

OCCASIONAL PAPER NO. 118

Records of the Zoological Survey of India

**Aquatic and Semi aquatic Hemiptera
(Insecta) of Javadi Hills, Tamil Nadu**

G. Thirumalai

Zoological Survey of India

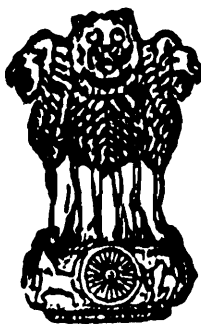
RECORDS
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ZOOLOGICAL SURVEY OF INDIA

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AQUATIC AND SEMI AQUATIC HEMIPTERA (INSECTA)
OF JAVADI HILLS, TAMIL NADU

By

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सत्यमेव जयते

Edited by the Director, Zoological Survey of India
1989

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Published ; April, 1989

Price : *Inland* : Rs. 40·00

***Foreign* : £ 4·00 \$ 5·00**

Produced by the Publication Division, Zoological Survey of India, Calcutta

**Printed in India by A. K. Chatterjee at Jnanodaya Press, 55B, Kabi Sukanta Sarani,
Calcutta 700 085 and Published by the Director, Zoological Survey of India, Calcutta**

RECORDS
OF THE
ZOOLOGICAL SURVEY OF INDIA

Occasional Paper

No. 118	1989	Pages 1-63
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INTRODUCTION

Our knowledge relating to the aquatic and semi-aquatic Hemiptera of India is limited to the taxonomic preliminaries and the available information is chiefly concerned with recording of species from different parts of the country. Annandale (1919), Distant (1903 ; 1906 ; 1909 ; 1910a & 1910b), Dover (1928), Horvath (1915) and Paiva (1919a & 1919b) were a few of the earliest to contribute to our knowledge of the aquatic and semi-aquatic bugs of the country. Chen (1960), Hafiz & Mathai (1938), Hafiz and Riberio (1939), Hafiz & Pradhan (1947), Hutchinson (1933), Pradhan (1950a & 1950b) also rendered some information on the Indian aquatic bugs. The revisionary work of Anderson (1975, 1980), Den Boer (1968), Hungerford and Matsuda (1958), Polhemus & Anderson (1984) on a few genera of Gerridae ; Brooks (1951) and Lansbury (1968) on the Genera *Anisops* Spinolae & *Enithares* Spinolae of Notonectidae ; Hutchinson (1940) and Wroblewski (1961 & 1962a) on Corixidae ; Lansbury (1972) on the genus *Ranatra* (Fabricius) of Nepidae ; Luna blad (1936) on the genera *Rhagovelia* Mayr and *Tetraripsis* Lundblad of Veliidae ; Anderson and Polhemus (1980) on Mesoveliidae ; Hungerford and Evans (1934) on Hydrometridae and Kormilev (1971) on Ochteride, of the world are of importance to understand the status of Indian aquatic bugs.

In this paper, an attempt has been made to consolidate the piecemeal information available in a scattered manner and to present a concise account on the Indian aquatic and semi-aquatic hemipterans, throwing more light on the present status of many of the water bugs.

TOPOGRAPHY

The Javadi hills are in North Arcot District of Tamilnadu and situated in the Southwest of the district. These hills which are part of the Southwest section of Eastern Ghats, lie in the rainshadow of South-east monsoon and are mainly composed of masses of charnockite associated with gneisses and varied metamorphic rocks. The Javadi hills abound in undulating terrains and riverine valleys having a few mountain peaks. The range extends in a north-easterly direction, gradually decli-

ning as it approaches towards the east. The Southwest and Northeast portions consist of slopes, rising steeply from the plains forming an undulating plateau. The centre and southern ranges consist of extensive plateaus on the top portion, interspersed with occasional peaks. The average elevation of the range is approximately 760 metres and the highest point is 1166 metres from sea level.

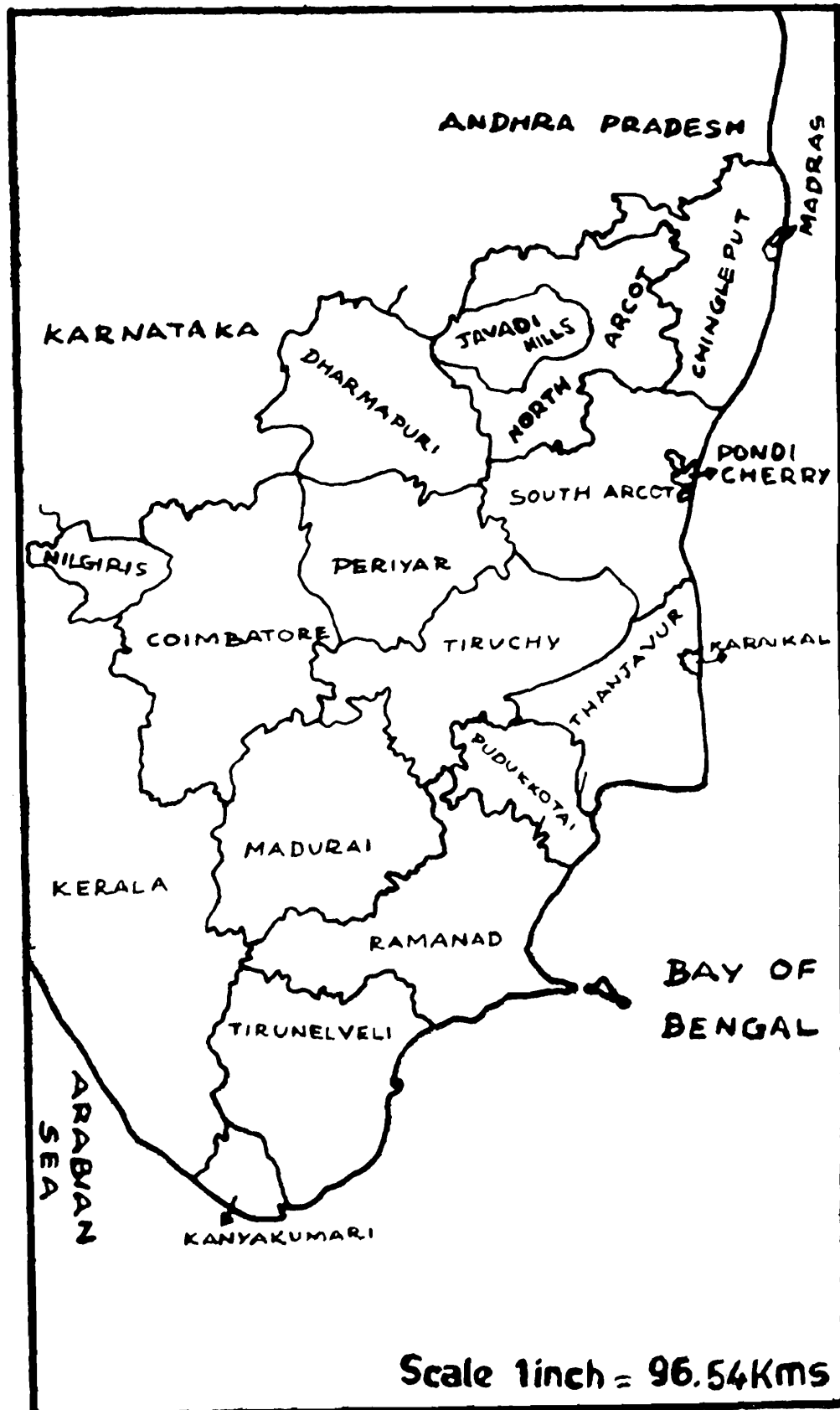


Fig. 1 : Map of Tamilnadu

The forest types here are tropical dry evergreen, tropical mixed dry evergreen, southern dry deciduous scrub forests and Karnatic evergreen forests. Three distinct regions can be seen in forests. The tall tree canopy of 5 to 8 metres above the ground, the second storey is just below the canopy in which are smaller trees and thirdly the shrubs taking the lower position. The grasslands are very much restricted. Besides, shrubs, climbers and evergreen trees, these hills are famous for natural sandalwood. The types of soil met with here are sandy soil, red loam and kall soil. Since this range lies in the rainshadow of Southeast monsoon, the rainfall is from October to December, the maximum rainfall being in October. However, the rainfall in the hills is evenly distributed.

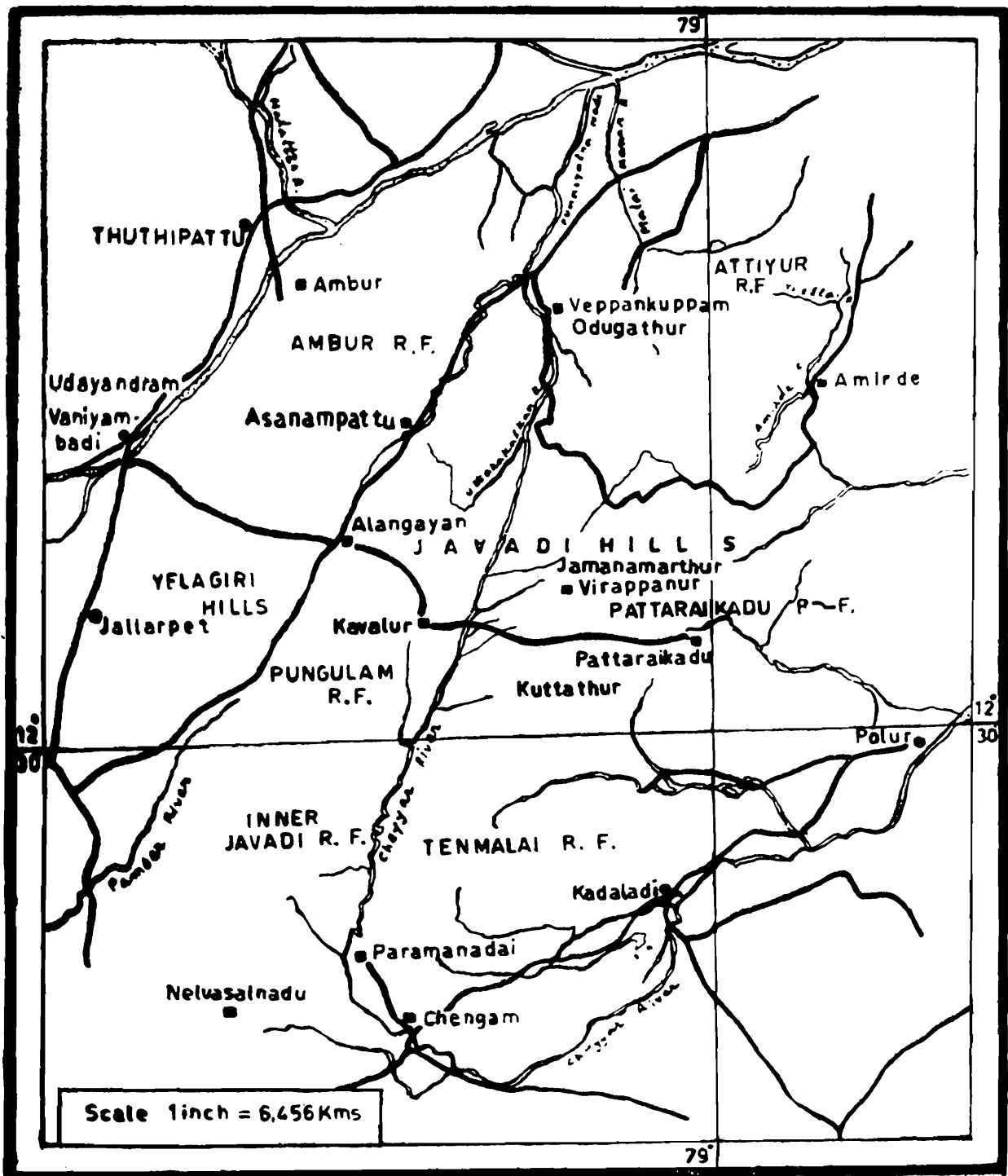


Fig. 2 : Map of Javadi Hills

RIVERINE SYSTEM

The Cheyar which forms one of the main tributaries of Palar, drains most of the Javadi Hills. It runs southwards, at Chengam, takes a wide curve, then takes a north easterly course and finally joins the Palar. The other less important rivers flowing in Javadi are 'Amridi Aru', 'Kad Aru', 'Utharakaveri Aru', 'Teertham Aru', and 'Agram Aru'. The Agram river is formed by mountain streams, rises in Javadi hills and flows northwards to join the Palar.

The Javadi hills area have not been surveyed by any agency and as such its fauna is not known. The survey has been taken up to study the aquatic and semi-aquatic hemipterans.

WORK PROGRAMME

Four surveys including a preliminary survey were undertaken during premonsoon, monsoon and postmonsoon periods by the author. The various reserve forest are many and include Singarapetta Extension R. F., Mambakkam. R. F., Inner Javadi R. F., Tenmalai R. F., Pungulam R. F., Pattarikadu R. F., Santhavasal R. F., Virappanur R.F., Alangayam R. F., Arsampattu R. F., Malaiyalam R. F., Ambur R. F., Karuthamalai R. F., Arsampattu R. F., Paravamalai R. F., Thellai R. F., to mention but a few. The different types of aquatic habitats surveyed include rivers, fast and slow moving streams, water falls, mountain streams, small and big puddles and pools, dried up wet stream and river beds, banks of rivers, streams, wet seeping rocks, rock pools, and other aquatic and semi-aquatic habitats.

The survey was planned and executed in four phases as mentioned below :

Phase I : Preliminary Survey

Area of Survey : Virappanur Reserve Forest, Pattarikadu Reserve Forests lying in Kavalur and Jamnamaruthur areas.

Duration : October 13, 1982 to October 17, 1982

Phase II : Post-monsoon Survey

Area of Survey : The reserve forests of Virappanur and Pattarikadu were surveyed.

Duration : February 22, 1983 to March 11, 1983

Phase III : Monsoon Period

Area of Survey : Various reserve forests from Nellivasal, Pudur, Kavalur, Kuttathur and Paramanandal which mainly falling under Tirupattur forest division were surveyed.

Duration : November 15, 1983 to December 9, 1983

Phase IV : Pre-monsoon period

Area of Survey : The reserve forests like Paravamalai, Ambur and other adjoining reserve forests coming under the Vellore Forest Division were surveyed from Odugathur and Amridi

Duration : April 18, 1984 to May 8, 1984

Under each species, the citation for the original description and other important citations necessary to understand the status of taxa or its presence in India are given.

KEYS TO SERIES AND FAMILIES OF AQUATIC AND SEMI-AQUATIC HEMIPTERA OF JAVADI HILLS

(After Bobb, 1974)

Key to series

1. Antenna visible and not concealed, as long as or longer than head.....Series *Gymnocerata*
 Antenna not visible and concealed in grooves below the head, shorter than head.....Series *Cryptocerata*.

Key to families of *Gymnocerata*

1. Claws apical ; apex of last tarsal segment entire 2
 Claws of at least the front tarsi pre-apical ; apex of last tarsal segment cleft or bifid 4
2. Head shorter than pronotum ; scutellum minute 3
 Head long, as long as entire thorax, body long, antennae and legs filiform **HYDROMETRIDAE**
3. Rostrum four-segmented, the first two basal segments are very small and usually hidden ; tarsi two segmented **HEBRIDAE**
 Rostrum three segmented ; tarsi three segmented **MESOVELIIDAE**
4. Hind femora long, greatly surpassing the end of abdomen ; middle legs inserted closer to hind legs than to forelegs **GERRIDAE**
 Hind femora short, distal end scarcely, if at all, surpassing the end of abdomen ; middle legs inserted about midway between front and hind legs **VELIIDAE**

Key to families of *Cryptocerata*

- 1- Ocelli present **OCHTERIDAE**
 Ocelli absent 2
2. Hind tarsi with two distinct claws 3
 Hind tarsi with claws indistinct and small, except in the family *Pleidae*. of which species are less than 4 mm long 5
3. Membrane of hemelytra without veins **NAUCORIDAE**
 Membrane of hemelytra with veins 4

4. Tip of the abdomen with non-retractile, long and slender siphon ; tarsi one segmented NEPIDAE
 Tip of the abdomen with retractile, short and flat siphon ; tarsi two or three segmented BELOSTOMATIDAE
5. Body flattened dorsally ; foretarsi one segmented, palae scooplike, fringed with setae CORIXIDAE
 Body convex ; fore tarsi two segmented, not as above 6
6. Elongate forms with long, oar-like hind legs ; hind tibiae and tarsi ciliated, rostrum four segmented ; abdomen with a midventral keel NOTONECTIDAE
 Oval forms with all legs alike : hind tibiae and tarsi simple not ciliated ; rostrum three segmented ; abdomen without midventral keel PLEIDAE

SYSTEMATIC LIST OF AQUATIC HEMIPTERA OF JAVADI HILLS

CLASS : INSECTA

ORDER : HEMIPTERA

SUBORDER : HETEROPTERA

Family : OCHTERIDAE

Genus : **Ochterus** Latreille

1. *Ochterus marginatus marginatus* (Latreille)

Family : CORIXIDAE

Subfamily : CORIXINAE

Genus : **Agraptocorixa** Kirkaldy

2. *A. (Agraptocorixa) hyalinipennis* (Fabricius)

Genus : **Corixa** Müller

3. *C. (Tropocorixa) gravelevi* Hutchinson

4. *C. (Tropocorixa) pruthiana* Hutchinson

Subfamily : MICRONECTINAE

Genus : **Micronecta** Kirkaldy

5. *M. (Indonectella) thyseta* Distant

6. *M. (Sigmonecta) quadristrigata* Breddin

7. *M. (Basileonecta) scutellaris scutellaris* (Stål)

8. *M. (Dichaetonecta) prashadana* Hutchinson

9. *M. (Dichaetonecta) janssoni* sp. nov.

Family : PLEIDAE

Genus : **Plea** Leach

10. *P. frontalis* (Fieber)

Family : NOTONECTIDAE

Subfamily : NOTONECTINAE

Genus : **Enithares** Spinolae

11. *E. ciliata* (Fabricius)

- Genus : **Hydrometra** Lamarck
30. *H. greeni* Kirkaldy
 Family : GERRIDAE
 Subfamily : GERRINAE
 Genus : **Limnogonus** Stål
31. *L. (Limnogonus) fossarum fossarum* (Fabricius)
32. *L. (Limnogonus) nitidus* (Mayr)
 Genus : **Neogerris** Matsumura
33. *N. parvula* (Stål)
 Genus : **Tenagogonus** Stål
34. *T (Limnometra) anadyomene* (Kirkaldy)
35. *T (Limnometra) fluviorun* (Fabricius)
 Subfamily : EOTRECHINAE
 Genus : **Onychotrechus** Kirkaldy
36. *O. rhexenor* Kirkaldy
 Genus : **Amemboa** Esaki
37. *A. (Amemboa) kumari* (Distant)
 Subfamily : HALOBATINAE
 Genus : **Metrocoris** Mayr
38. *M. stali* (Dohrn)
 Family : VELIIDAE
 Subfamily : PERITTOPINAE
 Genus : **Perittopus** Fieber
39. *P. horvathi* Lundblad
 Subfamily : RHAGOVELIINAE
 Genus : **Rhagovelia** Mayr
40. *R. (Rhagovelia) nigricans* (Burmeister)
 Subfamily : MICROVELIINAE
 Genus : **Microvelia** Westwood
41. *M. annandale* Distant
42. *M. diluta* Distant
43. *M. douglasi* Scott
44. *M. javadiensis* sp. nov.

Family : OCHTERIDAE

The Ochteridae or "Velvety Shore bugs" form a small family of semi-aquatic (rather littoral) bugs, characterised by their 2 : 2 : 3 tarsal formula. These bugs are small, brown or black insects, with the inner margin of eyes strongly concave. The rostrum is long, slender, reaching upto hind coxae. The antennae are moderately short and exposed and are inserted below the eyes. The ocelli are present. The legs are

slender, suited for running. The hemelytra are present, covering the abdomen. The abdominal segments of males are asymmetrical. This small family contains about 32 species in three genera, of which the genus *Ochterus* Latreille contains 30 species and is cosmopolitan. The species of the family inhabit the shores of ponds and streams, where they are found among weeds and grasses and upon sandy shores. They are predominantly shore dwellers and their cryptic colouration makes them nearly invisible, but they can run rapidly or jump when disturbed.

One species belonging to the genus *Ochterus* has been recorded from Javadi Hills.

1. *Ochterus marginatus marginatus* (Latreille)

1804. *Acanthia marginata* Latreille, *Hist. Nat. Crust. Ins. Paris*, 12 : 242.
1906. *Pelogonus marginatus* (Latreille) : Distant, *Fauna British India*, 3 : 14.
- 1910b. *P. marginatus* (Latreille) : Distant, *Fauna British India*, 5 : 310.
- 1919a. *P. marginatus* (Latreille) Paiva, *Rec. Indian Mus.*, 16 : 154.
- 1919b. *P. marginatus* (Latreille) Paiva, *Rec. Indian Mus.*, 16 : 372.
1934. *Ochterus marginatus marginatus* (Latreille) : Jaczewski, *Ann. Mag. nat. Hist.*, 13 : (10) 602.
1971. *O. marginatus* (Latreille) : Kormilev. *Pac. Ins.* 13 : 433.

