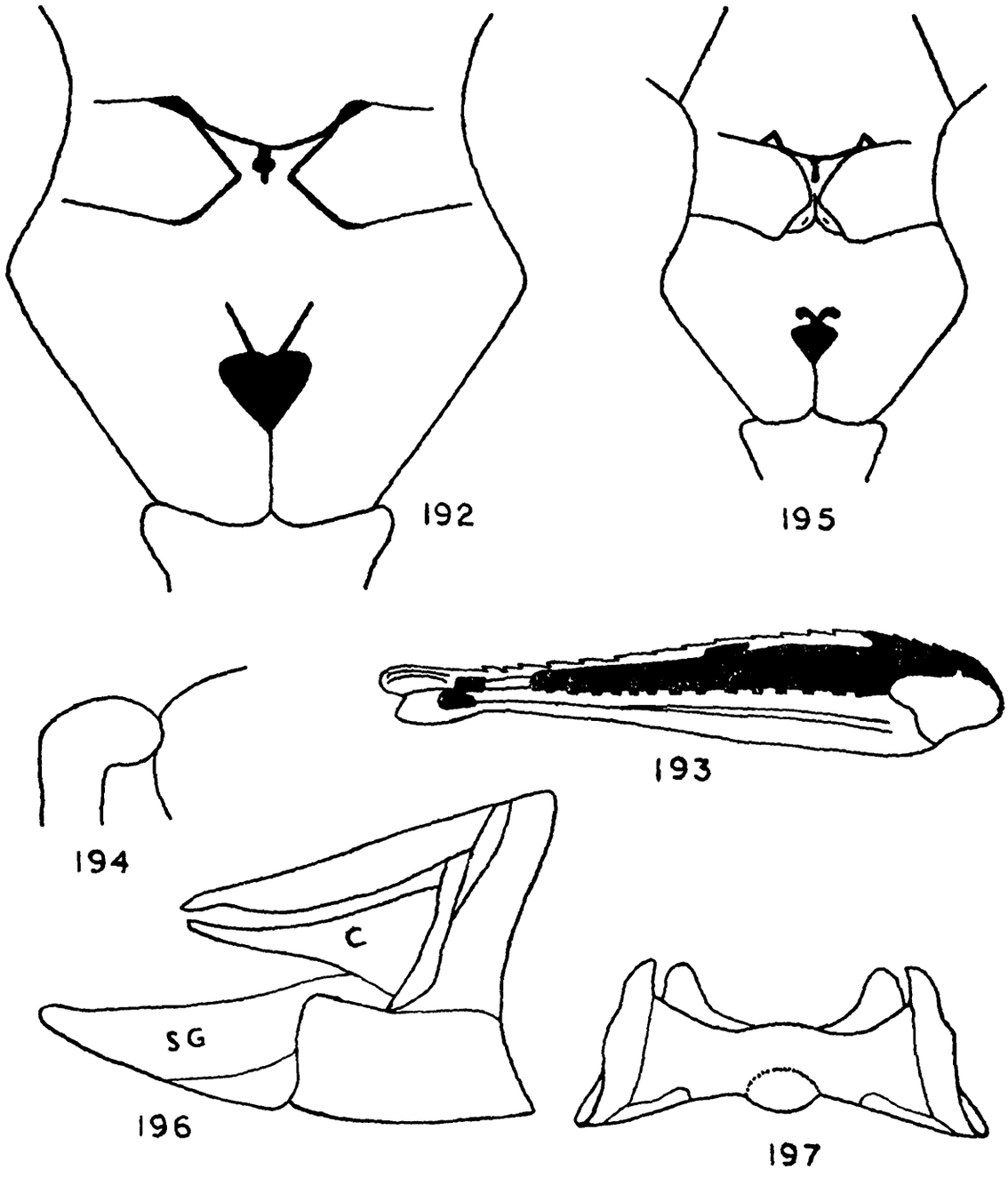
1870. *Oxya lutcola* : Walker, ibid., **4** : 648.

1871. *Cyrtacanthacris obliqua* Walker, ibid., **5** (suppl) : 58.

1873. *Catantops splenden* : Stal, *Recens Orth.*, **1** : 71.

1953. *Stenocatantops splendens* : Dirsh and Uvarov, *Tijdschr. Ent.*, **96** : 237.

Distribution : Burma ; India, including Andaman and Nicobar Islands ; Java.



Stenocatantops splendens

Fig. 191. Pronotal disc, male, dorsal view showing sulcation X 5.

Xonocatantops humilis

Fig. 192. Meso- and metasternal lobes, male X 11.

Stenocatantops splendens

Fig. 193. Colouration of inner side of post. femur X 5.

Fig. 194. Prosternal spine, side view X 5.

Fig. 195. Meso- and metasternal lobes, male X 5.

Fig. 196. Sub-genital plate and cercus, male, side view X 11.

Fig. 197. Epiphallus, ventral view X 32.

Material : 1 ♂ ; Sevok, Darjeeling, 22.7.1974 ; *H.K. Bhowmik* coll. 1 ♂, 1 ♀ ; Naxalbari, Darjeeling, W. B. ; *P Halder* coll. 1 ♀ ; Murti Revulet, Samsing, Darjeeling, 6.3.1974 ; *H. K. Bhowmik* coll.

Also 1 ♂ ; Andherikhola, Rangpoo, Sikkim ; 5.7.1978 ; *P. Halder* coll.

Description : Males : Body slender, elongate, finely rugose. Head small ; eye prominent, sloping, interocular space very narrow. Pronotum flat, punctured ; median carina linear, prominent throughout, lateral carinae represented by coarse punctuation ; prozona longer than metazona (fig. 191). Prosternal tubercle long, laterally compressed, obtuse and inclined, touching mesosternum (fig. 194). Meso-and metasternal lobes as shown in figure (195). Tegmen long, narrow, with rounded apex. Cercus slender, acutely pointed, incurved. Supra-anal plate somewhat tongue-shaped with a median longitudinal groove ; subgenital plate long (surpassing supra-anal plate), pointed, compressed (fig. 196). Epiphallic lophi divergent laterally with their ventral edges straight (fig. 197). Posterior tibia with 10 internal and 9 external black-tipped spines.

Females : Very similar to males. Prosternal tubercle stuppy, less inclined and not touches mesosternum. Supra-anal plate tongue-shaped with a median depression ; subgenital plate with truncated margin. Valves of ovipositor curved. Cercus short, conical.

Colouration : General colouration greenish-brown. Antenna yellow to reddish. Eye brown, with seven darkish linear bands. Episternum III with characteristic oblique pale band. Tegmina testaceous hyaline with small dark spots ; wings yellowish hyaline. Posterior femur yellowish externally with a narrow, linear dark line along medial area ; inner face uniquely black above, with two dorsal projections and also with a black spot at base of knee (fig. 193), red below. Posterior tibia and tarsus red.

Measurements : Body ♂ 30-32, ♀ 34-36 ; head ♂ 2.5-3, ♀ 3-3.1 ; antenna ♂ 11-12.5, ♀ 13-13.5 ; pronotum ♂ 6.3-7, ♀ 8-8.4 ; maximum width of pronotum ♂ 4-4.2, ♀ 5.2-5.8 ; prozona ♂ 3.1-3.4, ♀ 4-4.1 ; metazona ♀ 3.2-3.6, ♀ 4.1-4.3 ; tegmen ♂ 27.5-30, ♀ 34-36 ; post. femur ♂ 15.5-16, ♀ 20-20.1 ; post. tibia ♂ 12-13, ♀ 16-16.5.

Diagnostic features : This is the only one representative of the genus in India. It is unique in having a slender body, laterally compressed and bent prosternal spine, touching the mesosternum specially in males ; and the distinguished nature of its male genitalia. The characteristic colouration of its posterior femur and to some extent its male cercus and subgenital plate also help its spot identification easy.

Remarks : It is a less abundant species than *X. humilis* in India and less adequately known. Willemse (1968) has revised the species of the genus.

XI. Subfamily EYPREPOCNEMINAE

Key to Genera

1. Male cercus wide, compressed on apical half, with apex rounded 2
— Male cercus narrow, may be slightly compressed basad, but always acute or subacute apicad 4
2. Apex of abdomen inflated ; supra-anal plate with somewhat obtuse-rounded apex 3
— Apex of abdomen not inflated ; supra-anal plate with angular apex (Lateral carinae of pronotum strong. Tegmen mostly with small, dark spots enclosed) ... *Heteracris* Walker
3. Antenna filiform. Frontal ridge slightly constricted at apex. Male cercus long, thick, with coriaceous apical portion ; subgenital plate conical, compressed towards apical region, and almost pointed at apex ... *Choroedocus* Bolivar
— Antenna somewhat flattened and dilated in middle. Frontal ridge almost parallel-sided throughout. Male carcus shorter, and more or less entirely coriaceous ; subgenital plate transverse and very much obtuse (densely pubescent) ... *Eupreponotus* Uvarov
4. Posterior femur moderately long (14-15), moderately produced beyond abdomen, not inflated basally, not strongly narrowing on apical half. Posterior tibia with sparse spines. Prosternal process cylindrical, with rounded or inflated apex ... *Eyprepocnemis* Fiebor
— Posterior femur long, produced far beyond end of abdomen, inflated basally and strongly narrowed on apical half. Posterior tibia densely spined. Prosternal process almost spathulate, with rounded, sometimes slightly inflated apex ... *Tylotropidius* Stal

Genus (41) **Choroedocus** Bolivar

1878. *Demodocus* Stal, *Bih. Svensk. Vet. Akad. Handl.*, **5** (4) : 75.

1914. *Choroedocus* Bolivar, *Trab. Mus. nat. Cienc. nat. Madr.*, **20** : 110.

Type species : *Demodocus capensis* Stal, 1878.

Large and stout insects (40-75). Antenna filiform. Fastigium of vertex parabolic, with obtuse apex and slight depression and mostly with a median carinula. Frontal ridge wide, flat, more or less constricted towards apex. Pronotum compressed laterally, tricarinate, slightly tectiform, lateral carinae distinct at least up to prozona : median carina crossed by 3 sulci ; metazona much shorter than prozona, former with rounded posterior margin. Prosternal process cylindrical, rather acute, slightly inclined backwards. Last two

abdominal segments of male largely inflated. Male supra-anal plate tongue-shaped, impressed, with basal part rather narrowed, suddenly widened a little before middle with more or less obtuse apex, and with a median longitudinal sulcus basad ; cercus wide, thick, strongly compressed, incurved and downcurved, with an apical coriaceous portion ; subgenital plate conical, compressed towards apical region, upcurved and almost pointed at apex. Posterior femur attenuate on distal third ; posterior tibia with 12 external and 10 internal spines (no external apical spine).

Distribution : Africa ; Bangladesh ; China ; India ; Island of Hainan.

3 species having 2 endemic forms occur in India.

52. **Choroedocus robustus** (Serville)

(Figs. 198-202, 204, Plate I, figs. 220-221, Plate X, figs. 272-274).

1839. *Acridium robustum* Serville, *Ins. Orth.*, 647, no. 7.

1870. *Heteracris ducalis* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 663.

1914. *Heteracris robusta* : Kirby, *Fauna British India, Orth.*, **1** : 262.

1921. *Choroedocus* (?) *robustus* ; Uvarov, *Trans. R. ent. Soc. Lond.*, **69** (1 & 2) : 109.

