INTRODUCTION

The present study was aimed to establish the diversity of grasshoppers in greater Kolkata area. For this purpose altogether 37 localities were studied during mention year, with collections made in every month during the said period.

Altogether 35 species under 29 genera of the families Pyrgomorphidae and Acrididae were found, with genera and species recorded were as follows :-

The distribution of some species differed markedly from one site to another, maximum number of species was recorded from Narendrapur locality (20 species), while the minimum number of species was recorded from Botanical Garden (15). Such a wide variation of species may be due to the different conditions of vegetations and other microclimatic factors Hazra *et al.* (1981) and Tandon *et al.* (1988).

The grasshopper population observed maximum during July-October was probably associated with maximum vegetative growth during that period Dwivedi (1977), Tandon and Khera (1978) and Hazra (1984). The minimum population of Grasshoppers were recorded during the month of May when the temperature was high and grasses were dried up.

The specieswise break up of the total population showed that *Spathosternum prasiniferum prasiniferum*, *Oxya fuscovittata* and *Tristria pulvinata* constituted 36.68%, 20.36% and 19.80% of the total population and occupied 1st, 2nd and 3rd position in order of dominance respectively. The occurrence of these species throughout the year along with nymphal stages suggests continous breeding and multovoltine cycle of these species. This also supports the views of Uvarov (1977).

The species *Tristria pulvinata*, *Atractomorpha crenulata*, *Phlaeoba infumata*, *Aiolopus thalassinus tamulus*, *Oxya hyla hyla* were found to occupy 19.80%, 9.19%, 7.34%, 2.36%, 1.55% respectively of the total populations. They exhibited two annual population peaks and were found to be bivoltine in nature. While *Aulacobothrus luteipes*, *Gesonola punctifrons*, *Acrida exaltata* and *Epistaurus sinetyi* consisted of 1.38%, 1%, 0.33%, 0.08% of the total arthropod population and were univoltine. All these bivoltine and Univoltine species showed a very discrete distribution and were totally absent in many of the sampling months. Bhowmik (1986) and Hazra *et al.* (1991) reported the occurrence of 56 species under 45 genera and 69 species belonging to 40 genera from the State of West Bengal respectively. The present observation indicates a possible reduction in the species diversity of the grasshoppers.The total population of grasshopers has also changed considerably. Such a change is probably due to the massive developmental activities during last several years involving constructions of buildings and factories, roads, filling up of the wetlands and conversion of cultivated land into homestead ones. All these activities exert profound stress on the natural vegetation *vis-a-vis* the habitats of the grasshoppers. Thus a large number of them have probably migrated to some other zones still others have started changing their year old natural habitats and have developed into pests of certain crops. Further for the sustenance of their populations they have probably adopted themselves to change their breeding season to any favourable condition. All these findings were found to agree with those of Tandon and Khera (1978), Uvarov (1961), Baranov and Bei-Bienko (1926) etc.

The order Orthoptera which includes the dreadfully destructive locusts is one of the largest orders of insects having over 17,250 species known to science globally with more than 900 species have been recorded from India.

The orthopterans are distributed throughout the physiographic zones of the world but their distribution largely depends upon the vegetations prevailing in grassfields, forests and agricultural lands. Temperature, seasonal precipitation of rain fall and soil conditions are some important factors

which also determine the distribution of grasshoppers. India provides an unique habitat for this group of insects, for there exist humid grasslands in East and North-East India, semiarid grass plains in North West and Southern parts of India, vast agricultural fields, submountaneous forests and scrub jungles, vegetation adjoining lakes, river basins and numerous water bodies scattered throughout the country. The order is divided into 2 suborders *viz.* Ensifera and Caelifera (Anden, 1939). Ensifera has two superfamilies *viz.*, Tettigonoidea and Grylloidea. Caelifera is divided into four superfamilies *viz.*, Acridoidea Tridactyloidea, Eumastacoidea and Tetrigoidea according to Dirsh (1961, '65). Superfamily Acridoidea displays maximum diversity and is divided into five families of which families Acrididae and Pyrgomorphidae are widely distributed in India. Acrididae is divided into 17 sub-families and altogether over 6000 species under 138 genera and 14 sub-families are known from India. From West Bengal 69 species under 49 genera have been recorded (Hazra *et al.* 1992). The subfamily Pyrgomorphinae includes 440 species under 148 genera reported from all over the world, of which 40 species under 19 genera are known from West Bengal. Till date, no comprehensive as well as consolidated studies have been made on the grasshopper fauna in the vegetations of parks and grassyfields of adjoining areas of any Indian Metropolitan city. Therefore, the present investigation has been carried out to achieve the following objectives :

1) To undertake a thorough survey of the grasshopper fauna of Kolkata metropolis in relation to different vegetations.

2) To study in detail texonomy of the grasshopper fauna of Kolkata and its adjoining areas.

3) To study the seasonal abundance of grasshoppers in relation to some ecological factors.

REVIEW OF LITERATURE

Latereille (1793) first nameds the order Orthoptera. He gave the name as Saltatoria in the year 1817. Stål (1860) first initiated the study of Acridoidea and his work was mainly taxonomical. Walker (1870, 1871) prepared a catalogue of orthopteran specimens. Stal (1873) worked on some groups of Orthopteran belonging to the family Locustidae and established some new genera in the said family, but he could not postulate identifying characters of a single genus. Subsequently Stål (1876) while studying the taxomony of the family Pyrgomorphidae described for the first time, that median furrow on the apex of fastigium is an important taxonomic character. Saussure (1884 and 1888) and Boliver (1902, 1909, 1914, 1917, 1918) worked on the Orthoptera inhabiting Indian Subcontinant. Handlirsch (1908) divided the order Orthoptera into suborders Locustoidea and Acridoidea. Maxwell and Lefroy (1909) worked on Acridids in relation to colour pattren and environment they live in and also worked on the taxonomy of Indian Orthoptera. The most unique and useful taxonomic work came from Kirby(1914) who made a faunistic description in his book of 'Fauna of British India' which is very helpful even today. He discovered 8 subfamilies including 124 genera and 329 species. It must be worth mentioning that most of the species recorded during the present study have been included in Kirby's description. Chopard (1920) was the first to introduce the internal structure of mainly male genetalia for the purpose of systematics. Uvarov (1921) revised the genus *Locusta* and established a new theory regarding the periodicity of migration of locust. Uvarov (1923) observed some factors which are responsible for Locusts' invasion and periodicity and describe the species concerned as an economically important one. Uvarov (1924) worked on taxonomy of Indian grasshoppers. Uvarov (1928) published a hand book of Locusts and grasshoppers in that book he observed them studied in different aspects and suggested control measures against them. According to Roonwal (1936), Carpentier (1936) the thoracic skeleton of Tetrigoidea and Acridoidea differ in many essential features. The pronotum of Tetrigidae is a highly elongated

structure which is never in case of Acrididae. Chopard (1938) studied the systematics of Acriododea and observed that stridulatory organs in Acridoidea are of high taxonomic importance. Ander (1939) while working on the Orthopteran insects divided the order Orthoptera into two suborders namely Ensifera and Caelifera. The first of which follows to Handlirsch's Locustoidea and the second one to Handlirsch's Acridoidea. He also transferred the family Tridactylidae into suborder Caelifera. Nolte (1939) worked on colour pattern and chromosome complex of *Aiolopus thalassinus*. In his opinion the said species is a grassland type with two basic colour forms-green and light brown, the latter one being the more common. In the green forms colour could not be controled by changing their environs and in fact they became darker to brown on maturity. Silfer (1939-43) described the internal female genetalia mainly spermatheca in Acridoidea and according to him spermatheca may be an additional taxonomical character in Acridoidea. Henry (1940) worked on Orthoptera from the South Indian regions. Quadri (1940) worked on the developement of genetalia and their ducts of Orthoptera. He studied the ovipositor and named the first and second valves as anterior and lateral valves. Roberts (1941) used male genetalia for the differentiation of families. Phallic complex appears to be the most reliable character definitely for classification of higher taxnomic limits as because they are less subjected to the adaptive changes of the organisms in changing environmental conditions than any external structure. Uvarov (1942) worked on palaearctic Orthoptera in relation to the veriety of structures concerned with stridulations by which they can produce sound which is detectable by the human ear and in his opinion these stridulatory structures are of important taxonomic value. Henry (1942) who also worked on stridulation-mechanism pointed out its taxonomic importance at the species level. Uvarov (1943) studied the male genetalia and observed that it could be a supplementary character for differentiation of genera and species on a wider scale. Roonwal (1945) worked on the binomics of *Hieroglyphus nigrorepletus* at Beneras. Silfer (1949) studied the whole of female genetalia and in his view spermatheca is the most important characteristic features for each suborder as well as family. Bei-Binenko (1951) worked on Acridoidea and submitted the key to the species, in which he used a fairly large combination of characters. The genus is generally divided on the basis of the combination of characters as width of hind femur in relation to the width of tegmen. Katiyar (1953) worked on taxonomy of Indian grasshopper and showed the number of antennal segments varies even in the same individual. He also studied post embrynic growth of antennal segments in three species of Indian short horned grasshopper and recorded variation in the number of segments in adults. Mason (1954) studied the antennal segments of different subfamilies of Acrididae. She showed that number of antennal segments differed in different subfamilies of Acrididae and therefore suggested that number of antennal segments might be a good taxonomic character. Kevan (1954) studied the genus *Chrotogonus* of the family Pyrgomorphidae and described the species of the said genus in greater detail. Willemse (1955) studied one of the most important group, catantopinae under the superfamily Acridoidea. The specimens concerned were from Indo-Malayan region and he made a synopsis of the group with good illustrations which proved to be, for taxonomic purpose, one of the most useful documents. Dirsh (1955) worked on the stridulations in the different groups of Acridoidea and was the first to opine that stridulatory organs having variety of structures present in Acridoidea are very useful taxonomic characters. In some groups they are conspicuous and in some they are absent. Dirsh (1956) did a revisionery work on taxonomy of the group catantopinae and in this study most of the specific types and large series of material comprising 8600 specimens obtained from the different Museums and private collections were studied. Consequent upon such a revision 37 species remained in the old genus *Catantops*. subsequently Dirsh (1956) worked on the Phallic complex of Acridoidea in relation to taxonomy and this work revealed the taxonomy and this work revealed the taxonomy importance of the phallic complex upto species level. The same author (1956) also held the

view that female genetalia could be a supplementary character for taxonomical study. Further, he studied in detail structure of spermatheca and reported its taxonomic importance upto subfamily level. According to him spermatheca is the characteristic feature for each suborder and even for each family. Later Dirsh (1958) recorded the genus *Eyprepocnemis* having in its fold 19 species and 4 sub-species. Kevan (1959) revised the genus *Chrotogonus* under family Pyrgomorphidae and presented a monograph of Chrotogonini, in which each genus has been properly illustrated with its distribution along with some useful information on variability in biometric studies of the sub-species. Rotanlal and Baldev Prasad (1959) studied the male genetalia of 27 species representing Pusa collection. Dirsh (1961) revised the families and subfamilies of Acridoidea and in this work each identifying character has been fully described with adequate illustrations. He suggested that external and internal characters may not be simultaneously used for determining a species. Besides, the classification of higher taxonomic units has been included in his study. Hollis (1965) revised the genus *Trilophidia* (Acridoiea) taxonomically with some notes on biology and distribution and in this work keys of different species have been presented and each species has been nicely illustrated. Dirsh (1965) made another important contribution in the African genera of Acridoidea with excellent illustrations. Moreover this work gives keys and short diagnoses for families, subfamilies and genera. In addition, the terminology of some important morphological features including phallic complex has been presented. Kevan and Chen (1969) gave a synoptic account of the genus *Atractomorpha* and its aberrant group under the family Pyrgomorphidae. Tandon and Shishodia (1969) worked on Acridoidea from Nagarjuna Sagar Dam Area. Hollis (1971) while redescribing the genus *Oxya* presented its synonymy, distribution, biometry of some body parts and phallic complex etc. Mason (1973) revised the taxonomy with nice illustrations the genera *Hieroglyphus*, *Hieroglyphodes* and *Parahieroglyphus*. Tandon and Khera (1978) presented a brief account of the climate, vegetation, habitat and seasonal abundance of the species belonging to 23 genera under 3 families. According to them the species varies in colour during different seasons. Their work also depend upon the impacts of activities of human beings on ecology and distribution of the grasshoppers. Asket Singh (1978) worked for the first time, on the group, Catantopinae prevailing at Dehra Dun. Ritchie (1981) revised the taxonomy of genus *Oedaleus* of African as well as non-African origins. Hazra *et al.* (1982) worked on ecology of grasshoppers in a grassland and presented the impact of some physical factors. Bhowmic and Halder (1984) worked on this group obtained from Purulia and Bankura districts (W.B.) and presented data covering zoogeography, taxonomic characters and morphometry of the species. Dwivedi and Chattoraj (1984) worked on variation of population of grasshoppers in referance to some environmental factors in a grassland ecosystem. Bhowmik and Halder (1984) worked on Acridids on Population, ecology, seasonal occurance and abundance. Shishodia and Hazra (1984) described fauna of Orthoptera from Arunachal Pradesh and recorded 33 species of Orthoptera 16 of which were new records from that area. Shishodia and Hazra (1986) made a faunistic survey of Orthopteran fauna from silent vally. Tandon and Hazra (1988) worked on taxonomy as well as ecology of this group of insects. Tandon and Shishodia (1989) for the first time, studied the fauna of Acridoidea of Orissa with special referance to its distribution based on a large collection.

TOPOGRAPHY AND CLIMATE OF GREATER KOLKATA

The area under study is situated between 88°10' and 88°40' East longitude and between 22°20' and 22°45' North latitude in the district of 24 Parganas in West Bengal. It includes the entire city of Kolkata with its subarban areas such as Barrackpore, Palta, Baruipur, Canning, Narendrapur, Habra, Gobardanga, Bongaon,

Table 1 : Showing average maximum and minimum temperature relative humidity and rainfall per month, recorded at Alipore Metrological observatory, Kolkata

Month	Maximum Temperature (°C)	Minimum Temperature (°C)	Relative Humidity 8.30 hrs.	Humidity at 17.30 hrs.	Total Rainfall (mm)
January	26.6	13.4	69	52	12.5
February	31.5	18.7	66	44	11.7
March	34.6	22.1	66	43	16.8
April	36.9	25.2	68	53	47.2
May	35.7	26.4	71	65	120.7
June	34.0	26.8	79	76	221.8
July	32.2	26.3	83	80	339.2
August	32.2	26.4	83	82	249.0
September	32.2	26.0	81	82	315.0
October	31.4	24.2	73	74	183.6
November	29.5	18.3	65	60	6.3
December	26.9	14.1	68	56	0.3

Sibpur, Botanical garden, Tribeni and Chandan Nagar. The Hooghly river flows along the western side of the city and subarbs (Map I).

Vegetation : The following cultivated and non-cultivated vegetations are found in greater Kolkata areas such as paddy (*Oryza sativa*), maize (*zea maize*), wheat (*Triticum sativum*), pea (*Pisium sativum*), gram (*Ciceer esculentus*) and vegetables like cauliflower (*Brasica oleracea* var.-), cabbages (*Brasica aleracea* var.-), chilly (*Capsicum frutescens*), brinjal (*Solanum melongena*), arum (*Colocasia antiguorum*), sugarcane (*Saccharum officinarum*), ladies finger (*Abelmoschus esculentus*), hicha (*Enhydra fluctuens*) beside grasses and sedges like *Sporobolus diander* Beauv, *Arundinella* sp., *Dichanthium annulatum* Stapf., *Eragrostis brachyphylla* Stapf., *Digitaria marginata* (Linn.), *Digitaria royleana*, *Commelina oblilqua* Ham., *Vernonia cenerea* Less., *Panicum* sp., *Digitaria idscendens*, *Cynodon dactylon* Pers., and *Eupatorium odoratym* Linn.. The normal maximum and, minimum temperature, relative humidity and rainfall on average according to the Metrological observatory of the city at Alipore, are appended in table I.

It dealt with 35 species under 29 genera belonging to 2 families of which 23 species are recorded. for the first time from Kolkata.

In addition to description of the diagnostic features, the keys for identifications of subfamilies, genera excantentined in families and subfamilies affinities species keys, with other related species, synonyms, distribution and some other aspects of ecology and behaviour of some of the species have been incorporated. Also have been outlined the more important taxonomic criteria of grasshoppers for maintaining the identity of the species and broad classification of grasshoppers. A key to the families of grasshoppers studied here is also provided for guidance of future workers in this field.

MATERIAL AND METHODS

A. For Taxonomical Study : The grasshoppers were collected from the different areas of greater Kolkata. To have a good number of collections of grasshopper fauna several surveys have been conducted from all corners of Kolkata and its environs. Grasshoppers were mainly collected from the grassfields, low vegetation, bare ground, vegetations by the side of aquatic body, with

the help of insect nets, the collections were also made by using light trap. Unidentified materials, present in the collection of Zoological Survey of India have also been studied as and when required.

The male genetalia were studied by dissecting the dry specimens. After taking out genital parts, these specimens were kept in 10% KOH solution. Then the separated parts were washed in water and preserved in alcohol. Later the genital parts were studied by preparing temporary mounting with glycerine.

Measurements : All messurements have been taken in millimeter scale starting from the tip of the fastigium upto the end of the abodomen.

B. For Ecological Study : The site was located at the Botanical Garden grassfield in the district of Howrah, which is about 10 km. west of Kolkata. Site-area which was situated for the estimation of population of grasshoppers and their seasonal abundance was about 150 m X 100 m. The entire site was subdivided into 5 sq m. sub-plots and the area was marked with long wooden sticks for each sub-plot. The grasshoppers were collected by catch-count method (Andrewartha, 1970) by using standard net of conventional size of 36 cm in diameter and estimated the number, years (May, 1979 to April, 1981). Field soil temperature and relative humidity was recorded by using a soil thermometer obtained from France and a dial hygrometer respectively at sampling time. The grass field mainly comprised grassses like *Cynodon dactyln* Pers., *Dichanthium annulatum*, (Forsk.) Stapf, *Digitaria marginata* Linn., *Chrysopogon aciculatus*, Trin., *Eragrostis pilosa* Beauv., *E. brachyphylla* Beauv., *Digitaria royleana* Prain., *Arundinella* sp. Raddi, *Vernonia eneria* Less., *Eupatorium odoratum* Linn., (mentioned). Soil of the sites were gangetic alluvium, brownish grey in colour and clayloam in texture.

OBSERVATIONS

A. Detailed Taxonomic Characters For the Studied Grasshoppers.

Head : Anterior part generally short, broad, may be oval or conical; vertex usually rounded, sometimes it may be flat or depressed.Posterior part covered by pronotal margin called occiput. Mid-area above two eyes area behind antennae called fastigium of vertex with a ridge like structure known as fastigial furrow flanked laterally by lateral carinulae, Fastigum may be concave, shallow or depressed or weakly indented. Laterally placed area above two eyes called foveolae with its shape usually triangular or round in some cases, said structure very conspicuous in Gomphocerinae and Oedipodinae (Figs. 1 and 2).

Front ridge : Anterior surface of head called frons which may be vertically oblique, occupying central part of the face, is a ridge like structure called frontal ridge which is more or less raised and bounded by a carinula on either side. These carinulae run above each eye and downwards the antennae. Posterior to eye facial carina present (Fig. 3).

Eyes : Paired eye with interocular space, may be rounded oval or elongated in shape (Fig. 4).

Antennae : Paired antennae with several joints. First one which is bigger called scape (Fig. 5), second one called pedicel, other joints form flagellum. It may be filiform (Fig. 6) being equally broad throughout or ensiform (Fig. 7) which is flattened and gradually narrower upwards. These antennae generally short and always longer than anterior femur. The segments vary from 18-30 in number (Figs. 5-8).

Pronotum : It covers the whole prothorax, divided into anterior prozona and posterior metazona (Fig. 9). It is bounded by a median and two lateral carina (Fig. 10). Dorsum of pronotum covered by some depressions called 'Sulci' The texture of the margin is curved. Lower suface of thorax is sternum divided into pro, meso and metasternum (Fig. 11). It is smooth in Acridinae, Oedipodinae, Truxalinae and Gomphocerinae. In some cases it is of different shape being conical, cylindrical, etc. In between meso and metasternum there is a space called mesosternal or metasternal space

(Fig. 11) which has a good taxonomic value to subfamily, generic and even species level. Lower Surface of the Pronotum is called episternum (Fig. 12).

Hind femur or posterior leg : Trochanter small, and fused with coxa. Femora are very large and stout, swollen at base and gradually narrower towards apex (Fig. 13).

Posterior tibia : Thickened in some cases and provided with rigid acute spines in two rows, extreme end of each is known as apical spur, presence or absence of which spur is a very important feature (Fig. 13).

Tegmina and wings : The structural pecularities in venation of tegmina and wings are also taxonomically important. *Spathosternum*, possess stridulatory veinlerts between radial and medial area in the tegmen; serrated intercalated veins are also present in many species of oedipodinae where the medial vein is very well developed and mostly provided with a serrated intercalated vein. Presence of a row of bristles or spines at anterior margin of tegmen in some species and a band like structure in some cases help in identifying the individuals upto species level (Fig. 14).

The wings are sometimes coloured or hyaline. In some species of oedipodinae wings are provided with band called banded wings (Fig. 15).

Abdomen : composed of 11 segments. Tergites 9th and 10th very short. Externally both 8th and 9th sternites are visible in female and are referred to as subgenital plate (Figs. 16, 17).

Furcula : Posterior margin of tergite 10 is usually in curved, sometimes it is incised into two lateral portions which bear a small projection called furcula which is very prominent in the Genus *Epistaurus* (Fig. 18).

Supra-anal plate : Last Tergite 11 is called supra-anal plate of epiproct. In male it may be triangular, rectangular, pentagonal, ellyptical, etc. and bears tubercles laterally, ridge of furrow in the middle (Fig. 19).

Cercus : It is present on the sides of supra-anal plate having some variations specially in the male. In case of female it is a very simple structure (Fig. 20).

Subgenital plate : In female it is present on the 8th sternite. Its shape varies from species to species. The central surface may be smooth, flat or concave. In some cases two longitudinal ridges are found with or without tooth. Apex is round being bilobed or trilobed or toothed (Fig. 21).

Ovipositor : Found in female, it is the last abdominal segment having two upper and two lower valver, valves may be dented; differ in size and shape in different developmental stage. A comparative account of the ovipositors has been provided following Usmani and Shafee (1979) (Fig. 22).

Epiphallus : It is a strongly sclerorised part which varies in shape and size in different groups and is situated on the dorsal side of the phallic organ. The main body is called bridge. Sometimes bridge is opened or closed. In the antero-lateral position, there are two projections called anchorae. Postero-lateral position composed of two lobes called lophi (Fig. 23).

A. TAXONOMIC STUDIES

SYSTEMATIC ACCOUNT

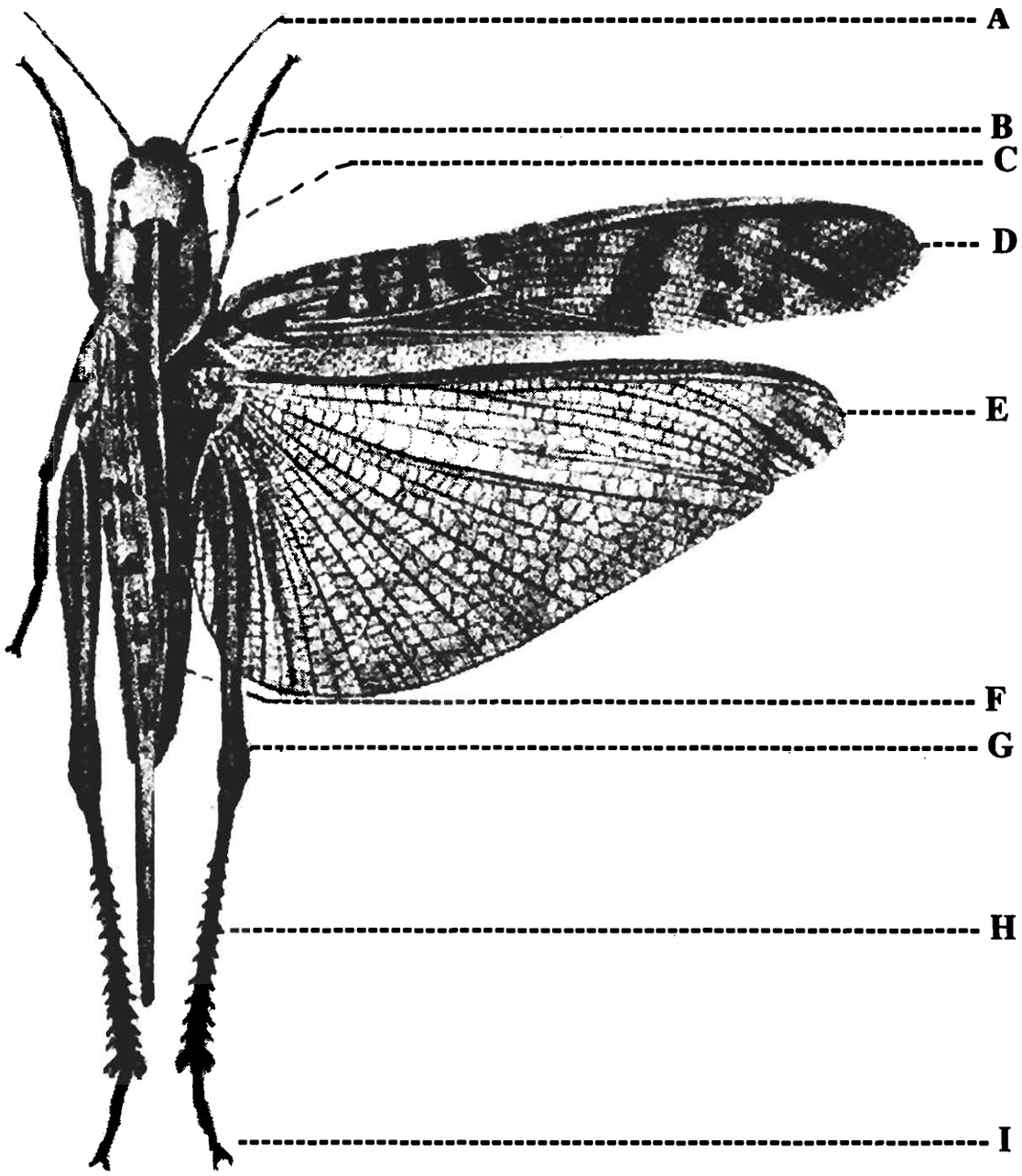
Order ORTHOPTERA

Superfamily ACRIDOIDEA

Key to Families

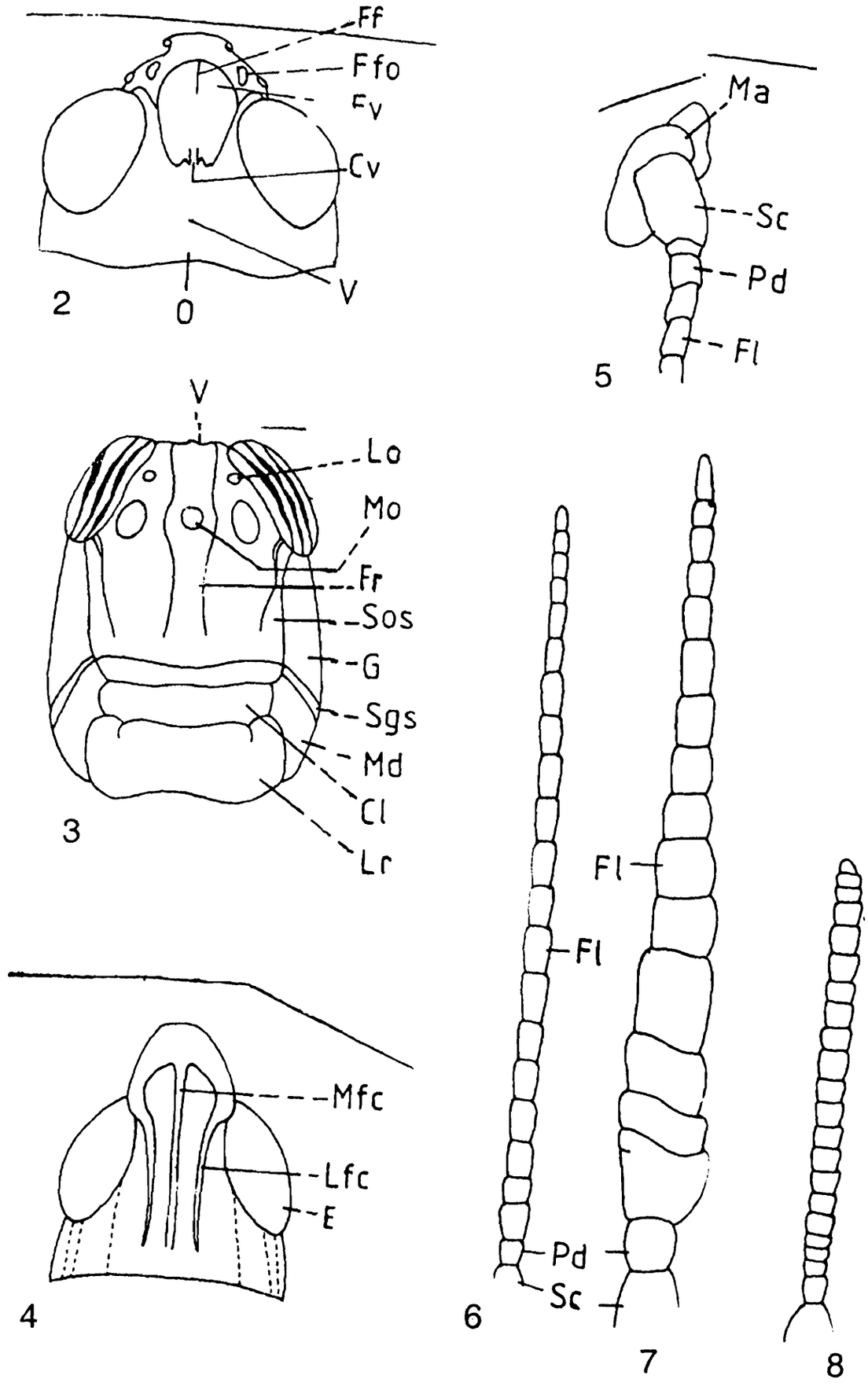
1. Fastigial furrow present, apical fastigial areolae more or less present, presence of fastigiofacial angle. Stridulatory mechanism absent, oval sclerites of ectophallus absent ..... PYRGOMORPHIDAE.

   Fastigial furrow absent, fastigio areolae absent, no fastigiofacial angle, stridulatory mechanism present, oval sclerites or ectophallus present, oval sclerites or ectophallus present ..... ACRIDIDAE.

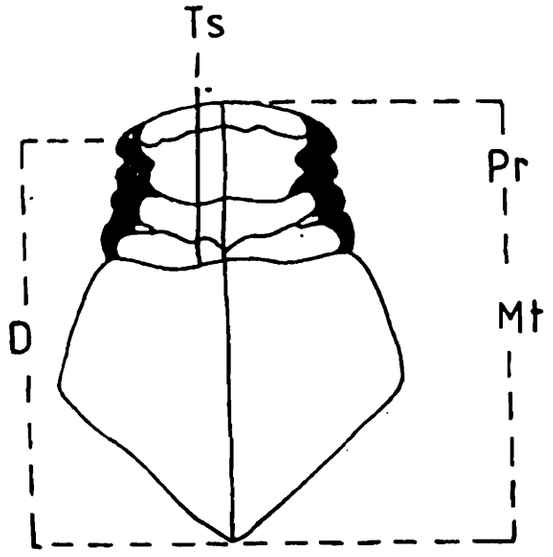


A. Antenna B. Head C. Thorax D. Fore wing E. Hind wing F. Abdomen G. Femur H. Tibia I. Tarsus

Fig. 1. Showing schematic diagram of a typical grasshopper



Figs. 2. Dorsal portion of head, **3.** Head (front view), **4.** Same as fig. 2. showing median carina, **5.** Base of antenna, **6.** Type of antenna (Filiform), **7.** Type of antenna (Thick filiform or rod like), **8.** Type of antenna (Ensiform). Cl. Clypeus; Cv. carinula of vertex; E. eye; Ft. Fastigial furrow; Ffo. fastigial foveolae; Fl. flagellum; Fr. frontal ridge; Fv. fastigium of vertex; G. gena; Lfc. lateral carinulae of fastigium of vertex; Lo. lateral ocellus (simple eye); Lr. Labrum; Ma. membranus area; Md. mandible; Mfc. median carinula off astigium of vertex; Mo. median ocellus; O. occiput; Pd. pedicel; Sc. scape; Sqs. sub genal sclerite; Sos. sub ocular; V. vertex.



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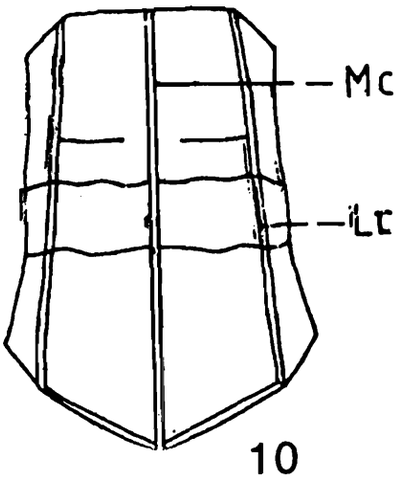

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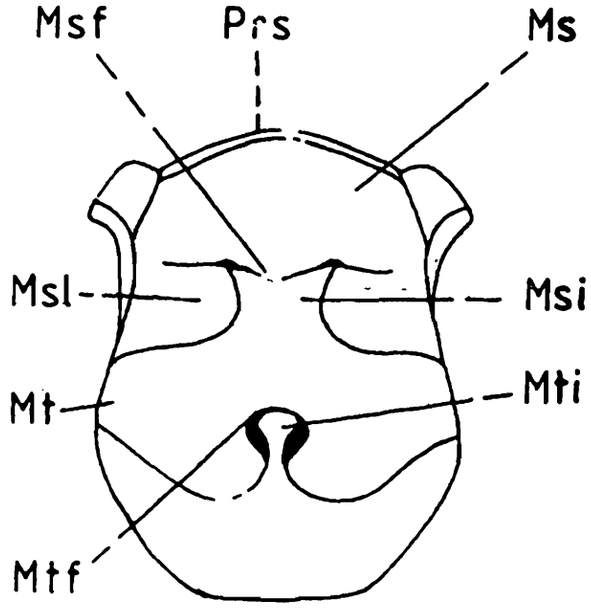

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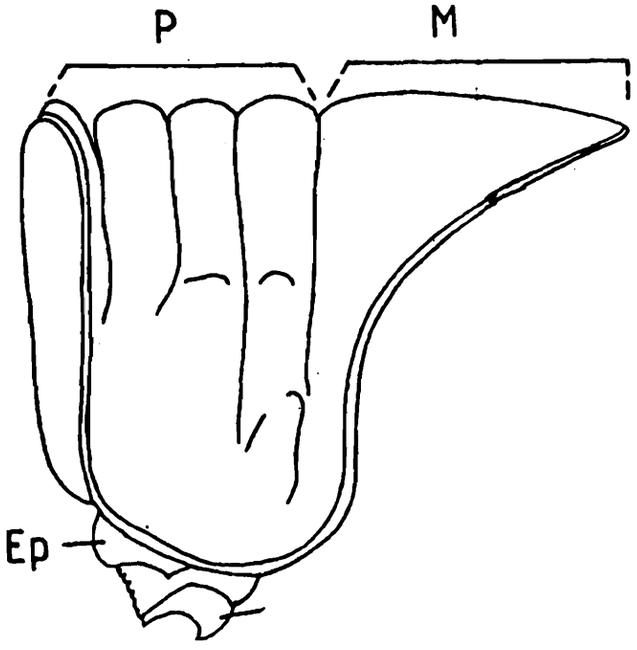

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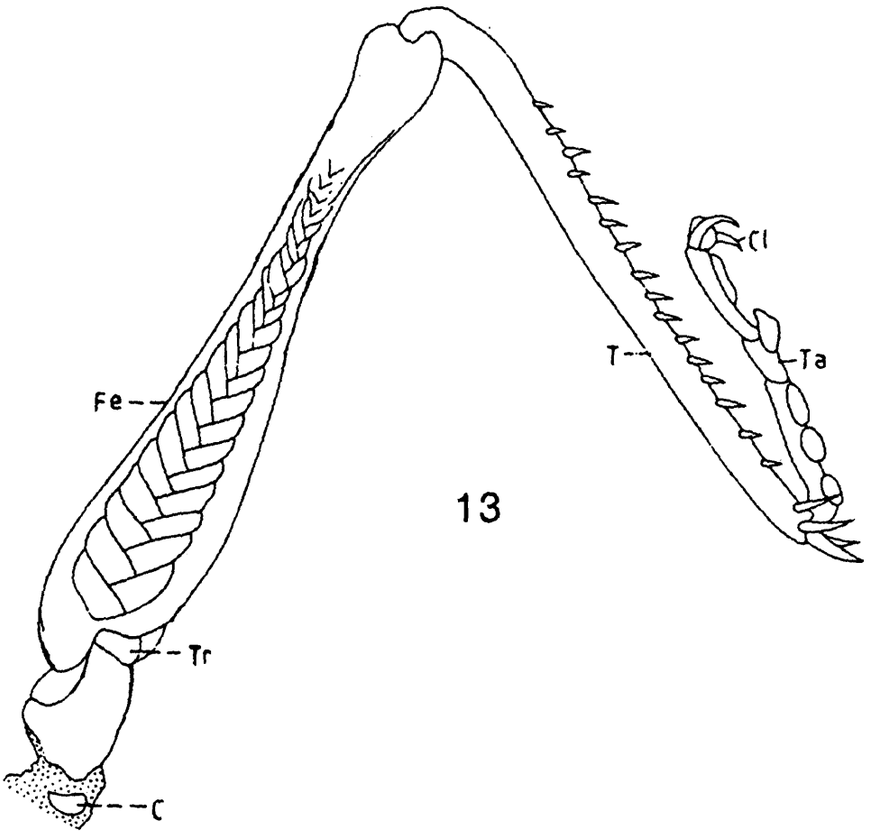
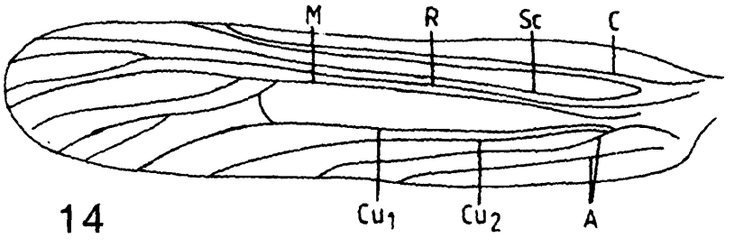
Figs. 9. Dorsal view of pronotum, **10.** Dorsal view of pronotum, **11.** Ventral view of thorax. **12.** Lateral view of pronotum. D. dorsum; Lc. lateral carina of pronotum; Mc. median carina; Ms. mesosternum; Msf. mesosternal furcal suture; Msi. mesosternal interspace; Msl. mesosternal lobe; Mt. metazona; Mtf. metasternal furcal suture; Pr. prozona of pronotum; Mti. Metasternal interspace; Mt. Metasternum; Ep. Episternum; P. pronotum; Ts. Transverse sulci.





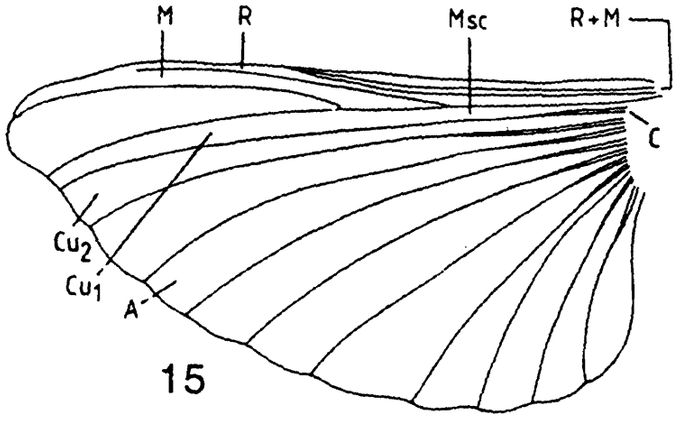
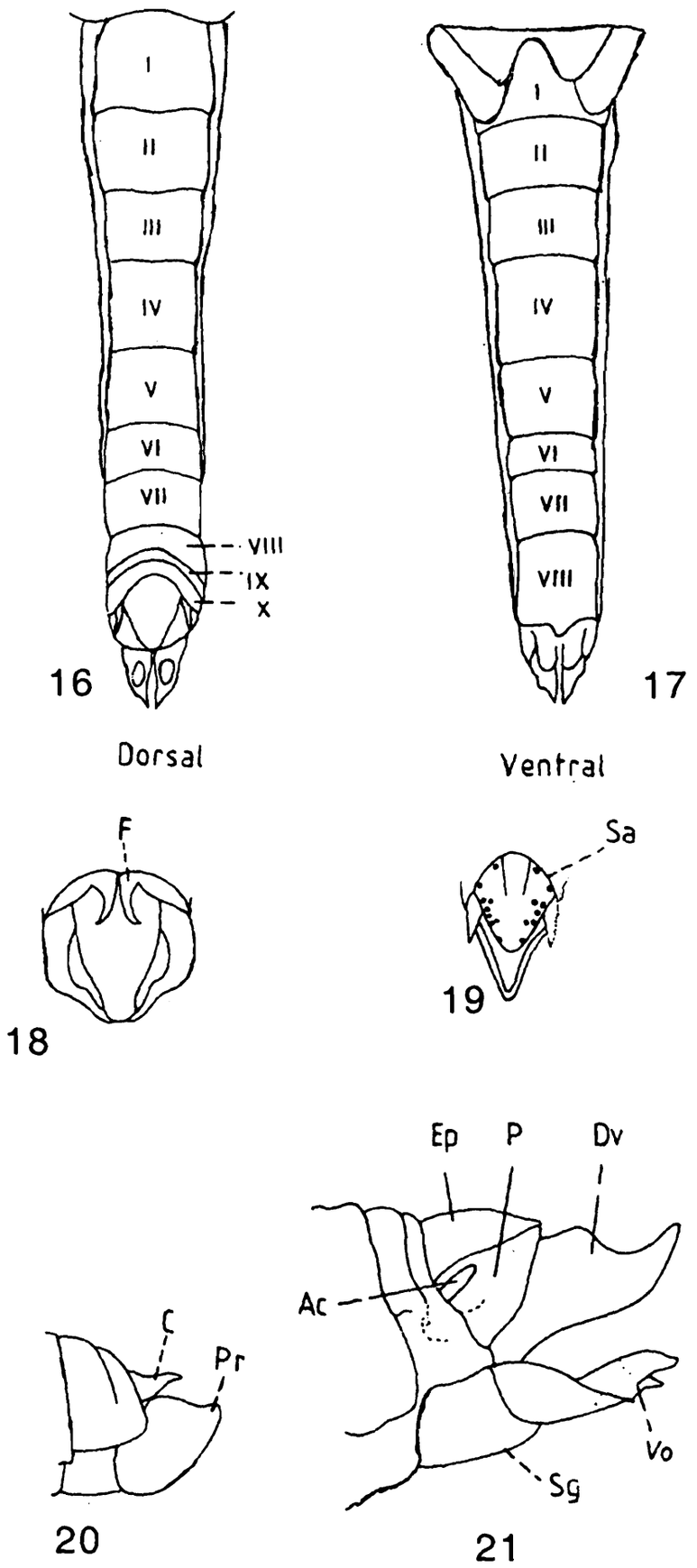
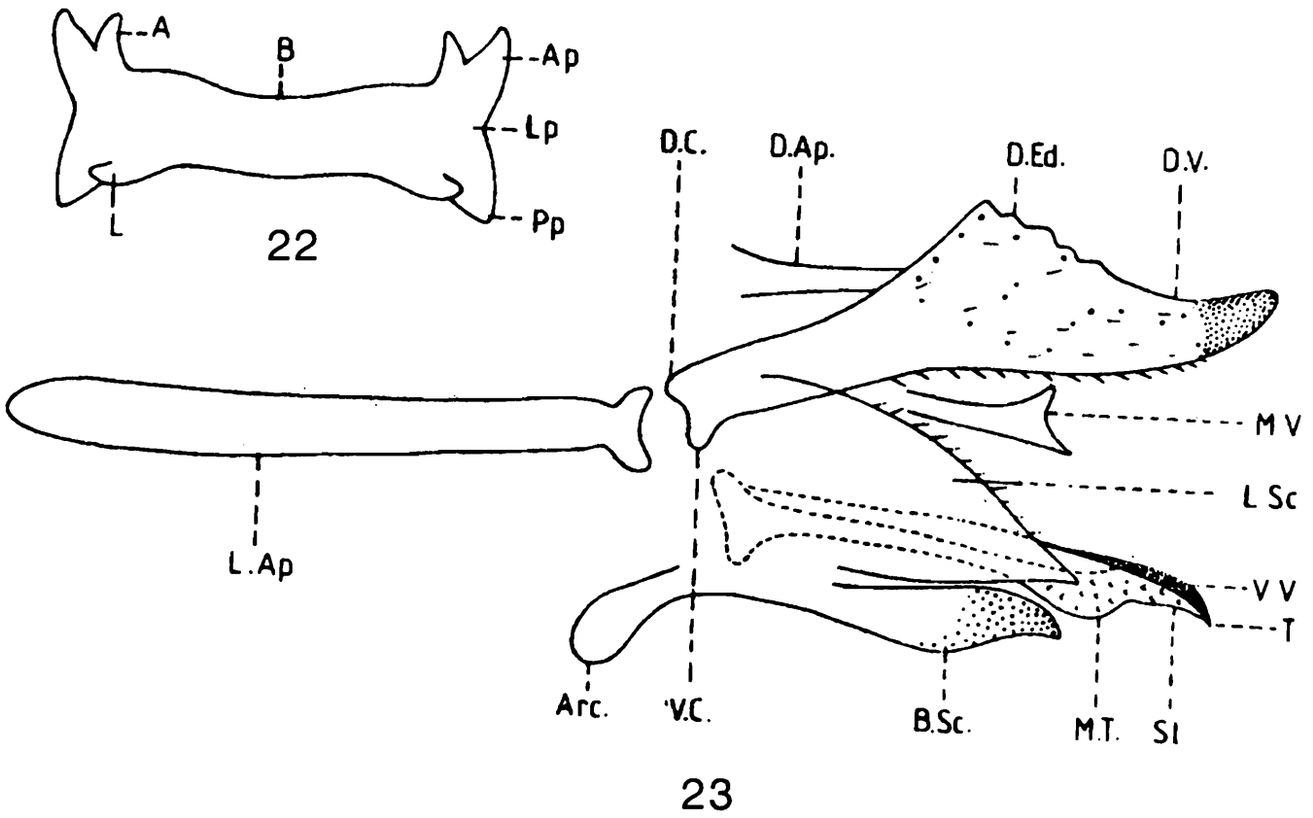


Fig. 13. Hind leg. C. coxa; Cl. claw; Fe. femur; T. tibia; Ta. tarsus; Tr. trochonter. **14.** Fore wings showing venation. **15.** Hind wings showing venation. A. annal; C, costa; Cu. cubitus; M. median; R. radius; Msc. median sub costa; R+M. radius + median; Sc. sub costa.



Figs. 16. Dorsal view of Abdomen (female), **17.** Ventral view of Abdomen (female) **Figs. 18.** Tip of the abdomen (male), **19.** Tip of the abdomen (male), **20.** Tip of the abdomen. Lateral view of hind end of male, **21.** Tip of the abdomen. Lateral view of Hind end of female. F. furcula; Sa. Supraanal plate; C. cerci; Pr. paraproct; Ep. epiproct; P. paraproct; Sg. subgenetal plate; v. ventral valve; Ac. anal cerci; Dv. dorsal valve.



Figs. 22. Structure of Ovipositor (Lateral view), **23.** structure of Epiphallus (Dorsal) Ovipositor : Arc. arcus; B.Sc. basal sclerite; D.AP. dorsal apodeme; Dc. dorsal condyle; D.Ed. dorsal edge; DV. dorsal valve; L.AP. lateral apodeme; L.Sc. lateral sclerite; M.T. mesial tooth; MV. mesial valve; Sl. slope; T. tip; V.C. ventral condyle; V.V. ventral valve. Epiphallus : A. ancora; Ap. apical valve of penis; B. bridge of lophus; L. lophus; Lp. lateral process; Pp. posterior process of epiphallus.

Family PYRGOMORPHIDAE

Key to Genera

1. Anterior margin of prosternum strongly reflexed and dilated. *Chrotogonus* Serville,
- Anterior margin of prosterum neither reflexed nor dialated 2
2. Antennae remote from the eyes being placed anterior to the ocelli 3
- Antennae near the eyes, placed posterior to the ocelli 4
3. Tegmina long and narrow, body moderately slender .....*Atractomorpha* Saussure,
- Tegmina rather short and broader, body very robust..... *Tagasta* Bolivar

Genus ***Chrotogonus*** Andinet Serville, 1839

1835. *Ommexcha*,Brulle, in Audouin & Brulle, *Hist. nat. Ins.* **9** : 229 [nec Andinet-Serville, 1831]

1836. *Ommexecha* Blanchard, *Ann. Soc. ent. Fr.*,**5** : 607 (Partim).

1838. *Ommexecha* Burmeister, *Handb.Ent.*, **2** : 653 (Partim).

1959. D. Keith McE Kevan, V.A. Revisional Monograph of Chrotogonin.VI. The History and Biogeography of Chrotogonin.

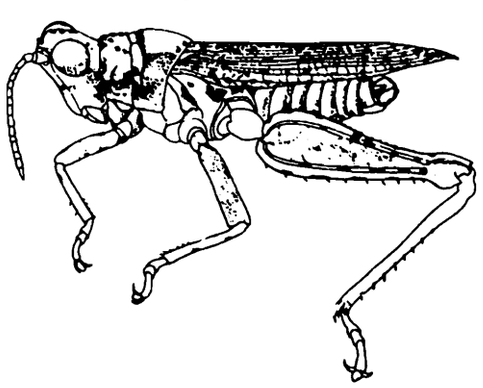
Type species : Ommexecha lugubre Blanchard, 1836 (AudinetServille, 1839, *Hist. nat. Ins. Orthopt.* : 703).

Size small, blackish brown, head small, antennae short, filiform, inserted close together

between the eyes. Frons smooth, wide with wavy margin. Clypeal suture is just below the eyes. Width of interoculatr distance is smaller than that of outer faces of the eyes. Mesosternal interspace broad and with curvature and angulation. Pronotum more or less rugose and much widened behind. Posterior margin of the disc with great degree of depression and concavity of lateral lobes but hind border obtusely angulated or rounded. Tegmen generally shorter than the abdomen. Wings in size variable, tegmina with dark pigments and it may be with or without fascia. Hind femora moderately stout and hind tibiae slightly thickened towards the extremity. No terminal spine on the upper outer carina. Other terminal spines of nearly equal length. Valves of ovipositor of the upper one curved upwards, while those of lower one pointed and curved downwards. Supraanal plate of male subtrigonal in outline, its median sulcus narrower reaching to the apical section of the plate.

1. ***Chrotogonus trachypterus trachypterus*** (Blanchard)

(Figs. 24-25)



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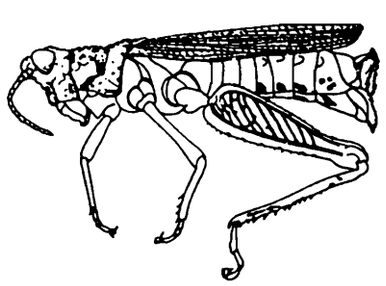

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Figs. 24. Showing general morphology of *Chrotogonus trachypterus trachypterus* (male), **25.** Showing general morphology of *Chrotogonus trachypterus trachypterus* (female)

1836. *Ommexycha trachypterus* Blanchard, *Ann. Soc. Ent. France*, **5**, p. 618, pl. 22, fig. 6.

1914. *Chrotogonus sordidus* Kirby *Faun. Brit. India.*, : 162 [f. brachypterus] 42-43.

1959. *Chrotogonus trachypterus trachypterus* Blanchard *Publ. cult. Diamang*, **43** : 224-225.

Diagnostic Characters : Medium size; brown coloured; robust body slightly depressed, ruguose and tuberculate. head, short, broad and rugose fastigial furrow present, antennae fulvous with black ring basally; eye round and brown; pronotum short and broad with a large number of crowded tubercles, lateral margin concave, infra-posterior angle of pronotum less concave, seven lobes on the hind border; front and its lateral borders not idented, sternum yellowish with blackish spots. Tegmen shorter than the abdomen, brown, considerably humped; wings hyaline, as long as tegmina. Abdomen brown above, paler beneath. Hind leg short with two black spots, one at the base and the other at the extremity; occasionally faintly tinged yellowish brown and never infumated or infuscated and always two third slender, rugose, yellow with brown spots. Femora as long as the abdomen, outer surface very rugose, and E/F ratio always over 1.0, tibia with short pale spines, tympanum always distinct and very moderately developed.

Male : Small, sternal inerspace as wide as long, frons more oblique, frontal angle nearly less than 57°, body not much depressed, penis with undivided valve. Cingulum capsule like, epiphallus without anchorae with dorsolateral appendices, oval sclerites absent. Anterior process curved and pointed. Dorsal appendices of penis large, arm like with apicular cavity. Lateral process curved bent downwards and projecting laterally, bridge undivided, posterior process bent downwards, pointed laterally. Larger, sternal interaspace more wide and long, frontal angel 67° and oblique (Fig. 24).

Female : Sternum larger and more robust than that of male, sternal interspace transverse, ovipositor with dorsal valves curved aplically (Fig.25).

Morphometry

Male (mm) : Length of the body 15 ; length of antenna 5.5 ; length of pronotum 4.42 ; length of tegmen 7.2 ; length of hind femur 8.3 ; length of hind tibia 7.1.

Female(mm) : Length of body 20.9 ; length of antenna 6.1 ; length of pronotum 5.3 ; length of the tegmen 12.6 ; length of hind femur 10.1 length of hind tibia 8.4.