Diagnostic characters : Lateral margins of pronotum distinctly convex. Costal margins of hemelytra bordered with yellow, widened at the extreme base and usually also at three other places forming three pale submarginal spots. The right paramere of the males with a rounded capitulum at the apex while the lateral appendages form more or less distinct claw-like point, at the base.

Material examined : 1 ♀ from Amridi Aru, Amridi, alt. 230 M, 6.V 1984.

Distribution : INDIA : Assam (Garo Hills), Maharashtra, Tamilnadu (Javadi Hills) ; ABYSSINIA ; COCHIN-CHINA ; FRANCE ; JAPAN ; SRI LANKA ; SUMATRA.

Remarks : In India, this species had been so far reported from Bhor Ghat and Garo Hills and its present record from Javadi hills indicates its distribution in the Eastern Ghats and Southern India. Pelogoniidae has been used as the name of the family (China & Miller,

1955), because it is the oldest group name ; but in most of this century the family name Ochteridae has gained general acceptance and Article 40 (a) of the code permits continuance of this usage. (Menke, 1979a).

Family : CORIXIDAE

The Corixidae or "water boatmen" is the largest family of aquatic Hemiptera with six subfamilies, 500 species under 30 genera. The corixid labium is broadly fused with the head, with distinctive transverse grooves and channels on its outer surface which harbours the stylets. The characteristic of the family is the single segmented front tarsus called 'Pala' which is flattened and scoopshaped. The scutellum is exposed or concealed and the male abdominal segments are asymmetrical. In most genera, VI segment of tergum bears a filelike plate called the "Strigil". The ocelli are absent except in *Diaprepocoris*. The antennae are short, three or four segmented and concealed. The membrane lacks veins. A distinctive character is the pattern of alternate dark and light transverse bands on the dorsum in most of the genera. The middle legs are long and slender, fringed with strong bristles which are used for gathering food. The hind legs are moderately stout, with two-segmented tarsi that are flattened and fringed for swimming.

The subfamily Corixinae contains the majority of the species. The corixids are cosmopolitan and have successfully invaded a wide range of habitats. They occur below sea level in saline waters and reach as high as 4575 m in the Himalaya. They inhabit cool subarctic waters beneath ice and hot spring waters with a temperature of 35°C, while a few of them are halobionts, living exclusively in saline or brackish waters. Often, extremely large numbers are found in their preferred habitat, and a number of different species may occupy the same pool.

Two subfamilies, Corixinae and Micronectinae are represented in the Javadi Hills.

SYSTEMATIC ACCOUNT

Family : CORIXIDAE

Subfamily : CORIXINAE

1. *Agraptocorixa (Agraptocorixa) hyalinipennis* (Fabricius)
2. *Corixa (Tropocorixa) gravelevi* Hutchinson
3. *Corixa (Tropocorixa) pruthiana* Hutchinson

Subfamily : MICRONECTINAE

1. *Micronecta (Indonectella) thyseta* Distant
2. *Micronecta (Sigmonecta) quadristrigata* Breddin
3. *Micronecta (Basileonecta) scutellaris scutellaris* (Stål)
4. *Micronecta (Dichaetonecta) prashadana* Hutchinson
5. *Micronecta (Dichaetonecta) janssoni* sp. nov.

Key to species of Corixidae found in Javadi Hills

1. Antenna three segmented ; scutellum visible 2
 Antenna four segmented ; scutellum hidden 6
2. Strigil absent in males *M. thyseta* Distant
 Strigil present in males 3
3. Eighth abdominal tergite of male sigmoid in
 outline *M. quadristrigata* Breddin
 Eighth abdominal tergite of male not as above 4
4. Large, size over 3 mm long *M. scutellaris*
 *scutellaris* (Stål)
 Small or moderate, size not more than 3 mm long 5
5. Right paramere of male emarginate ventrally at apex ; left
 paramere flat ; submedian lobe of 7th abdominal sternite
 elongate *M. prashadana* Hutchinson
 Right paramere not as above, long, shaft elongate, left
 paramere short, swollen apically *M. janssoni* sp. nov.
6. Pronotum and elytra not unicolorous *A. hyalinipennis*
 (Fabricius)
 Pronotum marked with lines 7
7. Right side of the eighth abdominal segment with prominent
 brush like fine hairs in males *C. graveleyi* Hutchinson
 Right side of eighth abdominal segment without the prominent
 brush like hairs *C. pruthiana* Hutchinson

Subfamily : CORIXINAE

1. *Agraptocorixa (Agraptocorixa) hyalinipennis* (Fabricius)
1803. *Sigara hyalinipennis* Fabricius, *Syst. Rhyn. Brusvigae*, 105.
1918. *Corixa unicolor* Paiva, *Rec. Indian Mus.*, 14 : 30.
1922. *Corixa paivana* Paiva & Dover, *Rec. Indian Mus.*, 24 : 333.
1926. *Agraptocorixa hyalinipennis* (Fabricius) : Jaczewski, *Ann. Zool. Mus. Polon. Warsaw*, 5 : 18.
1929. *A. hyalinipennis* (Fabricius) : Lundblad, *Arch. Hydrobiol. Stuttgart*, 20 : 297.

1933. *A. hyalinipennis* (Fabricius) : Hutchinson, *Rec. Indian Mus.*, 35 : 401.
1934. *A. hyalinipennis* (Fabricius) : Lundblad, *Arch. Hydrobiol. Suppl.*, 4 : 78.
1940. *A. (Agraptocorixa) hyalinipennis* (Fabricius) : Hutchinson, *Trans. Connecticut Acad. Art. Sci. New Haven*, 33 : 411.

Diagnostic characters : Pronotum and elytra unicolorous, hyaline brown, incomplete pleural sutures well developed. The abdominal sixth dorsum bearing the strigil, produced backward as a well defined peduncle. The strigil is small composed of 5-6 combs and pala with atleast twenty one pegs (21-25).

Material examined : 1 ♂, 2 ♀ & 25 immature stages from Pattanaru, Kuttathur, alt. 525 M, 27 XI 1983 ; 2 ♂♂, 6 ♀♀ ann 1 immature stage from Paramandal, alt. 200 M, 7 XII 1983.

Distribution : INDIA : Himachal Pradesh, Orissa, Punjab, and Tamilnadu ; BURMA ; TAIWAN ; JAVA ; NEW GUINEA ; PAKISTAN.

Remarks : This is the only representative of this genus, found in Oriental Region and probably not found Northwest of the Punjab and is the only member of the genus so far known from India. The available distribution records show that so far this species has been reported in Orissa, Punjab and Himachal Pradesh. The present record in Javadi hills is quite interesting, since this species is reported for the first time from Southern Indian and Eastern Ghats. Among Indian species, it may be very easily recognised by its uniform hyaline brown coloration.

2. *Corixa (Tropocorixa) graveleyi* Hutchinson

1940. *Corixa (Tropocorixa) graveleyi* Hutchinson, *Trans. Connecticut Acad. Arts. Sci. New Haven*, 33 : 453.

Diagnostic characters : This species can easily be identified by the development of the hairs on the rightside of the eighth abdominal segment in the males. Head yellowish-white, pronotum dark brown with ten pale yellowish lines, fourth and fifth lines broken.

Material examined : 2 ♀♀ from a forest stream, Nellivasal, alt, 540 M, 19 XI 1983 ; 2 ♂♂, 7 ♀♀ from Nellivasal, alt. 700 M, 20 XI 1983 ; 1 ♂, 1 ♀, from Nellivasal, alt. 640 M, 21 XI 1983.

Distribution : INDIA : Madhya Pradesh, Maharashtra, Tamilnadu.

Remarks : This species appears to be most common in elevated parts in Penninsular India and recorded by Hutchinson (1940) from artificial lake (Type) and pools. It was also reported to occur along

with other corixids, *C. (Tropocorixa) nilgrica* Hutchison and *Micronecta (Dichaetonecta) desertane dravida* Hutchinson (Hutchinson, 1940.)

3. *Corixa (Tropocorixa) pruthiana* Hutchinson

1940. *Corixa (Tropocorixa) pruthiana* Hutchinson, *Trans. Connecticut Acad. Arts. Sci.*, 33 : 447.

Diagnostic characters : General colour pale yellow or brown and palae are parallel sided with pegs uniformly, closely placed. The right paramere of male with broad base, a central blunt process on the dorsal margin, a well marked subapical tubercle on the ventral margin and a broad elongate beak at the apex.

Material examined : 1 ♀, from Matharakadu, 13.X.1982 ; 2 ♂♂, 5 ♀♀ from Kannaru, alt. 510 M, 26.II.1983 ; 1 ♂, from Vananthurai, alt. 590 M, 27.II.1983 ; 10 ♂♂, 11 ♀♀ from Maddikkaru, alt. 600 M, 28.II.1983 ; 1 ♂ from Bhimamadugu, alt. 500 M, 1.XII.1983 ; 1 ♂, 1 ♂ & 3 ♀♀ from Nellivasal alt. 540 M, 640 M & 720 M, 18.XI.1983 ; 19.XI.1983 and 21.XI.1983 respectively ; 3 ♂♂, 24 ♀♀ from Pattanaru, Kuttathur, alt. 525 M, 27.XI.1983 ; 1 ♀ and 4 immature stages from Kuttaru, Kuttathur, alt. 520 M, 29.XI.1983.

Distribution : INDIA : Karnataka, Tamilnadu (Present record) and Uttar Pradesh ; PAKISTAN.

Remarks : Hutchinson (1940) collected this species from pool of stream bed, river swamps and ponds. In Javadi Hills, this species were collected in good numbers from mountain stream beds, and forest stream beds. It has been recorded for the first time from the Eastern Ghats.

Subfamily : MICRONECTINAE

1. *Micronecta (Indonectella) thyesta* Distant

1910b. *Micronecta thyesta* Distant, *Fauna British India*, 5 : 349.

1940. *M. (Indonectella) thyesta* Distant, : Hutchinson, *Trans. Connecticut Acad. Arts Sci.*, 33 : 363.

1960. *M. (Micronectella) thyesta* Distant : Chen, *J. Kans. ent. Soc.*, 33 : 117.

1962. *M. (Indonectella) thyesta* Distant : Wr'oblewski, *Bull. Acad. Polon. Sci. C III.*, 10 : 177.

1969. *M. thyesta* Distant : Julka, *Entomologist Rec.*, 81 : 175.

Diagnostic characters : It can be differentiated from the known Oriental forms by the absence of strigil in males and the distal margin

of free lobe of eighth abdominal tergite deeply emarginate. General colour greyish-yellow with head darkened posteriorly. Head evenly rounded anteriorly.

Material examined : 2♂♂ coll. by light trap (Petromax light), Pattarikadu, alt 490 M, 5.III.1983 ; 1♂, 5♀♀ from Nellivasal, alt. 680 M, 18.XI.1983 ; 5♂♂, 8♀♀ from Kuttathur, alt. 525 M, 27.XI.1983 ; 1♂, 4♀♀ from Thopparu, Kuttathur, alt. 620 M 30. XI. 1983 : 1♂, 1♀ from Odugathur, alt. 410 M, 21.IV.84.

Distribution : INDIA : Andhra Pradesh, Bihar, Karnataka, Orissa, Tamilnadu, West Bengal ; CHINA ; VIETNAM.

Remarks : This species has also been reported to occur in flooded rice fields (Hutchinson, 1940) which indicates that *M. thyesta* can tolerate more high organic substrates. During the present study, this species was collected mainly from muddy pools with rich organic contents.

2. *Micronecta* (*Siamonecta*) *quadristrigata* Breedin

1905. *Micronecta quadristrigata* Breedin, *Soc. Ent. Zurich*, 20 : 57.

1910b. *M. minthe* Distant, *Fauna British India*, 5 : 347.

1934. *M. quadristrigata* Breedin : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 87.

1939. *M. quadristrigata* Breedin : Hafiz and Ribero, *Rec. Indian Mus.*, 41 : 435.

1940. *M. (Basileonecta) quadristrigata* Breedin : Hutchinson, *Trans. Conn. Acad. Arts Sci.*, 33 : 376.

1947. *M. (Basileonecta) quadristrigata* Breedin : Hafiz and Pradhan, *Rec. Indian Mus.*, 45 : 355.

1960. *M. quadristrigata* Breedin : Wr'oblewski, *Ann. Zool. Warszawa*, 18 : 301.

1962. *M. (Sigmonecta) quadristrigata* Breedin : Wr'oblewski, *Bull. Acad. Polon. Sci. CV II.*, 10 : 176.

1969. *M. quadristrigata* Breedin : Julka, *Entomologist. Rec.* 81 : 17.

Diagnostic characters : The eighth abdominal tergites of males is sigmoid in outline. The seventh abdominal tergite has four, moderately enlarged bristles.

Material examined : 3♂♂, 17♀♀, collected by light trap at Pattarikadu, alt. 493 M, 5. III. 1984.

Distribution : India : Bihar, Karnataka, Kerala, Orissa, Tamilnadu, West Bengal ; INDONESIA ; IRAN ; MALAYSIA ; PHILIPPINES ; SRI LANKA,

Remarks : This species is very common in the Southern and Eastern parts of India. It is also reported to occur in brackish water pools. It has also been collected from the backwaters of Madras Coast (salinity 4.2%) by the author.

3. *Micronecta* (*Basileonecta*) *scutellaris scutellaris* (Stål)

1858. *Sigra scutellaris* Stål, *Vetens akad. Forh.*, 15 : 339.
 1919b. *Micronecta dione* Distant, *Fauna British India*, 5 : 348.
 1910. *M. proba* Distant, *Fauna British India*, 5 : 348.
 1940. *M. (Basileonecta) scutellaris scutellaris* (Stål) : Hutchinson, *Trans. Conn. Acad. Arts Sci.*, 33 : 365.
 1947. *M. (Basileonecta) scutellaris scutellaris* (Stål) : Hafiz and Pradhan, *Rec. Indian Mus.*, 45 : 354.
 1962. *M. (Basileonecta) scutellaris* (Stål) : Wr'oblewski, *Bull. Acad. Polon. Sci., CI II*, 10 : 176.
 1969. *M. scutellaris* (Stål) : Julka, *Entomologist Rec.*, 81 : 175.
 1983. *M. scutellaris* (Stål) : Ahmed & Ahmed, *J. Bombay nat. Hist. Soc.*, 80 : 236.

Diagnostic characters : *M. scutellaris* is the largest Indian species of *Micronecta*. In males, the pronotum is grey or greyishbrown, paler margins and with obscure elytral pattern.

Material examined : 3 ♂♂, 7 ♀♀ from a forest stream in Nellivasal, alt. 540 M, 19. XI. 1983 ; 1 ♂ 1 ♀ from Thopparu, Kuttathur alt. 625 M, 30. XI. 1983 ; 2 ♂♂, 2 ♀♀ from Paramandal, alt. 200 M, 7. XII. 1983.

Distribution : INDIA : Andhra Pradesh, Bihar, Karnataka, Kerala, Tamilnadu, Uttar Pradesh, West Bengal ; CENTRAL AFRICA ; CHINA ; INDONESIA ; MALAYSIA ; SAUDI ARABIA ; SRI LANKA ; VIETNAM.

Remarks : This species has a very wide distribution in India and is probably the commonest member of the genus. This species which is very common in India, seems to decline in the frequency of its occurrence towards eastwards, though it reaches China. In India, it is usually found in stagnant water in ponds, pools and ditches.

4. *Micronecta* (*Dichaetonecta*) *prashadana* Hutchinson

1940. *Micronecta (Dichaetonecta) prashadana* Hutchinson, *Trans. Conn. Acad. Arts Sci.*, 33 : 387.
 1950a. *M. (Dichaetonecta) prashadana* Hutchinson : Pradhan, *Rec. Indian Mus.*, 48 : 102.

Diagnostic characters : This species is distinguished from all the known species by the very elongate submedian lobe of seventh sternite and the remarkable male parameres. The right paramere is emarginate ventrally, just proximal to its apex and the left paramere is flat.

Material examined : 58 ♂♂, 84 ♀♀ and 1 immature stage from Utharakaveri Aru, Odugathur, alt. 310 M, 22.IV.1984 ; 57 ♂♂, 30 ♀♀ alt. 300 M, 23.IV.1984 ; 84 ♂♂, 91 ♀♀ and 6 immature stages, alt. 310 M, 26.IV.1984 from the above locality ; 36 ♂♂, 31 ♀♀ from Agram Aru, Agram, alt. 260 M, 27.IV.1984 ; 111 ♂♂, 79 ♀♀ and 42 immature stages from Agram Aru, Gururajapalayam, alt. 200 M, 29. IV. 1984 ; 27 ♂♂, 36 ♀♀ and 2 immature stages from Kad Aru. Amride, alt. 240 M, 2.V.1984 ; 122 ♂♂, 148 ♀♀, 63 ♂♂, 76 ♀♀, 55 ♂♂, 53 ♀♀ and 6 immature stages ; 72 ♂♂, 66 ♀♀ and 3 immature stages from Amride River, Amride, alt. 260 M, 250 M, 220 M, 230 M, 3.V, 4.V, 5.V, 6.V 1984 respectively.

Distribution : INDIA : Karnataka, Tamilnadu and Uttar Pradesh.

Remarks : This species is recorded for the first time from Eastern Ghats. It is quite clear from the number of examples collected that this species is a running water species, found only in riverine ecosystem. Pradhan (1950) has also collected this species from Rihand River, in Uttar Pradesh and the type locality of this species is Gundal River, Ooty-Mysore Road in Western Ghats.

5. *Micronecta (Dichaetonecta) janssoni* sp. nov.

(Fig. 3 A-F.)

Size : Males : 2.3—2.4 mm long ; maximum width across the body 0.9—1.0 mm ; Females : 2.4—2.5 mm long ; maximum width across the body 0.9—1.0 mm.

Colour : General coloration dark, head pale brown, pronotum dark brown ; ventral side of thorax pale ; abdomen brown ; legs pale brown ; hemelytra blackish-brown.

Structural characteristics : Head narrower than pronotum, about half as long as pronotum ; vertex protruding without any visible stripes along the middle ; antenna three segmented without any peculiarities. Pronotum smooth, as wide as head ; posterior margin convex ; two times wider than long. Hemelytra shiny with very small hairs forming the pubescence, uniformly scattered, mainly on the distal half ; corium distal half transparent ; extending to the tip of abdomen ; brown pattern on the hemelytra linear as in many Oriental species ; average length 2.1 mm. The average measurement of fore legs are (in mm) :

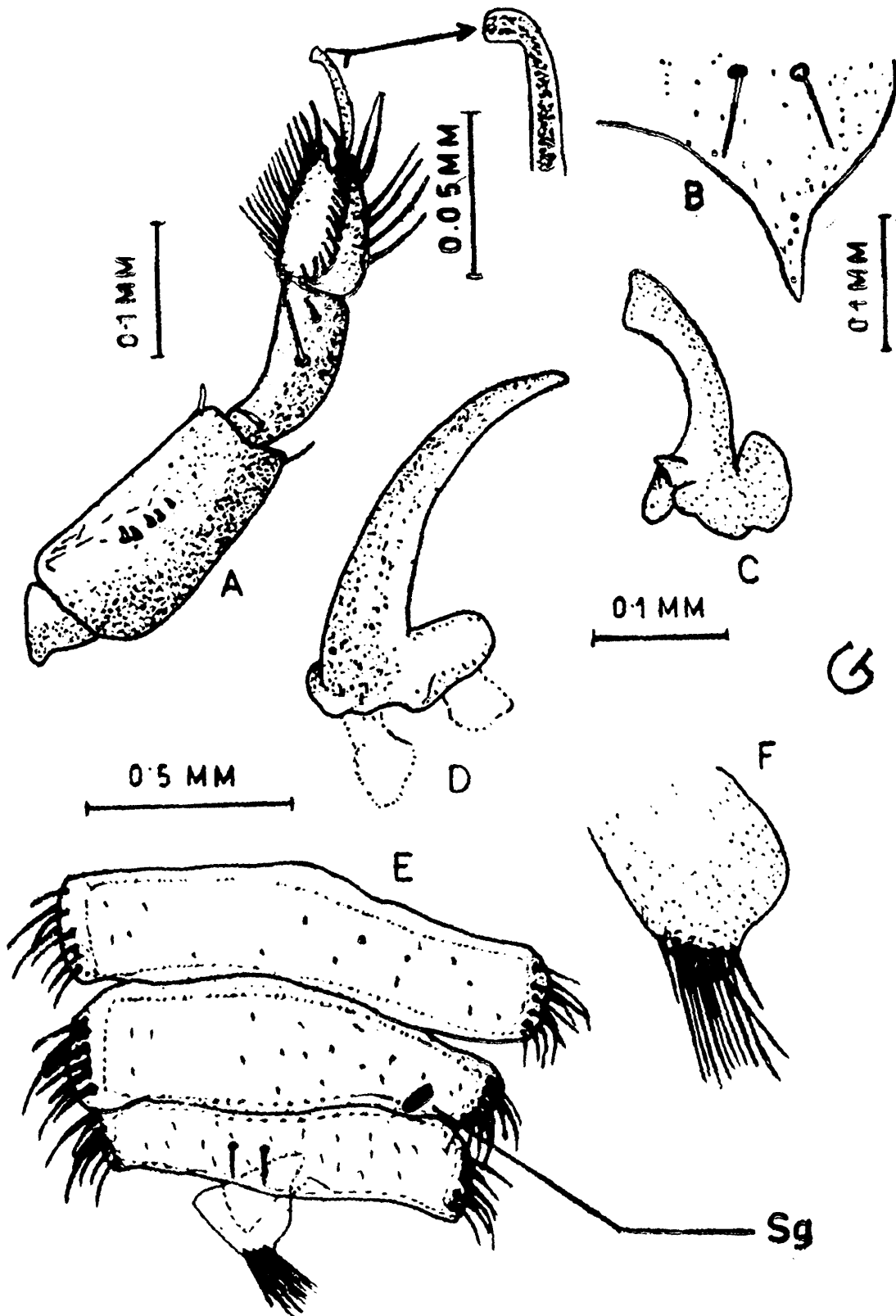


Fig. : 3 *Micronecta (Dichaetonecta) janssoni* sp. nov.