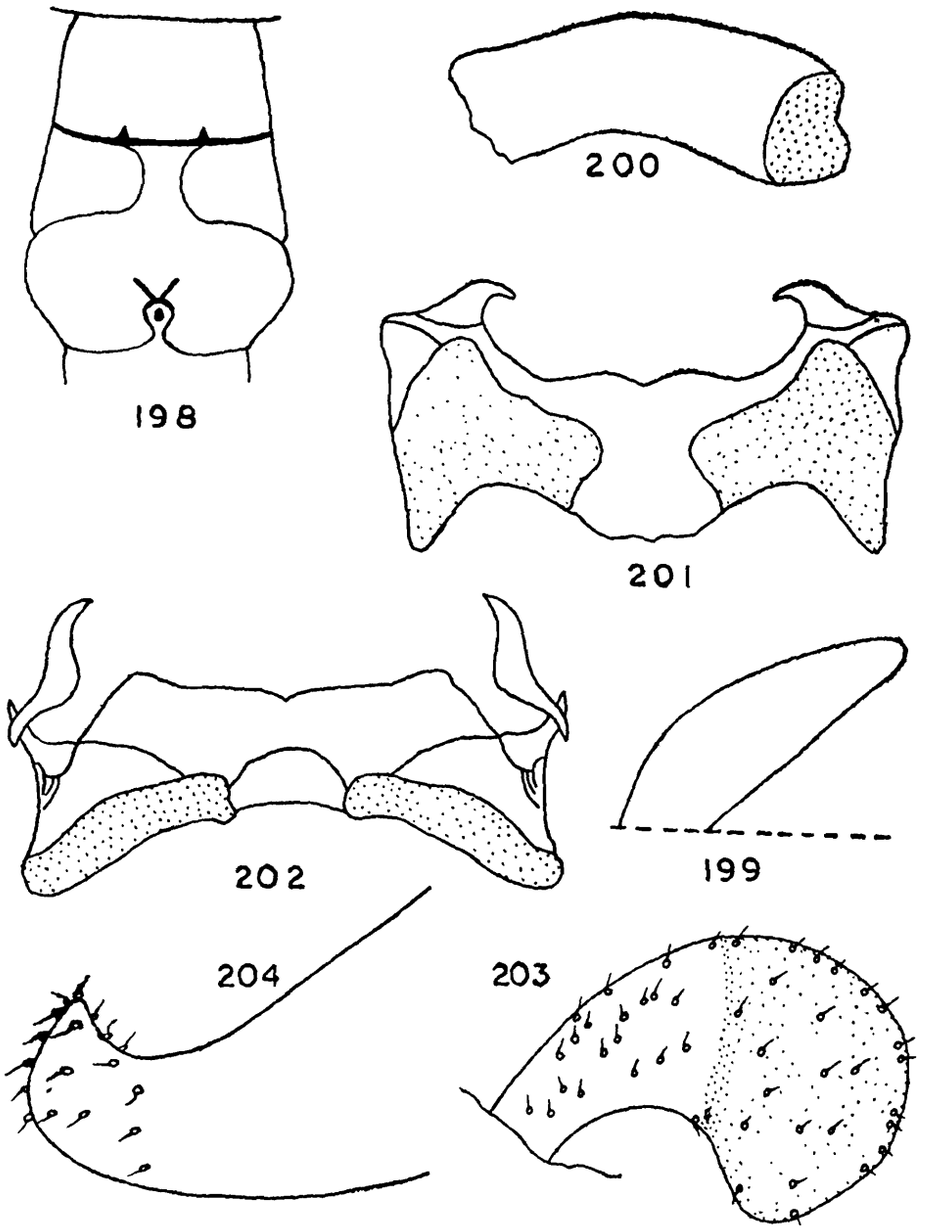
1984. *Choroedocus robustus* : Bhowmik and Halder, *Bull. Zool. Surv. India*, **6** (1 & 3) : 143.

Distribution : An endemic species of the eastern India.

Material : W. B. : 4 ♂, 3 ♀ ; Naxalbari, Darjeeling ; 11-12.9.74. 1 ♂ ; Suklapara, Jalpaiguri ; 29.8.75. 1 ♀ ; Bhutan Ghat, Jalpaiguri ; 6.9.1975. 1♂, 3 ♀ ; Calcutta, (Old collection).

Description : Males (Pl. X, figs. 272-273) : Moderately large insects. Antenna longer than head and pronotum taken together ; filiform, median segments almost twice as long as wide. Head short, slightly obtuse, occiput short ; fastigium of vertex short, about as long as wide, shallowly concave, obtusely rounded in front, with a median carinula reaching occiput and, in profile, sloping down into frontal ridge ; frontal ridge flat, surface with punctuation, narrowest between antennae, and gradually widening towards clypeus, convex in profile ; facial carina strong and straight ; interocular distance slightly wider at base of fastigium ; eye prominent, lateral, strongly elongate. Pronotum weakly tectiform with prominent median carina intersected by all three transverse sulci and with less prominent and slightly divergent lateral carinae which are obliterated in metazona due to coarse punctuation ; prozona slightly less than twice as long as metazona ; lateral pronotal lobes with transverse sulci as usual, surface punctured. Prosternal tubercle (fig. 199) cylindrical, gradually tapering apically, weakly incurved and pubescent ; mesosternal interspace about one third width of a mesosternal lobe, inner-margin of latter arcuate ; metasternal furcal suture distinct (fig. 198). Tegmen (Pl. 1, fig. 220) extending well beyond posterior

knees, almost $4\frac{1}{2}$ times as long as wide, venation as usual. Abdomen with last two tergites fused and hind margin of last tergite with a pair of small rounded projections medially. Supra-anal plate large, tongue-shaped, in basal half, sulcate medially, laterally, shallowly depressed apex broadly rounded.



Choroedocus robustus, male

Fig. 198. Meso- and metasternal lobes, ventral view X 5.
Fig. 199. Prosternal tubercle, side view X 16.
Fig. 200. Anal cercus, lateral view X 32.
Fig. 201. Epiphallus, dorsal view X 28.
Fig. 202. Epiphallus, ventral view X 28.
Fig. 204. Apex of sub-genital plate, lateral view X 24.

Eupreponotus inflatus, male

Fig. 203. Anal cercus, lateral view X 24.

Subgenital plate gradually tapering apically, distinctly upcurved, hairy, with truncate apex (fig. 204). Cercus very remarkable (fig. 200), laterally compressed, incurved, strongly expanded and widening distally with leaf-like obtuse angular tip. Epiphallus as figured (figs. 201-202). Posterior femora rather slender. Posterior tibia slightly shorter than posterior femora, with 10-11 internal and 12-13 external spines. Arolium well developed, longer than claws.

Females (Pl. X, fig. 274) : Very alike to males barring robust size and genital parts. Supra-anal plate with a prominent median depression on basal half and broadly rounded apex. Cercus very short, widened at base, tapers at apex. Valves of ovipositor typical.

Colouration : General colouration agrees fairly well with the description of female as given by Serville (1839), Walker (1870) (as *Heteracris ducalis*) and Kirby (1914) (as *Heteracris robusta*) with the following exceptions : - antenna yellowish ; prosternal tubercle greenish yellow ; tegmen with veins and veinlets yellow, membrane semitransparent, postcubital area and vannal vein 1 green ; wing bluish basally ; posterior tibia coral red with yellowish white-black tipped tibial spines.

Measurements : Body ♂ 43-45, ♀ 66-70 ; head ♂ 4.25-5.1, ♀ 5-7 ; maximum width of head ♂ 4-5.1, ♀ 5-6 ; interocular distance ♂ 1.95-2, ♀ 3-3.5 ; antenna ♂ 18-19, ♀ 23-24 ; pronotum ♂ 8-8.55, ♀ 12-13 ; maximum width of pronotum ♂ 5-6, ♀ 7.1-8.2 ; minimum width of ♂ 3.1-4, ♀ 4.8-5.35 ; prozona ♂ 4.65-5, ♀ 6.8-7.1 ; metazona ♂ 3.15-3.75, ♀ 5-6 ; tegmen ♂ 35-37, ♀ 53.65-69.15 ; maximum width of tegmen ♂ 6.25-7.1, ♀ 10-11 ; post. femur ♂ 26-27, ♀ 38.15-44 ; post. tibia ♂ 23-24, ♀ 32-39.

Diagnostic features : The species is unique in having non spotted tegmina, larger size and general green-yellowish appearance and particularly, reddish colouration of posterior tibiae and matatarsi.

It differs from other two Indian species, *C. illustris* (Walker, 1870) and *C. capensis* (Thunberg, 1815) in the following characters :—

Unspotted tegmina different from those of *C. illustris* and *C. capenis* (both of them with small or large, black or brown spots and points in tegmina).

Strongly infumated (except inner margin) wings somehow resemble that of *illustris* (where it is slightly infumated towards fore margin and apex) and different from greyish hyaline wing of *capensis*.

Male subgenital plate resembles *capensis* with truncate apex. In *illustris* it is conical.

Coral-red colouration of posterior tibiae different from those of *capensis* (yellowish) and *illustris* (purplish blue).

Unique in form of male cercus with leaf-like obtuse angular tip.

Remarks : The species seem to be a very rare one because since its description from Sylhet : Assam (now Bangladesh), though its systematic position has been changed repeatedly, no additional material information has been added. Uvarov (op. cit.) described the species doubtfully in the present genus because he had no male specimen before him. However, he placed it rightly in the present genus. Recently good number of specimens were collected comprising of both sexes, from the Eastern Himalayas. Moreover, previously collected material whose locality is mentioned as Calcutta have been examined.

The difference of colouration noted in this work (which is identical for both the sexes) is due perhaps the present study is based on fresh specimens whereas previous workers examined the dried up material.

Genus (42) **Eupreponotus** Uvarov

1921. *Eupreponotus* Uvarov, *Ann. Mag. nat. Hist.*, **7** (9) : 507.

Type species : *Eupreponotus inflatus* Uvarov, 1921.

Size medium (26-38 mm). Antenna long, somewhat flattened and dilated in middle. Fastigium of vertex prominent anteriorly, hexagonal, distinctly concave, margins raised, smooth ; frons feebly reclinate. Pronotum almost cylindrical, feebly compressed laterally ; disc convex, more so on prozona ; median carina low, obtuse, cut by 3 deep transverse sulci ; lateral carinae very obtuse, smooth, restricted to prozona only ; metazona distinctly shorter than prozona, very obtusely rounded behind. Prosternal spine cylindrical, slightly inclined backwards, with obtuse apex. Metasternal lobes not separate, with inner and posterior margins straight ; interspace narrower than one of its lobes, slightly broadened behind. Tegmina and wings fully developed. Posterior femur distinctly incrassate basally, with attenuated apical portion ; upper carina serrulate. Abdomen cylindrical, with two apical segments strongly inflated. Cercus large, foliaceous, widely rounded, bent downwards apically. Last abdominal tergite very large. Subgenital plate transverse, very obtuse.

Distribution : India, with 2 endemic species.

53. **Eupreponotus inflatus** Uvarov

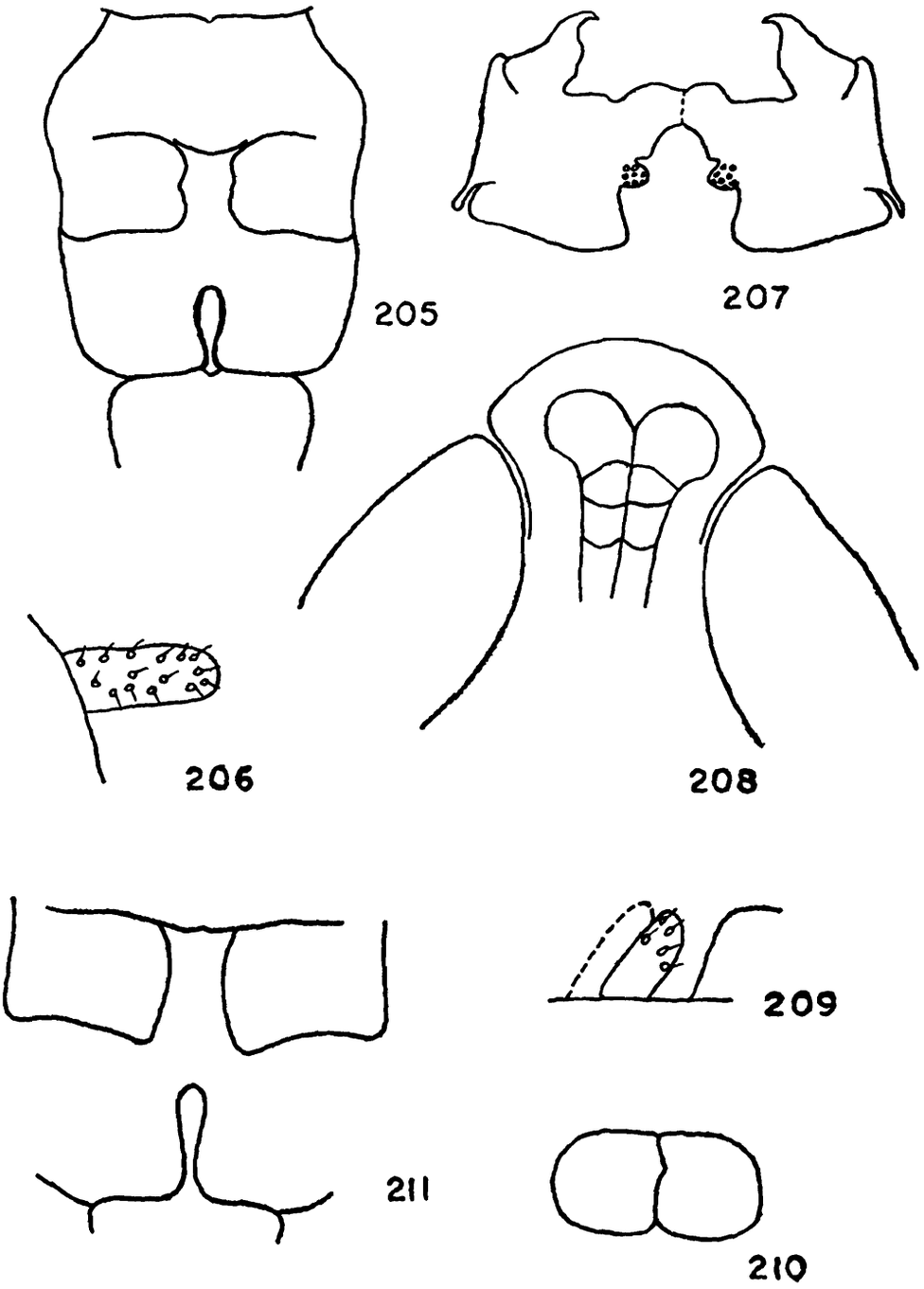
(Figs. (203, 205-206, Plate XI, figs. 275-276)

1921. *Eupreponotus inflatus* Uvarov, *Ann. Mag. nat. Hist.*, **7** (9) : 508.