Meterial examined :1♀ Calcutta 1.vii. 49, Coll. A.P. Kapur ; 2♂♂, 1♀, Dhapa, 2.ii.61 Coll. A.P. Kapur ; 2♀♀, Calcutta, 5.v.61 to 6.v.71, Coll. H. N. Singh; 1♀, Dhapa, 27.vii. 63, Coll. S. Ali; 1♂, 1♀ Narayanpur, 7.ix. 61, Coll. M. B. Kripalini; 1♂, Eden Graden, 19.vi. 60, Coll. A. P. Kapur; 1♂, 1♀, Ukilpara, 21.ix. 61, Coll. M. B. Kripalini ; 2♀♀, Titagarh, 15.v. 62, Coll. S. Lal, 1♂, 1♀, Sonarpur, 8.ix. 65, Coll S. P. Chakravarty and Party.

Distribution : INDIA (West Bengal, Bihar, Madhya Pradesh, Orissa, Maharastra, Rajasthan); BANGLADESH; NEPAL and PAKISTHAN.

Remarks : This species is easily identified by virtue of having hyaline wing ; rugose and tuberculate body ; broad and short pronotum, fulvous antennae with 19 segments of which first one is large.

Genus ***Atractomorpha*** Saussure, 1861

1861. *Atractomorpha* Saussure, *Ann. Soc. Ent. France,* (4) 1, p.474.

Type species : *Truxalis crenulatus* Fabricius.

Medium sized body with multisegmented antennae, green, some are dry grassy. Body long, slender and compressed and narrow. Head narrow, more or less conical. Fastigium longer, flat, horizontal, slightly upcurved with parabolic angular apex. Frontal ridge compressed in between antennae. Sulcation present at the extremeity. Antennae short, subfiliform, slightly depressed and widened at the base; in female it is placed away from eyes and in front of the ocelli. It is also shorter than head and pronotum together. Fronts slightly oblique with incurved frontal ridge. Eyes oval and long. Cheeks with a row of granules extending to the middle coxa. Pronotum elongated, widening backwards, submerginate in front and angulated behind, tricarinated. Metazona much shorter than prozona. Hind sulcus placed behind the middle Tegmina narrow, more or less pointed, costal area slightly expanded. Apex of elytra acutely attenuate, tympanal organ well developed. Length of wing more or less same as tegmina. Wing more or less hyaline, sometimes red at base. Femur slender, narrow lower marginal area externally narrow, ventrally with an externo-medium area. base of femur broader than distal area. Prosternum with an oblique truncated spine in the middle. Abdomen compressed with last segment angularly excised on its dorsal part.

Male : Supra-anal plate trigonate, elongate, angular, Cerci short, sub-conical, straight with sub-acute apex. Male subgenetal plate short with rounded apex.

Female: Ovipositor moderately long and robust. Valves of ovipositor curved at apiceswpper external margin more or less crenulated. Upper valves roughly serrated, lower valves externally with lateral projection.

Atractomorpha crenulata (Fabricius)

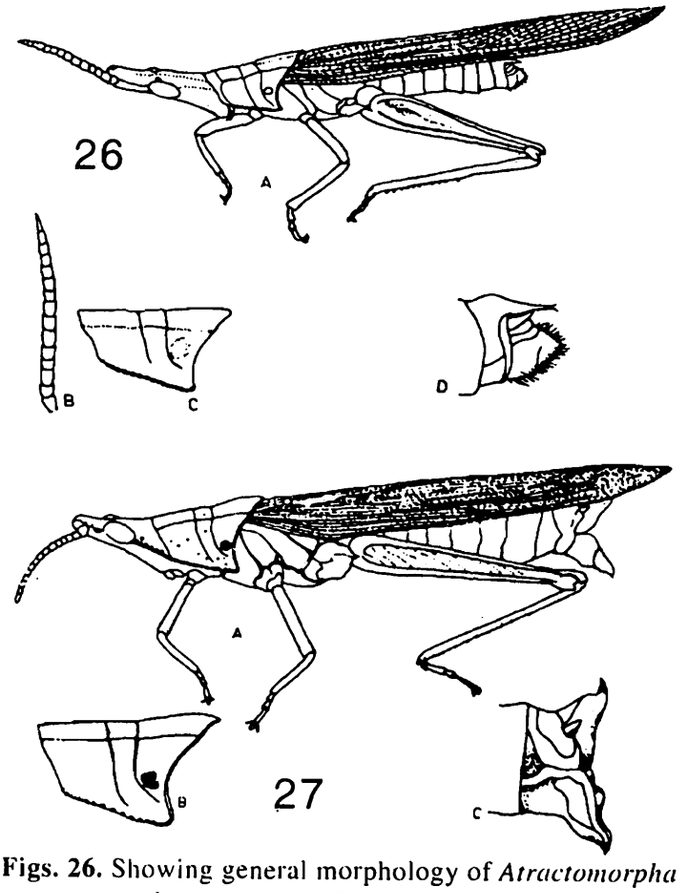
(Figs. 26, 27)

1793. *Truxalis crenulata* Fabricius, *Ent. Syst.*, **2** : 28.

1969. *Atractomorpha crenulata* Kevan and Chen, *Zool. J. Lin. Soc.*, **48** : 187.

Diagnostic characters : Size medium, length of body less than 20 mm in male or 30 mm in female; eyes generally shorter and rather convex; fastigium of vertex often comparatively

short; interocular space generally slightly convex; membransous area in metazona of lateral pronotal lobe usually more prominant in male than female; hind wings normally tyrian pink to light mallow purple or pale magenta at base, but quite often rather heavily infumed; phallic structure small, middle piece of epiphallus normally rather narrow, appendices usually extending at least as far as apices of lophi; aedeagal valves small and short.



Figs. 26. Showing general morphology of *Atractomorpha crenulata* (male), A. Entire specimen, B. Antenna, C. Pronotum (later view), D. Tip of Abdomen (later view), **27.** Showing general morphology of *Atractomorpha crenulata* (female), A. Entire specimen, B. Pronotum (later view), C. Tip of Abdimen (later view)

Male : Shorter, subfiliform antennae, fastigium elongate gradually sloping forwards, ocelli in front of the eyes; eye more or less oval, head long gradually broadened behind; the lateral margin of the vertex with a series of granular structure; pronotum long, prozona larger than metazona; transverse sulci not touching the lateral border of pronotum. Lateral lobe of metazona with membranous area. Posterior end of pronotum is much acute, gradually pointed towards tip; interocular space convex. Cerci conical and pointed at the tip. Epiphallus with narrow bridge, middle piece of epiphallus normally rather narrow; aedeagal valve very small and shorter and narrow; basal process of aedeagus with more or less triangular atructure; gonopore conical and sharply pointed; flexible sclerotised part of of aedeagus connected with basal and apical part of the process (fig. 26).

Female : Rather larger, metazona distinctly marked, fastigium gradually sloping forwards (fig. 27).

Morphometry

Male(mm.) : Length of the body 17.9; length of antennae 6.2; length of pronotum 4.4; length of tegmen 16.2; length of hind femur 12.25; length of hind tibia 8.6.

Female (mm.) : Length of the body 28.9; length of the antennae 6.4; length of the pronotum 7.1; length of the tegmen 23.6; length of hind femur 13.8; length of hind tibia 12.

Matrial examined : 2♀♀Duttapukur, 8.iii. 67, coll. K.R. Rao; 1♂, Tribeni, 12.xi. 65, Coll. M. M. Ghosh & S.P. Chakraborty; 1♂, Ichapur; 8.xii. 65, Coll. K.R. Rao; 2♀♀, Budge Budge, 24.i.67, Coll. K.R. Rao; 2♂♂, Calcutta, 30.vii.64, 2♀♀, Choonabati, Kolkata, 29.vii.64, Coll. S. Ali; 9♀♀, Kolkata, 26.xii.60, 1♀, Kolkata, 5.vii. 49, Coll. A.P. Kapur; 1♀, Kolkata, 25.i. 62, Coll. R.K.Varshney & S. Ali; 2♂, Birati; 24.x. 62, Coll. S.K. Ghosh; 5♂♂, 2♀♀, Botanical Garden, 27. x. 65, Coll. K.R. Rao & party; 1♂, 1♀ Botanical Garden, 29. xii. 64, Coll. K.R. Rao & party; 1♀, Botanical Garden, 10.xi. 61, Coll. K.R. Rao & party; 2♂♂, Botanical Garden, 20.iv. 6♀, Coll. B. Dhar; 130♂♂ 140♀♀, Botanical Garden, 21.viii. 79 to 23.v. 80, Coll. A.K. Hazra & party; 5♂♂, 2♀♀, Eden Garden, 11.vi. 57, 11.xi. 64, 26.ii. 65 to 26.v. 65, Coll. S. Ali; 3♂♂, 1♀, Eden Garden, 19.xi. 57 to 6.xii. 68, Coll. A.P. Kapur; 2♂♂, 1♀ V.M. Garden, 27.ii. 63 and 31.iii. 64, Coll. S. Ali; 1♂, Duttapukur, 6.xii. 66, Coll. A.N.T. Joseph; 1♀, Dhapa, 23.viii. 61, Coll. S.Ali; 1♀, Diamond Harbour, 31.xii. 65,

Coll. S.K. Tandon and party; 2♂♂, Bangaon, 7.i. 66, Coll. B.K. Bhattacharya; 16♂♂, 3♀♀ Narendrapur, April 1979; Coll. M.S. Shishodia, 15 ♂♂, 5♀♀ Garia, 6.x. 76, Coll. S.K. Mondal; 1♂, Calcutta, 14.ix. 65, Coll. J.C. Bhattacharya and M.B. Kripalini; 1 nymph, Santoshpur, 16.x. 62, Coll. S. Ali; 1 nymph, Ukilpara, 21.ix. 61, Coll. M.B. Kripalini; 2♀♀, Khardaha, 9.xii. 66, Coll. S.B. Roy and T.K. Chakraborty; 1♀(nymph), Titagarh, 15. V. 62, Coll. S. Lal; 1♀(nymph). Barrackpore, 14.xi. 61, Coll. K.V. Lal & N.K. Chakraborty.

Distribution : INDIA (West Bengal Andhra Pradesh, Tamil Nadu, Andaman Islands, Madhya Pradesh, Rajasthan, Bihar, Jammu and Kashmir, Goa, Maldiva and Laccadive Islands); BANGLADESH; SRI LANKA; LOWER MYANMAR; SOUTH VIETNAM; THAILAND; MALAYSIA AND N.W. ANDALAS.

Remarks : This species is widely distributed in India. A large number of specimens were studied from different parts of India (Orissa, Uttar Pradesh, Punjab, Haryana, Arunachal Pradesh, Assam, Manipur, Tripura, Gujrat, Maharastra etc.) and also from places outside India and found that the base of the wing colour depends upon the maturation of the specimens.

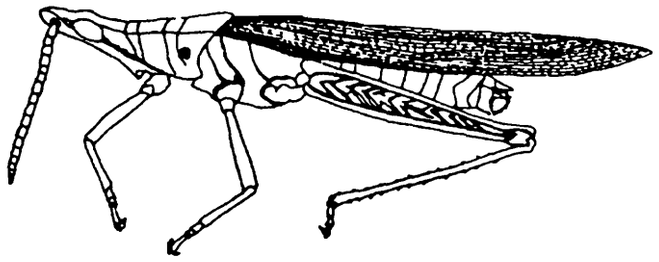
Atractomorpha psittacina Haan

(Figs. 28, 29)

1842. *Acridium (Truxalis) psittacinum* De Haan, *Temmick, Verhandel., Orth* : 146.

1969. *Atractomorpha paittacina* : Kevan & Chen, *Zool. J. Linn. Soc., 48* :, 191.

Diagnostic characters : Slender, greenish, antenna placed much before the eyes; Eye generally longer fastigium of vertex twice as long as broad with sub-parallel sides, obtusely rounded in front; pronotum rather shorter than head, very obtusely angulated behind, carinae distinct, lateral lobes of pronotum with a reddish crenulated line, hinder angle acute, posterior margin of pronotal disc typically distincty angular, lateral mesostermal lobes approximately placed behind tegmina very long and pointed, wings hyaline, rosy towards the base.



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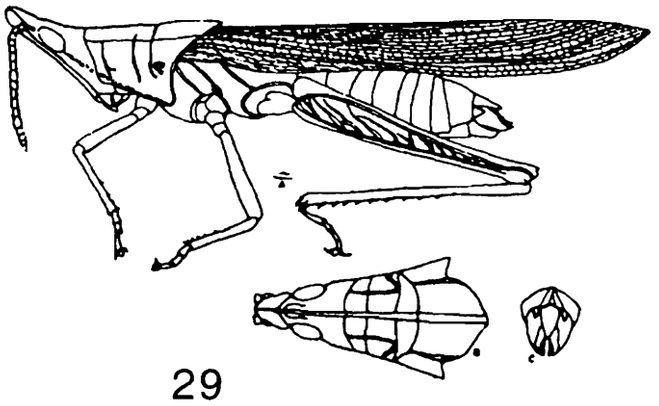

29

Figs. 28. Showing general morphology of *Atractomorpha psittacina* (male), **29.** Showing general morphology of *Atractomorpha psittacina* (female), A. Entire specimen, B. Head and pronotum, C. Tip of abdomen

Male : Body comparatively slender, interocular space not so width. Hind wings comparatively longer, male subgenetal plate somewhat pointed, phallic structures are smaller, aedeagal valve shorterits, gonopore process curved upwards, basal valve of penis baloon shaped, flexible sclerotised part connected with basal and apical parts of the valve (Fig. 28).

Female : Comparatively larger than male. Eye larger. Fastigium larger and gradually sloping forwards (Fig. 29).

Morphometry

Male (mm.) : Length of the body 20.3; length of the antenna 6.6; length of the pronotum 5.5; length of tegmen 19.8; length of hind femur 11.4; length of hind tibia 9.7.

Female (mm.) : Length of the body 26 mm; length of antenna 7; length of pronotum 6.5; length of tegmen 25.2; length of hind femur 13.5; length of hind tibia 12.2.

Material examined : 1 ♀ Narendrapur, 26.x. 79. Coll. M.S. Shishodia.

Distribution : INDIA (West Bengal; Assam); BANGLADESH TO S. CHINA, INDO-CHINA, THAILAND. MYANMAR. MALAYASIA, PHILIPPINES, INDONESIA, NEW GUINEA AND RYU-KYU.

Remarks : Tegmina extending for one third of their length beyond the Hind femora.

Genus ***Tagasta*** Bolivar 1905

1877. *Mestra* Stål (nec Hübner), *Oefv. Vet-Akad. Forh.*, *34* (10). p. 52.

1905. *Tagasta* Bolivar, *Bol. Soc. Espan. Hist. Nat.*, 5, p. 112.

Type specres : *Mestra hoplosterna* Stål.

More or less robust with subfusiform, compressed and pubescent body. Head conical, shorter than pronotum. Temporal region widened seperated by short suture. Frontal ridge flattened more or less sulcated. Antennae concolorous, filliform and inserted between eyes. Eye rounded, distinct ocelli present. Presence of granulation in cheeks. Pronotum shiny, obtusely angulated or rounded behind. Wing shorter than tegmina, base red or hyaline. Legs long and slender. Front femora distinctly thickened in the male. Hind femur compressed, radiation of ridges present in the outer area. Prosternum armed with short tooth. Mesosternal lobe separated by longer or shorter spaces. Metasternal lobe separated by transverse space.

Male : Cerci small. Ectophallus differentiated, forming a more or less complicated cingulum. Epiphallus bridge shaped with dorsolateral appendices.

Female : Ovipositor robust and sinuated.

Tagasta indica Bolivar

(Figs. 30, 31)

1905. *Tagasta indica* Bolivar, *Bol. Soc. esp. Hist. Nat.*, **5** : 112, 113.

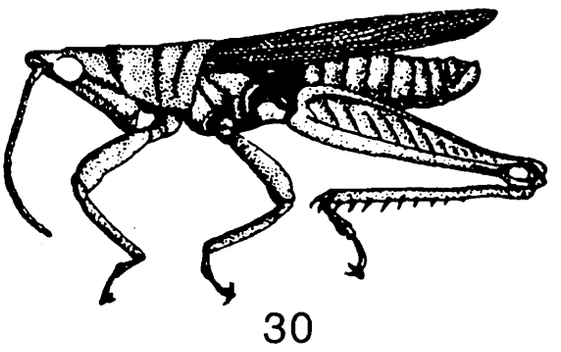

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Fig. 30. Showing general morphology of *Tagasta indica* (male).

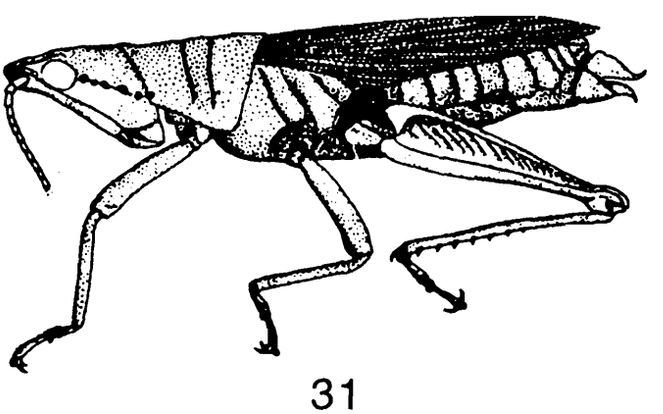

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Fig. 31. Showing general morphology of *Tagasta indica* (female)

Diagnostic characters : Olivaceous, very finely rugose-punctate. Fastigium of the vertex equilaterally triangular, antenna inserted near the eye, joints long, closely punctured; cheeks with a row of large yellow granules behind each eye. Pronotum in front and obtusely angulated behind, median carina almost and lateral carinae wholly obsolete; deflexed lobe with the lower margin very narrowly bordered with yellow and slightly produced above the coxa. Tegmina

nearly as long as hind femora, distinctly narrowed towards the extremity, with the tip narrowly obtuse, wing shorter than the tegmen with deep rose colour, hind tibiae dull green.

Male : Size rather smaller; cerci small; Ectophallus differentiated; forming more or less complicated cingulum. Epiphallus bridge shaped with dorso-lateral appendices (Fig.30).

Female : Ovipositor robust and sinuated (Fig. 31).

Morphometry

Male (mm.) : Length of the body 27.75; length of antenna 10.75; length of pronotum 7; length of tegmen 19; length of hind femur 16; length tibia 14.25.

Female (mm.), Length of the body 35.5; length of antenna 12; length of pronotum 10.25; length of tegmen 25; length of hind femur 18.75; length of hind tibia 16.

Meterial examined : 1♂, Panskura, 29.viii. 64, Coll. K.R. Rao and Party; 1♀ Andul, 28.ix. Coll. G.S. Arora and Party.

Distribution : INDIA (West Bengal); BHUTAN (Maria Basti).

Remarks : This species is easily distinguished by means of the following characters : Tegmina unspotted at the base, wing deep rose in colour, rounded eye, wing distinctly shorter than the tegmen.

Family ACRIDIDAE

Key to Sub-families

1. Prosternal process present 2
– Prosternal process absent 8
2. Lower external lobe of hind knee with spine like process in apex ..... Oxyinae
– Lower external lobe of hind knee with rounded angular or subacute apex 3
3. Radial area of tegmina with a series of regular, parallel stridulatory veinlers ..... Hemiacridinae
– Radial area of tegmina without stridulatory veinlets 4
4. Last abdominal segment with well developed furcula ..... Coptacridinae
– Last abdominal segment with absence of furcula 5
5. Mesosternal interspace closed ..... Tropidopolinae
– Mesosternal interspace open, Male subgenetal plate simple 6
6. Mesosternal lobes rounded or obtuse angular or acute angular, but not rectangular 7
– Mesosternal lobed rectangular ..... Cyrtacanthacridinae
7. Dorsum of pronotum of variable shape, lateral carinae absent, male cercus variable ..... Catantopinae
– Dorsum of pronotum weakly tectiform with median and lateral carinae, Male cerci with strongly compressed or subacute apex ..... Eyprepocnemidinae
8. Hind femur with stridulatory serrations... 9
– Hind femur without stridulatory serrations 10
9. Stridulatory file on inner side of hind femur with closely-set rigid tubercles and articulated bristles ..... Truxalinae
– Stridulatory file with articulated pegs ..... Gomphocerinae
10. Presence of tegminal intercalary vein, at least in male well developed, forming the file of stridulatory mechanism ..... Oedepodinae
– Stridulatory mechanism absent ..... Acridinae

Sub-Family GOMPHOCERINAE

Key to Genera

1. Fastigial foveolae lower, not visible from above, sulcation of frontal ridge above median oceli ..... *Leva* Bolivar

Fastigial foveolae visible from above, frontal ridge above median oceli but not sulcated ..... *Dnopherula* Karsch

Genus *Leva*

Key to species

1. Lateral carinae of pronotum in prozona parallel, divergent in metazona not forming 'X' shaped ..... *indica* Bolivar
- Lateral carinae of pronotum in prozona medially excurved which is divergent but forming 'X' shaped ..... *cruciata* Bolivar

Genus *Leva* Boliver 1909

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

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

1971. *Leva* Jago, *Proc. Acad. Sci. Philad.*, **123** (8) : 223, 229.

Type species : *Gynmobothrus indicus* Bolivar 1902

Diagnostic Characters : Very small species, integument finely dotted filiform antennae; subconical head. Fastigium with acute apex which is elongated and angular, lateral carinae well developed and concave. Foveolae not visible from above. Degree of sulcation of frontal ridge is the main generic feature. Frontal ridge more or less sulcated, lateral cartinulae present, pronotum constricted, tricarinated with incurved angular lateral carinae. 3 sulci present on pronotum of which one cuts median carina, prozona and metazona more or less equal. Posterior margin of metazona obtuse angular. Tegmina and wings more or less well developed. Cerci short, conical and narrow.

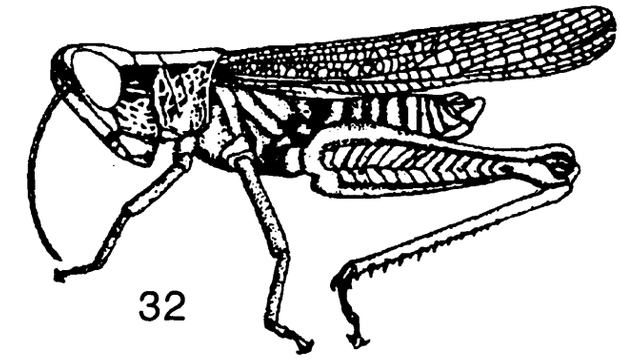
Leva indica (Bolivar)

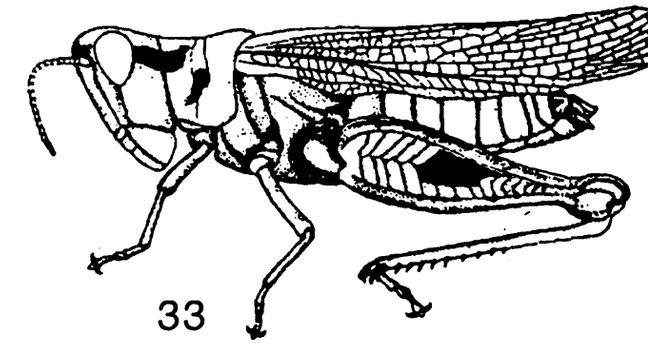
(Figs. 32, 33)

1902. *Gymnobothrus indicus* Bolivar, 1902. *Ann. Soc. ent. Fr.*, **70** : 596.

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

Dianostic Characters : The specimen is very small Finely pitted integument, filiform antennae and longer than head and pronotum. Fastigium of vertex long, apex acute and angular. Lateral carinae well developed and strong. The foveolae not visible from above. Subcylindrical pronotum which is compressed laterally in prozonal area, the carinae being tricarinated. Lateral carinae divergent towards anterior end. Median carina cut by 3rd sulcus in middle posterior margin of metazona obtuse angular. Tegmen reaches towards the tip of abdomen, posterior femur stout with pegs inside, knee lobe rounded, posterior tibiae with 10-11 spines on both sides.





Figs. 32. Showing general morphology of *Leva indica* (male), **33.** Showing general morphology of *Leva indica* (female)

Male : Supra-anal plate tongue shaped with median longitudinal groove, subgenetal plate is navicular in shape. Cerci is conical, short and narrow. Epiphallus-bridge undivided anterior process more or less baloon shaped, posterior process brode, lateral process straight, anchorae angulated and conical and lophi more or less bean shaped (Fig. 32).

Female : Larger than males. Frontal ridge more divergent and ovipositor valve is more or less curved (Fig. 33).

Morphometry

Male (mm.) : Length of the body 10.75; length of the antenna 4.9; length of pronotum 4.00; length of tegmen 9.9; length of hind femur 8.00; length of hind tibia 6.4.

Female (mm.) : Length of the body 10.75;

length of the antenna 4.9; length of pronotum 4.00; length of tegmen 9.9; length of hind femur 8.00; length of hind tibia 6.4.

Material examined : 2♂♂, 4♀♀, Madhumurali Barasat, 24-Parganas, 20.v. 65, Coll. M.S. Shishodia and B.K. Bhattacharya; 1♂, 4♀♀ Bamunmura, Barasat, Coll. M.S. Shishodia and B.K. Bhattacharya; 10 nymph; Bansdroni; 21.xi. 63, Coll. M.M. Ghosh and S Ali; 2♀♀ Uttarpara, 11.vi. 65, Coll. T.K. Chakraborty and B.K. Bhattachaya; 2♂♂, Chandannagar, Coll. K.S. Pradhan and Party; 2 nymphs, Eden Garden, 29.viii. 57, Coll. S. Ali; 1♂, Hugli Dist., Tribeni, 8.x. 65, Coll. T.K. Chakraborty and B.K. Bhattacharya; 1♀ Pandua, 29.i. 66, Coll. K.S. Pradhan and Party; 1♂, 1♀, Narendrapur, April 1979, Coll. M.S. Shishodia and Party.

Distribution : INDIA (West Bengal, Delhi, Orissa, Tamil Nadu and Tripura); SRI LANKA.

Remarks : It is a very small size specimen. Lateral carinae of pronotum parallel in prozona strongly divergent in metazona which is the most characteristic feature of the specimen.

Leva cruciata Bolivar,
(Figs. 34, 35)

1914. *Leva cruciata* Bolivar, *Trab. Mus. Cienc. nat. Madr.*, **20** : 65.

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

Diagnostic character : Small slender body; filiform antennae 24-25 segmented, the carinulae of vertex obsolete and foveolae upwardly angulated, eye large, lateral foveolae not visible from upwards. The direction of temporal foveolae anteriorly directed. Pronotum broad, 3 sulci on the pronotum, anterior end oval and posterior end more or less curved. Presence of the cruciform marks on the pronotum. Median carina straight and lateral carinae anteriorly more or less parallel and posteriorly greatly diverged, tricarinated. Small slender specimen, more or less like *Dnopherula* (*Aulacobothrus*), fastigium trapezoidal, the foveolae not visible from upwards, eyes larger and oval in shape. The direction of temporal foveolae latero-anteriorly directed, fastigium large. Small slender body; filiform antennae, 24-25 segmented, the carinulae of the vertex obsolete and foveolae upwardly angulated. Foveolae not visible upwards. The direction of temporal foveolae latero-anteriorly angulated; fastigium trapezoidal. Eye large, pronotum broad; 3 sulci on the pronotum-anterior end oval and posterior end more or less curved. Cruciform mark of the pronotum present. Median carina straight and lateral carinae anteriorly more or less parallel and posteriorly greatly diverge, pronotum-tricarinated. Three sulci on the pronotum only posterior one crossing the median carina. Prozona and metazona more or less equal. Mesosternal interspace wider than length. Elytra and wing fully developed. Hind femur slender, three black spots on the dorsal side of femur, lobes at tibiofemoral junctions rounded, arolium small.

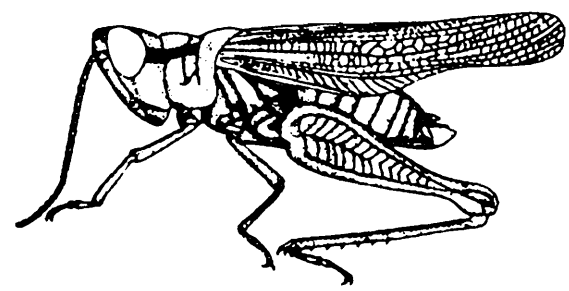


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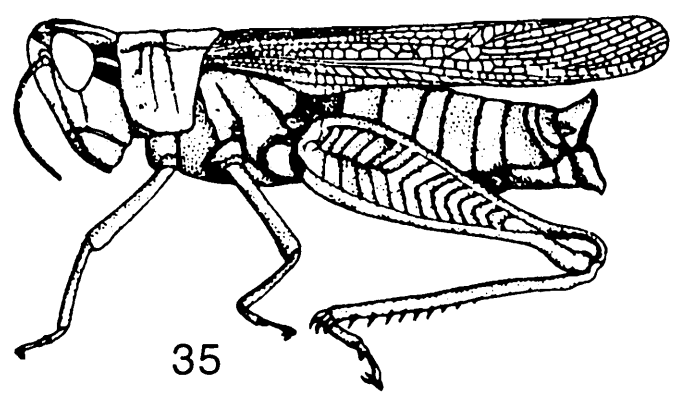
Fig. 34. Showing general morphology of *Leva cruciata* (male).



35

Fig. 35. Showing general morphology of *Leva cruciata* (female)

Male : Supra-anal plate elongated and angular; cercus short narrow and conical subgenetal plate short and more or less conical. Epiphallus-moderately narrow bridge, anchorae short and incurved, lophi trilobate (Fig. 34).

Female : Ovipositor more or less short and roubust form, valves curved (Fig. 35).

Morphometry

Male (mm.) : Length of the body 12.3; length of antenna 4.5 length of pronotum 3.5; length of tegmen 10; length of hind femur 8.5; length of hind tibia 6.5.

Female (mm.) : Length of the body 15.8; length of antenna 5.5; length of pronotum 4.6; length of tegmen 12.8; length of hind femur 10.4; length of hind tibia 8.2.

Material examined : 1♂, Madumuroli; Barasat, 20.v. 65, Coll. M.S. Shishodia and B.K. Bhattacharya; 1♂, Chandpara, 19.vii. 55, Coll. Mrs. Sarkar 1♂, Bamanmura, Barasat, 20.v. 65, Coll. M.S. Shishodia and B.K. Bhattacharya.

Distribution : INDIA (West Bengal, Bihar, Karnataka, Orissa, Tamil Nadu); ORIENTAL REGION.

Remarks : The most remarkable feature of this species are i) Cruciform mark dorsally on pronotum; ii) lateral carinae of pronotum run parallel anteriorly and divergent posteriorly; iii) Sulcation of frontal ridge between antennae.

Genus ***Dnopherula* (*Aulacobothrus*)** Karsch

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

1902. *Aulacobothrus* Bolivar *Assals. Soc. ent. Fr.*, **70** : 57.

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

1953. *Luenia* Uvarov, *Campauhia de Diamantes de Angola. Puble. Cult.*, **21** : 171.

Type species : *Dnopherula callosa* Karsch, 1896.

Small size, with rugosed integument. Filiform antenna, head sub-conical; fastigium longer trapezoidal, apex truncated with sharp marginal carinulae merging with carinulae of vertex. Dorsum of pronotum flattened, tricarinated slightly constricted, median carina sharp, linear cut by lateral carinae angularly incurved posterior sulcus only. Tegmen short; not reaching beyound the tip of hind femora with basal dialatation at the anterior margin. Inter-ulner area of male very regularly reticulated. Costal area beyond the middle of tegmen highly expanded with 12 oblique veinlets. Subcostal area less developed. Posterior tibia slightly shorter than posterior femur. Spurs less unequal, sometimes of about the same length. Supra-anal plate triangular. Subgenetal plate navicular, cercus narrow, acutely conical.

Dnopherula (Aulacobothrus) luteipes (Walker)

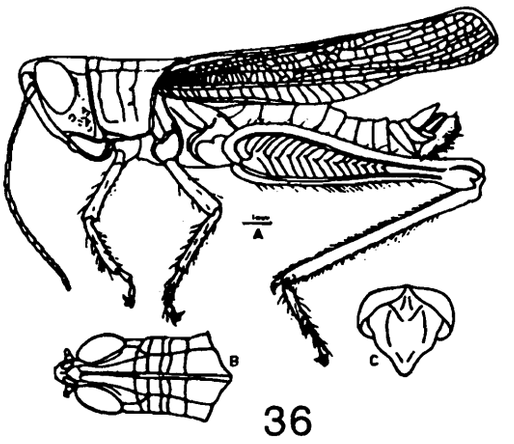
(Figs. 36, 37)

1871. *Stenobothrus luteipes* walker, *Cat. Derm. Salt B.M.V. Suppl.* P. 82.

1935. *Aulacobothrus luteipes* Tinkham, *Ibid.*, P. 486.

1939. *Aulacobothrus taeniatus* Rehn. *Rev. Soc. Ent. Arg.*, 10, P. 117.

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



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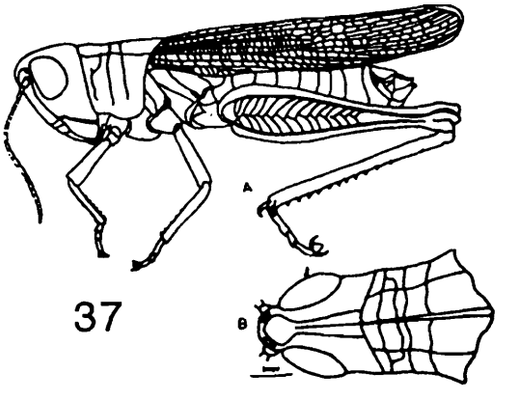

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Figs. 36. Showing general morphology of *Dnopherula (Aulacobothrus) luteipes* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Tip of abdomen (dorsal), **37.** Showing general morphology of same *(Aulacobothrus) luteipes* (female), A. Entire specimen, B. Head and pronotum (dorsal)

Diagnostic character : Size medium, slender form, head short, eye in the middle part of the head, antennae filliform; head slightly reclinate; frontal ridge distinct; antennae reaching beyond the posterior margin of the

pronotum. The middle carina running from the tip of the fastigium upto the posterior part of the pronotum; lateral facial keel distinct; slightly arcuate. Fastigium of the vertex sloping, more or less triangular, especially in the male, margins distinct, narrowing in front, apex acutely or obtusely rounded; elytra and wing well developed, head yellowish brown, vertex blackish brown, longitudinal band on each side, begining along the fastigium of vertex and terminating at the anterior area yellowish or light brown, anal area lighter, coloured; wings hyalineous. Tympanal organ well developed and present on the 1st abdominal tergite. Hind femur yellowish brown, knee black, hind tibiae red, basal insertion blackish, spines with black tips hind tarsi yellowish or reddish brown. Sternum and abdomen from below yellowish brown or olivaceous brown.

Male : Epipallus-bridge undivided, anterior proces sickle shaped, more pointed and curved inwards, both the anchorae are separated of which anterior part with posterior processes. Lateral part concave shaped i.e. invaginated, gradually goes upwards and diverged and pointed at the tip (Fig. 36).

Female : Similar like males but large in size. Median carinula of fastigium is very prominent which is visible from extreme anterior margin. Frontal ridge flat above median ocellus. Lateral carinae of the pronotum parallel upto prozona. Valve of the ovipositor moderatedly curved (Fig. 37).

Morphometry

Male (mm.) : Length of body 16; length of antenna 8.6; length of tegmen 12.6; length of hind femur 10.6; length of hind tibia 9.1.

Female : Length of body 23.4; length of antenna 9.2; length of pronotum 6; length of tegmen 18; length of hind femur 15.2; length of hind tibia 13.

Material examined : 3♂♂, 10♀♀ Botanical Garden, 21.i. 81-17.xi. 82, Coll. A.K. Hazra and Party; 1♂, 1♀ Narendrapur, April, 79, Coll. M.S. Shishodia.

Distribution : INDIA (West Bengal, Assam, Bihar, Himachal Pradesh, Madhya Pradesh, Maharastra, Sikkim and Karnataka); NORTH AMERICA; MYANMAR; CHINA; EUROPE; JAPPAN AND PAKISTAN.

Remarks : This species is differentiated from the other species by the following characters : head yellowish brown, occiput with a distinct median carina extending from the anterior tip to the posterior part of vertex to the end of metazonal part of pronotum.

Subfamily ACRIDINAE

Key to genera

1. Acute or subacute apex of tegmen, posterior femoral knee lobe acute pointed, prosternal process absent ..... *Acrida* (Linnaeus)

– Apex of tegmen not acute, rounded apex of posterior femoral lobe ..... *Phlaeoba* Stål

3. Lateral carinae of pronotum continuous; fastigium of vertex shallowly concave with a strong median dividing carinula; hind femur thickened at base .....

Genus ***Acrida*** Linnaeus 1758

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

1910. *Acrida* (*Partim*) Kirby, *Syn. Cat. Orth., III* : 90.

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

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

Body strongly elongated and stick like; ratio of length to maximum width 6.3-13.0; antenna flattened, broadened and conical. Fastigium of vertex large and strongly projecting in front of the eyes.

Pronotum long, disc flat with single transverse sulcus, median and lateral carinae substraight or feebly divergent in prozona, in metazona feebly low and very distinct, not swollen behind.

Elytra long and narrow with dense recticulation, costal and subcostal veins finely serrated. Area mediastine and scapularies of the elytra in both sexes with irregular dense network of veins and false longitudinal veins. Wing widened, lustrous speculum, without any pattern.

Anterior femora shorter or feebly longer then the pronotum. Hind femur long and narrow, lateral lobes of hind knee acute; the upper internal lobe very slightly than the external; median projection with, aeroliyum moderately large. Claws shorter than half the third joint of tarsus. Pulvillus large, broad, about as long as the claw.

Male : supra-anal plate triangular and simple. Cercus short, narrow and conical, subgenetal plate conical.

Female : supra-anal plate obtuse and angulate, subgenetal plate weakly trilobate. Ovipositor short, robust with broad, slightly curver valves.

Acrida exaltata (Walker)

(Figs. 38, 39)

1859. *Truxalis exaltata* walker, *Ann. Mag. Nat. Hist.* (3) *iv* : 222.

1892. *Truxalis brevicollis* Bolivar, *Ann. Soc. Ent. France.* **70** : 588.

1914. *Acrida exaltata* Kirby, *The Fauna of British India*, Including Ceylon and Burma, Orthoptera **1** : 99

1954. *Acrida exaltata* Dirsh, V.M. *Bull. Soc. Funad Ler Entom.*, **38** : 149-151.

Diagnostic charater : Body slender green; head and pronotum of equal length; tegmen obtusely pointed, scarcely longer than the hind femora; wing yellowish hyaline; cells in the posterior part closely in the middle; pronotum tricarinated; lateral carinae parallel at prozona and slightly divergent at posterior end but in metazona, it is distinctly divergent and a little excurved; front leg short and hind leg much longer; hind tibiae with the upper interior spur nearly one half shorter than the lower one; claws of the tarsi short, arolium large.

Male : Rather small; fronts strongly concave, antennae shorter than head and pronotum together, fastigium of the vertex moderately long with parallel lateral margin and broadly rounded apex. Lateral carinae of pronotum convergent forwards, transverse sulcus slightly before the middle, posterior margin of metazona acute angulate with weakly incurved sides. Elytra produced beyond the knee, wing shorter than tegmen lateral lobe of hind knee moderately long and acute. Supra-anal plate longer shaped with a broad median sulcation; subgenetal plate short and acutely conical, cercus narrow, conical with obtuse apex. Epiphallus with broad bridge. anchorae large, and bilobate. Anterior process round, posterior process conical. Sclerites oval shaped (Fig. 38).

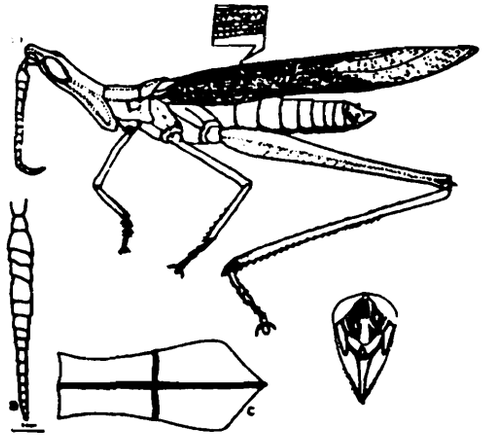


Fig. 38. Showing general morphology of *Acrida exaltata* (male), A. Entire specimen, B. Antenna, C. Pronotum (dorsal), D. Tip of abdomen (dorsal).

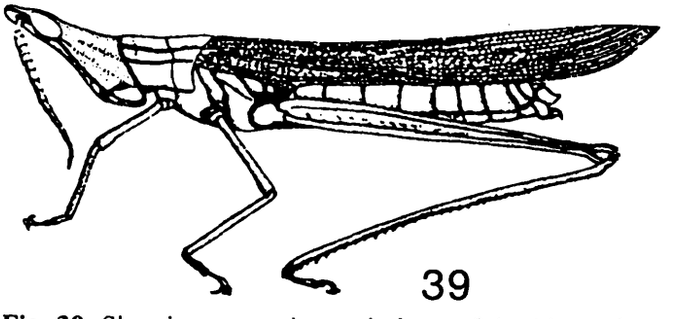


Fig. 39. Showing general morphology of *Acrida exaltata* (female).

Female : Larger, lateral carinae of prozona mostly incurved, in metazona divergent; posterior of metazona divergent; posterior margin of metazona less acute; subgenetal plate short and broad with acute apex more infumate and darker (Fig. 39).

Morphometry

Male (mm.) : Length of body 31.7., length of antenna 10.4., length of pronotum 5.9., length of tegmen 31., length of hind femur 27.8., length of hind tibia 26.8.

Female (mm.) : Length of body 51.9., length of antenna 14.2., length of pronotum 10.1 mm., length of tegmen 41.6., length of hind femur 30.5., lenght of hind tibia 28.6.

Material examined : 1♂, 1♀, Canning, 18.xi. 65, Coll. G.S. Arora; 1♀, Botanical Gardens, 1.vii. 49, Coll. A.P. Kapur; 1♂ Botanical Gardens, August 1949, Coll. A.P. Kapur; 1♂, Calcutta, 2.xi. 66, Coll. Survey party; 1♀ Madanpur, 11.xi. 66, Coll. M.M. Arora and party; 1♂, Shyam Nagar, 11.xi. 66, Coll. T.K. Chakraborty & B.K. Bhattacharya; 1 nymph, Clacutta, 5.v. 62. Coll. S.N. Prasad & H.N. Sing; 1♀ B. Lake, 26.vi. 67, Coll. T.K. Chakravarty; 2♂♂, Garia, 13.viii. 76 & 26.x. 79, Coll. S.K. Mandal. 1♂, Calcutta, 20.vi. 63, Coll. R.K. Kacker & S. Ali; 1♂, Bansdroni, 20.vi. 63, Coll. R.K. Kacker & S. Ali; 4♂♂, 1♀ Botanical Gardens, 27.x. 65, Coll. K.R. Rao & party; 1♂, Botanical Gardens 30.iv. 62, Coll. S.N. Prasad & K.D. Chakraborty; 1♂, nymph, Dum Dum, 24.xi. 65, Coll. P. Parui; 1♀ Calcutta, 7,ix. 61, Coll. M.B. Kripalini; 1♀, Madhumurail, Barasat, 20.v. 65, Coll. M.S. Shishodia & B.K. Bhattacharya; 1♂, Eden Gardens, 20.viii. 66, Coll. T.K. Chakraborty & K.L. Bhatta 1♂, Calcutta, 5.viii. 59, Coll. A.P. Kapur;1♂, 1♀ Calcutta, viii. 57, Coll. A.P. Kapur; 1 nymph, Titagrh, 15.v. 62, Coll. S. Lal; 1♀ 28.ix. 61, Dalang-ghata, Coll. M.B. Kripalini; 2♂♂, 3♀♀ Narendrapur, April, 79, Coll. M.S. Shishodia.

Distribution : INDIA (West Bengal, Arunachal Pradesh, Jammu and Kashmir, Kerala, Rajasthan, Tamil Nadu); AFGHANISTHAN; BANGLADESH; IRAN; PAKISTHAN; SAUDI ARABIA; S. E. TIBET; YEMEN AND WEST EDEN.

Remarks : The above specimen is identified by the presence of the following characters : (1) Apex of tegmen acute and pointed (2) Costal and Subcostal area of tegmen with irregularly reticulated (3) Head and pronotum of about equal length (4) Transverse sulcus of pronotum is slightly before the middle (5) Posterior margin of metazona acute angular.

Genus ***Phlaeoba*** Stål 1860

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

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

Type-species : *Gomophocerus* (*Phlaeoba*) *rusticus* Stål, 1869.

Medium size with well developed tegmen and wings. Antenna ensiform of which the basal portion is broad and flat and longer than head and pronotum together. Fastigium present before the eye and more or less rounded, lateral carinula divides fastigium which continues on vertex. Frons more or less oblique. Pronotum flat, tricarinated, lateral carinae always linear, disc crossed by always more than one sulcus. Tegmina with dense reticulatio intercalary vein absent. L Posterior femur moderately stout, narrowing at apex. Male subgenetal plate rounded or acutely pointed at apex. Epiphallus with broad bridge and large anchorae. The lophi are spindle shaped.

Key to the species

1. Wing fuscous at apex 2
   Wing hyalinous at apex, pronotum rugulose and strongly striated with black spots .... *pantelei* Bolivar
2. Antennae unicolourous .... *infumata* Brunner

Phlaeoba infumata Brunner
(Figs. 40, 41)

1893. *Phlaeoba infumata* Brunner. v. Wattenwyl. *Ann. Mus. Civ. Stor. Nat. Genova*, **33**, p.124.

1901-(02). *Phlaeoba infumata* Bolivar I. *Ann. Soc. Ent. France*, **70** p. 390.

1910. *Phlaeoba infumata* Kirby, *Syn. Cat. Orth.* III p. 138.

1914. *Phlaeoba infumata* Kirby, *Fauna Brit. Indi. Orth. Acrdi.* p. 103, fig. 86.

1921. *Phlaeoba infumata* Uvarov, *Ann. Mag. Nat. Hist.* **9** (7), p. 486.

1924-(25). *Phlaeoba infumata* Uvarov, *Journ. Asiat. Soc. Bengal*, NS. **20**, p. 318.

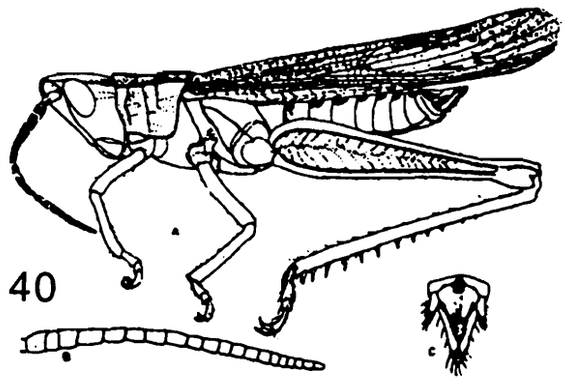
1929. *Phlaeoba infumata* Tsai pang hawa, *Journ. Coll. Agric. Imper. Univ.* Tokyo, X, p. 146.

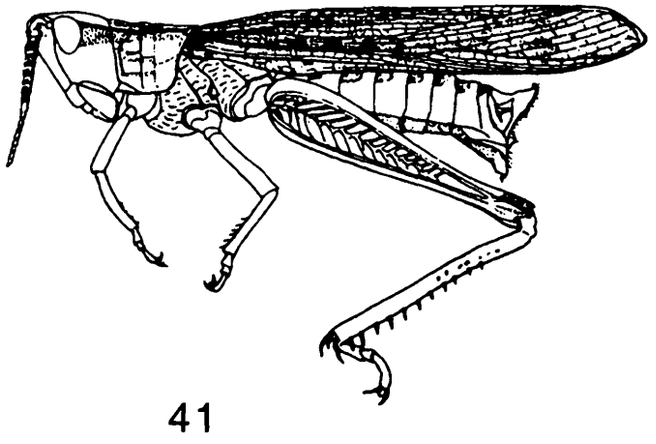
1934. *Phlaeoba infumata* Miller, *Journ. F. M. S. Mus.*, **17**, p. 530.

1935. *Phlaeoba infumata* Tinkham, *Lingn. Sc. Journ.*, **14**, p. 483.

1936. *Phlaeoba infumata* Tinkham, *Ibid.* **15**, p. 204.

1941. *Phlaeoba infumata* Ramme, *Mitt. Zool. Mus. Berlin*, **25**, p. 13.





Figs. 40. Showing general morphology of *Phlaeoba infumata* (male), A. Entire specimen, B. Antenna, C. Tip of abdomem (dorsal), **41.** Showing general morphology of *Phlaeoba infumata* (female)

Diagnostic character : Size medium and robust body, slender; antennae with the joint flattened, ensiform and more filliform; head elongate, face oblique, rugosely punctured or with irregular low regosities. Frontal ridge raised between the antennae without imperssion near the median ocellus, narrowly sulcate, slightly widened towards the clypeus, in the female sometimes less distinct near the clypeal margin. Lateral facial keel straight; pronotum, compressed laterally cylindrical; rugosely punctured; anterior margin truncated, posterior margin rounded; elytra and wing well developed; elytra with anterior and posterior margin nearly parallel, anterior margin with a basal dialatation, area mediastina, scapularis, discodalis and interulnaris with a more or less distinct supplementary vein; basal third of elytra densely reticulated, apex rounded or rounded truncate. Wings about as long as the elytra, apex rounded; hind femora short or more slender, keels finely, but sparsely serrate, kneelobes obtusely pointed. Hind tibiae straight and rounded with 11-12 spines on outer and inner margin; inner spars a little longer than the outer ones. Hind tarsi short; first joint about as long as the two other together.

Male : Medium size, antennae reaching beyond the hind margin of pronotum, slightly ensiform fastigium of vertex short, lateral margin parallel, apex obtuse. Pronotum with distinct lateral and parallel margin subgental plate with apex pointed, cercus slender (Fig. 40).

Female : Larger than male, antennae more ensiform (Fig. 41).

Morphometry

Male (mm.) : Length of body 21; length of antenna 10.4; length of pronotum 4.4; length of tegmen 18.2; length of hind femur 13.3; length of hind tibia 11.3.

Female (mm.) : Length of body 30.8; length of antenna 11.4; length of pronotum 6; length of tegmen 25.4; length of hind femur 17.4; length of hind tibia 16.2.

Material examined : 2♂♂, 2♀♀ 1 nymph, Botanical Garden, 10.i. 58, 8.vii.59, Coll. A.P.

Kapur; 1♂, Botanical Garden, 8.viii. 59, Coll. P.C. Dhar; 160♂♂, 124♀♀ Botanical Garden from 14.vi. 79 to 26.iv. 83, Coll. A.K. Hazra and party; 1♂, Nilguange, 15.vi. 57, Coll. A.P. Kapur; 1♂, Eden Garden, 13.ix. 52; 1♂, Calcutta, 1.vii. 70, Coll. R.K. Singh; 1♂, Calcutta, 9.xi. 66, Coll. S.B. Ray and T.K. Chakraborty, 1♂, Sonarpur, 8.ix. 65, Coll. K.S. Pradhan and party; 1♂, Bongaon, 7.1. 66, Coll. B.K. Bhattacharya and party; 1♀ Budge Budge, 5.xi. 66, Coll. A.N.T. Joseph; 18♂♂, 4♀♀ Garia, 6.viii. 76-13.vii. 77 Coll. S.K. Mandal; 13 ♂♂, 15♀♀ Narendrapur, April, 1979, Coll. M.S. Shishodia.

Distribution : INDIA (West Bengal, Arunachal Pradesh, Bihar, Delhi, Himachal Pradesh, Madaya Pradesh, Orissa, Rajasthan, Tamil Nadu); E. NEPAL; MYANMAR.

Remarks : Frontal ridge with the margine not thickened, smooth. Antennae with the joints flattened. Fastigium of vertex short, little shorter than the eye, lateral margin parallel narrowing anteriorly, vertex without irregular longitudinal ridges subsmooth or rugously punctured, elytra brown, wing hyalinous. This species occurs in grassland, low vegetation along stream courses, outskirts of jungles.

Phlaeoba pantelei Bolivar

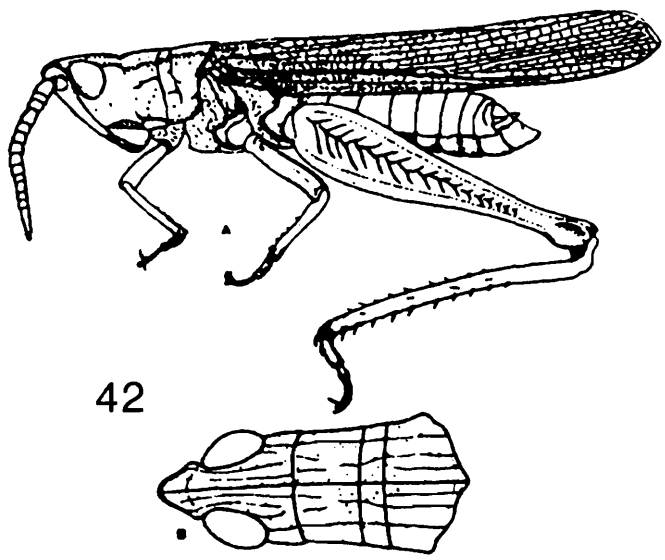
(Figs. 42, 43)

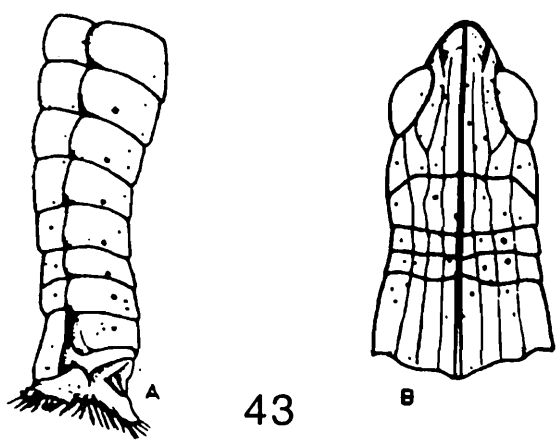
1902. *Phlaeoba pantelei* Bolivar, *Annals. Soc. ent. Fr.*, **70** : 589.

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

1914. *Phlaeoba pantelei* Kirby, *Fauna British India*, Orth., **1** : 104-105.

