FURTHER NOTES ON THE INDIAN SPECIES OF *RODOLIA* MULSANT (COLEOPTERA: COCCINELLIDAE).

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In an earlier paper[1] on the Indian species of *Rodolia* Mulsant, I had listed nine species including an introduced Australian species, *Rodolia cardinalis* (Mulsant). Since its publication I had the opportunity of examining the collections in the Zoological Survey of India (Indian Museum) and some further material from other institutions in India, principally from the Directorate of Plant Protection, Quarantine and Storage. As a result of this study two more species (one of them new and the other hitherto recorded only from Burma) are now added to the earlier list and described with the same standard as was done for the previous paper. A revised key to the species and additional records of their geographical distribution, where available, are also given. Synonymies and most of the references for the species dealt with in my earlier paper have been omitted; for these a reference may be made to that paper. The material from various institutions is indicated as follows:—

Z. S. I.=Zoological Survey of India, Indian Museum, Calcutta.

P. P. A.=Directorate of Plant Protection, New Delhi.

I. A. R. I.=Indian Agricultural Research Institute, New Delhi.

B. M.=British Museum (Natural History), London.

I wish to record my thanks to Dr. S. L. Hora, the Director of this Survey and to Dr. H. S. Pruthi, Plant Protection Adviser with the Government of India, for providing the opportunity and material for this study.

Rodolia fumida Mulsant.

1949. *Rodolia fumida*, Kapur, *Bull. ent. Res.* XXXIX, p. 534, figs. 1-3, 12, 15.

The material examined is from the following localities:—

India[2]: Ganohala Reserve Forest, *ca.* 4 miles from Choa Saidan Shah, Salt Range. Punjab, 2. v. 1931 (*H. S. Pruthi*); 8 ex., *Z.S.I.*, Reg. Nos. $\frac{7843}{H4}$ — $\frac{7850}{H4}$ Kangra Valley, Punjab, 4,500 ft., —vii 1908 (Dudgeon) (1 example, *B. M.*). Lahore, Punjab, 7. v. 1908 (*N. Annandale*); 3 ex., *Z.S.I.*, Reg. Nos. $\frac{5270}{H4}$, $\frac{5274\text{-}5}{H4}$. Lahore, on *Aleurodes citri*, 18.v. 1913; 1 ex., *Z.S.I.*, Reg. No. $\frac{5721}{H4}$ Dehra Dun, U. P., —ii. 1901 (*F. Gleadow*); 1 ex., *Z. S. I.*

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[1] Kapur, A. P., *Bull. ent. Res.* XXXIX, p. 531-538 (1949).

[2] Used throughout in the same sense as was the case before the partition of the country.

Reg. No. $\frac{1904}{14}$. Cherrapunji, Assam, 2-8.x. 1914 (*S. W. Kemp*); 1 ex., *Z S. I.*, Reg. No. $\frac{7834}{H4}$. Pusa, Bihar, preying on *Monophlebus*, 20.iv. 1918 (*Haq*) (3 ex., *I. A. R. I.*). Jubbulpur, C. P., 28. v. 1922 (*S. H. Ribeiro*) 1 ex., *Z. S. I.*, Reg. No. $\frac{5272}{H4}$. Bandra, Bombay, (*Dr. Jaykar*) (1 ex., *B. M.*).

Remarks.—A widely distributed species, already recorded from various parts of India and from Burma and Ceylon.

Rodolia guerini (Crotch).

1949. *Rodolia guerini*, Kapur, *Bull. ent. Res.* XXXIX, p. 535.

The material examined is from the following localities :—

India: Dehra Dun, U. P., predacious on *Monophlebus stebbingi*,—iv. 1909 (*E. P. Stebbing*) 22 examples, *Z. S. I.*, Reg. Nos. $\frac{4309}{14} - \frac{4323}{14}$ Sikkim Singhik, 3,500 ft., 23.iv. 1924 (*R. W. G. Hingston*) (1 ex., *B. M.*). Cape Comorin, South India, feeding on *Icerya pilosa* 16.vi.1949 (*V. K. S.*); 3 ex., *P. P. A.'s* bequest to *Z. S. I.*, Reg. Nos. $\frac{7853}{H4} - \frac{7855}{H4}$.

Remarks.—In one example from Dehra Dun, the two anterior black spots on the elytron are large and almost confluent with each other; in the material from Sikkim and from Cape Comorin these spots are completely fused to form a transverse band. The Cape Comorin examples agree more closely with Crotch's description. Though smaller in size and subhemispherical, their genital structure and other characters are similar to those of the rest of the material.

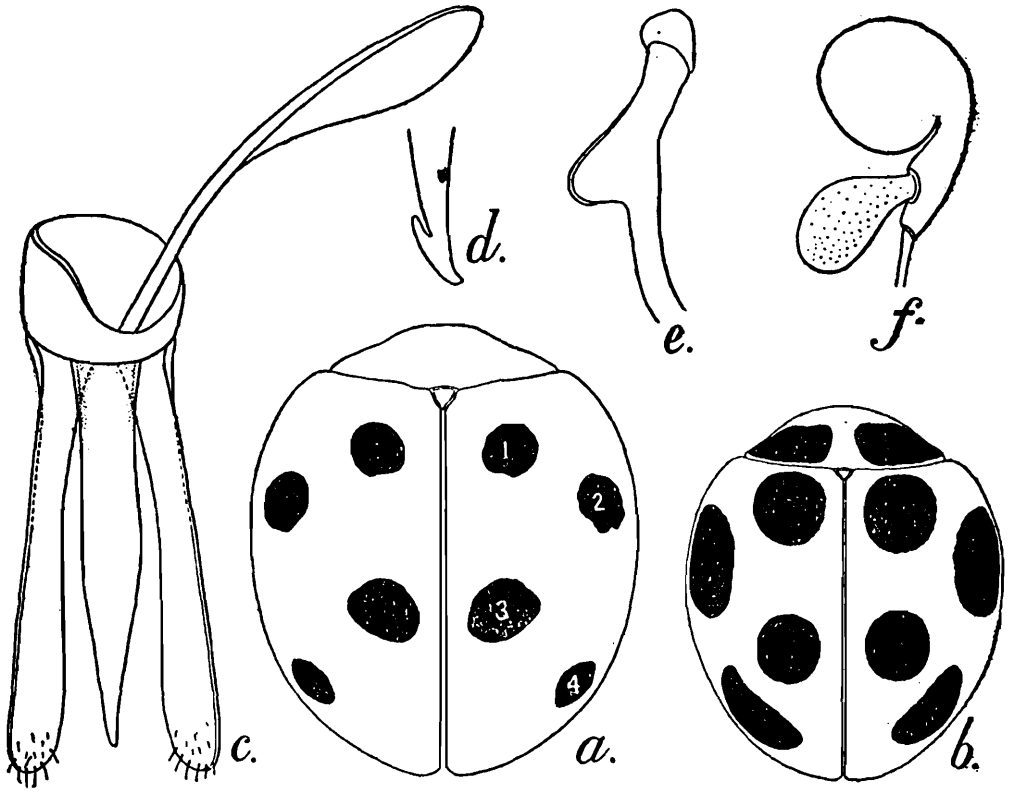
Previously recorded from Pondicherry (South India; type-locality) and the United Provinces, it is now being recorded from as far north as Sikkim.