- A. Male fore leg with claw enlarged.
- B. Submedian process of Seventh abdominal sternite of male.
- C. Left Paramere.
- D. Right Paramere.
- E. Fifth, Sixth & Seventh abdominal segment of male (Sg. Strigil).
- F. Free lobe of eighth abdominal tergite of male.

	Femur	Tibia	Pala	Claw
Male	0.34	0.18	0.23	0.14
Female	0.36	0.2	0.22	0.14

The male femur, has near its base on the inner side five short conically shaped spines ; tibia with two bristles at apex, one longer ; palar claw long, narrow, tip broad and curved (Fig. 3A). The average measurement of middle and hind legs are (in mm) :

	Femur	Tibia	Tarsus I	Tarsus II	Claw
Male					
Middle leg	0.86	0.3	0.46	—	0.16
Hind leg	0.62	0.5	0.48	0.28	0.12
Female					
Middle leg	1.0	0.28	0.5	—	0.2
Hind leg	0.68	0.48	0.52	0.28	0.2

Abdomen with strigil present on the right side of sixth dorsal abdominal segment, consisting of numerous minute combs ; seventh abdominal sternite with two very conspicuously developed elongate bristles ; submedian process of seventh abdominal sternite as in Fig ; free lobe of eighth abdominal tergite of male broad, long with hair like setae at the tip (Fig. 3F) ; Parameres asymmetrical, characteristic ; right (Fig. 3D) with its shaft being elongate, broad at base, gradually tapering, apex acute ; left paramere (Fig. 3C) short, curved, widening at apex, innerside covered distally with very few tiny minute scales.

Distribution : INDIA : Tamilnadu.

Material examined : HOLOTYPE : ♂ from a forest stream known as 'Kastaru', Nellivasal, alt. 540 M, Coll. G. Thirumalai, 19. XI.1983.

Paratype : 11 ♂♂, 28 ♀♀ (in liquid) data same as holotype.

Remarks : This species resembles *M. orientalis* Wr'oblewski in the general shape of free lobe of eighth abdominal tergite and right paramere, from which it can be distinguished by the smaller size, structure of palar claw. The left paramere of the present species is curved slightly, swollen and broad distally. There are no barbs on the upper half on the left paramere as seen in *M. orientalis*.

Family : PLEIDAE

Members of this family are minute, compact, with strongly convex body, swimming upside-down, somewhat resembling miniature notonectids, having the head and thorax fused. Because of their small size

they may escape notice by collectors. Head relatively large, directed ventrocaudad ; rostrum short, three segmented. Elytra conjointly forming oval convex carapace closely fitted over abdomen, no trace of membrane. Legs are subequal in length and appearance, tibiae and tarsi not flattened and ciliated along the margins. The pleids appear to prefer freshwater ponds in coastal and other lowland situations, where they are found among submerged aquatic plants. They move from place to place often by clinging to floating vegetation. The females insert their eggs into plants. This family is cosmopolitan with three genera and forty species.

One species of the genus *Plea* is recorded from Javadi Hills.

1. *Plea frontalis* (Fieber)

1844. *Plea frontalis*, Fieber, *Entomologische Monographien, Leipzig*, 18.
1906. *Plea frontalis* (Fieber) : Distant, *Fauna British India*, 3 : 48.
- 1910b. *P. pelopea* Distant, *Fauna British India*, 5 : 336.
1934. *P. (Paraplea) frontalis* (Fieber) : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 138.
1939. *P. (Paraplea) frontalis* (Fieber) : Hafiz and Ribeiro, *Rec. Indian Mus.*, 41 : 434.
1947. *P. (Paraplea) frontalis* (Fieber) : Hafiz and Pradhan, *Rec. Indian Mus.*, 45 : 349.
1969. *P. frontalis* (Fieber) : Julka, *Entomologist*, : 81 : 175.

Diagnostic characters : Head with a small dark reddish-brown longitudinal stripe, without three dashes on front. Frons and vertex finely punctate. Elytra with very fine hairs, coarsely and reticulately punctate. Thoracic keels with spine like protuberance in each, metasternal keel with a more or less irregular anterior margin and a shallow depression near the middle of the ventral margin. Spines in the right ovipositor varying between 14 to 17, and in left from 16 to 20. Males smaller than females.

Material examined : 9 ♂♂, 8 ♀♀ and 22 immature stages collected from Kondikallur, alt. 580 M, 6.III.1983.

Distribution : INDIA : Bihar, Pondicherry, Tamilnadu, Uttar Pradesh, West Bengal ; CHINA ; FORMOSA ; INDONESIA ; MALAYA.

Remarks : This species is restricted to Oriental region and has a wide range of distribution, being recorded from India, Indo-China,

Malaya and Indonesia. This species is reported for the first time from Javadi Hills and thereby forms new report from Eastern Ghats.

Family : NOTONECTIDAE

The members belonging to the family Notonectidae, known as backswimmers, are truly aquatic forms, which differ from all other aquatic bugs (except Pleidae and Helotrephidae) in the habit of swimming on their backs. They are long and slender, deep bodied insects, flat ventrally and convex dorsally. The eyes are large, reniform and occupy most of the dorsal side of the head. The ocelli are absent. The antennae are short, three or four segmented and concealed. The rostrum is short and four segmented. The fore and middle legs are adapted for grasping while the long hind legs are flattened and heavily fringed with long hairs for swimming. The tarsi are two segmented, except the males of Old world genus *Anisops* which has one segmented fore tarsi. The tarsi possess two apical claws which are greatly reduced on the hind pair of legs. The abdominal venter has a prominent longitudinal keel fringed with long hairs. About 300 species of backswimmers are known, divided among nine genera, under two subfamilies, namely Notonectinae and Anisopinae. The notonectids are good swimmers and occur in a variety of freshwater habitats. They are predatory and majority of them prefer quite water of pools and lakes but a few are more frequently found in creeks. In Javadi Hills, the two known subfamilies were found and the following species were collected.

SYSTEMATIC ACCOUNT

Family : NOTONECTIDAE

Subfamily : NOTONECTINAE

1. *Enithares ciliata* (Fabricius)
2. *Enithares hungerfordi* Brooks

Subfamily : ANISOPINAE

1. *Anisops barbata* Brooks
2. *Anisops bouvieri* Kirkaldy
3. *Anisops cavifrons* Brooks
4. *Anisops nigrolineata* Lundblad
5. *Anisops nivea* (Fabricius)
6. *Anisops sardea* Herrieh-Shaffer

7. *Anisops stali* Kirkaldy
8. *Anisops waltirensis* Brooks

**Key to the species of family Notonectidae of Javadi Hills
(FOR MALES)**

1. Hemelytral commissure without hair-lined pit at anterior end
(Subfamily : Notonectinae) 2
Hemelytral commissure with a hair-lined pit
(Subfamily : Anisopinae) 3
2. Mesotrochanter with a large patch of black spicules
... .. *E. ciliata* (Fabricius)
Mesotrochanter without the large patch of black
spicules *E. hungerfordi* Brooks
3. Synthlipsis wide, one-third or more the anterior width
of vertex 4
Synthlipsis narrow, less than one-third the anterior
width of vertex 7
4. Large robust species, more than 8.0 mm long 5
Moderate less than 8.00 mm long 6
5. Small anterior cephalic projection with slightly depressed
frons *A. stali* Kirkaldy
Not as above, two tufts of hair on fascial tubercle
present *A. barbata* Brooks
6. Facial tubercle not excavate, interocular space is
swollen beyond the margin of eyes, (viewed laterally)
... .. *A. nigrolineata* Lundblad
Facial tubercle excavate, interocular space not
as above *A. nivea* (Fabricius)
7. Anteriorly, interocular space produced into a cephalic
projection 8
Interocular space not as above, fore tarsi with a median
row of three small setae on its inner side
... .. *A. waltirensis* Brooks
8. Cephalic projection more or less acuminate 9
Cephalic projection rounded at apex *A. cavifrons* Brooks
9. Inner side of fore tibiae with a row of prominent
setae on the margins *A. sardea* Herrich-Shaffer
Fore tibiae not as above *A. bouvieri* Kirkaldy

Subfamily : NOTONECTINAE

1. *Enithares ciliata* (Fabricius)

1798. *Notonecta ciliata* Fabricius, *Suppl. Ent. Syst.*, 524.

1906. *Enithares indica* (Fabricius) : Distant, *Fauna British India*, 3 : 42.

1910b. *E. paviana* Distant, *Fauna British India*, 5 : 329.

1912. *E. indica* (Fabricius) : Nowrojee, *Mem. Dept. Agric. India Ent.*, 2 : 168.
 1919a. *E. lactea* Pavia, *Rec. Indian Mus.*, 19 : 155.
 1928. *E. indica* (Fabricius) : Dover, *J. Bombay nat. Hist. Soc.*, 32 : 615.
 1938. *E. abbreviata* (Kirby) : Hafiz & Mathai, *Rec. Indian Mus.* 40 : 210.
 1968. *E. ciliata* (Fabricius) : Lansbury, *Pacif. Ins.*, 10 : 413.

Diagnostic character : The mesotrochanter is rounded with patch of black spicules along the ventral margin, covering a much larger area.

Material examined : Total number of material examined : 69 ♂♂, 67 ♀♀ and 10 immature stages from the following localities. Both Pale & dark forms were represented in the collection. 4 ♂♂, 1 ♀ from Komattiyur alt. 300 M, 14. X. 1982 ; 2 ♂♂, 1 ♀ from Pattaraikadu alt. 500 M, 15. X. 1982 ; 5 ♂♂, 1 ♀ from Kannaru, Jamnamaruthur, alt. 510 M, 26. II. 1983 ; 10 ♂♂, 8 ♀♀ from Vannanthurai, Kavalur, alt. 590 M, 27. II. 1983 ; 4 ♂♂, 3 ♀♀ from Maddaikaru, alt. 560 M, 28. II. 1983 ; 2 ♂♂, 4 ♀♀ from Bhimamadugu, alt. 500 M, 1. III. 1983 ; 4 ♂♂, 10 ♀♀ from Thopparu, Pattaraikadu, alt. 540 M, 3. III. 1983 ; 4 ♂♂, 3 ♀♀ from Thenmathisaragam, alt. 450 M, 4. III. 1983 ; 4 ♂♂, 5 ♀♀ from Pudur, alt. 500 M, 5. III. 1983 ; 14 ♂♂, 10 ♀♀ & 6 immature stages, from Karadaikallur, alt. 580 M, 6. III. 1983 ; 1 ♂, 1 ♀ & 2 immature stages from Thopparu, alt. 520 M, 7. III. 1983 ; 1 ♂, 2 ♀♀ from Pudur, alt. 840 M, 15. XI. 1983 ; 2 ♂♂, 2 ♀♀ from Nellivasal, alt. 540M, 19. XI. 1983 ; 2 ♂♂, 9 ♀♀ from the above locality, alt. 700 M, 20. XI. 1983 ; 2 ♂♂, 4 ♀♀ from the same locality, alt. 640 M, 21. XI. 1983 ; 5 ♀♀, 6 immature stages, from Kavalur, alt. 520 M, 24. XI. 1983 ; 1 ♂, 3 ♀, from Kuttathur, alt. 530 M, 26. XI. 1983 ; alt. 525 M, 28. XI. 1983 respectively ; 3 ♀♀ from Kalyanamandai, Kuttathur, alt. 600 M, 1. XII. 1983 ; 1 ♂, 1 ♀ from Velichannur, Kuttathur, alt. 520 M, 2. XII. 1983 ; 1 ♀, 2 immature stages from Kuttaru. Kuttathur, alt. 500 M, 3. XII. 1983 ; 2 ♂♂, 2 ♀♀ and 1 immature stages from Amerdi, alt. 250 M, 4. V. 1983.

Distribution : INDIA : Andaman Islands, Andhra Pradesh, Bihar, Goa, Kerala, Maharashtra ; BHUTAN and much of South East Asia.

Remarks : This species, like the other known species of the genus, is found on water surface and usually feeds on prey caught in the surface film or floating at the surface of deep water or clinging to submerged objects. The females glue their eggs on submerged aquatic plants.

2. *Enithares hungerfordi* Brooks

1948. *Enithares hungerfordi* Brooks, *J. Kans Ent. Soc.*, 21 : 41.
 1968. *E. hungerfordi* Brooks : Lansbury, *Pacif. Ins.*, 10 : 372.

Diagnostic characters : The basal width of the metaxyphus equals the median length. The males of *E. hungerfordi* lack a flap on the forefemora near the back of the trochanters.

Material examined : 1 ♀ from Pudur, alt. 500 M, 5. III. 1983 ; 1 ♀ from Thopparu, alt. 520 M, 7. III. 1983 ; 1 ♀ from Nellivaṣal, alt. 700 M, 20. XI. 1983.

Distribution : INDIA : Kerala and Tamilnadu.

Remarks : Out of the five species so far known from India, *E. hungerfordi* along with *E. fusca* Brooks so far restricted to southern part of India. The distribution records so far revealed that this species has been found in Western Ghats and during the present study it is being reported for the first time from Eastern Ghats.

Subfamily : ANISOPINAE

1. *Anisops barbata* Brooks

1951. *Anisops barbata* Brooks, *Kan. Univ. Sci. Bull.*, 34 : 387.

1962. *A. barbata* Brooks : Leong & Fernando, *J. Bombay nat. Hist. Soc.*, 59 : 516.

1964. *A. barbata* Brooks : Lansbury, *Ann. Zool. Warszawa*, 22 : 211.

Diagnostic characters : *A. barbata* can be easily identified by its large size (over 8.1 mm). It has, however, two tufts of hairs on the fascial tubercles.

Material examined : 1 ♂ 1 ♀ from Bhimamadu, Jamnamaruthur, alt. 500 M, 1. III. 1983 ; 1 ♀ from Vannanthurai, alt. 590 M. 27. II. 1983 ; 7 ♂ ♂ 4 ♀ ♀ & 3 immature stages from Kondikallur, alt. 580 M, 6. III. 1983.

Distribution : INDIA : Andhra Pradesh, Himachal Pradesh, Karnataka, Orissa, Tamilnadu, West Bengal ; BURMA ; CHINA ; INDONESIA ; MALAYSIA ; SRILANKA ; TAIWAN ; VIETNAM.

Remarks : This is the largest species of *Anisops* so far reported from India. Its data on distribution includes plains to base of Western Himalayas.

2. *Anisops bouvieri* Kirkaldy

1904. *Anisops bouvieri* Kirkaldy, *Wiener Ent. Zeit.*, 23 : 116.

1951. *A. bouvieri* Kirkaldy : Brooks, *Univ. Kans. Sci. Bull.*, 34 : 430.

1962. *A. bouvieri* Kirkaldy : Leong & Fernando, *J. Bombay nat. Hist. Soc.*, 59 : 516.

Diagnostic characters : Though the females of *A. bouvieri* and *A. batillifrons* Lundblad are indistinguishable, the males of *A. bouvieri* have

the cephalic projection more or less acuminate and longer, which extends one fifth of its ventral length beyond the anterior margin of eyes. There are tufts of labral hairs in this species.

Material examined, 1 ♂, 2 ♀ ♀ from Pattan Aru, Kuttathur, alt. 525 M, 27. XI. 1983.

Distribution : INDIA : Andhra Pradesh, Andaman Islands, Assam, Madhya Pradesh, Orissa, Tamilnadu, West Bengal : BANGLADESH ; BURMA ; CHINA ; MALAYSIA ; NEW GUINEA ; THAILAND.

Remarks : This species is found mainly in India, but Lundblad (1934) listed this species in Indo-Australian Pacific regions. This species is found in freshwater pools, lakes, ponds, forest streams etc. It is a very mobile species and has been recorded at light in India (Brooks, 1951).

3. *Anisops cavifrons* Brooks

1951. *Anisops cavifrons* Brooks, *Univ. Kans. Sci. Bull.*, 34 : 418.

Diagnostic characters : This species is very closely related to *Anisops batillifrons* Lundblad and appears identical to it in almost every superficial details (Brooks, 1951). However, the males of *A. cavifrons* have a procumbent spine on the foretibia which is absent in *A. batillifrons*.

Material examined : 1 ♂ 1 ♀ and 15 immature stages from Komathiyur, alt. 600 M, 14.X.1982 ; 2 ♂ ♂ 8 ♀ ♀ from Kannaru, alt. 510 M, 26.II.1983 ; Vannandurai, alt. 590 M, 27.II.1983 ; 2 ♂ ♂, 6 ♀ ♀, 1 immature stage from Madikkaru, alt. 600 M, 28.II.1983 ; 1 ♂, 6 immature stages from Pudhur, alt. 580M, 5.III.1983 ; 1 ♂, 1 ♀ from Nellivasal, alt. 720 M, 18.XI.1983 ; 2 ♂ ♂, 5 ♀ ♀ from Nellivasal, alt. 540 M, 19.XI.1983 ; 1 ♂, 1 ♀ from Pattanaru, Kuttathur, alt. 525 M, 27.XI.1983 ; 3 ♂ ♂, 3 ♀ ♀ from Paramandal, alt. 200 M, 7.XII.1983 ; 1 ♂, 1 ♀ from Theerthakanaru, Odugathur, alt. 420 M, 21.IV.1984 ; 4 ♂ ♂, 10 ♀ ♀ Utharakaveri Aru, Odugathur, alt. 300 M, 23.IV.1984.

Distribution : INDIA : Himachal Pradesh, Kerala, Maharashtra, Punjab, Tamilnadu, Uttar Pradesh, West Bengal ; PAKISTAN.

Remarks : This species has been reported from Western Ghats and during the present study it was collected from Javadi hills, and thereby recorded for the first time from Eastern Ghats. It is also

interesting to note in Kerala, it was recorded from Cochin backwaters. This species was also known to occur in temple tank.

4. *Anisops nigrolineata* Lundblad

1934. *Anisops nigrolineata* Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 160.
 1951. *A. nigrolineata* Lundblad : Brooks, *Univ. Sci. Kans. Bull.* 34 : 409.
 1964. *A. nigrolineata* Lundblad : Lansbury, *Ann. Zool. Warszawa*, 32 : 215.

Diagnostic characters : It can be easily identified by the swollen interocular space beyond the margins of the eyes in males while in females the head is rounded with the vertex extending slightly beyond the anterior margin of the eyes.

Material examined : 1 ♀ from Kannaru, alt. 510 M, 26.II.1983 ; 22 ♂ ♂, 25 ♀ ♀ and 1 immature stage from Vannandhurai, alt. 590 M, 27.II.1983 ; 7 ♂ ♂, 11 ♀ ♀ and 1 immature stage from Bhimamadu alt. 500 M, 1. III.1983 ; 1 ♂, 2 ♀ ♀ from Nellivasal, alt. 540 M, 19.XI.1983 ; 1 ♀ from a mountain stream at Kuttathur, alt. 530 M, 26.XI.1983 ; 4 ♂ ♂, 3 ♀ ♀ from Kuttaru, Kuttathur, alt. 520 M, 29.XI.1983.

Distribution : INDIA : Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Tamilnadu : AFGHANISTHAN ; BANGLADESH ; BURMA ; INDONESIA.

Remarks : This species has a remarkable discontinuous distribution having been described from Sumatra, but being found mainly in India. In Southern India, it has been so far known only from Coimbatore.