Distribution : Orissa (Cuttack) ; West Bengal (Calcutta ; Howrah ; Duars).

Material : 1♂, 1♀ ; Baman Pokkri, Darjeeling ; 22.8.75 ; *H. K. Bhowmik* coll. 1♂ (and 1♂, 2♀ nymphs) ; Sankrail, Howrah ; 8.7.80 ; *P. Halder* coll.

Description : Males (Pt. XI, figs. 275-276) : Size moderate. Antenna distinctly longer than head and pronotum taken together. Frontal ridge subparallel-sided, narrowed near fastigium and feebly constricted below ocellus ;



Eupreponotus inflatus, male

Fig. 205. Meso- and metasternal lobes X 5.
Fig. 206. Prosternal tubercle, side view X 5.

Heteracris pulcher

Fig. 207. Epiphallus, dorsal view X 28.

Tylotropidius varicornis, male

Fig. 208. Fastigium of vertex, dorsal view X 11.
Fig. 209. Prosternal spine, lateral view X 11.
Fig. 210. Ibid., front view X 11.
Fig. 211. Meso- and metasternal lobes, ventral view X 5.

slightly excavated below ocellus ; coarsely impress-punctate throughout ; its margins raised, shining, obtuse. Facial keels raised, smooth, almost straight. Pronotum not punctured, but opaque on its whole surface except along lateral kneels and shoulders of metazona which are rugosely impress-punctate. Lateral lobe slightly higher than long, opaque ; its lower margin with a widely rounded coxal angle, oblique and feebly concave before it ; fore angle obtuse rounded ; posterior angle a little more than 90°, rounded. Tegmen extending beyond posterior knees, rather narrow, not densely reticulate. Male cercus, mesosternal lobes and prosternal spine as shown in figures (203, 205-206).

Females : Very similar to males except larger in size. Supra-anal plate tongue-shaped with medially a longitudinal groove ; ovipositai valves curved ; subgenital plate long, rectangular with truncated apex. Cercus stout, shorter than supra-anal plate, blunt apically.

Colouration : General colouration fawn, with dull black and pale markings. Face velvety, olive-brown, with kneels and frontal ridge shining ; cheeks fawn, shining, with darker clouding ; vertex and occiput fawn, with a velvety-black longitudinal fascia prolonged on to pronotum, where it is included between two halves as broad light fawn stripes ; median carina of pronotum fawn, shining ; lateral lobes velvety fawn with a stripe along upper margin, between lateral and sublateral kneels, all sulci and a narrow stripe along hind margin, black ; all margins of pronotum pale, shining. Tegmen hyaline, with veins brown ; vanal field blackish brown ; base of costal and radial areas, as well as a longitudinal stripe along vanal vein yellowish. Posterior femur fawn, with three irregular black fasciae (not reaching lower margin) in externo-median area ; upper side almost unicolorous ; inside yellowish, with a reddish shade in basal half, an indefinite spot in middle of upper carina, and a postmedian transverse fascia black ; latter fascia extending on to lower surface of femora ; knees with semilunar black spots and light lobes. Posterior tibia red ; posterior tarsus brownish red.

Measurements : Body ♂ 26, ♀ 38 ; head ♂ 4, ♀ 5 ; maximum width of head ♂ 3, 4 ♀ ; interocular distance ♂ 1.5, ♀ 2 ; antenna ♂ 15, ♀ 17 ; pronotum ♂ 5, ♀ 7 ; width of pronotum ♂ 3.8, ♀ 5 ; prozona ♂ 3, ♀ 4 ; metazona ♂ 2, ♀ 3 ; tegmen ♂ 24, ♀ 34 ; maximum width of tegmen ♂ 4.5, ♀ 5.5 ; post. femur ♂ 18, ♀ 23 ; post. tibia ♂ 15.5, ♀ 20 (measured 1 male and 1 female).

Diagnostic features : This insect is easily separated from all other members of the Euprepocnemini by the extremely peculiar shape of the last abdominal segments and of the male cerci. The type of its colouration, and especially

the deep velvety colouration of the head and pronotum, is also very striking, and should make the insect easily recognisable.

Remarks : Lately Singh (1978) has described the second species of the genus from Dehra Dun from which this species differs chiefly by the larger size, texture of male cerci and general colouration.

Presence of an advanced nymphs from Howrah during July indicates that the species completes its life cycle in the hot, rainy season.

Genus (43) **Heteracris** Walker

1870. *Heteracris* Walker, *Cat. Derm. Salt. Br. Mus.*, **4** : 655.

1878. *Demodocus* Stal, *Bih. Svensk. Vet. Akad. Handl.*, **4** (5) : 75.

1893. *Thisoicetrus* Brunner, *Annali Mus. Civ. Stor. nat.* **13** (33) : 1-230.

1914. *Bibulus* Bolivar, *Trab. Mus. nat. Cienc. nat. Madr.* **20** : 51.

Type species : *Acridium herbaceum* Serville, 1838.

Medium to large (25-60) sized insects. Antenna almost filiform, or slightly compressed, sometimes slightly widened and thickened in middle. Fastigium of vertex parabolic or angular, with obtuse apex and slight depression ; median carinula mostly present. Frons oblique and slightly convex ; frontal ridge wide, flat, parallel-sided throughout (not constricted at apex). Pronotum flattened or weakly tectiform, with sharp median carina and with sharp lateral carinae (at least in prozona) which sometimes diverge backwards, straight or sometimes weakly incurved ; posterior margin of metazona slightly excurved. Prosternal process slightly incurved backwards, cylindrical or slightly antero-posteriorly compressed, with rounded apex. Last abdominal tergite of male not inflated and with a pair of projections. Male supra-anal plate with angular apex ; cercus wide, rather thin, strongly compressed, incurved and down-curved, with rounded or subacute apex. Subgenital plate subconical, with wide, sometimes bilobate apex.

Distribution : Africa ; Australia ; Oriental region.

2 species occur in India.

54. **Heteracris pulcher** (Bolivar)

(Fig. 207, Plate II, figs. 222-223, Plate XI, fig. 279)

1902. *Euprepocnemis pulchra* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 630.

1927. *Thisoecetrus pulchra* : Uvarov, *Spolia Zeylan*, **14** : 113.

1958. *Heteracris pulcher* : Dirsh, *Tijdschr. Ent.*, **101** : 54.

Distribution : Tamil Nadu ; West Bengal ; Sri Lanka.

Material : 3♂, 2♀ ; Naxalbari (alt. c. 150 m), Siliguri Darjeeling; 13.9.75 ; *P. Halder* coll. 2♂, 1♀ ; Gaur, Maldah, W. B. ; 19.9.1975;

P. Halder coll. 1♂, 1♀ ; Falacata, Cooch Behar ; 14.9.75 ; *H. K. Bhowmik* coll.

Description : Males (Pl. XI, fig. 279) : Size medium. Antenna filiform (15-16), longer than head and pronotum taken together, brown, but from below, segments appear dark giving it a different colouration ; middle segments elongate, about twice as long as their width. Fastigium of vertex smooth, almost transverse, shallowly concave. Face slightly oblique ; frontal ridge nearly parallel-sided, impress-punctate, narrowed towards clypeus. Pronotum with distinct lateral carinae ; prozona longer than metazona, posterior margin of latter being almost rounded. Prosternal spine subcylindrical, compressed in front, obtuse towards apex. Mesosternal lobe wider than interspace, rounded on inner margin ; metasternum almost close. Cercus compressed, laterally incurved, apex subacute and directed downwards. Supra-anal plate sulcated with its tip somewhat pointed. Subgenital plate rounded, curved upwards, apical margin straight. Epiphallus as figured (207). Tegmen about 4 times longer than its maximum width and without spots or with ill-defined brownish spots (Pl. II, fig. 222) ; rounde at apex ; costal vein with a few branches on precostal side ; medial vein giving of 4 branches of elongate cells and occupies more space than radial veinlets ; space usually occupied by intercalary vein filled with some irregular cells ; cubital veins run independently to be united with post. cubital apically, space between two again filled with irregular cells. Wing shorter than tegmen, basally with bluish tinge (decoloured in wet specimens). Posterior tibia pilose with 10 to 11 white but black tipped spines.

Females : Much larger. Frontal ridge sparsely punctate. Antenna more dark even on dorsum. Tegmen slightly extends beyond posterior tibia, clearly with brownish spots and areas (Pl. II, fig. 223), separated by hyaline areas. Cercus small and gradually tapers. Superior valves of ovipositor comparatively larger than inferior ones, curved upwards and with pointed apices.

Field colouration : The colouration oi specimens (both sexes) as noted in the field is as follows : "Two lateral colour bands on pronotum distinctly green which are in continuation to vanal field of tegmina. Face yellowish except frontal ridg which is blackish. Pronotum with its lobes yellowish ; rest of ventrum greyish yellow. Base of antenna yellowish ; rest blackish. Base of wing bluish ; rest dark".

Measurements . Body ♂ 27.5-28, ♀ 54-56 ; head ♂ 3.5-4, ♀ 5-5.2 ; interocular distance ♂ 1-1.25, ♀ 2-2.15 ; antenna ♂ 15-16, ♀ 20-22 ; prozona ♂ 3-3.13, ♀ 6-6.16 ; metazona ♂ 2-3, ♀ 5-5.25 ; tegmen ♂ 23-24.15, ♀ 45-46 ; post. femur ♂ 19.5-20, ♀ 32-33 ; post. tibia ♂ 17-18.25, ♀ 29.5-30.

Diagnostic features : The species is uniqe for having a broad velvety black stripe from vertex of head to dorsum of pronotum bordered with green. Tegmen with ill defined to fairly clear brownish spots, which may be confluent ; vanal field green.

It differs from the other North-western Indian and Pakistani species, *H. nobilis* (Uvarov, 1942), chiefly by its spotted tegmina and genitalia. In the letter species, the tegmen is spotless.

Remarks : The species must be a very rare one. However, its availability from Naxalbari (borders of W. B., Bihar and Nepal), Cooch Bihar and Maldah indicates that the species must be distributed throughout the plain terrain of the sub-Himalayan region.

Genus (44) **Eyprepocnemis** Fieber

1853. *Eyprepocnemis* Fieber, *Lotos*, **3** : 98.

1873. *Euprepocnemis* Stal, *Recens. Orth.*, **1** : 75.

Type species ; *Gryllus plorans* Charpentier, 1825.

Medium sized insects (20-43) with finely rugose integument. Antenna filiform. Fastigium of vertex short, slightly concave with broadly parabolic apex ; frons oblique ; frontal ridge flat, sometimes with shallow concavity at ocellus. Pronotum flat dorsally, with weak lateral carinae ; median carina linear ; metazona shorter than prozona, with obtuse-angular posterior margin. Prosternal process cylindrical, slightly inclined backwards, with rounded and sometimes slightly inflated apex ; mesosternal lobes rounded. Male supra-anal plate elongate-triangular ; cercus moderately broad at base, gradually tapering towards apex, incurved and slightly decurved, with apex acute or subacute, often oblique at upper apical edge. Female subgenital plate trilobate.

Distribution : Africa ; Malayan archipelago ; Mediterranean Coasts of Europe ; South Asia.

5 species including 3 endemic ones occur in India.

55. **Eyprepocnemis alacris alacris** (Serville)

(Plate II, fig. 224)

1839. *Acridium alacre* Serville, *Ins. Orth.* : 682.

1859. *Acridium deponens* Walker, *Ann. Mag. nat. Hist.* **4** (3) : 222.

1870. *Heteracris rudis* Walker, *Cat. Derm. Salt. Brit. Mus.* **4** : 662.

1870. *Caloptenus reductus* Walker, ibid., **4** : 713.