Rodolia octoguttata Weise.

1910. *Rodolia octoguttata*, Weise, *Verh. Naturf. Ver. Brünn.* XLVIII, p. 51.

Body medium sized, subhemispherical; dorsal surface reddish brown to testaceous; pronotum with a pair of large, ill-defined, black to fuscous spots situated near the base and on either side of the longitudinal median line of pronotum; the spots in some examples are further enlarged and fused with each other but in another example they are altogether missing. Scutellum without any black or fuscous marking. Each elytron with four subrounded, rather large to small, black spots which are generally of uniform size in the same example. Numbering the spots on the left elytron (Text-fig. 1*a*) from left to right and from the base to apex, the first and third spots are situated closer to the suture while the second and fourth spots are near the external margin. The first spot is as distant from the base and the transverse middle line of the elytron as from the suture; the second begins from about the same level as the centre of the first spot and extends to a little distance below the transverse median line of elytron in the case

where the spots are large, (Text-fig. 1*b*) but otherwise it stops short near the said line ; the third spot which is situated in line behind the first, extends from the transverse median line to as far back as 3/5—7/10th the length of elytron ; the fourth or the subapical spot is equidistant from the second and third spots and the external margin. Underside of the same colour as the dorsal or slightly paler, in some cases with the parts of metathorax and the last two pair of femora fuscous. Pubescence grey, moderately long and dense except for the head and underside where it is short and rather depressed. Punctation fairly close and fine on the head and pronotum, rather coarse and impressed on the elytra, much more so than in *R. guerini*. Scutellum with the pubescence and punctation similar to that of the elytra. Pronotum with the anterior angles and the lateral margin subrounded ; elytra with the shoulder-boil



TEXT-FIG. 1.—*Rodolia octoguttata* Weise. *a.* showing elytral pattern : × 8 ; *b.* another pattern : × 8 ; *c.* male genitalia (front-view) except sipho : × 10 ; *d.* apex of penis (side-view) : × 10 ; *e.* siphonal capsule : × 10 ; *f.* spermatheca : × 10.

indistinct. Prosternum narrow, nearly two-and-half times as long as wide, slightly narrowed and raised anteriorly. The apical margin of the sixth abdominal sternite of the male notched in the middle ; entire and subrounded in the female. Male genitalia (Text-fig. 1*c-e*) similar to that of *R. fumida* but differs from the latter in that the penis instead of being very pointed near the apex, as is the case in *fumida*, tapers very gradually from the middle of its length to the apex which is less sharply pointed (Text-fig. 1*c*) ; its subapical projection (Text-fig. 1*d*) is also larger and more deeply notched. Siphonal capsule (Text-fig. 1*e*) also similar to that of *fumida* but with the inner lobe narrower and shorter. Female genitalia, including the shape of the spermatheca (Text-fig. 1*f*), like that of *fumida*.

Length 3·5—5·0 mm. ; width 3·2—4·6 mm.

Geographical distribution.—Type-locality : Pegu, Upper Burma. The material examined is from the following localities :—

India : Bhim Ku, Talkumaon Hills, U. P., 18.v.1930 (*H. S. Pruthi*) 1 ; ♀, *Z. S. I.* Reg. No. $\frac{5294}{H4}$. Shillong, Khasi Hills, Assam, 5.xi.1930 (*H. S. Rao*) ; 2 ♂, 1 ♀ ; *Z. S. I.*, Reg. No. $\frac{5292}{H4}$.

Burma : Hmodon, 3,900 ft. Upper Burma, 5.v.1918. ; 1 ♂, *Z. S. I.*, Reg. No. $\frac{7864}{H4}$.

Remarks.—This species falls in the same group as the *R. fumida R. guerini* and *R. andamanica* Weise by the general shape of the body, and the characteristic subapical projection of penis, but is easily distinguishable from them by its markings on the pronotum and elytra.

Rodolia breviuscula Weise.

1949. *Rodolia breviuscula*, Kapur, *Bull. ent. Res.* XXXIX, p. 536, figs. 6,11,21.

The material examined is as follows :—

India : Poshok, 2,500 ft., Darjeeling district, Bengal, 26.v—14.vi.1916 (*F. H. Gravely*) 1 ex., *Z. S. I.*, Reg. No. $\frac{5715}{H4}$. Whitefield, Bangalore, Mysore. State, on *Icerya purchasi* Maskell, (*V.K. Subramanyam*) ; 2 ex., *P. P. A. S*, bequest, *Z. S. I.* Reg. No. $\frac{808--9}{H4}$. Coorg, South India, feeding on *I. purchasi* and *Icerya aegyptiaca* Douglas, 18.ix.1949 ; 4 ex., *P. P. A.* ; 3 ex. *Z. S. I.*, Reg. Nos. $\frac{7851}{H4}$ — $\frac{7852}{H4}$.

Burma : Pyinmana (Lower Burma) 7.iii.1918, (*Y. R. Rao*) ; 1 ex., *I. A. R. I.* 1 ex., *Z. S. I.*, Reg. No. $\frac{7841}{H4}$

Remarks.—Previously known from the Central and Southern India and from Ceylon, this species is now being recorded from Lower Burma and may in fact be more widely distributed than is known at present.

Rodolia amabilis Kapur.

1949. *Rodolia amabilis*, Kapur, *Bull. ent. Res.* XXXIX, p. 536, figs. 7, 13, 18.