Diagnostic character : Size medium, antennae narrow and ensiform. Fastigium of vertex broad, rounded and concave. Median carinula strong which is external form vertex to head and pronotum. Head with distinct linear striated callosities like pronotum. Pronotum tricarinated, rugulose and with irregular striated callosities. Pronotum truncated in front and very obtusely angulated behind. Head pronotum is very rugosed and the callosities are irregularly striated. The three dorsal carinae parallel. Some black spots are present on the head and pronotum and as well as on frontal carinulae. Meso and metasternal lobes are very distinct. Tegmina moderately broad, narrow and longer than abdomen, apex obliquely rounded, being narrow, bluish hyaline and nervures are greenish. Posterior femur slender with apical filliform portion. Posterior tibiae with twelve internal and eleven external spines. Both posterior femur and tibia are uni-colours. Posterior femur also with very small black dots and spines of tibiae with black tipped.





Figs. 42. Showing general morphology of *Phlaeoba pantelei* (male), A. Entire specimen, B. Head and pronotum (dorsal), **43.** Showing general morphology of *Phlaeoba pantelei* (female), A. Entire abdomen (lateral), B. Head and pronotum (dorsal)

Male : Supra-anal plate triangular, subgenetal plate pointed and acute; Cercus small conical with subacute apex. Epiphallus-bridge undivided. Posterior process of epiphallus more or less rounded at the end. There are two distinct lophi at the medial side of the posterior process. Lateral process bent, anchorae conical (Fig. 42).

Female : Very similar to male but the size is large supraanal plate tongue shaped with median depressions. Posterior margin of subegental plate produced in medial apex. Valve of ovipositor of moderately curved (Fig. 43).

Morphometry

Male (mm) : Body 18-20; antennae 7.5-10; head 3-3.5; pronotum 3-4.5; tegmen 16-20.5; hind femur 11.0-14.5; hind tibia 9.5-12.0.

Female (mm) : Body 24.9-40.5; antennae 7-12.8; head 3.4 to 6.2; pronotum 4.5-7.8; tegmen 3.5-5.1; hind femur 14.5-24.2; hind tibia 12.5-214.

Material examined : 1♂, Kamina, Howrah dist. 27.1. 86, Coll. B. Dutta and party; 1♂, Jalpai. Howrah dist. 29.1. 86, Coll. B. Datta and party; 1♂, 2♀♀, Ulubaria, Howrah dist. 26.1. 86, Coll. B. Datta and party.

Distribution : INDIA : (Andhra Pradesh, Bihar, Himachal Pradesh, Madhya Pradesh, Tamil Nadu).; AFGANISTAN.

Subfamily OEDIPODINAE

Key to the genera

1. Pronotum longer than the width 2
- Pronotum not larger its width 6
2. Fastigium of vertex closed, elongated fastigial foveolae trapezoidal 3
- Fastigium of vertex open 4
3. Internal spur of hind tibiae greatly unequal, lower one is much longer than other and much hooked at apex which is very acute ..... *Heteropternis* Stål
- Internal Spur of hind tibiae equal and normal 4
4. Head and pronotum granulose, bituberculate, posterior margin of metazona rectangular intercalary vein weakly serrated ..... *Dittopternis* Saussure
- Head and pronotum not granulated; posterior margin of metazona obtuse-angular; intercalary vein strongly serrated ..... *Aiolopus* Fieber
5. Pronotal 'X' marking always with anterior and posterior arms which is separated. Posterior arms straight, not converging. Posterior margin of metazona more or less rounded or rectangular not acute angular... ..... *Oedaleus* Fieber
- Pronotum not 'X' marking, anterior and posterior arms continuous, posterior arms generally curved, posterior margin of matazona never rounded, pronotum with prominent median carina ..... *Gastrimargus* Saussure
6. Pronotum smooth 7
- Pronotum with well marked crest, median carina of pronotum strongly raised in prozona forming two tooth like projections ..... *Trilophidia* Stål
7. Wing without black fascia, pronotum with moderate raised median carina and rounded posterior margin ..... *Locusta* Linnaeus

Genus ***Aiolopus*** (Fieber), 1853

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

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

Type specise : *Gryllus thalassinus* Fabricius, 1781.

Size medium, filiform antenna, pentagonal fastigium, Foveolae trapezoid or rectangular, frontal ridge convex, marginal carinulae ill devoloped. Pronotum saddle shaped constricted at prozona but sometime medially constricted. Transverse sulci three but posterior one only crosses linear median carina. Metazona larger than prozona. Tegmina and wing well developed and tegmina with apical lobe rounded. Male supraanal plate rounded, triangular, moderately long apex sub-angular, cercus narrow, conical subgenetal plate short, apex rounded. Epiphallus-

bridge narrow, curved anchorae, lophi-bilobed. Lower valve of ovipositor with small external ventral teeth.

Aiolopus thalassinus tamulus (Fabricius)

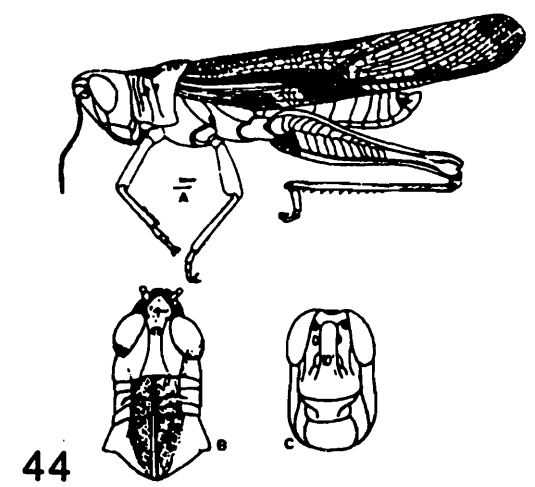
(Figs. 44, 45)

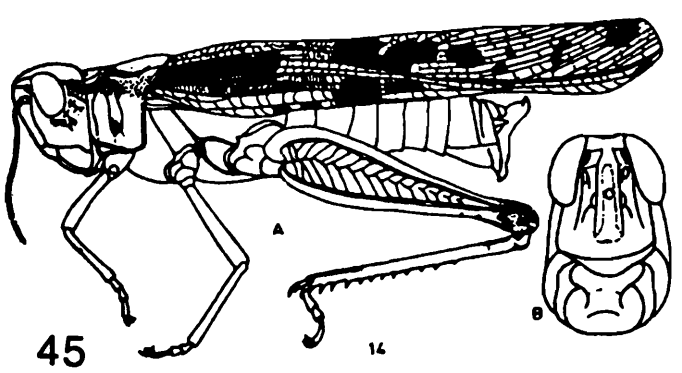
1798. *Gryllus tamulus* Fabricius, *Entomologia Systematica Suppl* : 195.

1838. *Gomphocerus tricoloripes* Burmeister, *Hand. der Entomologis* **2** : 649.

1888. *Epacromia rufostriata* Kirby, *W. F. Proc. Zool. Soc. Lond.* 550.

1968. *Aiolopus thalassinus* tamulus (Fabr.) *Bull. Br. Mus. nat. Hist. (Ent.)* ; 307-350.





Figs. 44. Showing general morphology of *Aiolopus thalassinus tamulus* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Entire portion of head, **45.** showing general morphology of *Aiolopus thalassinus tamulus* (female), A. Entire specimen, B. Head (front view).

Medium size : antenna filiform; longer than head and pronotum together; fastigium of vertex pentagonal; frontal ridge narrow and gradually narrowing upwards. Eye oval, long, pronotum sligthly constricted between prozona and metazona; metazona longer than prozona. Presence of two brown stripes from both middle part of the eyes and running laterally up to the upper part of metazona. Tegmen and dots on the elytra; wing more or less semitransparent. Intercalary vein on medial part of the elytra also prominent. Hind femur slender and broad and with well developed rounded apical lobe. Presence of yellow band on the base to tibia, then bluish band and at the apex, there is red band, aerolium medium sized.

Male : Fastigium is more acute and angular structure, fastigial foveolae is narrow; post margin of pronotum is more rounded. Cerci rounded and conical; supra-anal plate short, triangular; epiphallus medium sized, bridge short, broad, anchorae oval shaped, bilobed, bent in the inner side, anterior process baloon shaped, posterior process round and small. Cingulum horse-shoe shaped, lophi bilobed. Phallic complex with basal valve of pennis less expanded. Anterior process perpendicular to posterior (Fig. 44).

Female : Fastigium is less acute and angular; fastigial foveolae less narrower, subgenetal plate short and conical and subconical with rounded apex. Ovipositor short, valve moderately robust, lower valve with small tooth. Spermatheca with sac like preapical and short finger like notched apical diverticula (Fig. 45).

Morphometry

Male (mm) : Length of body 17.6; length of antenna 7.1, Length of pronotum 4.6; length of tegmen 17.2; length of hind femur 10.6; length of hind tibia 9.2.

Female (mm) : Length of body 22.1; length of antenna 6.2; length of pronotum 5.2; length of tegmen 21.5; length of hind femur 13; length of hind tibia 10.4.

Material examined : 36♂♂, 12♀♀, Eden Garden, 10.xi. 50 to 20.viii. 66, Coll. A.P. Kapur; 3♂♂, 1♀ Horticulture Garden 23.vi. 61 to 25.v. 62, Coll. H.K. Bhowmick, 1♀ 30.ix. 63, Coll. B.N. Das and A.K. Chakravorty; 1♀, Dunlop bridge, 17.vi. 65 to 1.vi.65, Coll. M.S. Shishodia and B.K. Bhattacharya; 2♀♀, Kalighat, 24.iii. 69 to 13.vi. 69, Coll. M.S. Shishodia; 2♂♂, Botanical Garden, 11.xi. 66, Coll. M.S. Shishodia and B.K. Bhattacharya; 52 ♂♂, 60♀♀ 23.v. 79 to Coll. A.K. Hazra and party; 1♀ 11.vii. 50, Coll. B. Biswas; 7♂♂, 4♀♀, Khardaha, 9.xi. 66, Coll. S.B. Roy & T.K. Chakravorty; 4♂♂, Khardaha, 21.xi. 66, Coll. S.B. Roy and K.L. Bhatta; 1♂, Kankinara, 18.vii. 65, Coll. K. Rai; 1♂, Titagarh, 15.v. 62, Coll. S. Lal & S.N. Prasad; 1♂, Santragachi, 10.vi. 70, Coll. R.K. Singh; 1♀ Hastings, 1.vi. 66, Coll. M.S. Shishodia; 8♂♂, 8♀♀ Narendrapur, 26.x. 79, Coll. M.S. Shishodia; 2♂♂, 2♀♀, Baruipur, 8.xii. 66, Coll. K.R. Rao and party; 1♂, 1♀, Uluberia, 19.xi. 65, Coll, M.S. Shishodia and B.K. Bhattacharya; 19 ♂♂, 12♀♀, Garia, 26.x. 79, Coll. S.K. Mandal.

Distrubution : INDIA : (West Bengal, Orissa, Andaman Island) THAILAND; SRI LANKA; MYANMAR; THAILAND; CHINA; HAINAN; HONG KONG; TAIWAN; MALAYA; SINGAPORE; JAVA; LOMBOK; TINMOR; JAPAN and CHRISMOS ISLAND and AUSTRALION REGIONS PHILIPPINE ISLAND; MARIANA; KALIMANTAN; BRUNEI; SABAH; CELEBES; NEW GUINEA; PAPUA; AUSTRALIA; LORD HOWE ISLAND.

Remearks : This species can be easily differetiated by the presence of the following characters-frontal ridge narrow, gradually and continously pointed upwards; hind tibia yellow coloration at the base, blue in the middle and red at the apex.

Dittopternis Saussure 1884

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

Type species : Dittopternis ceylonica Saussure, 1884.

Size medium, body granulosed, filiform antenna, longer than head and pronotum together. Head broad, round, granulosed. Pentagonal fastigium, longer, apex truncated. Pronotum granulosed, bituberculate median structure infront. Anterior border of pronotal disc truncated, posterior margin rectangular, lateral part of pronotal lobe square type. Tegmen long, narrow, reticulate type, apical half membranous and hyaline. Wing hyalined or coloured but without any bands. Posterior femur denticulated. Male cercus conical. Epiphallus with narrow bridge, long and narrow anchorae, lophi bilobate.

Dittopternis venusta (Walker)
(Figs. 46, 47)

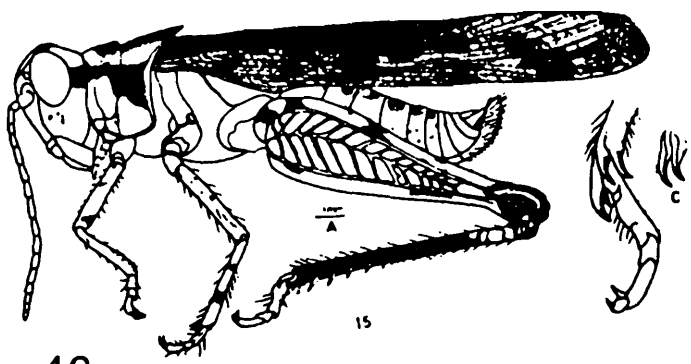
1870. *Oedipoda venusta* Walker, *Cat. Derm. Salt. B.M. IV*, p. 740.

1888. *Dittopternis venusta* Saussure, *Mem. Soc. Phya. Hist. Geneve*, **30** (1), p. 40.

Brown colour; paler beneath; head broad and longer than broad, truncated in front and the lateral carinae not extending behind the eyes; frontal ridge broadly sulcated. Pronotum graulosed rugosed and strongly carinated cut by principle sulcus before the middle, obtusely angulated behind. Pronotum moderately granulated, laterally compressed at prozonal area, with a strong median carina, crossed by at prozona with a strong median carina, crossed by posterior sulcus before middle, metazona divergent in middle and obtusely angular at medial posterior margin, lateral lobes with posterior edge straight; posterior angle rounded. Tegmen long and narrow; apex obliquely rounded; intercalated vein incompletely developed. Abdomen yellow with a blackish band behind and carinated. Hind femora stout, delicate and slightly longer than posterior tibia with black transverse bands; hind tibiae black at the base followed by light yellow band and then blue; spines of the tibiae yellow, tipped with black with 8 external and 11 internal spines.

Male : Rather small in size, supra-anal plate tongue shaped, subgenetal plate navicular;

circus short, conical, apex acute and slightly incurved. Epiphallus-no bridge, undivided; anterior process inwardly round. Posterior process broad and blunt, lophi more or less bean shaped with stalk. Anchorae hooked and pointed inwards; sclerites small and oval in structure (Fig. 46).



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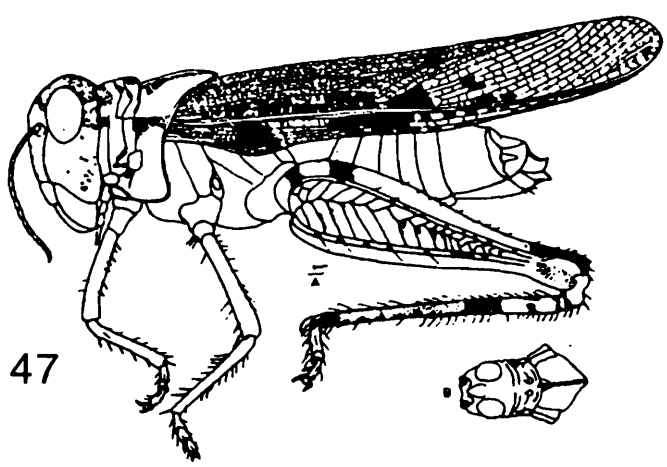

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Figs. 46. Showing general morphology of *Dittopternis venusta* (male), A. Entire specimen, B. Posterior portion of tibia, C. Internal calcaria of posterior tibia, **47.** Showing general morphology of *Dittopternis venusta* (female), A. Entire specimen, B. Head and pronotum (dorsal).

Female : Size rather large, very similar to males, valve of the ovipositor more or less curved (Fig. 47).

Morphometry

Male (mm) : Length of body 16.8; length of antenna 9; length of pronotum 4.6; length of tegmen 17; length of hind femur 11.3; length of hind tibia 9.3.

Female (mm) : Length of body 21.8; length of antenna 11.8; length of pronotum 5.8 mm; length of tegmen 22; length of hind femur 13.4; length of tibia 11.

Material examined : 1 ♀ Narendrapur, July 1979, Coll. M. S. Shishodia.

Distribution : INDIA (Madhya Pradesh, Orissa, Tamil Nadu, West Bengal); SRI LANKA.

Remarks : Internal calcaria of posterior tibiae more or less normal; lateral lobes of pronotum rectangular behind; antennae very long tawny at the base.

Genus ***Heteropternis*** Stål 1873

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

Type species : *Acridium respondens* (Walker, 1859)

Medium size, head smooth or granulated, filiform antennae and longer than head and pronotum. Angular vertex, lateral carinulae well developed. Pronotum rugose, median carina prominent and lateral carinae distinct, pronotum tectiform. Tegmina and wing well developed. Frontal ridge constricted at apex and gradually widening, downwards, depression of ocellus present. Metazona longer than prozona, posterior margin acutely angular. Mesosternal interspace wider than its length. Elytra and wing well developed, median area widened with finely serrated intercalary vein which is regular and thickened. Veinlets transversed. Hind femur robust. Femur and tibia are of equal length. Inner spur on inner side of hind tibia with small preapical position which is much longer than external one. Arolium medium size. Male supra-anal plate elongated and angular. Cercus narrow conical with obtuse apex, incurved slightly, subgenetal plate conical or narrow conical with obtuse or subacute apex. Epiphallus with bridge short, small ancore and bilobate lophi. Ovipositor with moderately short, robust, curved valves. Lower valve with external, lateral projection.

Heteropternis respondens Walker

(Figs. 48, 49)

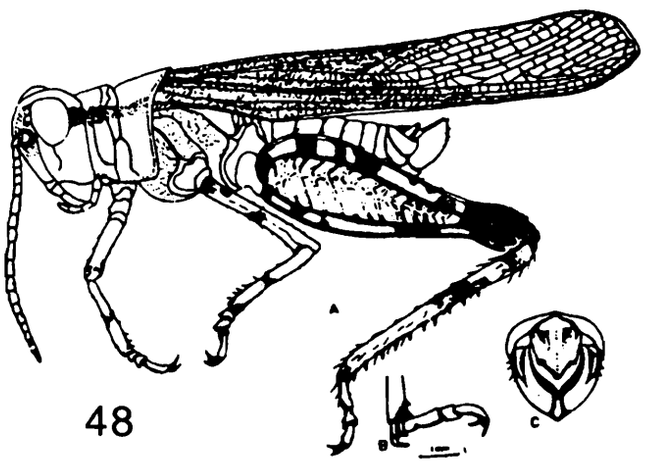
1859. *Acridium respondens* Walker, *Ann. Mag. Nat. Hist.* (3) **4**. p. 223.

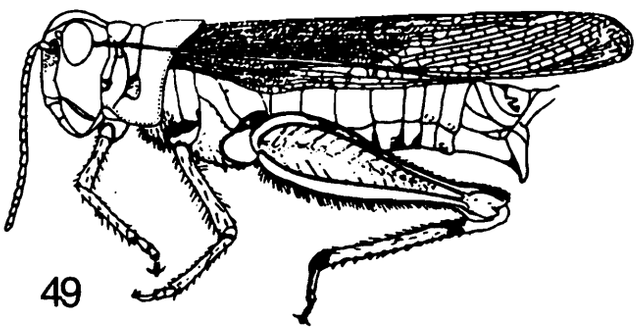
1873. *Heteropternis pyrrhoscelis* Stål, *Recens. Orth.* **1**, p. 128.

1888. *Heteropternis pyrrhoscelis* Saussure, *Mem. Soc. Geneva.* **28** (9), pp. 129, 130; 30 (1), 1888, p. 46.

1968. *Heteropternis respondens* Bei-Bienko, *Rev. Ent. Ussr.* **47** : 125.

1982. *Heteropternis respondens* Agicultural Manwell, C.O.P.R.





Figs. 48. Showing general morphology of *Heterpoternis respondens* (male), A. Entire specimen, B. Posterior portion of tibia with calcaria, C. Tip of abdomen (dorsal). **49.** Showing general morphology of *Heterpoternis respondens* (female)

Marbelled brown and yellow, dorsum brown, more or less unicolours, often with a distal pale band. Body rather slender; head smooth and may be slightly granulated, vertex of the scutelum broad behind, narrowed and truncated in front, costal ridge sulated; pronotum medium, slightly compressed in front and with the typical sulcus placed somewhat before the middle; only posterior sulcus crossing the median carina, metazona longer than prozona, hind border rectangular. Tegmen long, narrow, brown, wing hyaline, more or less clouded, may be milky or tinged red or yellow basally. Hind femora yellowish, irregularly spotted and mottled with black above and on the outer side; hind tibiae red with black-tiped spines.

Male : Males with conical cercus, and subacute apex. Subgenetal plate navicular, apex conical. Epiphallus-undivided bridge, broad, anterior process oval, posterior process bilobed, lateral process with irregular margin, wavy. The lophi are broad and more or less kidney shaped with stalk. Both lophi are entangled with the inner part of the posterior process. The sclerites are pea shaped in structure (Fig. 48).

Female : Larger than males; frontal ridge comparatively narrower and angular at fastigial end; sharp carinae in the fastigium of the vertex which is more prominent. Supra-anal plate tongue shaped, flat subgenetal plate and posterior margin broadly rounded, valve of the ovipositor is weakly curved (Fig. 49).

Morphometry

Male (mm) : Length of body 18; length of antenna 9.2; length of pronotum 5; length of tegmen 18; length of hind femur 12; length of hind tibia 10.

Female (mm) : Length of tegmen 22.6; length of hind femur 14.3; length of hind tibia 12.

Material examined : Reg. No. 1156/1 purchased, Calcutta 2 exs.; Reg. No. 1164/1 purchased, Calcutta 2 exs.

Distribution : INDIA (West Bengal and other States); NEPAL, BANGLADESH, SRI LANKA, UPPER MYANMAR; CHINA; MALAYSIA; INDONESHIA; NEFA-KAMENG; DUBONG; NILGIRI; THAILAND; PHILIPPINES; TIWAN; JAPAN.

Remarks : Internal calcarea of the posterior tibiae is grealty unequal; size moderate and slender, head slightly granulated, truncated, coastal ridge sulcated; Pronotum not much longer than broad, slightly compressed infront, hind border rectangular; tegmen long, narrow with brown colour; wing hyaline; hind tibiae red, claws very unequal, incurved.

Genus ***Oedaleus*** Fieber, 1853

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

Type species : *Acridium nigrofasciatum* Degeer, 1773.

Body medium size, rugosity of integument and pitted. Fastigium of vertex angular with truncated apex. Antennae filiform and longer than head and pronotum together. Frontal ridge sulcated, marginal carinula diverged ventrally. Eye more or less oval, pronotum constricted anteriorly and junction between prozona and metazona. Median carina linear, crossed by only posterior sulcus. There is distinct 'X' marking on prnotum which is covered on both arms of prozona and metazona. Posterior margin of metazona more or less rounded. Cercus conical apically acutely rounded, subgenetal plate short, subconical with rounded apex. Epiphallus bridge-shaped, anchorae well developed, lophi biloded. Ectophallic membrane sclerotized and forming sheath below apical pennis valves. Cingulum horse shoe shalped arch with moderately long apodmes, cingular valve acute. Ovipositor short with robust valve, excurved veritically. Spermatheca with sac like apical diverticulum with or without short pre-apical diverticulum.

Oedaleus abruptus (Thunb.)

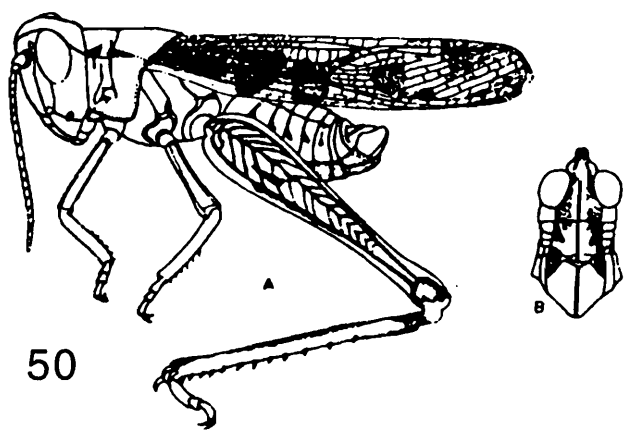
(Figs. 50, 51)

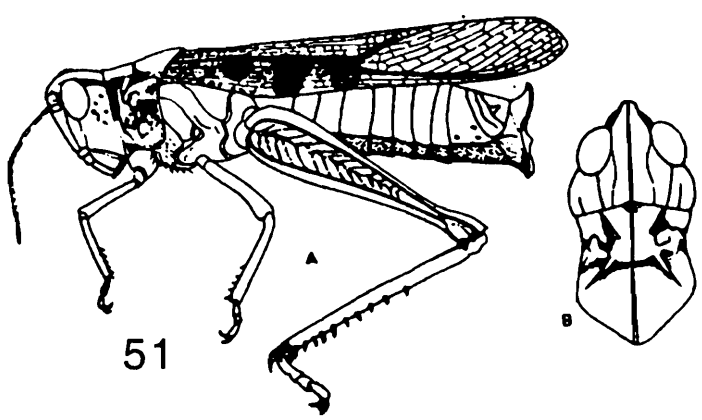
1815. *Gryllus abruptus* Thunb. *Mem. Acad. Petersb.* **5**. p. 233; **9**. 396-412.

1873. *Pachytylus* (*Oedaleus*) *abruptus*, Stål, *Recens. Orth.* **1**. p. 127.

1884. *Oedaleus abruptus* Saussure, *Mem. Soc. Geneve*. **28** (9) 110-117.

1981. *Oedaleus abruptus* (Thunb.) *Bull. Br. Mus. nat. Hist. (Ent.)* **42** (3) : 104-107.





Figs. 50. Showing general morphology of *Oedaleus abruptus* (male), A. Entire specimen, B. Head and pronotum (dorsal), **51.** Showing general morphology of *Oedaleus abruptus* (female), A. Entire specimen, B. Head and pronotum (dorsal)

Medium sized, greenish with brown or white markings, multisegmented antennae nearly one third times longer than head and pronotum together, fastigium of vertex concave, apex truncated, frontal ridge sulcated, constricted just below median ocellus, scutellum of the vertex long, narrow, subtriangular and pointed; pronotum brown low tectiform, median carina low arcuate not intersected by posterior sulcus with white cross mark above the white and brown oblique stripes on the sides of the head

and pronotum. Tegmina brown with three pale bands before the middle, beyond the middle subhyaline, sometimes with axillary area is green; wing very pale greenish yellow towards the base with a brownish central fascia, posterior tibiae with 13 inner and 12 outer spines, inner apical spurs one and four fifths as long as outer, apical tursal segment twice of claw length, aerolium three fifth of claw length, outer surface of ventral inner apical spur with row of conical sensila.

Male : Cerci four-fifths times as long as its basal width. Epiphallus rectangular with narrow bridge, inner lobe of lophi two and half times as wide as outer lobes, outer lobes outwardly protruding and pointed. Anterior projections rounded and acutely angular; posterior projections also acutely angular (Fig. 50).

Female : Larger than males, ventral ovipositor valve strongly sclerotized with strongly curved apices; spermatheca without sub-apical diverticulum (Fig. 51).

Morphometry

Male (mm) : Length of body 13.5; length of tegmen 14.1; length of hind femur 9.5; length of hind tibia 8.7.

Female (mm) : Length of body 19.4; length of antenna 5; length of pronotum 5; length of tegmen 19.5; length of hind femur 12.6; length of hind tibia 10.5.

Material examined : 2♀♀ Shyampur, 24 Pargs. 24. vi. 65, Coll. T.K. Chakraborty & B.K. Bhattacharya.

Distribution : INDIA : (West Bengal, Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Jammu and Kashmir, Kerala, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh); BANGLADESH; MYNAMAR; CHINA; INDO-CHINA; E. NEPAL; PAKISTAN; SRI LANKA AND THAILAND.

Remarks : This species is abundant specially in West Bengal the size is small, 'X' mark pronotum; long and narrow angulated and pointed the scutellum of vertex, greenish yellow wing base with brownish fascia.

Genus ***Gastrimargus*** Saussure, 1884

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

Type species : Grullus virescens (Thunberg, 1815)

Genus *Gastrimargus* Filliform antenna, slightly longer than head and pronotum together, fastigium of vertex concave. Marginal carinulae raised. Median carina with prominent crest present. Fastigium narrowing forwards, median portion maximum width, frontal ridge with sulcation, smooth, pronotum low to high tectiform with median carina, weakly intersected or may not, posterior margin of metazona rectangular or acute angular.

Gastrimargus africanus africanus (Saussure) (Figs. 52, 53)

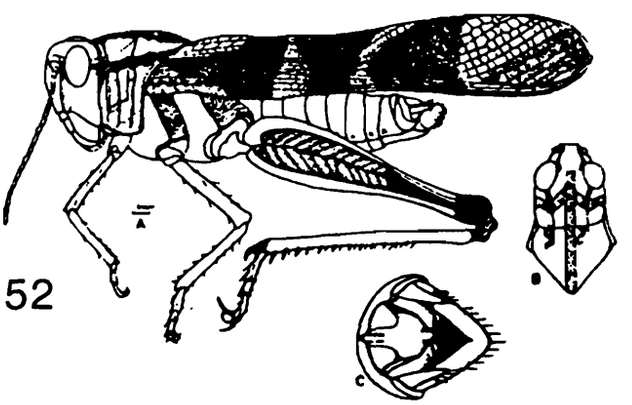


Fig. 52. Showing general morphology of *Gastrimargus africanus africanus* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Tip of abdomen (dorsal).

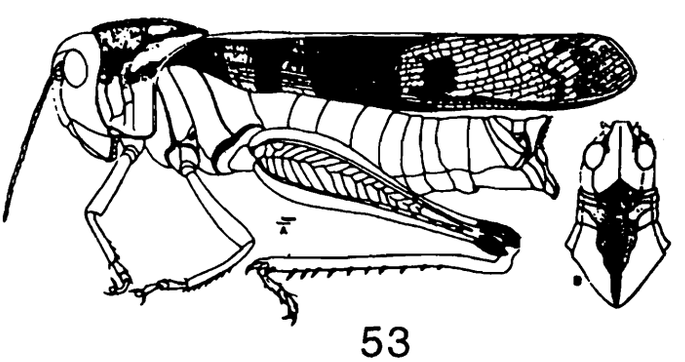


Fig. 53. Showing general morphology of *Gastrimargus africanus africanus* (female), A. Entire specimen, B. Head and pronotum (dorsal).

1888. *Oedaleus (Gastrimargus) marmoratus* Var. *africana*. Saussure, *Mem. Soc. Phus. Hist Mat. Geneve*, **30** (1) : 39

1922. *Gastrimargus marmoratus* (nec. Thunb.) Bolivar *Afrique Orientale Anglaise* : 174.

1925. *Gastrimagus africanus* Uvarov, *Ann. Mag. Nat. Hist.* (9) **15** : 622.

1926. *Gastrimargus africanus* Uvarov, *Trabs. Ent. Soc. Lond.* p. 436.

1928. *Gastrimargus africanus* var. Orientalis Sjostedt. *Sevemski Akad. Handi.* (3) **6**, No. 1 : 11, tab. 8, figs 6.7.

1982. *Gastrimargus agricanus africanus* Ritchie. *Bull. Br. Mus. Nat. Hist. (Ent.)* **44** (4) : 248-250.

Medium to large size; integument smooth or finely rugose. Antenna filiform; head globular; fastigium of vertex narrowing forwards, with truncated apex and well developed lateral and weak median carinuale. Pronotum tectiform with high madian carina. Metazona longer than prozona. Prozona sometimes its posterior margin is acute angular or elongate acute angular. Mesosternal interspace much wider than its length. Elytra and wings fully developed. Intercalary vein of median area of elytra prominent and strong and finely scattered, long narrow inner margin greenish, rest of the tegmen brown to the middle with whitish markings. Wings shorter than the tegmina, bright sulphur yellow colour at the base with a black central band curving round to the anal angle. Hind femora long and slender yellowish; hind tibiae red, spines tipped with black.

Male : Rather small size, frontal ridge sulcated, parallel sided, densely punctured, pronotum moderately tectiform, cerci conical, inner portion slightly blunt. Epiphallus-bridge undivided, anchorae long, blunt inwards and pointed. Anterior process broad and blunt. Lateral process a notch like projections present. Anterior process composed of a hook like structure which is more or less dense like Lophi are stacked which is bent outwards. Mesosternum larger, incomplete division. Metasternum small, angular, incomplete division present (Fig. 52).

Female : Rather large, fastigium furcated, mesosternal lobes shorter, angular incomplete division present. Metasternal lobe large. Two lateral division present on the metasternal lobe (Fig. 53).

Morphometry

Male (mm) : Length of body 28.1; length of antenna 8.62; length of pronotum 7.06; length of hind femur 15.4; length of hind tibia 14.4.

Female (mm) : Length of body 35; length of antenna 11.2; length of pronotum 10.3; length of tegmen 34.9; length of hind femur 21.3; length of hind tibia 19.6.

Material examined : 1♂, Calcutta, 13.xi. 07 (K) Reg. No. 1246/I.

Distribution : INDIA : (West Bengal, East Himalaya, Madras, Goa, Rajasthan, Sikkim, Orissa, Assam); SRI LANKA; BRITISH MUSEUM-CORMANDEL (MAINDRON); MUS. PARIS-STOCKHOLM; MYANMAR; AFRICA; NEPAL; PAKISTAN; THAILAND.

Remarks : Distinct white and more or less reverse triangle like whitish transverse bands present in the elytra and next an incomplete and light hyalinious area on the elytra. Wing-basal area bright yellow and apex informate prominent median carina on the pronotum. Total length of head and prozona greater than metazona posterior femur with three dark oblique transverse bands externally, internal surface with black zone, posterior tibia basally brownish, subbasally straw, apical region reddish.

Genus ***Trilophidia*** Stål, 1873.

1873. *Trilophidia* Stål *Recene. Orth.*, **1** : 117, 131.

1965. *Trilophidia* Hollis *Trans. R. ent. Soc. Lond.*, **117**(8) : 245-262.

Type species : *Oedipoda cristella* Stål, 1860

Size : Small, strongly rugosed on the integument, tuberculated and hairy. Antennae filiforms longer than head and pronotum together. Head subconical, fastigium of vertex angular, truncated apex. Frons oblique and

straight. Lateral carinae almost parallel. Pronotum tectiform, constricted at prozona. Median carina of prozona forming two elevated projections more or less tooth like. Lateral carinae irregular forming small tooth like lateral tubercles in front of first sulcus which is strongly diverged. Posterior sulcus cut medians carina before its middle. Posterior margin of metazona rectangular with obluse apex. Tegmina and wing well developed, intercalary vein of median area of tegmen strong. Base of the wing coloured. Hind femur moderately robust.Upper outer carina somewhat raised. Posterior femora inner side banded. Cercus narrow and conical, subgenetal plate short and conical. Epiphallus with narrow bridge, small venticulated anchorae with bilobate lophi. Ovipositor short, robust. curved valves. Lower valve small roundeed with externo-lateral projection. spermatheca short apical part and large Sac like pre-apical diverticula.

Remarks : Genus *Trilophidia* is the Geophilous long insect which lives specially in the Ethiopian and oriental region.

Trilophidia annulata (Thunberg)

(Figs. 54,55)

1810. *Trilophidia anulata* Kirby, *Syn. Cat. Orth.*, **3** : 244.

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

1914. *Trilophidia annulata* Kirby, *Fauna British India, Orthoptera : Acrididae* : 149.

1965. *Trilophidia annulata*, Hollis, *Trans. R. ent. Soc. Lond.*, **117** (8) : 251-253.

Size medium : Vertex behind eyes with a pair of tubercles. Fastigium of vertex elongated and it is trapezoid like structure; lateralcarinae highly sinous; fastigial foveolae irregularly oval, wide and deep. Pronotum with strongly crest median prozonal projections which can be found or sideways with varying strength and with three pairs of lateral projections, which decrease in size posteriorly. Lateral plate higher than wide irregular and small tuberoles. Tegmen considerably exceeding tip of the abdomen and on the dorsal side of femur presence of two brown spots. Hind tibia slightly shorter than femur. Base of the femur 1st black, then is yellow which is defferentiated next by brown colour and then again yellow band and apex is brown colour.

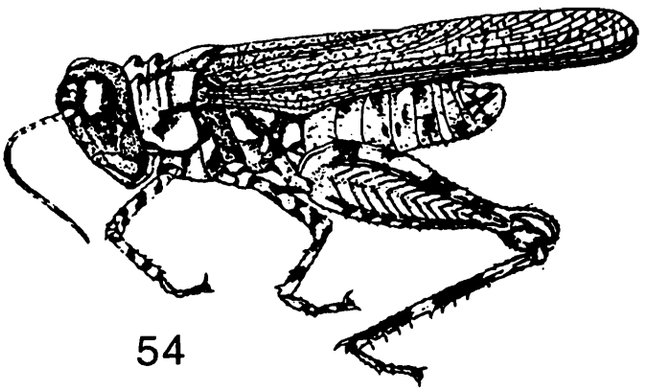


Fig. 54. Showing general morphology of *Trilophidia annulata* (male).

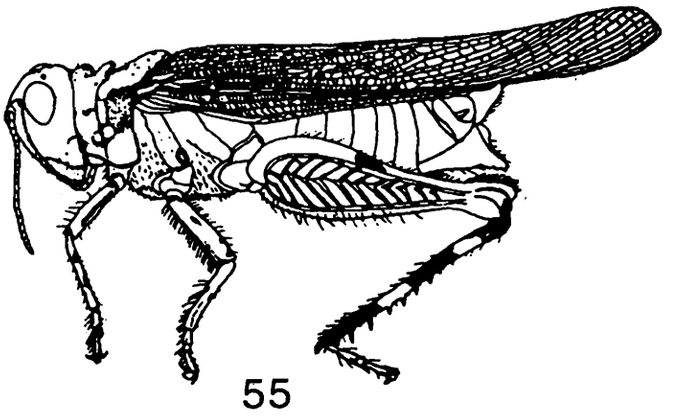


Fig. 55. Showing general morphology of *Trilophidia annulata* (female).

Male : Smaller, fastigium of vertex elongated more or less trapezoid in structure, fastigial foveolae irregularly oval, wide and deep, vertex behind eye with a pair of tubercles. Pronotum with median prozonal projections and three pair of lateral projections, posterior projections smaller. Metazona strongly pitted, cercus narrow and conical. Epiphallus with large and pointed anchorae, posterior lobe strongly bent up at right angles, bridge undivided. Anterior process oval and posterior process bilobed of which inner one are large and outer

one small in height. Sclerites oval in structure. The wavy pattern of lophi is the most characteristic feature for this species (Fig. 54).

Female : Large and more robust than male. Tegmen extends upto the tip of the abdomen. Dorsal valve of ovipositor miderately broad, slightly more than three times as long as wide, slightly shorter than lateral apodeme. Apical tip short and blunt. Dorsal condyle less prominent. Ventral valve along which is apically tuberculated. Mesial valve with apical tip is medium size. Spermatheca with oval preapical and short apical diverticula. Apex of sub-genetal plate obtuse-angular. Others general characters are same as male (fig. 55).

Morphometry

Male (mm) : Length of body 15; length of antenna 6; length of pronotum 4; length of tegmen 15; length of hind femur 9; length of hind tibia 8.

Female (mm) : Length of body 18.2; length of antenna 6.5; length of pronotum 4.5; length of tegmen 17.6; length of hind femur 10.5; length of hind tibia 8.9.

Material examined : 1♂, Uttarpara, 19.3. 66, Coll. B.K.Bhattacharya, 2♂♂ 3♀♀ Narendrapur, April, 1979, Coll. M.S. Shishodia, 14♂♂, 4♀♀ 6.viii. 76-20. vii. 77, Coll. S.K. Mandal.

Distribution : INDIA : (Andhra Pradesh, Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Karnataka, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh); BANGLADESH; MYANMAR; BORNEO; CHINA; HONG-KONG; JAPAN; JAVA; KOREA; SARAWAK; SINGAPORE; SRI LANKA; SUMATRA; TAIWAN (FORMOSA); MANGOLIA; PAKISTAN.

Remarks : Basal disc of wing green-yellow, hind femur with two black band; fastigium of the vertex elongated, trapezoid, tegmen ecxeeding from the tip of the abdomen and reaches upto middle of tibia; pronotum with median prozonal projections; metazona sharply pitted with strongly median and lateral carinae.

Genus ***Locusta*** Linnaeus,1758

1758. *Locusta* Linnaeus *Syst. nat.* (ed. 10) **1** : 431.

1915. *Locusta* Uvarov, *Bull. Off nat enti Acrid.*, **1** : 14.

1921. *Locusta* Uvarov, *Bull. ent. Res., Lond.*, **12** (2) : 135, 163.

Large size, frontal ridge not widend at the median ocellus, pronotum with its typical transverse furrow cutting the median keel about the middle, furrows in the prozona feeble. Mesosternal lobe longer than broad. Elytra five to six times greater as long as their maximal width. Hind radial vein diverging from the middle radial only and close to the bifurcation of the former. Discoidal area much shorter than half the elytra; inter-ulner area about half as broad again as the discoidal area, rather densely areolated with areolates more than three deep, without a regular false vein. Hind femora narrow, more than four times as long their maximal width; upper margin of these more or less distinctly serrated. Upper carina of the externo-median area straight.

Male : Supra-anal plate triangular, its surface practically flat. Cerci short, conical, apex obtuse subgenetal plate with apex obtusely conical. Pennis very large, strongly recurved apically. Epiphallus with comparatively large anchorae and with large bilobate lophi with strongly separated lobes.

Female : Subgenetal plate with lateral margins straight, apex truncated; lower valve of ovipositor with basal part distinctly longer broad, with an obtuse lateral both in the apical part.

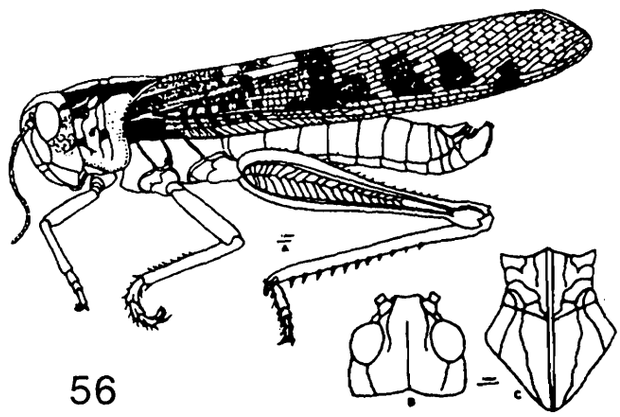
Systematic account : Kirby catalogue pp. iii, pt. 229, 230.

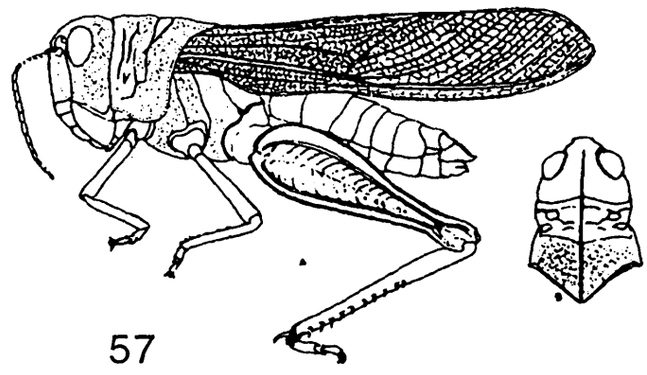
Locusta migratoria Linnaeus
(Figs. 56, 57)

1914. *Locusta migratorioides* : Kirby, *Faun. Brit. India Orth., (Acrididae)* : 146.

1921. *Locusta* Uvarov, *Bull. ent. Res., Lond.*, **12** (2) : 135, 163.

1951. *Locusta migratoria migratoroides* : Uvarov, *Bull. off nat. anti Acrid. Paris* no. **1** : 1-4.





Figs. 56. showing general morphology of *Locusta migratoria* (male), A. Entire specimen, B. Head (dorsal), C. Pronotum (dorsal), **57.** Showing general morphology of *Locusta migratoria* (female), A. Entire specimen, B. Head and Pronotum (dorsal)

Large, integument smooth; vertex convex, with a median longitudial keel gradually narrowing and obtuse, apex truncated and slightly concave. Pronotum only feebly compressed laterally but distinctly constricted before the middle; median keel low, neither tectiform, nor convex in profile. Fore margin not prominent, hind angle not acute. Hind femora shorter than half the elytra. Hind tibiae exceptionally red. Pronotum with median carina straight in profile. Hind margin rotandato-angulate. Supra-anal plate triangular, its surface flat, cerci conical.

Male : Epiphallus-bridge undivided, anchorae upper portion rounded, lower portion conical and pointed, bent nearly inwards. Anterior process more or less rounded and directed laterally. Posterior process long, bifurcated anteriorly, lophi bilobed anteriorly, lophi bilobed. Sclerites are almost round (fig. 56).

Female : Subgenetal plate with lateral margins straight. Lower valve of ovipositor long with basal part distinctly longer than towards with an obtuse lateral tooth in the apical part (fig. 57).

Morphometry

Male (mm) : Length of body 30; length of antenna 12; length of head 5; length of pronotum 8; length of elytra 34; length of hind femur 18; length of hind tibia 16.

Female (mm) : Length of body 44; length of antenna 15; length of head 6; length of pronotum 11; length of elytra 48; length of hind femur 25; length of hind tibia 23.

Material examined : 1♂, Calcutta 1.iii. 1950, Coll. A. Guha, Reg. No. 1327/H5; 1♀, Calcutta, 1.iii. 1950, Coll. A. Guha, Reg. No. 1326/H5.

Distribution : *Locusta migratoria* (Linnaeus) has a greater world wide distribution than of any other acridoid. It is represented by nine sub-species of which *Locusta migratoria migratorioides* is found in SOUTH ASIA, SOUTH IRAC SOUTH IRAN, AFGANISTHAN, INDIA, PAKISTHAN, SRI LANKA, BANGALADESH, AND (LOWER) MYANMAR. The locust found in India resembles *Locusta migratoria migratorioides* in general ecology and the solitary phase is found almost all over India. But still its sub-species status is uncertain.

Remarks : The following characters are very important for the above specimen.

1. Convex vertex with a median longitudinal keel, fastigium separted from the frontal ridge by a regular transverse keel.
2. Shorter and broader in metazona of the pronotum with a distinct constriction in the middle. Fore margin rounded, median keel low, may be straight or concave.

3. Elytra relatively longer, slight yellow tinting of the wings, the smoky apperence of the ends of the branches of the radial sector and the blacked veins are distinctive.
4. Hind femora relatively shorter.
5. Appears in small swarms and causing damage of rice, corn etc.
6. It occurs in two forms–form solitaria and form gregaria, both are sharply different and solitary phase is found all over India.

Subfamily HEMIACRIDINAE

Key to genera

1. Prosternal process spatulate, fastigium of vertex not much produced before eyes, parabolic or obtuse angular, well developed tricarinated pronotum .... *Spathosternum* Krauss

– Prosternal projecting far in front of eyes, interocular distance narrow, pronotum not exactly tricarinated, madian carina obsolate, lateral carinae represented in metazona only, posterior tibiae dorsoverntrally flattened on apical half for swimming .... *Gesonula* Uvarov

2. Male supra-anal plate narrower than long, male cercus bifurcated, all sulci of pronotum black ..... *Hieroglyphus* Krauss

Genus ***Spathosterum*** Krauss 1877

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

Type species : *Tristria nigrotaeniata* Stål 1876.

Multisegmented, filiform, antennae, shorter than combined length of head and pronotum together with small size body. Integument finely rugose, nearly smooth. Head conical. Fastigium of vertex parabolic or obtuse angular, frons strongly oblique. Pronotum flattened crossed by 3 sulci, linear median and lateral carinae present, metazona shorter than prozona and its posterior margin excurved. Prosternal process large, spatulate, antero-posteriorly strongly compressed which is inclined backwards. Mesosternal interspace strongly constricted. Elytra and wings fully developed or shortened, the former is narrow, apex rounded. Close transverse parallel sided veinlets present between radial and medial area. Posterior tibia with an external apical spine.

Male : Supra-anal plate elongate, triangular, apex obtuse, disc with median basal impressions and in the middle with transverse simple cercus, conical. Sometimes slightly incurved, cercus not reaching beyond the supra-anal plate. Subgenetal plate short, sub-conical, with obtuse apex. Epihallus with undivided bridge, short anchorae and lobiform lophi. Subgenetal plate short, curved, apex obtuse.

Female : Ovipositor short moderately robust, with curved valves. Supra-anal plate long triangular, apex obtuse with a median sulcus from base to nearly the top. Cercus conical, apex subacute not reaching beyond the supra-anal plate. Valves of ovipositor of the usual type, straight, apex of lower and upper valve hooked, margins smooth or subserrate. Subgenetal plate longer than broad, hind margin with a small, median triangular projection.

Male : Subgenetal plate short, subconical, elongated, apex obtuse or pointed. Supraanal plate triangular, hexagonal with a basal median sulcus, margins straight or slightly rounded. Cercus are of various forms. Epiphallus wide, bridged undivided with large, curved anchorae, moderately small, lobiform lophi.

Female : Supra-anal plate triangular, apex more or less smooth or obtuse, Valve of ovipositor short, moderately curved at apices. Longer as longer broad, posterior margin slightly expanded with a triangular median projection.

Spathostrenum prasiniferum prasiniferum (Walker)

(Figs. 58, 59)

1914. *Spathosternum prasiniferum* Kirby : 208.

1929. *Spathosternum abbreviation* Uvarov, : 556.

1929. *Spathosternum medium* Uvarov : 558.

1936. *Spathosternum prasiniferum prasiniferum* (Walker 1871) *Tinkhanm* : 51.

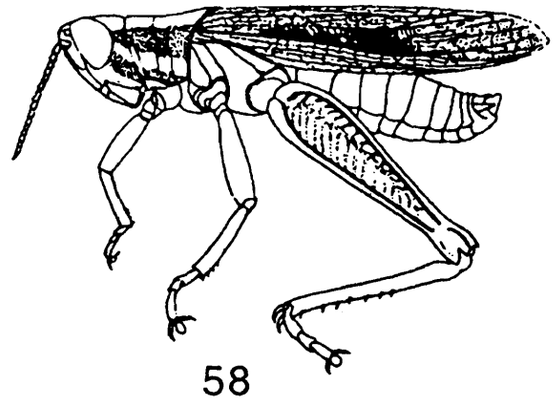


Fig. 58. Showing general morphology of *Spathosternum prasiniferum prasiniferum* (male).

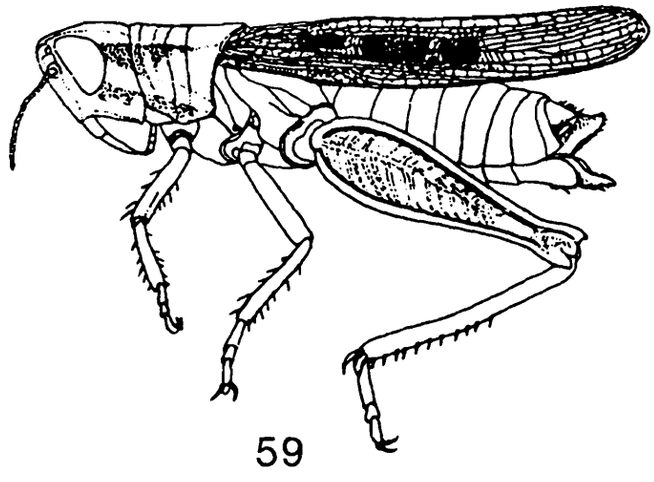


Fig. 59. Showing general morphology of *Spathosternum prasiniferum prasiniferum* (female).

Small, green, integument finely rugose almost smooth. Head conical, fastigium of vertex obtusely angular or parabolic. filiform antennae, frontal ridge narrow and sulcated. Two broad blackish band or dark greenish band running behind the lower part of the eyes and below the lateral carine of the pronotum which is banded above by a narrow pale yellow line and lateral carinae present. Prosternal process large, strongly antero-posteriorly compressed, spatulate, inclined backwards. Mesosternal interspce strongly constricted. Elytra and wing fully developed or shortened. Tegmina is light brown towards the base and subhyaline beyond, central area with a longitudinal black streak, generally almost obsolete in the male and well marked in female. Wings hyaline, hind femur slender, aroleum large. Male supra-anal plate elongate angular, abdominal appendage of female is unusually short.

Male : Supra-anal plate elongated, triangular, apex obtuse, disc with median basal impression and in the middle with a transverse impression. Cercus simple, conical sometimes slightly incurved not reaching beyond the supra-and plate. Subgenetal plate short, sub-conical with obtuse apex. Epiphallus with undivided bridge, short anchorae and lobiform lophi. Subgenetal plate short, curved, apex obtuse (fig. 58).

Female : Ovipositor short, moderately robust with curved valves. Supra-anal plate long triangular, apex obtuse with a median sulcus from base to nearly the top. Cercus conical, apex subacute not reaching beyond the supra-anal plate. Valves of the ovipositor of the usual type, straight, apex of lower and upper valve hooked, margins smooth or subserate. Subgenetal plate longer than broad, hind margin with a small, median triangular projection (fig. 59).

Morphometry

Male (mm) : Length of body 14.4; length of antenna 3.9; length of pronotum 3.4; length of tegmen 11.4; length of hind femur 8.6; length of hind tibia 6.8.

Female (mm) : Length of body 17.9; length of antenna 4.8; length of pronotum 4.4; length of tegmen 14.4; length of hind femur 10.8; length of hind tibia 8.8.

Material examined : 6♂♂, 4♀♀, Calcutta, 3.ix. 57, Coll. A.P. Kapur; 1♂, Calcutta, 24.xi. 65, Coll. S. Ali; 7♂♂, 12♀♀, Calcutta, 11.x. 66, Coll. M.S. Shishodia, 400♂♂, 652♀♀, Botanical Garden, 14.vi. 79 to 26.iv. 83, Coll. A.K. Harzra and staff; 1♂, Bandel, 26. x. 64, Coll. A.N.T. Josseph and party, 1♂, Dum Dum, 2.xi. 65, Coll. P. Parui; 4♂♂, 5♀♀, Narendrapur, April 1979, Coll. M.S. Shishodia,

28 ♂♂, 19♀♀, 27.xi. 75 to 17.xi. 77, Garia, Coll. S.K. Mandal.