1871. *Acridium scitulum* Walker, ibid, **5** : 62.

1902. *Euprepocnemis plorans* var. *intermedia* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 650.

1958, *Eyprepocnemis alacris alacris* : Dirsh, *Proc. R. ent. Soc. Lond.*, (**27**)**B** : 40.

Distribution : Afganisthan ; India (North Bengal ; Chota Nagpur ; Nilgiris) Pakistan ; Sri Lanka ; Upper Burma.

Material : 1♂, 1♀ ; Sukna, Mohar tea estate ; 16.2.1974 ; *P. Halder* coll. 1♀ (nymph) ; Adalpur, Sukna ; 15.2.74 ; *H. K. Bhowmik* coll. 1♂ (damaged) ; Sevok ; 22.2.74 ; 1♀ ; Mirik (alt. ca. 1688 m), Darjeeling ; *H. K. Bhowmik* coll. 1♂ ; Nilpara, Jalpaiguri ; 30-31.8.75 ; *H. K. Bhowmik* coll.

Description : Males : Antenna filiform, longer than head and pronotum taken together. Fastigium of vertex with deep concavity, with parabolic apex. Frontal ridge flat, impress-punctate, gradually narrowing towards fastigial end ; from below middle ocellus gradually diverges but with hardly detectable carinulae. Pronotum flat, crossed by 3 sulci, with somewhat prominent median linear carina ; lateral carinae weak, a little approximating towards head, in metazonal area it is represented by coarse punctuation, diverging posteriorly ; prozona longer than metazona. Prosternal tubercle cylindrical, slightly curved backwards, with rounded apex. Tegmen mostly longer than abdomen, rarely as long as abdomen, with rounded and slightly oblique apex. Posterior femur stout with an attenuated apical area ; posterior tibia without external apical spine, with 9 to 10 external and 9 internal creamwhite black-tipped spines. Abdomen with a median carina. Supra-anal plate elongate, broadly triangular, with a median groove. Cercus broad basad, narrowing towards apex, incurved and slightly decurved with apex acute.

Females : Similar to males but larger in size. Concavity of fastigium of vertex lesser than males. Ovipositor simple with valves moderately curved. Supra-anal plate alike to males but subgenital plate very characteristic—trilobate.

Colouration : General colouration variable, usually yellowish to yellowish-testaceous. Antenna yellowish. Eye brownish with 8 longitudinal stripes. A broad velvety dark-brown subparallel-sided stripe runs starting from concavity of fastigium of vertex to pronotum through vertex ; lateral borders of pronotum yellowish ; lateral lobes with a oblique blackish bar. Tegmen subhyaline, with numerous brown spots, patterned basad in a linear series, radial area also with scattered spots. Wing hyaline, often with greenish tinge basad. Posterior femur yellowish, rarely with two oblique dark bands which extend on both sides. Posterior tibia bluish-grey with two whitish rings at base ; its apex and tarsus reddish.

Measurements : Body ♂ 22-24, ♀ 35-36 ; antenna ♂ 10-10.6, ♀ 12.5-13 ; head ♂ 3-3.05, ♀ 4-4.1 ; prozona ♂ 2.95-3, ♀ 3.85-3.9 ; metazona ♂ 2-2.25, ♀ 3.15-3.25 ; tegmen ♂ 20.55-22.1, ♀ 29.5-30 ; post., femur ♂ 14.85-15, ♀ 21.15-21.25 ; post., tibia ♂ 12.1-12.85, ♀ 18.5-18.6.

I have two male examples from Rydak which are very small in size (16-17 mm) with tegmina (11-11.5 mm) as long as abdomen.

Diagnostic features : This subspecies is unique in having a very pointed apex of male cercus (Uvarov, 1942, fig. A) which differentiates it from allied Indian species. This nominate subspecies differs from the designated one, *E. a. impicta* Uvarov, 1933, which occurs in Pakistan, S. W. Asia, S. W. Persia, Iraq, S. E. Arabia, and recently recorded by me from Mandi, Himachal Pradesh, by the colouration of its posterior tibia. In the latter, it is uniformly grey or olive grey with two whitish rings at base and slightly ochraceous apex and tarsus.

Remarks : This typical subspecies is the commonest in the genus and in India it is widely distributed in all habits. It is available both in plains as well as high altitudes.

The availability of nymphal stages both in September and in February indicates that it has at least two generations in a year—once after monsoon and again immediately after winter.

Genus (45) **Tylotropidius** Stal

1873. *Tylotropidius* Stal, *Recens. Orth.*, **1** : 74.

Type species : *Pozotettix* (*Tylotropidius*) *didymus* Stal, 1873.

Medium sized insect with finely rugose body. Antenna almost filiform, slightly compressed, shorter than head and pronotum taken together. Fastigium of vertex elongate, almost parabolic, with slightly truncate apex, with two depressions at basad ; frons very oblique ; frontal ridge moderately wide, flat, narrowing towards apex and obliterated below ocellus. Pronotum slightly tectiform, with sharp median carina and obtuse lateral carinae which are excurved and diverge slightly behind ; metazona shorter than prozona, with rounded or widely obtuse-angular posterior margin. Prosternal tubercle antero-posteriorly compressed, almost spathulate (somewhat bifid) with rounded, sometimes slightly inflated apex. Posterior femur very slender, elongate, with apical portion (one third) filiform. Anal segment of male not inflated ; cercus slightly compressed, apically slightly downcurved, with oblique, acute or subacute apex.

Distribution : Africa ; Burma ; India ; Sri Lanka.

1 species occurs in India.

56. **Tylotropidius varicornis** (Walker)

(Figs. 208-211, Plate XII, fig. 280).

1870. *Heteracris varicornis* Walker, *Cat. Derm. Salt. Br. Mus.* **4** : 667.

1893. *Tylotropidius ceylonicus* Brunner von Watterwyl, *Annali Mus. Civ. stor. nat. Giacoma Doria, Genova*, **13** (33) : 164.

1910. *E. (Uprepocnemis) varicornis* : Kirby, *Syn. Cat. Orth.*, **3** : 561.

19.4. *Tylotropidius varicornis* : Kirby, *Fauna British India, Orth.*, **1** : 265, fig. 140.

Distribution : Burma ; India (Himachal Pradesh ; Orissa ; Tamil Nadu ; West Bengal) and Sri Lanka.

Material : 2♂ ; Sevok, Darjeeling ; 22.2.74 ; *H. K. Bhowmik* coll.

Description : Males (Pl. XII, fig. 280) : Body finely rugose. Antenna filiform, slightly compressed, as long as head and pronotum taken together. Fastigium of vertex long, almost parabolic, with two characteristic basal depressions (fig. 208). Frontal ridge, pronotum and prosternal spine (fig. 209) generic. Meso-and metasternal lobes as figured (211). Tegmen and wing longer than abdomen but shorter than posterior femora. Basal half of posterior femur very stout, apical half strikingly attenuate. Posterior tibia with 10 internal and 14 external black-tipped spines. Supra-anal plate tongue-shaped ; subgenital plate navicular with somewhat pointed apex ; cercus a little compressed, apically slightly downcurved, with subacute apex.

Females : Very similar to males except larger in size. Supra-anal plate somewhat identical with males. Subgenital plate truncate with a median projection. Valves of ovipositors curved.

Colouration : General colouration yellowish to greenish-yellow. Pronotum brown with pale lateral carinae. Tegmen castaneous with a row of triangular whitish spots on radial area and a pale longitudinal stripe in costal area (Pl. XII, fig. 280) ; wing bluish hyaline. Posterior femur externally marked with brown, inner surface with two black spots. Apices of posterior tibiae and tarsi dull blue.

Measurements : Body ♂ 25-26, ♀ 36-37 ; antenna ♂ 8-8.5, ♀ 9-9.5 ; pronotum ♂ 5-5.25, ♀ 6-6.25 ; tegmen ♂ 22-23, ♀ 28-29 ; post. femur ♂ 20-21, ♀ 25-26 ; post. tibia ♂ 17-17.5, ♀ 21-22.

Diagnostic features : The species is easily recognizable by having fastigium of vertex with two depressions at base ; compressed, truncated and somewhat bituberculated apex of prosternal tubercle and, in the castaneous tegmen having "a row of triangular whitish spots upon the radial nervure" and also with distinctly attenuated apical half of posterior femur.

Remarks : The elongate and almost parabolic but flat (without any concavity) fastigium of vertex having two unique basal depressions, the bifid prosternal spine and the characteristic ornamentation of tegmina of this species is unique in the whole of Indian fauna and helps its spot identi fication easy.

The species is yet inadequately known. But the availability of an advance ♀ nymph (30 mm) from Orissa (Balugaon) on 30th September, 1983, indicates that its new generation starts after monsoon.

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APPENDIX 1

Distribution of grasshoppers in West Bengal, district-wise
(+ =indicates availability for this study,
O =indicates recorded earlier but not available now)

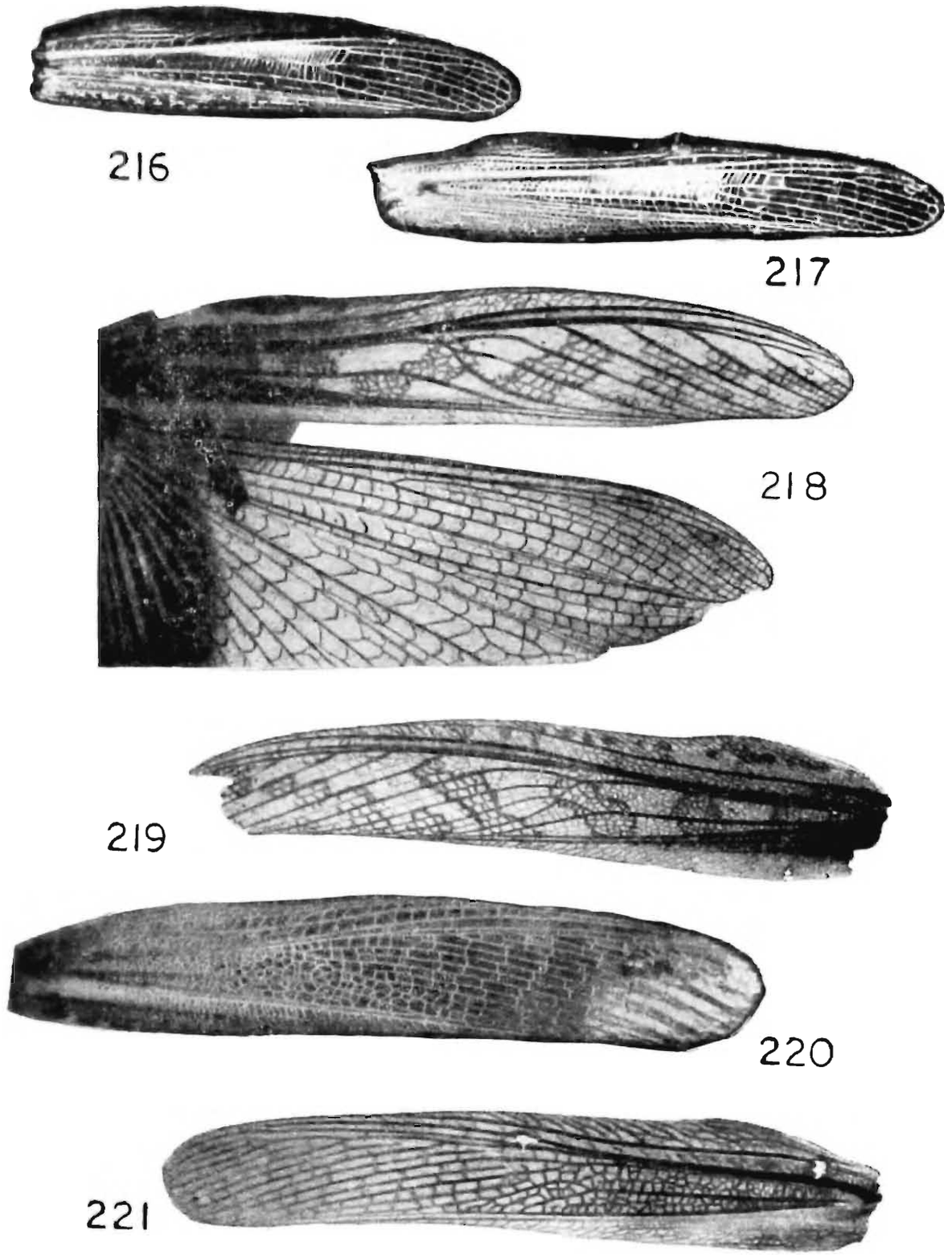
Species	Darjeeling	Jalpaigurf	Cooch Behar	West Dinajpur	Maldah	Murshidabad	Birbhum	Burdwan	Bankura	Purulia	Midnapur	Nadia	Hooghly	Howrah	24-Parganas	Remarks
—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Acrida exaltata	+	+												+	+	
Phlaeoba antennata	+	+					+									
P. panteli	+	+											+	+	+	
Ceracris nigricornis laeta	+															Also in Sikkim
Holopercna darjeelingensis	0															
Duopherula (A.) luteipes									+							
D. (A.) physopoda	0															
D. (A.) rubripes	0															
Leva indica									+	+						
Aiolopus (tha.) tamulus	+	+			+					+			+	+		
Dittopternis venusta	+	+														
Heteropternis respondens	+	+														
Oedaleus abruptus	+	+	+		+				+	+						
Gastrimargus af. africanus	+	+								+						
Acrotylus humbertianus	+									+						