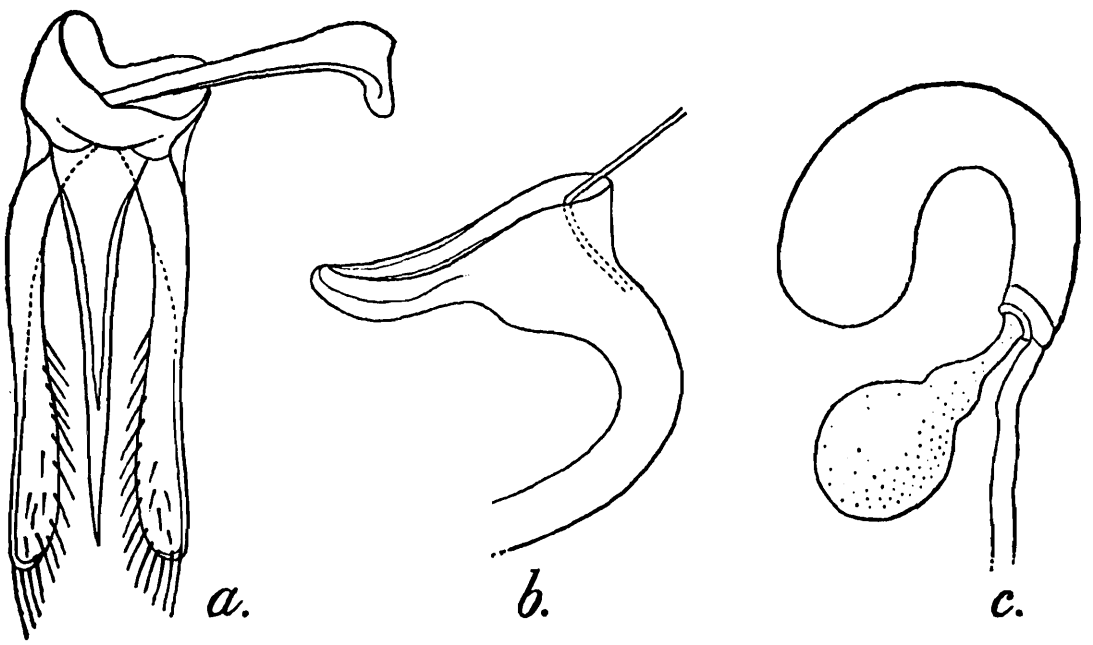
The material examined is from the following localities :—

India : Calcutta, Bengal, predacious on *I. aegyptiaca*, 27. xi. 1894 ; 24 examples *Z. S. I.*, Reg. Nos. $\frac{6191}{13}$ — $\frac{6209}{13}$ Puri, Orissa coast, 24-28.i.1911 (*N. Annandale & F. H. Gravely* ; 1 ex., *Z. S. I.*, Reg. No. $\frac{7833}{H4}$. Barkuda Island, Chilka Lake, Orissa, 9.ix.1920, (*N. Annandale*) ; 1 ex., *Z. S. I.* Reg. No. $\frac{7842}{H4}$. White field, Bangalore, feeding on *I. purchasi*, 18.ix.1949 (*V. K. Subramanyam*) ; 1 ex., *P. P. A's* bequest, *Z. S. I.*, Reg. No. $\frac{7859}{H4}$. Coorg, South India, feeding on *I. purchasi* and *I. aegyptiaca* ; 3 ex., *P. P. A.'s* bequest, *Z. S. I.*, Reg. Nos. $\frac{7856}{H4}$ — $\frac{7858}{H4}$

Ceylon: Ragalla, attacking *I. purchasi*, 19.xi.1917; 6 ex., *Z. S. I.*, Reg. Nos. $\frac{7835}{H4} - \frac{7840}{H4}$.

Rodolia nigrofrontalis, sp. nov.

Body subhemispherical, closely resembling *R. amabilis* in size and outline. Head piceous except for the antennae and mouth-parts which like the rest of dorsal surface are uniformly reddish brown with a slight tinge of carmine. Underside piceous except for the epipleurae (of both pronotum and elytra), the apices of femora, the tibia and tarsii and the external margin of abdomen. Pubescence yellowish, short, moderately dense and a little slanting on the dorsal sufrace and almost depressed on the underside. Punctation fine, moderately impressed and close on the head and pronotum except for a few scattered coarser punctures on the latter; elytral punctures, as a rule rather coarse, fairly close and shallowly impressed. Prosternum very small, at the apex rather squarish. Sixth abdominal sternite in the male weakly emarginate at



TEXT-FIG. 2.—*Rodolia nigrofrontalis*, sp. nov. *a*. male genitalia, except sipho: × 14; *b*. siphonal capsule: ×22; *c*. spermatheca: ×22.

apex; entire and rounded in the female. Male genitalia (Text-fig. 2 *a*) similar to that of *amabilis* but with the penis distinctly narrower and sharply pointed towards the apex; paramera spathulate, with the distal half to two-thirds being closely beset with long setae; sipho (Text-fig. 2 *b*) as in *amabilis* except that the inner lobe of the siphonal capsule is shorter and narrower. Female with the spermatheca (Text-fig. 2 *c*) curved like a semicircle and slightly but gradually increasing in width towards the apex which is rounded.

Length 3·0—3·2 mm.; width 2·45—2·7 mm.

Holotype.—A male from Travancore, South India, 1948 *P. P. A.*'s bequest, in *Z.S.I.*, Reg. No. 7861/H4. *Allotype*.—A female with the same data as the above, in *Z.S.I.*, Reg. No. 7862/H4; *Paratype*.—Three, with the same data as the above, one each in *Z.S.I.* (Reg. No. 7863/H4); the *P. P. A.*'s collection and in the British Museum (N.H.).

Remarks.—Very close to *R. amabilis* from which it is readily distinguished by the black front of the head, the coarser punctures on the elytra and by the structure of the genitalia.

Rodolia minima Kapur.

1949. *Rodolia minima*, Kapur. *Bull. ent. Res.* XXXIX, p. 537-538, figs. 8 9, 19, 20.

The material examined is from the following locality :—

India: Ooty, Nilgiri Hills, South India, 11.vii.1928, (*T. V. Subramaniam*; 2 ex., *Z. S. I.*, Reg. Nos. $\frac{2739}{H4}$; $\frac{2740}{H4}$

Remarks.—Already known from Ooty (not 'Coty' as given by mistake in my earlier paper) which is the type-locality.

KEY TO THE INDIAN SPECIES.