5. *Anisops nivea* (Fabricius)

1775. *Notonecta, nivea* Fabricius, *Systema Entomologiae*, 690.
 1906. *Anisops niveus* (Fabricius) : Distant, *Fauna British India*, 3 : 46.
 1918. *A. niveus* (Fabricius) : Paiva, *Rec. Indian Mus.* 14 : 27.
 1928. *A. niveus* (Fabricius) : Dover, *J. Bombay, nat. Hist. Soc.* 32 : 615.
 1934. *A. nivea* (Fabricius) : Lundblad, *Arch. Hydrobiol, Suppl.*, 12 : 613.
 1939. *A. (Anisops) nivea* (Fabricius) : Hafiz & Ribeiro, *Rec. Indian Mus.*, 41 : 433.
 1947. *A. (Anisops) nivea* (Fabricius) : Hafiz & Pradhan, *Rec. Indian Mus.*, 45 : 353.
 1950a. *A. nivea* (Fabricius) : Pradhan, *Rec. Indian Mus.* 48 : 102.
 1951. *A. nivea* (Fabricius) : Brooks. *Univ. Kans. Sci. Bull.*, 34 : 373.
 1962. *A. nivea* (Fabricius) : Leong & Fernando, *J. Bombay nat. Hist. Soc.*, 59 : 517.

Diagnostic characters : The males of *A. nivea* have an excavation restricted to the fasciocl tubercle which is bordered by one carina on each side.

Material examined : 1 ♂, 1 ♀ from a Mountain stream, Pattan Aru, Kuttathur, alt. 525 M, 27.XI.1983 ; 1 ♂, 2 ♀ from a mountain stream, Thopparu, Kuttathur, alt. 620 M, 30.XI.1983.

Distribution : INDIA : Bihar, Kerala, Orissa, Tamilnadu, West Bengal ; AFRICA ; BURMA ; INDONESIA ; JAVA ; MALAYA ; PHILIPPINES ; SEYCHELLAS ; SRI LANKA ; SUMATRA ; VIETNAM.

Remarks : This is the most abundant species in Vietnam, although not very widely distributed, but found over a large part of the Oriental regions. Hafiz and Ribeiro (1939) reported that this species has also been recorded from Eastern Palaearctic regions and North Africa.

6. *Anisops sardea* Herrich-Shäffer

1850. *Anisops sardeus* Herrich-Shaffer, *Die wanzenartigen Insecten*, 9 : 41.
 1906. *A. sardeus* Herrich-Shaffer : Distant, *Fauna British India*, 3 : 45.
 1918. *A. sardeus* Herrich-Shaffer : Pavia, *Rec. Indian Mus.*, 14 : 28.
 1928. *A. sardeus* Herrich-Shaffer : Dover, *J. Bombay nat. Hist. Soc.*, 32 : 615.
 1938. *A. sardea* Herrich-Shaffer : Hafiz & Mathai, *Rec. Indian Mus.*, 40 : 210.
 1939. *A. (Anisops) sardea* Herrich-Shaffer : Hafiz & Ribeiro, *Rec. Indian Mus.*, 41 : 432.
 1947. *A. (Anisops) sardea* Herrich-Shäffer : Hafiz & Pradhan, *Rec. Indian Mus.*, 45 : 350.
 1951. *A. sardea* Herrich-Shaffer : Brooks, *Univ. Kans. Sci. Bull.*, 34 : 423.

Diagnostic characters : In males, the basal tibial setae of anterior legs spatulate and lacks the laterally expanded keel of the third abdominal sternite.

Material examined : 1 ♂ from a puddle, Paramandal, Chengam, (found along with *A. waltirensis* Brooks), alt. 200 M, 7.XII.1983.

Distribution : INDIA : Bihar, Himachal Pradesh, Karnataka, Maharashtra, Orissa, Punjab, Tamilnadu, Uttar Pradesh, West Bengal ; AFGHANISTAN ; AFRICA ; ALBANIA ; BURMA ; CANARY ISLANDS, SYRIA, TURKEY.

Remarks : This species has a widespread distribution. It is known to occur in Mediterranean countries and Western Asia. It is also widely distributed in Ethiopian, Oriental and Southern Palaearctic regions. In Southern India, this species has been reported to be attracted by light (Dover, 1928).

7. *Anisops stali* Kirkaldy

1904. *Anisops stali* Kirkaldy, *Wiener Ent. Zeit.*, 23 : 113.
 1951. *A. stali* Kirkaldy : Brooks, *Univ. Kans. Sci. Bull.*, 34 : 319.

Diagnostic characters : The base of middle tibia with an inward projection which bears on its inner surface an oval patch of short, stout, closely set setae in males. The males also have a short cephalic projection. The females can be easily identified by their relatively larger size.

Material examined : 2 ♂♂ & 7 immature stages from Pattanaru, Kuttathur, alt. 525 M, 27.XI.1983 ; 4 ♂♂, 7 ♀♀ from Paramandal, alt. 200 M, 7.XII.1983.

Distribution : INDIA : Javadi Hills, Tamilnadu (First record) ; AUSTRALIA ; CELEBES ; OKINAWA ; PHILIPPINE ISLANDS ; TIMOR.

Remarks : This species is for the first time reported from India.

8. *Anisops waltirensis* Brooks

1951. *Anisops waltirensis* Brooks, *Univ. Kans. Sci. Bull.*, 34 : 457.

Diagnostic characters : The synthlipsis is much narrower, one eighth the anterior width of the vertex, rostral prong acuminate at apex. The males are characterised by a median row of small setae on inner surface of anterior tarsi.

Material examined : 1 ♂, 1 ♀ from Kanaru, alt. 510 M, 26.III.1983 ; 2 ♂♂, 1 ♀ from Vannanthurai, alt. 590 M, 27.III.1983 ; 1 ♂ from Pattanaru, Kuttathur, alt. 525 M, 27.XI.1983 ; 1 ♂ from Thopparu, Kuttathur, alt. 620 M, 30.XI.1983 ; 28 ♂♂, 3 ♀♀ from Paramandal, alt. 200 M, 7.XII.1983.

Distribution : INDIA : Andhra Pradesh, Himachal Pradesh, Tamilnadu.

Remarks : *A. waltirensis* has been known from Waltair in Andhra Pradesh and Simla hills in Himachal Pradesh and its occurrence in Javadi Hills indicates its first record from Tamilnadu.

Family : NEPIDAE

The family Nepidae, popularly known as 'Water Scorpions', are dorsoventrally flattened or cylindrical bugs with long and slender legs, the anterior pair being raptorial. The bugs are characterised in having single segmented tarsi and absence of ocelli. The long slender, non-retractile respiratory siphon is derived from the eighth abdominal tergum and has two spiracles at its base. Two subfamilies, namely, Nepinae and Ranatrinae are recognised and the family contains nearly 200 species besides the status of several Old world generic taxa remains.

unclear. The members of this family prefer still water habit and species belonging to the genus *Ranatra* commonly found entangled with aquatic vegetation or debris. Other genera are frequently found in shallow, muddy pools or slow-moving streams with little vegetation.

The two known subfamilies of Nepidae were found in Javadi Hills. The following species of nepids have been recorded during the present study.

SYSTEMATIC ACCOUNT

Family : NEPIDAE

Subfamily : NEPINAE

1. *Laccotrephes griseus* (Guêrin)
2. *Laccotrephes ruber* (Linnaeus)

Subfamily : RANATRINAE

1. *Ranatra elongata* Fabricius
2. *Ranatra filiformis* Fabricius

Key to the species of Nepidae of Javadi Hills.

1. Body oblong or elongately subovate ; pronotum about as long or a little shorter than broad 2
 Body very long, narrow and thin ; pronotum longer than broad 3
2. Small, not exceeding 20 mm in length ; prosternum strongly acute along the median line *Laccotrephes griseus* (Guêrin)
 Long, more than 20 mm in length ; prosternum is convex *Laccotrephes ruber* (Linnaeus)
3. Large body size (38-57 mm) ; respiratory siphon longer than the body *Ranatra elongata* Fabricius
 Small body size (20-26 mm) ; respiratory siphon shorter than the body *Ranatra filiformis* Fabricius

Subfamily : NEPINAE

1. *Laccotrephes griseus* (Guêrin)

1844. *Nepa griseus* Guerin, *Iconogr. Regne Anim. Ins.*, 352.
 1910b. *Laccotrephes griseus* (Guêrin) ; Distant, *Fauna British India*, 5 : 314.
 1919a. *L. griseus* (Guêrin) : Paiva, *Rec. Indian Mus.*, 16 : 154.
 1928. *L. griseus* (Guêrin) : Dover, *J. Bombay nat. Hist. Soc.*, 32 : 615.
 1938. *L. griseus* (Guêrin) : Hafiz & Mathai, *Rec. Indian Mus.*, 40 : 208.
 1939. *L. griseus* (Guêrin) : Hafiz & Ribeiro, *Rec. Indian Mus.*, 41 : 430.
 1947. *L. griseus* (Guêrin) ; Hafiz & Pradhan, *Rec. Indian Mus.*, 45 : 363.

Diagnostic characters : The tubercle situated at the anterior area of prosternum is strongly acute. The base of the anterior femora is characterised by a tooth which more obtusely rounded. The paramere of the male is as in the fig. 4. The abdominal appendages are distinctly shorter than the body.

Material examined : 1 ♀ from Kannaru stream, alt. 510 M, 20.II.1983 ; 2 ♂♂, 5 ♀♀ from Kannikovil, Odugathur, alt. 310 M, 20.IV.1984 ; 7 ♂♂, 2 ♀♀ from Utharakaveri Aru, Odugathur, alt. 310 M, 22.IV.1984 and 1 ♀ from the same locality, alt. 300 M, 23.IV.1984 ; 4 ♂♂, 5 ♀♀ from Pinnathurai, alt. 415 M, 24.IV.1984 ; 1 ♀ from Agram river, Agram, alt. 260 M, 26.IV.1984 ; 1 ♂, 3 ♀♀ from Pudupattu, alt. 340 M, 28.IV.1984.

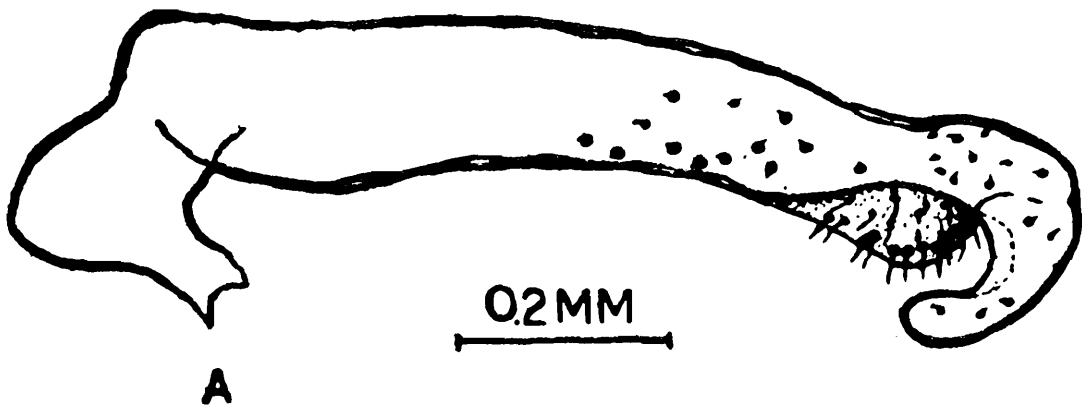


Fig. : 4. *Laccotrephes griseus* (Guêrin)
Paramere of adult male.

Distribution : INDIA : Andhra Pradesh, Bihar, Kerala, Maharashtra, Orissa, Pondicherry, Punjab, Tamilnadu, Uttar Pradesh and West Bengal ; BURMA ; MALACCA ; SEYCHELLES, THAILAND, SRI LANKA.

Remarks : This is a very sluggish species often found in the slow or stagnant pools under the weeds or at the bottom of water. In Javadi Hills, it commonly occurs in slowflowing rivers, especially in the shallow areas. This is a very common species in Peninsular India. It commonly occurs in habitats with dark soil matching its body colour, in permanent ponds near the edges.

2. *Laccotrephes ruber* (Linnaeus)

1764. *Nepa ruber*, Linnaeus, *Mus. Lud. Utr.*, 165.
 1906. *Laccotrephes ruber* (Linn.) : Distant, *Fauna British India*, 3 : 18
 1919a. *L. ruber* (Linn.) : Paiva, *Rec. Indian Mus.*, 16 : 154.
 1928. *L. ruber* (Linn.) : Dover, *J. Bombay nat. Hist. Soc.*, 32 : 615.
 1939. *L. ruber* (Linn.) : Hafiz & Ribeiro, *Rec. Indian Mus.*, 41 : 429.
 1947. *L. ruber* (Linn.) : Hafiz & Pradhan, *Rec. Indian Mus.*, 45 : 364.
 1950a. *L. ruber* (Linn.) : Pradhan, *Rec. Indian Mus.*, 48 : 101.

Diagnostic characters : Compared with *L. griseus*, this species is larger with the abdominal appendices distinctly longer than the body. The prosternum is convex along the middle and provided with a tubercle in the anterior region and slightly raised medianally near the posterior margin.

Material examined : 1 ♂ from a mountain stream locally called Kannaru stream, alt. 510 M, 20.II.1983 ; 1 ♂ from Kuttaru, Nellivasal, alt. 640 M, 21.XI.1983 ; 1 ♂ and 1 ♀ from Utharakaveri Aru, Odugathur, alt. 310 M, & 300 M, 22.IV.1984 ; & 23.IV.1984 respectively ; 1 ♀ from Pinnathurai, alt. 415 M, 24.IV.1984.

Distribution : INDIA : Bihar, Gujarat, Jammu & Kashmir, Kerala, Maharashtra, Meghalaya, Orissa, Tamilnadu, Uttar Pradesh, West Bengal ; CHINA ; FORMOSA ; JAPAN ; NEPAL ; PAKISTAN.

Remarks : This is the most common species and widely distributed towards Indo-Australian region. It is also reported from a wide variety of habitats like rivers, streams, tanks, etc.

Subfamily : RANATRINAE

1. *Ranatra elongata* Fabricius

1790. *Ranatra elongata* Fabricius *Skrif. Nat. Selsk.* 1 : 228.
 1906. *R. elongata* Fab., Distant, *Fauna British India*, 3 : 20.
 1928. *R. elongata* Fab., Dover, *J. Bombay nat. Hist. Soc.*, 32 : 615.
 1938. *R. elongata* Fab., Hafiz & Mathai, *Rec. Indian Mus.*, 40 : 208.
 1947. *R. elongata* Fab., Hafiz & Pradhan, *Rec. Indian Mus.*, 45 : 368.
 1950a. *R. elongata* Fab., Pradhan, *Rec. Indian Mus.*, 48 : 101.
 1969. *R. elongata* Fab., Julka, *Entomologist Rec.*, 81 : 175.
 1972. *R. elongata* Fab., Lansbury, *Trans. R. ent. Soc. Lond.*, 124 : 306.

Diagnostic characters : *R. elongata* can be distinguished by the following characters ; forecoxae are two-thirds the length of prothorax, hind femora do not extend beyond the operculum, anterior lobe of prothorax less than twice the length of posterior lobe. This species can also be distinguished by the structure of the anterior femur which is provided with a large triangular tooth beyond the middle of its length and a pair of short teeth a little before the apex as the proximal border of a shallow notch and the characteristic metasternal process which is subtriangular and centrally longitudinally foveately sulcate.

Material examined : 1 ♂, 1 ♀ from Bhimamadugu, alt. 490 M, 24.II.1983 ; 5 ♂ ♂, 4 ♀ ♀ from Kannaru stream, alt. 510 M, 26.II.1983 ; 2 ♂ ♂, 4 ♀ ♀ from Vannanthurai, alt. 590 M, 27.II.1983 ; 1 ♂ from Madikkaru, alt. 600 M, 28.II.1983 ; 1 ♀ from Thopparu, Pattarikadu, alt. 540 M, 3.III.1983 ; 2 ♂ ♂, 1 ♀ and 2 immature stages from

Kondikallur, alt. 580 M, 6.III.1983 ; 1 ♂, 2 ♀ ♀ Kad Aru, Nellivasal, alt. 640 M, 21.XI.1983 ; 3 ♂ ♂, 3 ♀ ♀ from Thopparu, Kuttathur, alt. 620 M, 30.XI.1983 ; 2 ♂ ♂, 4 ♀ ♀ from Velichanur, Kuttathur, alt. 520 M, 2.XII.1983 ; 1 ♂, 1 ♀ & 10 immature stages from Paramandal, alt. 200M, 7.XII.1983.

Distribution : INDIA : Bihar, Jammu & Kashmir, Kerala, Maharashtra, Orissa, Pondicherry, Tamilnadu, Uttar Pradesh, West Bengal ; AUSTRALIA ; NEPAL ; SRI LANKA.

Remarks : This genus is cosmopolitan in distribution and contains more than 120 species all over the world. In the field, *R. elongata* has been reported to feed on tadpoles, nymphs of dragonflies and mayflies and other groups of aquatic hemipterans. It inhabits temporary water puddles and prefers deeper parts of pools. The bioecological studies of this species have been made by Ragunatha Rao (1962, 1976). During unfavourable seasons, especially when water dries up, *R. elongata* is known to migrate in search of a suitable aquatic medium.

2. *Ranatra filiformis* Fabricius

- 1790 *Ranatra filiformis* Fabricius, *Skrif. Nat. Selsk.*, 1 : 228.
 1906. *R. filiformis* Fab., Distant, *Fauna British India Rhynchota*, 3 : 21.
 1934. *R. filiformis* Fab., Lundblad, *Arch. Hydrobiol., Suppl.* 12 : 36.
 1838. *R. filiformis* Fab., Hafiz & Mathai, *Rec. Indian Mus.*, 40 : 209.
 1939. *R. filiformis* Fab., Hafiz & Ribeiro, *Rec. Indian Mus.*, 41 : 430.
 1947. *R. filiformis* Fab., Hafiz & Pradhan, *Rec. Indian Mus.*, 45 : 364.
 1969. *R. filiformis* Fab., Julka, *Entomologist's Rec.*, 81 : 175.
 1972. *R. filiformis* Fab., Lansbury, *Trans R. ent. Soc. Lond.*, 124 : 320.

Diagnostic characters : This species is smaller than *R. elongata* and rather difficult to identify. However, the most reliable diagnostic characters are the parameres, which lack a tooth on inner side of the hook and the wide interocular space.

Material examined : 1 ♀ from Kannaru stream, Jamnamaruthur, alt. 510 M, 20.II.1983 ; 1 ♂ from Thopparu, Kuttathur, alt. 620 M, 30.XI.1983.

Distribution : INDIA : Assam, Kerala, Maharashtra, Orissa, Pondicherry, Punjab, Tamilnadu, Uttar Pradesh, West Bengal ; NEPAL ; PAKISTAN ; PHILIPPINE ISLANDS ; SRI LANKA.

Remarks : *R. filiformis* mostly occurs among vegetation fringing the shallower parts of water bodies, clinging to submerged vegetation and is scarce in deeper areas. It preys on live nymphs of dragonflies

and mosquito pupae caught between the raptorial forelegs. The bioecological studies of *R. filiformis* have been studied by Nowrojee (1911) and Raghunatha Rao (1976).

Family : BELOSTOMATIDAE

Members of this family are large, flat, brown, oval or oblong-oval insects, commonly known as 'giant Waterbugs' because of their size. The eyes are large, projecting caudally over anterior angles of pronotum; ocelli are absent. The rostrum is stout, three segmented and the four segmented antennae are hidden in pockets beneath the eyes. The scutellum is large, flat, triangular, with acute apex; the hemelytra are large, covering the entire abdomen. The strong thick, fore legs are raptorial, with enlarged femora. The middle and hind legs are broad, flat, natatorial and fringed with swimming hairs. The tarsi are two or three segmented, front tarsi with one long claw, middle and hind ones with two claws. The most distinctive adult belostomatid feature is a pair of retractable, strap like appendages at the abdominal apex which are used to obtain air for respiration. Each strap bears a spiracle basally. Eight genera of belostomatids, in three subfamilies, were recognised and about 150 species are known in the family (Menke, 1979b).

Belostomatids are cosmopolitan, having been recorded from North, Central and South America, from Europe, Asia, Africa and Australia, New Guinea, New Caledonia, Cuba, Puerto Rico and other Islands. Species of this family live in large and small ponds, streams, and swamps. The smaller members prefer the shallow waters of ponds and swamps where other emergent aquatic vegetation abound. The larger species live in deeper waters, with or without aquatic vegetation, clinging to some support, with the tip of the abdomen in contact with the surface film.

In Javadi hills, the Belostomatidae are represented by one species, belonging to the subfamily Belostomatinae.

Subfamily : BELOSTOMATINAE

1. *Diplonychus rusticus* (Fabricius)

1794. *Nepa rustica* Fabricius, *Entomologica, systematica*, IV : 62.
 1906. *Sphaerodema rusticum* (Fabricius) : Distant, *Fauna Brit. India*, 3 : 36
 1915. *S. rustica* (Fabricius) : Bergroth, *J. Bombay nat. Hist. Soc.*, 24 : 179.
 1918. *S. rusticum* (Fabricius) : Paiva, *Rec. Indian Mus.*, 14 : 26.
 1928. *S. rusticum* (Fabricius) : Dover, *J. Bombay nat. Hist. Soc.*, 32 : 615.