Distribution : INDIA (West Bengal, Andhra Pradesh, Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharastra, Orissa, Rajasthan, Tamil Nadu); MYANMAR; S.E; CHINA; THAILAND AND VIETNAM.

Remarks : This species is easily identified by the following characters : (1) Tegmina with a patch of densely placed transverse nervures at the parting of the radial veins (2) postocular band well marked.

Genus ***Gesonula*** Uvarov, 1904

1878. *Gesonia* Stål, *Bih. Svensk. vet. Akad. Handl. Stockholm*, **5**(4) : 1-100.

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

Type Species : Acridium (oxya) punctifrons Stål, 1861.

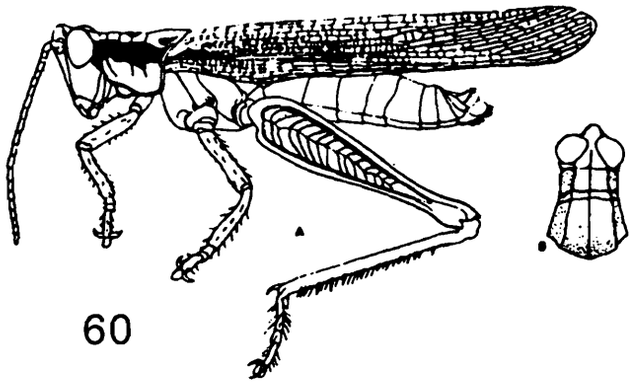
Size small, rugosity in the integument, multisegmented and filiform antennae, apical region thickened, longer than head and pronotum taken together. Head conical. Fastigium large, longer moderately sloping and extends beyonds the eyes. Frontal ridge not projecting between the antennae, depression also present, acutely pointed at apex or slightly obtuse and rounded. Sulcation on frontal ridge, slight constriction at apex. Eye large and prominent, laterally placed. A black stripe persent on both sides from the base of the eye upto the end to tegmen. Median carina not prominent. Pronotum cylindrical, slightly widened posteriorly, not distinct. Three sulci present on dorsum of pronotum. Prozona larger than metazona. Posterior margin of pronotum more or less rounded. First transverse and present both on disc and lobes. Prosternal tubercle conical and curved backwards. Tegmen and wing fully developed. Transverse veinlets present between radial and medial area of tegmen. Posterior femur yellowish brown, longer, lower lobe with an acute sharp spine of posterior tibia with an external spine. Inner margin of hind tibia with a row of about eight spines. Distance between pre-apical and apical spine being about two or three times the distance of the basal ones. Apical portion flattened for swimming.

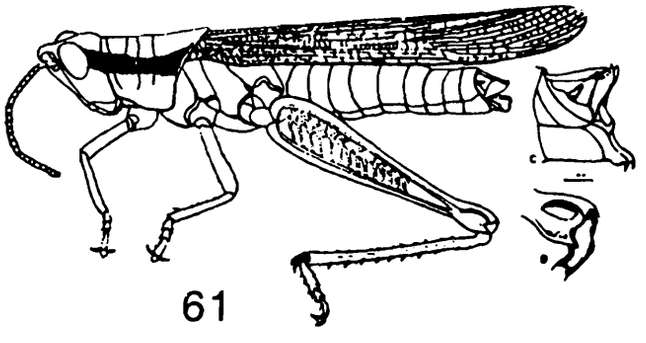
Male : Tongue shaped supra-anal plate with a median longitudinal groove throughtout. Cerci simple, as long as subgenetal plate.

Female : Larger than male, cerci shorter than the male, supra-anal plate with lesser sulcation, valves of hook like. Ovipositor short with margins apically dentated.

Gesonula punctifrons (Stål)

(Figs. 60, 61)





Figs. 60. showing general morphology of *Gesonula punctifrons* (male), A. Entire specimen, B. Head and pronotum (dorsal), **61.** Showing general morphology of *Gesonula punctifrons* (female), A. Entire specimen, B. Joint of femur and tibia, C. Tip of abdomen (lateral)

1861. *Acridium (Oxya) punctifrons* Stål, *Enginies Resa. Orth.*, p. 336.

1870. *Heteracirs tenuis, oxya punctifrons* Walker, *Cat. Derm. Salt. B. M.* **4** pp. 647, 668.

1873. *Oxya punctifrons* Stål. *Rec. Orth.* **1** p. 81.

1878. *Gesonia punctifrons* Stål. *Bih. Svennk. Akad. Handl., Stockholm.* **5** (4) : p. 47.

1952. *Gesonula punctifrons* Mistschenko, *Fauna U. S. S. R.*, **4** (2), p. 172.

1952. *Gesonula punctifrons* Rehn, *Trans. Amer. Entom. Soc.*, **78**, pp. 123, 124, pl. V, figs, 1,2 pl. VI, fig. 16.

Body slender ; size medium. antennae filiform, reaching behind the hind margin of the pronotum; fastigium of vertex moderately sloping forming with th frontal ridge a distinct, acute angle; its surface concave, apex rounded triangular, margins obtuse. Occiput convex. Pronotum slightly widened posterior and it is cylindrical, absence of lateral keels; lateral lobe of pronotum longer than high; anterior angle obtuse, posterior angle rounded; Matasternal lobe sub-contiguous. Elytra and wing well developed, reaching beyound the apex of the hind femora; wing hyalinous or slughtly infumated, keel of hind femora smooth; hind tibiae strongly expanded in the posterior half with the margins sharp; there are 7 spines on the outer margin, 8 on the inner margin, sternum and abdomen yellowish brown; teeth of ovipositor brownish black.

Male : Cerci simple, spine like and incurved, supra-anal plate triangular, oval, the groove of which tubular in shape, large anterior process diverged, tip more or less rounded. Posterior process with a notch like structure, below of which bilobed structure below of which bilobed structure present. The upper lobe connected with a membrane (fig. 60).

Female : Ovipositor broad, robust, large. Upper one is moderately enlarged, tip end with a large upcurved spine. But the lower valve which is narrower less widened. Tip of the valve with a large spine which is directed downwards. Rest spines in the both valves uniform (Fig. 61).

Morphometry

Male (mm.) : Length of body 18.2; length of antenna 9.4; length of pronotum 3.9; length of tegmen 17.8; length of hind femur 11; length of hind tibia 9.

Female (mm.) : Length of body 23.4; length of pronotum 6.2; length of tegmen 20.5; length of hind femur 13.4; length of hind tibia 10.2.

Material examination : 17♂♂, 22♀♀ Botanical Garden, 23.v. 79 to 83, Coll. A.K. Hazra and party; 1♂, 2♀♀ Narenderapur, May, 1979, Coll. M.S. Shishodia; 5♂♂, 1♀ Garia, 13.x. 76, Coll. S.K. Mandal.

Distribution : INDIA (West Bengal, Arunachal Pradesh, Assam, Goa, Kerala, Orissa, Tamil Nadu); MYANMAR; BORNEO; CHINA; HAINAN; JAPAN; JAVA; MALACCA; PHILIPPINES; SRI LANKA; TAIWAN; TONGKING AND THAILAND.

Remarks : Slender medium size; fastigium of vertex sloping forming an acute angle, two black lines passing from the lateral side of the eye to the anterior 1/3rd of the elytra.

Hieroglyphus Krauss 1877

1877. *Hieroglyphus* krauss, *Sber, Akad, Wiss, Wine.* **76** : 41.

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

1973. *Hieroglyphus* Mason, *Bull, Br. Mus. nat. Hist. (Ent.).* **28** (7) : 512.

Type-species : *Hieroglyphus daganensis* Krauss 1877.

Medium to large size. Body finely dotted and shiny. Multi-segmented filifrom antennae longer than head and pronotum taken together. Integument coarsely or finely pitted. Head conical, slightly inflated. Fastigium of vertex rounded, trapezoidal with slight depression in front of a bow shaped transverse furrow, broader than long with an obtuse angular apex. Frontal ridge sulcate, straight lateral carinulae diverged downwards. Inter-ocular distance about three times as wide as antennal space. Pronotum cylindrical, median carina weak, lateral carinae absent. Three deep and wide sulci crossing dorsum and median carina. Metazona less than half length of prozona, posterior margin widely excurved. Prosternal

process long, acutely conical or bifurcated. Mesosternal interspace elongate and strongly constricted. Elytra and wing well developed or shortened. Radial area of tegmen with several regular, thickend, transverse, stridulatory veinlets. Precostal area of elytron strongly serrated; membrane transparent, reticulation spares. Tubercles present on anterior margin of tegmen in the precostal and subcostal area, the function of which is not known. Hind femur slender to robust. External apical spine of hind tibia present. Anterior and middle femore thickened. Arolium very large.

Male : Supra-anal plate elongate angular with attenuate acute angular or trilobate apex. Apical and basal valve of pennis divided or with tendency to form a very thin connection between the valves. Basal valve of pennis moderaterly robust to robust. Ectophallic membrane with ventral sclerotization. Cercus with apical incurved tooth or with subacute, slightly curved apex. Subgenetal plate acutely conical with subacute apex, or elongate conical, from above depressed and with bilobate apex. Epiphallus large, bridge shaped, not divided, with small to moderately large anchorae and small or large lophi.

Female : Ovipositor slender to moderately rubust with curved valves. Lower valve of ovipositor with a pair of strong or weak teeth. Female subgenetal plate with median lobe only or trilobate with median lobe longer than the lateral lobe.

Hieroglyphus banian (Faricius)

(Figs. 62,63)

1798. *Gryllus banian* Fabricius, *Emtom. Ststem.*, *Suppl.*, p. 194.

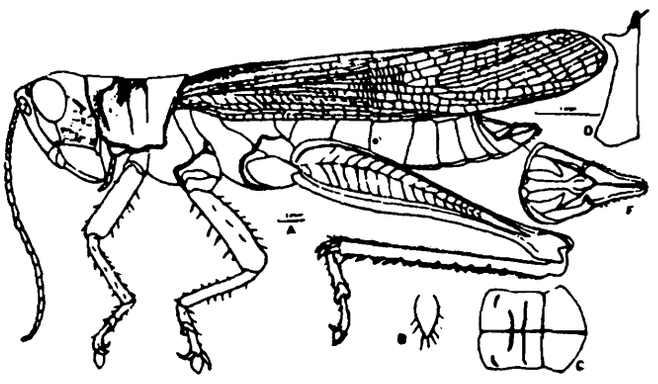
1877. *Hieroglyphus furcifer* Krauss, *Sitz. Ber. Akad. Wiss. Wien.* 76. p. 43.

1909. *Hieroglyphus banian* Maxwell Lefroy, *Ind. Ins. Life* : p. 87.

1927. *Hieroglyphus banian* var. elongata Uvarov, *Rec. Ind. Mus.* **29** : p. 237.

1940. *Hieroglyphus banian* Tinkham, *Ibid.*, **19** : pp. 299, 300.

1973. *Hieroglyphus banian* var. elongata (Uvarov, 1922), Mason 1973, *Bull. Br. Mus. nat. Hist. (Ent.)* **28** (1) : 541.



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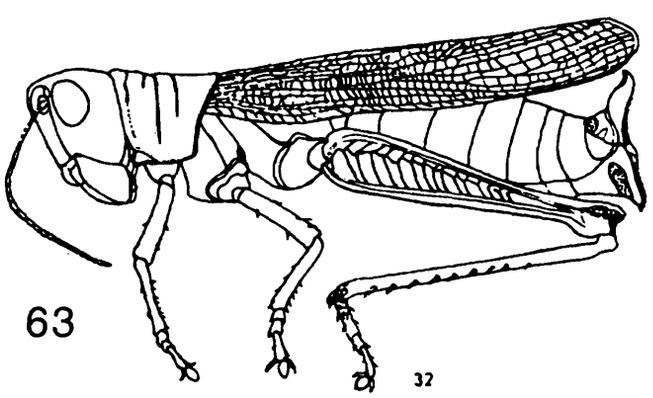

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Figs. 62. Showing general morphology of *Hieroglyphus banian* (male), A. Entire specimen, B. Prosternal tubercle, C. Pronotum (dorsal), D. Cercusl E. Tip of abdomen (dorsal). **63.** Showing general morphology of *Hieroglyphus banian* (female)

Medium size : Fastigium of vertex as broad as long; occiputal carinula weak; prozona of pronotum longer than metazona; median carina weak but present along whole length of dorsum; prosternal process conical; mesosternal interspace open; tympanal otrgan with subtympanal ridge, tegmen and wings reaching upto the end of the abdomen; Hind femur moderately slender, reaching upto the end of abdomen; Hind tibia shorter than femur; supra-anal plate longer than wide in apical part with two ridge like elevation; cercus slender; sub-genetal plete in profile elongate, narrow of the apex.

Male : Smaller : Fastigium of vertex as broad as long; an elongate depression in the middle, frontal ridge with deeply sulcus in the middle; prozona greater than metazona, median carina not so prominent. Whole prozona covered by three sulci the first one prosent laterally. Second one situated in the middle and third sulci is semiparabolic type but it does not touch the lateral magin of prozona; Supra-anal plate longer, conical with two more or less zig-zag type of elevation-its apical part wide, basal part narrow-its median part absence of any elevation. Cercus bifurcate-upper one blunt and curved and lower one pointed with black tip. Epiphallus large, lateral plate of epiphallus fused in the bridge shaped anchorae pointed and curved; anterior process short and oval shaped, posterior process widened, lophi large, lateral process with constriction in the middle. Phallic complex-Zygoma broad, gradually narrow in the middle; apodems not pointed i.e. more or less round, basal vale of penis gradually widened in the above and forms a constriction a notch like structure at the tip (fig. 62).

Female : Larger, differs in fastigum of vertex being broader than long; subgenetal plate simple, oval rounded with one pointed median lobe; lower vale of ovipositor narrow, elongated with two well defined teeth on each side. Spermatheca large, apical diverticulum moderately narrow, elongate curving backwards basally and apically; perapical diverticulum double the size of apical diversiculum also elongate, apical diverticulum short bent backwards. Other characters are same as male (fig. 63).

Morphometry

Male (mm.) : Length of body 36.6; length of antenna 18.5; length of pronotum 6.8; length of tegmen 25.4; length of hind femur 19; length of hind tibia 16.4.

Female (mm.) : Length of body 48.8; length of antenna 15.8; length of pronotum 9.1; length of tegmen 32.9; length of hind femur 24.2; length of hind tibia 21.6.

Material examined : 1♂, Narendrapur, Oct. 1974, coll. M.S. Shishodia; 2♂♂, (nymphs) Garia, 2.viii. 76, Coll. S.K. Mandal; 10 nymphs, Garia, 26. viii. 76, Coll. S.K. Mandal.

Distribution : INDIA (West Bengal, Andhra Pradesh, Sikkim, Himachal Pradesh, Bihar, Orissa, Rajasthan, Maharastra, Tamil Nadu), MYANMAR; BANGLADESH; BHUTAN; CHINA; NEPAL; THAILAND and VIETNAM.

Remarks : Male cercus 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.

Subfamily OXYINAE

Genus ***Oxya*** Serville 1831

Key to Species

1. ♂ Supra anal plate with a tubercle on each side of median apical process 2

   ♂ Supra anal plate without laterat tubercle 3

2. ♂ Cercus laterally compressed, apex bifurcated .....*fuscovittata* (Marschall)

   Cercus conical which may be truncated or compressed .....*hyla hyla* Serville

3. Cercus with subacute apex, supra-amal plate without any fold on lateral apical margin ... .*velox* (Fabricius)

   Cercus conical, supra-anal plate rounded, triangular, cercus with truncated apex, outer lophi relatively straight, inner lophi slender ..... *nitidula* (Walker)

Genus ***Oxya*** Serville 1831

1831. *Oxya* Serville, *Annals, Sci. nat.*, **22** : 286.

1871. *Oxya* Hollis, *Bull. Br. Mus. nat. Hist. (Ent.)* **26(7)** : 272-274.

Type-species : *Oxya hyla* serville 1831.

Body size medium. Integument shiny and rugose. Fastigium short with widely rounded

apex without median longitudinal carinula. Filiform antenna which is longer than head and pronotum together and in some cases shorter than combined length of head and in some cases shorter than combined length of head and pronotum together. Frontal ridge sulcated. Facial carinae distinct. Eyes large and ellyptical. Pronotum subcylindrical of which median carina is very weakly developed. Lateral carinae absent. Dorsum crossed by three fine sulci. Metazona shorter than prozona. Prosternal spine conical with rounded or subacute apex. Metasternal interspace much narrower than long. Tegmen fully developed or shortened but most of the species touching the mid dorsal line. In female anterior margin densely, weakly or not all spined. Wings usually with dense hairs. Hind femur slender, upper knee lobe rounded, lower lobe with acute spine like projection. Hind tibia expanded on apical two-thirds. External apical spine present. Male supra-anal plate rounded and triangular with rounded or angular apex or slightly trilobate. Cerci conical or compressed with rounded, acute, truncate or bifurcate apex. Subgenetal plate short, conical, with obtuse or weakly truncated apex. Epiphallus usually with narrow divided bridge of anchorae absent, (but may be present in some species) with 2 pair lophi present. Cingulum horse shoe shaped and a large posterior process. Female subgenetal plate with apical and subapical tooth or tuberculae, ventral surface with longitudinal ridge, valve of ovipositor with hook like marginal spines, inner ventral margin of posterior ventral basi valvular sclerite with either one or two large 14 tooth like spiny or a row of small spinelets or may be completely unarmed.

Oxya hyla hyla Serville

(Figs. 64, 65)

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

1870. *Heteracris viridivitta* Walker, 1870 Caltalogue of the specimens of Darmaptera Saltatora in the collection of the British Museum, p. 662.

1925. *Oxya viridivitta* (Walker), Willemse, *Tidjschr. Ent.* **68** : 38.

1956. *Oxya hyla* Audinet-Serville : Johnston, *Annotated catalogue* of African Grasshoppers : 252.

1958. *Oxya viridivtta* (Walker) : Chopard, *Mem. Inst. Fr. Afr. noire.* **53** : 128.

1962. *Oxya humeralis* (Walker) Dirsh, *Bull. Br. Mus. nat. Hist. (Ent.).* **12** : 309.

1971. *Oxya hyla hyla* Serville; Hollis, *Bull. Br. Mus. Nat. Hist. Ent.* Vol. **26** : 282.

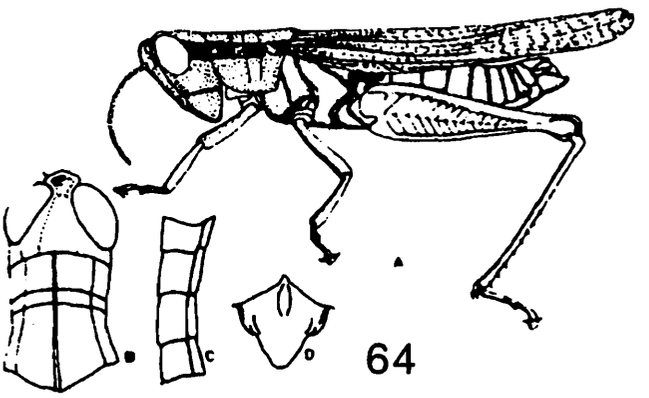

Fig. 64. Showing general morphology of *Oxya hyla hyla* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Pleural margin of the tergite, D. Supraanal plate (dorsal view).

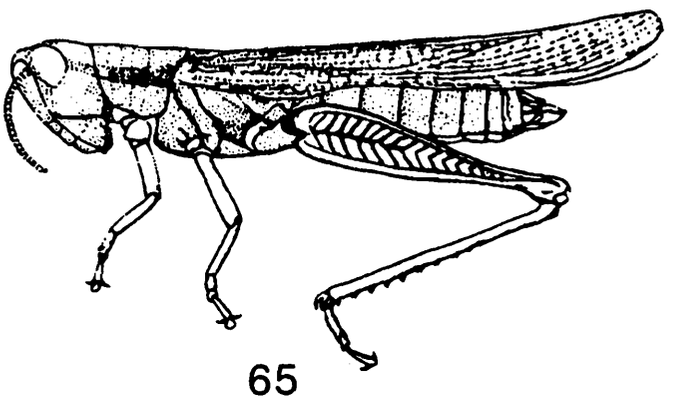

Fig. 65. Showing general morphology of *Oxya hyla hyla* (female).

Male : Antenna slightly longer than head and pronotum together. Interocular distance slightly narrower than frontal ridge of median ocellus. Supra-anal plate trapezoidal with triangular apical projection. At base of this projection, there is a small tubercle. Cerci conical and compressed laterally with acute or subacute apex. Epiphallus-bridge narrow, anchorae absent. Outer lophi hook like and inner lophi tooth like. Cingulum-zygoma flat and broad, apodemis broader at the base, narrower at apex,

basal valve of penis broader at apex narrower at base-sickle shaped without serration (fig. 64).

Female : Larger and robust than male. Antenna slightly shorter than combined length of head and pronotum. Interocular distance slightly wider than frontal ridge at median ocellus valve of ovipositor with hook like marginal spines. Inner ventral margin of posterior ventral basivalvular sclerite with very small spinelets. Vental surface of subgenetal plate with two longitudinal ridges are extending forwards from posterior margin, these ridges are often toothed. Subgenetal plate with a pair of median spines on posterior margin (fig. 65).

Medium size : Integument pitted and shiny; antenna slightly longer than head and pronotum together; fastigium of vertex with widely rounded or obtuse apex; eye large ellypsoid; pronotum subcylinderical, metazona shorter than prozona; prosternal process conical with rounded or subacute apex tegmina fully developed or shortened, hind femur slender, upper knee lobes rounded, knee lobes extended into acute spine like projections; hind tibia expanded in apical two-thirds with upper outer margin acute; external apical spine present; first segment of tarsus dorsoventrally compressed: Abdomen with distal segments having dense clusters of hairs ventrally.

Morphometry

Male (mm) : Length of body 25.2; length of antenna 10.8; lenght of tegmen 19.4; length of hind femur 14.7; length of hind tibia 11.2.

Female (mm) : Length of body 30; length of antenna 11.2; length of pronotum 7.1; length of tegmen 27; length of hind femur 17.6; length of hind tibia 14.8.

Male : Supra-anal plate trapezoidal with triangular, apical projection. At base on both sides of dorsum, there is small tubercle cingular valves fused dorso-medially to form a plate.

Female : Subgenetal plate with a pair of median spines on posterior margin, ventral surface with median longitudinal concavity which is broadered on each side by a long ridge bearing short spines ovipositor valves long and slender with spined or two third external edges; spermatheca with long sinous preapical and short sac like apical diverticulum.

Material examined : 5♀♀ Calcutta, 18.x. 52, Coll. S. Ali; 1♀, Uttarpara, 14.ix. 57, Coll. T.G. Vazirani; 1♀, Canning, 18.vi. 65, Coll. G.S. Arora; 4♂♂, 1♀, Calcutta, iv. 61-10.xi. 61, Coll. S. Ali and K. R. Rao; 45 ♂♂, 62♀♀, Botanical Garden, 23.v. 79-26.iv. 83, Coll. A.K. Hazra and party; 2♂♂, Kharibaria, 9.xi. 62, Coll. P.Singh; 1♂, Barrackpur, 14.xi. 61, Coll. K.V. Lakshminarayana and K.D. Chatterjee; 7♂♂, 2♀♀, Narendrapur, April 1979, Coll. M. S. Shishodia; 1♂, Titagarh, 23. xii. 61, Coll. K.D. Chatterjee; 1♂, Calcutta, 16.x. 61, Survey party; 1♂, Chaprasibad 24.xi. 62, Coll. S.K. Ghosh; 2♂♂, Tribeny, 12.1. 65, Coll. M.M. Ghosh, and S.P. Chakravorty; 10 ♂♂, 12♀♀, Garia, 13.xi. 76 to 7.viii. 77, Coll, S.K. Mandal; 7♂♂, 2♀♀, Narendrapur, April, 1979, Coll, M.S. Shishodia.

Distribution : INDIA (West Bengal, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh) : SRI LANKA; WEST PAKISTAN; AFGANISTHN, MALDIVE, EAST PAKISTAN; PERSIA; MADAGASCAR; ANGOLA; MALAYI; TANZANIA; UGANDA; KENYA; KORYA; ETHIOPIA; PRINCIPE; MALI; SENEGAL; SIERRA LEONE; GHANA; IVORY COAST; NIGERIA; GUINEA and SIBERIA.

Remarks : Inner tooth like pair of lophi of epiphallus usually well developed. Ventral surface of subgenetal plate with two longitudinal ridges extending forwards from posterior margin, these ridges often toothed-Africa, Madagascar and oriental region, West of Indo-Burmese border.

Oxya fuscovittata (Marschall)

(Figs. 66, 67)

1836. *Gryllus fuscovittatus* Marschall *Ann. Wien. Mus. Vienna* 1, 211.

1918. *Oxya turanica* Uvarov Trab. *Mus. nac. cienc. nat. Madr. Zool.* **34** : 28

1925. *Oxya orizivora* Willemse, *Tidjachar. Ent.* **68** : 25.

1925. *Oxya uvarovi* Willmese, *Tidjachar. Ent.* **68** : 27.

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

1952. *Oxya fuscovittata* (Marschall) Mishchenko, Fauna SSSR, Orthoptera IV, 2 Locusts and Grasshoppers, Catantopinae : 148.

1969. *Oxya fuscovittata* (Marschall) : Tandon and Shishodia, *Orient. Insects* **3** : 265.

1971. *Oxya fuscovittata* : Hollis, *Bull Br. Mus. nat, Hist. (Ent.)* **26** (7), 289.

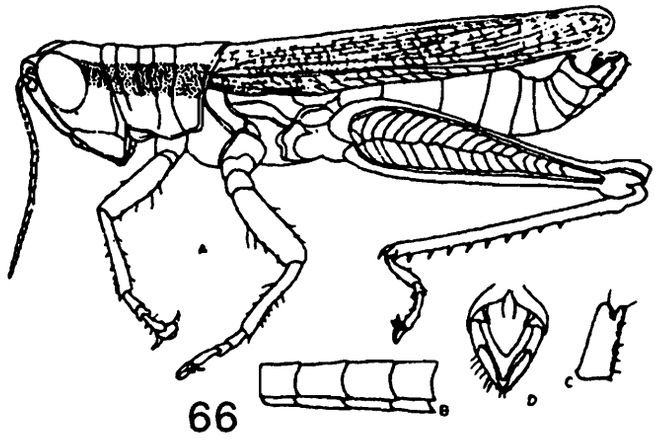

Fig. 66. Showing general morphology of *Oxya fuscovittate* (male), A. Entire specimen, B. Pleural margin of the tergite, C. Cercus, D. Tip of abdomen (dorsal).

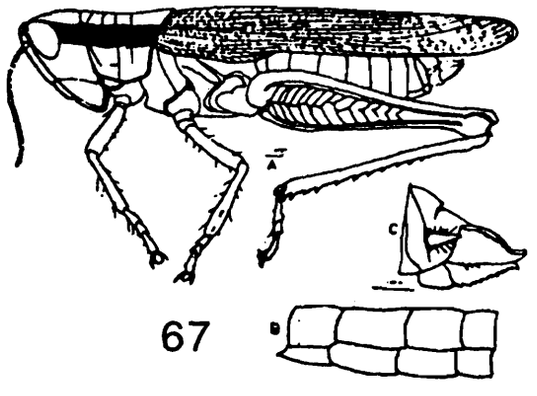

Fig. 67. Showing general morphology of *Oxya fuscovittata* (female), A. Entire specimen, B. Pleural margin of the tergite, C. Tip of abdomen (dorsal).

Male : Integument shiny, greenish or yellowish green; antenna 26-28 segments and it is equal or slightly longer than total length of head and pronotum; interocular distance slightly narrower than frontal ridge at median ocellus; tegmen fully developed, epiphallus with narrow bridge, without an anchorae and with tooth like lophi; valvular plate of cingulum with shallow structure; apical valve of penis is thickened (fig. 66).

Female : Larger and more robust than male. Antenna slightly shorter than combined lengths of head and pronotum; interocular distance slightly wider than frontal ridge;anterior margin of tegmen weakly spined; valve of the ovipositor with tooth like marginal spines; subgenetal plate very broadly flattened on ventral surface; post margin emarginates marginally straight (fig. 67).

Male : Shorter, antenna longer than combined length of head and pronotum. Interocular distance narrower than frontal ridge at median ocellus. Pronotum with dorsum flattened, parallel sided supra-anal plate triangular, trapezoid, lateral tubercles prominent, posterior lobe slightly less developed, cercus broad, strongly compressed, apex bifid, epiphallus with narow bridge, without anchorae, outer lophi boot shaped bent and curved of which left lophus is always less developed than the right and inner lophi tooth like valvular plate or cingulum with curved end, apodemis long with rounded end.

Female : larger and robust than male. Interocular distance slightly wider than frontal ridge at median ocellus. Valve of ovipositor with tooth like marginal spines, sparmatheca short-apical diverticulum short and preapical diverticulum is double the size of apical diverticulum and forms an inverted 'L' shaped loop. Subgenetal plate with very broadly flattened ventral surface. Posterior margin emerginates medially straight or with two very small medial spines.

Morphometry

Male (mm) : Length of body 18.3; length of antenna 7.5; length of pronotum 4.2; length of tegmen 13.4; length of hind femur 11.4; length of hind tibia 9.1.

Female (mm) : Length of body 23.7; length of antenna 8.0; length of pronotum 5.6; length of tegmen 18.2; length of hind femur 14.6; length of hind tibia 11.8.

Material examined : 1♂, Santoshpur, 18.x. 67, Coll. S. Ali; 2♀♀ Calcutta environs, 21.xi. 62, Coll. K.R. Rao and party; 1♂, 1♀, Botanical Garden, 11.x. 66, Coll. M.S. Shishodia and party; 1♂, 4♀♀ Ichapur, 10.xi. 61, Coll. K.R. Rao and S. Ali, 301♂♂, 367♀♀ Botanical Garden, 23.v. 79 to 26.iv. 83, Coll. A.K. Hazra and party; 4♀♀ Eden Garden, 29.ii. 60, 31.x. 58, 6.xii. 58, 13.xi. 59, Coll. A.P. Kapur, 1♂, 2♀♀, Eden Garden, 23.x. 59, Coll. H.N. Singh; 2♂♂, Horticulture Garden, 14.xi. 65, Coll. J.C. Bhattacharya and S.K. Mitra; 2♂♂, 6♀♀ Narendrapur, April, 1979, Coll. M.S. Shishodia & party; 22♂♂, 4♀♀ Garia, 26.viii. 76 to 23. iii. 77, Coll. S.K. Mandal; 2♂♂, Titagarh; 15.v. 62, Coll. S. Lal and S.N. Prasad; 1♂, Ichapur, 21.xi. 62, Coll. K.R. Rao and party, 5♂♂, Eden Garden, 20. viii. 50, 13.ix. 59, 13. viii. 57, 30.x. 50, Coll. A.P. Kapur; 2♂♂, Kharibaria, 9.xi. 62, Coll. Puran Singh; 1♀, Ichapur, 14.xi. 61, Coll. K.V. Lakshminarayana and K.D. Chatterjee; 1♀ Chandannagar, 28.ix. 65, Coll. K.S. Pradhan and party; 1♀ (nymph) Calcutta, 27.ii. 59, Coll. P.C. Dhar, 1♀, (nymph), Calcutta, 21.ix. 61, Coll. M.B. Kripalini.

Distribution : INDIA (West Bengal, Andhra Pradesh, Jammu and Kashmir, Madhya Pradesh, Orisa, Rajasthan, Uttar Pradesh): WEST PAKISTAN; AFGHANISTAN AND U.S.S.R. (SOUTH WEST).

Remarks : Cercus laterally compressed, apex narrow and it is bifurcated of the apex. Supra-anal plate with lateral tubercles, epiphallus with narrow bridge without anchorae ventral surface of subgenetal plate almost completely flat and it is widened posteriorly, without lateral longitudinal ridges anterior margin of tegmen with a few small bristles.

Oxya nitidula (Walker)

(Figs. 68, 69)

1870 *Acridium nitidulum* Walker, Catalogue of the specimen of Dermaptera Saltatoria in the collection of the British Museum, **4**, p. : 631.

1971 *Oxya nitidula* Hollis, *Bull. Br. Mus. nat. Hist. (Ent.)*, **26** (7) : 315.

Male : Integument is shiny; antenna is more or less equal to the combined tength of head and pronotum; segment 24-26; pronotum almost cylindrical, narrowing forwards; posterior margin of metazona rounded; tegmen fully developed; supraanal plate rounded and triangular with well developed basal fold; cercus conical with narrow bridge without ancorae, with relatively straight outer lophi and small slender inner lophi; posterior process of cingulum narrowly rounded triangular in dorsal view with strong median division posteriorly, valvular plate of cingulum long, broad, curved and bent inwards, rami broad and stout, apical valve of penis long, slender, upcurved (fig. 68).

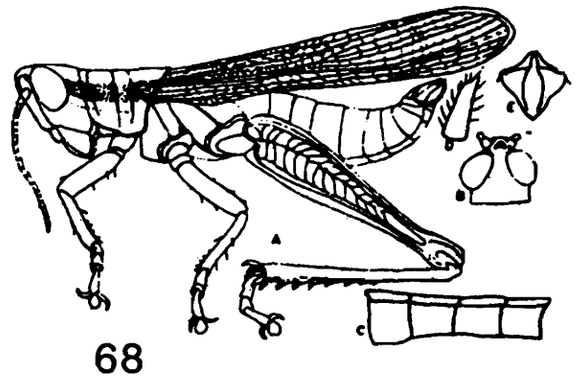

Fig. 68. Showing general morphology of *Oxya nitidula* (male). A. Entire specimen. B. Head (dorsal). C. Pleural margin of the tergite. D. Cercus. E. Supraanal plate (dorsal plate).

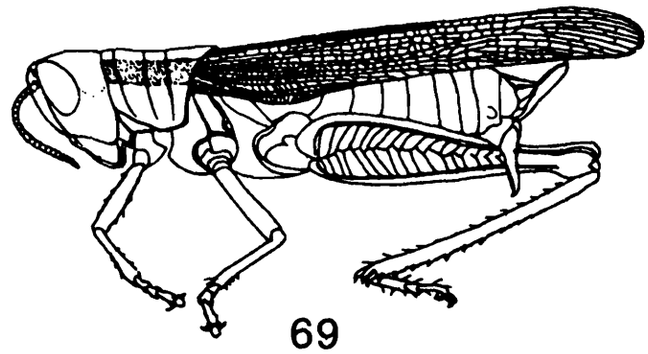

Fig. 69. Showing general morphology of *Oxya nitidula* (female).

Female : Larger than male, antenna slightly shorter than combined length of head and pronotum. Interocular distance slightly wider than frontal ridge at medium ocellus. Anterior

margin of tegmen is weakly spined; spermatheca short-apical diverticulum with a knob like structure on the slight coiled, preapical deverticulum larger than apical and bent downward, valve of ovipositor with tooth like spines; ventral surface of subgenetal plate with a pair of well developed submargin at lateral spines (fig. 69).

Morphometry

Male (mm) : Length of body 19.8; length of antenna 6.3; length of pronotum 5.0; length of tegmen 14.0; length of hind femur 11.1; length of hind tibia 9.3.

Female (mm) : Length of body 27.3; length of antenna 7.3; length of pronotum 7.3; length of tegmen 20.0; length of hind femur 15; length of hind tibia 13.0.

Material examined : 2♂♂, Calcutta, 27.iv. 77, Coll. S.K. Mandal; 12 ♂♂, 8♀♀ Garia from 18.viii. 76 to 23.iii. 77, Coll. S.K. Mandal.

Distribition : INDIA : (West Bengal, Andhra Pradesh, Orissa); SRI LANKA.

Remarks : Posterior process of cingulum when viewed from above broadly triangular, cercus conical with strongly truncated apex, ventral surface of subgenetal plate with a sub-apical tooth on each side of a median apical spine.

Oxya velox (Fabricius)

(Figs. 70. 71)

1787. *Oxya velox* Fabr. *Mantissa insectorum stens corum species nuper detectus adjectis characteribus genericis, differentis specificis, emendanomibus observationibus.* 2 vols. **1** : 239.

1870. *Heteracris opta* Walker, catalogue of the specimens of Dermaptera and Saliatoria in the collection of the British Museum, part IV and Acrididae, : 666.

1971. *Oxya velox* Hollis. *Bull. Br. Mus. Nat. Hist. (Ent.)* **26** (7) : 297.

Body more or less shiny; antenna as long as combined length of head and pronotum; Dorsum of pronotum slightly flattened and slightly narrowing forwards, posterior margin of metazona widely obtuse angular; tegmen fully developed. Pleural-margin of only the second tergite terminating into a long and distinct tooth. Supraanal plate with rounded triangular posterior projection; cercus conical, with sub-acute apex; epiphallus with narrow bridge without anchorae with hook like outer lophi and large tooth inner lophi; valvuar plate of cingulum very large, upcurved and rolled; tegmen fully developed; antenna shorter than combined length of head and pronotum; ventral subgenetal plate with its posterior half with a median longitudinal concavity bordered by lateral longitudinal ridge.

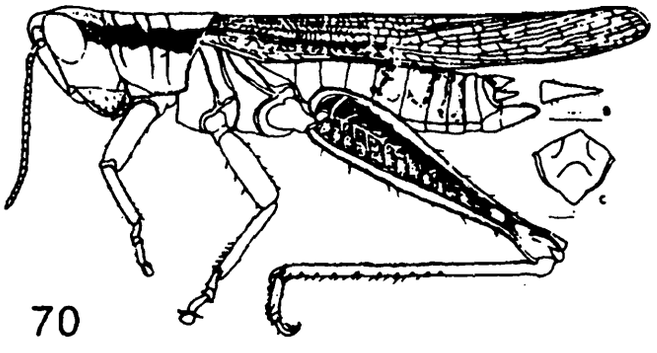

Fig. 70. Showing general morphology of *Oxya velox* (male), A. Entire specimen, B. Cercus, C. Supraanal plate (dorsal).

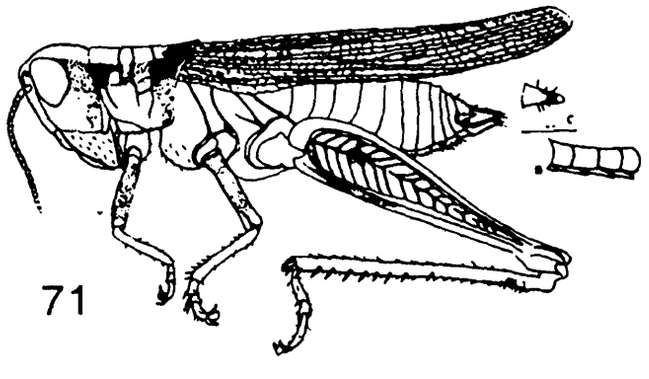

Fig. 71. Showing general morphology of *Oxya velox* (female). A. Entire specimen, B. Pleural margin of the tergite, C. Cercus.

Male : Size medium; antenna is as long as combined length of head and pronotum together. Interocular distance as wide as frontal ridge at

median sulcus, Posterior margin of metazona of pronotum is sharply pointed and angular. Supra-anal plate rounded, triangular posterior portion, cercus conical with subacute apex. Epiphallus with narrow bridge, without anchorae vulvular plate of cingulum large, upcurved, apex enlarged. Apodemis long, flat, curved at the anterior end, valvular plate of cingulum more or less bean shaped (fig. 70).

Female : Larger than male. Antenna shorter than combined length of head and pronotum. Interocular distance wider than frontal ridge at median ocellus. Spermatheca-medium size, apical diverticulum bent downwards and pre-apical narrow, more or less straight and coiled at the anterior end, valve of ovipositor with tooth like spiny structures, ventral surface of subgenetal plate in posterior half with median longitudinal concavity bordered on each side by lateral longitudinal ridge. Median pair is spiny on posterior margin, widely spread. Costal buldge of tegmen is poorly developed (fig. 71).

Morphometry

Male (mm) : Length of body 22.4; lenght of antenna 6.4; length of pronotum 6.1; length of tegmen 19.4; length of hind femur 14.4; length of hind tibia 13.2.

Female (mm) : Length of body 26.6; length of antenna 8.2; length of pronotum 6.4; length of tegmen 23.0; length of hind femur 17.6; length of hind tibia 14.2.

Material examined : 2♂♂, 1♀ Calcutta 1904, Coll. Runetti; 2♀♀, Calcutta, 5♂♂, 2♀♀ Calcutta, 6.x. 1904, Coll. Runetti; all specimens partially damaged in flood in 1943; 1♂, Calcutta, 4.xi, 1904, Runetty; 1♂, Bangaon, 19.i. 62, Coll. S. Majumder.

Distribution : INDIA (West Bengal, Himachal Pradesh, Jammu and Kashmir, Rajasthan); BANGLADESH; MYANMAR; CHINA; PAKISTAN AND THAILAND.

Remarks : This species is easily identified by the following reasons : 1) Costal bulge of tegmen poorly developed; 2) In the female, pleural margin of the second tergit produced in a distinct fairly long tooth, other tergits normal. Tergit in the male also normal; 3) Posterior margin of subgenetal plate of which median pair of spines which is wider apart; 4) Valvular plate of cingulum very long, upcurved with an expanded apex.

Subfamily COPTACRIDINAE

Key of genera

1. Frontal ridge narrowed at apex, distinctly widened between antennae and wider than vertex between eyes, median carina of pronotum low interrupted by 3 transverse sulci, no transverse carina between eyes ... . *Eucoptacra* Bolivar

   Frontal ridge narrowed almost to a point, median carina of pronotum well raised interrupted by posteior transverse sulcus only, a transverse carina between eyes .... *Epistaurus* Bolivar

Genus ***Eucoptacra*** Bolivar 1902

1902. *Eucoptacra* Bolivar, *Annls. Soc. ent. Fr.*, **70** : 623 625.

1912. *Coptacrodies* Bolivar, *Trab. Mus. nat. cienc. nat. Madr., Madrid* no **6** : 62.

Type species : *Acridium saturatum* Walker, 1870 : 628.

Frontal costa distinctly widened between the antennae where it is much broader than the introcular distance. Lateral lobe of pronotum higher as long. Prosternal spine cylindrical or somewhat conical, apex obtuse. Transverse veinlets in the apical part of elytron placed obliquely. Posterior margin of penultimate tergit in the male on both sides with an obtuse projection. Cercus in the male laterally, compresed, decurved, apex rounded.

Eucoptacra saturata (Walker)

(Figs. 72, 73)

1870. *Acridium saturatum* Walker, *Cat. Derm. Salt. Br. Mus.* p. 4, Locustidae : 628

1921. *Eucoptacra saturata* : Uvarov, *Ann. Mag. nat. Hist.*, (9) **7** : 503.

Type species : *Acridium* (*Caantops*?) *praemorsm* Stål 1860.

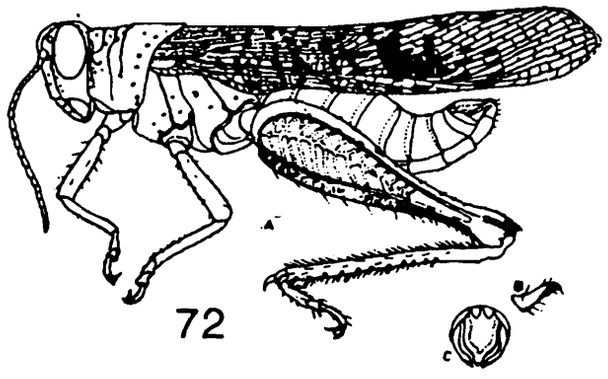

Fig. 72. Showing general morphology of *Eucoptacra saturata* (male). A. Entire specimen. B. Cercus. C. Supraanal plate (dorsal).

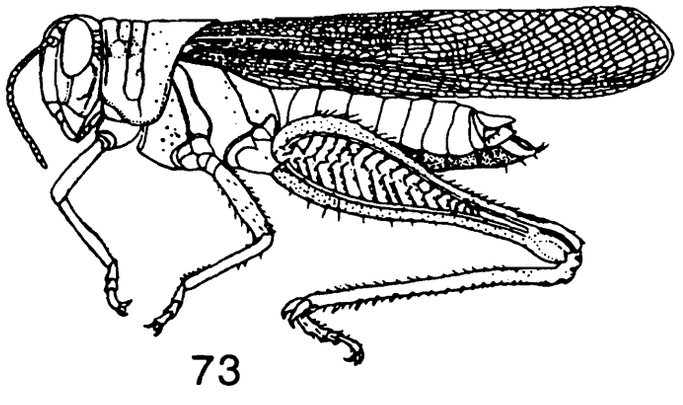

Fig. 73. Showing general morphology of *Eucoptacra saturata* (female).

Medium size body; integument finely rugose. Filiform with multisegmented antennae, generally longer than head and pronotum together. Base slightly flattened. Frontal costa distinctly widened beteween the antenna where it is much broader than the interocular distance. Fastigium of vertex narrow, concave in middle, sloping with sharp lateral carinulae. Front straight, almost vertical, slightly inclined backwards. Frontal ridge wide, flat, expanded between antennae, narrowed apically. Pronotum weakly tectifrom with linear median carinulae. 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, apex obliquly truncated.

Male : Cercus laterally compressed, decurved, apex rounded. Male supra-anal plate with strongly attenuate apical part and truncated apex. Epiphallus divided, division very sharp. Anchorae mainly large and incurved. Lophi large, hooked shaped or lophiform. Lateral plate well developed, presence of anterior projection but sometime indistinct. Posterior projection small, distinct (fig. 72).

Female : Larger than male, brown, head short, higher than the prothorax. Tip of the vertex flat, punctured, nearly round form, thickly punctured, presence of slight keel. Inner keel slightly converging towards the face, slight diverge of outer keel. Eyes elongate, ellyptical. Prothorax finely scabrous, widening slightly hindward, keels very slight, transverse compressed lines slight; fore border very slightly rounded. Sides much rounded; elongation of hind border, slightly angular. Prosternal spine stout, slightly acute. Hind femora black beneath, as long as the adbomen; hind tibiae red, nearly as long as the hind femora, their spines with black tips. Fore wings a little shorter than body, with black tips. Fore wings a little shorter than the body, with numerous small marks formed by blackish bordered veins. Hind wings hyaline (fig. 73).

Morphometry

Male (mm) : Length of body 18.0; length of antenna 8.0; length of elytra 19.0; length of hind femur 12.0; length of hind tibia 11.0.

Female (mm) : Length of body 22.0; length of antenna 9.0; lenght of elytra 24.0; length of hind femur 16.0; length of hind tibia 15.0.

Matrial examined : 2♂♂, 2♀♀ Botanical Garden, 10.xi. 61, Coll. K.R. Rao & S. Ali.

Distribution : It has very limited distribution of INDIA. Records from Madhya Pradesh, Orissa have been observed only.

Remarks : The most characteristic feature of this species are (1) rounded apex of cercus with compressed laterally and decurved structure. (2) Large incurved anchorae, lophi

large. (3) Flat vertex, obtuse, conical prosternal tubercle.

Genus ***Epistaurus*** Bolivar

1889. *Epistaurus* Bolivar, *J. Sci. Acad. Lisboa, Lisb.*

Type species : *Epistaurus crucigerus* (2) 164. Bolivar, 1889.

Size more or less small, narrow frontal ridge round, widened between antennae, apex narrow. A well developed transverse carina present in between two eyes on vertex; Tegmen and being well developed pronotum tectiform well raised median carina. Cercus conical with acute apex. Segments 20-21 narrowest up to 1/3 of antenna than gradually thickened.

Epistaurus sinetyi Bolivar
(Figs. 74, 75)

1902. *Epistaurus sinetyi Ann. Soc. Ent. France*, **70** : 62.

Medium size, pale reddish colour; median carina of vertex very indistinct, wings yellowish hyaline; hind femora obliquely trifasciate with brown; lower outer area brown, interupte in the middle; tibiae clothed with long grey hairs brown at the base, ringed with pale and thin red, abdomen red. In male, supra-anal lamina smooth, transversely and rather indistinctly impressed in the middle. Cerci short, subgenetal lamina obtuse, valve of ovipositor coarsely impresso-punctate.

Male : Small size, antenna filiform, head short less than half length of pronotum. Fastigium of vertex extends before eyes. Frontal ridge widest between the eyes but narrowest posteriorly. Pronotum with raised and well marked median carina. Prozona longer than metazona and later with angular posterior margin. Prosternal process short and conical. Mesosternal lobes with rounded inner margins, metasternal lobes separate, wing as long as abdomen. Posterior femur stout. Supra-anal plate tongue shaped, both side of left turga 'V' shaped, furcula present, apex angular. Cercus wavy, longer than supraanal plate, curved downwards, and pointed and acute at apex. Epiphallus divided, anchorae large and incurved, lophi large and hooked shaped. Lateral plate well developed. Anterior projections present, posterior projections small and distinct (fig. 74).

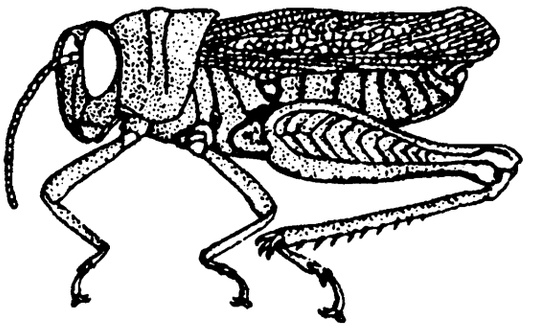

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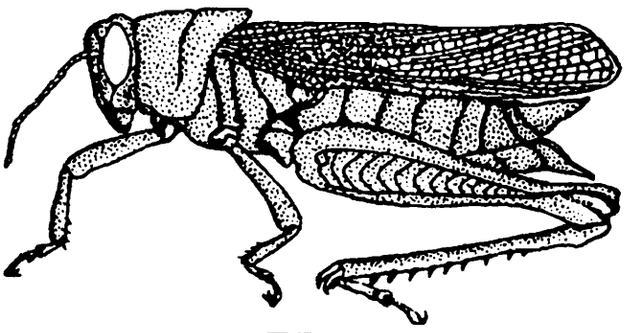
Fig. 74. Showing general morphology of *Epistaurus sinetyi* (male).



75

Fig. 75. Showing general morphology of *Epistaurus sinetyi* (female).

Female : Size larger, mesosoternal lobes not rounded, metasternal lobe slightly differ from that of males, abdomen dark brown with some scattered spots, anal cercus short, compressed basally and apically acute. Valves of ovipositor coarsely impresso-punctate (fig. 75)

Morphometry

Male (mm) : Length of antenna 7.04; length

of pronotum 5.0; length of tegmen 8.40; length of hind femur 10.9; length of hind tibia 10.0.

Female (mm) : Length of body 20.0; length of antenna 8.0; length of pronotum 6.0; length of tegmen 10.0; length of hind femur 12.0; length of hind tibia 11.0.

Material examined : 1♂, 2♀♀ Narendrapur, Oct. 1979, coll. M.S. Shishodia; 2♂♂, 1♀ Botanical Garden, 16.iii. 82 and 14.vi. 79, coll. A.K. Hazra and party.

Distribution : INDIA (West Bengal, Orissa, Madras, Tamil Nadu).

Remarks : Pale reddish brown, median carina not so prominent; wings yellowish hyaline, costal ridge very broad between the antennal and narrowed towards the extremity; abdomen red, spotted on the back; median carina of pronotum very distinct.

Subfamily TROPIDOPOLINAE

1. Fastigium of vertex obtuse angular, sulcation of frontal ridge, prosternal spine conical, wing acute at apex, hind femur reaching apex of abdomen ..... *Oxyrrhepes* Stål

   Fastigium of vertex parabolic, flat frontal ridge, prosternal spine strongly widened with raised lateral margin, using rounded at apex and shorter than abdomen, hind femur shorter than abdomen ..... *Tristria* Stål

Genus ***Tristria*** Stål, 1873

1873. *Tristria* Stål *Recens. Orth.*, **1** : 80.

1907. *Matapula* Giglio Tos. *Boll. Musei. Zool. Anat. Camp. R. Univ. Tornio*, **22** : 1.

1921. *Tapinophyma* Uvarov. *Ann. Mag. nat. Hist.*, **7** (9) : 497.

Type species : *Tristria lacetra* Stål 1873.

Medium size, from subcylindrical, antennae short, dorsoventrally flattened, middle part dialated. Head otusely conical, shorter than prontum, frontal ridge in profile distinctly convex, thick, flat but the median part is depressed very clearly. Fastigium of vertex parabolic, with median carinula, short and very obtuse. Its upper surface convex, feebly marginated anteriorly. Eye, egg shaped strongly narrow towards apex. Pronotum subcylindrical; disc slightly convex, rugulose with irregular longitudinal carinulae in apical and basal part. These transverse furrows of which the first is as distinct from the fore margin as the third is from the hind margin, while the distance between them is shorter and the second furrow is placed twice as near to the first as it is to the third. Pronotum tricarinated and cut by 3 sulci. Prosternal tubercle broad, curved backwards, apically strongly broadened. Tegmen more or less develope Last abdominal tergites of male with or without a triangular projections on posterior margin on either side. Male cercus incurved and downcurved, acute or subacute apex, apical part either conical or compressed. Subgenetal plate acutely conical or somewhat compressed. Subgenetal plate of female with or without a triangular projections on posterior margin or either side of egg guide.

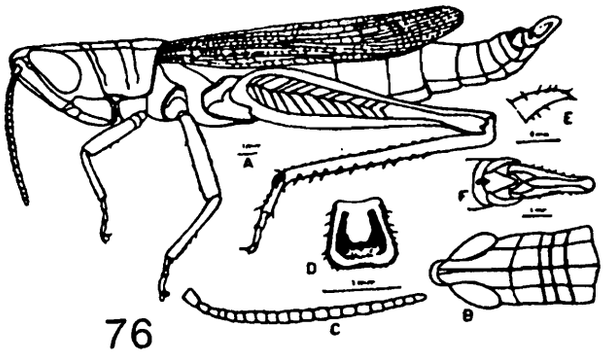
Tristria pulvinata Uvarov
(Figs. 76, 77)

1921. *Tapinophyma pulvinata* Uvarov. *Ann. Mag. nat. Hist.*, London (9) **7** : 497.

1929. *Tristria pulvinata* : Uvarov, *Revue Suisses Zool.*, **29** : 559.