1.	Elytra reddis brown to carmine-red, with black spots ..	2
	Elytra pusually uniformly yellowish brown, brown, reddish or carmine-red, rarely fuscous, sometimes fuscous only along the margins or at the adices. ..	5
2.	Elytron with one small, black spot situated a little anterior to the middle and as distant from the suture as the length of its own diameter ; body 3·25 mm. long (South India)	
	Elytron with more than one black spots ; body longer than 3·5 mm.	3
3.	Elytron with 3 or 4 black spots, without the black sutural and apical borders	4
	Elytron with the black sutural and apical borders and with two black spots : one curved round the inner side of the shoulder-boil and the other discal, at 3/5ths the length of elytron and appearing as if composed of two fused spots. (Australian species, widely distributed in the world, introduced in India, mainly in the South) ..	*cardinalis* (Mulsant)
4.	Elytron with 3 black spots : two placed transversely a short distance before the middle and one (oval) in the apical third of elytron ; the former spots sometimes enlarged and fused to form a transverse band. Body usually subovate. (India) ..	*guerini* (Crotch)
	Elytron with 4 black spots, each situated at different levels and not forming a transverse band : the first near the scutellar angle, the second below the shoulder-boil, the third near the suture and immediately below the transverse median line and the fourth subapical. Body usually subhemispherical. (India ; Burma)	*octoguttata* Weise
5.	Head with the exception of antennae and mouth-parts black : body subhemispherical. (S. India) ..	*nigrofrontalis* sp. nov.
	Heads not at all black ; body shortly oval or subhemispherical :	6
6.	Body shortly oval, 5-5·6 mm. long ; elytra entirely or partly testaceous, reddish testaceous, nearly red or light piceous, some times only the margins or part of them fuscous ; median part of prosternum narrowed and less conspicuously raised anteriorly, (widely distributed in India)	*fumida* Mulsant
	Body subhemispherical, median part of prosternum more distinctly raised	7
7.	Body small, nearly 2·3 mm. long ; head, prodtum and greater part of elytra reddish testaceous to carmine-red, the apical third and lateral borders of elytra darker. (South India) ..	*minima* Kapur
	Body medium to large, 3 mm. long or over .. .	8
8.	Body nearly 6 mm. long ; head and pronotum and orange-yellow, elytra reddish brown, with the external border orange. (N. India)	*ruficollis* Mulsant

Body less than 5·5 mm. long ; head, pronotum and elytra uniformly coloured .. **9**

9. Body 4·8-5·2 long ; rusty, opaque and matt, finely and closely punctate with long, yellowish and sparser pubescence ; anterior angles of pronotum broadly rounded. (Andaman Islands) .. *andamanica* Weise

Body 3-4.25 mm. long ; upper surface shiny, anterior angles of pronotum narrower ; pubescence denser and shorter **10**

10. Body usually larger (3-4.25 mm. long) ; pubescence greyish or slightly yellowish and moderately dense ; elytral punctures rather shallow. (India, Burma and Ceylon) *breviuscula* Weise

Body smaller (3 mm. long) ; pubescence yellowish and close ; elytral punctures closer and more impressed (India) *amabilis* Kapur

ON THE COLLECTION OF LYCOSID SPIDERS IN THE ZOOLOGICAL SURVEY OF INDIA, (INDIAN MUSEUM) WITH CRITICAL NOTES ON THE SPECIES.

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CONTENTS.

INTRODUCTION.

The work of checking and rearranging the identified material of spiders in the collection of the Zoological Survey of India, which had a good part of its collection affected during the Varuna floods of 1943 (Chopra 1946) was undertaken at the suggestion of Dr. S. L. Hora, Director of the Survey. The present notes relate to the family Lycosidae. Besides the identified collection, the unnamed material of the family, collected by the staff of the Zoological Survey of India from Eastern Ghats Survey, Nerbuda Survey, Chota Nagpur Survey, Chilka Survey and from other places has also been identified and the results incorporated in this paper.

The arrangement proposed by Gravely (1924) has in the main been followed in this work.

The earlier description of *Hippasa nilgiriensis* Gravely (1924) is quite inadequate. It has, therefore, been described in greater detail and its systematic position discussed. Certain species which were hitherto known only from their type-localities have now been recorded from other places.

Measurements have been given only of the females. Field observations, where available, have been incorporated and an attempt has also been made to record, as far as possible, the complete distribution of the species dealt with in this paper.

The collection of Lycosidae examined consists of 39 species of 6 genera as follows :—

Genus **Hippasa** Simon.

1. *H. himalayensis* Gravely.
2. *H. nilgiriensis* Gravely.
3. *H. olivacea* (Thorell).
4. *H. lycosina* Pocock

Genus **Hippasa** Simon—*contd.*

5. *H. lowndesi* Gravely.
6. *H. pantherina Pocock.*
7. *H. agelenoides* Simon.
8. *H. pisaurina* Pocock.
9. *H. holmerae* Thorell.
10. *H. madraspatama* Gravely.

Genus **Ocyale** Audouim.

11. *O. atlanta* Audouin.

Genus **Lycosa** Latrielle.

12. *L. indagatrix* Walckenaer.
13. *L. catula* Simon.
14. *L. barnesi* Gravely.
15. *L. bistriata* Gravely.
16. *L. khudiensis* sp. nov.
17. *L. prolifica* Pocock.
18. *L. nigrotibialis* Simon.
19. *L. madani* Pocock.
20. *L. kempi* Gravely.
21. *L. stictopyga* (Thorell).
22. *L. himalayensis* Gravely.
23. *L. leucostigma* Simon.
24. *L. punctipes* Gravely.
25. *L. carmichaeli* Gravely.
26. *L. sumatarana* Thorell.
27. *L. fletcheri* Gravely.
28. *L. sutherlandi* Gravely.
29. *L. mackenziei* Gravely.
30. *L. annandalei* Gravely.
31. *L. birmanica* (Simon).
32. *L. quadrifir* Gravely.

Genus **Venonia** Thorell.

33 *V. himalayensis* Gravely.

Genus **Pardosa** Koch.

34 *P. puniola* (Thorell).
35. *P. tropalpis* Gravely.
36. *P. oakleyi* Gravely.
37. *P. leucopalpis* Gravely.

Genus **Evippa** Simon.

38. *E. rubignosa* Simon.
39. *E. praelongipes* (Cambridge).

ACKNOWLEDGEMENT.

I am grateful to Dr. S. L. Hora, Director, Zoological Survey of India for his keen interest taken during the preparation of this work and also for providing me with the necessary facilities. My sincere thanks are also due to Mr. K. S. Pradhan of the Zoological Survey of India for his guidance and valuable suggestions and to Dr. A. P. Kapur (also of the Survey) for going through the manuscript and making some suggestions. I am also thankful to Dr. Browning of the British Museum (Natural History) for the information regarding the Types deposited in that Museum.

KEY TO THE GENERA.

1. Sides of caput vertical. Lip as wide as or wider than long. Fourth metatarsus longer than or as long as tibia and patella together ... 2.

   Sides of caput slanting. Lip longer than wide. Fourth metatarsus shorter than tibia and patella together ... 3.

2. Superior claws long and slender and toothed only at the base. Anterior portion of cephalothorax somewhat abruptly elevated ... *Evippa* Simon.

   Superior claws not long and slender and armed with teeth throughout their length. Anterior portion of cephalothorax not elevated .. ... *Pardosa* Koch.

3. Posterior pair of spinnerets longer than the anterior pair; terminal joint of posterior spinnerets as long as the basal joint .. .. *Hippasa* Simon.

Posterior pair of spinnerets not longer than the anterior pair; terminal joint of posterior spinnerets shorter and rounded	4.
4. Third pair of legs longer than the first pair	*Ocyale* Aud.
Third pair of legs shorter than the first pair	5.
5. Anterior line of eyes always strongly procurved	*Venonia* Thor.
Anterior line of eyes straight, recurved or very feebly procurved	*Lycosa* Latr.