1934. *S. rusticum* (Fabricius) : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 55.
 1947. *S. rusticum* (Fabricius) : Hafiz & Pradhan, *Rec. Indian Mus.*, 45 : 374.
 1962. *D. rusticus* (Fabricius) : Lauk & Menke, *Ann. Ent. Soc. Amer.*, 54 : 649.

Diagnostic characters : This species can easily be differentiated by the pale lateral basal margins of pronotum and the embolium, single segmented fore tarsi with a smaller claws.

Material examined : 2 ♀ ♀ from Kondikallur, alt. 580 M, 6.III. 1983 ; 1 ♀ & 2 immature stages from Odugathur, alt. 310 M, 20.IV.1984.

Distribution : INDIA : Bihar, Jammu & Kashmir, Kerala, Maharashtra, Orissa, Tamilnadu, West Bengal ; AUSTRALIA ; BURMA ; CHINA ; FORMOSA ; INDONESIA ; JAPAN ; MALAYA ; NEW GUINEA ; NEW ZEALAND ; SRI LANKA ; THAILAND.

Remarks : *D. rusticus* is commonly found in fish ponds and are voracious feeders on the fish fry. They are also known to feed on a wide variety of aquatic organisms including mosquito larvae.

Family : NAUCORIDAE

The naucorids are oval, flattened bugs with raptorial forelegs. They are commonly known as 'Creeping water bugs' or 'Saucer bugs'. The other legs are modified for swimming. The antennae are four segmented which are hidden below the head. Ocelli are absent and veins are absent in hemelytral membrane. The nymphs possess a pair of abdominal scent glands with openings on the hind margin of tergum III. The general colour varies from blackish-brown to yellow brown, greenish or grey. These bugs are often quite specific as to their preferred habitat. They inhabit ponds, streams, lakes and a few species inhabit brackish waters. They are carnivorous and feed upon a variety of small organisms. The family Naucoridae is divided into eight sub-families, containing 37 genera and about 300 species.

In Javadi hills, the Naucoridae are represented by *Heliocoris breviceps*, Montand., which belongs to the subfamily Laccocorinae.

SYSTEMATIC ACCOUNT

Family : NAUCORIDAE
 Subfamily : LACCOCORINAE

1. *Heliocoris breviceps* Montandon

1897. *Helicoris breviceps* Montandon, *Ann. Soc. Belgique*, 41 : 55.
 1906. *H. breviceps* Montandon : Distant, *Fauna British India*, 3 : 29.

1910b. *H. breviceps* Montandon : Distant, *Fauna British India*, 5 : 320.

1934. *H. breviceps* Montandon : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 633.

Diagnostic characters : This species can be easily recognised by its oval shape and the yellow impression of spots on the head and pronotum. The abdomen is dark brown or brownish black, with its apex lighter in colour on the ventral side.

Material examined : 1 ♀ from Kanaru, Jamnamaruthur, alt. 510 M, 26.II.1983 ; 2 ♀ ♀ from Kad Aru, Ameride, alt. 240 M, 2.V. 1984 ; 2 ♂ ♂, 1 ♀ from Ameride river, Amride, alt. 250 M, 4.V.1984.

Distribution : INDIA : Maharashtra, Tamilnadu (Javadi Hills).

Remarks : This species has been found in calm pools of mountain rivers of Javadi Hills clinging to solid substrata.

Family : MESOVELIIDAE

The family Mesoveliidae comprises small, slender, semiaquatic, greenish, insects, popularly known as 'Water Treaders' or 'Pondweed bugs'. The members of this family are characterised by the saw-like ovipositor in female which is about one-fourth the length of the body and the three segmented tarsi. The macropterous forms usually have two or three closed cells in the forewing, usually have ocelli and exposed scutellum, elevated at its base. In apterous individuals the ocelli are absent or reduced and the thorax is divided into three simple segments without differentiation of a scutellum or wing pads. They occupy a variety of habitats. The majority of these bugs live upon the floating and emergent vegetation growing in the shallow waters of pools and ponds. These bugs forage on the plants and run over open water with amazing agility. Although they are traditionally thought of as associated with surface and edge of standing freshwaters, certain species have been found to be essentially terrestrial. Their habitat range from cavernicolous to truly terrestrial. These bugs are carnivorous and feed on a variety of dead or disabled insects found on the watersurface of floating vegetation. They may also feed on weaker members of their ownkind. A few of them feed on Ostracods that are spread through the surface film. Apterous forms far outnumber macropterous forms in *Mesovelia*. The macropterous forms of *Mesovelia* have been reported to be taken at light.

The family Mesoveliidae is divided into two subfamilies, Madeoveliinae and Mesoveliinae and includes nine genera and thirty seven species. This family is distributed worldwide but most genera

have a seemingly a restricted distribution range, with the genus *Mesovelia* cosmopolitan in its distribution.

In Javadi Hills, the family Mesoveliidae is represented by the genus *Mesovelia* and two species, of the subfamily Mesoveliinae.

SYSTEMATIC ACCOUNT

Family : MESOVELIIDAE

Subfamily : MESOVELIINAE

1. *Mesovelia horvathi* Lundblad

2. *Mesovelia vittigera* Horvath

Keys to the male species of Mesoveliidae found in Javadi Hills.

1. The last abdominal segment of male with a single median spines in group *Mesovelia vittigera* Horvath
The last abdominal segment of male without the single median group of spines *Mesovelia horvathi* Lundblad

Subfamily : MESOVELIINAE

1. *Mesovelia horvathi* Lundblad

1934. *Mesovelia horvathi* Lundblad, *Arch. Hydrobiol Suppl*, 12 : 190.

1980. *Mesovelia horvathi* Lundblad : Anderson and Polhemus, *Ent. Scand.*, 11 : 390.

Diagnostic characters : In males, the last abdominal segment is without the median spines, but with two lateral groups of spines. The size is small, not more than 2 mm long, with middle femora hairy below.

Material examined : Macropterous 2 ♂♂, Apterous 4 ♂♂ from Pinnathurai, Odugathur, alt. 415 M, 24.IV.1984 ; Apterous 2 ♂♂ from Amridi River, Amridi, alt. 230 M, 6.V.1984.

Distribution : INDIA : Tamilnadu ; JAVA ; MALAYA ; SRI LANKA ; SUMATRA ; THAILAND ; VIETNAM.

Remarks : Though there is no distributional data available in India, Anderson & Polhemus (1980) while discussing the phylogeny and classification of the family, listed India. It is apparently widely distributed in India. On the contrary, Lundblad (1934) while describing the species from Sumatra & Java, never stated its distribution in India. This species is recorded for the first time from Eastern Ghats.

2. *Mesovelia vittigera* Horvath

1895. *Mesovelia vittigera* Horvath, *Rev. Entomologie*, 14 : 160.

1901. *M. orientalis* Kirkaldy, *Entomologist*, 34 : 808.

1903. *M. mulsanti* White : Distant, *Fauna British India*, 2 : 169.
 1910b. *M. mulsanti* White : Distant, *Fauna British India*, 5 : 137.
 1915. *M. vittigera* Horvath, *Ann. Mus. Nat. Hung.*, 13 : 550.
 1918. *M. mulsanti* White : Paiva, *Rec. Indian Mus.*, 14 : 20.
 1924. *M. vittigera* Horvath, *Ann. Mus., Nat. Hungar.*, 21 : 135.
 1934. *M. orientalis* Kirkaldy : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 186.
 1939. *M. vittigera* Horvath : Hafiz and Ribeiro, *Rec. Indian Mus.*, 41 : 424.
 1980. *M. vittigera* Horvath : Anderson and Polhemus, *Ent. Scand.*, 11 : 390.

Diagnostic characters : The males are easier to identify in this species. The second hind tarsi are longer than the third ; the last abdominal ventral segment with a single median spine in a group and with two sets of brush like hairs laterally.

Material examined : Macropterous 1 ♀, apterous 2 ♂♂, 2 ♀♀ and 2 immature stages from Kondikallur, alt. 580 M, 6.III.1983 ; macropterous 2 ♂♂ from Pinnathurai, Odugathur alt. 415 M, 24.IV.1984 ; macropterous 10 ♂♂, 11 ♀♀ from Agram river, Agram, Odugathur, alt. 260 M, 27.IV.1984 ; macropterous 1 ♀ from Kad Aru, Amridi, alt. 240 M, 2.V.1984 ; macropterous 2 ♂♂, 1 ♀ from Amridi Aru, Amridi, alt. 230 M, 5.V.1984 ; macropterous 3 ♂♂, 5 ♀♀, apterous 1 ♂ from Amridi, alt. 330 M, 6.V.1984.

Distribution : INDIA : Andaman Islands, Bihar, Karnataka, Orissa, Tamilnadu (Javadi Hills) Uttar Pradesh, West Bengal, AFRICA ; AUSTRALIA ; EGYPT ; JAVA ; MALAYA ; PALESTINE ; PHILIPPINES ; SAMOA ISLAND ; SRI LANKA ; SUMATRA ; SYRIA.

Remarks : This species has an extraordinarily wide distributional range viz., South Europe, Eastern Palaearctic, Ethiopian, Orient, Australia, Oceanica eastward to Samoa Islands, unmatched by any other species of semi-aquatic bugs. This species prefers stagnant or slow flowing water covered by emergent or floating vegetation.

Family : HEBRIDAE

Hebridæ is a small family of semi-aquatic bugs and include small, inconspicuous, predaceous plump bodied bugs called 'Velvet Water Bugs'. The body is densely covered with velvety hydrofuge piles. The antennae are four segmented (Anderson, 1981). The short legs are equally spaced and the tarsal claws are apical. The rostrum rests in a groove on the underside of the head and prothoracic sternum. The ocelli and scutellum are well developed in macropterous form. The clavus and membrane of the forewing are devoid of veins or cells, but corium has a single cell. There is a single median metathoracic scent gland, opening on the sternum. Many species of

hebrids have prominent white markings on the hemelytra. The hebrids occupy two types of habitats, moist places at shorelines and floating plants. They prefer humid terrestrial or marginal aquatic habitats rather than the habitats of the watersurface. The family Hebridae is divided into two subfamilies, about 125 species divided among eight genera and six subgenera. In terms of number of species, the Hebridae are the most successful group of semi-aquatic bugs occupying the ancestral type of habitats.

In Javadi Hills, the family is represented by a single species.

SYSTEMATIC ACCOUNT

Family : HEBRIDAE
Subfamily : HEBRINAE

1. *Hebrus (Hebrus) bengalensis* Distant

1909. *Hebrus bengalensis* Distant, *Ann. Mag. nat. Hist.*, 3 : 497.

1910b. *H. bengalensis* Distant, *Fauna British India*, 5 : 132.

1934. *H. bengalensis* Distant : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 272.

Diagnostic characters : The scutellum is not distinctly bifid at the apex. The bucculae well developed throughout the ventral surface. The body length is about 2 mm.

Material examined : 1 ♀ from Utharakaveri Aru, Odugathur, alt. 310 M, 22.IV.1983.

Distribution : INDIA : Orissa, Tamilnadu

Remarks : This species is described by Distant (1909) from Chilka Lake, Orissa. Though Lundblad (1934) redescribed this species, he has not reported from Java or Sumatra or Bali Islands. This is the first record of this species from Eastern Ghats.

Family : HYDROMETRIDAE

The members of this family include 'Marsh Treaders' or 'Water Measurers' which are extremely slender, strick-like bugs with thread like legs and very elongated head that are about as long as the thorax. The lengthening and narrowing of the body and appendages are adaptations to live on the surface film. The eyes are large and placed slightly behind the middle of the head. The ocelli are absent, except in one exotic species. The antennae are filiform, four segmented, inserted, on sides of the head. The rostrum is slender and three segmented. The tarsi are three segmented and with two apical claws. The adults are

dimorphic with respect to wings. The family contains about 110 species, that are divided among three subfamilies and seven genera. The species of this family spend most of their lives on or near the edge of ponds and ditches or on floating or emergent vegetation. They are carnivorous, feeding upon dead or disabled insects and other invertebrates that they find on the water or floating vegetation.

In Javadi Hills, the family Hydrometridae is represented by a single species of the genus *Hydrometra* belonging to the subfamily Hydrometrinae.

SYSTEMATIC ACCOUNT

Family : HYDROMETRIDAE
Subfamily : HYDROMETRINAE

1. *Hydrometra greeni* Kirkaldy

1898. *Hydrometra greeni* Kirkaldy, *Entomologist*, 30 : 2.
1903. *H. vittata* Stäl : Distant, *Fauna British India*, 2 : 170.
1919a. *H. vittata* Stäl : Paiva, *Rec. Indian Mus.*, 16 : 153.
1928. *H. greeni* Kirkaldy : Dover, *J. Bombay nat. Hist Soc.* 32 : 614.
1934. *H. greeni* Kirkaldy : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 429.
1943. *H. greeni* Kirkaldy : Hungerford & Evans, *Ann. Mus., Nat. Hung.*, 28 : 79.
1947. *H. vittata* Stäl : Hafiz and Pradhan, *Rec. Indian Mus.*, 45 : 372.
1950a. *H. vittata* Stäl : Pradhan *Rec. Indian Mus.*, 48 : 102.

Diagnostic characters : A transverse depression on the sixth ventral abdominal segment, the dorsal margin of the sixth segment fringed with short erect hairs in male. The hemelytra extend upto the 5th abdominal segment in both the sexes.

Material examined : 1 ♀ from Nellivasal, alt. 700 M, 20.XI.1983 ; 3 ♀ ♀ from Kuttaru, Kuttathur, alt. 530 M, 26.XI.1983 ; 4 ♂ ♂, 2 ♀ ♀ from Kuttathur, alt. 500 M, 3.XII.1983 ; 6 ♂ ♂, 4 ♀ ♀ from Cheyyar, Chengam, alt. 200 M, 6.XII.1983 ; 1 ♂ 2 ♀ ♀ from Amridi river, Amride, alt 330 M, 5.V.1984.

Distribution : INDIA : Orissa, Maharashtra, Tamilnadu, Uttar Pradesh ; BURMA ; JAPAN ; MALAYA ; PHILIPPINES ; SRI LANKA.

Remarks : This is one of the three representative of this family found in India and it is widely distributed all over India. This species is also reported to have been taken by light.

Family : GERRIDAE

Gerrids, popularly known as 'Water Striders' or 'Pond Skaters', are elongate or oval bodied insects. The body of these bugs are covered

with a velvety hydrofuge hair pile, and the colour varies from black or grey to brown, the dorsum being marked with light grey or yellow lines or spots.

They occur as macropterous form with apterous individuals are also frequently encountered. These insects are characterised by long four segmented antennae and absence of ocelli. The claws are usually pre apical. The family Gerridae contains about 56 genera and over 450 species under eight subfamilies (Polhemus & Chapman, 1979).

In Javadi Hills, the family Gerridae is represented by six genera, two subgenera and eight species, under three subfamilies, namely *Gerrinae*, *Eotrechinae* and *Halobatinae*.

SYSTEMATIC ACCOUNT

Family : GERRIDAE

Subfamily : GERRINAE

1. *Limnogonus* (*Limnogonus*) *fossarum fossarum* (Fabricius)
2. *Limnogonus* (*Limnogonus*) *nitidus* (Mayr)
3. *Neogerris parvula* (Stål)
4. *Tenagogonus* (*Limnometra*) *anadyomene* (Kirkaldy)
5. *Tenagogonus* (*Limnometra*) *fluviorum* (Fabricius)

Subfamily : EOTRECHINAE

1. *Onychotrechus rhexenor* Kirkaldy
2. *Amemboa* (*Amemboa*) *kumari* (Distant)

Subfamily : HALOBATINAE

1. *Metrocoris stali* (Dohrn)

Key to subfamilies of Gerridae of Javadi Hills

1. Metasternum greatly reduced, represented by a very short subtriangular plate behind mesonotum Halobatinae.
 Metasternum well developed, laterally the meta-acetabular region ... 2
2. Pronotal lobe reduced in wingless forms; middle and hind tarsi with ventral spinous hairs; lateral sutures between meso and metathorax distinct Eotrechinae,
 Pronotal lobe not reduced in wingless forms. Lateral sutures between meso and metathorax indistinct Gerrinae.

Keys to the species of Gerridae of Javadi Hills

1. Body comparatively long and thin 2
 Body comparatively elongate or oval 6

2. Anterior part of pronotum with a pair of elongate spots or lines. Pronotal lobe usually with a median line covering the entire mesonotum in winged forms 3
 Anterior part of pronotum not as above, but with a large median light spot. Pronotal lobe almost reduced in wingless individuals *Neogerris parvula* (Stål)
3. Seventh abdominal tergite in male produced into a spine like process. Pronotum with dark line to its entire length 4
 Seventh abdominal tergite in male not as above, but connexivum terminating in a fairly prominent spine. Pronotum with yellow spots or median yellow longitudinal stipe 5
4. Middle coxae with a spine like projection on the dorsolateral rear margin. Second front tarsal segment not longer than first *Tenagogonus (Limnometra) fluviorum* (Fabricius)
 Middle coxae without spine like projection. Second front tarsal segment longer than first *Tenagogonus (Limnometra) anadyomene* (Kirkaldy)
5. Connexivum terminating in a fairly prominent spine, Pronotal lobe without yellow median line *Limnogonus (Limnogonus) nitidus* (Mayr)
 Connexivum not terminating in a prominent spine. Pronotal lobe with a median yellow line extending to its entire length *Limnogonus (Limnogonus) fossarum fossarum* (Fabricius)
6. Body flattened & oval, eighth tergite semicircular in outline in males *Metrocoris stali* (Dohrn)
 Body elongate. Eighth tergite in males not as above 7
7. Hind tibia and tarsus shorter than hind femur. Front femur in males armed with two separate hair tufts *Amemboa kumari* (Distant)
 Hind tibia and tarsus longer than hind femur. Front femur in males not armed with hair tufts but with patch of dark spinules on inner side *Onychotrechus rhexenor* Kirkaldy

Family : GERRIDAE

Subfamily : GERRINAE

1. *Limnogonus (Limnogonus) fossarum fossarum* (Fabricius)

1755. *Cimex fossarum* Fabricius, *Syst. Ent.*, 727.
 1903. *Gerris fossarum* (Fabricius) : Distant, *Fauna British India*, 2 : 178.
 1910b. *G. fossarum* (Fabricius) : Distant, *Fauna British India*, 5 : 142.
 1918. *G. fossarum* (Fabricius) : Paiva, *Rec. Indian Mus.*, 14 : 23.
 1960. *Limnogonus (Limnogonus) fossarum* (Fabricius) : Matsuda, *Kans. Univ. Sci. Bull.*, 41 : 198.
 1975. *L. (L) fossarum* (Fabricius) : Anderson, *Ent. Scand. Suppl.*, 7 : 30.

Diagnostic characters : *L. fossarum* is one of the common species of gerrids which can be separated from all other known species by the colour pattern and the characteristic apical, abdominal segments. The males of these are recognised by a large, elongate patch of short, golden

pubescence posteriorly on the mesonotum. The hind margin of dorsal vesicle plate is concave. The females are characterised by the small, median tooth on hind margin of sternum VII. However, there is a broad transverse band of silverish pubescence on the abdominal dorsum of both the sexes.

Material examined : Macropterous 1 ♀ from a forest stream, Theerthakanaru, Odugathur, alt. 410 M, 21.IV.1284.

Distribution : INDIA : Southern, Eastern, Western and Northern parts of India ; CHINA ; JAVA ; MALACCA ISLANDS ; PHILIPPINES ; SUMATRA ; TAIWAN ; THAILAND ; VIETNAM.

Remarks : This is a very common species widely distributed in Indo-Australian regions. It is also reported from wide variety of habitats including hot springs, brackish pools, from sea level to about 1000 Metres.

2. *Limnogonus (Limnogonus) nitidus* (Mayr)

1865. *Hydrometra nitida* Mayr, *Verh. Zoo.*, 15 : 443.

1903. *Gerris nitida* (Mayr) : Distant, *Fauna British India*, 2 : 178.

1910b. *G. nitida* (Mayr) : Distant, *Fauna British India*, 5 : 142.

1939. *Limnogonus nitidus* (Mayr) : Hafiz and Ribeiro, *Rec. Indian Mus.*, 41 : 427.

1950a. *L. nitidus* (Mayr) : Pradhan, *Rec. Indian Mus.*, 48 : 102.

1960. *L. (Limnogonus) nitidus* (Mayr) : Matsuda, *Kans. Univ. Sci. Bull.*, 41 : 198.

1975. *L. (L.) nitidus* (Mayr) : Anderson, *Ent. Scand. Suppl.*, 7 : 62.

Diagnostic characters : This species is easily separated from all the known species of this genus by the presence of fairly prominent connexival spines in both the sexes.