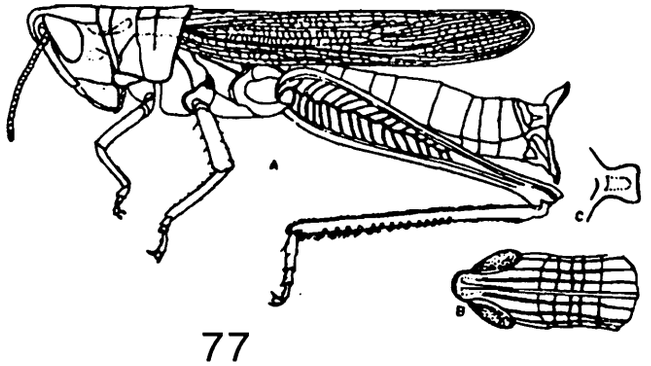
Size slender, medium size, antenna reaching the middle of the pronotum; face rugosely punctate except frontal and facial carinae, cheeks punctate in lower part and smooth with irregular rows of fine impressed points elsewhere, vertex and occiput transversely rugulose, pronotum and pleurae rugulose, yellowish gray colour with fawn coloured radially vein. Hind femora and tibiae unicolourus, the later slightly bluish and rather densely haired. Prosternal tubercle is strongly bent backwards, its lower surface very broad, concave, trapezoidal with lateral margins raised and hind margin lying on mesosternum. Elytra not reaching the apex of the abdomen, wings developed. Fore rounded middle laterally compressed; hind femora long and strong, with long filliform parts. Hind tibiae strong carinated throughout beneath. Supra-anal plate of female very narrow and elongate, subgental plate long,

valve of ovipositor elongate, the lower armed with basal tooth.



76

Fig. 76. Showing general morphology of *Tristria pulvinata* (male). A. Entire specimen. B. Head and Pronotum (dorsal). C. Antenna. D. Prosternal tubercle. E.Cercus. F. Tip of abdomen (dorsal).



77

Fig. 77. Showing general morphology of *Tristria pulvinata* (female). A. Entire specimen. B. Head and Pronotum (dorsal). C. Prosternal tubercle.

Male : Last abdominal tergite with a triangular on posterior margin on either side of midline. Cercus more or less conical for the basal 2/3rd, apical 1/3rd compressed, conical, curved downwards. Supra-anal plate wide, gradually tapering to an angular apex. Subgenetal plate strongly produced upturned, strongly compressed laterally forming a dorsal ridge, apex is round. Epiphallus-bridge undivided anterior process smaller, conical, sharply pointed at the tip, anchorae larger, pointed at the tip and curved inwards. Lophi large, elongated, posterior process very small (fig. 76).

Female : Very similar to males-Mesosternal body very close; Long subgenital plate, ovipositor elongated. The lower one armed with basal tooth. Larger, other characters like males, lobes of mesosternal interspace is very close (fig. 77).

Morphometry

Male (mm) : Length of body 27.8; length of antenna 7.6; length of pronotum 6.7; length of elytra 17.5; length of hind femur 14.8; length of hind tibia 12.0;

Female (mm) : Length of body 35.4; length of antenna 7.0; length of pronotum 7.0; length of elytra 23.2; length of hind femur 19.0; length of hind tibia 17.6.

Material examined : 2♂♂, 3♀♀, Narendrapur, April, 1979, coll. M.S. Shishodia; 54♂♂, 60♀♀ from Botanical Garden, 19.vii. 79 to 23.ii. 80, coll. A.K. Hazra and party.

Distribution : INDIA (West Bengal, Andhra Pradesh, Assam, Bihar, Karnataka, Maharastra, Tamil Nadu, Uttar Pradesh); SRI LANKA.

Remarks : This species easily separated from other by the extremely peculiar shape of the last abdominal segments and of the cerci. The type of its colouration and especially the light striking. Prosternal tubercle very broad at lower surface, bent backwards behind the middle, touching the anterior margin of mesosoternum, broadly flattened behind the middle, apex more or less truncated.

Subfamily CYRTACANTHACRIDINAE

Key to the genus

1. Prosternal process straight, vertical never bent towards mesosternum usually compressed laterlly ..... *Patanga* Uvarov

   Prosternal process never straight, curved backwards, angularly bent and almost touching mesosternum, inflated in middle, apex acute or subcute 2

2. Pronotum not strongly tectiform, male cercus with subacute apex, never tuberculated, wing lemon yellow, disc of pronotum smooth and velvety ..... *Cyrtacanthacris* Walker

Genue ***Patanga*** Uvarov, 1923

1763. *Gryllus locusta succinctus* Johansson *Amoen. Acad.*, **6** : 398 (Partim).

1838. *Acridium* Burmeister, *Hand Entom.*, **2**. pp. 602, 626 (Partim).

1914. *Orthacanthacris* Kirby, *Fauna Brit. India Acrid.* pp. 224, nec. XII, p. 362.

1923. *Patanga* Uvarov, *Ann. Mag. nat. Hist.*, vol. *XI* : 143 *XI* : 14 p. *XII*, p. 362.

1930. *Patanga* Willemse, *Tijds. Entom.*, **23**, no. 4, p. 26.

1951. *Patanga* Mistshenko, Grasshoppers of the Fauna U.S.S.R. and adjacent countries I, pp. 145, 247 (in Russian).

Type species : *Gryllus Locusta succinctus* (Johansson), 1763.

Body large, robust size, coarsely punctated. Multi segmented filiform antennae reaching behind the hind margin of pronotum. Head broad like pronotum, face vertical or slightly reclinate. Frontal ridge more or less parallel sided and more or less constricted at the median oceli, lateral facial keels curved or angulately bent, fastigium of vertex distance broader than the frontal ridge. Presence of yellow line from the tip of the fastigium and continued up to the tegmen.

Pronotum distinctly compressed laterally, and constricted in prozona rounded, median keel low. Anterior margin rounded entire or with a small median triangular incision, posterior margin more widely rounded. Presence of transverse sulci. First sulcus only indicated on the disc, second and third both on the disc and on the lobes. Third sulcus nearly in the middle of pronotum, lateral lobe deeper, lower margin slightly ascendent from its middle anteriorly. Posterior angle rectangularly rounded. Anterior margin with a sub-marginal sulcus. Prosternal spine slightly comperssed laterally, slightly attenuated towards the apex, inclined or substraight towards the mesosternum, but not reaching the later; apex obtusely pointed.

Mesosternal lobe longer than broad, inner margin more or less concave. Metasternal lobes contiguous in the male, slightly separated in the female.

Elytra reaching beyond the hind knees with a length as long as the pronotum, almost narrowed towards the apex. Reticulation of the discoidal field in its basal part is more or less opaque while rest of the field is remotely reticulate and more transparent. Wing hyalinous and the base is coloured. Sometimes slightly infumate along the hind margin.

Hind femora long, slender, with the apical part attenuate. Hind tibia substrainght with outer nine and inner eleven spines.

Hind tarsi short, reaching the middle of hind tibia, third joint a little shorter than the two others together. Aerolium large.

Male : Supra-anal plate triangular with the lateral margins undulate, apex triangularly projected with the very apex obtuse; disc concavely and longitudianally impressed along the elevated median keel which at its base is longitudinally sulcated. Cerci laterally compressed, reaching beyond the supra-anal plate, curved inwards and upwards, attenuate towards the apex, more or less pointed. Subgenetal plate long, curved upwards, conical, apex pointed.

Female : Supra-anal plate triangular apex obtuse or rounded, disc with shallow median tarsal impression. Cercus short, not reaching beyond the supra-anal plate, conical, apex obtuse.

Valve of ovipositor with its margin smooth, apex curved and hooked. Subgenetal plate longer than broad, lateral margins subconvex, posterior margin with a median intervalver projection.

Patanga succinata (Johansson)

(Figs. 78, 79)

1763. *Gryllus locusta succinctus* Johansson, *Amoen. Acad.* **6**, *Centur Ins. rarior.*, p. 398, no. 6.

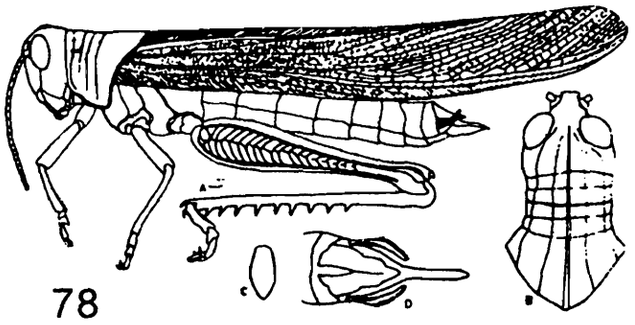
1838. *Acridium succinctum* Burmeister, *Handl. Entom.*, **2**, p. 831, no. 10.

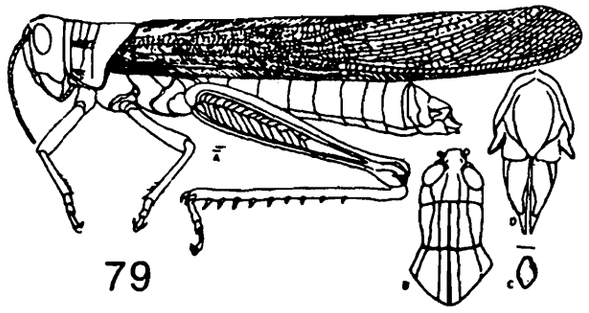
1900. *Cyrtacanthacris succinta* Kirby *Ann. Mag. Nat. Hist.* 7 (6), p. 380.

1923. *Patanga succincta* Uvarov *Bull. Entom., Res.*, **14**, p. 36.

1951. *Patanga succinct* Mistshenko, Grasshopper Fanua S.S.S.R. a adjacent countries p. 247 (in Russian).

1952. *Patanga succincta* Mistshenko, Fauna S.S.S.R. **4** (2), pp. 493 and 494 (in Russian).





Figs. 78. Showing general morphology of *Patanga succincta* (male), A. Entire specimen, B. Head and Pronotum (dorsal), C. Prosternal tubercle, D. Tip of abdomen (dorsal). **79.** Showing general morphology of *Patanga succincta* (female), A. Entire specimen, B. Head and Pronotum (dorsal), C. Prosternal tubercle, D. Tip of abdomen (dorsal)

Body large, pale yellow or black or yellowish brown with multisegmented filiform and yellowsih brown antennae. Face punctate and occiput subsmooth, carinae dark coloured, cheeks with two brown stripes, a dark stripe below the eye is mostly present. Lateral postocular fusciae brown more or less well developed. A broad yellow or reddish brown band starting from the middle of vertex and continuing on the pronotum.

Pronotum brown, yellowish, may be sometimes reddish brown, disc with brown median yellowish band from anterior to posterior end. Lateral lobes mostly yellow with narrow blackish glittering stripe in the upper part of the prozona and with more broader dark stripe in the lower part, lower margin yellowish. Elytra yellowish or yellowish brown, subhyaline, in the basal part brownish with a row of dark brownish spots, in the middle part mostly prominent. Wings hyaline, at the base mostly with a rose or beautiful red stringe. Sometimes it is absent also. Anterior and median legs are of general colouration but hind femora yellowish or yellowish. Hind femorae with the carina media superior with serration of teeth.

Hind tibia yellowish browish, spines pale yellow with dark or black tips. Hind tarsi brownish or yellowish brown.

Male : Cerci stouter and broader in lateral aspect more incrassately compressed. Variation of apical valve of penis. Epiphallus which is very strong with comparatively narrow bridge, undivided, anchorae small. Anterior process lobular, more or less oval and rounded. Anterior process large with its lobes with some transverse lines, posterior process small and round. Posterior process with its lobe connected with horizontal linning. Lateral plate is very large. Lophi lobed and large (fig. 78).

Female : Valve of ovipositor smooth, apex curved and hooked. Subgenetal plate longer than broad, lateral margin sub-convex (fig. 79).

Morphometry

Male (mm) : Length of body 40.0; length of antenna 15.0; length of head 6.0; length of pronotum 11.0; length of elytra 58.0; length of hind femur 32.0; length of hind tibia 20.0.

Material examined ; 1♂ Calcutta Reg. No. 1243/19 Indian Museum. 1♀, Calcutta, Reg No. 1243/9 Indian Museum.

Distribution : INDIA : (West Bengal, Arunachal Pradesh, Goa, Delhi, Maharastra, Rajasthan, Himachal Pradesh, Tamil Nadu, Uttar Pradesh); SOUTH ARABIAN DESERT; MYANMAR; CHINA; HAINAN ISLAND; JAPAN; S.E. ASIA; SRI LANKA; TAIWAN.

Remarks : This specimen is commonly known as Bombay locust and it is widely distributed throughout the plains of Indian continent, South and South-eastern Asia and Malayan Archipelogo. This species can easily be distinguished in having tegmina and in apical part with straight venation. Transverse veins forming right angles with principal vein. The base of the wing is rosy colour, male subgenetal plate long, curved upwards and conical with pointed apex.

Genus ***Cyrtacanthacris*** Walker, 1870a

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 size, body granulated and punctate; Antenna filiform. Frontal ridge narrow, depression at ocellus; narrower than interocular space. Pronotum tectiform, slightly constricted at prozona, median carina obtuse. Posteior end of metazona angular. Prosternal tubercle large, strongly curved backwards and almost touching mesosternum, compressed at base, widened in the middle and later on formed into subacute apex. Tegmen and wing well developed. Tegmen semimembranous with prominent and irregular venation and apical half with brownish spots. Cercus compressed, conical with subacute apex. Epiphallus robust, bridge shaped, no distinct anchorae. The lophi lobiform more or less hook like ovipositor-valve curved.

Cyrtacanthacris tatarica (Linn.)

(Figs. 80, 81)

1758. *Gryllus locusta tataricus* Linnaeus, *Syst. Nat. Ed.* **10**. i. p. 432.

1839. *Acrididum ranaceum*, *Acridium aeruginosum* Burmeister, *Handle. Ent.*, **2**, p. 630, no. 7,8.

1914. *Cyrtacanthacris ranacea* Kirby, *Fauna Brit. India. Acrid.*, p. 231.

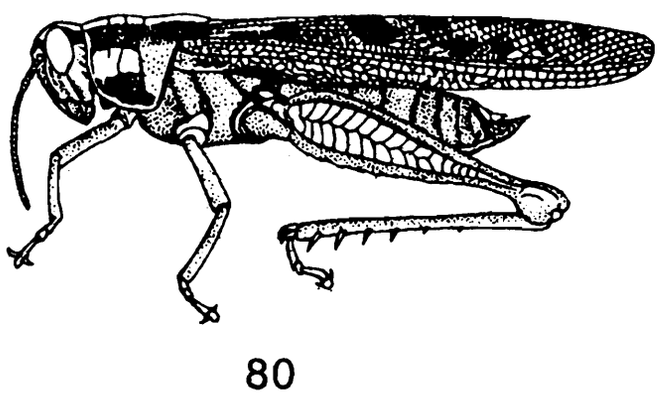
1920. *Cyrtacanthacris tatarica* Bainbrigge Flecther. *Proc. Third Entom.* meeting at Pusa, **1**, p. 310.

1923. *Cyrtacanthacris tatarica* Uvarov, *Bull. Entom. Research*, **14**, p. 39.

1933. *Cyrtacanthacris tatarica* Uvarov, *Proc. Zoolog. Soc. London*, p. 277.

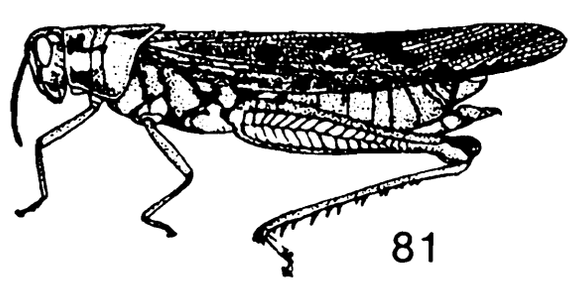
1914 (40). *Cyrtacanthacris tatarica* Rehn. *Proc. Acad. Natur. Sci., Rhibd.*, **92**, p. 287.

1941. *Cyrtacanthacris tatarica* Rehn. *Trans. Amer. Ent. Soc.* **67**, p. 266.



80

Fig. 80. Showing general morphology of *Cyrtacanthacris tatarica* (male).



81

Fig. 81. Showing general morphology of *Cyrtacanthacris tatarica* (female).

Cyrtacanthacris tatarica (Linnaeus)

1758. *Gryllus Locusta tataricus* Linnaeus : 432

1839. *Acridium ranaceum*, Burmeister : 630.

1839. *Acridium ruficorne* (nec Fabricius) Serville : 643.

1870. *Cyrtacanthacris concisa* Walker : 560.

1909. *Cyrtacanthacris ranacea* Lefroy : 86.

1923. *Cyrtacanthacris tatarica* Uvarov : 39.

1933. *Cyrtacanathacris tatarica* Uvarov : 277.

Size large or medium; antenna filiform, head globular, prosternal process large and slightly curved; pronotum without lateral carinae, dorsum crossed by three sulci; Metasternal interspace large; Elytra and wings fully developed; pronotum from above on both sides with broad velvety blackish brown band running from the anterior to the posterior margin; in the middle mostly lighter coloured; anterior and posterior margin slightly widened, these band are bordering the broad yellowish or yellowish brown median stripe very destinct, anterior and posterior margin itself yellow; lateral lobe dark brown with large whitish or yellowish spots in the upper part of the prozona, metazona light brown or yellowish brown, contrasting with the white spot as indicated, white; elytra with the discoidal area coriaceous, with dense and thick reticulation; its colour is light brown to yellowish; wing is hyalinous; at the base somewhat yellowish; Hind femur yellow or yellowish white, spines of the upper keel black, carinula superior externa and the basal half of the inferior externa bordered with black, area externomedia whitish; Hind tibia from below yellowish brown to yellowish, from above of the same colour or bluish, spines yellow or yellowish white, epiphallus strong with the anchorae shortened or absent.

Male : Supra-anal plate triangular with deep median groove, subgenital plate conical. Cercus broad at base, the apex is narrow. Epiphallus-weakly developed anchorae, lophi are tooth like, posterior femur long and stout with dark denticle like structure persent at upper carina. The internal spine are stouter than external one (fig. 80).

Female : More larger and robust, cerus small conical. Sub-genetal plate with truncated apex. Valves of ovipostor strongly curved (fig. 81).

Morphometry

Male (mm) : Length of body 36.2; length of antenna 13.6; length of pronotum 9.9; length of tegmen 34.4; length of hind femur 22.0; length of hind tibia 19.8.

Female (mm) : Length of body 51.4; length of antenna 14.8; length of pronotum 12.7; length of tegmen 49.6; length of hind femur 29.4; length of hind tibia 27.0.

Material examined : 1♂, Dhapa, 26, viii. 63, Coll. S. Ali; 1♂, Garia, 26. vii. 63, Coll. S. Ali; 3♀♀, Garia, 2 nymph, Garia, 2♂♂, Garia, 22.ix. 76 to 31.xii. 80, Coll. S.K. Mandal.

Distribution : INDIA : (West Bengal, Andhra Pradesh, Arunachal Pradesh, Bihar, Himachal Pradesh, Jammu and Kashmir, Kerala, Orissa, Rajasthan, Tamil Nadu); AFRICA; NORTH AFRICA AND SAHARA; HAINAN; MADAGASCAR; PHILIPPINES; SEYCHELLES; SRI LANKA; SUMATRA AND THAILAND.

Remarks : The important character of this group is the presence of rectangular mesosternal lobes, pointed and curved prosternal tubercle, large size, white band of elytra with blackish or brownish spots and absence of lateral carinae on the pronotum.

Subfamily CATANTOPINAE

Genus ***Catantops*** Schaum 1853

1853. *Catantops* Scheum, *Bericht Akad. Wiss. Berlin* : 779.

1862. *Catantops* Schaum, *Peters Reise Mossambeique* : 134.

1910. *Apalacris* (Partim) Kirby, *Syn. Cat. Orth.*, **3** : 476.

1931. *Catantops* (Vitti Catantops) Sjostedt, *Ark. Zool.* **22**(15) : 13.

1956. *Catantops* Dirsh, *Publ. Cult. Comp. Diam. Angola*, no. 28, (Revision, pp. 1-150).

Type-species : *Catantops melanostictus* Schaum, 1853.

Size medium, body rather stout, moderately rugose, filifrom with multisegmented antennae, reaching beyoud the posterior margin of pronotum, weakly compressed on basal region. Apically, fastigium above. Frontal ridge flat or slightly depressed, lateral carinulae faint. Fastigium of vertex sloping forming with the

frontal ridge a rounded angle, general form hexagonal. Pronotum subcylindrical, slightly narrowing forwards, metazona dialated posteriorly, median carina with posterior margin of metazona obtusely angulated. Prosternal tubercle thick, cylindrical, compressed laterally or backwards, widened frontally, straight or slightly bent backwards, apex is rounded. Elytra is longer than abdomen. Hind femur relatively strong, more or less attenuate, upper keels finely dentate or serrate. Hind tibia slightly curved with twelve inner and nine outer spines without apical spines. Hind tarsus short.

First transverse sulcus only indicated on the disc, second and third on both side on disc and lateral lobe. Sulci cutting the median keel.

Catantops pinguis innotabilis (Walker)

(Figs. 82, 83)

1870. *Acridium innotabile* Walker, *Cat. Derm Salt. B.M.* **4** : 629.

1870. *Caloptenus ferrugineus* Walker, **1**. c., p. 705.

1902. *Catantops indicus* I. Bolivar *Ann. Soc. ent. France*, **70** : 626.

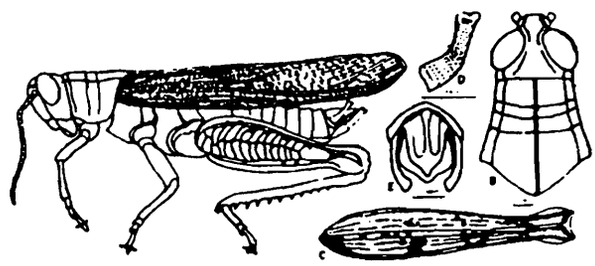
1925. *Catantops innotabilis* Uvarov *Mission Babault Inde. Acrididae Paris* **30**.

1943. *Catantops innotabilis* Uvarov *Ann. Mag. nat. Hist.* (11) **10** : 127.

1956. *Catantops pinguis innotabilis* : Dirsh *Publcoes cult co. Diam. Angola*, **28** : 105.

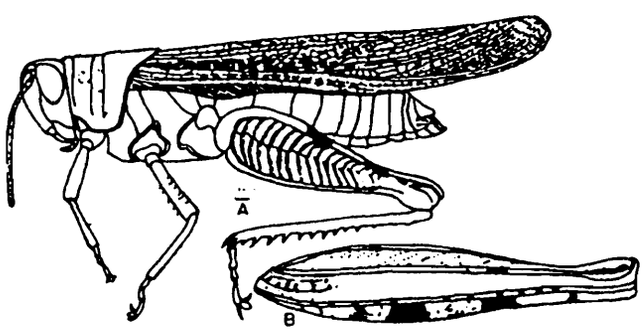
Size medium; general colouration from buff to dark brown; basal disc of wing from colourless to weakly greenish; the external disc of the hind femur with a small black median spot, the size of which varies sometimes; Male cercus varies strongly in the shape of the apex, which is sometimes strongly broadened with strongly projecting upper and lower angles; pronotum smooth, eye medium size; prosternal tubercle stout and conical. Tegmina and wings cully developed.

Male : Cercus slender, compressed, upcurved, expanded at apex, cercus bifurcated like, upper one blunt and the lower one pointed, lateral plates of epiphallus fused with bridge. Supra-anal plate triangular with a median longitudinal groove. Subgenetal plate navicular, laterally compressed; pointed at epiphallus. Epiphallus-bridge undivided, anterior process diverged more or less blunt at apex, anchorae tip pointed, curved inwards, lophi small, posterior process elongated hanging downwards (fig. 82).



82

Fig. 82. Showing general morphology of *Catantops pinguis innotabilis* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Hind femur, D. Cercus, E. Tip of abdomen (dorsal).



83

Fig. 83. Showing general morphology of *Catantops pinguis innotabilis* (female), A. Entire specimen, B. Hind femur.

Female : Very similar to males except larger. Cercus short, conical, valve of ovipositor moderately curved. Subgenetal plate with truncated apex (fig. 83).

Morphometry

Male (mm) : Langth of body 26.2; length of antenna 9.5; length fo hind tibia 12.2.

Female (mm) : Length of the body 32.0; length of the antenna 10.2; lenght of pronotum 8.3; length of tegmen 30.7; length of hind femur 19.0; length of hind tibia 15.7.

Mateial examined : 1 ♀ Dalanghata, 28.ix. 61, Coll. M.B. Kripalini; 1 ♀, Bansdroni, near Calcutta, 4.xii. 55, Coll. S. Ali; 1 ♂, 28.vi. 65, coll. P. Parui; 1 ♀ Santragachi, 12. ix. 64, coll. K. Rai and party; 3 ♂ ♂, Andul town, 9.xii. 65, coll. M.S. Shishodia & K.L. Bhatta.

Distribution : INDIA : (West Bangal, Assam, Himachal Pradesh, Kerala, Orissa, Tamil Nadu, Uttar Pradesh); JAVA; INDO-CHINA; MYANMAR; MALAYESIA; NEW-GUINEA; PHILIPPINES; SRI LANKA; SUMATRA; S. TIBET; THAILAND; YUNAN.

Remarks : Elytron exceeds the hind knee by more than the length of the pronotum. The species is easily identified by the cercus which is upcurved, more broadened apex and projecting upper apical angle is more projecting. The species is also easily identified by the character of the hind femur.

Subfamily EYPREPOCNEMIDINAE

Key to the genera

1. Male cercus broad, apical half compressed, apex round 2

   Male cercus narrow, apex always acute or subacute 4

2. Abdominal apex inflated, supra-anal plate with obtuse rounded apex 3

   Abdominal apex not inflated, supra-anal plate with angular apex. Lateral carinae of pronotum strong, tegmen consists of some dark spots ..... *Heteracris* Walker

3. Antenna fillifrom, frontal ridge slightly con stricted apically, male cercus long, broad, thick in the apical part. Subgenetal plate conical, compressed towards apical region and apex pointed ..... *Choroedous* Bolivar

   Antennae flattened and dilated in middle. Frontal ridge parallel sided, male cercus short, subgenetal plate transverse and very ..... much obtuse ..... *Eyprepocnemis* Uvarov

4. Posterior femur moderately long, produced beyond abdomen, not narrow strongly on apical half, posterior tibiae with spurs spines, prosternal process cylindrical, apex rounded or inflated ..... *Eyprepocnemis* Fieber

   Posterior femur very long, produced far beyoud end of abdomen inflated basally and strongly narrowed on apical half. Posterior tibiae densely spined. Prosternal process rounded sometimes slightly inflated apex .... *Tylotropidius* Stål

Genus ***Heteracris*** Walker 1870

1870b. *Heteracris* Walker *Cat. Derm. Salt. Br. Mus.*, **4** : 655.

1878. *Demodocus* Stål *Bih. Svensk. vet. Akad. Handl.*, **4**(5) : 75.

1893. *Thisoicetrus* Bruner *Annali Mus. nat. Civ. Stor. nat.* **13**(33) : 1-230.

1914. *Bibulus* Bolivar, *Trab. Mus. nat. Cienc. nat. Madr.* **20** : 51.

Type-spicies : *Acridium herbaceum* Serville, 1838.

Medium size. Antenna filiform, middle portion thickened and widened, fastigium of vertex shallowly concave, frontal ridge narrow. Pronotum flat with sharp median carian as well as lateral carina, posterior margin of metazona slightly excurved. Prosternal process incurved backwards, cylindrical, compressed antero-posteiorly, apex round. Last abdimnal segments with a pair of rounded apex. Male supra-anal plate with angular apex. Cercus wide, compressed, incurved and downcurved with round or subacute apex. Subgenetal plate subconical, with wide, sometimes apex is bilobate.

Male : Size small. Antennae filiform, longer than head and pronotum together, middle segment elongated about double of their width length. Fastigium smooth, transverse and concave. Face slightly oblique. Pronotum with sharp lateral carinae, prozona is longer than metazona. Prosternal process is semicylindrical, front compressed, apex is obtuse. Mesosternal lobe wider, inner margin rounded. Metasternum is closed, cercus compressed, laterally incurved, pointed and narrow apex and directed

downwards. Supra-anal plate sulcated of which tip is pointed with angular apex. Subgenetal plate subconical and curved upwards.

Female : Larger than male, punctation of frontal ridge, antennae more dark. Tegmen extends beyoud the posterior tibia. Cercus small and gradually tappering. Superior valve of ovipositor more larger than inferior, curved upwards with pointed apex.

Heteracris pulcher Bolivar

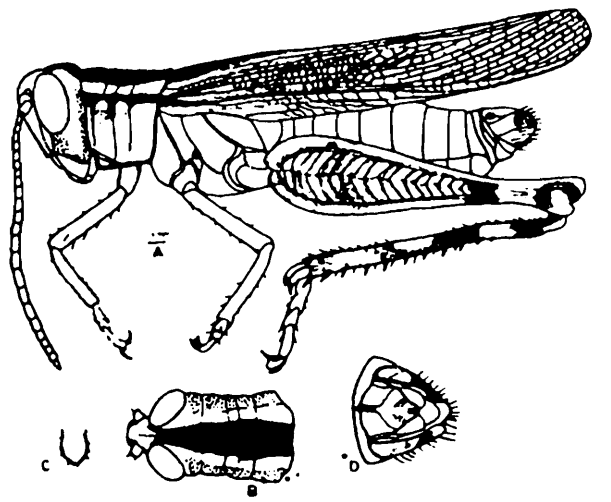
(Figs. 84, 85)

1902. *Euprepocnenis pulchra* Bolivar, *Ann. Soc. Ent. France* **70** : 630.

1958. *Heteracris pulcher* Dirsh Tijdschar, *Ent. The Hague* : 54.

Large to medium size; head pale red, broadly banded with black below the eyes; frontal ridge nearly parallel sided, narrowed towards the clypeus, impressopunctate; fastigium of the vertex smooth slightly sulcated; antennae pale above brown below; pronotum with broad velvety-black stripe on the back, distinctly expanded and paler in the middle borders green, median carina compressed in front and obtuse towards the tip; tegmen extending beyond the hind femora pale red or green obscurely spotted with brown; pronotum with broad velvety black stripe on the back distinctly expanded and paler in the middle, the border of black stripe marked by green colour, median carina compressed; prosternal tubercle compressed and subcylindrical in front and obtuse towards the female, femore pale red or green, obscurely spotted with brown, a broad pale ring before the extremity black at the base on the inner side, hind tibiae brown at the base, cerci flat front, compressed, curved and more or less large.

Male : Size small. Antennae filiform, longer than head and pronotum together, middle segment elongated double of their width length. Fastigium smooth, transverse and concave. Face slightly oblique. Pronotum with sharp lateral carinae, prozona is larger than metazona. Prosternal process is semicylindrical, front compressed, apex is obtuse. Mesosternal lobes wider, inner margin rounded (fig. 84).



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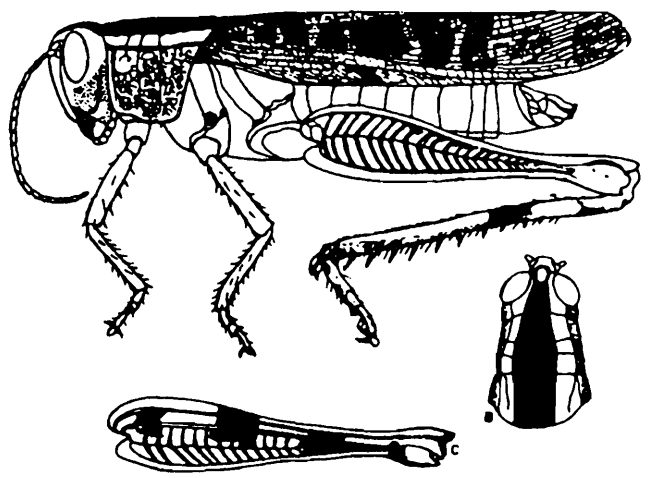


85

Figs. 84. Showing general morphology of *Heteracris pulcher* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Cercus, D. Tip of abdomen (dorsal), **85.** Showing general morphology of *Heteracris pulcher* (female), A. Entire specimen, B. Head and pronotum (dorsal), C. Hind femur

Female : Larger than male, antennae more darker. Tegmen extends the posterior tibia with cleared brownish spots and separated by hyalinous area. Cercus small and gradually tapers. Superior valve of ovipositor comparatively larger than inferior one, curved upwards with pointed apices. Metasternum is

closed cercus compressed, lateral incurved, pointed and narrowed apex and directed downwards. Supra-anal plate sulcated of which tip is pointed. Subgenetal plate rounded and curved upwards. Epiphallus-Bridge weakly sclerotised. Anterior process triangular, curved inwards, small. The anchorae broad at the base, narrow at the apex, pointed organs present on the lateral part. Posterior process broad, apex rounded and two lobes like structures comes out from the medial portion of posterior part (fig. 85).

Morphometry

Male (mm) : Length of body 25.4; length of antenna 15.6; length of the pronotum 0.7; length of tegmen 22.4; length of hind femur 19.0; length of hind tibia 17.0.

Female (mm) : Length of body 51.0; length of antenna 18.0; length of pronotum 11.5; length of tegmen 39.5; length of hind femur 32.0; length of hind tibia 30.0.

Material examined : 1♂ Ballygunge Scinence College, 26.vi. 80, Coll. D.K. Guha; 16♂♂, 4♀♀, Garia, 6.viii. 76-20. vii. 77, coll. S.K. Mandal.

Distribution : INDIA : (West Bengal, Orissa, Tamil Nadu); SRI LANKA.

Remarks : Vertex horizontal : frontal ridge round obtuse, Presence of two lateral colour bands on pronotum distinctly green, extends upto tegmen, pronotum with its lobe is yellowish, rest of it is greyish yellow. Pronotum truncated at the apex, subtruncating; prosternal tubercle obtuse towards the tip, anal segment of male not enlarged, cerci, slender, compressed, pointed, flat.

Genus ***Choroedocus*** Bolivar 1914

1878. *Demodocus* Stål, *Boh. Svensk. vet. Akad. Handl.*, **5** (4) : 75.

1914. *Choroedocus* Bolivar, *Trab. Mus. nat. Cienc. nat. Madr.*, **20** : 110.

Type-species : *Demodocus capensis* Stål 1878.

Body large and stout, antenna filiform, fastigium parabolic with obtuse apex. Frontal ridge wide and flat, constricted towards apex. Pronotum compressed distinct at prozona. Median carina crossed by 3 sulci.

Metazona shorter than prozona of which posterior margin one is rounded. Prosternal process cylindrical, round shaped, impressed, basal part narrowed, but before middle widened, apex obtuse. Cercus wide, thick, strongly compressed, incurved conical, apical region compressed and curved upwards and pointed at apex. Posterior femur attenuate on distal third. Posterior tibia with twelve external and ten internal spine. Apical external spine absent.

Choroedocus robustus Serville
(Figs. 86, 87)

1839. *Acridium robustum* Serville, *Ins. orth.*, 647, no. 7.

1914. *H. (eteracris) robusta* Kirby, ; the *Fauna of British India, including Ceylon and Burma, Orthoptera, Acrididae* **9** : 262.

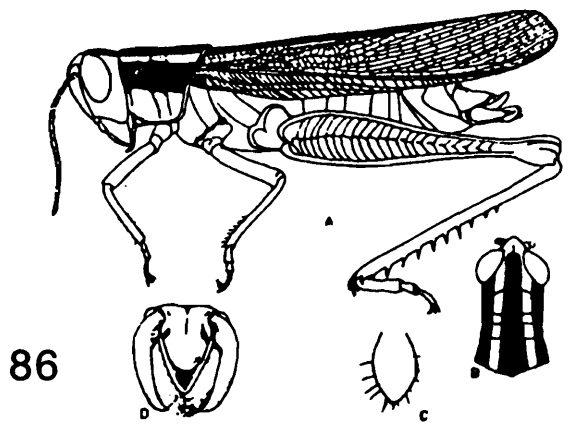
1912. *Choroedocus* (?) *robustus* : Uvarov. *Trans. R. ent. Soc. Lond.*, **69** (1& 2) : 109.

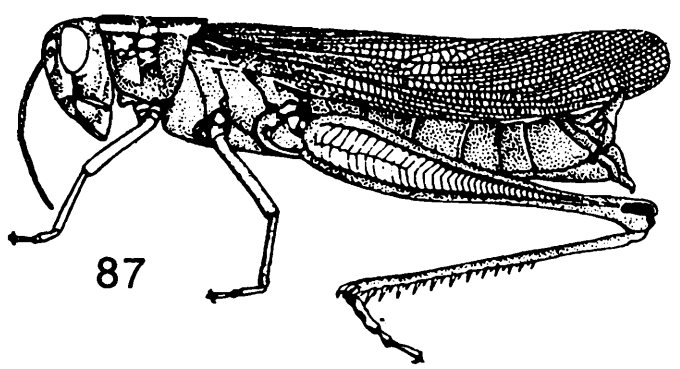
1984. *Choroedocus robustus* : Bhowmik and Halder, *Bull. zool. Surv. India*, **6** (1& 3) : 143.

Large, greenish brown varied with darker brown and with yellow stripes. Antennae filiform. Head sub-globular, narrow, fastigium of vertex angular, in middle depressed. Antennae as long as head and pronotum together, ovate, anterior margin rounded; a white band present on the lateral side of pronotum, vertex dark brown bordered with yellow on wach side; pronotum dark brown, closely and rather finely rugose punctate and without lateral carina; abdomen greenish brown; tegmen yellowish subhyaline; hind femora longer than the abdomen; hind tibiae red with the extreme base blackish.

Male : Antenna longer than head and pronotum together of which median segments nearly almost twice as long as wide. Head short. Fastigium of vertex short, obtuse Median carinula reaching occiput and sloping down into frontal ridge which is flat and gradually

narrowing between antennae. Pronotum tectiform with 3 transverse sulci and slightly divergent and less prominent lateral carinae, median carina prominent. Prosternal tubercle cylindrical and gradually tapering apically and slightly incurved. Mesosternal interspace is 1/3 width of mesosternal lobes. Tegmen extending beyond posterior knee. Abdomen with last two tergits fused and hind margin of last tergits with a pair of small rounded projections. Supra-anal plate large, tongue shaped, in basal half subcated medially. Subgenetal plate gradually tapering at apex, hairy, distinct by upcurved, apex truncated. Cercus remarkable, incurved, compressed laterally, greatly expanded. The angular tip obtuse and leaf like. Aerolium well developed, longer than claw. Epiphallus large, bridge undivided, lophi are bean shaped, posterior process angular, anterior process broad and blunt at apex. The anchorae are bean shaped structure pointed at apex (fig. 86).





Figs. 86. Showing general morphology of *Choroedocus* (?) *robustus* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Prosternal tubercle, D. Tip of abdomen (dorsal) **87.** Showing general morphology of *Choroedocus* (?) *robustus* (female)

Female : Larger than males, robust in size and genetal structures. Supra-anal plate with broadly rounded apex, a prominent depression on basal half of supra-anal plate. Cercus small, base broad, apex tapering. Valve of ovipositor typical like (fig. 87).

Morphometry

Male (mm) : Length of body 42.04; length of antenna 14.4; length of pronotum 9.4; length of tegmen 36.2; length of hind femur 26.8; length of hind tibia 25.0.

Female (mm) : Length of body 60.2; length of antenna 20.8; length of pronotum 14.6; length of tegmen 51.8; length of hind femur 39.6; length of hind tibia 35.6.

Material examined : 1♂ 1♀ Botanical Garden, 26. iv. 80 and 25.ix. 82, Coll. A.K. Hazra and party; 1♀ Calcutta, 24.x. 60, Coll. S.K. Ghosh; 1♀ Narendrapur, Oct. 1979, Coll. M.S. Shishodia; 7♂♂ 2♀♀ Garia, 18.vii. 76 to 7.vii. 77, coll. S.K. Mandal.

Distribution : INDIA (West Bengal, Assam, Arunachal Pradesh); BANGLADESH.

Remarks : Pronotum with a distinct median carina, head with broad brown band bordered in front by a yellow stripe; pronotum dark brown without lateral carina. Dorsum crossed by three sulci. Upper part with the brown yellow bordered band of the vertex continued to the extremity; tibiae and tarsi-red, cercus broad, compressed, sub conical and flattened, sub acute apex, strongly.

Genus ***Eupreponotus*** Uvarov 1921

1921. *Eupreponotus* Uvarov, *Ann. Mag. nat. Hist.*, 7 (9) : 507.

Type-species : *Eupreponotus inflatus* Uvarov 1921.

Medium, long antennae, may be flattened or dialated. Fastigum of vertex hexagonal, distinctly concave, margins raised. Pronotum cylindrical

and compressed sulci, lateral carinae restricted to prozona only. Prozona larger than metazona. Apical part of metazona rounded, prosternal process cylindrical and inclined backards, apex obtuse. Metasternal lobe not separated, inner and posterior margins straight. Tegmen and wing well developed. Posterior femur incrassate basally, apical portion attenuated, upper carina serrulated. Cylindrical abdomen, apical two segments strongly inflated. Cercus large, tergite is very large. Subgenetal plate transverse and very obtuse.

Eupreponotus inflatus Uvarov

(Figs. 88, 89)

1921. Uvarov, *Ann. Mag. nat. Hist.*, (9) **7** : 508.

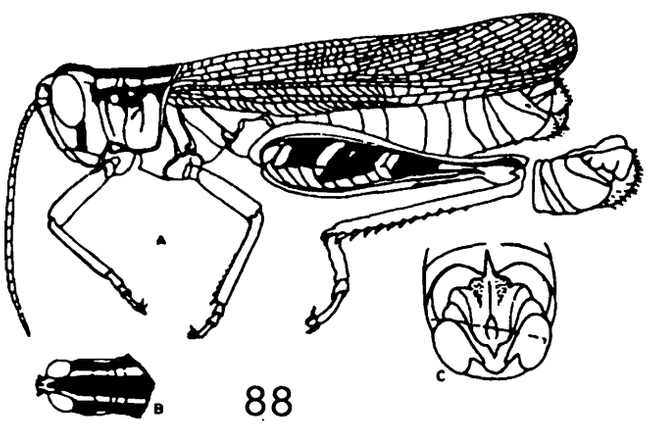


Fig. 88. Showing general morphology of *Eupreponotus inflatus* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Tip of abdomen (dorsal).

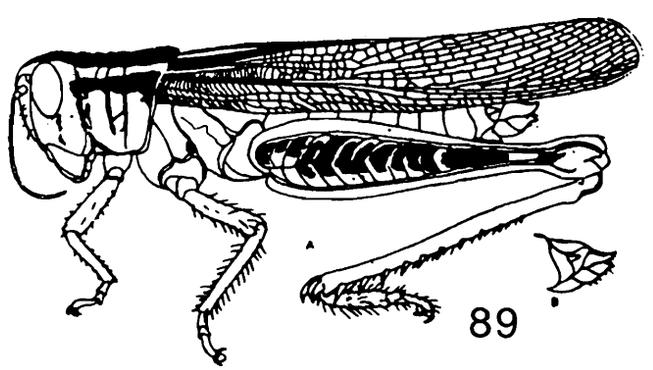


Fig. 89. Showing general morphology of *Eupreponotus inflatus* (female), A. Entire specimen, B. Tip of abdomen (lateral).

Medium size; antenna distinctly longer than head and pronotum together; front ridge subparallel sided, narrowed near fastigium and feebly constricted below ocellum; coarsely impresso-punctate throuhout; its margin raised shining and obtuse facial keel raised, smooth, almost straight; pronotum not punctured but opaque on its whole surface except along the lateral keel raised, smooth, almost straight; pronotum not punctured but opaque on its whole surface except along the lateral keels and shoulders of metazona which are rugosely impressopunctate. Elytra extending beyond the hind knees rather narrow not densely venulated. General colouration fawn with dull black and plate marking. Last abdominal segments very large. Face velvetty olive brown with keels and frontal ridge shining, median carina of pronotum fawn shining, lateral lobes velvetty, fawn with a stripe along upper margin. Elytra hyaline with veins brown, and field blackish brown. Hind femora with three irregular black facia-upper side unicolourous, inside yellowish with a reddish shade in the basal half, an indefinite spot at the middle of the upper carina and post median transverse fascia is black the later fascia extending on the lower side of the femora. H. tibiae red, tarsi, brownish red.

Supraanal plate of female very narrow, elongate lanceolate with medially a longitudinal groove, subgenetal plate long, valve of ovipositor curved elongate, upper sites sinuated the lower armed with basal tooth.

Remarks : Vertex and occiput fawn (light greenish brown, shiny) with a velvety black longitudinal fascia lined on to pronotum and it is included in between two halved as broad light fawn stripes. Median carina of pronotum fawn and shining, lateral lobe velvety fawn with a stripe along upper margin. All margin of pronotum pale, shining. Posterior femur also fawn with three irregular black fasciae. Posterior tibia red, posterior tarsus brownish red.

Male·: Smaller, antennae longer than head and pronotum together. Frontal ridge subparallel sides, narrow near the fastigium and constricted below ocellus. Facial keel raised pronotum opaque, lateral keel and shoulders of metazona

rugose and impressopunctate. Lateral lobe higher than long, lower margin with a widely rounded coxal angle, fore angle obtuse and rounded. Tegmen extending beyond posterior knees. Male cercus narrow at the base with bristles broad and bent downwards at apex which is more darker. Posternal spine more or less 'tube' like structure. Mesosternal lobe oper (fig. 88).

Female : Rectangular with truncated apex, cercus stout and shorter compressed laterally than supraanal plate, blunt apically. All tarsi with large pulvilli, anal plate is very narrow and elongate, lanceolate. Subgenetal plate long; valve of ovipositor elongate, upper sites sinuate, lower armed with basal tooth (fig. 89).

Morphometry

Male (mm) : Length of body 22; length of antenna 12.0; length of pronotum 27; length of tegmen 25.0; length of hind femur 18.0; length of hind tibia 16.0.

Female (mm) : Length of body 33.0; length of antenna 14.0; length of pronotum 8.0; length of tegmen 32.0; length of hind femur 25.0; length of hind tibia 23.0.

Material examined : 1♂ 5♀♀ Naraendrapur, Oct. 74, coll. M. S. Shishodia.

Distribution : INDIA (West Bengal, Orissa).

Remarks : The above mentioned species is identified by the following characters. Antenna long and flattened, vertex feebly reclinate, fastigium prominent anteriorly, cylindrical pronotum, prosternal spine cylindrical, mesosternal lobes about as long as cylindrical, slightly inclined backwards with apical part attenuated, upper carina serrulate, abdomen cylindrical with two apical segments, strongly inflated, knee with semi black spots, hind tibiae and tarsi are red, knees with semiluner black spots, supra-anal plate very narrow and elongate, lanceolate, cerci short, subgenetal plate long, valve of ovipositor elongate, upper side sinuate, lower armed with basal tooth.

Genus ***Eyprepocnemis*** Fieber 1853

1853 *Eyprepocnemis* Fieber, Lotos, **3** : 98.

1873. *Eyprepocnemis* Stål *Recens. Orth.*, **1**: 75.

Type-species : *Gryllus plorans* Charpentier 1825.

Body size medium, filiform antenna, fastigium of vertex short, concave and broadly parabolic apex. Frontal ridge flat, pronotum above flat, lateral carinae not so prominent, median carina linear. Prosternal tubercle cylindrical, slightly curved backwards, with rounded, sometimes slightly inflated apex. Mesosternal interspace elongated, metasternal lobe rounded. External apical spine of hind tibia absent. Supra-anal plate simple, elongated triangular. Male subgenetal plate short and subconical. Cercus basally broad but apically narrow, may be incurved or excurved, apex acute or subacute. Female subgenetal plate trilobate valves of ovipositor simple, valves curved.

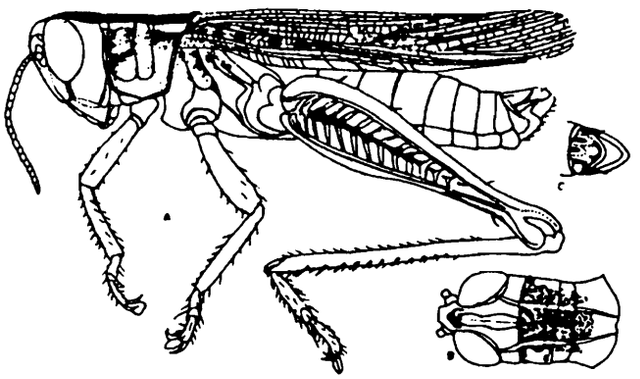
Smaller, filiform antennae longer than head and pronotum taken together. Fastigium of vertex flat, with deep concavity apex parabolic. Frontal ridge flat, impressopunctate, narrowing towards fastigial end. Pronotum flat, crossed by 3 sulci with prominent median linear carina. Lateral carinae weak. The metazonal area is provided with coarse punctation, diverging posteriorly and area is provided with coarse punctation, diverging posteriorly and this area is smaller than prozona. Prosternal tubercle cylindrical curved backwards, apex is round. Tegmen longer than abdomen with rounded and slightly oblique apex. Posterior femur stout. The most charateristic feature of hind tiabia is bluish-grey colour with two whitish rings at the base and reddish apex and tarus. Median carina present on abdomen, Supra-anal plate elongate, broadened, triangular with a median groove, Base of the cercus broad, apex narrow, incurved and acute apex. Epiphallus- Bridge undivided, anterior process elongated. Ephphallus-Bridge weakly sclerotised. Anterior process triangular, curved, small. The anchorae broad at the base,

narrow at the apex, pointed and curved inwards. Two protruberance and invaginated organs present on the lateral part. Posterior process broad, apex rounded and two lobe like structure comes cut from the medial portion of posterior part.

Female : Size large. Similar like males. From the tip of the fastigum two greenish white borders coming upto pronotum and gardually goes to tip of tegmen and converge, supra-anal plate tongue shaped with longitudinal groove on medial side. Ovipositor valve curved, subgenetal plate long, rectangular with truncated apex. Cercus stout, shorter than supra-anal plate, apex blunt.

Eyprepocnenis alacris alacris Serville

(Figs. 90. 91)



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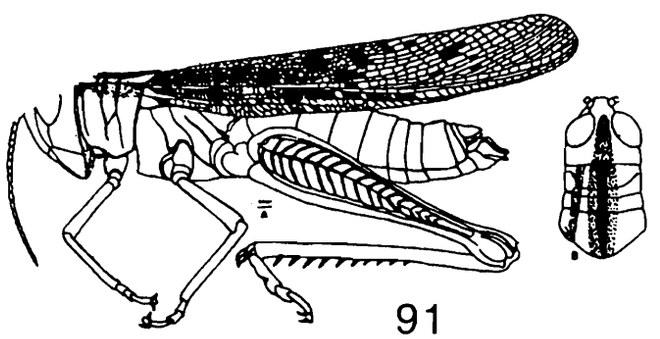

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Fig. 90. Showing general morphology of *Eyprepocnenis alacris alacris* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Tip of abdomen (dorsal)

Fig. 91. Showing general morphology of *Eyprepocnenis alacris alacris* (female), A. Entire specimen, B. Head and pronotum (dorsal)

1839. *Acridium alacre* Serville, *Ins. Orth.* : 682.

1918. *Eyprepocnemis alacris* Kirby *Fauna of Brit. India, Acrid.* : 267.

1950. *Eyprepocnemis alacris* Dirsh, *Bull. Entom. Res.*, **41**, p. 318. a adjacent country pp. 269.

1951. *Eyprepocnemis alacris* Mishchenko, Catantopinae in grasshopper fauna S.S.S.R., a adjacent country pp. 269.

1952. *Euprepocnemis alacris* Mischenko, Fauna S.S.S.R., **4**(2) pp. 583, 585, 586.

1958. *E. alacris* Dirsh. *Proc. R. ent. Soc. London* (B), **27** : 40.

Medium size; vertex without median carinula, prosternal tubercle cylindrical, apex obtusely rounded slightly bent backwards, cercus in the male reaching a little beyond the supraanal plate, flattened, gradually narrowed apically slightly bent inwards, apex in the female longer than broad elytra reaching the base, hind femur yellowish with longitudinal black stripe, hind tibiae dark blue-green, tarsus brown, abdomen brown.

Male : Smaller, filiform antennae longer than head and pronotum taken together. Fastigium of vertex flat, with deep concavity apex parabolic. Frontal ridge flat, impressopunctate, narrowing towards fastigial end. Pronotum flat, crossed by 3 sulci with prominent median linear carina. Lateral carinae weak. The metazona area is provided with coarse punctation, diverging posteriorly and this area is smaller than prozona. Prosternal tubercle cylindrical curved backwards, apex is round. Tegmen longer than abdomen with rounded and slightly oblique apex. Posterior femur stout. The most characteristic feature of hind tibia is bluish-grey colour with two whitish rings at the base and reddish apex and tarsus. Median carina present on abdomen. Supra-anal plate elongate, broadened, triangular with a median groove. Base of the cercus broad, apex narrow, incurved and acute apex. Epiphallus-Bridge undivided, anterior process elongated and blunt. Both the anchorae broad at base; gradually narrowed and jointed at the tip. Both the anchorae are joined by membranous linging basally. The lophi are

broadened lying horizontally. Middle portion is more broadened and apex is pointed (fig. 90).

Female : Larger, fastigum of vertex less concave than males, ovipositor simple, valves curved, supra-anal plate like males but subgenetal plate is triolobate the most characteristic features. Dorsal valve moderately broad, more or less longer, central valve sloped more or less concave. Basal valve punctated and the mesial valve apically dialated slightly (fig. 91).

Morphometry

Male (mm) : Length of body 24.8; lenght of antenna 8.3; length of pronotum 6.1; length of tegmen 19.3; length of hind femur 15.6; length of hind tibia 13.4.

Female (mm) : Length of body 35.4; length of antenna 12.5; length of pronotum 8.3; length of tegmen 29.4; length of hind femur 21.2; length of hind tibia 20.4.

Material examined : 1♂, 2♀♀ Narendrapur, May, 1979, coll. M.S. Shishodia; 1♂, Garia, 17.xi. 76, coll. S.K. Mandal.

Distribution : INDIA (West Bengal, Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Kerala, Panjab, Rajasthan, Bombay, Madhya Pradesh, Orissa, Uttar Pradesh and Tamil Nadu); UPPER MYANMAR; THAILAND; SRI LANKA; PAKISTAN; AFGHANISTAN; E. PERSIA AND CEYLON.

Remarks : Size small to large; Head subglobular; fastigium of vertex roundly with frontal ridge and it is parabolic medium and with characteristic dark brown markings lateral carinae; prosternal process cylindrical and antero-posteriorly compressed; elytra and wings fully developed, elytra with numerous brown spots, bluish grey post tibiae. Tympanum present; male cercus at apex flattened, widened and down curved, epiphallus machanism not found, subgenetal plate in the female less deep incised on the posterior margin.