SYSTEMATIC ACCOUNT.

Genus **Hippasa** Simon.

(Type ; *H. agelenoides* Simon, Minhla (Burma)).

1885. *Hippasa*, Simon, *Bull. Soc. Zool. Fr.* X, p. 31.

1900. *Hippasa*, Pocock, *Faun. Brit. Ind.*, Arch., p. 249.

1924. *Hippasa*, Gravely, *Rec. Ind. Mus.* XXVI, p. 588.

1935. *Hippasa*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* I, p. 142.

The genus *Hippasa* though allied to *Lycosa* differs from it in having the posterior spinners considerably longer than the anterior ones. The posterior eyes are more widely separated and the eyes of the anterior line a little wider than those of the second line. In all the species, excepting one listed here, the sternum is marked with a black median stripe. Spiders of this genus spin silken threads which expand into a sheet-like snare.

This is a widely distributed genus.

Hippasa himalayensis Gravely.

1924. *Hippasa himalayensis*, Gravely, *Rec. Ind. Mus.* XXVI, p. 593, fig. 1i. (*Type-locality* : Darjiling district, alt. 1,000-3,000 ft., India. *Lectotype* : Reg. No. $\frac{2268}{18}$. Zoological Survey of India).

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5153 5155 / H2, H2 5152 / H2	Darjiling Dt., alt. 1,000-3,000 ft., E. Himalayas, India.	v-vi. 1912 (Lord Carmichael's Colln.).	Numerous ♂♂ and ♀♀ (*Paralectotype*).
2268 / 18	Ditto	Ditto	♀ (*Lectotype*).
5164 / H2	Sevoke, alt. 1,000 ft., Darjiling Dt., E. Himalayas, India.	iii. 1914 (Lord Carmichael's colln.).	2 ♀♀.
5161 / H2	Pashok, alt. 2,000-3,500 ft., Darjiling Dt., E. Himalayas, India.	23.iv-v.1915 (F. H. Gravely).	3 ♂♂, 9 ♀♀.
5162 / H2	Pashok, alt. 3,500 ft., Darjiling Dt., E. Himalayas, India.	26. v-14. vi. 1916. (F. H. Gravely).	3 ♀♀.

Reg. No.	Locality.	Date and donor/ collector.	No- of specimens
5163 / H2	Kalimpong, alt. 2,000-4,500 ft., Darjiling Dt., E. Himalayas, India.	(S. W. Sutherland).	2 ♀♀.
5159 / H2	Kalimpong, alt. 600-4,500 ft., Darjiling Dt., E. Himalayas, India.	24. iv-10. v. 1915. (F. H. Gravely).	1 ♀.
5158 / H2	Kalimpong, Darjiling Dt., E. Himalayas, India.	1914. (S. W. Sutherland).	1 ♂.
5156 5165 / H2 H2	Kalimpong, alt. 600-1,500 ft. Darjiling Dt., E. Himalayas, India.	—	7 ♂♂, 31 ♀♀.

Remarks.—Spiders of large size with the carapace always more than 5 mm. in length. General colouration is ochraceous and the pit of vulva is exposed and triangular in form. However, in one specimen from Darjiling, the pit of vulva is not triangular, but is slightly rounded. One specimen from Simla (Reg. No. 5160/H2) has been referred to this species by Gravely (1924), but in my opinion it does not belong to this species, because the anterior part of the pit of vulva is triangulate and markedly differs from all other examples. It has not been possible for me to refer it to any known species and has, therefore, been set aside for the present.

Measurements.—Body 9-14 mm.; carapace 4-6½ mm.

Hippasa nilgiriensis Gravely.

1924. *Hippasa nilgiriensis*, Gravely, *Rec. Ind. Mus.* XXVI, p. 593, fig. 1*d*.

(*Type-locality*: Gudalur Ghat, 3,000-6,000 ft., Nilgiris, India. *Type-specimen*: Reg. No. $\frac{5226}{H2}$. Zoological Survey of India).

Anterior part of the pit of vulva (Text-fig. 1*a*) of the type-specimen of this species is angular and not rounded as figured by Gravely (*op. cit.*). Gravely (*op. cit.*) described the new species *H. nilgiriensis* and placed it along with species *H. olivacea*, and *H. lycosina* in which the anterior part of the pit of vulva is rounded. Now that the present author regards the anterior part of the pit of vulva to be angular, the species is taken out from the above group and is placed near *H. himalayensis* in which the pit of vulva is triangular. In the light of the above observation, the species may be redescribed as follows :—

General colouration is brownish yellow. Abdomen on the ventral surface is paler in the middle line. Carapace is marked with a median band extending as far as the anterior limit of the thoracic groove; a pair of lateral marginal pale bands are bounded on their outer side by fine black streaks. Eyes of the anterior row are black and small. The anterior row of eyes is slightly recurved. Small white hairs are present

in the ocular area and two long bristle-like hairs are seen between the posterior median eyes. Pit of the vulva is exposed and its anterior margin is angular as seen in the text-fig. 1*a*.

The species is known only from its type-locality.

Measurements.—(type-specimen). Body 12½ mm., carapace 7 mm.

Hippasa olivacea (Thorell).

1887. *Diapontia olivacea*, Thorell, *Ann. Mus. Stor-Nat. Genova* XXV, pp. 297 300 (*Type-locality*: Rangoon and Bassein, Burma).

1895. *Hippasa olivacea*, Thorell, *Descriptive Catalogue of Spiders of Burma*, pp. 217, 218.

1900. *Hippasa olivacea*, Pocock, *Faun. Brit. Ind.*, Arch., p. 250.

1924. *Hippasa olivacea*, Gravely, *Rec. Ind. Mus.* XXVI, p. 593, fig. 1*c*.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
2392/17	Kyeikpeden, Burma.	Oates.	1 ♀.
5169/H2	Pegu, Burma.	?	1 ♀.
5170/H2	?	?	1½♀.

The species has been previously recorded from Burma, Tharrawaddy Bassein, Rangoon, Bhamo and Me-tan-Ja.

Measurements.—Body 14-17 mm.; carapace 7-8 mm.

Hippasa lycosina Pocock.

1900. *Hippasa lycosina*, Pocock, *Faun. Brit. Ind.*, Arch., p. 250, (*Type-locality* Nasik, India. *Type-specimen* in B. M. (N. H.) 1899. 11.2.37-38).

1924. *Hippasa lycosina*, Gravely, *Rec. Ind. Mus.* XXVI, p. 593, fig. 1*b*.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5168/H2	Helvak, Kayna Valley, Satara Dt., *ca.* 2,000 ft.	28-30.iv.1912. (F. H. Gravely).	1 ♂, 5 ♀♀.
5167/H2	Bombay.	..	11 ♀♀.
?	Ditto		1 ♀.