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
A. insubricus inficita																Recorded from "North Bengal"
Meristopteryx rotundata																—As above—
Trilophibia annulata	+	+													+	
Chloebora grossa	0															
Pternoscirta bimaculata									+	+						
P. cinctifemur	0															
Sphingonotus longipennis	0	+														
Chondronotuls bengalensis																Described from N. Bengal
Gesonula punctifrons	+												+	+		
Spathosternum pra. prasiniferum	+	+					+							+	+	
Leptacris vittata																Recordcd from North Bengal
Hieroglyphus banian				0	0	0	0	0	0		0	0	0	0	0	A rice pest
H. nigrorepletus				0	0	0	0	0	0		0	0	0	0	0	—do—
H. oryzivorus						0										
Parahieroglyphus bilineatus																Recorded from "Bengal"
Oxya velox	+	+					+							+	+	All over
O. fuscovittata	+	+											+			W. Bengal
O. hyla hyla		+												+	+	
O. ja. japonica	+													+	+	
Eucoptacra praemorsa	+								+							
Epistaurus sinetyi									+					+		
Circocephala indica	+	+												+		
Tristria pulvinata																
Oxyrrhepes obtusa	+															
Pachyacris vinosa																
Patanga (P.) japonica	+															Recorded from "North Bengal"

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Cyrtacanthacris tatarica	+								+							
Chondracris rosea	+	+	+													
Peripolus pedarius	+															
Paraconophyma scabra								0								Described from Burdwan
Catantops innotabilis	+	+														
C. erubescens																Described from "North Bengal"
Xenocatantops humilis	+	+														
Stenocatantops splendens	+															
Cingalia(=Mesambria) dubia	+															
Gerenia bengalensis	+	+												+		
Choroedocus robustus	+	+													+	
Eupreponotus inflatus	+													+		
Heteracris pulcher	+		+	+												
Eyprepocnemis alacris alacris	+	+														
Tylotropidius varicornis	+															

PLATES

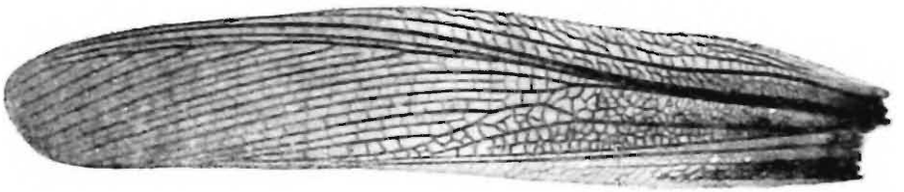
PLATE I



Figures 216-224. Tegmina of—

		Length (in mm)
Fig. 216.	*Spathosternum prasiniferum prasiniferum*, ♂	14
Fig. 217.	Same as above, ♀	17
Fig. 218.	*Cyrtacanthacris tatarica*, ♂	40
Fig. 219.	Same as above, ♀	52
Fig. 220.	*Choroedocus robustus*, ♂	36
Fig. 221.	Same as above, ♀	62

PLATE II



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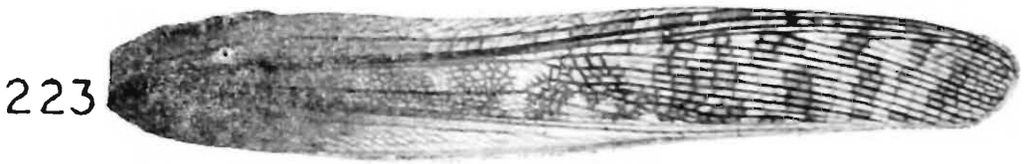

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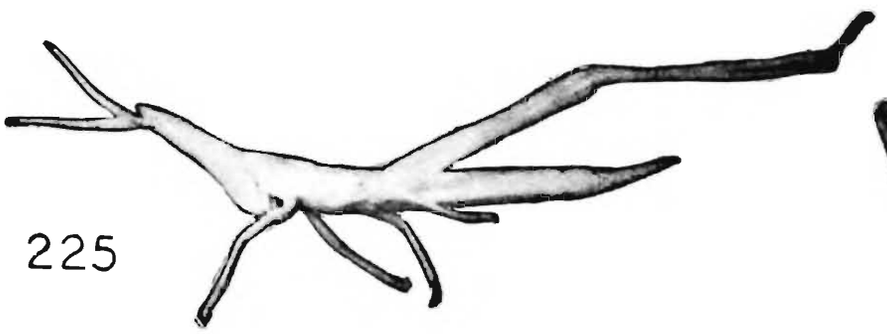
224



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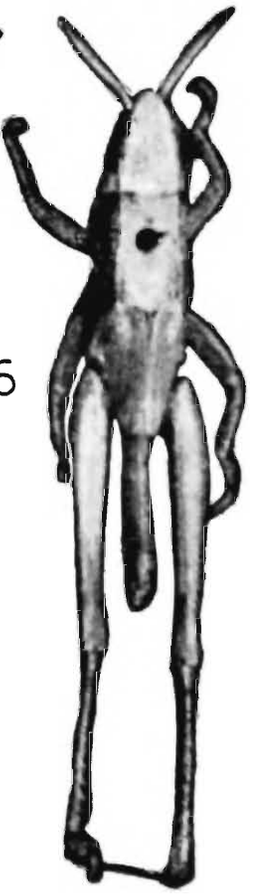

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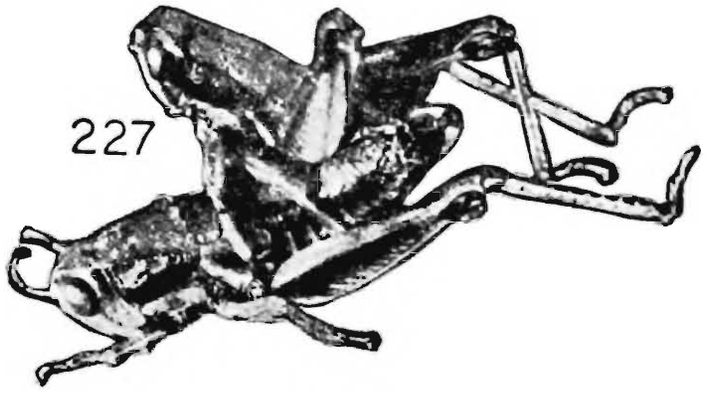
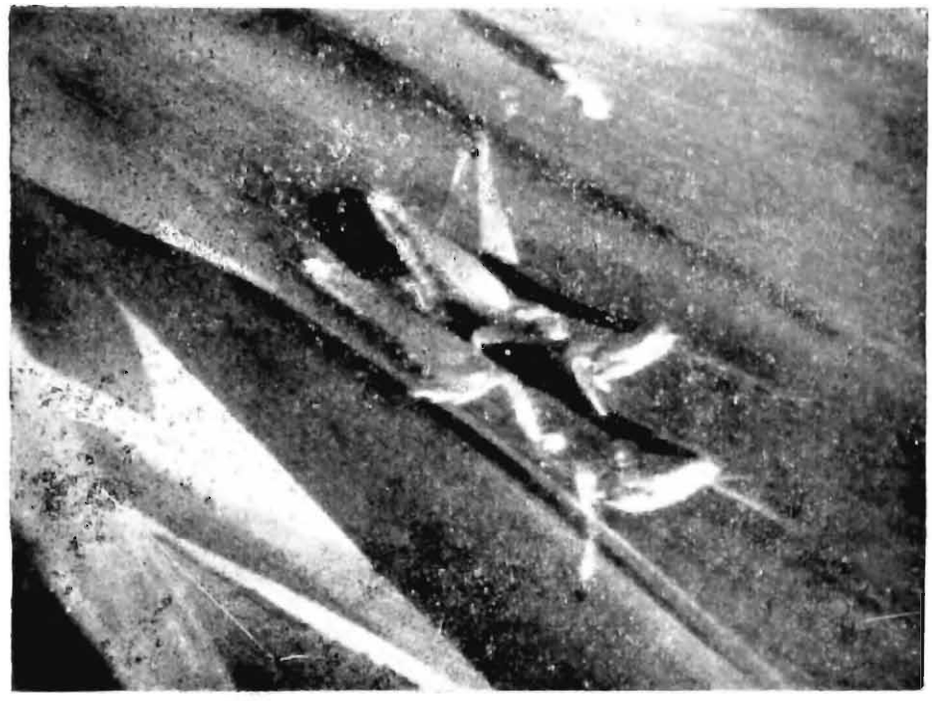


227

	Length (in mm)
Fig. 222. *Heteracris pulcher*, ♂	23
Fig. 223. Same as above, ♀	45
Fig. 224. *Eyprepocnemis alacris alacris*, ♂	21
Figures 225-226. Nymphal stage of—	
Fig. 225. *Acrida exaltata*, ♀ (3rd instar)	
Fig. 226. *Spathosternum p. prasiniferum*, ♀ (3r instar)	
Figures 227-228. Mode (1) of Copulation of—	
Fig. 227. *Paraconophyma scabra*, in situ	14 (♂) 19 (♀)