Material examined : Macropterous 1 ♂ from Periaru, Jamnamaruthur, alt. 590 M, 27.II.1983 ; macropterous 11 ♂ ♂, 5 ♀ ♀, apterous 1 ♂, 3 ♀ ♀ from Madikkaru, Jamnamaruthur, alt. 500 M, 28.II.1983 ; macropterous 1 ♀ from Bhimamadu, Jamnamaruthur, alt. 500 M, 1.III.1983 ; apterous 2 ♀ ♀ from Kondikallur, alt. 580 M, 6.III.1983 ; macropterous 1 ♂, 3 ♀ ♀ from Nellivasal, alt. 680 M, 700 M, & 720 M, on 17.XI.1983, 18.XI.1983 and 20.XI.1983 respectively ; macropterous 2 ♂ ♂, 2 ♀ ♀ from Kattaru, Nellivasal, alt. 640 M, 26.XI.1983 ; macropterous 1 ♂ from Velicharam, Kuttathur, alt. 520 M, 2.XII.1983.

Distribution : INDIA : Assam, Bihar, Kerala, Orissa, Tamilnadu, Uttar Pradesh, West Bengal ; BORNEO ; BURMA ; CELEBES : JAVA ; MALDIVE ISLANDS ; MALAYA ; NEPAL ; SRI LANKA ; SUMATRA ; THAILAND ; VIETNAM.

Remarks : This species is mostly available as winged individuals. It has been recorded from temporary pools, rice fields, ponds etc., from

sea level to about 1000 metres. It is also reported to be attracted by light. Temporary pools and mountain springs are the main habitats of this species in Javadi Hills.

3. *Neogerris parvula* (Stål)

1859. *Gerris parvula* Stål, *Zoology*, 4 : 265.
 1903. *G. tristan* Kirkaldy : Distant, *Fauna British India*, 2 : 179.
 1939. *Limnogonus parvulus* (Stål) : Hafiz and Ribeiro, *Rec. Indian Mus.*, 41 : 427.
 1950a. *L. parvulus* (Stål) : Pradhan, *Rec. Indian Mus.*, 48 : 102.
 1960. *L. (Neogerris) parvulus* (Stål) : Matsuda, *Kans. Univ. Sci. Bull.*, 41 : 114.
 1975. *Neogerris parvulua* (Stål) : Anderson, *Ent. Scand. Suppl.*, 7 : 86.

Diagnostic characters : In male the pygopore hind margin is straight while in the female the hind margin of 7th ventral abdominal segment is bisinuate. A large round or quadrangular yellow spot on pronotum makes this species separates from all other known species.

Material examined : 1 ♂ apterous, 2 ♀ ♀ macropterous and 3 immature stages from Bhimamaduku, Jamnamaruthur, alt. 500 M, 1. III. 1983.

Distribution : INDIA : Assam, Bihar, Kerala, Orissa, Tamilnadu, Uttar Pradesh, West Bengal ; AMOY ; BURMA ; CHINA ; IRAN ; JAVA ; MALAYSIA ; MUSCAT ; NEW GUINEA ; OMAN ; OSHIMA ; PAKISTAN ; PHILIPPINES ; RYUKYU ISLANDS ; SOLOMON ISLANDS ; SRI LANKA ; TAIWAN ; THAILAND ; TIMOR ; VIETNAM.

Remarks : This gerrid is one of the most widely distributed species in Indo-Australian region, enjoying its distribution from the eastern part of the Arab Penninsula to the Solomon Islands and from Ryukyu Island to Java. While studying this genus, Anderson (1975) has observed that there is considerable variation in the relative length of the pronotal lobe among apterous forms and concluded that it is not correlated with any distributional pattern. This species is normally very common in slow flowing streams, reservoirs, ponds and temporary pools. It has also been reported from sea level to about 1500 Metres altitude. It has also been known to be attracted by light.

4. *Tenagogonus (Limnometra) anadyomene* (Kirkaldy)

- 1901a. *Gerris anadyomene* Kirkaldy, *Entomologist*, 34 : 117.
 1903. *G. anadyomene* Kirkaldy : Distant, *Fauna British India*, 2 : 177.
 1928. *G. anadyomene* Kirkaldy : Dover, *J. Bombay nat. Hist. Soc.*, 32 : 614.

1958. *Limnometra anadyomene* (Kirkaldy) : Hungerford and Matsuda, *Kans. Univ. Sci. Bull.*, 39 : 402.
1960. *Tenagogonus (Limnometra) anadyomene* (Kirkaldy) : Matsuda, *Kans. Univ. Sci. Bull.*, 41 : 206.
1969. *Limnometra anadyomene* (Kirkaldy) Cheng and Fernando, *Oriental Ins.*, 3 : 105.

Diagnostic characters : This species can be easily identified by the second tarsal segment of front leg longer than first, middle femur longer than the total body in male and about equal in female; the abdominal connexival spines in males surpassing the first genital segment and not the abdominal tip and never do so in females.

Material examined : Apterous 3 ♂♂ and 3 ♀♀ from a forest stream at Pudur, alt. 840 M, 15. XI. 1983.

Distribution : INDIA : Kerala, Tamilnadu and presumably all over Southern India; BORNEO; BURMA; MALAYA; PHILIPPINE ISLANDS; SRI LANKA; SUMATRA.

Remarks : It is interesting to note that in this species, females are strikingly broader and larger than males. Its habitat is highly restricted to forest streams. In Malaya, this species is known to occur in fastflowing mountain streams.

5. *Tenagogonus (Limnometra) fluviorum* (Fabricius)

1775. *Cimex fluviorum* Fabricius, *Syst. Ent.*, 4 : 727.
1903. *Gerris fluviorum* (Fabricius) : Distant, *Fauna British India*, 2 : 177.
1934. *Limnogonus fluviorum* (Fabricius) : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 374.
1958. *L. fluviorum* (Fabricius) : Hungerford and Matsuda, *Kans. Univ. Sci. Bull.* 39 : 401.

Diagnostic characters : The middle coxae are with a spine-like projection on the dorsolateral rear margin, which differentiate this from all other known species of this subgenus.

Material examined : Macropterous 3 ♂♂, 4 ♀♀ and 13 immature stages from Mantharakuttai, Kavalur, alt. 600 M, 13.X. 1982; Macropterous 7 ♂♂, 6 ♀♀ from Bhimamaduku, alt. 490 M, 24.II.1983 and Macropterous 3 ♂♂ from same locality, alt. 500 M, on 1.III.1983; Macropterous 5 ♂♂, 12 ♀♀; Apterous 19 ♂♂ 5 ♀♀ from Madikkaru, alt. 600 M, 28.II.1983; Macropterous 8 ♂♂, 12 ♀♀ from Thenmathisaragam, alt. 450 M, 4.III.1983; Macropterous 4 ♂♂, 15 ♀♀ Apterous 1 ♂ from Pudur, alt. 580 M, 5.III.1983; Macropterous 6 ♂♂, 5 ♀♀ alt. 840 M, 15.XI.1983; Macropterous 7 ♂♂, 12 ♀♀ apterous 1 ♂, 2 ♀♀ and 1 immature stage collected from Thopparu,

alt. 520 M, 7.III.1983 ; Macropterous 1 ♂, 1 ♀ alt. 580 M, 8.III.1983 ; Macropterous 6 ♂ ♂, 10 ♀ ♀ & 3 immature stages from Kadaru, alt. 510 M, 9.III.1983 ; Macropterous 6 ♂ ♂, 3 ♀ ♀ from Selaiparai Aru, Nellivasal, alt. 680 M, 18.XI.1983 ; Macropterous 4 ♂ ♂, 8 ♀ ♀ ; apterous 1 ♀, and 2 immature stages from Kaka Aru, Nellivasal, alt. 800 M, 20.XI.1983 ; Macropterous 11 ♂ ♂, 10 ♀ ♀ and 6 immature stages from Vannanthurai, Kavalur, alt. 520 M, 24.XI.1983 ; Macropterous 17 ♂ ♂, 17 ♀ ♀ ; apterous 1 ♂ and 2 immature stages from Peigalkuttaru, Kuttathur, alt. 525 M, 28.XI.1983 , Macropterous 7 ♂ ♂, 5 ♀ ♀ and 3 immature stages from Kuttaru, Kuttathur, alt. 520 M, 29.XI.1983 ; Macropterous 2 ♂ ♂, 2 ♀ ♀ and 2 immature stages from Kuttaru, Kuttathur, alt. 500 M, 3.XII.1983 ; Macropterous 8 ♂ ♂, 8 ♀ ♀ ; apterous 1 ♂ 7 ♀ ♀ and 1 immature stage from Kalyanmandai, Kuttathur, alt. 600 M, 1.XII.1983 ; Macropterous 9 ♂ ♂, 5 ♀ ♀ ; apterous 2 ♂ ♂, 4 ♀ ♀ from Periaru, alt. 590 M, 27.II.1984 ; Macropterous 7 ♂ ♂, 14 ♀ ♀ and 1 immature stage from Thopparu, Pattarikadu, alt. 540 M, 3.III.1984.

Distribution : INDIA : Kerala, Maharashtra, Pondicherry, Tamilnadu ; PHILIPPINE ISLANDS ; SRI LANKA.

Remarks : It is a very common species of gerrids found in Southern India and known to occur from a wide variety of freshwater habits. In javadi Hills, it is recorded from jungle streams, pools, ponds and lakes.

Subfamily : EOTRECHINAE

The tribe, Eotrechini, of the subfamily Gerrinae, was raised to Subfamilial rank by Anderson (1980) because the subfamily Gerrinae was considered to be paraphyletic. This subfamily includes five genera, namely *Chimarrhometra* Bianchi, *Amemboa* Esaki, *Eotrechus* Kirkaldy, *Onychotrechus* Kirkaldy and *Tarsotrechus* Anderson. The species belonging to these five genera of Eotrechinae are distributed exclusively in the Oriental Region, with the exception of a single record of *Onychotrechus* from the Islands of Socotra, East of Africa.

1. *Onychotrechus rhexenor* Kirkaldy

1903. *Onychotrechus rhexenor* Kirkaldy, *Entomologist*, 36 : 44.

1903. *O. rhexenor* Kirkaldy : Distant, *Fauna British India*, 2 : 183.

1919. *O. rhexenor* Kirkaldy : Annaudale, *Rec, Indian Mus.*, 16 : 120.

1919a. *O. rhexenor* Kirkaldy : Paiva, *Rec. Indian Mus.*, 16 : 154.

1980. *O. rhexenor* Kirkaldy : Anderson, *Steenstrupia*, 6 : 128.

Diagnostic characters : This species can be differentiated by the presence of short sublateral light stripes in mesonotum (in apterous forms), usually not surpassing middle of mesonotum. The front femur of male presents elongate patch of dark spinules on inner surface.

Material examined : Winged 8 ♂♂, 3 ♀♀, Wingless 14 ♂♂, 7 ♀♀ and 1 immature stage from Thopparu, alt. 520 M, 7.III.1983 ; winged 3 ♂♂, 1 ♀, Wingless 2 ♂♂, 3 ♀♀ and 3 immature stages from the above locality, alt. 680 M, 8.III.1983 ; 15 immature stages collected from Nellivasal village, alt. 580 M, 16.XI.1983 ; Winged 2 ♂♂, 1 ♀ wingless 1 ♀ and 2 immature stages collected from Kuttathur, alt. 530 M, 26.XI.1983 ; Winged 1 ♀ and 2 immature stages from Peigalkuttaru, Kuttathur, alt. 525 M, 28.XI.1983 ; Winged 1 ♂ from Kuttaru, Kuttathur, alt. 520 M, 29.XI.1983.

Distribution : INDIA : Karnataka, Kerala, Maharashtra, Rajasthan, Tamilnadu ; AFRICA.

Remarks : The genus *Onychotrechus* includes the only water striders of the family Gerridae, which are known to live on seeping rock-faces, rocks splashed by waterfalls and similar habitats. *O. rhexenor* known to occur in several places, most of them in Western Ghats, between 900 to 1200 Metres above the sea level. In Javadi Hills, *O. rhexenor* was found on inclined wet rocky faces and wet areas between the rocks, close to mountain streams. It is interesting that the record of the species from the island of Socotra, just east of the African Continent and the Red Sea, is difficult to understand. This species is reported for the first time from Eastern Ghats.

1. *Amemboa* (*Amemboa*) *kumari* (Distant)

1910a. *Onychotrechus kumari* Distant, *Ann. Mag. nat. Hist.*, 5 (8) : 145.

1910b. *Onychotrechus kumari* Distant, *Fauna British India*, 5 : 147.

1928. *Amemboa kumari* (Distant) : Esaki, *Ann. Mag. nat. Hist.*, 2 (10) : 509.

1950b. *Amemboa pervati* Pradhan, *Rec. Indian Mus.*, 48 : 12.

1984. *A. (Amemboa) kumari* (Distant) : Polhemus and Anderson, *Steenstrupia* 10 (3) : 85.

Diagnostic characters : The male fore femur relatively slender, with two separate hair tufts beyond middle, the basal hair tuft small and pointed. The females cannot safely be identified without the associated males.

Material examined : Wingless 1 ♂ from Vannanthurai, alt. 590 M, 27.II.1983 ; Wingless 1 ♂, 3 ♀ ♀ from a jungle stream, Periaru, alt. 590 M, 27.II.1983 ; Wingless 1 ♀ from Kastharu, Nellivasal, alt. 560 M, 19.XI.1983 ; Wingless 3 ♂ ♂, 3 ♀ ♀ from Kakkal Aru, Nellivasal, alt. 700 M, 30.XI.1983 ; Wingless 1 ♂ from Kad Aru, Amridi, alt. 240 M, 2.V.1984 ; Wingless 1 ♀ from Amridi river, Amridi alt. 260 M, 3.V.1984.

Distribution : INDIA : Karnataka, Kerala, Orissa, Tamilnadu.

Remarks : This species is reported to occur in small pools, puddles near the streambeds or on river banks. In Javadi Hills, this species was collected from pools and puddles of slow moving streams and rivers. *A. kumari* has not been so far recorded outside the Indian Peninsula.

Subfamily : HALOBATINAE

1. *Metrocoris stali* (Dohrn)

1860. *Halobates stali* Dohrn, *Stett. ent. Zeit.*, 21 : 408.
 1903. *Metrocoris stali* (Dohrn) : Distant, *Fauna British India*, 2 : 190.
 1910b. *M. stali* (Dohrn) : Distant, *Fauna British India*, 5 : 158.
 1928. *M. stali* (Dohrn) : Dover, *J. Bombay, nat. Hist. Soc.*, 32 : 614.
 1939. *M. stali* (Dohrn) : Hafiz and Ribeiro, *Rec. Indian Mus.*, 41 : 429.
 1947. *M. stali* (Dohrn) : Hafiz and Pradhan, *Rec. Indian, Mus.*, 45 : 373.
 1950. *M. stali* (Dohrn) : Pradhan, *Rec. Indian Mus.*, 48 : 102.
 1965. *M. stali* (Dohrn) : Den-Boer, *Zool. Verh.*, 74 : 8.

Diagnostic characters : This species can be identified by the following characters ; Male eighth tergite semicircular in outline ; Female : posterior margin of seventh abdominal segment always somewhat convex.

Material examined : Winged 1 ♂, 3 ♀ ♀, wingless 44 ♂ ♂, 32 ♀ ♀ and 5 immature stages from Periaru, alt. 580 M, 27.II.1983 ; Wingless 17 ♂ ♂, 16 ♀ ♀ and 3 immature stages collected from Madikkaru, alt. 600 M, 28.II.1983 ; Winged 3 ♂ ♂, Wingless 3 ♀ ♀ and 13 immature stages collected from Pudur, alt. 840 M, 15.XI.1983 ; Winged 6 ♂ ♂, 16 ♀ ♀, Wingless 3 ♂ ♂, 3 ♀ ♀ and 40 immature stages collected from Selaiparai aru, Nellivasal, alt. 680 M, 17.XI.1983 ; Winged 3 ♂ ♂, 2 ♀ ♀ and 6 immature stages collected from Nelliavsal, alt. 720 M, 18.XI.1983 ; Winged 8 ♂ ♂, 5 ♀ ♀, Wingless 2 ♂ ♂, 2 ♀ ♀ and 10 immature stages from Kastaru, Nellivasal, alt. 540 M, 19.XI.1983 ; Winged 8 ♂ ♂, 4 ♀ ♀, Wingless 3 ♂ ♂, 3 ♀ ♀ and 8 immature stages from Kakal aru, Nellivasal, alt. 700 M, 20.XI.1983 ; Winged 2 ♂ ♂,

2 ♀ ♀, Wingless 2 ♀ ♀ and 2 immature stages from Kavalur, alt. 560 M, 25.XI.1983 ; Winged 1 ♀ from Thottapettaiaru, Kuttathur, alt. 530 M, 26.XI.1983 ; Winged 2 ♂ ♂, 2 ♀ ♀, Wingless 10 ♂ ♂, 3 ♀ ♀ and 2 immature stages collected from Peigalkuttaru, Kuttathur, alt. 525 M, 28.XI.1983 ; Winged 5 ♂ ♂, 4 ♀ ♀, Wingless 2 ♂ ♂, 1 ♀ and 2 immature stages from Kuttaru, Kuttathur, alt. 520 M, 29.XI.1983 ; 2 ♂ ♂, 2 ♀ ♀ Wingless 1 ♀ and 3 immature stages from Kuttathur, alt. Winged 4 ♂ ♂, 6 ♀ ♀, Wingless 4 ♂ ♂, 1 ♀ and 4 immature stages from Kalayanamandai, Kuttathur, alt. 600 M, 1.XII.1983 ; Winged 8 ♂ ♂, 10 ♀ ♀, Wingless 2 ♂ ♂, 4 ♀ ♀ and 6 immature stages from Velichannur, Kuttathur, alt. 520 M, 2.XII.1983. Winged 500 M, 3.XII.1983.

Distribution : INDIA : Bihar, Maharashtra, Orissa, Punjab, Sikkim, Tamilnadu, Uttar Pradesh, West Bengal ; NEPAL ; SRI LANKA.

Remarks : *M. stali* has been, so far, recorded from reservoirs, rivers, fast and slow flowing mountain streams. In Southern India, it has been recorded at an altitude of 2400 metres. It is a species which is widely distributed in India.

Family : VELIIDAE

The family Veliidae popularly known as "Small Water Stridres" or "Water Crickets" or Riffle bugs" is characterised by pre-apical claws, short legs and absence of ocelli. The veliids are mostly small, oval or elongate bugs. The hemelytra are present or absent ; when present, they reach the tip of abdomen. The middle pair of legs are located about midway between the front and hind pair except in the Rhagoveliinae and a few forms in other subfamilies. The antennae are four segmented, long to moderately long. The tarsal segments are variable and the claws are pre-apical, inserted in a cleft, near the apex of last tarsal segments. The general colour varies from yellowish brown to grey or black, with dorsum often marked with yellow or blueish grey or silver spots. The body is covered with velvety hydrofuge pile. Wing polymorphism is common and apterous forms are the mostly commonly encountered morphs. The habitats include freshwater streams, ponds, springs, marshes, saltwater bays, brackish water pools, mangrove swamps and open water of bays close to shore.

The Veliidae is divided into seven subfamilies containing about 30 genera and approximately 420 species (Polhemus & Chapman, 1979),

four subfamilies restricted to the Old World while the remaining are cosmopolitan. China and Usinger (1949) includes Macroveliinae in Veliidae which Stys (1976) & Polhemus & Chapman (loc. cit) recognised as Macroveliidae.

Curiously, a number of veliids have only four nymphal instars, rather than the normal five.

Three subfamilies, Perittopinae, Rhagoveliinae and Microveliinae are represented in the Javadi Hills.

Key to Subfamilies of Veliidae of Javadi Hills.

1. Last tarsal segment of middle leg with a cleft extending about three fourths length, two plumelike structures arising from base to cleft Rhagoveliinae
Last tarsal segment of middle leg not as above 2
2. Tarsal formula 2 : 3 : 3, the basal segments of fore & hind legs very short ; Hemelytra with 2 closed cells on corium Perittopinae
Tarsal formulae 1 : 2 : 2, claws are preapical, hemelytra with 4 closed cells Microveliinae

SYSTEMATIC ACCOUNT

Family : VELIIDAE

Subfamily : PERITTOPINAE

1. *Perittopus horvathi* Lundblad

Subfamily : RHAGOVELIINAE

1. *Rhagovelia (Rhagovelia) nigricans* (Burmeister)

Subfamily : MICROVELIINAE

1. *Microvelia annandalei* Distant
2. *Microvelia diluta* Distant
3. *Microvelia douglasi* Scott
4. *Microvelia javadlensis* sp. nov.