The species has been previously recorded from Pykara, Maryland and Attakutti (S. India); E. Poona, Kanara, Nasik and Urana.

Measurements.—Body 13-20 mm.; carapace 6½-9½ mm.

Hippasa loundesi Gravely.

1924. *Hippasa loundesi*, Gravely, *Rec. Ind. Mus.* XXVI, p. 594, fig. 1*b* (*Type locality*: Yercaud, India. *Type-specimen*: Reg. 5225/H2, Zoological Survey of India).

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5225 / H2	Yercaud, Shevaroy Hills, S. India.	vi. 1920 (Deacones Loundes).	1 ♀ with 1 cocoon (*Type*).
2232 / 18	Eastern Ghats, Nagalaur, 3,900 ft., Shevaroy Hills, S. India.	6-15 vi. 1929 (H. S. Pruthi).	3 ♀♀.
2229 / 18	Eastern Ghats, (under-stones) at Nadur, 1,800 ft., Javadi Hills, S. India.	26-30,vi..1929 (H. S. Pruthi).	3 ♀♀.

Measurements.—(type-specimen). Body 14 mm.; carapace 7 mm.

Hippasa pantherina Pocock.

1899. *Hippasa pantherina*, Pocock; *Jour. Bombay Nat. Hist. Soc.* XII, p. 752 [*Type-locality*: Trivandrum, Travancore, S. India. *Type-specimen* in B. M. (N. H.) "not designated or registered but most probably 3 specimens ♂ + 2 ♀♀"].

1900. *Hippasa pantherina*, Pocock, *Faun. Brit. Ind.*, Arach., p. 250.

1924. *Hippasa pantherina*, Gravely, *Rec. Ind. Mus.* XXVI, p. 594, fig. 1*f*.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5167 / H2	Ceylon ?		♂ ♀.
5182 2235 / H2 H2, 5178 5177 / H2 H2, 5174 and / H2	Chalakudi, Cochin State, S. India.	14-30.ix.1914 (F. H. Gravely).	40 ♂ 6 ♀♀ (from Webs).
5181 / H2	Trichur, 0-300 ft., Cochin State, S. India.	1-4.x.1914 (F. H. Gravely).	♂, 3 ♀♀.

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5179 / H2	Cochin State, S. India.	ix. 1914 (F. H. Gravely).	2 ♀♀, ♀.
2236 / 18	Bangalore, *ca.* 300 ft.	15.x.1910 (N. Annandale).	♀.
5183 H2, 5184 H2	Madras, S. India.	viii. 1921. (F. H. Gravely).	2 ♂♂, 2 ♀♀.
5171 / H2	Ditto	(Madras Mus.),	2 ♂♂, 17 ♀♀.
5185 / H2	Gheria Id., Chilka Lake, Orissa.	22.vii.1914 (Chilka Survey).	♀
?	Barkuda Id., Chilka Lake, Orissa.	3-19.viii.1919 (F. H. Gravely).	♂ ♀ (In one web).
5172 / H2	Barkuda Id., Chilka Lake, Orissa.	2.xi.1924 (N. Annandale).	4 ♀♀ (a few juv. ones).
2233 / 18	Ditto	15-22.vii.1916 (F. H. Gravely).	♀, 2 ♀♀.
5180 / H2	Barkuda, Chilka Lake, 1,000 ft., Orissa.	1-3.viii.1914 (F. H. Gravely).	♂.
5175 / H2	Balighai, near Puri, Orissa.	16-20.viii.1911 (N. Annandale & F. H. Gravely).	♀.
2234 / H2	Rungjo, *ca.* 900 ft., Darjiling Dt., E. Himalayas, India.	x.1917 (F. H. Gravely).	2 ♂♂, 3 ♀♀.

This species has been previously recorded from Trincomali (Ceylon); Gulf of Manaar; Krusadai Island; Coimbatore; Ootacamund; Ramnad; Red Hills and Kambakkan Hills (Chingleput dist.);

Bangalore; Poona district and E. Khandesh. It is now recorded from the E. Himalayas.

Measurements.—Body 10-16 mm.; carapace 4½-7½ mm.

Hippasa agelenoides Simon.

1884. *Pirata ? agelenoides*, Simon, *Ann. Mus. Stor. Nat. Genova*, XX, pp.334-335 (*Type-locality*: Minhala, Burma).

1895. *Hippasa agelenoides*, Thorell, *Descriptive Catalogue of Spiders of Burma*, p. 218.

1900. *Hippasa agelenoides*, Pocock, *Faun. Brit. Ind.*, Arach., p. 251.

1924. *Hippasa ? agelenoides*, Gravely, *Rec. Ind. Mus.* XXVII, p. 595, fig. 1*g*.

1935. *Hippasa agelenoides*, Dyal, *Bull. Dept. Zool. Panjab Univ.* Lahore I, pp. 142, 143.

Remarks.—Anterior median eyes are definitely larger than the anterior laterals and specimens of this species can be distinguished from *H. himalayensis*, *H. nilgiriensis*, *H. olivacea*, *H. lycosina*, *H. loundesi* and *H. pantherina* by the characteristic shape of the plate of vulva having a pair of outwardly directed truncate processes behind.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5152 —— H2	Prambikulam Cochin State, S. India.	16-24.xi.1914 (F. H. Gravely).	♂, 6 ♀♀.
2237 —— 18	Eastern Ghats, Mathiapalli, Craigmore Road, 4,500 ft., Yercaud, Shevaroy Hills, S. India.	9.vi.1929. (H. S. Pruthi).	1 ♀.

It has been recorded from North Malabar; Gudalur, foot of Nilgiris, *ca.* 3,000 ft., Mansahra, 5,000 ft. (W Pakistan); Dehra Dun (U. P.); Konkan, India; Tharrawaddy and Rangoon, Burma.

Measurements.—Body 6-10 mm.; carapace 3-5 mm.

Hippasa pisaurina Pocock.

1900. *Hippasa pisaurina*, Pocock, *Faun. Brit. Ind.*, Arach., pp. 250, 251; (*Type-locality*: E. Khandesh, India. B. M. (N. H.) 1899, 12.5.123).

1924. *Hippasa pisaurina*, Gravely, *Rec. Ind. Mus.* XXVI, p. 595, fig. 1*h*.

1935. *Hippasa pisaurina*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* I, p. 143.

The most characteristic feature of the species is the triangular backwardly pointed plate of vulva, which is not as much backwardly produced as in *H. holmerae* Thor.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5187 / H2	Bangalore, S. India, *ca.* 3,000 ft.	6-12. v. 1921 (F. H. Gravely).	1♂.
2238 / 18	Medha, Yenna Valley, Satara Dt., *ca.* 2,200 ft.	17-23. iv.1912 (F. H. Gravely).	1 ♀.
2391 / H2	Poona, Bombay Precy	(R. C. Wroughton)	3 ♀♀.
5186 / H2	Siripur, Saran, Bihar		1♀.
2231 / 18	Baghdad.	Summer 1923 (Maj. R. W. C. Hingston).	6 ♀♀.