Genus ***Tylotropidius*** Stål 1873

1873. *Tylotropidius* Stål, *Recens. Orth.*, **1** : 74.

Type-species : *Pezotettix (Tylotropidius) didymus* Stål, 1875.

Body size medium, rugosely of the body is present. Antennae compresed and filiform and shorter than head and pronotum. Fastigium parabolic, vertex elongate, apex truncated, basal portion is provided with two depressions. Frontal ridge wide, more or less flat, gradually becoming narrow towards apex. Pronotum with sharp median carina and lateral carinae obtuse and diverged behind. Prozona larger than metazona. Posterior margin of metazona more or less rounded. Prosternal tubercle spatulated with rounded, slightly bifid, apex inflated. Posterior femur slender and elongated. Cercus slightly compressed, apex region slightly downward, oblique, down-curved or subacute apex.

Tylotropidius varicornis (Walker)

(Figs. 92,·93)

1870. *Heteracris varicornis* Walker, *Cat. Derm. Salt. B.M.* **4** : 667.

1893. *Tylotropidius ceylonicus* Brunner, *Ann. Mus. Genova*, **33** : 164.

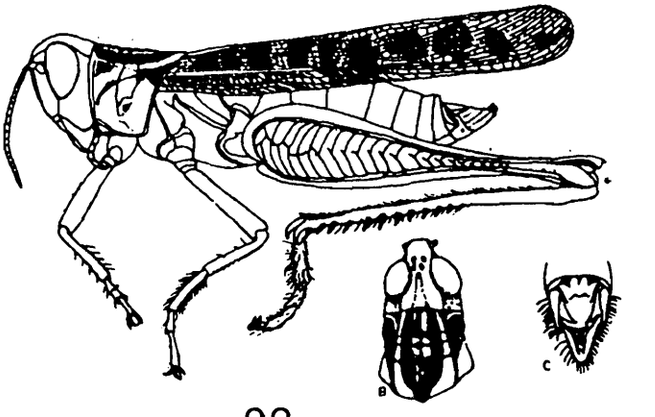
1910. *E. (uprepocnemis) varicornis* : Kirby *Syn. Cat. Orth.*, **3** : *Orth. Salt.*, Part II. : 561.

1914. *Tylotropidius varicornis* : Kirby, *Fauna British India Orth.*, **1** : 265, fig. 140.

Size medium to large; fastigium of vertex with two depressions at the base; pronotum with front and hind lobes of equal length; Tegmen and wing well developed. Tegmen continues with a row of triangular whitish spots upon radial nervure and pale longitudinal stripe in the costal area; wings bluish hyaline; hind femur thickened at the base very slender at the apical part; hind tibia towards the extremity dull blue, tarsi dull blue, cerci straight, rounded slightly compressed.

Male : Size medium, antenna filiform, compressed, shorter than head and pronotum together. Fastigium of vertex elongate, more or less parabolic with truncated apex. Pronotum tectiform, median carina sharp and lateral carina obtuse. Metazona shorter than prozona. Prosternal process anteroposteriorly

compressed, almost spatulate. Hind femur very slender, strongly narrowing in the apical third. Hind tibia with densely placed spines. Hind tarsi is also elongate. Subgenetal plate of male broad, round curved and bent inwards with pointed apex. Cerci long, curved and pointed apical part slightly downwards and subacute apex. Supra-anal plate elongate and angular and gradually tappering forwards and tongue shaped. Epiphallus large, bridge more or less straight, anchorae toothed and bifurcated, posterior process large (fig. 92).



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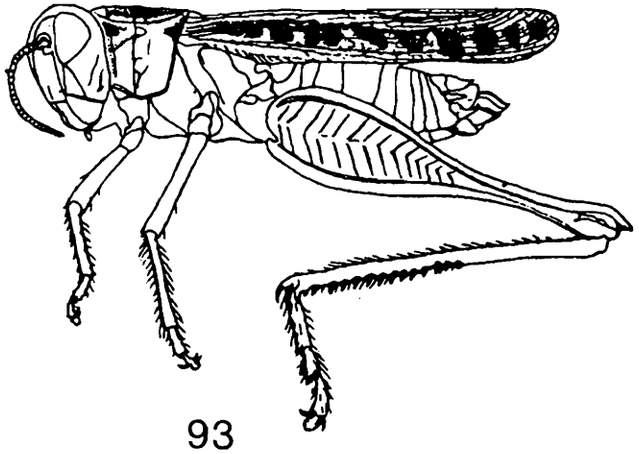

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Fig. 92. Showing general morphology of *Tylotropidius varicornis* (male), A. Entire specimen, B. Head and pronotum (dorsal), C. Tip of abdomen (dorsal)

Fig. 93. Showing general morphology of *Tylotropidius varicornis* (female)

Female : Larger; subgenetal plate short, obtusely conical. Supra-anal plate like male ones. Valve of the ovipositor moderately strong with curved ends. Other characters more or less same as male (fig. 93).

Morphometry

Male (mm) : Length of body 32.5; length of antenna 11.0; length of pronotum 7.5; length of tegmen 25.5; length of hind femur 23.5; length of hind tibia 21.0.

Female (mm) : Length of body 36.0; length of antenna 13.0; length of pronotum 7.5; length of tegmen 29.5; length of hind femur 29.0; length of hind tibia 26.0.

Material examined : 3♀♀ Botanical Garden, 26.v. 81, Coll. A.K. Hazra and party.

Distribution : INDIA : (West Bengal, Andhra, Goa, Orissa, Rajasthan, Tamil Nadu and Maharashtra); MYANMAR; SRI LANKA.

Remarks : Prosternal tubercle compressed and bilobed at the apex. Hind femora very slender towards the tips and, thickened at the base, the upper carinae sparsely serrated prosternal tubercle bifid, metasternal lobe of the female truncated on the inner side; *T. varicornis* identified by specific characters of the dark brown mark on the dorsm of the pronotum.

B. ECOLOGICAL STUDY

a. Faunal make up

The total Orthopterans collected during the year 1979-1981 was 2304, with an year wise breakup of 933 during the year 1979-80 and 1371 during the year 1980-81. (Table-2 & fig. 100).

The total population of Orthoptera collected, belonged to 11 species under 10 genera viz., *Spathosternum prasiniferum prasiniferum*, *Oxya fuscovittata*, *Tristria pulvinata*, *Atractomorpha crenulata*, *Phlaeoba infumata*, *Aiolopus thalassinus tamulas*, *Oxya hyla hyla*, *Aulacobothrus luteipes*, *Gesonula*

punctifrons, *Acrida exaltata* and *Epistaurus sinetyi*. Of these *Spathosterum prasiniferum prasiniferum*, *Oxya fuscovittata* and *Tristria pulvinata* ocupied 1st, 2nd and 3rd position in order of dominance with a percentage composition of 36.68, 20.36 and 19.80 respectively of the total population and were observed to be well distributed throughout the year, while the rest of the species were found to be numerically low and very much irregular in distribution. (Table-25) with a percentage composition of 9.19, 7.34, 2.36, 1.55, 1.38, 1.00, 0.33 and 0.08, respectively.

A calculation was made to draw a pie-chart for showing the species dominance index (fig. 101). It also revels that *Spathosternum prasiniferum prasiniferum* (36.68%) was most dominant taxa, therafter *Oxya fuscovittata* and Tristria pulvinata which occupied 20.36% and 19.80% and other taxa occupied 23.16% (fig. 101).

The faunal makeup of *Spathosternum prasiniferum prasiniferum* also indicated that the nymphal population was 15.56% (male 3.03; female 12.53%) of the total population while the adult population 21.12%. The male; female ratio among nymphs and adults were observed to be 1.00 : 4.14 and 1.41 : 1.00 respectively. (Table-3).

Oxya fuscovittata exhibited a nymphal population of 10.62% with a male : female ratio of 1.00 : 6.64 while the abult population was of 9.38% with a male : female ratio of 1.76 : 100 (Table-4).

In the population of Tristria pulvinata the nymphs constituted 18.27% of the total population while the adults found to be 1.00 : 8.18 and 1.07 : 1.00 in the nymphs and adults respectively. (Table-5).

The population break up of male, female and nymphs as well as adults of other species are shown in the table 3 to 13 and 14 to 25.

b. Seasonal changes of grasshopper population

It is evident from table 2 that the total number of grasshoppers population showed its peak during the month of September, 1980 (14.409%) i.e. in the post monsoon period and minimum in May (0.998%). It actually showed another two distinct peaks one in October (Post monsoon) and other in July (monsoon) during the period under study.

The *Spasthosternum prasiniferum prasiniferum* was most dominant taxa. Its population was maximum in the month of October in both the year under study, however their density increased considerably during the year 1980 and '81, with the values being 4.04% and 7.73 in the respective years. The minimum population was obtained in the month of January, 1980 (0.04%), however in the year 1980-81 the maximum population was obtioned in the month of October (7.73) (Table-3).

Oxya fuscovittata exhibited maximum population during the month of October in the year 1979-80, the value being 2.38% however in the month of September, the value being 5.17%. The minimum population was obtained during the month of January-February in the year 1979-80 the value 0.17% was obtained in the month of March. (Table-4).

Tristri pulvinata showed its highest peak in the month of January 181 (4.12%) however, it was not found in the month of June in both the years (Table-5).

The fluctuations of other species populations are shown in the tables 6 to 13 and 14 to 24 and figs. 102-112. The percentage of the studied eleven species has been shown in Table 25.

Physical factors

Two parameters *viz.* temperature and relative humidity have been considered for studying the climate of the experimental field. The climate of this area can be divided into four apparently distinct seasons as that of the Kolkata City : Summer (April-June middle), rainy (mid June to September), autumn (mid September-November), winter (December-January). Heavy rainfall was received during the monsoons from late June to middle of September. Temperature gradually increased from end of February and

reached the maximum of 38.50° C during May. It is then steadily falls with the onset of rains. The minimum temperature recorded 20° C in the month of January to 92% in the month of August (Table-26). Monthly fluctuations of Air (°C) and Relative humidity (%) at Botanical Gardens Howrah has been shown in fig. 113.

C. Statistical analysis

Data pertaining to two physical factors and population density of grasshopper fauna were subjected to regression and correlated analysis (Table-27).

The study of correlation coefficient indicated that *Oxya* sp. population showed positive correlations with both the parameters but it is significant only with the temperature. The population of *Tristria* sp. showed non-significant positive correlation with temperature and there exists a negative non-significant correlation with the relative humidity. The population of *Spathosternum* sp. showed positive correlation with both the parameters and highly significant correlation exists between population of this species and relative humidity.

DISCUSSION

The results presented in this study were based on a detailed survey of 37 localities of the greater Kolkata. The grasshopper fauna obtained in this study belonged to 35 species under 29 genera of the families Acrididae and Pyrgomorphidae. On the contrary the grasshopper species known from West Bengal were 56 species (Bhowmik, 1986) under 45 genera and Hazra *et al.* 1991 who recorded 69 species under 49 genera from the State. Of the thirty five species studied here, 23 species are new record from these regions and therefore, have been described with proper illustrations. The distribution of some forms of grasshopper differed markedly from one site to another. Maximum number of taxa were encountered from Narendrapur, Ramkrishna Mission locality (20 species), Garia (17 spp.) and Botanical Garden (15 spp.). These variation in species composition may be due to the prevalence of undistrubed conditions and luxuriant growth of vegetations in these localities. Similar results were also obtained from the above localities. by Hazra *et al.* (1981) and Tandon *et al.* (1988). It is to be noted in this context that not a single species of grasshopper was recorded from all the studied localities. This variation in faunal make-up might be due to the differences in vegetation, crop condition and other microclimatic factors of the localities concerned (Dwivedi, 1977, Hazra *et al.* 1981, '84 and Tandon *et al.* 1988).

Maximum population of grasshopper was observed during July-October and their abundance may be related to the maximum vegetative growth of the grass species in the field during this period. This agrees with the findings of Dwivedi (1977), Tadon and Khera (1978) and Hazra (1984). The minimum population was recorded in May (0.99%) when the temperature was high and grasses were dried up.

When specieswise (male, female of both Adult and nymph) break up was taken into consideration it showed their population maximum during monsoon or in the post monsoon except *Aulacobothrus luteipes* & *Epistaurus sinetyi* which showed their nymphal peak in winter (Tables 3 to 19 except 11 & 13). This might be due to the favourable climatic conditions along with the prefered grass food which also sprout during the respective season. Similar results were also oblained by Adamovi (1959) and Hazra (1984).

The species like *Spathosternum prasiniferum prasiniferum* and *Oxya fuscovittata* were present in the field throughout the year, and such a year round occurance with different nymphal stages suggest of polyvoltine cycle in these species as reported earlier by Uvarov (1977).

Similarly *Tristria pulvinata, Atractomorpha crenulata Phlaeoba infumata, Aiolopus thalassinus tamulus, Oxya hyla hyla* were

bivoltine and *Aulacobothrus luteipes*, *Gesonula punctifrons*, *Acrida exaltata*, *Epistaurus sinetyi* were univoltine in the present study field i.e. breed once in a year. (Tables 3-13 and figs 102-112).

The temperature showed direct influence on the population structure of grasshoppers but failed to show any significant correlation in this field. This is in perfect agreement with the findings of Hazra (1984) according to whom temperature alone is of little influence in governing the abundance and distribution pattern of grasshoppers.

The relative humidity content of the surface soil was positively correlated with the grasshopper population. But with *Tristria* sp. it showed negative correlation. In the monsoon months, higher content of relative humidity enhanced the growth rate of vegetation. This observation too agrees with that of Hazra (1984).

The developmental activities in the Greater Kolkata in recent years have been enhanced rapidly. These activities involve construction of buildings, roads and filling up of the wetlands in the city and urban areas, which collectively exerts a profound influence on the entire natural habitat of animals and grasshoppers in particular. The encroachment of man into the habitual areas of grasshoppers (anthropogenic pressure) leads to a considerable reduction of both the number of grasshopper species and the total number of grasshoppers in the modified field. The other effect of the aforesaid activities on the grasshopper species is that these species were forced to concentrate and develop the potentiality for mass multiplication in favourable year and move to neighbouring area of cultivation and emerge as pests. The occurence of large number of *Spathosternum* sp. and *Oxya* sp. supports this contention. Korelina (1961) reported some 2000 individuals of *Chorthippus albomarginatus* per square meter in Yakertia and at higher densities signs of phase-change are also observed. Tandon and Khera (1978) also observed the same condition in Arunachal Pradesh. Uvarov (1961) has also reported such change in the habitat of grasshoppers.

Baranov and Bei-Bienko (1926) have observed the changes in the behaviour of certain species of Orthoptera of different stations, in dense stands of grass. These species behave as Phytophites, while in sparse stands these are geophites (Bei-Bienko 1958). Tandon and Khera (1978) also reported this kind of behaviour in case of *Trilophidia annulata* in Arunachal Pradesh. *Aulacobothrus luteipes Gesonula punctifrons*, dealt in this study was also affected by changes in environment leading to its emergence as a serious pest in the neighbouring cultivated field (Tables 21 & 22).

Further it is worthmentioning here that some of the species namely *Tagasta indica*, *Leva cruciata*, *Oxya velox*, *Locusta migratoria*, *Heteropternis respondens*, *Patanga succincta*, *Tylotropidius varicornis*, *Eucoptacra saturata*, *Eyprepocemis alacris alacris* etc. which were available in the past from the grass fields/crop fields/greenaries etc. in and around Kolkata were not found in the present sample survey.

It may be concluded from the present study that the vegetation in conjunction with the other physical factors considered in this study collectively influence the population fluctuation and distribution of grasshoppers in greater Kolkata area.

SUMMARY

The present shedy deals with morphology, taxonomy and ecology of some grasshoppers in and around the greater Kolkata area.

35 species of grasshoppers have been recorded under 29 genera of the families Pyrgomorphidae and Acrididae. The species *Chrotogonus tr. trachypterus*, *Atractomorpha crenulata*, *A. psittacina*, *Tagasta indica*, *Leva cruciata*, *L. indica*, *Phlaeoba infumata*, *Dittopternis venusta*, *Heteropternis respondens*, *Gastrimargus africanus africanus*, *Oedaleus abruptus*, *Trilophidia annulata*, *Locusta migratoria*, *Hieroglyphus banian*, *Oxya*

nitidula, O. velox, Eucoptacra saturata, Patanga succincta, Catantops pinguis innotabilis, Heteracris pulcher, Eyprepocnemis alacris alacris, Tylotropidius varicornis and Cyrtacanthacris tatarica have been recorded, for the first time, from the Greater Kolkata area.

Detail description of each species supported by illustrations is also provided. A list of distribution of each of these species has also been given.

Key to the identification of the species concerned including their subfamilies and genera are given for easy identification of the grasshopper fauna of Greater Kolkata area.

It was observed from the present study that the species *Tagasta indica, Leva cruciata, Patanga succincta, Locusta migratoria, Heteracris pulcher, Epistaurus sinetyi* which were collected earlier but not recorded from these areas are here missing during the course of this observation. This might be due to the change of habitat along with vegetation in which they prevailed interference.

The ecological studies have been conducted in some chosen localities within the greater Kolkata area to study their behaviour in the field and also their population fluctuations in relation to some physical parameters like humidity and temperature. The number of species encounters from these areas were eleven, of which the species *Spathosternum* pr. *prasiniferum* were most dominant (36.68%), *Oxya fuscovittata* (20.36%), *Tristria pulvinata* (19.80%), *Atractomorpha crenulata* (9.19%), and *Phlaeoba inrumata* (7.34%) occupying the 1st, 2nd, 3rd, 4th and 5th position respectively in order of dominance. The maximum population was obtained during the month of September, 1980 and minimum population was encountered in the month of May, 1979 (Table 28).

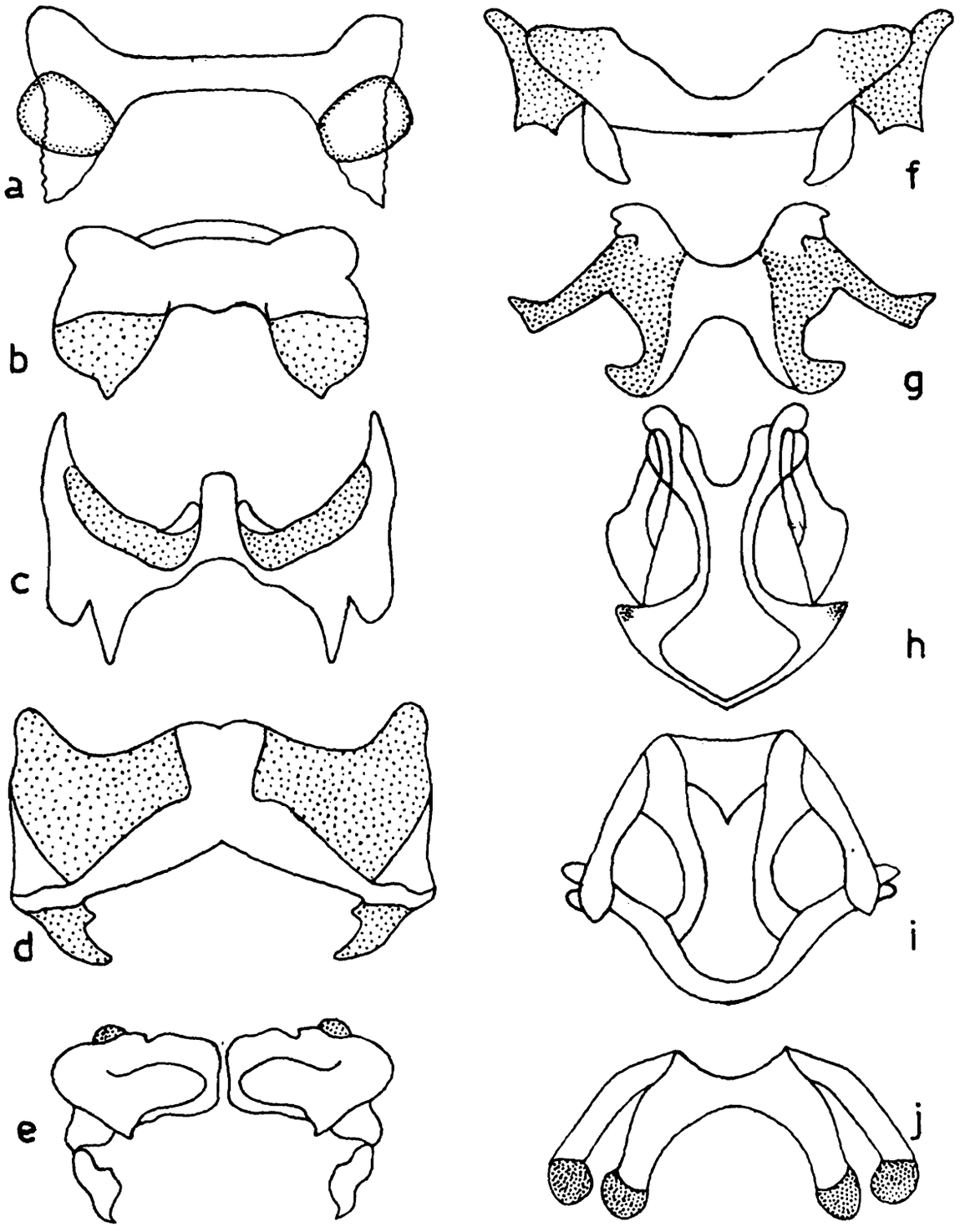
The statistical analysis showed that the maximum population of grasshoppers was associated with quite high temperature and relative humidity 36.0°C and 85% respectively.

It must be worth mentioning in this context that in some species studied here, in case of occurrence of male : female nymphs and corresponding male : female adults it was noticed stages females outnumbered males while in adult stages males outnumbered females. Such observation in respect of catch was unexpected though, it might be due to : (a) small size of sample, (b) easy/greater availability of female nymphs than male nymphs during sampling, (c) experimental error. The pinpointed answer as to the causal factor of such an unusual phenomenon can be had only after making more comprehensive ecological studies with laboratory experiments in respect of preferential feeding, predator-prey relation, etc.

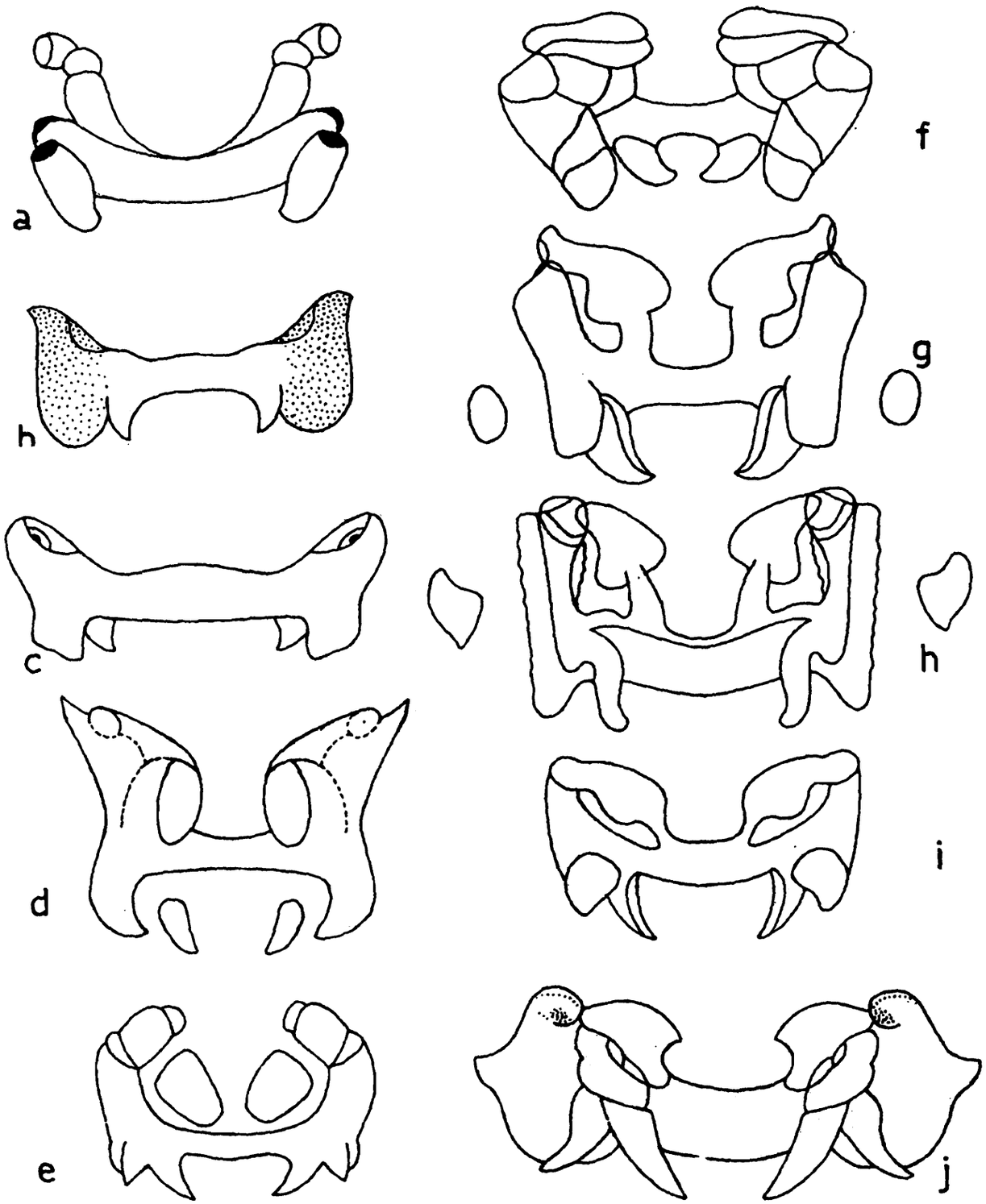
Besides the physical parameters discussed above, vegetation was found to be the most vital factor for regulating the distribution of grasshoppers in Greater Kolkata area.

ACKNOWLEDGEMENT

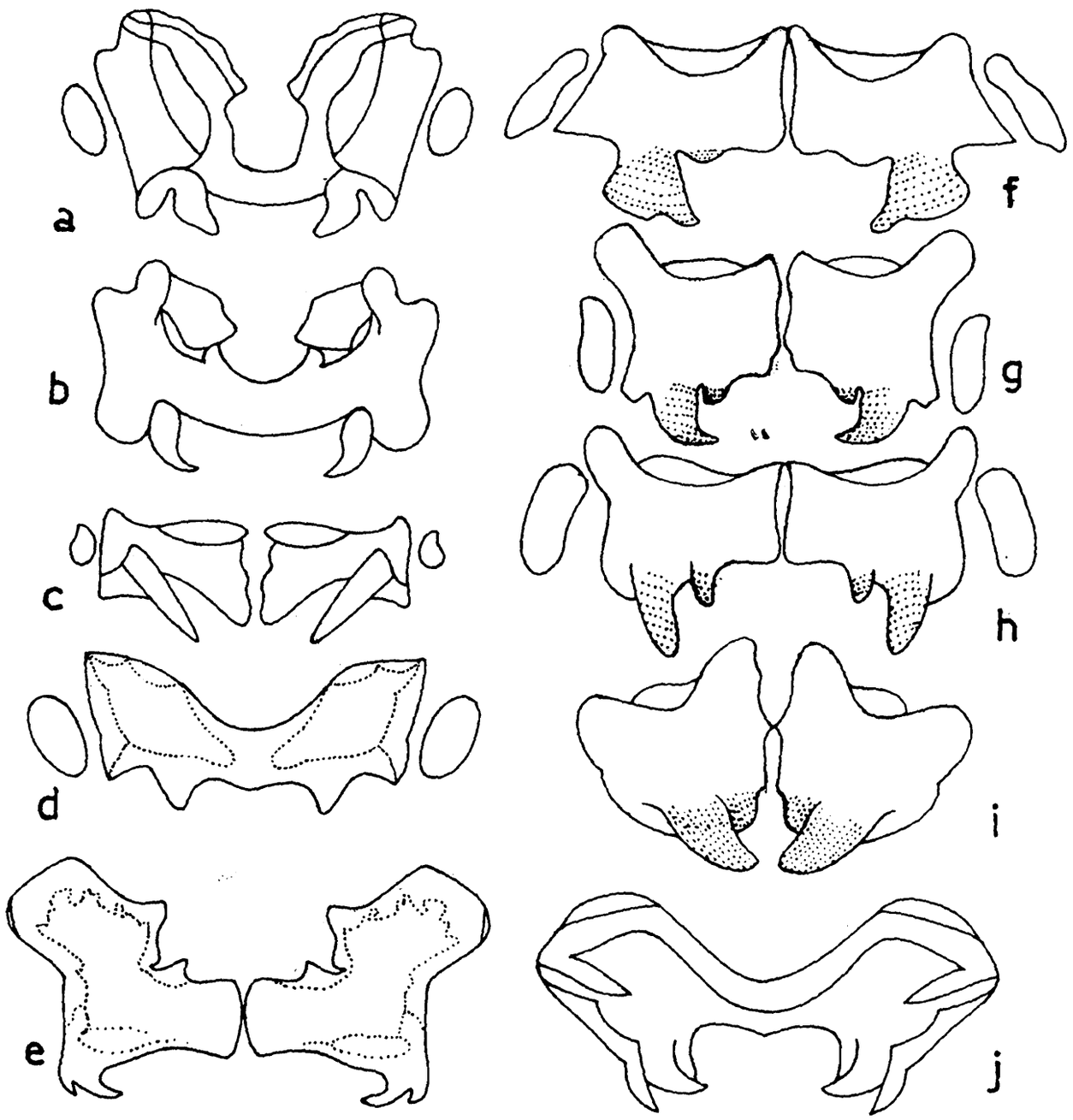
We take this opportunity to express our sincere gratitude to Dr. J.R.B. Alfred, Director, Zoolgical Survey of India, for providing the laboratory facilities. We like to record our gratefulness to Prof. D.K. Chowdhuri, former Dean, Faculty of Science of the University of Burdwan for his constant guidance and encouragement for this study. We are grateful to Dr. J.K. Jonathan, Additioinal Director (Retd.), Zoological Survey of India, for his constructive criticism for this work. Our sincere thank is also due to Dr. S.K. Tandon, former Joint Director of the same organisation for his constant inspirarion during the course of this investigation. Last but not the least to Dr. S.K. Mondal. Asstt. Zoologist and Officer-in-Charge of Orthoptera Section for his timely help.



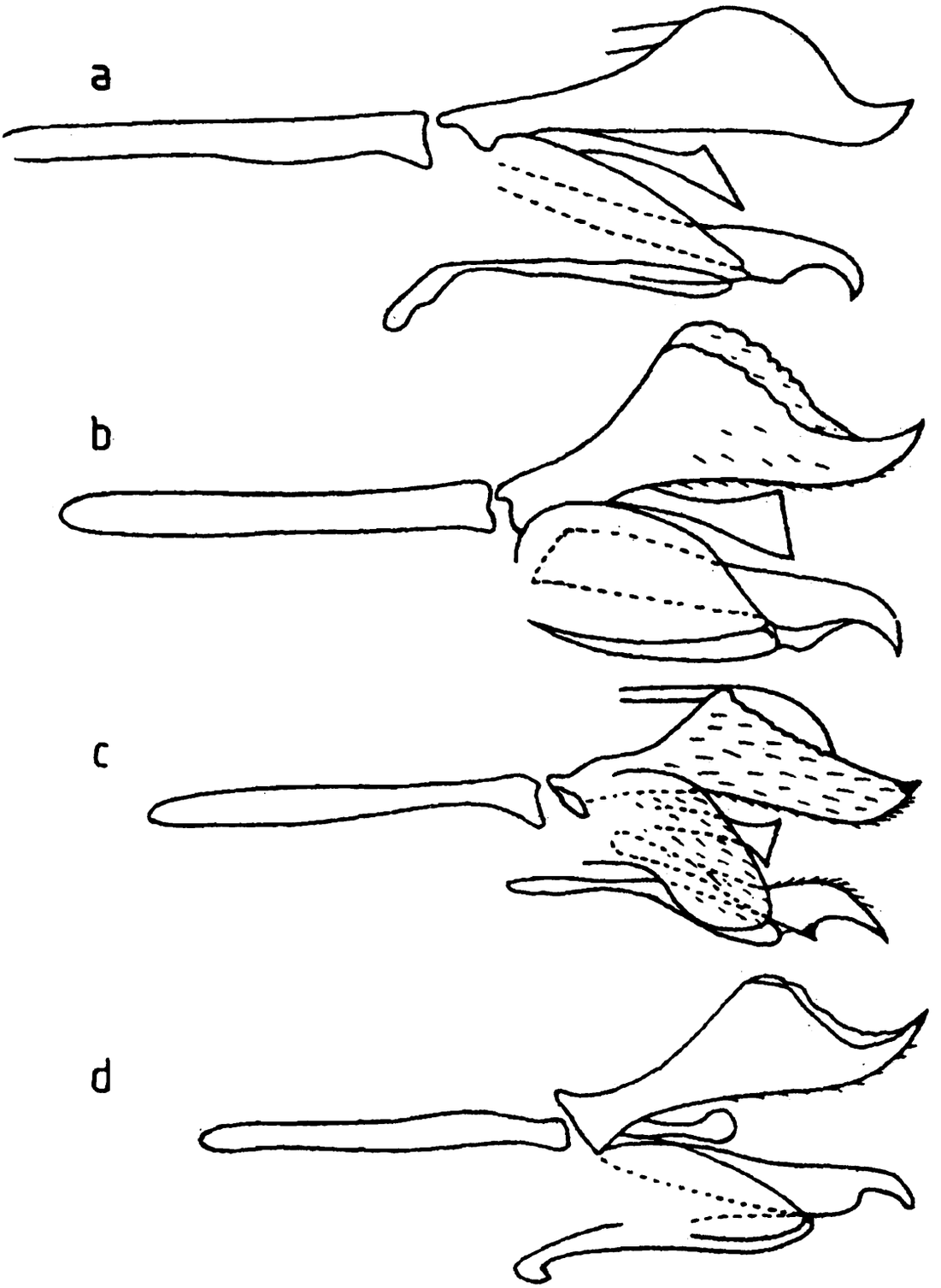
Figs. 94. Showing male genetalia (epiphallus) of studied grasshoppers, a. *Cyrtacanthacris tatarica*, b. *Patanga succincta*, c. *Catantops pinguis innotabilis*, d. *Choroedocus robustus*, e. *Eupreponotus inflatus*, f. *Eyprepocnemis alacris alacris*, g. *Chrotogonus trachypterus trachypterus*, h. *Atractomorpha crenulata*, i. *Atractomorpha psittacina*, j. *Tagasta indica*



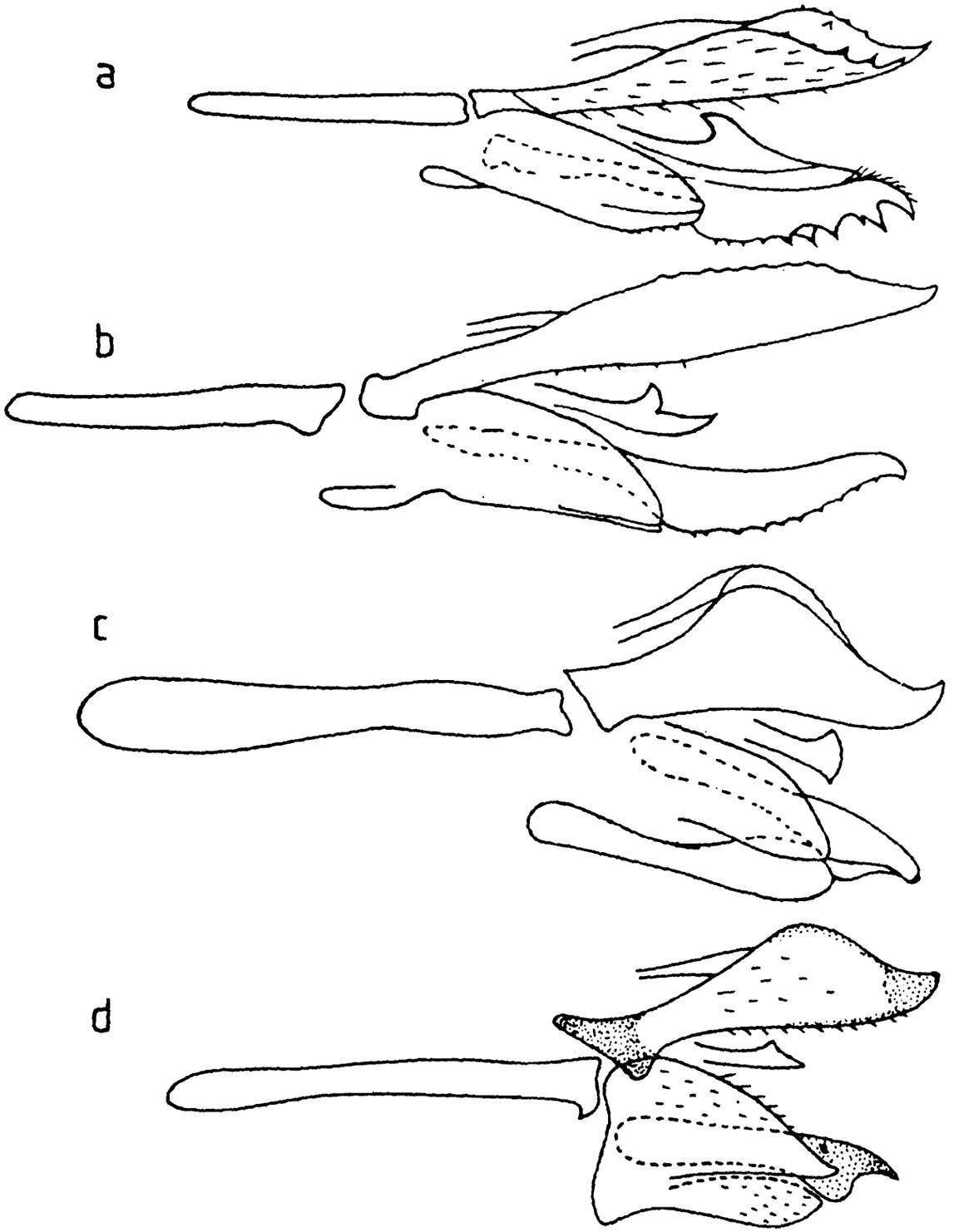
Figs. 95. Showing male genetalia (epiphallus) of studied grasshoppers, a. *Acrida exaltata*, b. *Phlaeoba infumata*, c. *Phlaeoba pantelei*, d. *Aulacobothrus luteipes*, e. *Leva indica*, f. *Aiolopus thalassinus tamulus*, g. *Dittopternis venusta*, h. *Heteropternis respondens*, i. *Oedaleus abruptus*, j. *Gastrimargus africanus africanus*



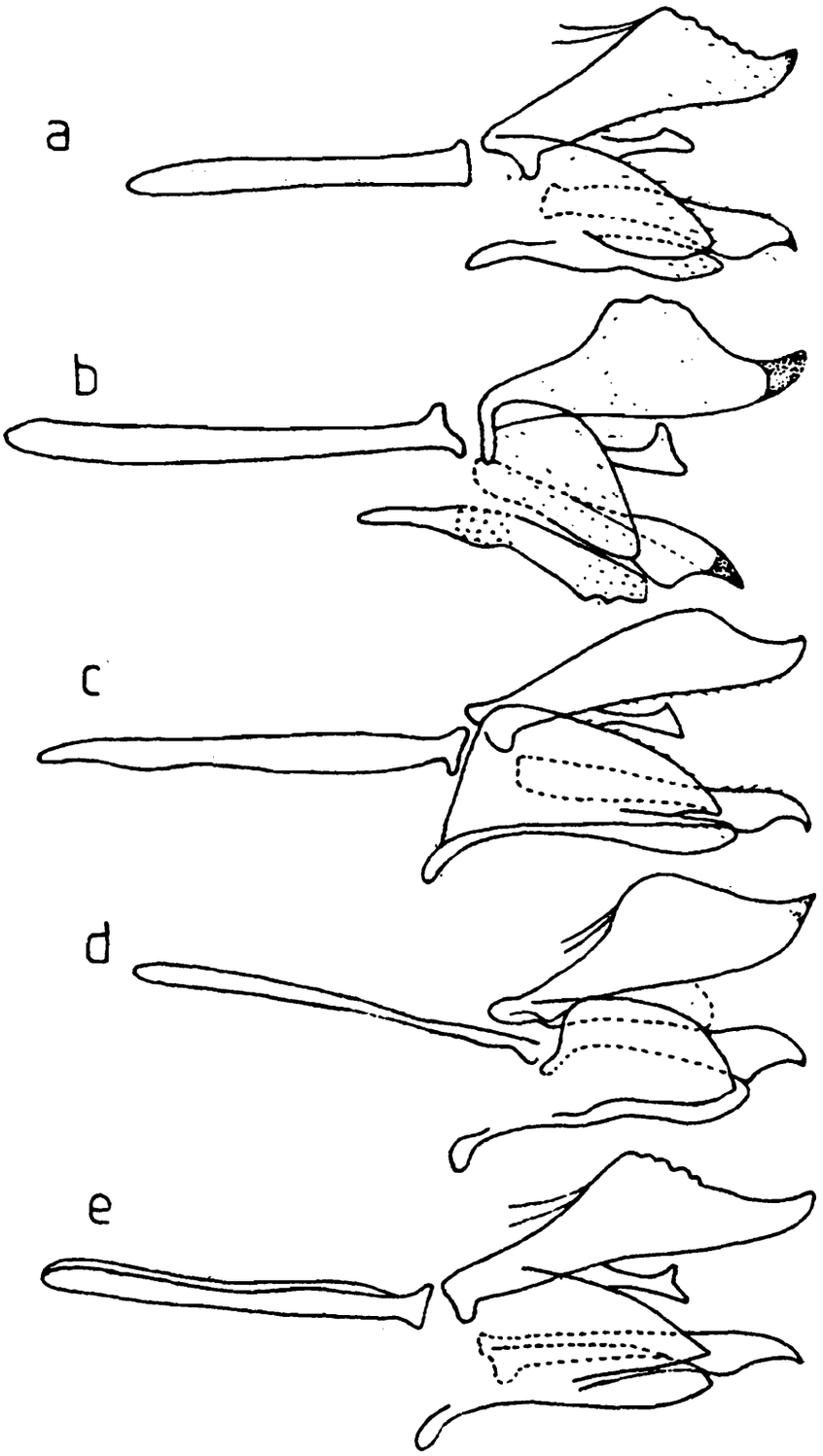
Figs. 96. Showing male genetalia (epiphallus) of studied grasshoppers, a. *Trilophidia annulata*, b. *Locusta migratoria*, c. *Gesonula punctifrons*, d. *Spathosternum prasiniferum*, e. *Hieroglyphus banian*, f. *Oxya fuscovittata*, g. *Oxya hyla hyla*, h. *Oxya nitidula*, i. *Oxya velox*, j. *Tristria pulvinata*



Figs. 97. Showing female genetalia (ovipositor) of studied grasshoppers, a. *Atractomorpha crenulata, b. Chrotogonus trachypterus trachypterus, c. Hieroglyphus banian, d. Spathosternum prasiniferum prasiniferum*



Figs. 98. Showing female genetalia (ovipositor) of studied grasshoppers, a. *Oxya hyla hyla*, *b. Oxya velox*, *c. Choroedocus robustus*, *d. Locusta migratoria*



Figs. 99. Showing female genetalia (ovipositor) of studied grasshoppers, a. *Trilophidia annulata*, *b. Oedaleus abruptus*, *c. Phlaeoba infumata*, *d. Acrida exaltata*, *e. Eyprepocnemis alacris alacris*

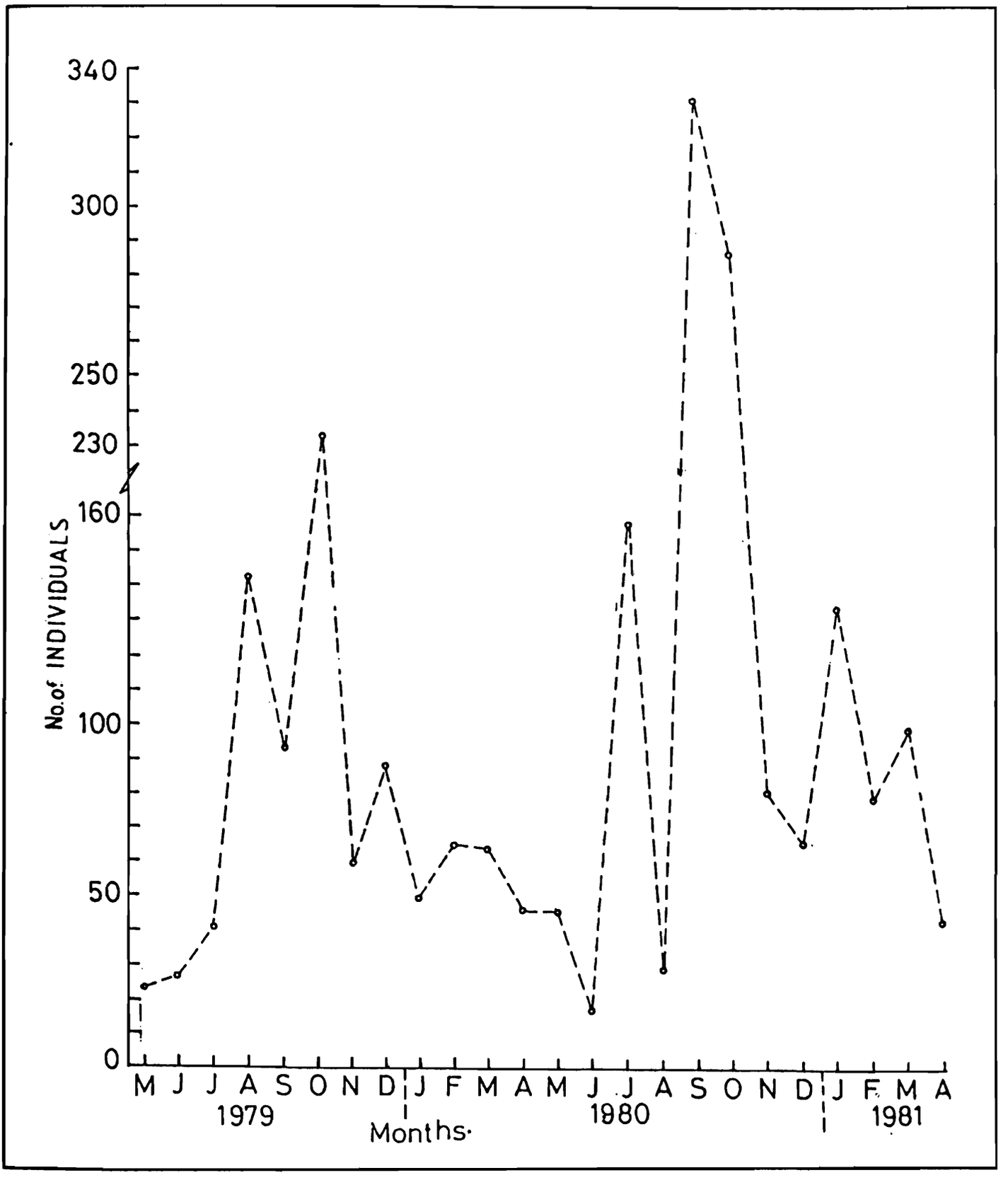


Fig. 100. Diagram showing monthly fluctuations of total Grasshoppers population at Botanical Gardens.

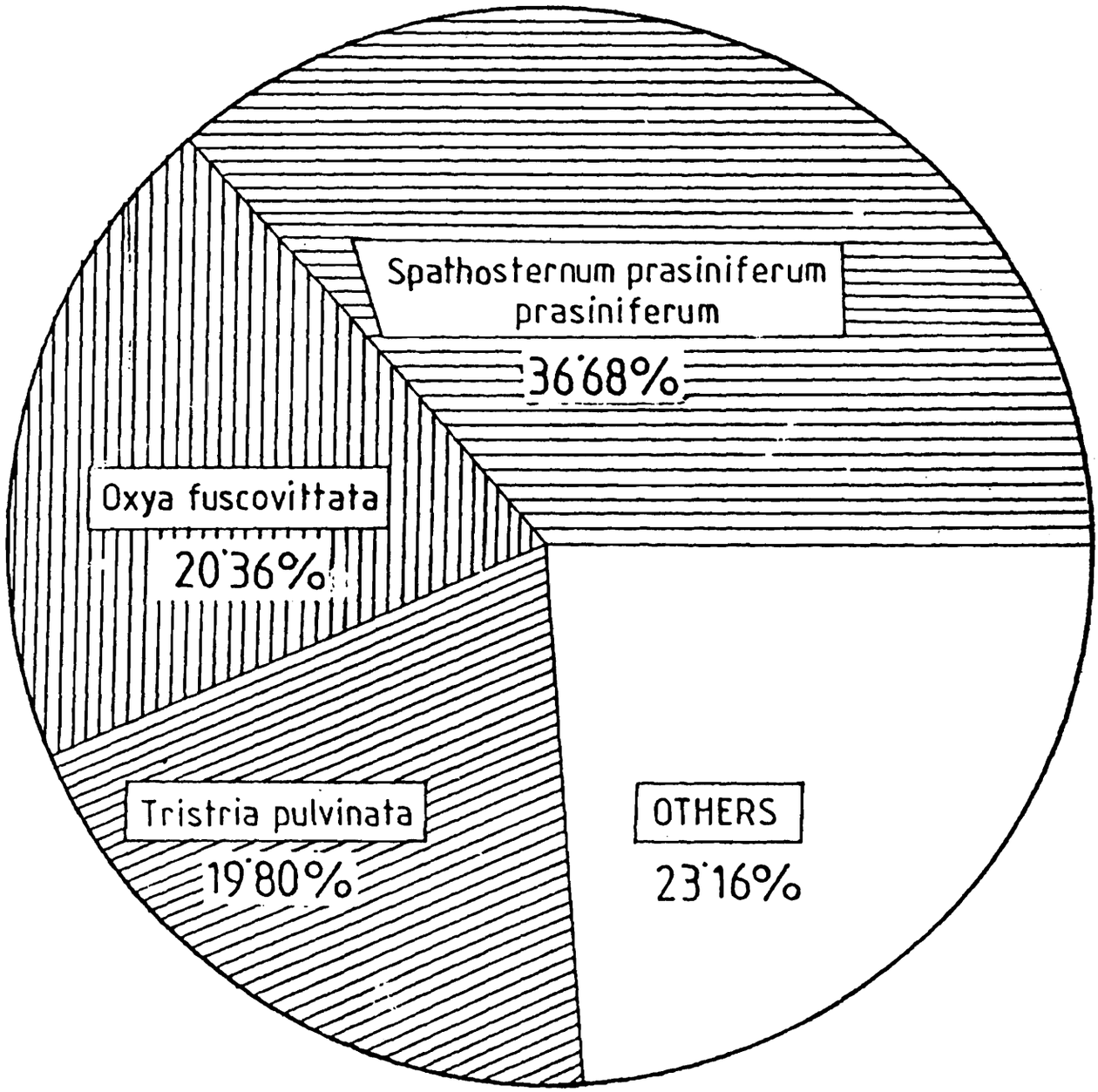


Fig. 101. Schematic pie-diagram showing composition of three dominant and other species of grasshopper population at Botanical Garden (%).

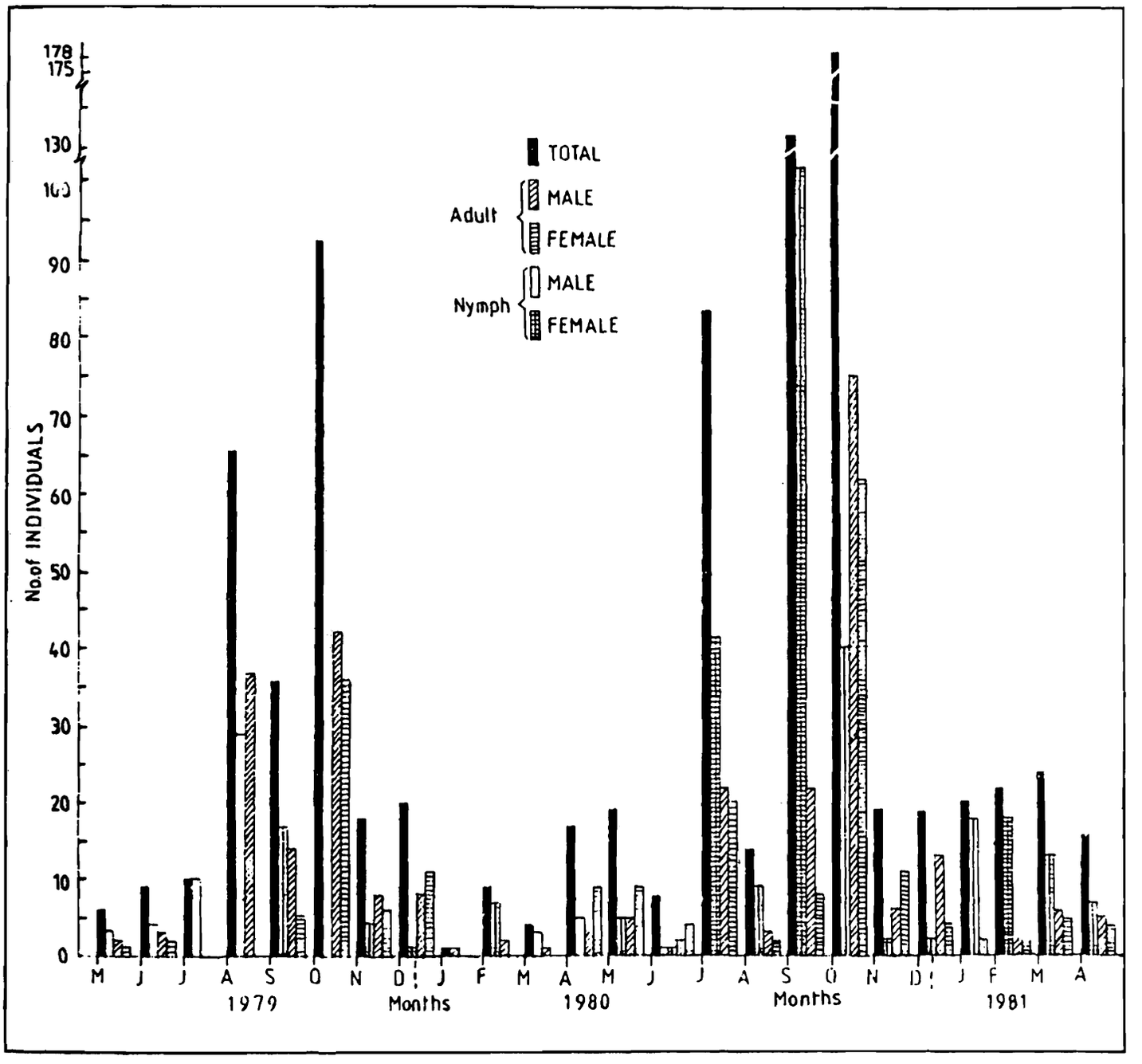


Fig. 102. Showing monthly fluctuations of *Spathosternum prasiniferum prasiniforum* male, female and nymphal population.