PLATE III



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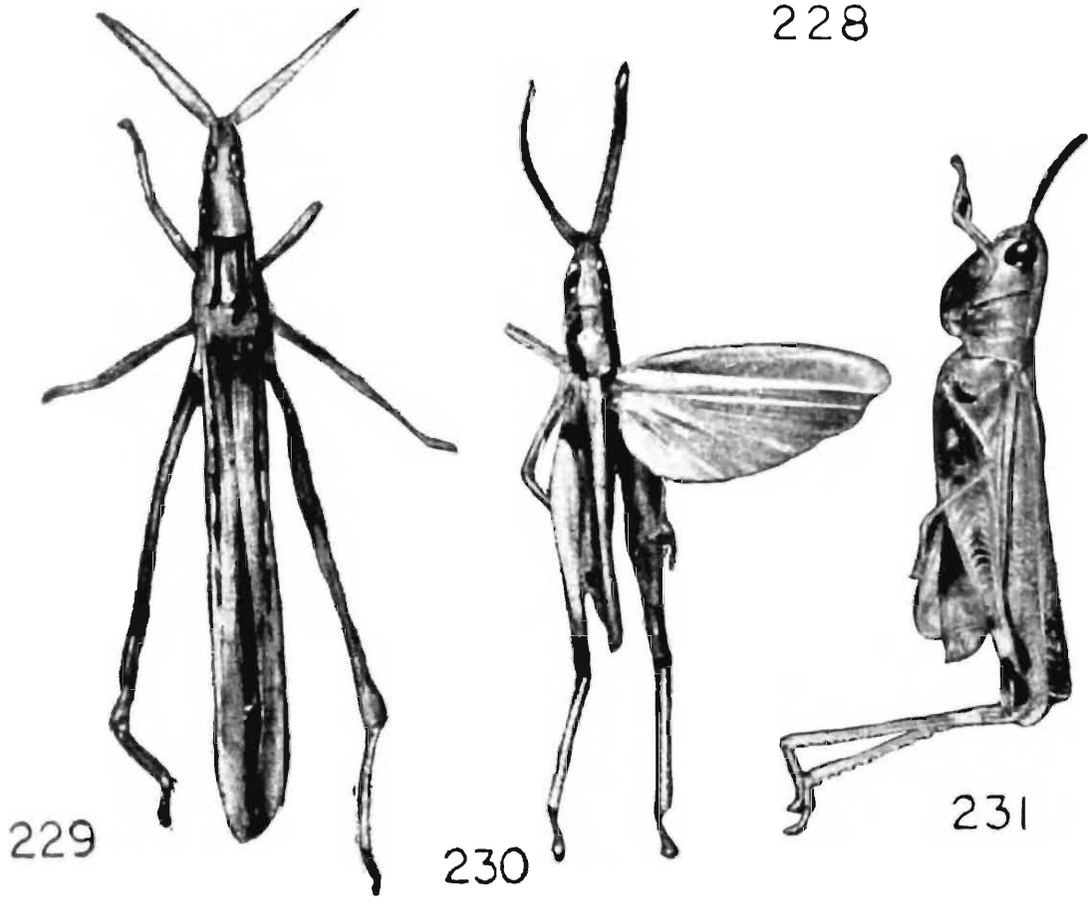
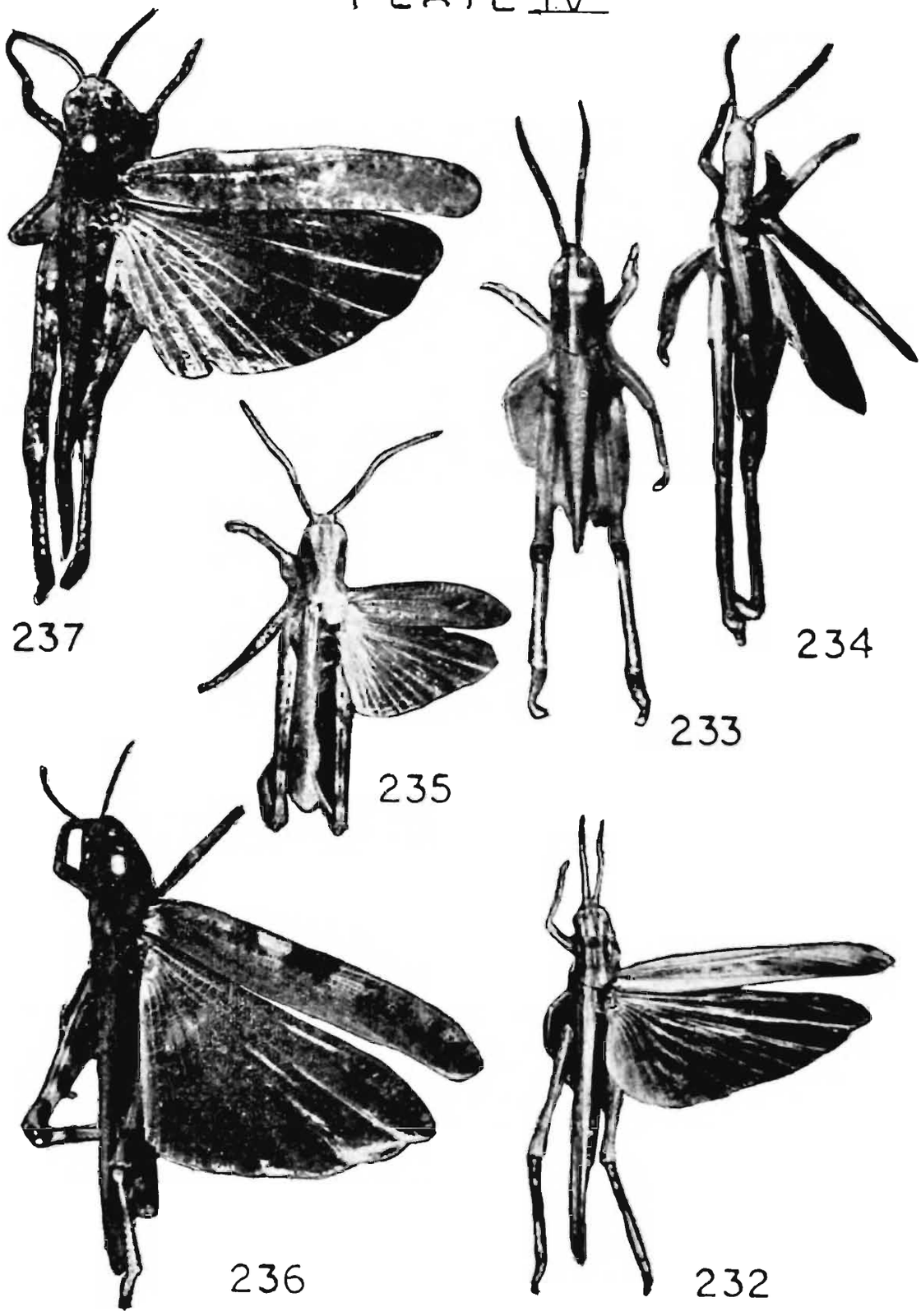


229 230 231

Fig. 228. Oxya sp. on maize leaf, natural position
Figures 229-282. Photographic profile of—

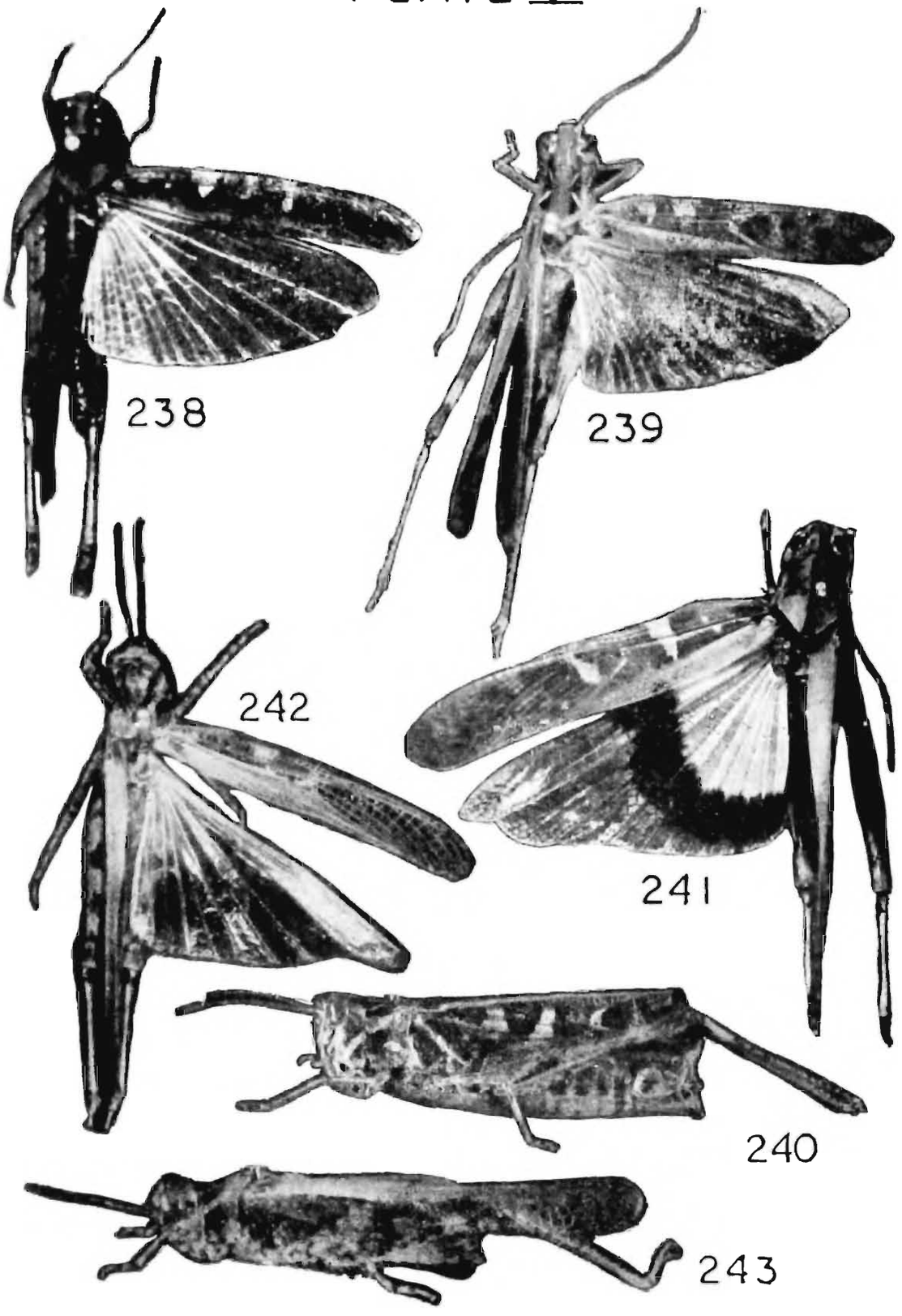
		Length (in mm)
Fig. 229.	*Acrida exaltata*, ♀	52
Fig. 230.	*Phlaeoba antennata*, ♂	22
Fig. 231.	*Ceracris nigricornis* laeta, ♀	32

PLATE IV



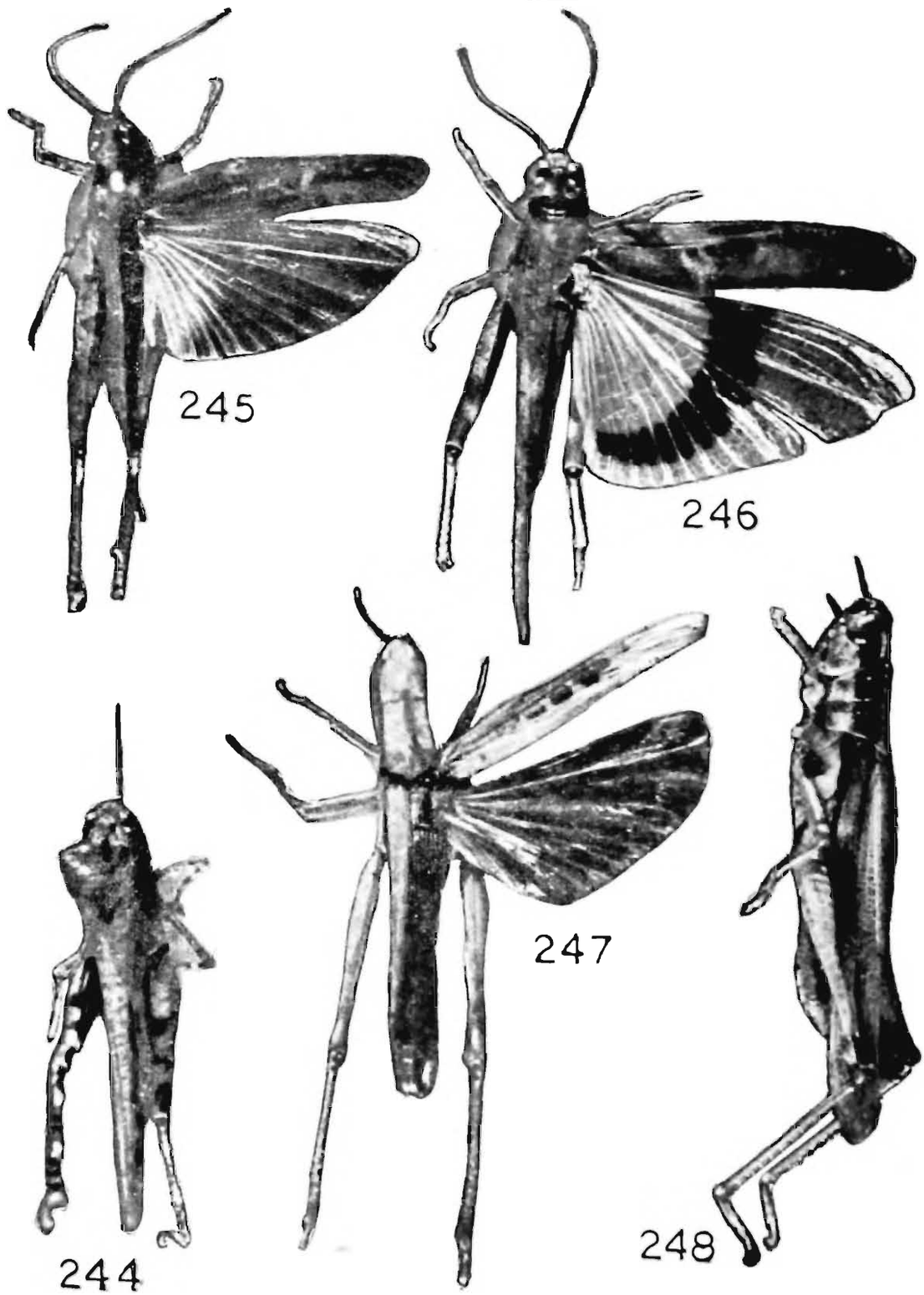
		Length (in mm)
Fig. 232.	*Holopercna darjeelingensis*, ♀	30
Fig. 233.	*Dnopherula* (*A.*) *luteipes*, ♂	15
Fig. 234.	Same as above, ♀	22
Fig. 235.	Leva sp., ♂	13
Fig. 236.	*Aiolopus thalassinus tamulus*, ♀	24
Fig. 237.	*Dittopternis venusta*, ♀	28