It is common in Lahore (Panjab) and is recorded for the first time from Baghdad.

Measurements.—Body 10-11 mm. ; carpace 4-5 mm.

Hippasa holmerae Thorell.

1895. *Hippasa holmerae*, Thorell, *Descriptive Catalogue of the Spiders of Burma*, pp. 218-221 (*Type-locality*: Tharrawaddy, Burma. *Type-specimen* in B. M. (N. H.). 1895-9.21.731-732).

1900. *Hippasa holmerae*, Pocock, *Faun. Brit. Ind.* Arach., p. 251.

1924. *Hippasa holmerae*, Gravely, *Rec. Ind. Mus.* XXVI, p. 595, fig. 1*i*.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5165 / H2	Kalimpong, alt. 600-1,500 ft., Darjiling Dt., E. Himalayas, India.		16♂♂, 15♀♀.
5166 / H2	Between Tengueh and Nan Tien, Yanan, W. China.	1909-1910 (J. C. Brown).	1♀.
2393 / H2	Tharrawaddy, Lower Burma.	(Oates).	2♂♂, 2♀♀.

The species has also been previously recorded from Singapur.

Measurements.—Body 6-8 mm. ; carapace 2½-3 mm.

Hippasa madraspatama Gravely.

1924. *Hippasa madraspatama*, Gravely, *Rec. Ind. Mus.* XXVI, p. 595, fig. 1j.

(*Type-locality*: Madras city. *Type-specimen*: Reg. No. $\frac{5224}{H2}$, Zoological Survey of India).

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
$\frac{5224}{H2}$	Madras City, S. India.	vii-ix. 1921 (F. H. Gravely).	♂, ♀ (*Type*).
$\frac{2253}{18}$	Eastern Ghats (under-stones) at Chitteri Hills, S. India.	20-22. vi. 1929 (H. S. Pruthi).	7 ♀♀.
$\frac{2252}{18}$	Eastern Ghats, (under stones) at Nadur, 1,800 ft., Javadai Hills, S. India.	26-30. vi. 1929 (H. S. Pruthi).	1♀.

Remarks.—Specimens from Chitteri Hills, S. India are marked with a faint blackish median longitudinal band on the sternum, but it is absent in the type-specimen. Formerly the species was known only from its type-locality.

Measurements.—Body 6½ mm.; carapace 3 mm.

Genus **Ocyale** Audouin.

(Type, *O. atlanta* Audouin).

*1826. *Ocyale*, Audouin, in Savigny's "*Description de l'Egypte, Arachnides*" *Paris*, p. 149.

Spiders of the genus *Ocyale* are allied to *Lycosa* but have the third pair of legs longer than the first pair of legs and the quadrangle of the posterior eyes is much wider behind than in front. The eyes of the anterior row are slightly recurved and the medians being much larger than the laterals. Cephalothorax is thick and convex and anterior pair of spinnerets is long and cylindrical.

The genus has a wide distribution and has been recorded from Africa, Ceylon, India, Burma, Senegal, Guinea, Congo and Europe.

Ocyale atlanta Audouin.

*1826. *Ocyale atlanta*, Audouin, in *Savigny's*, "*Description de*" *Egypte Arachnides*", *Paris*, p. 150 (*Type-locality*: Eygpt).

1900. *Ocyale atlanta*, Pocock, *Faun. Brit. Ind.*, Arach., p. 252.

1924. *Ocyale atlanta* Gravely, *Rec. Ind. Mus.* XXVI, p. 595.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5150 / H_3	Haragama, Ceylon.	vii. 1908 (H. Nerina).	1♀ with numerous young ones (caught as it had captured a butterfly).
5149 / H_2	Peradeniya, Ceylon.	26. vi. 1910.	1♀.
2249 / 18	Barkuda Id., Chilka Lake, Orissa.	5-22. vii. 1916 (F. H. Gravely).	1♀.
2886 / H_2	Barkuda Id., Chilka Lake, Orissa.	28. viii. 9119.	1♀ at the edge of the lake in Sands.
5143 / H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie).	1♀.

The species has been recorded from Egypt, Ethiopia, Senegal, Guinea and Congo coasts and Burma.

Measurements.—Body 10—20 mm. ; carapace 5—8 mm.

There is also an extra Indian species *O. mirabilis* Clerck from Europe and is represented in the collection by two female examples. (Reg. No. 8326/6).

Genus **Lycosa** Latrielle.

(Type, *L. taruntula* Rossi).

*1804. *Lycosa*, Laterielle, *Nouv. Dict. d'Hist. Nat.* XXIV, p. 135.
1900. *Lycosa*, Pocock, *Faun. Brit. Ind., Arach.* p. 252.
1924. *Lycosa*, Gravely, *Rec. Ind. Mus.* XXVI, p. 588.
1935. *Lycosa*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* I, p. 134.

Almost all the species of *Lycosa* Latr. listed in the present paper have the same fundamental colour scheme *viz.*, one median and a pair of lateral, parallel or subparallel, pale, longitudinal stripe on a dark ground of the carapace and with similar stripes broken into blotches on the abdomen. Eyes of the anterior row are small and the anterior line of eyes is straight or curved with the convexity either facing backwards or forwards. Ventral margin of the chelicera is armed with three teeth and the mandibles are strong and powerful. Legs are beset with short and strong spines. Dyal (1935) treats *Xerolycosa* Dahl as a synonym of *Lycosa* Latr. I am, however, opposed to such a view since the ventral or retromargin of the chelicera of *Xerolycosa* Dahl is armed with only two teeth, while that of *Lycosa* is provided with three teeth.

It is a widely distributed genus and has been recorded from the Temperate, Tropical and Arctic countries.

Lycosa indagatrix Walckenaer.

1837. *Lycosa indagatrix*, Walck., *Ins. Apt.* I, p. 339 (*Type locality* : Coromandal Coast, India).

1900. *Lycosa indagatrix*, Pocock, *Faun. Brit. Ind.* Arach., p. 254.

1924. *Lycosa indigatrix*, Gravely, *Rec. Ind. Mus.* XXVI, p. 599, figs. 2*a* & 3*a*.