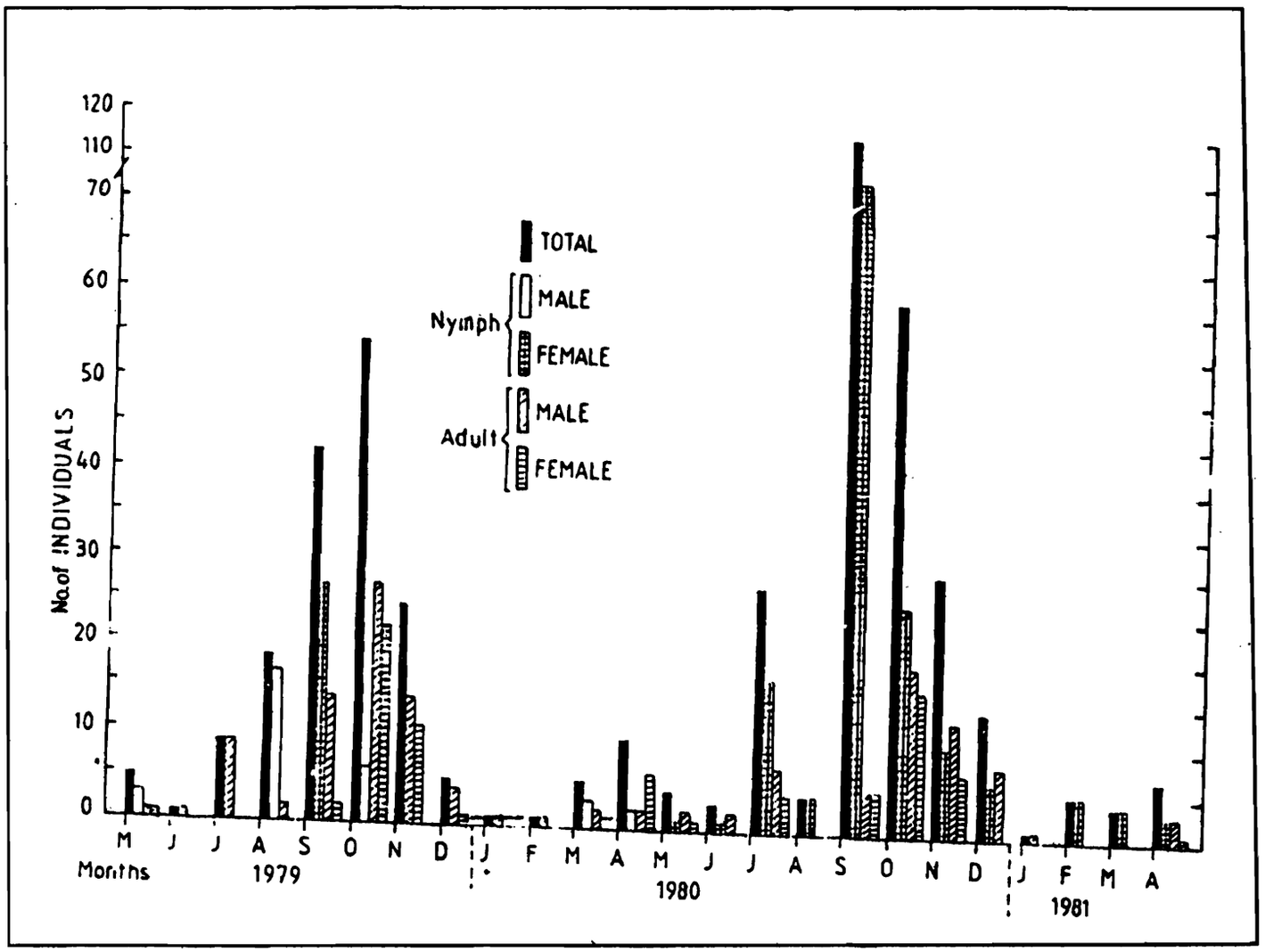


Fig. 103. Showing monthly fluctuation of *Oxya fuscovittata* male, female and nymphal population.

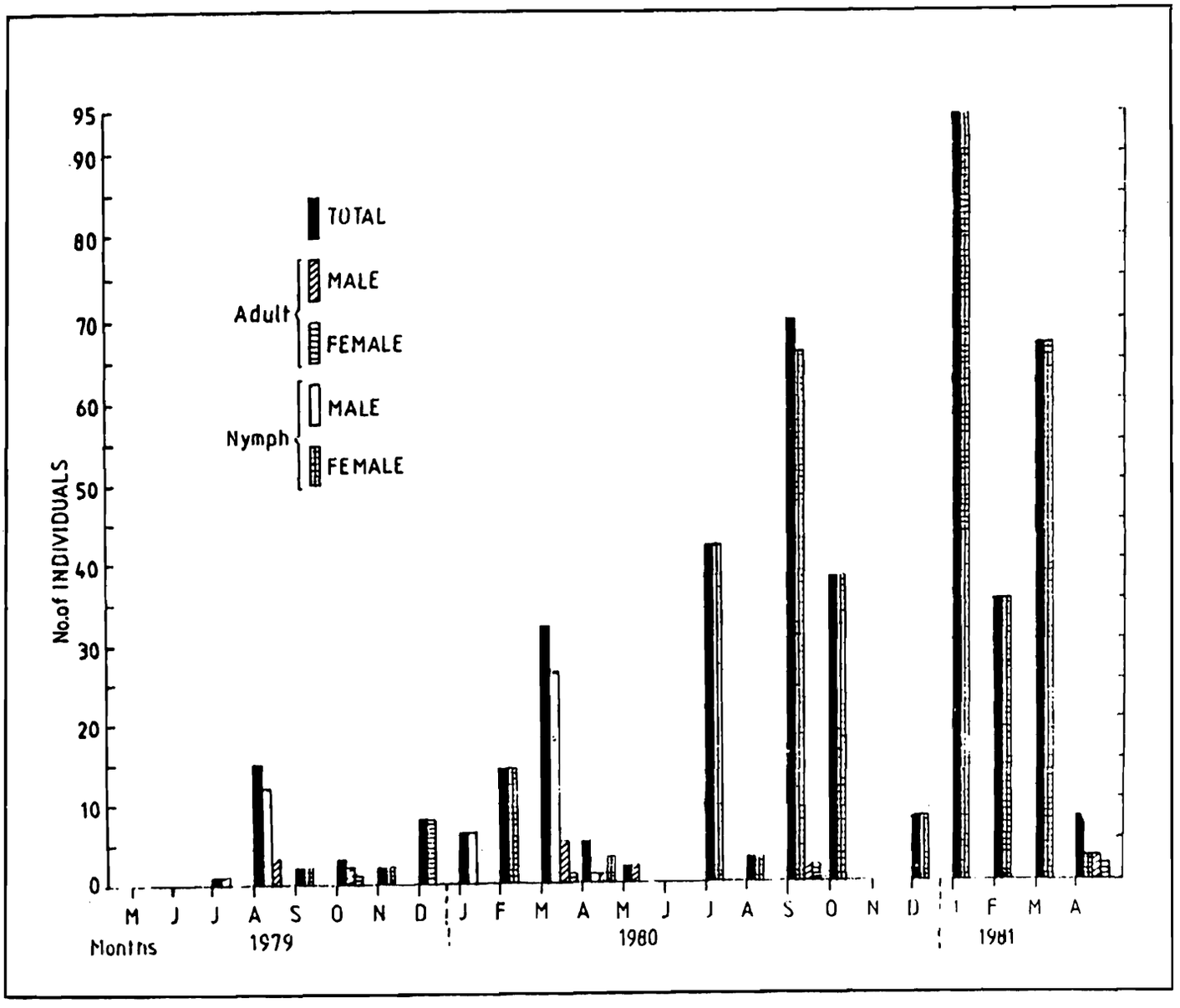


Fig. 104. Showing monthly fluctuation of *Tristria pulvinata* male, female and nymphal population.

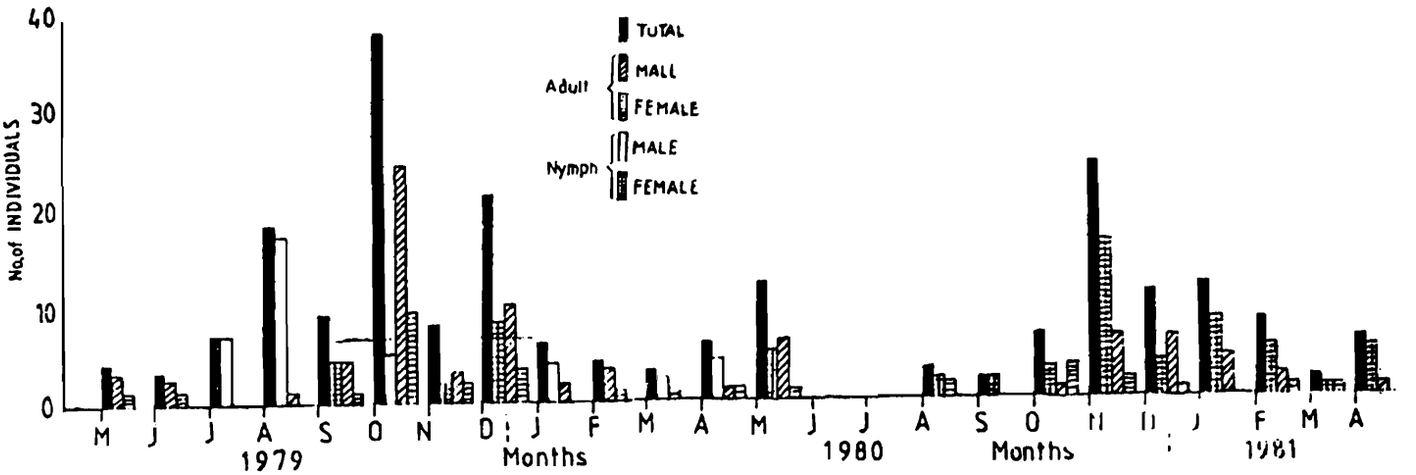


Fig. 105. Showing monthly fluctuation of *Atractomorpha crenulata* male, female and nymphal population.

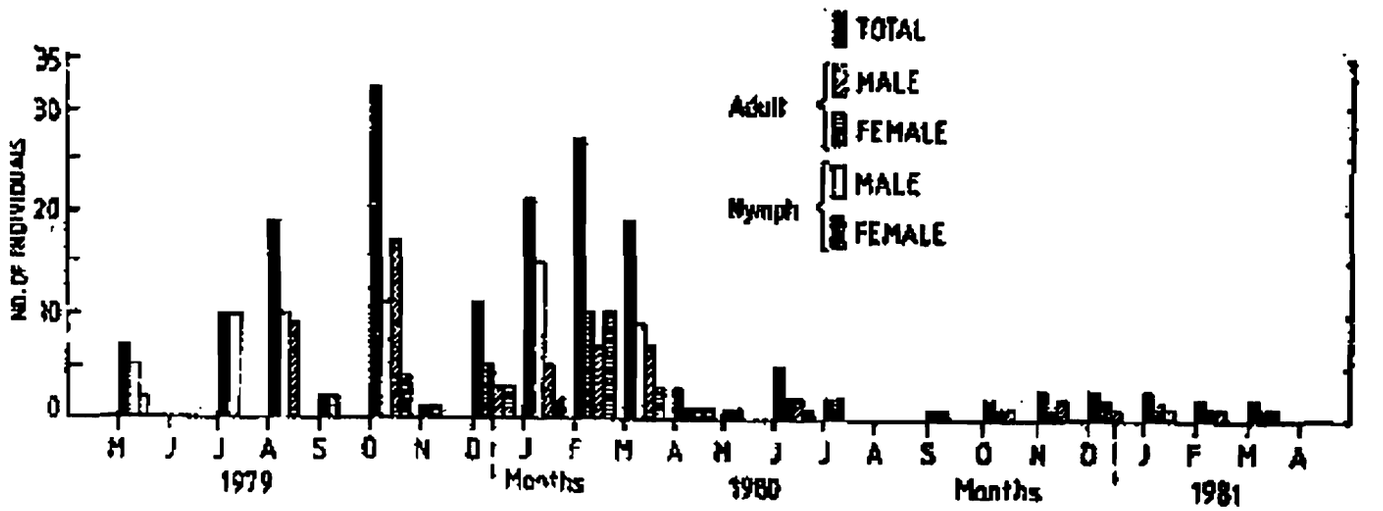
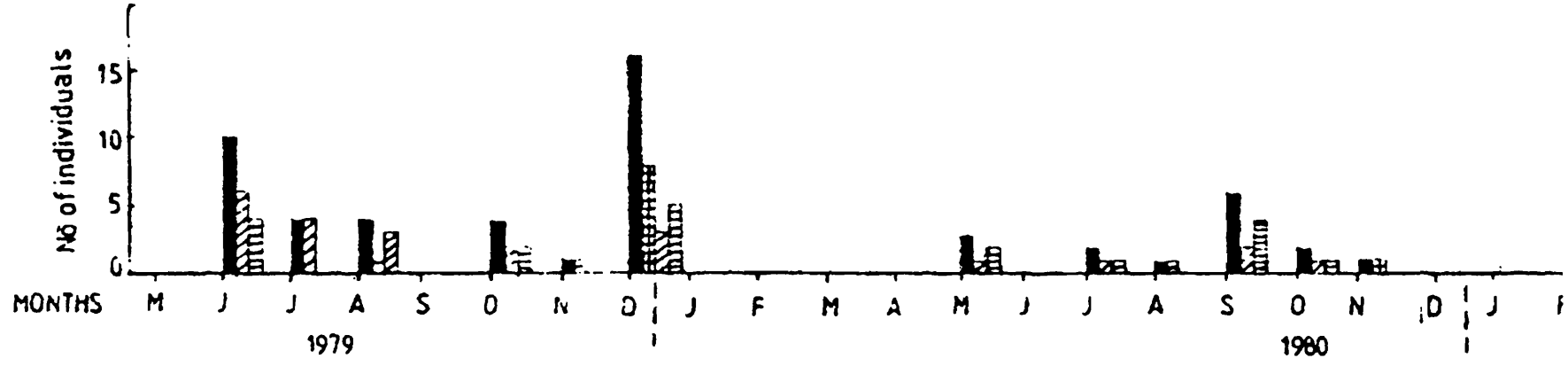
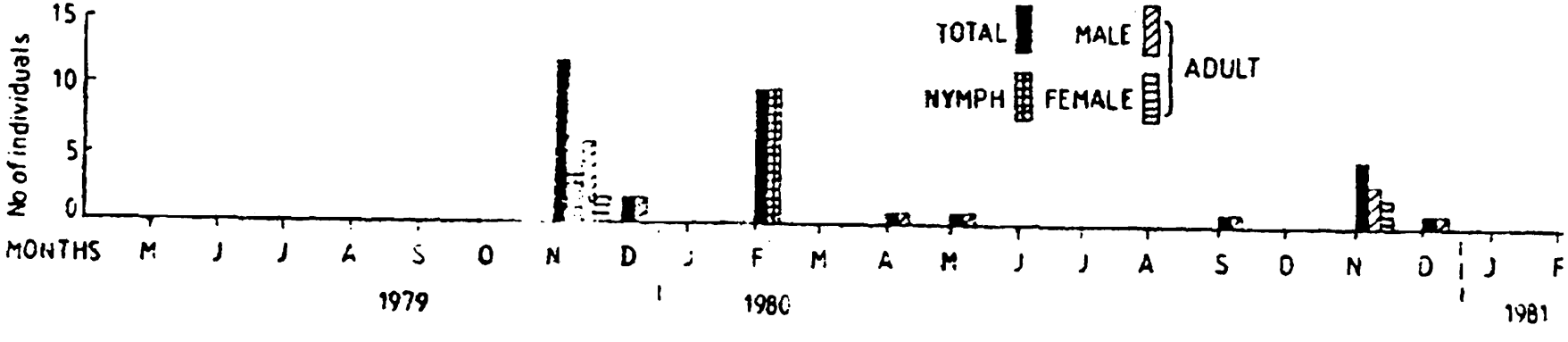


Fig. 106. Showing monthly fluctuation of *Phlaeoba infumata* male, female and nymphal population.





Figs. 107. Showing monthly fluctuation of *Aiolopus thalassinus tamulus* male, female and nymphal population, **108.** Showing monthly fluctuation of *Oxya hyla hyla* male, female and nymphal population.

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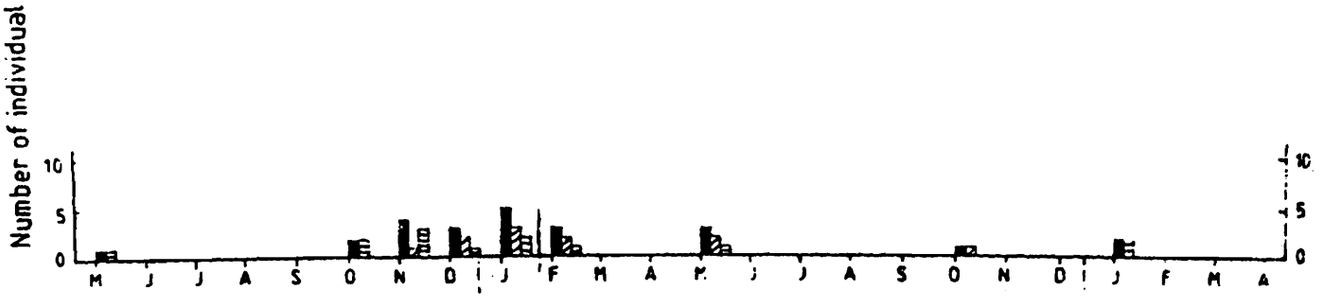

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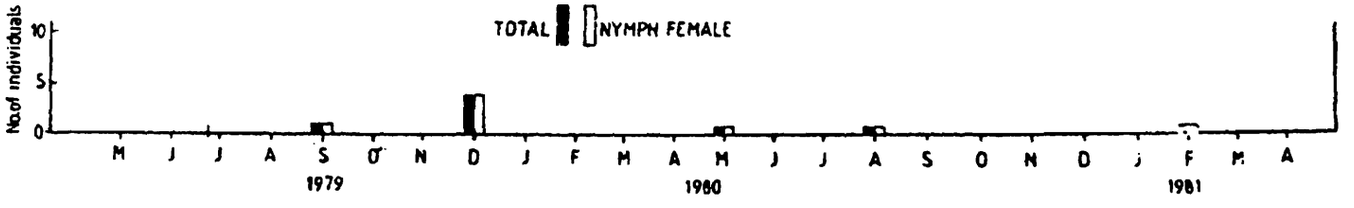

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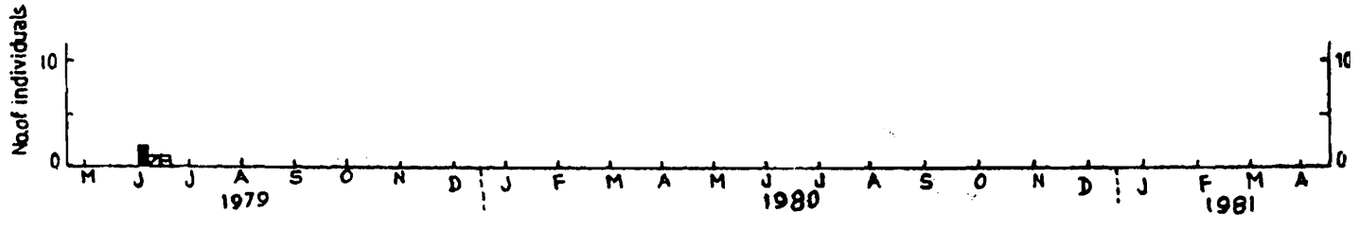

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Figs. 109. Showing monthly fluctuation of *Aulacobothrus luteipes* male, female and nymphal population. **110.** Showing monthly fluctuation of *Gesonula punctifrons* male, female and nymphal population, **111.** Showing monthly fluctuation of *Acrida exaltata* male, female and nymphal population, **112.** Showing monthly fluctuation of *Epistaurus sinetyi* male, female and nymphal population.

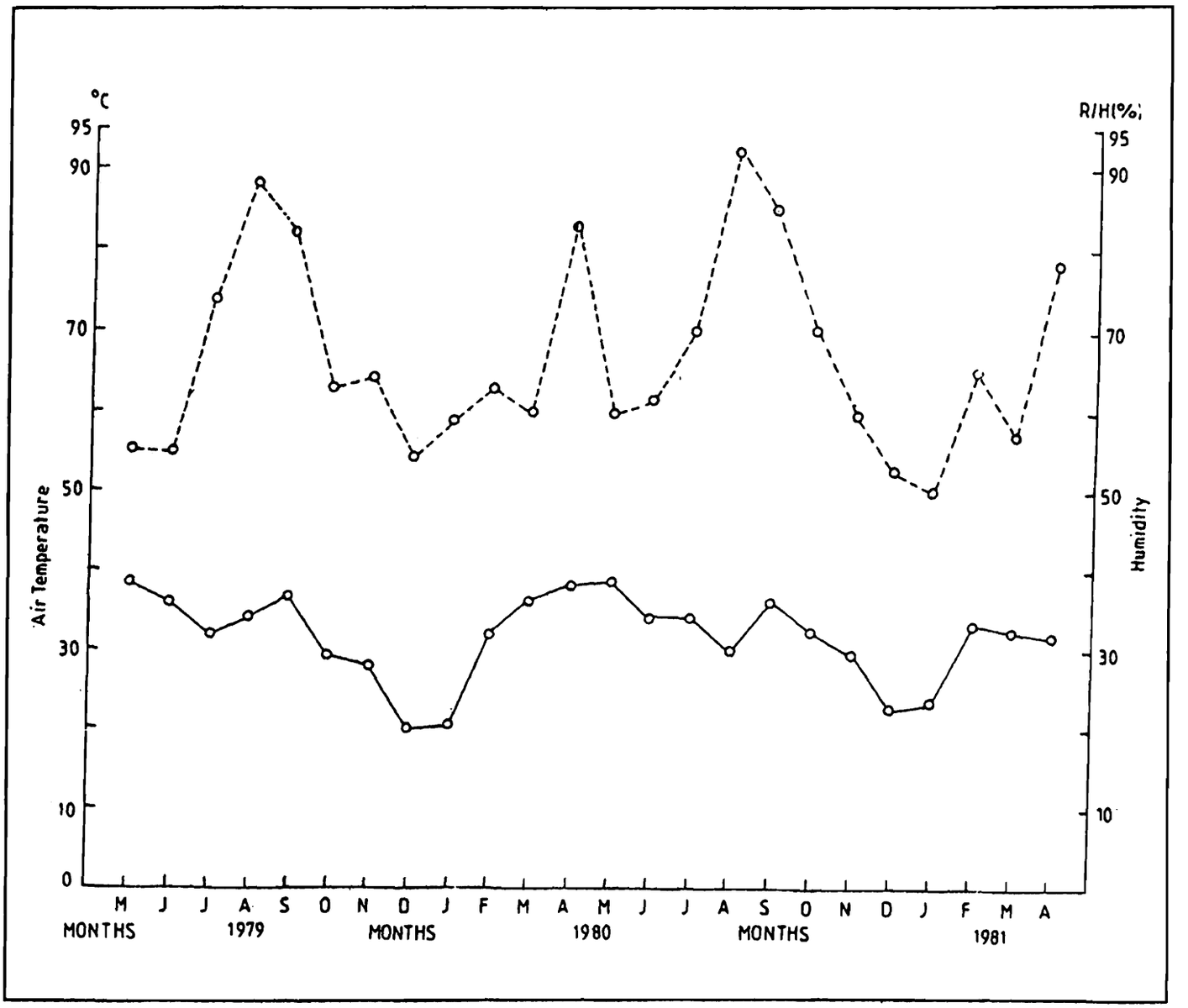
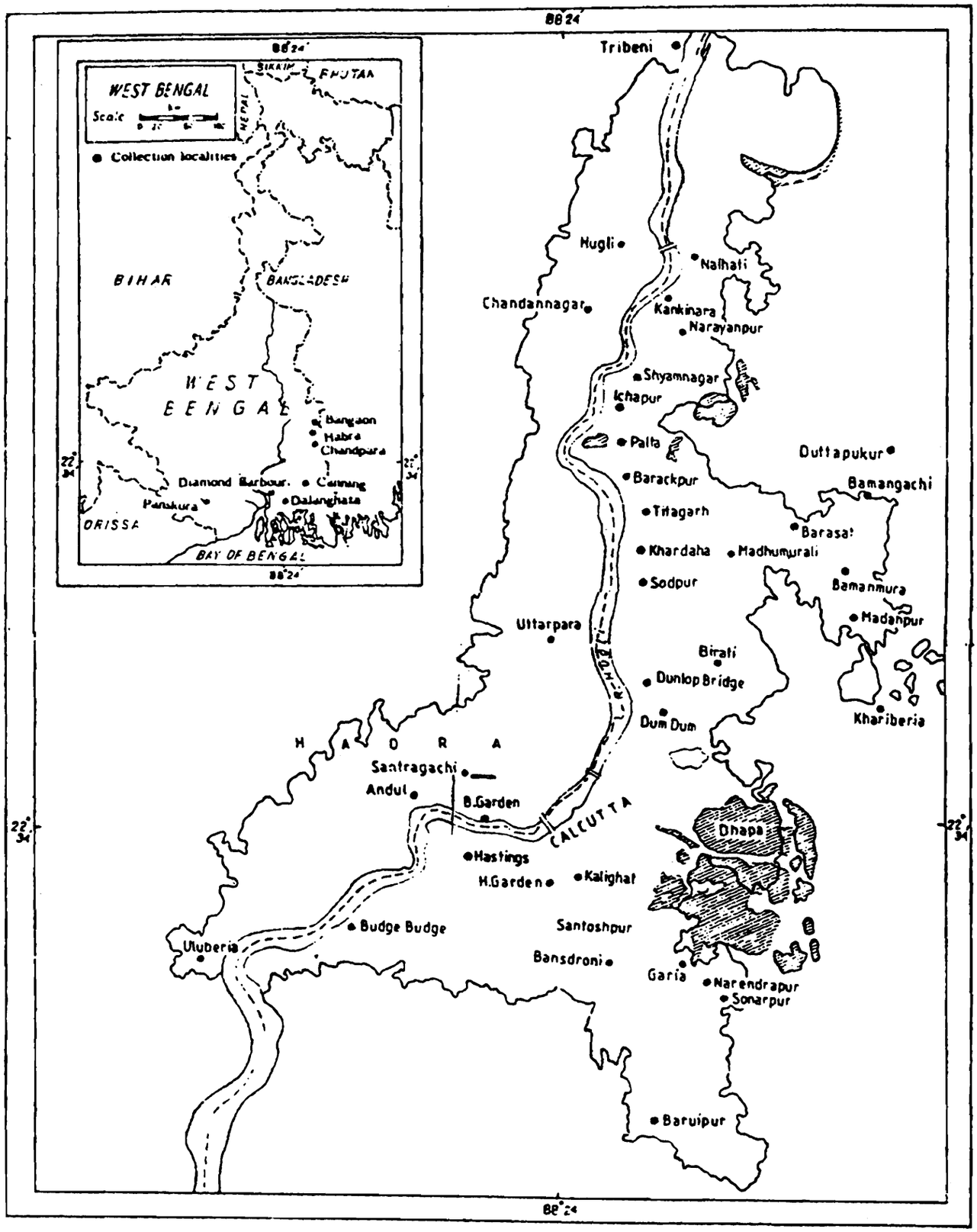
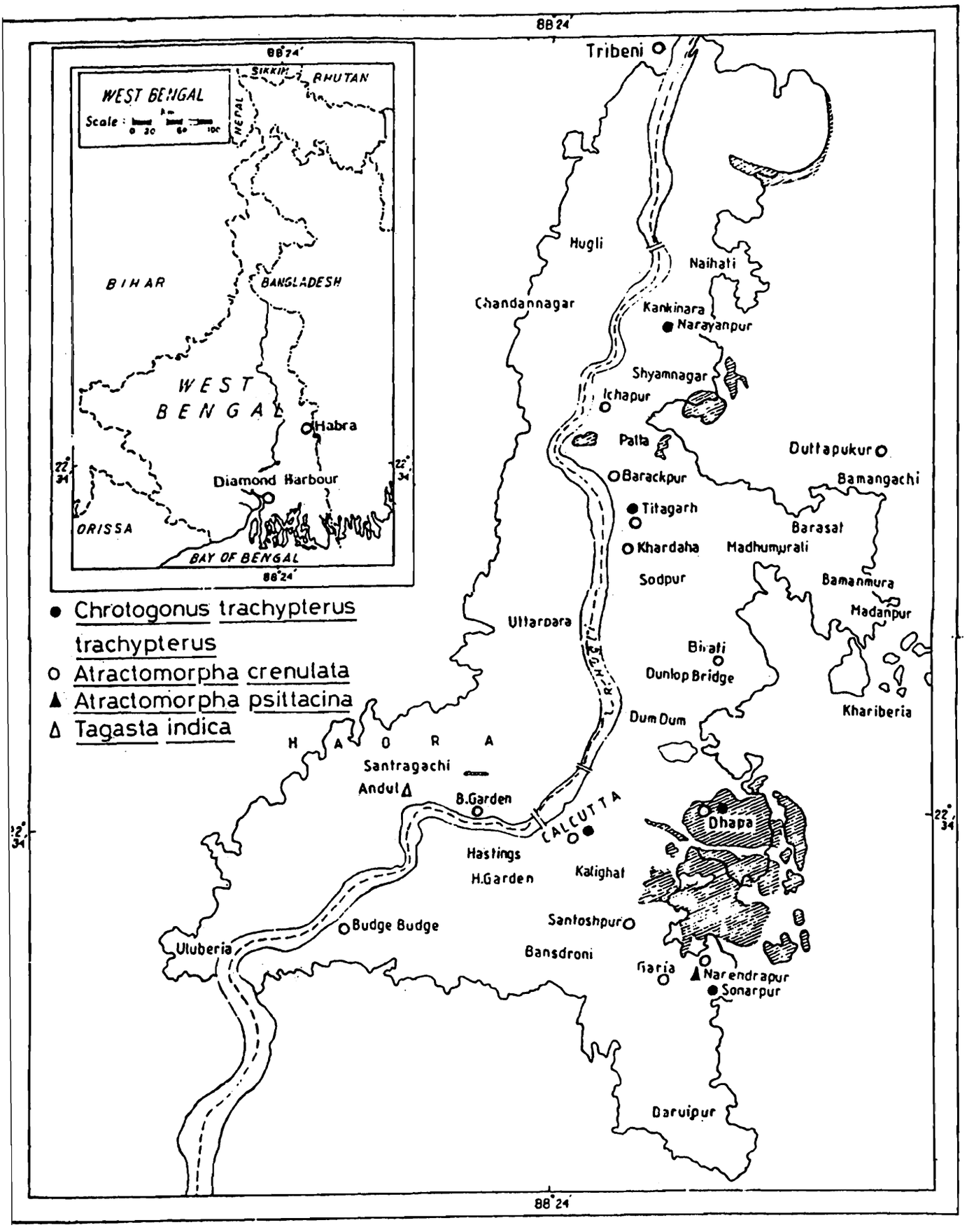


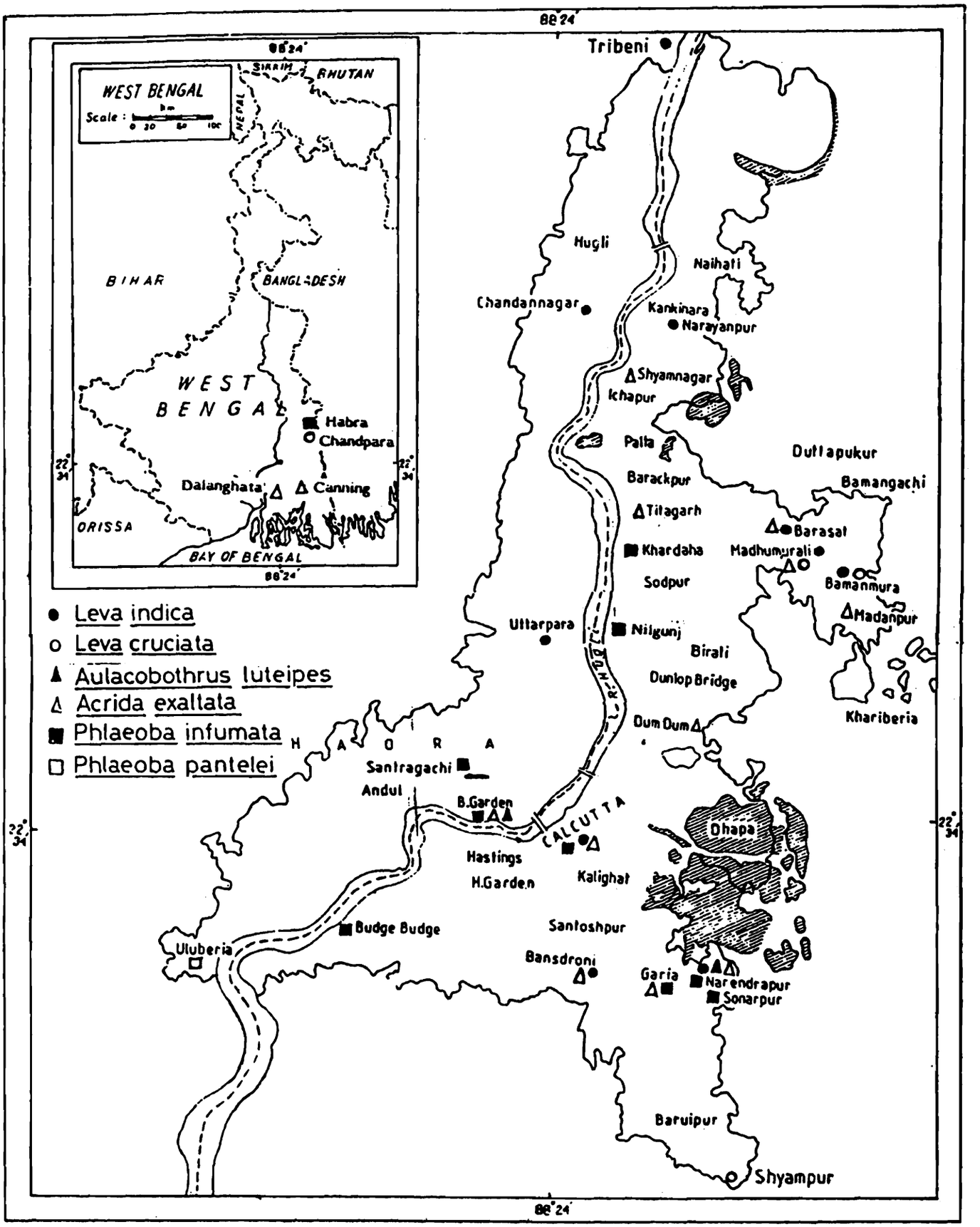
Fig. 113. Showing monthly fluctuaion of Air temperature (°C) and R/H (%) at Botanical Garden, Howrah.



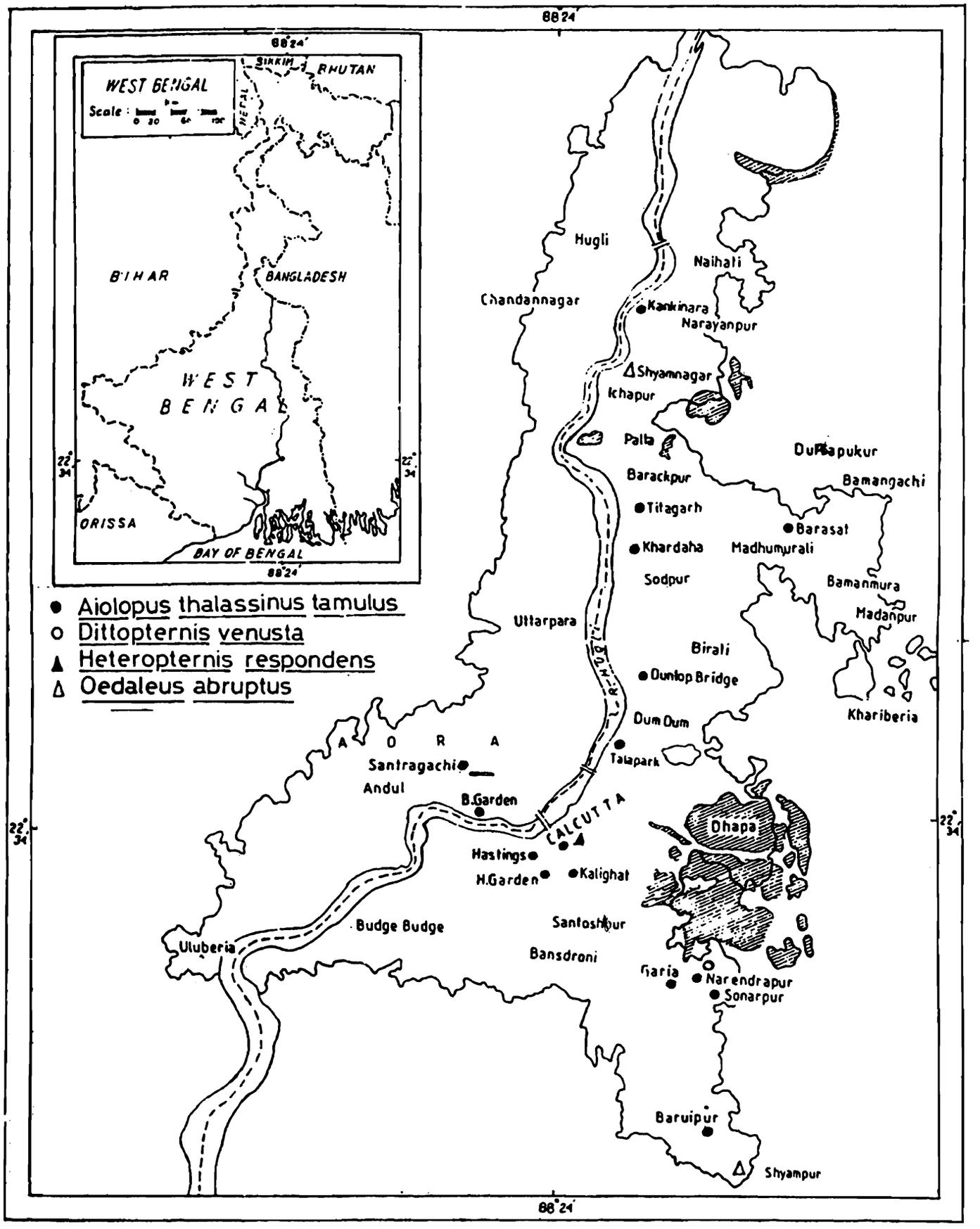
MAP 1 : MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)



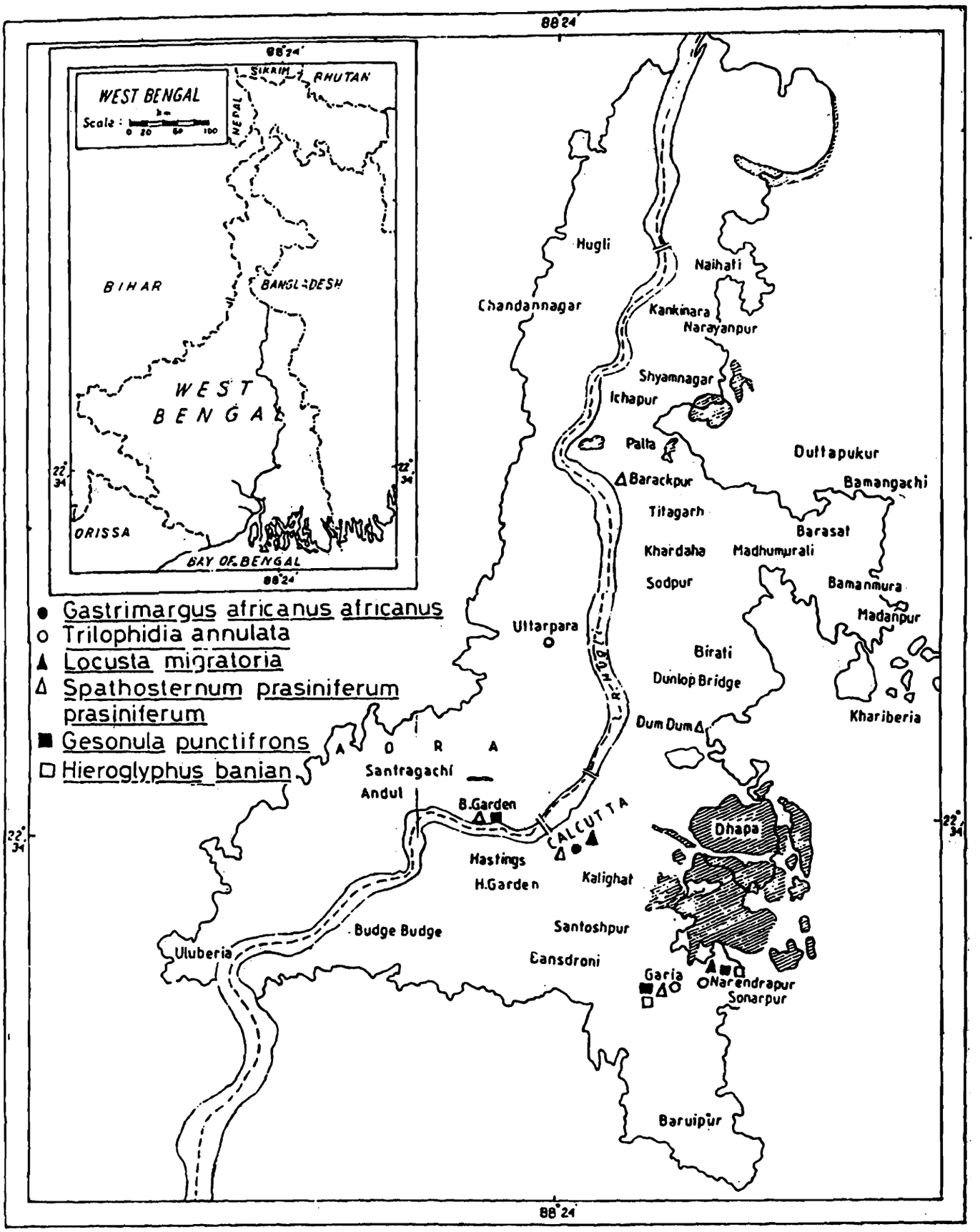
MAP 2 : MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)



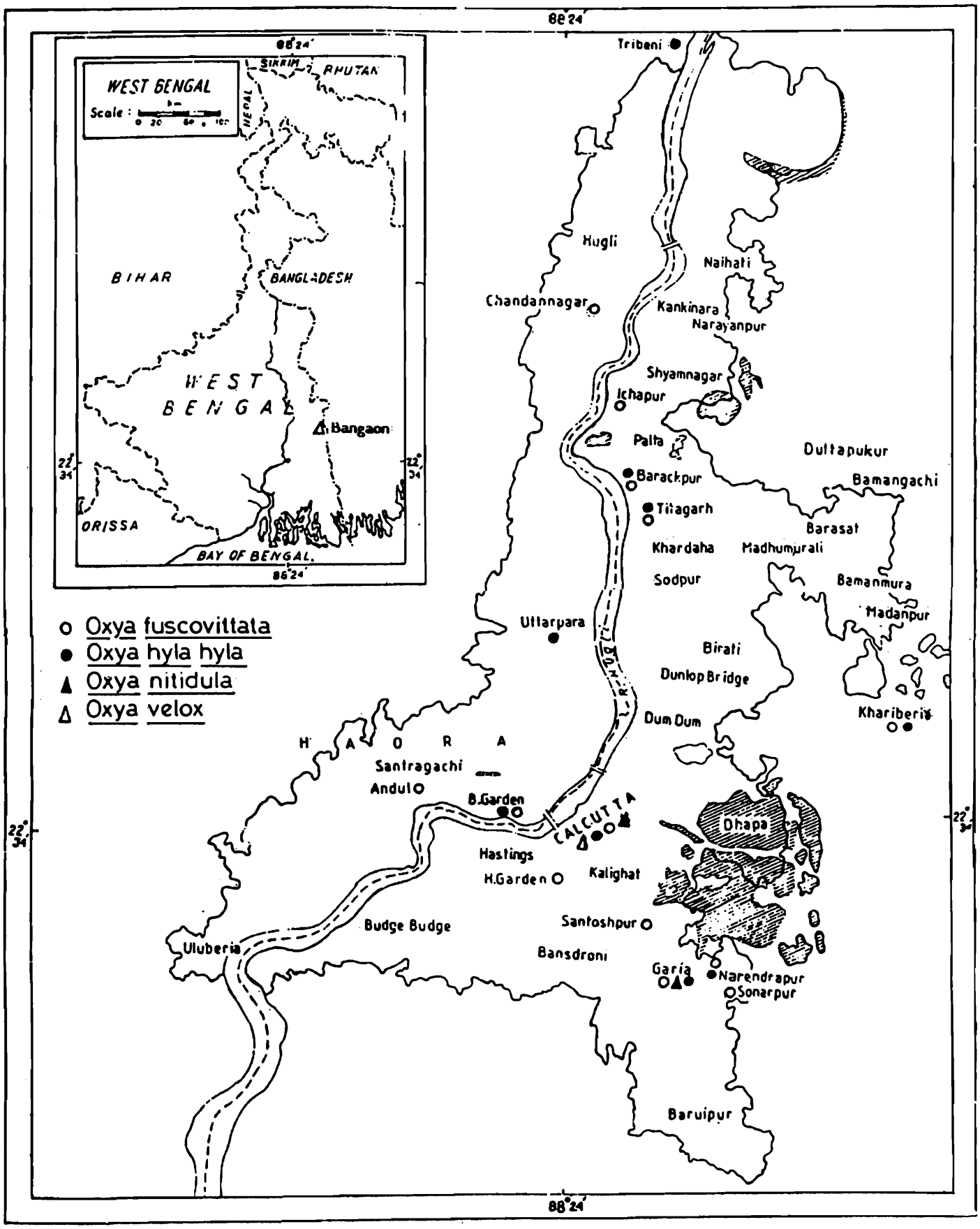
MAP 3 : MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)



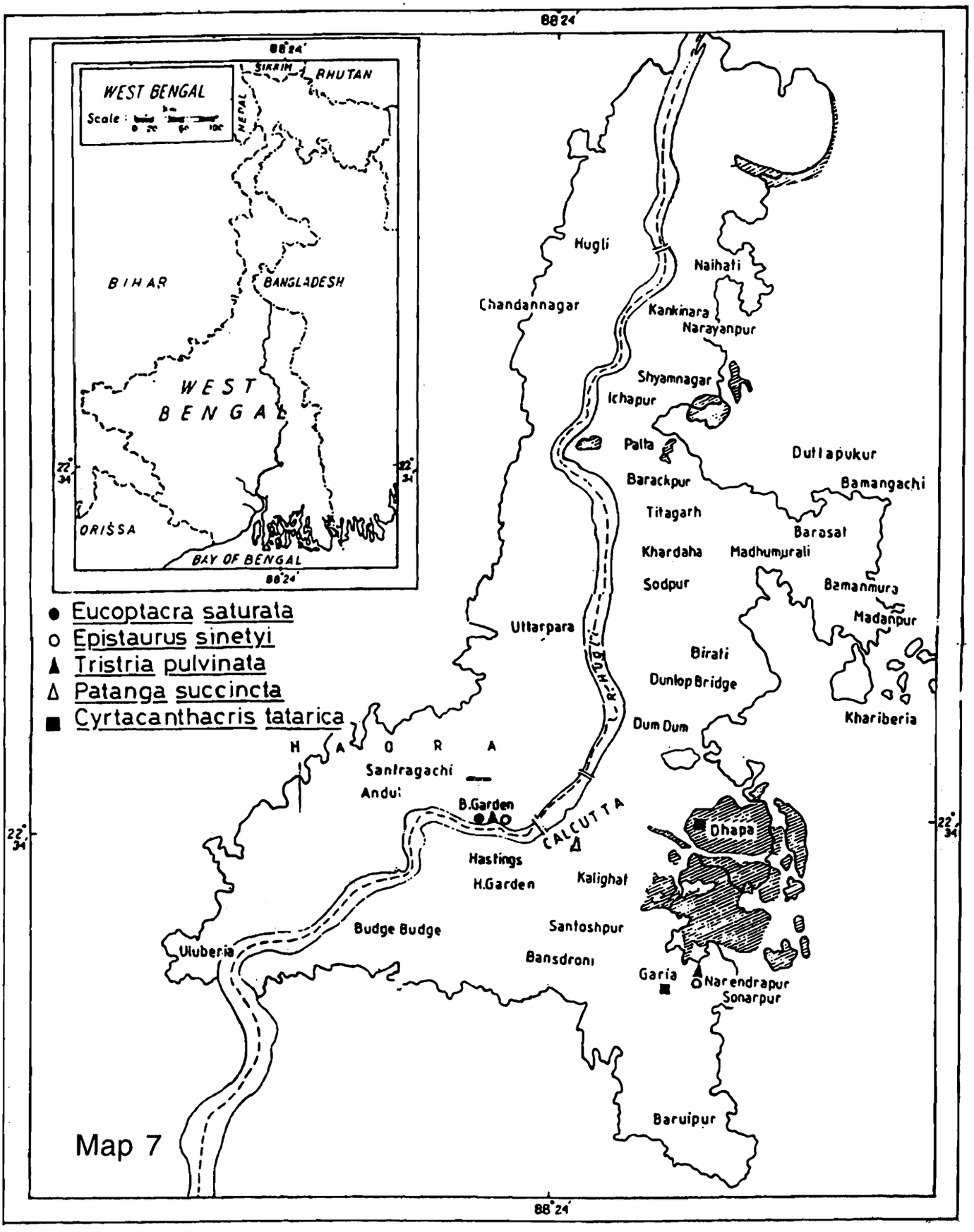
MAP 4 : MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)



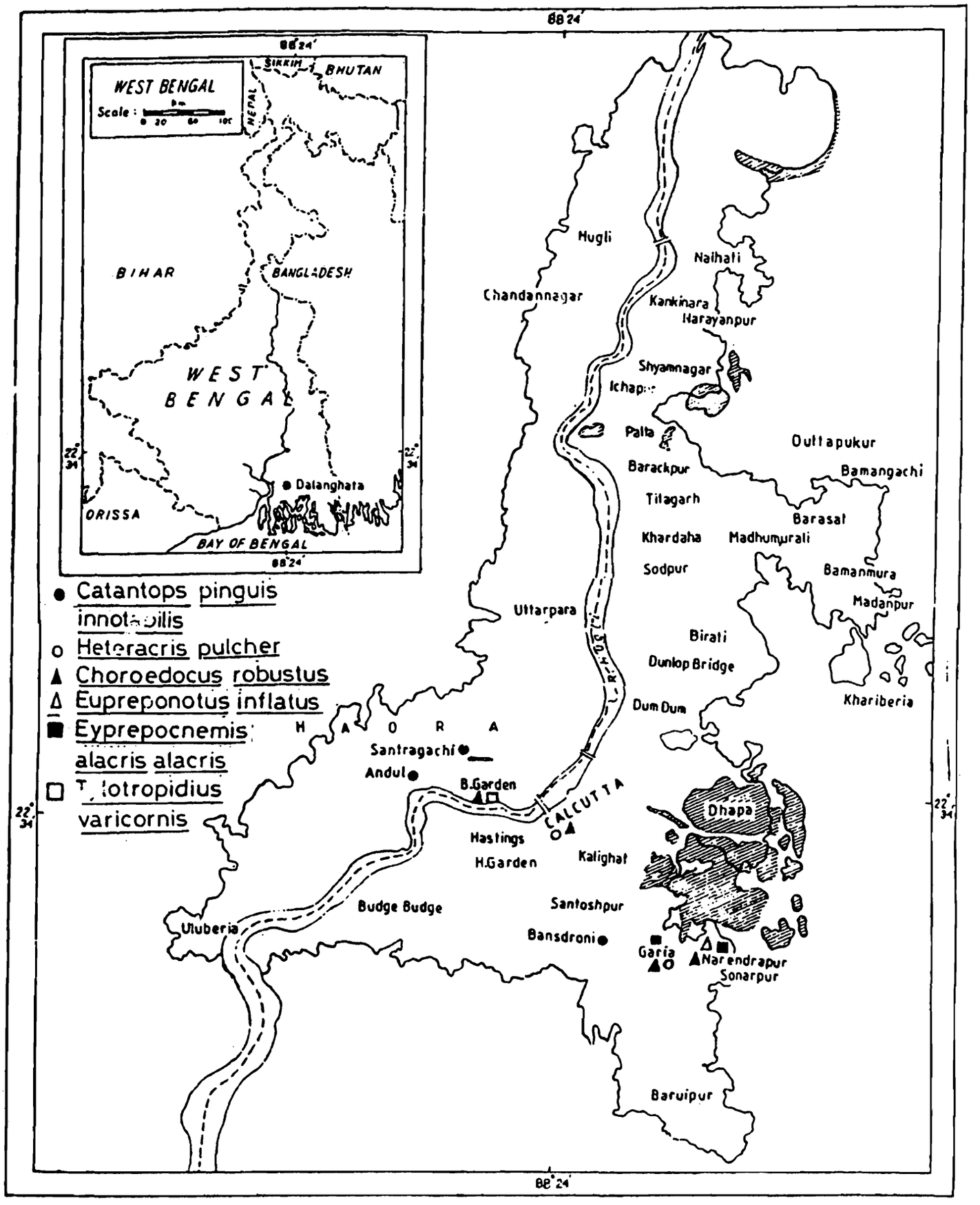
MAP 5 : MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)



MAP 6 : MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)



MAP 7 :*MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)



MAP 8 : MAP OF CALCUTTA WITH ADJOINING AREAS (NOT TO THE SCALE)

Table 2 : Monthly occurence of Grasshoppers (number) at Botanical Garden. (From May 1979 to April 1981) Percentage shown in parenthesis

	1979	1980	1981
Jan.		50(2.170)	134(5.815)
Feb.		65(2.821)	79(3.428)
Mar.		64(2.777)	99.(4.296)
Apr.		46(1.996)	43(1.866)
May.	23(.998)	46(1.996)	
Jun.	27(1.171)	17(0.737)	-
Jul.	41(1.779)	158(6.587)	
Aug.	141(6.119)	29(1.258)	
Sep.	93(4.036)	332(14.409)	
Oct.	235(10.199)	287(12.456)	
Nov.	60(2.604)	81(3.515)	-
Dec.	88(3.819)	66(2.864)	-
	Total		2304

Table 3 : Showing monthly fluctuatuins of population of *Spathosternum prasiniferum prasiniferm* (%) at Botanical Garden Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979	.13		.09	.04	.26
Jun.		.17		.13	.09	.39
Jul.	-	.43		-		.43
Aug.		1.26		1.61	-	2.87
Sep.			.74	.61	.22	1.57
Oct.		.65		1.82	1.57	4.04
Nov.			.17	.35	.26	.78
Dec.			.04	.35	.48	.87
Jan.	1980		-	.04	-	.04
Feb.			.30	.09	-	.39
Mar.		.13		.04		.17
Apr.	-	.22		.13	.39	.74
May.			.22	.22	.39	.83
Jun.		.04	.04	.09	.17	.34
Jul.			1.82	.95	.87	3.64
Aug.			.39	.09	.13	.61
Sep.	-p;		4.47	.95	.35	5.77
Oct.			1.74	3.30	2.69	7.73
Nov.			.09	.26	.48	.83
Dec.			.09	.56	.17	.82
Jan.	1981		.78	.09	-	.87
Feb.			.78	.09	.09	.96
Mar.			0.56	.26	.22	1.04
Apr.			.30	.22	.17	.69
	Total	=3.03	=12.53	=12.34	=8.78	=36.68

Table 4 : Showing monthly fluctuations of population of *Oxya fuscovittata* (%) at Botanical Garden Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979	.13		.04	.04	.21
Jun.		.04		.04	.04	.12
Jul.				.39		.39
Aug.		.74		.09		.83
Sep.			1.17	.61	.09	1.87
Oct.		.26		1.17	.95	2.38
Nov.				.61	.48	1.09
Dec.				.17	.04	0.21
Jan.	1980			.04		.04
Feb.				.04		.04
Mar.		.13		.09		0.22
Apr.		.09		.09	.26	0.44
May.			.04	.09	.04	0.17
Jun.			.04	.09	.04	.17
Jul.			.74	.30	.17	1.21
Aug.			.17			0.17
Sep.			4.73	.22	.22	5.17
Oct.			1.13	.82	.69	2.64
Nov.			.43	.56	.30	1.29
Dec.			.26	.35		0.61
Jan.	1981			0.4		0.40
Feb.			.22			.22
Mar.			.17			0.17
Apr.		-	.13	.13	.04	0.30
	Total	=1.39	=9.23	=5.98	=3.40	=20.36

Table 5 : Showing monthly fluctuations of population of *Tristria pulvinata* (%) at Botanical Garden Howrah.