**Keys to the species of Microveliinae found in Javadi Hills
(Based on males)**

1. Tibial comb is very short and present in fore and middle tibiae. Parameres are very small or rudimentary symmetrical *Microvelia diluta* Distant
Tibial comb present in fore tibiae only. Middle tibiae shorter than femora. Parameres not rudimentary symmetrical or asymmetrical 2
2. Parameres symmetrical 3
Parameres asymmetrical *Microvelia javadiensis* sp. nov.
3. Intermediate tibiae distinctly smaller than femora.
Parameres long, curved, tip pointed *Microvelia douglasi* Distant
Intermediate tibiae slightly smaller than femora. Parameres are small, slender and not whip shaped *Microvelia annandalei* Distant

Subfamily : PERITTOPINAE

1. Perittopus horvathi Lundblad

1934. *Perittopus horvathi* Lundblad, *Arch. Hydrobiol, Suppl.*, 4 : 306.

While studying the aquatic and semiaquatic bugs of Java, Sumatra and Bali, Lundblad (1934), described *P. horvathi* based on one male (apterous) and one female (macropterous) collected from Tiruchirapalli (S. India). The description given by Lundblad (loc. cit) is inadequate and a detailed description is given below based on the materials collected from Javadi Hills.

Description : Size : Males (Macropterous) length : 3.2-3.4 mm ; width (across pronotum) : 1.4-1.5 mm ; Females (Macropterous) length : 3.3-3.7 mm ; width (across pronotum) : 1.5-1.6 mm.

Colour : Ground colour dark brownish or brownish black. Pronotum dark brown with blackish cruciform patch in the middle ; a pair of round fairly distinct broad brown spots at anterior part of pronotum. Antennae and legs dark brown with femora light brown. Tegmina brown with dark brownish veins. Abdomen reddish brown.

Macropterous male : Elongate, body covered with a dense pile of dark suberect hairs. Antenna 4-segmented, about half of total length of body ; segments subequal ; all segments covered by long pile of hairs. Pronotum broad, as long as wide, hind margin convergent, tip rounded ; dark punctures as illustrated (Fig. 5.A). Legs clothed

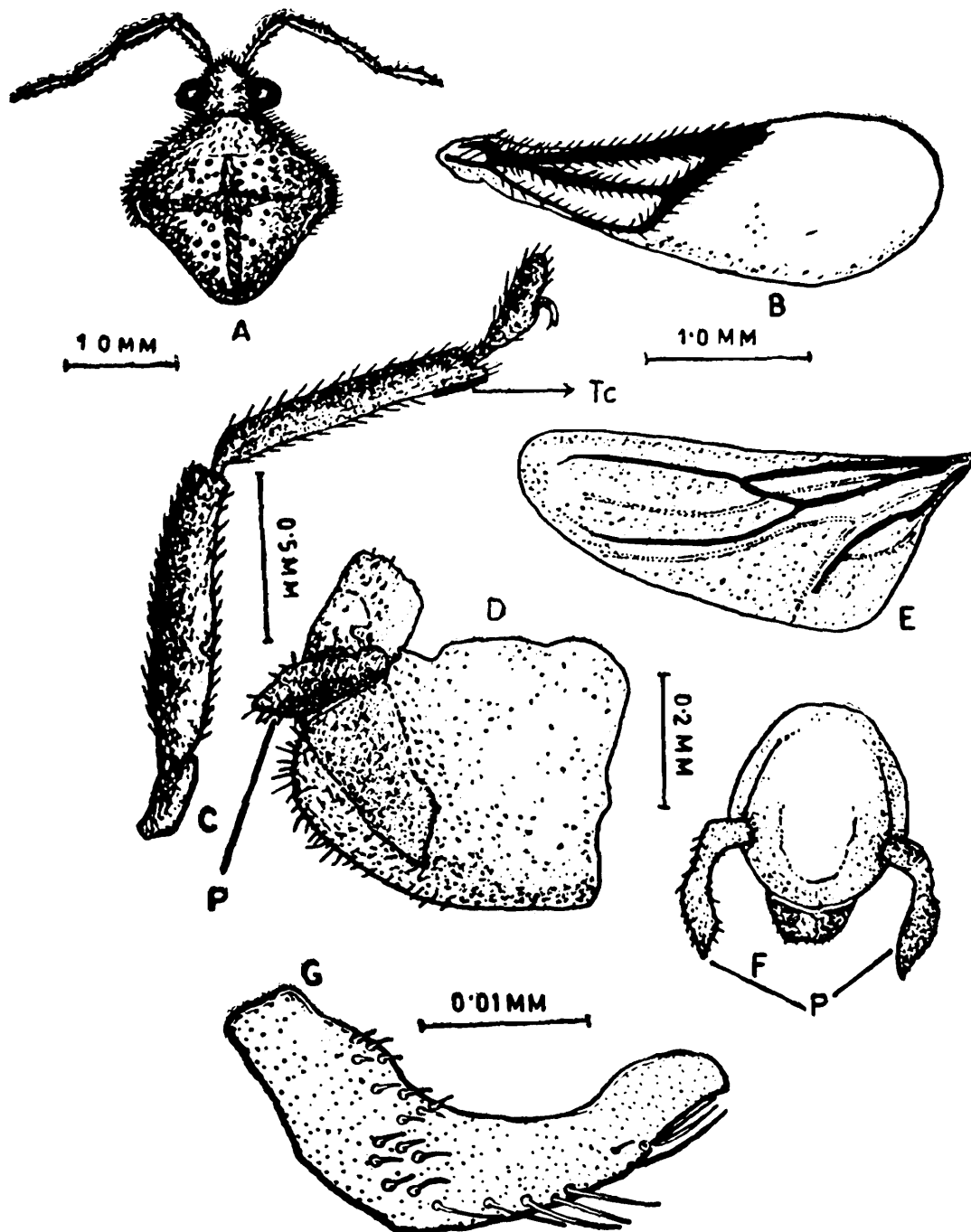


Fig. : 5 *Perittopus horvathi* Lundblad

- A. Head & thorax of macropterous male.
- B. Fore wing.
- C. Fore leg of Macropterous male (Tc. Tibial Comb).
- D. Lateral view of macropterous male genital segments (P. Paramere).
- E. Hind wing.
- F. Ventral view of macropterous male genital segments (P. Paramere).
- G. Paramere, lateral view.

with long suberect dark bristles. Tegmina three times as long as broad. Foretibia slightly widened at apical part; tibial comb extending one fourth length of tibia; claws preapical. Measurements of leg segments (in mm); Fore leg: 1.0: 0.9: 0.05: 0.3; Middle leg: 1.2: 1.6:

0.1 : 0.3 ; 0.4 ; Hind leg : 1.2 : 1.3 : 0.2 : 0.4 : 0.4. Genital segments small, parameres symmetrical, hairy, gradually tapering toward apex (Fig 5 F.G.).

Macropterous female : Same as macropterous males. Antennae and legs structures as in males except for the absence of fore tibial comb. Measurements of leg segments (in mm) : 1.0 : 0.9 : 0.05 : 0.3 : Middle leg : 1.0 : 1.6 : 0.1 : 0.3 : 0.3 ; Hind leg : 1.1 : 1.6 : 0.1 : 0.3 : 0.3.

Material examined : 3 ♂♂, 3 ♀♀ (Macropterous) collected from a mountain stream, Thopparu, Pattarikadu, alt. 520 M, 7.III.1983.

Distribution : INDIA : Tamilnadu.

Remarks : This species has not been so far reported outside Tamilnadu. After the type locality, this species has been recorded from Javadi Hills and not recorded anywhere from India. This species can also be easily identified by the structure of paramere which is gradually tapering to end.

Subfamily : RHAGOVELIINAE

1. *Rhagovelia* (*Rhagovelia*) *nigricans* (Burmeister)

1835. *Velia nigricans* Burmeister, *Handbuch Entomologie*, 2 : 213.

1910b. *Rhagovelia nigricans* (Burmeister) : Distant, *Fauna British India*, 5 : 137.

1919b. *R. nigricans* (Burmeister) : Paiva, *Rec. Indian Mus.*, 16 : 153, 362.

1936. *R. nigricans* (Burmeister) : Lundblad, *Ark. Zool.*, 28 : 44.

1938. *R. nigricans* (Burmeister) : Hafiz and Mathai, *Rec. Indian Mus.*, 40 : 207.

1939. *R. nigricans* (Burmeister) : Hafiz and Ribeiro, *Rec. Indian Mus.*, 41 : 424.

1950a. *R. nigricans* (Burmeister) : Pradhan *Rec. Indian Mus.*, 48 : 102.

Diagnostic characters : *Males* : The proximal part of middle legs is rounded and with thorn like spines and small pegs. The hind legs with pegs and without spines. The tergites 7 & 8 are lustrous. The base of antennae and fore legs are broad and bright. *Females* : The connexivum is horizontal, without inwardly bent, and without long hairs at the distal end. The antennae, fore and back sides of legs are yellow.

Material examined : 3 ♂♂, 1 ♀, Macropterous ; 8 ♂♂, 18 ♀♀ apterous from Kad Aru, Amridi, alt. 240 M, 2.V.1984.

Distribution : INDIA : Assam, Bihar, Himachal Pradesh, Kerala, Maharashtra, Meghalaya, Punjab, Tamilnadu, (present study) ; ABYSSINA ; EGYPT ; MASCARVENE ISLANDS ; PALESTINE ; SEYCHELES ; SRI LANKA ; SYRIA ; WEST & EAST AFRICA.

Remarks : This species has a very wide distribution in Orient, Palearctic & Ethiopian. This is the first species of *Rhagovlia* recorded from Eastern Ghats.

Subfamily : MICROVELIINAE

1. *Microvelia annandalei* Distant

1909. *Microvelia annandalei* Distant, *Ann. Mag. nat. Hist.*, 3 : (8) : 501.

1910b. *M. annandalei* Distant, *Fauna British India*, 5 : 140.

1934. *M. annandalei* Distant : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 318.

Diagnostic characters : Males with intermediate tibiae shorter than femora ; hind femora more than half as long as tibiae ; tibial combs in fore tibiae one fourth as long as that of tibiae, parameres slender, not whip-shaped.

Material examined : Apterous 2 ♂♂, 7 ♀♀ from Vannanthurai, Jamnamaruthur, alt. 590 M, 27.II.1983 ; apterous 1 ♀ from Kastaru, Nellivassal, alt. 540 M, 19.XI.1983 ; Apterous 18 ♂♂, 9 ♀♀, 1 ♂ macropterous and 23 immature stages from Odugathur, alt. 410 M, 21.IV.1984 ; apterous 16 ♂♂, 10 ♀♀ from Kad Aru, Amirdi, alt. 240 M, 2.V.1985 ; apterous 1 ♂, 3 ♀♀ ; macropterous 1 ♂, apterous 12 ♂♂, 10 ♀♀ from Amerdi Aru, Amirdi, alt. 260 M, 220 M, 3.V & 5.V.1985 respectively.

Distribution : INDIA : Tamilnadu (Javadi Hills), West Bengal.

Remarks : This has been reported for the first time from Southern part of India.

2. *Microvelia diluta* Distant

1909. *Microvelia diluta* Distant, *Ann. Mag. nat. Hist.*, 3 : (8) : 500.

1910b. *M. diluta* Distant, *Fauna British India*, 5 : 139.

1918. *M. diluta* Distant : Paiva, *Rec. Indian Mus.* 14 : 21.

1934. *M. diluta* Distant : Lundblad, *Arch. Hydrobiol. Suppl.*, 12 : 307.

Diagnostic characters : This can be readily identified by the presence of tibial comb both in the anterior and middle tibiae in males. The parameres are very small or rudimentary.

Material examined : Macropterous 6 ♂♂, 3 ♀♀, apterous 38 ♂♂, 32 ♀♀ from Madikaru, Jammnamaruthur, alt. 600 M, 28.II.1983.

Distribution : INDIA : Bihar, Tamilnadu (Javadi Hills), West Bengal ; INDONESIA,

Remarks : This is one of the commonest of *Microvelia* species almost found in India. This is the first record of this species from Eastern Ghats.

3. *Microvelia douglasi* Scott

1874. *Microvelia douglasi* Scott, *Ann. Mag. nat. Hist.*, 14 : 448.
 1903. *M. repentina* Distant, *Fauna British India*, 3 : 174.
 1903. *M. singalensis* Distant, *Fauna British India*, 3 : 174.
 1909. *M. kumaonensis* Distant, *Ann. Mag. nat. Hist.*, 3 : 500.
 1934. *M. douglasi* Scott : Lundblad, *Arch. Hydrobiol., Supp.*, 12 : 347.
 1947. *M. douglasi* Scott : Hafiz and Pradhan, *Rec. Indian Mus.*, 45 : 373.

Diagnostic characters : Fourth antennal segment longest in males, tibial comb present only in fore tibia and the intermedise tibiae distinctly smaller than femora.

Material examined : Macropterous 1 ♂, 2 ♀ ♀ from Kuttathur, alt. 500 M, 3.XI.1983 ; apterous 4 ♂ ♂, 2 ♀ ♀ macropterous 2 ♂ ♂, 1 ♀ ; 10 ♂ ♂, 2 ♀ ♀ from Odugathur, alt. 310 M, 410 M, 20.IV & 21.IV.1984 respectively ; macropterous 3 ♂ ♂, 2 ♀ ♀ from Utharakaveri Aru, Odugathur, alt. 310 M, 22.IV.1985 ; macropterous 1 ♂, 1 ♀ from the same locality alt. 300 M, 23.IV.1284 ; apterous 1 ♂, 2 ♀ ♀, macropterous 4 ♂ ♂, 3 ♀ ♀ from Pinnanthurai, alt. 415 M, 24.IV.1984 ; macropterous 8 ♂ ♂, 6 ♀ ♀ from Agaram River, Agaram, alt. 260 M, 27.IV.1984 ; macropterous 9 ♂ ♂, 6 ♀ ♀ from Kad Aru, Amirdi, alt. 240 M, 2.V.1984 ; macropterous 40 ♂ ♂, 24 ♀ ♀ alt. 210 M, 3.V.1984 ; macropterous 40 ♂ ♂, 24 ♂ ♀ alt. 210 M, 3.V.1984 ; 24 ♂ ♂, 17 ♀ ♀ alt. 220 M, 5.V.1984 ; 24 ♂ ♂, 19 ♀ ♀ alt. 230 M, 6.V.1984 from Amirdi River, Amirdi.

Distribution : INDIA : Orissa, Tamilnadu (Javadi Hills) ; INDONESIA, JAPAN, SRI LANKA.

Remarks : Among the recorded species, *M. douglasi* is most common, found in Javadi Hills.

4. *Microvelia javadiensis* sp. nov.

Description :

Size : Apterous males, length 1.2-1.3 mm ; maximum width 0.5-0.6 mm.

Colour : Dark brown. Pronotum with a light transverse band. Antennae brownish black. Legs pale brown.

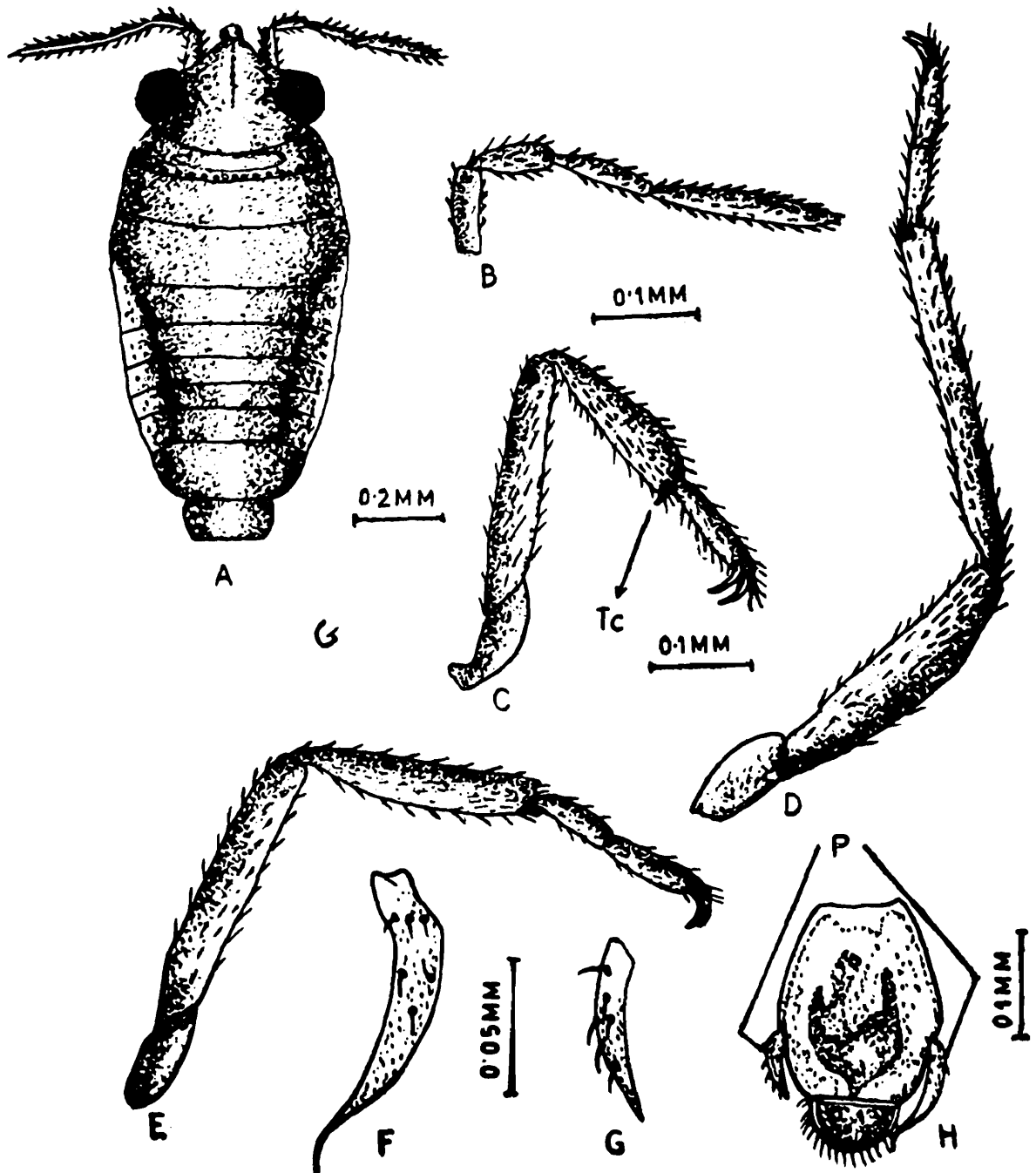


Fig. : 6 *Microvelia javadiensis* sp. nov.

- A. Apterous male.
- B. Antenna of male.
- C. Fore leg of male (Tc. Tibial comb).
- D. Hind leg of male.
- E. Middle leg of male.
- F. Right Paramere.
- G. Left Paramere,
- H. Ventral view of last genital segments (P. Paramere).

Structural characters : Apterous males : Small, elongate, narrow, with thorax wider than abdomen ; body mostly covered with small scattered dark setae. Head broader than long, two pairs of short setae near the anterior margin of eyes, one below the other, another pair

near the posterior margin below the eyes ; eyes as long as broad. Antennae slender, four-segmented, covered with bristly hairs, about two fifth of total body length, 1st segment thickest, 2nd small, shortest, club-shaped, 3rd uniformly slender, basally subdivided, 4th longest, actually narrowed at apex ; measurements of segments (in mm) : 0.11 : 0.1 : 0.12 : 0.2. Pronotum small, anterior margin concave, posterior margin almost straight, with a single row of regular large fuscous punctures, about seven times broader than long. Mesonotum large, twice as long as the pronotum. Legs long, robust, clothed with long suberect hairs ; fore femur swollen at base ; fore tibia straight, tibial comb small hook-like, projecting distally beyond the apex, hind legs slightly longer and thicker than middle legs ; middle tibiae with a row of distinct group of erect setae arranged in a row at tip ; tarsal formulae 1 : 2 : 2 ; measurement of leg segments (in mm) : foreleg : 0.24, 0.2, 0.17 ; middle legs : 0.29, 0.26, 0.1, 0.11 ; hind leg : 0.3, 0.36, 0.1, 0.12. Terga 2-7 fully visible, tergum 7 about as long as 5th and 6th together ; 6 pairs of laterotergites ; genital segments small, pygophore as in Fig 6 H : paramere asymmetrical, right longer than left, tip whip-like ; left small, tip pointed (Fig 6 F, G.).

Apterous females and macropterous forms unknown.

Distribution : INDIA : Tamilnadu (Javadi Hills).

Material examined : HOLOTYPE : Apterous ♂ (on slides) ; PARATYPE : Apterous 2♂♂ (in liquid), genitalia mounted ; from Pinnanthurai, Odugathur, alt. 415 M, 24.IV.1984.

Remarks : This species can be differentiated from all other known species of *Microvelia* by the asymmetrical parameres, the structure of male tibial comb which is short and hook shaped, and in the absence of tibial comb in middle tibia. This is the smallest of *Microvelia* so far known from India.

The type materials are deposited in Southern Regional Station of Zoological Survey of India, Madras and will be transferred to the National collections of Zoological Survey of India, Calcutta in due course.