PLATE V



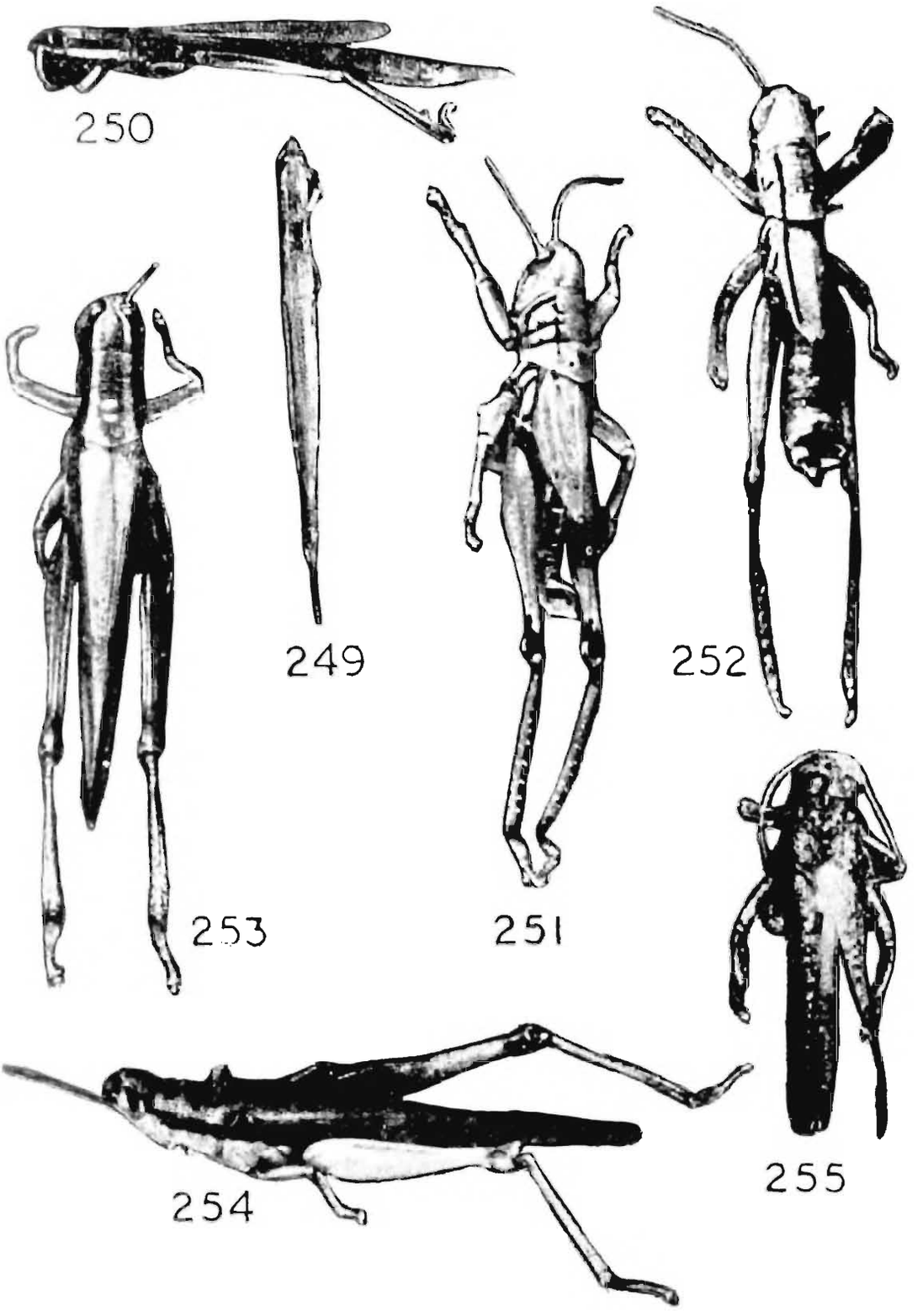
		Length (in mm)
Fig. 238.	*Heteropternis respondens*, ♀	24
Fig. 239.	*Oedaleus abruptus*, ♂	15
Fig. 240.	Same, ♀ (lateral)	20.5
Fig. 241.	*Gastrimargus afr. africanus*, ♀	35
Fig. 242.	*Acrotylus humbertianus*, ♀	20
Fig. 243.	Same, ♀ (lateral)	20

PLATE VI



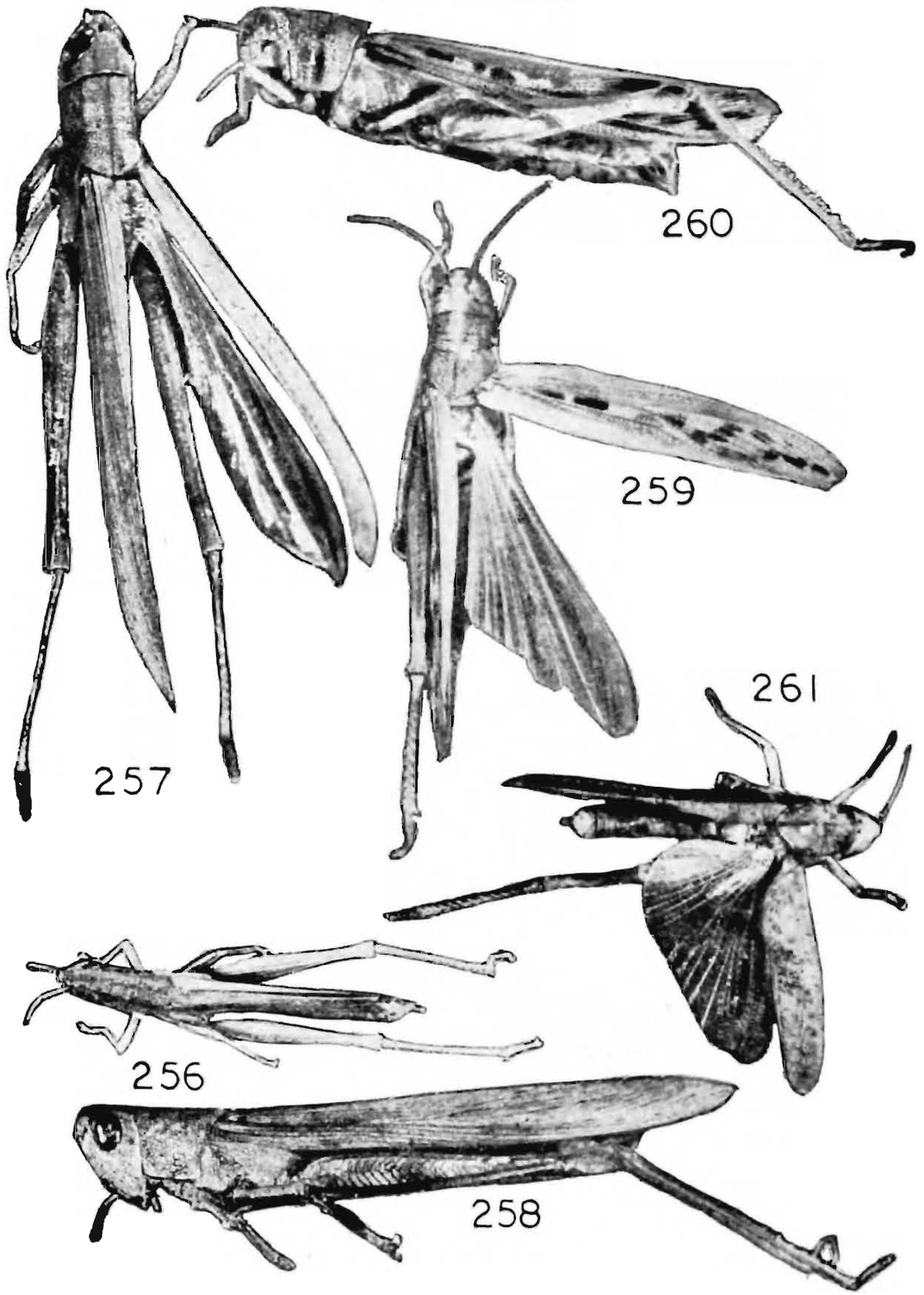
		Length (in mm)
Fig. 244.	*Trilophidia annulata*, ♂	14
Fig. 245.	*Pternoscirta bimaculata*, ♂	16
Fig. 246.	*Sphingonotus longipennis*, ♂	25
Fig. 247.	*Spathosternum pr. prasiniferum*, ♀	21
Fig. 248.	*Gesonula punctifrons*, ♀	21

PLATE VII



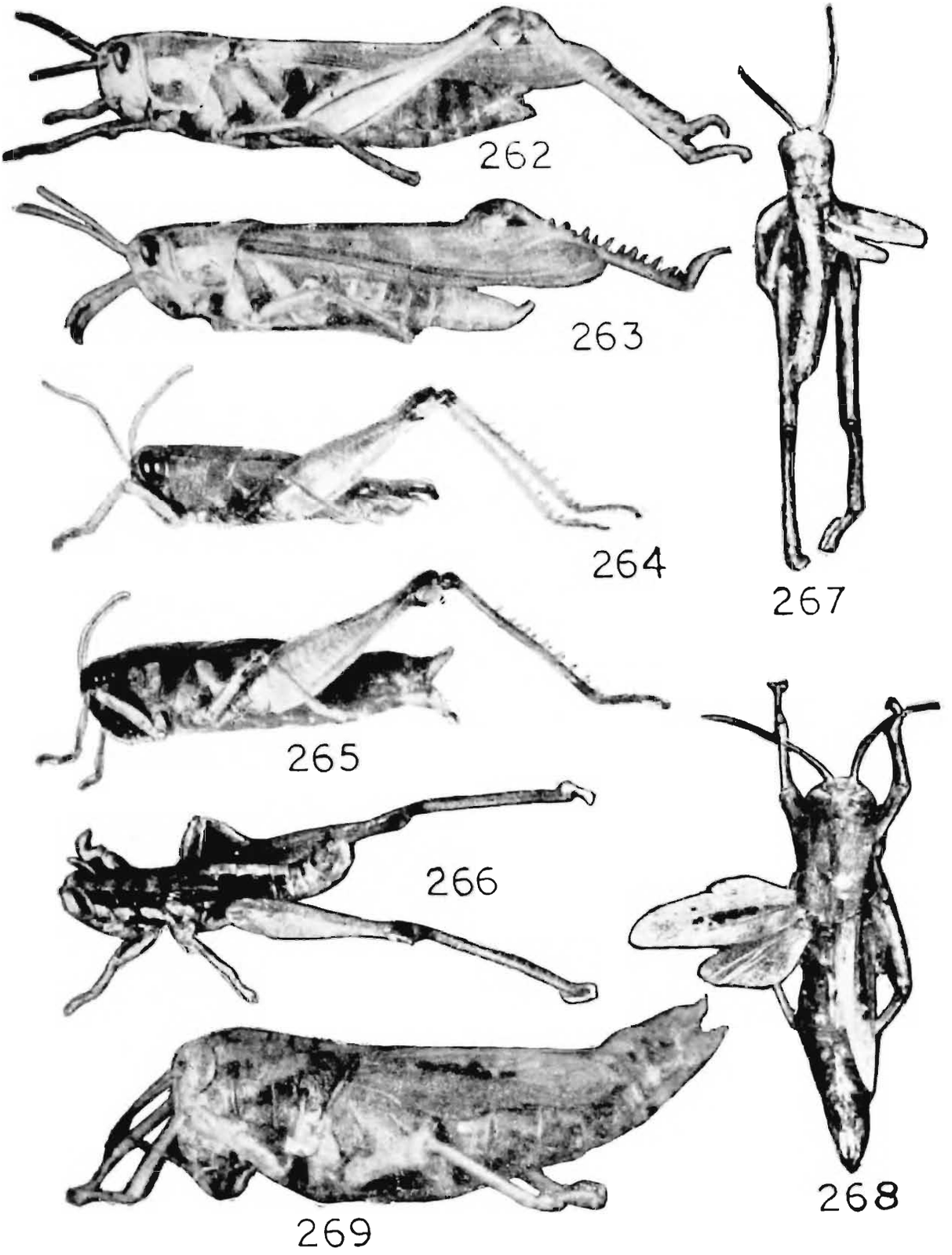
		Length (in mm)
Fig. 249.	*Leptacris vittata*, ♂ (from China : *Br. Mus.*)	51
Fig. 250.	Same as above, ♂ (lateral)	51
Fig. 251.	*Hieroglyphus nigrorepletus*, ♂	33
Fig. 252.	*Parahieroglyphus bilineatus*, ♂	22
Fig. 253.	*Oxya fuscovittata*, ♀	30
Fig. 254.	Same as above, ♀ (lateral)	30
Fig. 255.	*Epistaurus sinetyi*, ♂	13