Month	Year	N♂	N♀	A♂	A♀	Total
May.	1979			-		
Jun.						
Jul.		.04				.04
Aug.		.52		.13		.65
Sep.			.09			.09
Oct.				.09	.04	.13
Nov.			.09			.09
Dec.					.35	.35
Jan.	1980	.26				.26
Feb.			.61			.61
Mar.		1.13		.22	.04	1.39
Apr.		.04		.04	.13	.21
May.				.09		.09
Jun.						
Jul.			1.82			1.82
Aug.			.13			13
Sep.			2.86	.09	.09	3.04
Oct.			1.65			1.65
Nov.						
Dec.			.35			.35
Jan.	1981		4.12			4.12
Feb.			1.52			1.52
Mar.			2.91			2.91
Apr.			.13	.13	.09	.35
	Total	=1.99	=16.28	=.79	=.74	=19.80

Table 6 :Showing monthly fluctuations of poplation of *Atractomorpha crenulata* (%) at Botanical Garden Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979			.13	.04	.17
Jun.				.09	.04	.13
Jul.		.30				.30
Aug.		.74		.04		.78
Sep.			.17	.17	.04	.38
Oct.		.22		1.04	.38	1.64
Nov.			.09	.13	.09	.31
Dec.			.35	.43	.13	.91
Jan.	1980	.17		.09		.26
Feb.				.13	.04	.17
Mar.		.09			.04	.13
Apr.		.17		.04	.04	.25
May.			.22	.26	.04	.52
Jun.						
Jul.						
Aug.			.09		.04	.13
Sep.			.09			.09
Oct.			.13	.04	.13	.30
Nov.			.69	.26	.09	1.04
Dec.			.17	.26	.04	.47
Jan.	1981		.35	.17		.52
Feb.			.22	.09	.04	.35
Mar.			.04		.04	.08
Apr.			.22	.04		.26
	Total	=1.69	=2.83	=3.41	=1.26	=9.19

Table 7 :Showing monthly fluctuations of poplation of *Phlaeoba infumata* at Botanical Garden, Howrah.

Month	Year	N♂	N♀	A♂	A♀	Total
May.	1979	.22		.09		.31
Jun.	"					
Jul.	"	.43				.43
Aug.	"	.43		.39		.82
Sep.	"			.09		.09
Oct.	"	.48		.74		1.22
Nov.	"			.04		.04
Dec.	"		.22	.13	.13	.48
Jan.	1980	.65		.22	.04	.91
Feb.	"		.43	.30	.43	1.16
Mar.	"	.39		.30	.13	.82
Apr.	"		.04	.04	.04	.12
May.	"		.04			.04
Jun.	"		.09	.09	.04	.22
Jul.	"		.09			.09
Aug.	"					-
Sep.	"		.04			.04
Oct.	"			.04		.04
Nov.	"		.04	.04		.08
Dec.	"		.04	.09		.13
Jan.	1981		.09	.04		.13
Feb.	"		.04	.04		.08
Mar.	"		.04		.04	.08
Apr.	"					
	Total	=2.60	=1.20	=2.68	=0.85	=7.33

Table 8 :Showing monthly fluctuations of poplation of *Aiolopus thalassinus tamulus* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					
Jun.				.26	.17	.43
Jul.				.17		.17
Aug.		.04		.13		.17
Sep.		.04				.04
Oct.				.09	.09	.18
Nov.					.04	.04
Dec.			.35	.13	.22	.70
Jan.	1980					
Feb.						
Mar.						
Apr.						
May.				.04	.09	.13
Jun.						
Jul.				.04	.04	.08
Aug.					.04	.04
Sep.				.09	.17	.26
Oct.				.04	.04	.08
Nov.			.04			.04
Dec.						
Jan.	1981					
Feb.						
Mar.						
Apr.						
	Total	=.08	=.39	=.99	=.90	=2.36

Table 9 :Showing monthly fluctuations of poplation of *Oxya hyla hyla* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					
Jun.						
Jul.						
Aug.						
Sep.						
Oct.	-		.17	.26	.09	.52
Nov.				.09		.09
Dec.						
Jan.	1980		.43			.43
Feb.						
Mar.				.04		.04
Apr.			-			
May.				.04		.04
Jun.						
Jul.						
Aug.						
Sep.				.04		.04
Oct.						
Nov.				.13	.09	.22
Dec.				.04		.04
Jan.	1981					
Feb.						
Mar.						
Apr.			.09	.04		.13
	Total	=0	=.69	=.68	=.18	=1.55

Table 10 : Showing monthly fluctuations of poplation of *Gesonula punctifrons* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979				.04	.04
Jun.						-
Jul.						
Aug.						-
Sep.						
Oct.					.09	.09
Nov.				.04	.13	.17
Dec.				.09	.04	.13
Jan.	1980			.13	.09	.22
Feb.				.09	.04	.13
Mar.						
Apr.						
May.				.09	.04	.13
Jun.						
Jul.						
Aug.				-		
Sep.						
Oct.						
Nov.						
Dec.						-
Jan.	1981					
Feb.					.09	.09
Mar.	-				-	-
Apr.						-
	Total	0	0	.44	.56	1.00

Table 11 : Showing monthly fluctuations of poplation of *Aulacobothrus luteipes* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					-
Jun.						
Jul.						
Aug.						
Sep.						
Oct.						
Nov.						
Dec.						
Jan.	1980					
Feb.			.26	.04		.30
Mar.		.13			.09	.22
Apr.						
May.						
Jun.						
Jul.						-
Aug.						
Sep.						
Oct.						
Nov.						
Dec.			.43			.43
Jan.	1981		.13			.13
Feb.			.17			.17
Mar.						
Apr.			.13		-	.13
	Total	=.13	=1.12	=.04	=.09	=1.38

Table 12 : Showing monthly fluctuations of poplation of *Acrida exaltata* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979	-				
Jun.						
Jul.						
Aug.	-					
Sep.			.04			.04
Oct.						
Nov.						
Dec.			.17			.17
Jan.	1980					
Feb.						
Mar.						
Apr.						
May.			.04			.04
Jun.						
Jul.						
Aug.			.04			.04
Sep.						
Oct.						
Nov.						
Dec.						
Jan.	1981					
Feb.			.04			.04
Mar.						
Apr.						
	Total	=0	=.33	=0	=0	=.33

Table 13 : Showing monthly fluctuations of poplation of *Epistaurus sinetyi* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					
Jun.				.04	.04	.08
Jul.						
Aug.						
Sep.						
Oct.						
Nov.						
Dec.						
Jan.	1980					
Feb.						
Mar.						
Apr.						
May.						
Jun.						
Jul.						
Aug.						
Sep.						
Oct.						
Nov.						
Dec.						
Jan.	1981					
Feb.						
Mar.	-					
Apr.						
	Total	=0	=0	=.04	=.04	=.08

Name of the species : *Spathosternum prasiniferum prasiniferum* (Walker)

Table 14 : Showing monthly fluctuations of population of *Spathosternum prasiniferum prasiniferum* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total	
May.	1979	3		2	1	6	
Jun.	"	4		3	2	9	
Jul.	"	10				10	
Aug.	"	29		37		66	
Sep.	"		17	14	5	36	
Oct.	"	15		42	36	93	
Nov.	"		4	8	6	18	
Dec.	"		1	8	11	20	
Jan.	1980			1		1	
Feb.	"		7	2		9	
Mar.	"	3		1		4	
Apr.	"	5		3	9	17	
May.	"		5	5	9	9	
Jun.	"	1	1	2	4	8	
Jul.	"		42	22	20	84	
Aug.	"		9	2	3	14	
Sep.	"		103	22	8	133	
Oct.	"		40	76	62	178	
Nov.	"		2	6	11	19	
Dec.	"		2	13	4	19	
Jan.	1981		18	2		20	
Feb.	"		18	2	2	22	
Mar.	"		13	6	5	24	
Apr.	"		7	5	4	16	
	Total	=70	=289	=284	=202	=845	

Name of the species : *Oxya fuscovittata* (Marschall)

Table 15 : Showing monthly fluctuations of population of *Oxya fuscovittata* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979	3		1	1	5
Jun.	"	1		1	1	3
Jul.	"			9		9
Aug.	"	17		2		19
Sep.	"		27	14	2	43
Oct.	"	6		27	22	55
Nov.	"			14	11	25
Dec.	"			4	1	5
Jan.	1980			1		1
Feb.	"			1		1
Mar.	"	3		2		5
Apr.	"	2		2	6	10
May.	"		1	2	1	4
Jun.	"		1	2	1	4
Jul.	"		17	7	4	28
Aug.	"		4			4
Sep.	"		109	5	5	119
Oct.	"		26	19	16	61
Nov.	"		10	13	7	30
Dec.	"		6	8		14
Jan.	1981			1		1
Feb.	"		5			5
Mar.	"		4			4
Apr.	"		3	3	1	7
	Total	=32	=213	=138	=79	=462

Name of the species : *Tristria pulvinata* (Uvarov)

Table 16 : Showing monthly fluctuations of population of *Tristria pulvinata* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					
Jun.	"					
Jul.	"	1				1
Aug.	"	12		3		
Sep.	"		2			2
Oct.	"			2	1	3
Nov.	"		2			2
Dec.	"				8	8
Jan.	1980	6				6
Feb.	"		14			14
Mar.	"	26		5	1	32
Apr.	"	1		1	3	5
May.	"			2		2
Jun.	"					
Jul.	"		42			42
Aug.	"		3			3
Sep.	"		66	2	2	70
Oct.	"		38			38
Nov.	"					
Dec.	"		8			8
Jan.	1981		95			95
Feb.	"		35			35
Mar.	"		67			67
Apr.	"		3	3	2	8
	Total	=46	=375	=18	=17	=456

Name of the species : *Atractomorpha crenulata* (Marschall)

Table 17 : Showing monthly fluctuations of population of *Atractomorpha crenulata* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979			3	1	4
Jun.	"			2	1	3
Jul.	"	7				7
Aug.	"	17		1		18
Sep.	"		4	4	1	9
Oct.	"	5		24	9	38
Nov.	"		2	3	2	7
Dec.	"		8	10	3	21
Jan.	1980	4		2		6
Feb.	"			3	1	4
Mar.	"	2			1	3
Apr.	"	4		1	1	6
May.	"		5	6	1	12
Jun.	"					
Jul.	"					
Aug.	"		2		1	3
Sep.	"		2			2
Oct.	"		3	1	3	7
Nov.	"		16	6	2	24
Dec.	"		4	6	1	11
Jan.	1981		8	4		12
Feb.	"		5	2	1	8
Mar.	"		1		1	2
Apr.	"		5	1		6
	Total	=39	=65	=79	=30	=213

Name of the species : *Phlaeoba infumata* (Brunner)

Table 18 : Showing monthly fluctuations of population of *Phlaeoba infumata* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979	5		2		7
Jun.	"					-
Jul.	"	10				10
Aug.	"	10		9		19
Sep.	"			2		2
Oct.	"	11		17		28
Nov.	"			1		1
Dec.	"		5	3	3	11
Jan.	1980	15		5	1	21
Feb.	"		10	7	10	27
Mar.	"	9		7	3	19
Apr.	"		1	1	1	3
May.	"		1			1
Jun.	"		2	2	1	5
Jul.	"		2			2
Aug.	"					
Sep.	"		1			1
Oct.	"			1		1
Nov.	"		1	1		2
Dec.	"		1	2		3
Jan.	1981		2	1		3
Feb.	"		1	1		2
Mar.	"		1		1	2
Apr.	"					-
		T=60	T=28	T=62	T=20	T=170

Name of the species : *Aiolopus thalassinus tamulus* (Fabr)

Table 19 : Showing monthly fluctuations of population of *Phlaeoba infumata* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					-
Jun.	"			6	4	10
Jul.	"			4		4
Aug.	"	1		3		4
Sep.	"	1				1
Oct.	"			2	2	4
Nov.	"				1	1
Dec.	"		8	3	5	16
Jan.	1980					
Feb.	"					-
Mar.	"					-
Apr.	"					-
May.	"	-		1	2	3
Jun.	"					
Jul.	"			1	1	2
Aug.	"				1	1
Sep.	"			2	4	6
Oct.	"			1	1	2
Nov.	"		1			1
Dec.	"					-
Jan.	1981					
Feb.	"					-
Mar.	"					
Apr.	"					-
		T=2	T=9	T=23	T=21	T=54

Name of the species : *Oxya hyla hyla* Serville

Table 20 : Showing monthly fluctuations of population of *Oxya hyla hyla* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					
Jun.	"					
Jul.	"					
Aug.	"					
Sep.	"					
Oct.	"		4	6	2	12
Nov.	"			2		2
Dec.	"					
Jan.	1980		10			10
Feb.	"					
Mar.	"			1		1
Apr.	"					
May.	"			1		1
Jun.	"					
Jul.	"					
Aug.	"					
Sep.	"			1		1
Oct.	"					
Nov.	"			3	2	5
Dec.	"			1		1
Jan.	1981					
Feb.	"					
Mar.	"					
Apr.	"		2	1		3
		T=0	T=16	T=16	T=4	T=36

Name of the species : *Aulacobothrus luteipes* Walker

Table 21 : Showing monthly fluctuations of population of *Aulacobothrus luteipes* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979		-		-	
Jun.	"					
Jul.	"		-			
Aug.	"					
Sep.	"					
Oct.	"					
Nov.	"					
Dec.	"					
Jan.	1980					
Feb.	"		6	1		7
Mar.	"	3			2	5
Apr.	"					
May.	"					
Jun.	"				-	
Jul.	"					
Aug.	"					
Sep.	"					
Oct.	"					-
Nov.	"					
Dec.	"		10			10
Jan.	1981		3			3
Feb.	"	-	4			4
Mar.	"					
Apr.	"		3			3
		T=3	T=26	T=1	T=2	T=32

Name of the species : *Gesonula punctifrons* (Stål)

Table 22 : Showing monthly fluctuations of population of *Gesonula punctifrons* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979				1	1
Jun.	"					-
Jul.	"					-
Aug.	"					-
Sep.	"					-
Oct.	"				2	2
Nov.	"			1	3	4
Dec.	"			2	1	3
Jan.	1980			3	2	5
Feb.	"			2	1	3
Mar.	"					-
Apr.	"				-	-
May.	"			2	1	3
Jun.	"					-
Jul.	"					-
Aug.	"				-	-
Sep.	"					-
Oct.	"					-
Nov.	"					-
Dec.	"				-	-
Jan.	1981			-	-	-
Feb.	"				2	2
Mar.	"			-		-
Apr.	"			-		-
		T=0	T=0	T=10	T=13	T=23

Name of the species : *Acrida exaltata* (Walker)

Table 23 : Showing monthly fluctuations of population of *Acrida exaltata* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979		-		-	-
Jun.	"					-
Jul.	"					-
Aug.	"					-
Sep.	"		1		-	1
Oct.	"					-
Nov.	"					-
Dec.	"		4			4
Jan.	1980			-		-
Feb.	"		-		-	-
Mar.	"			-	-	-
Apr.	"	-		-		-
May.	"		1	-	-	1
Jun.	"					-
Jul.	"			-	-	-
Aug.	"		1		-	1
Sep.	"					-
Oct.	"				-	-
Nov.	"					-
Dec.	"					-
Jan.	1981					-
Feb.	"		1			1
Mar.	"					-
Apr.	"					-
		T=0	T=8	T=0	T=0	T=8

Name of the species : *Epistaurus syneityi* Bol

Table 24 : Showing monthly fluctuations of population of *Epistaurus syneityi* (%) at Botanical Garden, Howrah.

Month	Year	N ♂	N ♀	A ♂	A ♀	Total
May.	1979					
Jun.	"			1	1	2
Jul.	"					
Aug.	"					
Sep.	"					
Oct.	"					
Nov.	"					
Dec.	"					
Jan.	1980					
Feb.	"					
Mar.	"					
Apr.	"					
May.	"					
Jun.	"					
Jul.	"					
Aug.	"					
Sep.	"					
Oct.	"					
Nov.	"					
Dec.	"					
Jan.	1981					
Feb.	"					
Mar.	"					
Apr.	"					
		T=0	T=0	T=1	T=1	T=2

Table 25 : Percentage of studied eleven Species of Grasshoppers at Botanical Garden, Howrah.

Name of the species	Nymph ♂	♀	Total	in percentage Adult ♂	♀	Total	Gross Total
1. *Spathosternum prasiniferum prasiniferum*	3.03	12.53	15.56	12.34	8.78	21.12	36.68
2. *Oxya fuscovittata*	1.39	9.23	10.62	5.98	3.40	9.38	20.36
3. *Tristria pulvinata*	1.99	16.28	18.27	.79	.74	1.53	19.80
4. *Atractomorpha cernulata*	1.69	2.83	4.52	3.41	1.26	4.67	9.19
5. *Phlaeoba infumata*	2.60	1.20	3.80	2.68	0.85	3.53	7.33
6. *Aiolopus thalassinus tamulus*	.08	.39	.47	.99	.90	1.89	2.36
7. *Oxya hyla hyla*	0	.69	.69	.68	.18	.86	1.55
8. *Aulacobothrus luteipes*	.13	1.12	1.25	.04	.09	.13	1.38
9. *Gesonula punctifrons*	0	0	0	.44	.56	1.00	1.00
10. *Acrida exaltata*	0	.33	.33	0	0	0	.33
11. *Epistaurus sinetyi*	0	0	0	.04	.04	.08	.08

Table 26 : Monthly fluctuations of Air temperature (°C) and R/H (%) of Botanical Garderns grass field

	Temperature (°C)	Relative humidity (%)
1979		
Month		
May.	38.50	55.00
Jun.	36.20	55.00
Jul.	32.00	74.00
Aug.	34.00	88.00
Sep.	36.50	82.00
Oct.	29.50	63.00
Nov.	28.00	64.00
Dec.	20.00	54.00
1980		
Jan.	20.50	59.00
Feb.	32.00	63.00
Mar.	36.00	60.00
Apr.	38.00	83.00
May.	38.50	60.00
Jun.	34.00	61.50
Jul.	34.00	70.00
Aug.	29.50	92.00
Sep.	36.00	85.00
Oct.	32.50	70.00
Nov.	29.20	59.50
Dec.	22.50	52.50
1981		
Jan.	23.00	50.00
Feb.	33.00	65.00
Mar.	32.00	57.00
Apr.	31.50	78.00

Table 27 : Relationship between grasshopper fauna and Physical factors

	Mean ± SD	'r' value
Y : Grasshopper population	96 ± 82.71	
Air temperature	31.54 ± 5.47	0.01
Humidity	66.69 ± 12.17	0.23
Y : *Oxya fuscovittata*	0.84 ± 1.18	
Air temperature	31.54 ± 5.47	0.46*
Relative humidity	66.69 ± 12.17	0.37
Y : *Tristria pulvinata*	0.99 ± 1.18	
Air temperature	31.54 ± 5.47	0.06
Relative humidity	66.69 ± 12.17	-0.09
Y : *Spathosternum prasiniferum prasiniferum*	1.53 ± 1.93	
Air temperature	31.54 ± 5.47	0.06
Relative humidity	66.69 ± 12.17	*0.81
* Significant at 5% level		

Table 28 : Monthly occurrence of Grasshoppers (number) at Botanical Garden, Howrah (From May, 1979 to April, 1981)

Month & Year	Total no. of specimen	Total
May.'79	7+6+4+5+1+0+0+0+0+0+0 =	23
Jun.	0+9+3+3+0+10+2+0+0+0+0 =	27
Jul.	10+10+7+9+0+4+0+1+0+0+0 =	41
Aug.	19+66+18+19+0+4+0+15+0+0+0 =	141
Sep.	2+36+9+43+0+0+0+2+1+0+0 =	93
Oct.	28+93+38+55+2+4+0+3+0+0+12 =	235
Nov.	1+18+7+25+4+1+0+2+0+0+2 =	60
Dec.	11+20+21+5+3+16+0+8+4+0+0 =	88
Jan.'80	21+1+6+1+5+0+0+6+0+0+0 =	50
Feb.	27+9+4+1+3+0+0+14+0+7+0 =	65
Mar.	19+4+3+5+0+0+0+32+0+0+1 =	64
Apr.	3+17+6+10+0+0+0+5+0+5+0 =	46
May.	1+19+12+4+3+3+0+2+1+0+1 =	46
Jun.	5+8+0+4+0+0+0+0+0+0+0 =	17
Jul.	2+84+0+28+0+2+0+42+0+0+0 =	158
Aug.	0+14+3+4+3+1+0+3+1+0+0 =	29
Sep.	1+133+2+119+0+6+0+70+0+0+1 =	332
Oct.	1+178+7+61+0+2+0+38+0+0+0 =	287
Nov.	2+19+24+30+0+1+0+0+0+0+5 =	81
Dec.	3+19+11+14+0+0+0+8+0+10+1 =	66
Jan.'81	3+20+12+1+0+0+0+95+0+3+0 =	134
Feb.	2+22+8+5+2+0+0+35+1+4+0 =	79
Mar.	2+24+2+4+0+0+0+67+0+0+0 =	99
Apr.	0+16+6+7+0+0+0+8+0+3+3 =	43
		2304.00

REFERENCES

Akbar, S.S. and Balock, H. A. 1970. A new species of *Gesonula* Uvarov, 1940 (Orthoptera. Acridoidea : Acrididae) from West Pakistan. *Pakistan J. Zool.*, **2** : 11-15.

Ander, K. 1939a. Systematiche Einteilung Und phylongenie der Ensisferen (Saltatoria) auf Grund von Vergleichend anatomischen Untersuchungen.- *Verh.7er intern. Kongr. Ent. (Berlin* 1939), *Berlin*, 2 pp. 621-627.

Ander, K. 1939b. Vergleichend-anatomische und Phylongenetische Studien Über die Ensifera (Saltatoria). *Opusc. Ent. Lund.* 2 (suppl.), 306 pp.

Bei-Bienko,G.ya. and Mishchenko, L.L. 1951. Locusts and grasshoppers of the U.S.S.R. and adjacent countries, Catantopinae, 131-270, figs. 103-562, Leningard (in Russian).

Bei-Bienko, G. ya, 1958. Principle of change of stations and the problem of initial divergence of species.-xvth *Int.Sci. Comg. zool. Sect :* II, **31** : 1-3.

Blanchard, E. 1836. Monographie du genere *Ommexecha,* da la famille des Acridiene. *Ann Soc. Ent. France,* **5** : 618.

Bhowmik, H. K. and Halder, P. 1983. A new species of *Gerenia* Stål 1878 (Orhtoptera : Acrididae) from the foothill of the Eastern Himalaya, West Bengal, India. *Rec. zool. Surv. India,* **81** : 23-26, 1983.

Bhowmik, H. K. and Halder, P. 1984. Population ecology of some Acridids of Howrah, West Bengal, India. *Proc. Fourth. Nat. Zool. Conf., Bangladesh,* **1984** : 106-121.

Bhowmik, H. K. and Halder, P. 1984. Remarks of twelve species of newly recorded grasshoppers (Orth.) from West Bengal. *Bull. zool. Surv. India,* **6**(1-3) : 45-55.

Bhowmik, H. K. 1985. Outline of distribution with an index-Catalogue of Indian grasshoppers (Orth: : Acrididae). Part I. Acridinae, Truxalinae, Gomphocerinae and edipodinae. *Rec. zool. Surv. India, Occ. Pap. No.* **78** : 1-47, 1 tab.

Bhowmik, H. K. 1986. Grasshopper Fauna of West Bengal, India (Orthoptera : Acrididae). *Technical Monograph* No.14, pp. 1-180.

Boliver, I. 1884. Monographia de los pirgomorfinos. *Ann. Soc. esp.Hist. nat. Madrid,* **13** :1-73, 420-500, pls. 1-4.

Boliver,I. 1889. Orthopteros de Africa del Museo de Lisboa. *J. Sci. Acad. Lisboa Lisboa* (2) **1** : 73-112, 150-73, 211-32, 1 pl.

Boliver,I.1902. Les Orthopteres de St. Joseph's College a Trichinopoly (Sud de I' inde) 3me. partie. *Ann. Soc. ent. Fr.,* Paris, **70** : 580 635, pl.9.

Boliver,I. 1905. notes sobre los Pyrgomorfidos (Pyrgomorphidae) x sub-family Atractomorphinae. *Bol. Soc. Espan. Hist. Nat.,* 5, pp. 196-217.

Boliver,I. 1917. Contribution al concocimento de la fauna India. *Rev. Acad. Ciene. Madr.,* **16** : 278-412.

Boliver,I. 1922. Extrait du voyage de M. le Baron Maurice de Rothschild on Ethiopie et en Afrique Orientale Anglaise (1904-5) : 169- 219, 3 pls.

Brunner, L, 1900b. *A Brief Account of the Genera and Species of Locusts or Grasshoppers of Argentina, together with Descriptions of New Forms.* 68 pp.- *Lincoln* (Nebraska).

Brunner von Wattenwyl 1874. Uber die ausseren Gehororgane der Orthoperen-*Verh. Zool.bot. Ges. wien Vienna,* **24**, *Abh,* pp. 285-288.

Brunner von Wattenwyl, 1882. *Prodromus der europaischen Orthopteren, Leipzig,* 466 pp., pls. 1-11.

Cheng, Che-Min 1964. A review of the Orthoptera of the genus *Oxya* Serville, 1831, of Shensi Province, *Acta. ent. Sin.,* **13** : 885-887, 7 figs. (In Chinese).

Chopard, L. 1943. Orthopteroides de 1 Afrique due Nord-*Fauna de I' Empire Francais,* Paris, I : 1-450, 653 figs.

Chopard, L. 1949. Ordre des Orthopteres. *In Traite de Zoologie* (ed. P. P. Grasse), Vol. *IX* (Insectes), pp. 617-722 Paris (Masson & Co.).

Dirsh, V. M. 1951. A new injurious Indian grasshopper (Orthoptera, Acrididae). *Bull. ent.Res. London.* **41** : 599-601.

Dirsh, V. M. and Uvarov, B. P. 1953. Preliminary diagnoses of new genera and new synonymy in Acrididae. *Tijdschr. ent. Amsterdam,* **96**(3) : 231-237.

Dirsh, V. M. 1954, Revision of the species of the genus *Acrida* Linne (Orthoptera : Acrididae). *Bull. Soc. Faunad. ler. d' ent., Cairo,* **38** : 107-160, 8 maps.

Dirsh, V. M. 1956a. The phallic complex in Acridoidea (Orth.) in relation to taxonomy. *Trans. R. ent. Soc. Lond., London,* **108** : 223-356, 66 pls.

Dirsh, V. M. 1956b. Preliminary revision of the genus Catantops Schaum and review of the group Catantopini (Orthoptera : Acrididae). *Publ. Cult. Cia. Diamant. Angola. Lisbon,* **28** : 11-150, figs. 518.

Dirsh, V. M. 1958b. Revision of the genus *Eyprepocnemis* Fieber, 1853 (Orthoptera : Acridodea). *Proc. R. ent. Soc. Lond., London.,* B, **27** : 33-45, 27 figs.

Dirsh, V. M. 1958c Acridological notes. *Tijdsach. Ent.,* The Hauge : 51-63.

Dirsh, V. M. 1961. A preliminary revision of the families and sub-families of Acridodea (Orthoptera : Insecta). *Bull. Br. Mus. nat. Hist. (Ent.),* London, **10** : 349-419.

Dirsh, V. M. 1965. the African Genera of Acridoidea.-Cambridge University Press For the Anti-Locust Research Centre, : 1-579, 452 figs.

Dwivedi, K. P. 1977. Ecological studies of certain grasshoppers in the grassland ecosystem. Ph. D. thesis, submitted and awarded in the University of Rabisankar, M. P.

Dwivedi, K. P. and Chattoraj, A. N. 1984. Population studies on grasshpooers in a grassland ecosystem of Mahanbhata, Bilaspur, (M. P.) *Indian J. Ecol.,* **11** : 207-213.

Fabricius, J. C. (1781). 'Species Insectorum exhibentes eorum. Differentias specificas, Synonyma Auctorum, Loca natalia, Metamorphosin adjectis observationibus, Descriptionibus. Vol.1 (C. G. Profit : Hafnia).

Fabricus. J. C. (1793). *'Entomologia systematica Emendata et Aucta Secundum classes, Ordines. Genera. species. adjectis Synonymis. Locis. Observationibus. Descriptionibus'* Vol.2(C. G. profit : Hafnia).

Fabricus, J. C. 1792-1794.*Entomologia systematica Emendata et Aucta Secundum classes,Ordines. genera. species. adjectis Synonymis. Locis. Observationibus. Descriptionibus.* 4 vols. in 7. Hafniae Ulonata [Orthoptera] 2 pp. 1-62, 1793.

Fabricus, J. C. 1798. *Supplementum Entomologiae Systematicae* (4) + 572 pp, Hafniae.

Fletcher, T.B.1914. Some South Indian Insects and other animals of importance, considered especially from an economic point of view, 565 pp. Madras.

Grunshaw, J P. 1991. A revision of the grasshopper genus *Heteracris* (Orthoptera : Acrididae : Eyprepocnemidinae) *NRI Bull.*, **38** : 1-106.

Handlirsch, A. 1906-1908. *Die Fossilen Insecten,* 2 vols. ix + 1430 pp., 51 pls. Leipzig.

Henry, G. M. 1940. New and little known South Indian Acrididae (Orthoptera) *Trans. R. ent. Soc. Lond., London,* **90** : 497 540, 18 figs.

Hazra, A. K., Barman, R. S., Mukherjee, T. K., Dey, A., Mandal, S. K. 1982. Ecology of grasshoppers in two grasslands of West Bengal, relation to some physical factors. *Bull. zool. Surv. India,* **4** : 309-317.

Hazra, A. K. 1984. Ecology of the above ground and underground insects fauna in relation to the respective, floral changes of Botanical Garden grassland, West Bengal, India. *Proc. Indian. Acad. Sci. (anim. sci.)*, Vol **93**, No.7, December 1984, pp.675-689.

Hollis, D. 1965. A revision of the genus *Trilophidia* Stal (Orthoptera : Acridoidea) *Trans. R. ent. Soc. Lond.*, **117**(8) : 245-262, 33 figs. 1965.

Hollis, D. 1966. A revision of the genus *Dnopherula* Karsch.*Eos. Madrid,* **51**(2-3) : 267-329, 117 figs.

Hollis, D. 1967. New combinations affecting the genus *Aiolopus* (Orthoptera : Acridoidea) and a description of a related new genus and species from Australia. *J. nat. Hist.*, **1** : 157-162, figs. 1-8.

Hollis, D. 1968. A revision of the genus Aiolopus Fiber, (Orthoptera : Acridoidea). *Bull. Br. Mus. nat. Hist. (Ent.)*, **22**(7) : 307-355, 102 Text figs.

Hollis, D. 1971. A preliminary revision of the genus *Oxya* Audinet- Serville (Orthoptera : Acridoidea), *Bull. Br. Mus. nat. Hist. (Ent.)*, **26**(7) : 269-343.

Ibrahim, M. M. 1963. Further investigations into the humidity behaviour of *Aiolopus thalassinus* (F.) (Orthoptera : Acrididae). *Bull. soc. ent. Egypte,* **47** : 97-103.

Jago, N. D. 1984. The alart genera of East African Catantopinae (Orthoptera : Acridoidea) includung revision of the genus *Catantops* Schaum. *Trans. Amer. ent. Soc.*, **110** : 295-287.

Joyce, R. J. V. 1952. The ecology of grasshoppers in East Central Sudan. *Anti-Locust Bull.*, **11** : 97 pp., 34 figs.

Joyce, R. J. V. 1952. The ecology of grasshoppers in East Central Sudan. *Anti-Locust Bull.*, No. **11** : 99.

Johnston, H. B. 1956. Annotated catalogue of African Grasshoppers. 1-447.

Julka, J. M., Tandon, S. K. Halder, P. and Shishodia, M. S. 1982. Ecological observation grasshoppers (Orthoptera : Acridoidea) at Solan, Himachal Pradesh, India. *Orient. Insects*, **16** : 63-75.

Kapur, A. P. and Dutta, D. K. 1952. Studies on the bionomics of the semi-aquatic grasshpooers *Gesonula punctifrons* Stål (Abstr.). *Proc* 39th Indian Science Congr., Calcutta, **952** : 339.

Katiyar, K. N. 1956. The life-history and ecology of the short horned grasshopper, *Parahieroglyphus bilineatus* Bolivar (Orthoptera : Acrididae). *Agra Univ. J. Res.*, **5** : 179-192.

Katiyar. K. N. 1960. Ecology of oviposition and the structure of egg ponds and eggs in some Indian Acrididae.- *Rec. Indian Mus.*, **55**(1957) : 29-68, 19 figs.

Kevan, D. K. MCE. 1954. A study of the genus *Chrotogonus* Audinet Serville 1839 (Orthoptera : Pyrgomorphidae). III. A review of available information on its economic importance, biology etc. *Indian J. Ent., New Delhi*, **16** : 145-72.

Kevan, D. K. MCE. 1959. A study of the genus Chrotogonus Audinet Serville 1839 (Orthoptera : Acridoidea : Pyrgomorphidae). V. A. revisional monograph of a chrotognini, VI. The History and Biogeography of the Chrotognini. *Publ. Cult. Diamens*, **43** : 42-43, 224-225.

Kevan, D. K. MCE (1963a.) Pyrgomorphidae (Orthoptera : Acriodoidea) in the collection of C. P. Thunberg Upsala, with notes on type meterial of the species represented *Ark. Zool.* (2) **16** : 69-96.

Kevan, D. K. MCE (1963b). A revision of the *Desmopterini* (Orthoptera : Acriodoidea : Pyrgomophidae) Part I. Genera other than *Desmopterella. Nova Guinea*, **19** : 361-407.

Kevan, D. K. MCE and Akbar, S. S. 1964. The Pyrgomorphidae (Orthoptera : Acridoidea) their systematics, tribal divisions and distribution. *Can. Ent.*, **96** : 1505-36, 7 figs.

Kevan, D. K. MCE and Chen, Y. K. (1969). a revised synopsis of the genus *Atractomorpha* Saussure, 1882 (Orthoptera : Prygomorphidae) with an account of the African Aberans-group. *Zool. J. Linn. Soc.*, **48** : 141-98.

Key, K. H. L. (1967a).The type meterial of *Aiolopus tamulus* (F.) (Orthoptera : Acrididae). *J. Anst. Entomol. Soc.*, **6** : 69-70.

Kirby, W. F. 1900. Notes on some insects from Yangtse-Kiang. *Ann. Mag. nat. Hist., London*, **7**(6) : 380-381.

Kirby, W. F. 1910. *A synonymic catalogue of Orthoptera* vol. 3. *Orthoptera Saltatoria*. Part II Locustidae vel Acrididae ix + 674 pp., London, (*Brit. Mus. Nat. Hist.*).

Kirby, W. F. 1914. The fauna of British India, including Ceylon and Burma. Orthoptera (Acrididae). IX-296 pp. London.

Korelina, R. I. 1961. Injurious Acrididae of Yakartia. (In Russian) *Zshch. Rast. Vvedit. Bolezn.* **6**(11) : 28.

Latreilie, P. A. 1802-1805. Histoire naturelle, generale *et* Particuliere des crustaces *et* des insectes. Ouvrge faisant suite auxoeuvres de Leclere de Buffon et partie due cours complete d' historie naturelle, redige par Charles Sigisbert Sonnini de Manoncourt 14 vols. (Orthoptera **12** : 81-164, pls. 94-95, 1804).

Lefroy, H. M. 1909. *Indian Insect life. A manual of the insects of plains* (tropical India) xii + 786 pp., 84 cols. pls., Calcutta, Simla and London.

Linnaeus, C. 1758. *Systema Natural per Regna Tria naturae* (10th ed.) holmiae.

Linne, Carl, V. 1767. Systema Naturae per Regna tria naturae (12th ed.). Vindobnae.

Marschall, J. A. 1983. The Orthopteroid insects described by Linnaeus, with notes on the Linnaean collection. *zool. J. Linn. Soc.*, **78** : 375-96.

Mason, J. B. (Miss) 1954. The number of antennal segments in adult acrididae (Orthoptera). *Proc. R. ent. Soc. Lond., London*, (B) **23**(11-12), pp. 228-238.

Mason, J.B. 1973. A revision of the genera Hieroglyphus Krauss, Parahieroglyphus Carl and Hieroglyphodes Uvarov (Orthoptera : Acridoidea). *Bull. Br. Mus. nat.Hist.* (*Ent.*), **28**(1) : 507-560, 12 text fig., 4 maps.

Mistshenko, L. (L.) 1950. New data on harmful central Asiatic locusts and grasshoppers. In Russian-*Dokl. Akad. Nauk. S.S.S.R. (N.S.) Moscow*, **71**(4), pp. 789-792.

Mistshenko, L (L.) 1952. Nasekomye priamokrylye. Saranchevye (Catantopinae). (Acrididae of the U.S.S.R., Catantopinae). *Fauna* U.S.S.R., Moscow, (N. S., Insecta : Orthoptera : **4**(2) : 610 pp. 520 figs.

Nolte, D. J. 1939. A comparative study of seven species of Transvaal Acrididae with special referance to the Chromosome Complex. *J. ent. Soc. 5th Afr.*, **2** : 196-260, 144 figs., 14 tabs.

Odum, E.P. 1953. Fundamentals of Ecology. Philadelphia and London, W.B., Sun ders 371, 372.

Oliver, G.A. 1804. *Voyage daṇs l' Empire Othoman, l' Egypte et la perse, fait par ordre du Government, Pendant les six premieres annees de la Republique, 3 vols. and l Atlas.* Paris. vol. 2 contains, on p. 425, an account of *Acridium peregrinum nov. Schistocerca gregaria* Forskal. J.

Popov, G.A. 1964. On the acridid fauna of South-east Transbakalia. (in Russian with English Summary). *Zool. Zh.*, **43** : 1309-1310.

Popov, G. B. 1959a. Ecological studies on oviposition by *Locusta migratoria migratorioides* (R. & F.) in its outbreak area in the French Sudan. *Locusta* no. **6** : 3-63, 6 maps (1 fid), 5 pls., 7 figs. 148, 257, 258, 275.

Popov, G.B. 1959c. Some notes on injurious acrididae (Orthoptera) in the Sudan-Chand area. *Entomologists mon. Mag.*, **95** : 90, 92 76, 147, 432.

Popov, G.B. 1961. Preliminary report on the third survey-Niger, Algerian Sahara, Western Chad, Nigeria. *In report of a meeting of specialists Desert Locust Ecological Survey*, Paris 1961, Rome, FAO. Appendix 1.

Popov, G.B. 1965. *Review of the work of the Desert Locust Entomological survey June 1958-March 1964 and the considerations and conclusions arising from it.* Rome *FAO Report* No. UNSF/DL/ES/8 246, 498, 499, 500, 502, 509, 516, 517.

Popov, G.B., Zeller, W. and Cocheme 1965. *Ecological Survey Report on studies in India, Pakistan and Iran during 1963-64.* Rome, FAO Report No. UNSF/DL/ES/7- 251, 254, 498, 500, 501.

Prasad, Kumar and C. A. Viraktamath, 1991. Illustrated key for identification of common species of short horned grasshoppers (Orthoptera : Acridoidea) of Karnataka and notes on their ecology and behaviour, *Hexapoda* **3** (1 & 2) : 53-70.

Prasad, Kumar and C. A. Viraktamath, 1991. Taxonomic significance of the male genetalia (Epiphallus) of some species of short horned grasshoppers (Orthoptera : Acridoidea). *J. Bombay nat. Hist. Soc.*, **88**(2) : 200-209.

Quadri, M.A.H. 1940. On the developement of genetalia and their ducts of orthopteroid insects. *Trans. R. ent. Soc. Lond.*, London, **90**(6), pp. 121-175.

Ragge, D.R. 1955. The wing venation of the Orthoptera saltatoria with notes on the Dictyopteran wing venation British Museum Publication : 1-159, 106 figs.

Ramme, W. 1941. Beitrage Zur Kenntnis der Palaearktischen Orthoptera fauna (Tettig. & Acrid.), III. *Mitteilungen Zoologische Museum in Benlin,* **24**(1) : 41-150, 3 pls., fig. 59.

Ramme, W. 1952. The third Danish Expedition to central Asia. Zoological results 6. Tettigonidae and Acrididae (Insecta) aus Afghanistan. *Vidensk. Medd. dansk naturh. Foren Kbh.*, **114** : 187-202, 3 pls. 4 figs, Orth.

Rehn, J.A.G. and Grant Jr. H.J. 1961. A monograph of the Orthoptera of North America (North of Maxico). 1. *Monogr. Acad. nat. Sci. Philad, Philadelphia,* **12** : 1-255.

Ritchie, J.M. 1981. A taxonomic revision of the genus *Odealeus* Fiber (Orthoptera : Acrididae). *Bull. Br. Mus. nat. Hist. (Ent.).* **42**(3) : 83-183.

Ritchie, J.M. 1982. A taxonomic revision of the genus *Gastrimargus* Saussure (Orthoptera : Acrididae). *Bull. Br. Mus. (Nat. Hist.). Entomol,* **44** : 239-329.

Saussure, H. DE 1884. Prodromus oedepodiorum, insectorum exordine Orthopterorum. *Mem. Soc. Phys. Geneve, Geneve,* **28**(9) : 1-254, 1 pl.

Saussure, H. De, 1888. Additamenta and prodromum oedepodiorum, Insectorum ex ordinae Orthopterorum. *Mem. Soc. Hist. Nat. Geneve, Geneve,* **30**(1), pp. 1-180.

Serville, J.G.A. 1831. Revue methodique des Insectes de l' ordre des Orthopteres, *Ann. Sci. Nat. Paris,* 22 : 28-65, 134-167, 262 292, Separate 101 pp.

Shishodia, M.S. and Hazra, A.K. 1985. Records of the Zoological Survey of India, Orthoptera fauna of silent Valley, Kerala. *Rec. zool. Surv. India,* **82**(1-4) : 15-32, 1985. (In special issue on fauna of Namdhapa).

Shishodia, M.S. and Hazra, A.K. 1986. Orthoptera fauna of silent vally Kerala. *Rec. zool. Surv. India,* **84**(1-4) : 191-228, 1986.

Shrinivasan; C. & Muralirangan, M.C. 1992. Studies on short horned grasshoppers (Acridoidea) of Tamil Nadu Part I Acridinae, Truxalinae, Gomphocerinae and Locustinae. *Hexapoda* **4**(1) : 13-26.

Silfer, E.H. 1939. The internal genitalia of female Acridinae oedepodinae and Pauliniinae (Orthoptera : Acrididae). *J. Morph.*, **65** : 437-455, 7 pls.

Sjostedt, Y. 1928. Monographie der Gattung *Gastrimargus* Sauss. (Orthoptera : Oedipodidae) *Kungl. Sven. veten. Handl., Stockholm,* (3) **6**(1) : 1-51, 11 pl.

Stål, C. 1860. *Orthoptera species novas descripsit. Kong. Svens. Fregatten Eugenies Resa Omkrina Jorden, Stockholm,* **3** : 299-350.

Stål, C. 1861. *Orthoptera species novas descripsit. C.* Stål. *In. Konglia. Svenska. Fregatten Eugenies Res. aomkring under of C.A. Virgin, aren 1851-1853. D 2, Zoologi, Insecta,* **10** : 324-348.

Stål, C. 1873. Orthoptera, nova descripsit *C.* Stål, *Ofvers vetensk Akad. Forth., Stockh, Stockholm,* **30**(4) : 39-53.

Stål, C. 1878. Systema Acridiodeorum. Essai une systematisation des Acridiodees. *Bihang Kungl. Svensk. vet. Akad. Handl., Stockholm,* **5**(4) : 1-100.

Tandon, S.K. abd Shishodia, M.S. 1969. On a collection of Acriodoidea (Orthoptera) from the Nagurjuna Sagar Dam Area. *Orient. Insects,* **3**(3) : 265-267, 1977.

Tandon, S.K. and Shishodia, M.S. 1975. On the genus *Chondracris* Uvarov (Insecta, Orthoptera) : Acridoidea : Acrididae : Cyrtacanthacridinae in India. *Dr. B.S. Chauhan Comm.,* Vol. 395-402.

Tandon, S.K. and Shishodia, M.S. 1976. On a collection of Orthoptera from Rajasthan, India. *Newsl. zool. Surv. India,* **2**(1) : 7-11, 1976.

Tandon, S.K. Shishodia, M.S. 1976. Acridoidea (Insecta : Orthoptera) collected along the Bank of river Tawi (Jammu and Kashmir), India. *Newsl. zool. Surv. India,* **2**(2) : 58-61, 1976.

Tandon, S.K., Shishodia, M.S. 1976. On a collection of Orthoptera (Insecta) from the Kanha National Park, Mandla, Madhya Pradesh, India. *News. Zool. Surv. India,* **2**(6) : 269-271.

Tandon, S.K. and Shishodia, M.S. 1977. The Acridoidea (Insecta : Orthoptera) of Goa. *Rec. zool. Surv. India,* **72** : 295-307, 1977.

Tandon, S.K. 1976. A check list of the Acridoidea. *Rec. zool. Surv. India, Occ. Pap. No.* **3** : 1-48.

Tandon, S.K. and Khera, S. 1978. Ecology and Distribution of Grasshoppers (Orthoptera : Acridoidea) in Arunachal Pradesh, India and impact of Human activities on their ecology and distribution. *Memoirs of the School of Entomology,* Agra, **6** : 73-92 April, 1978.

Tandon, S.K. and Shishodia, M.S. 1989. Fauna of Orissa : *State Fauna Series,* 1, pt. **2** : 93-145, 1989 (*Publ. Zool. Surv.*).

Tinkham, E.R. 1936. *Spathosternum sinense* Uvarov considered to be a race of *Spathosternum prasiniferum* (Walker) Orth. : Acrididae. *Lngn. Sci. Journ. Canton,* **15** : 47-54, 1 pl.

Usmani, M. Kamil (1979). Taxonomic significance of ovipositior in some Indian Grasshoppers (Orthoptera : Acrididae). *J. Bombay nat. hist. Soc.,* **79** : 576-580. 1979.

Usmani, M. Kamil & Adamshafee, S. 1990. Classification of Indian Acrididae (Orthoptera : Acridoidea). *Indian J. Syst. Ent.,* **7**(2) : 89-102.

Uvarov, B.P. 1921. Records and description of Indian Acrididae. *Ann. Mag. nat. Hist. London,* (9) **7** : 480-509.

Uvarov, B.P. 1921. A revision of the genus *Locusta* L. (*Pachytylus Fieb.*), *with a new theory as to the periodicity and migrations of* Locusts. *Bull. ent. Res., London,* **12**(2) : 135-163.

Uvarov, B.P. 1923. A revision of the old world Cyrtacanthacridini (Orthoptera : Acrididae). Part I. Introduction and key to genera. *Ann. Mag. nat. Hist., London.* (9) **11** : 130-144. fig. 1-7 : II (9) **11** : 473-90. III (9) **12** : 345-66.

Uvarov, B.P. 1923. Notes on locusts of economic importance with some new data on the periodocity of Locusts invasion. *Bull. ent. Res. London,* **14**(1) : 31-39

Uvarov, B.P. 1927. Distributional records of Indian Acrididae. *rec. Indian Mus. Calcutta,* **29** : 233-239.

Uvarov, B.P. 1929. Acrididen (Orthoptera). *aus-Sud-Indian Rev. Susse. Zool. Geneva,* **36** : 533-563.

Uvarov, B.P. 1933. Orthoptera collected by Mr. Bertram Thomas in South Arabia. *Proc. Zool. Soc. Lond., London* : 251-271.

Uvarov, B.P. 1940. Twenty eight new generic names in Orthoptera. *Ann. Mag. nat. Hist., London* (11) **5**(26) : 173-176.

Uvarov, B.P. 1940. Twenty four new generic names in Orthoptera. *Ann. Mag. nat. Hist., London* (11) **6**(31) : 112-117.

Uvarov, B.P. 1940. Eleven new generic names in Orthoptera-*Ann. Mag. nat. Hist. London* (11) **6**(34) : 377-380.

Uvarov, B.P. 1942. New Acrididae from India and Burma. *Ann. Mag. nat. Hist. London* (11) **9**(56) : 587-607.

Uvarov, B.P. 1961. Quantity and quality in insect populations. *Proc. R. ent. Soc. Lond., C,* **25** : 52-9 379, 380, 386.

Uvarov, B.P. 1966. "Grasshoppers and Locusts" A handbook of general Acridology, Vol. I University press, Cambridge, 1-481, 245 figs.

Uvarov, B.P. 1977. "Grasshoppers and Locusts" A handbook of general Acridology. Vol. 2 Published by Centre for Overseas pest Research, London.

Walker, F. 1870. Catalogue of the specimens of Dermaptera and Saltatoria in the collection of the British Museum Part IV Locustidae (Concluded) and Acrididae (Part), pp., 4 + 425-604, London *Brit. Mus. Nat. Hist.*

Walker, F. 1871. Catalogue of the Specimens of Dermaptera and Saltatoria in the collection of the British Museum Part V. Tettigidae and Suppliments to the earlier parts pp., 4 + 811-850 + 43 + 116-(*Brit. Mus. nat. Hist.*).

Willemse, C. 1925. Revision der Guttung *Oxya* Serville. *Tijdschr. Ent., the Hague,* **68** : 1-60.

Willemse, C. 1928. Revision des Acridoidea, descrites par de Haan, avec. descriptions de nouvelles especes. *Zool. Meded Leiden* **11** : 11-27.

Willemse, C. 1951. Overdruk uit publicities van Het Natuurhistorisch Genoots chap in Limberg Vol. IV, 1951-15th August, 1951. Synopsis of the Acridoidea of the Indo Malayan and adjacent regions (Insecta : Orthoptera).

Willemse, C. 1955. Publicaties van Het Natuurhistorisch Genoots chap in Limberg Vol. VIII. Synopsis of the Acridoidea of the Indo Malayan and adjacent regions (Insecta : Orthoptera) (*Publ. Natuurhist. Gen. Limberg*) : 1-225.

Willemse, C. 1959. Publicaties van Het Natuurhistorisch Genoots chap in Limberg Vol.X. Synopsis of the Acridoidea of the Indo Malayan and adjacent regions, Part II. Family Acrididae, Subfamily, Catantopinae pp. 227-500.

Willemse, F. 1967. A preliminary revision of the genus *Tauchiridea* I. Boliver, 1918. (Orth., Acridoidea, Acrididae, Oxinae). *Publties natuurh. Genoot. Limberg*, **17** : 19-26.

Willemse, F. 1968. Revision of the genera *Stenocatantops* and *Xenocatantops* (Orthoptera, Acrididae, Catantopinae). *Mon. Ned. Ent. Ver.*, **4** : 1-77.

Willemse, F. 1975. Studies on the Acridoid genera *Opiptacris* Walker and *Bumacris* Willemse (Orthoptera : Acridoidea). *Tijdschr. Ent.*, **118** : 117-158.

Willemse, F. 1977. A study on the genus *Cranae* Stål (Orthoptera : Acridoidea, Catantopinae). *Tijdschr. Ent.*, **120** : 121-152.