SUMMARY

The aquatic and semi-aquatic Hemiptera of Javadi Hills, Tamilnadu (Southern India), collected by the author for a period of two years, are reported. The results of this study yielded 22 genera and 44 species, belonging to 12 families including two new species, *Micronecta janssoni* (Family : Corixidae) and *Microvelia javadiensis* (Family : Velidae). The notonectid, *Anisops stali* Kirkaldy is recorded for the first time from India. A good number of species, hitherto recorded or reported from elsewhere, have been reported as new records from this part of Eastern Ghats. In addition to the world distribution of each species, a brief note on the bioecology of the species is given. Keys to the series, families, subfamilies and species are provided.

ACKNOWLEDGEMENTS

A survey of this kind could not have been undertaken but for the willing cooperation of the Tamilnadu Government Forest Officials. The author is indebted to the State Forest Departments, especially The Chief Conservator of Forests, Madras, The Additional Chief Conservator of Forests (Wildlife), Coimbatore, The District Forest Officers of Vellore and Tirupattur Divisions. A special word of appreciation is due to Shri S. Govindarajan, I.F.S., District Forest Officer, Vellore Division, Vellore for his assistance and help in various ways during the entire survey period. His sincere thanks are due to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta and Dr. R. S. Pillai, Scientist 'D' and Officer-in-Charge, Southern Regional Station, Madras for the facilities and encouragements. The services of Mrs. A. Chandra, Librarian, Southern Regional Station for the German and French translations of references quoted in the text, Messrs. K. Ramachandra Rao (Leader of the party), Shri T. Gunasekaran, C.S. Rao, J. Ramalingam, K. G. Unni, B.D. Singh and D. Sengupta for their assistance in various ways are thankfully recorded. Last but not the least, the author expresses his sincere gratitude to all his colleagues, in particular, Dr. K. V. Lakshminarayana, Scientist 'C' for their guidance and advice. The author is grateful to Dr. A. Jansson, Zoology Museum, University of Helsinki, Helsinki and Dr. John T. Polhemus, University of Colorado Museum, Englewood, U.K. for their help in confirmation of new species and for sending some important references pertaining to this work respectively. Thanks are due to Mrs. Anuradha Thirumalai for her untiring effort in typing manuscripts.

REFERENCES

- AHMAD M. and S. AHMAD 1983. Field observations on the occurrence of *Micronecta scutellaris* stål (Hemiptera : Corixidae). *J. Bombay nat. Hist. Soc.*, **80** (1) : 236-239.
- ANDERSON, N. M. 1975. The *Limnogonus* and *Neogerris* of the Old world with character analysis and a reclassification of the Gerrinae (Hemiptera : Gerridae). *Ent. Scand. Suppl.*, **7** : 1-96.
- ANDERSON, N. M. 1980. Hygropterid water striders of the genus *Onychotrechus* Kirkaldy with description of a related genus (Insecta : Hemiptera : Gerridae). *Stenstrupia*, **6** (10) : 113-146.
- ANDERSON, N. M. 1981. Semi-aquatic bugs : phylogeny and classification of the Hebridae (Heteroptera : Gerromorpha) with revisions of *Timasius* *Neotimasius* and *Hyrceanus*. *Systematic Entomology*, **6** : 377-412.
- ANDERSON, N. M. and J. T. Polhemus : 1980. Four new genera of Mesoveliidae (Hemiptera : Gerromorpha) and the phylogeny and classification of the family. *Ent. Scand.*, **11** : 369-392.
- ANNANDALE, N. 1919. The fauna of certain small streams in the Bombay Presidency. *Rec. Indian Mus.*, **16** (1) : 109-161.
- BERGROTH, E. 1915. Hemiptera from the Bombay Presidency. *J. Bombay nat. Hist. Soc.*, **24** : 170-179.
- BOBB, M. L. 1974. The aquatic and semi-aquatic Hemiptera of Virginia. *Bull. Virginia Polytechn. Inst. State Univ.*, **87** : 1-195.
- BREDDIN, G. 1905. Übersicht der javanischen *Micronecta*-Arten. *Soc. Ent. Zurich*, **20** : 57.
- BROOKS, G. T. 1948. New species of *Enithares* (Hemiptera, Notonectidae). *J. Kans. Ent. Soc.*, **21** (2) : 37-54.
- BROOKS, G. T. 1951. A revision of the Genus *Anisops* (Notonectidae, Hemiptera). *Kans. Univ. Sci. Bull.*, **34** (8) : 301-519.
- BURMEISTER, H. C. 1835. *Handbuch der Entomologie-Rhynchota*. **2** : 404 pp.

- CHAPMAN, C. Lauck, R. D., Menke, A.S., Polhemus, J. T. and Truxal, F. S. 1976. *The Semi-aquatic and Aquatic Hemiptera of California* (Heteroptera : Hemiptera) in Arnold S. Menke (Ed.) *Bull. California Ins. Surv.*, **21** : 2-166 pp. *University of California Press, London.*
- CHEN, L. C. 1960. A study of the Genus *Micronecta* of India, Japan, Taiwan and adjacent regions. *J. Kans. Ent. Soc.*, **33** (3) : 99-118.
- CHENG, L. and C. H. Fernando 1969. A taxonomic study of the Malayan Gerridae (Hemiptera : Heteroptera) with notes on their biology and distribution. *Oriental Ins.*, **3** (2) : 97-160.
- CHINA, W. E and N. C. E. Miller, 1955. Checklist of family and sub-family names in Hemiptera-Heteroptera. *Ann. Mag. nat. Hist.*, **8** (12) : 257-267
- DENBOER, M. H. 1965. Revisionary notes on the Genus *Metrocoris* Mayr (Heteroptera, Gerridae), with descriptions of four new species. *Zool. Verh.*, **74** : 1-38.
- DISTANT, W L. 1903. *The fauna of British India including Ceylon and Burma. Rhynchota. 2* : 503 pp.
- DISTANT, W L. 1906. *The fauna of British India including Ceylon and Burma. Rhynchota. 3* : 503 pp.
- DISTANT, W. L. 1909. Oriental Rhynchota, Heteroptera. *Ann. Mag. nat. Hist.*, **3** (8) : 491-507.
- DISTANT, W L. 1910a. Some undescribed Gerrinae *Ann. Mag. nat. Hist.*, **5** (8) : 140-153.
- DISTANT, W.L. 1910b. *The fauna of British India including Ceylon and Burma. Appendix 5* : 362 pp.
- DOHRN, A. 1860. Zur Heteroptern-Fauna Ceylon's *Stett. ent. Zeit.*, **21** : 399-409.
- DOVER, C. 1928. Aquatic Rhynchota in the College of the Agricultural College, Coimbatore, Southern India. *J. Bombay nat. Hist. Soc.*, **32** (3) : 614-615.
- ESAKI, T. 1928. New or little known Gerridae I, Ceylonese species. *Ann. Mag. nat. Hist.*, **2** (10) : 503-513.
- FABRICIUS, J. C. 1775. *Systema Entomologiae. Flensburgi et Lipsiae* 832 pp.

- FABRICIUS, J. C. 1790. *Nova Insecta Genera. Skrift Nat. Selsk. Kjobenhaven, 1 : 227-228.*
- FABRICIUS, J. C. 1794. *Entomologia Systematica. emendata et aucta. IV. Hafinae 477 pp.*
- FABRICIUS, J. C. 1798. *Supplementum Entomologic systematica. emendata et aucta. Hafinae 527 pp.*
- FABRICIUS, J. C. 1803. *Systema Rhyngotorum. Brunsvigae 314+21 pp.*
- FIEBER, F. X. 1844. *Monographie der Gattung Ploa. Entomologische Monographien. Leipzig. 138 pp.*
- GUERIN,—Meneville, F. E. 1844. *Les Hemipteres. Iconographie due Regne Animal de G. Curier, 2 : 343-831.*
- HAFIZ, H. A. and G. Mathai 1938. *On a collection of aquatic Rhynchota from the Rajmahal Hills, Santal Parganas, Bihar, Rec. Indian Mus., 40 (2) : 207-210.*
- HAFIZ, H. A. and K. S. Pradhan 1947. *Notes on a collection of aquatic Rhynchota from the Patna State, Orissa, with descriptions of two new species. Rec. Indian Mus., 45 (4) : 347-376.*
- HAFIZ, H. A. and K. S. Ribeiro. 1939. *On a further collection of aquatic Rhynchota from the Rajmahal Hills, Santal Parganas, Bihar, with a description of Microvelia santala sp. nov. Rec. Indian Mus., 41 (4) : 423-436.*
- HERRICH—Schaeffer, G. A. W 1850. *Die Wanzenartigen Insekten 9 : 45-256.*
- HORVATH, G. 1895. *Rev. Entomologie, 14.* (Original not seen ; as quoted in *Ann. Mus. Nat. Hung.*, vol. 8, page 551)
- HORVATH, G. 1915. *Monographie des Mesoveliidas. Ann. Mus. Nat Hung., 8 : 535-556.*
- HORVATH, G. 1924. *Remarques Sur Toris Especes du Genre Mesovelia M. R. Ann. Mus., Nat. Hung., 21 : 135-136.*
- HUNGERFORD, H. B. 1958. *Some interesting aspects of the world distribution and classification of aquatic and semi-aquatic Heteroptera. Proc. 10th International Cong. Ent., 1 (1956) : 337-348.*
- HUNGERFORD, H. B. and N. E. Evans, 1934. *The Hydrometridae of the Hungarian National Museum and other studies in the family (Hemiptera) Ann. Mag. Nat. Hung., 28 : 31-112.*

- HUNGERFORD, H. B. and R. Matsuda. 1958. The *Tenagogonus-Limnometra* Complex of the Gerrinae. *Kans. Univ. Sci. Bull.*, **39** (9) : 371-457.
- HUTCHINSON, G. E. 1933. A revision of the Distantian and Paivian types of Notonectidae and Corixidae in the Indian Museum. *Rec. Indian Mus.*, **35** (4) : 393-408.
- HUTCHINSON, G.E. 1940. A revision of the Corixidae of India and Adjacent Regions. *Trans. Connecticut Acad. Arts. Sci.*, **33** : 339-476.
- JACZEWSKI, T. 1926. Notes on Corixidae *Ann. Zool. Mus., Polon. Warsaw*, **5** : 15-21.
- JACZEWSKI, T. 1934. Notes on the Old World species of Ochteridae (Heteroptera). *Ann. Mag. nat. Hist.*, **13** (10) : 597-613.
- JULKA, J.M. 1969. Aquatic Bugs of a fish Pond. *Entomologist's Record*, **81** : 174-176.
- KIRKALDY, G.W. 1898. Notes on aquatic Rhynchota I. *Entomologist*, **31** : 2-4.
- KIRKALDY, G.W. 1901. On some Rhynchota, principally from New Guinea (Amphibicorisae, Notonectidae). *Ann. Museo civ. Stor. nat. Giacomo Doria*, **20** : 804-810.
- KIRKALDY, G.W. 1901a. Miscellanea Rhynchotalia, *Entomologist*, **34** : 116-117.
- KIRKALDY, G.W. 1903. Miscellanea Rhynchotalia No. 6 *Entomologist*, **36** : 44-45.
- KIRKALDY, G.W. 1904. Uber Notonectidae. *Wien Entomol. Zeit.*, **23** : 93-135.
- KORMILEV, N.A. 1971. Ochteridae from the Oriental and Australian regions, *Pacif. Insects*, **13** : 429-444.
- LANSBURY, I. 1964. Some observations on the Notonectidae (Hemiptera-Heteroptera) of Vietnam and Adjacent Regions. *Ann. Zool. Warszawa*, **21** (10) : 203-219.
- LANSBURY, I. 1968. The *Enithares* (Hemiptera-Heteroptera : Notonectidae). *Pacif. Insects*, **10** (2) : 353-442.
- LANSBURY, I. 1972. A review of the Oriental species of *Ranatra* Fabricius (Hemiptera : Heteroptera : Nepidae). *Trans. R. ent. soc. London.*, **124** (3) : 287-341.

- LATRELLE, P.A. 1804. *Historie Naturelle, Genrale at Particuliere des Crustacea et des Insectes* vol. 12 Paris.
- LAWCK, D.R. and A.S. Menke 1962. The higher classification of the Belostomatidae (Hemiptera). *Ann. Entomol. Soc., Amer.* **54** : 644-657.
- LEONG, C.Y and C.H. Fernando, 1962. The Genus *Anisops* (Hemiptera : Notonectidae) in Ceylon. *J. Bombay nat. Hist. Soc.*, **59** (2) : 513-519.
- LINNAEUS, C. 1764. *Systema naturale. Museum ;S:ae R:ae M : tis Ludovicae Ulricaee etc. Holmiae.*
- LUNDBLAD, O. 1929. Uber einige Corixiden des Berliner Zoologischen Museums. *Arch. Hydrobiol.*, **20** : 296-321.
- LUNDBLAD, O. 1934. Zur Kenntniss der aquatilen und semi-aquatilen Hemiptern von Sumatra, Java and Bali. *Arch. Hydrobiol. Suppl.*, **12** 1-195, 263-489.
- LUNDBLAD, O. 1936. Die altweltlichen Arten der Veludengattungen *Rhagovelia* und *Tetraripis*. *Arkiv. För. Zoologi*, **28** (21) : 1-63.
- MATSUDA, R. 1960. Morphology, evolution and a classification of the Gerridae (Hemiptera-Heteroptera). *Kans. Univ. Sci. Bull.*, **41** (2) : 25-632.
- MAYR, G.L. 1865. Diagnosen neuer Hemipteran ii. *Verh. Zool.*, **15** : 429-446.
- MENKE, A, S. 1979a. Family Ochteridae in the Semi-aquatic and aquatic Hemiptera of California ed. A. S. Menke. *Bull. California Ins. Surv.*, **21** : 124-125.
- MENKE, A.S. 1979b. Family : Belostomatidae in the semi-aquatic and aquatic Hemiptera of California ed. A.S. Menke. *Bull. California Ins. Surv.*, **21** : 76-86.
- MONTANDON, A.L. 1897. Hemipteres-Heteropteres exotiques. Notes at descriptions III. Family Naucoridae. *Ann. Soc. Ent. Belgique.* **41** : 55-61.
- NOWROJEE, D. 1912. Life histories of Indian Insects ii. Some aquatic Rhynchota. *Mem. Dep. Agric India Ent. Ser.*, **2** (9) : 168-170.
- PAIVA, C.A. 1918. Aquatic Rhynchota from the Southern Shan States. *Rec. Indian Mus.*, **14** : 19-32.
- PAIVA, C.A. 1919a. Aquatic and Semi-aquatic Rhynchota from the Satara and Poona Districts. *Rec. Indian Mus.*, **16** (1) : 152-156.

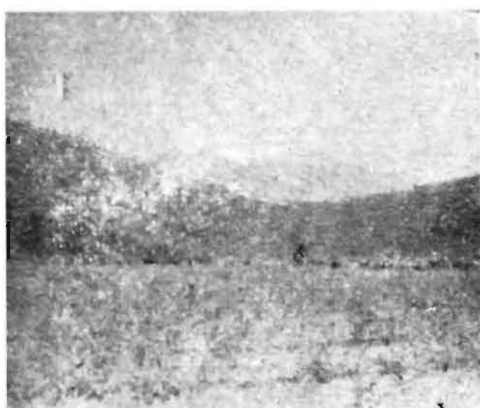
- PAIVA, C. A. 1919b. Rhynchota from the Garo Hills, Assam. *Rec. Indian Mus.*, 16 (3) : 349-377.
- PAIVA, C. A. and C. Dover. 1922. Five new speies of the Rhynchotan genus *Corixa*. *Rec. Indian Mus.* 24 : 331-333.
- PRADHAN, K. S. 1950a. On a collection of Aquatic Rhynchota from the Rihand Dam site, Mirzapur District (U. P.), with the description of a new water strider (Insecta : Hemiptera : Gerridae). *Rec. Indian Mus.*, 48 (2) : 101-105.
- PRADHAN, K. S. 1950b. On the distribution of the Genus *Amemboa* Esaki (Hemiptera : Heteroptera) with the description of a new species. *Rec. Indian Mus.*, 48 (3 & 4) : 11-16.
- POLHEMUS, J. T. and H. C. Chapman. 1970. Family : Gerridae in The Semi-aquatic and Aquatic Hemiptera of California. ed. A. S. Menke *Bull. California Insect Surv.*, 21 : 58-69.
- POLHEMUS, J. T. and N. M. Andersen. 1984. A revision of *Amemboa* Esaki with notes on the phylogeny and ecological evolution of Eotrechine water striders (Insecta, Hemiptera, Gerridae) *Steenstrupia*, 10 (3) : 65-111.
- RAGHUNATHA Rao, T. K. 1962. On the biology of *Ranatra elongata* F. (Belostomatidae). *Proc. R. ent. Soc. Lond.*, (A) 37 : 61-64.
- RAGHUNATHA Rao, T. K. 1976. Bioecological studies on some aquatic Hemiptera-Nepidae. *Entomon.* 1 (2) : 123-132.
- SCOTT., J. 1874. On a collection of Hemiptera Heteroptera from Japan. Descriptions of various new Genera and species. *Ann. Mag. nat. Hist.*, 14 (4) : 442-462.
- STAL, C. 1958. Orthoptera och Hemiptera fran Sodra-Afrika. *Ofv. Svensk Vetens. akad. Forh.*, 15 : 307-320.
- STAL, C. 1859. Hemiptera species novas descripsit. *Kongl. svenska fregatten Sugemies resa omkring jorden—Zoology*, 4 : 219-298.
- WROBLEWSKI, A. 1960. Notes on some Asiatic species of the genus *Micronecta* Kirk. (Heteroptera, Corixidae). *Ann. Zool., Polon. Warsaw*, 18 (17) : 301-331.
- WROBLEWSKI, A. 1962. Notes on Micronectinae from Vietnam (Heteroptera. Corixidae). *Bull. Acad. Pol. Sc. Cl II, Warszawa*, 10 (5) : 175-180.



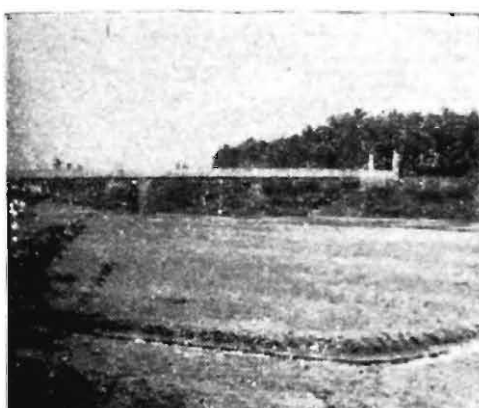
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PLATE I

1. A view of the Inner Javadi Hills.
2. The foothills of Paramanandal and adjoining area.
3. A portion of Pattaraikadu Reserve Forest.
4. The Cheyyar River bed near Chengam.
5. A view of a mountain stream at Nellivasal, typical habitat of the gerrid, *Amemboa kumari*.
6. A stagnant rockpool at Kuttathur, one of the habitats of *Limnometra fluviarum*, *Metrocoris stali* and *Enithares ciliata*.



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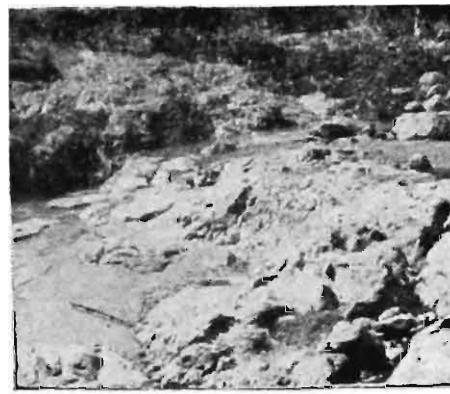
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PLATE II

7. Habitat of the Corixid, *Agraptocorixa hyallipennis*, a lake near Kuttathur Forest Bungalow.
8. Collecting Aquatic hemipterans from the Kuttathur lake.
9. A rockpool near Nellivasal, habitat of the corixids, *Corixa pruthiana*, *C. graveleyi* and *Micronecta janssoni*.
10. A rainwater pool near the foothills of the Paramandal, ideal habitat of the notonectid, *Anisops barbata*.
11. and 12. Two slow moving mountain streams near Nellivasal.



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PLATE III

13. Kastaru, a mountain stream, another habitat of *Amemboa kumari*.
14. The River Thattapeta aru, a tributary of Cheyyar the habitat of the Hydrometrid, *Hydrometra greeni*, the *Anisops nigrolineata* and *Enithares cillata*.
15. Aquatic bugs collection from a stagnant pool of water near Nellivasal.
16. The habitat of Hygropetric water strider, *Onychotrechus rhexenor*.
17. A stagnant pool adjoining Nellivasal Range, from where *Limnogonus nitidus*, *Metrocoris stali*, *Anisops cavifrons*, *Corixa pruthiana* were collected.
18. A stagnant rocky stream, habitat of the back swimmers, *Anisops cavifrons*, *A. nigrolineata*.