PLATE VIII



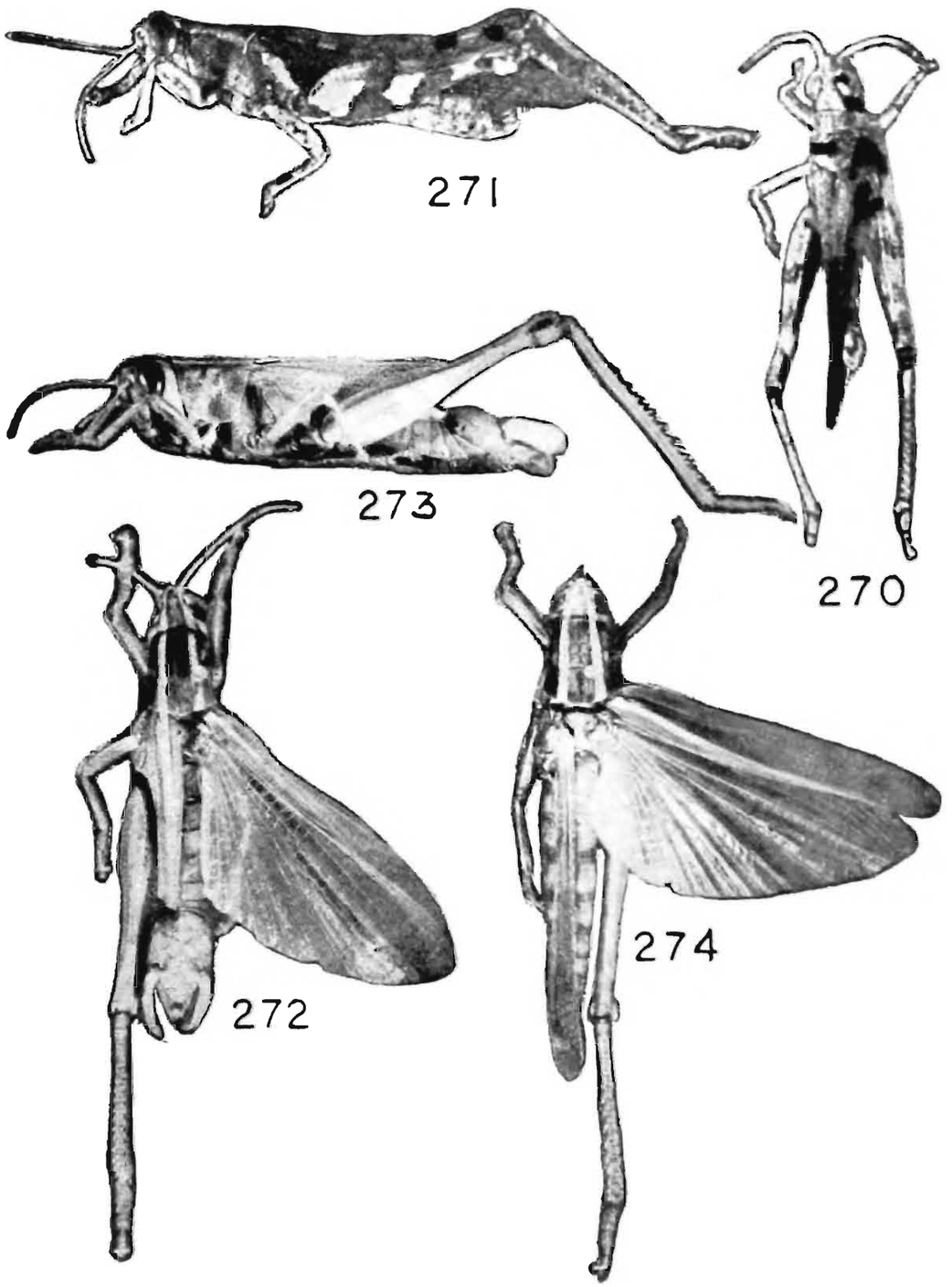
		Length (in mm)
Fig. 256.	*Tristria pulvinata*, ♂	25
Fig. 257.	*Oxyrrhepes obtusa*, ♀	46
Fig. 258.	Same as above, ♀ (lateral)	46
Fig. 259.	*Patanga japonica*, ♀	50
Fig. 260.	Same as above, ♀ (lateral)	50
Fig. 261.	*Pachyacris vinosa*, ♀	35

PLATE IX



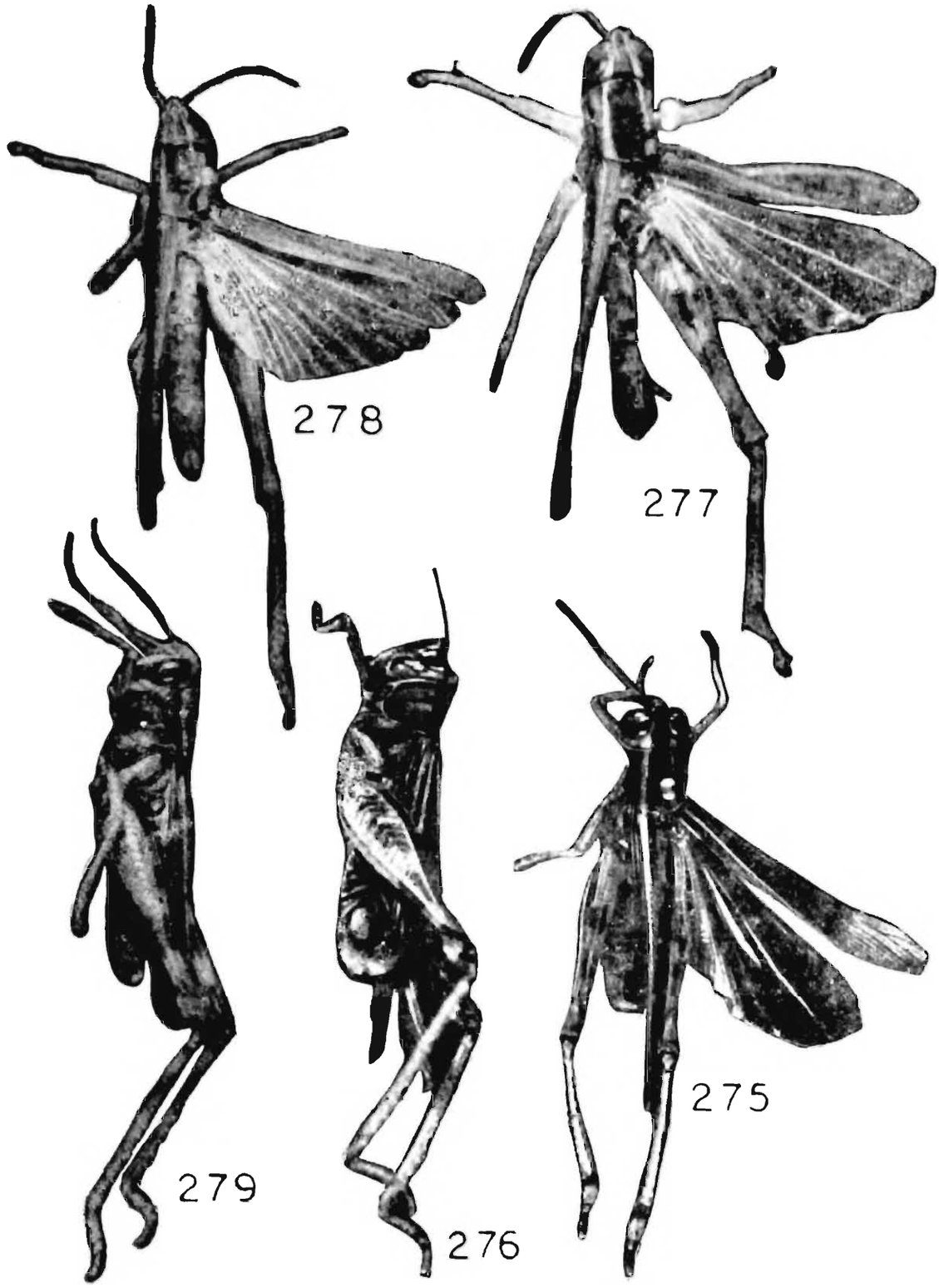
		Length (in mm)
Fig. 262.	*Cyrtacanthacris tatarica*, ♀	59
Fig. 263.	Same as above, ♂	45
Fig. 264.	*Peripolus pedarius*, ♂	27
Fig. 265.	Same as above, ♀	44
Fig. 266.	*Mesambria dubia*, ♂	14
Fig. 267.	*Gerenia bengalensis*, ♂	33
Fig. 268.	Same as above, ♀	33
Fig. 269.	Same as above, ♀ (lateral)	33

PLATE X



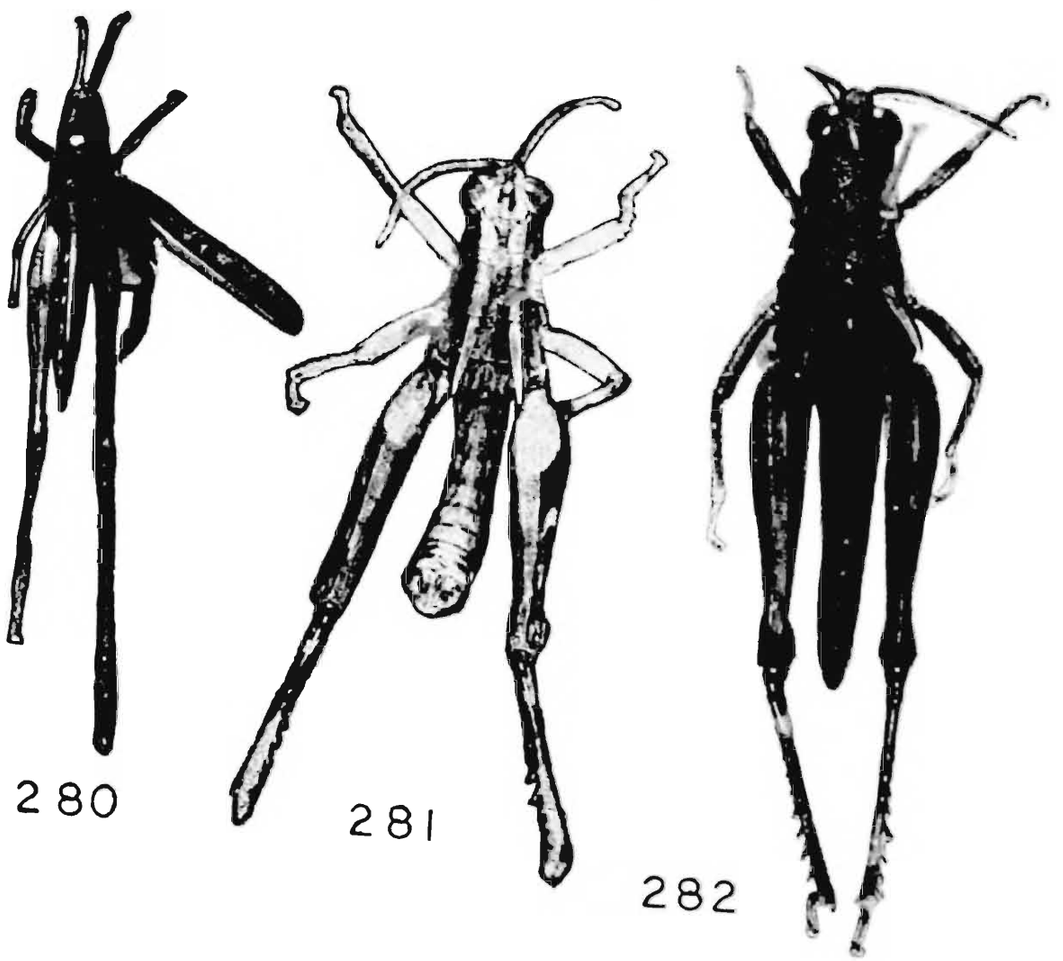
		Length (in mm)
Fig. 270.	*Xenocalantops humilis*, ♂	22
Fig. 271.	Same as above, ♂ (lateral)	22
Fig. 272.	*Choroedocus robustus*, ♂	44
Fig. 273.	Same as above, ♂ (lateral)	44
Fig. 274.	Same as above, ♀	68

PLATE XI



		Length (in mm)
Fig. 275.	*Eupreponotus inflatus*, ♂	26
Fig. 276.	Same as above, ♂ (lateral)	26
Fig. 277.	*Eyprepocnemis alacris alacris*, ♂	24
Fig. 278.	Same as above, ♀	36
Fig. 279.	*Heteracris pulcher*, ♂ (lateral)	27

PLATE XII



		Length (in mm)
Fig. 280.	*Tylotropidius varicornis*, ♂	25
Fig. 281.	*Circocephalus indica*, ♂	22
Fig. 282.	Same as above, ♀	29