Remarks.—Gravely (*op. cit.*) has merged *L. catula* Simon with *L. indigatrix* but in my opinion they should be considered as distinct species, as the structure of vulva is markedly different in the two species.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5101 / H_2	Killinochchi, Ceylon.	x. 1914 (Col. R. Hedley).	1♀.
2228 / 18	Eastern Ghats, Nagalur, 3900 ft., Shevaroy Hills, S. India.	6-15. vi. 1929 (H. S. Pruthi).	4♀♀.
5189 / H_2	Pallavaram, Chingleput Dt., S. India.	6. viii. 1921 (F. H. Gravely).	1♀,
4899 / 9	S. Arcot, S. India.	vi-vii (Jaffer).	1♀.
5188 / H_2	Madras, S. India.	(F. H. Gravely).	1♂, 14♀♀.

The species has been previously recorded from Jalarpet, Salem district; Pondicherry; Horsleykonda, Chittoor district; Wagrakaroor (Bellary) in S. India.

Measurements.—Body 17½-24 mm.; carapace 10-12 mm.

Lycosa catula Simon.

1885. *Lycosa catula*, Simon, *Bull. Soc. Zool. Fr.* X, p. 457 (*Type-locality :* Collegal, Coimbatore district, S. India).

1990. *Lycosa catula*, Pocock, *Faun. Brit. Ind.*, Arach., p. 254.

1924. *Lycosa catula*, Gravely, *Rec. Ind. Mus.* XXVI, p. 589.

1934. *Hogna catula*, Reimoser, *Rev. Suise Zool.* XLI, pp. 471, 472, fig. 4.

1938. *Hogna catula*, Reimoser, *Mem. Soc. Ent. Ital.* XVI, p. 18.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
2250 / 18	Eastern Ghats, (understones) at Nadur, 1,800 ft., Javadai Hills, S. India.	26-30. vi. 1929 (H. S. Pruthi).	2♀♀ with one cocoon.
5190 / H_2	Bangalore, *ca.* 3,000 ft., Mysore, S. India.	6-12. v. 1921 (F. H. Gravely).	2♀♀.

Remarks.—Spiders of this species can be differentiated from those of *L. indagatrix* by the shape of the vulva (text-fig. 1*b*.) and by the white striations on the venter of the abdomen.

It has been previously recorded from Ceylon ; Coimbatore ; Yercaud; Sheveroy Hills ; Madras ; Chingelput district ; Chittoor district ; Masnigudi and from Collegal.

Measurements.—Body upto 20 mm. ; carapace 10½ mm.

Lycosa barnesi Gravely.

1924. *Lycosa barnesi*, Gravely, *Rec. Ind. Mus.* XXVI, pp. 599, 600, fig. 3 (*Type-locality :* Dhoni Forest, *ca.* 1,500-4,000 ft., S. Malabar India *Type-specimen :* Reg. No. $\frac{7699}{H_2}$, Zoological Survey of India).

So far the species is known only from its type-locality.

Measurements.—(Type-specimens) Body 12 mm. ; carapace 5 mm.

Lycosa bistriata Gravely.

1924. *Lycosa bistriata*, Gravely, *Rec. Ind. Mus.* XXVI, p. 600 (*Type-locality :* Madras city, India. *Lectotype :* Reg. No. $\frac{2269}{18}$, Zoological Survey of India).

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of Specimens.
$\frac{7613}{H_2}$	Madras, S. India	(Madras Mus.).	5♂♂, 4♀♀ (*Paralecto-type*).
$\frac{2269}{18}$	Ditto	Ditto	1♀ (*Lectotype*).
$\frac{7611}{H_2}$	Gmatia, Birbhum Dt. (W. Bengal).	—	3♀♀.
$\frac{7610}{H_2}$	Calcutta, India	—	2♂♂, 9♀♀.
$\frac{7612}{H_2}$	Darjiling Dt., alt. 1,000-3,000 ft., E. Himalayas, India.	May/June 1912 (Lord Carmichael).	1♀.

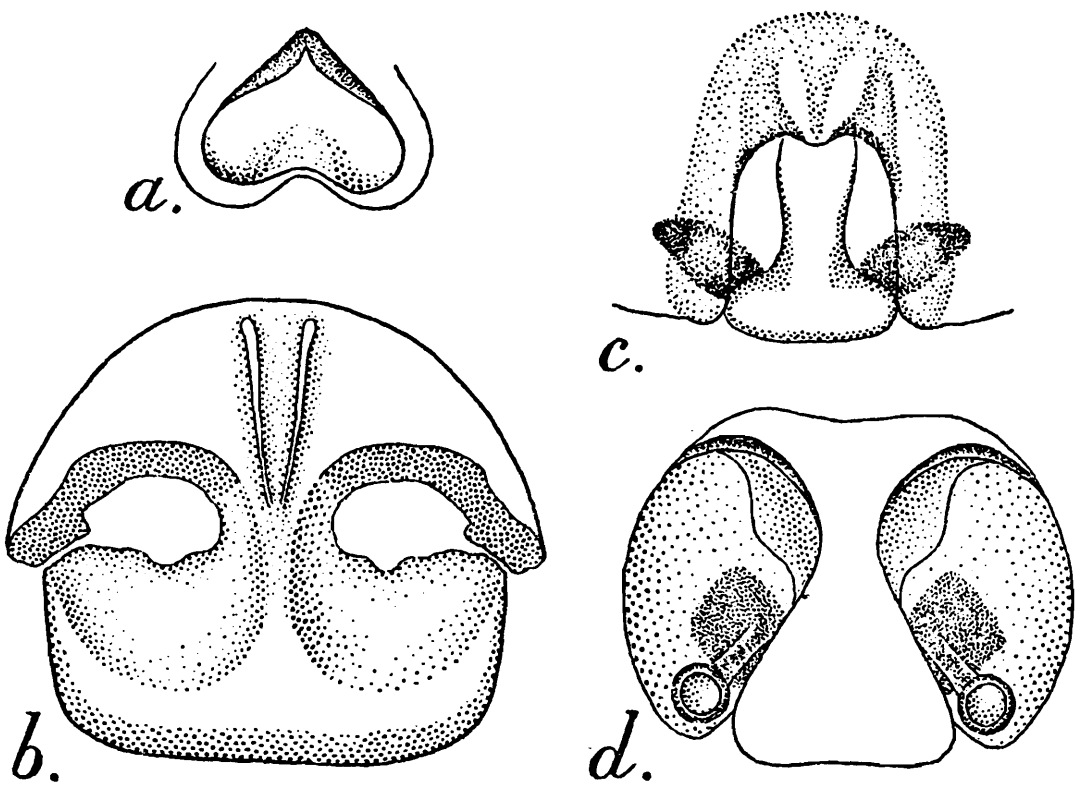
Remarks.—The coloration of male and female specimens collected from Calcutta is exactly alike, while the male specimens collected from Madras are of two different kinds as mentioned by Gravely (1924). The epigyneal plate (text-fig. 1*c*) of a specimen from the type locality is appended here as it has not been illustrated by Gravely (1924).

Measurements.—Body 9-10½ mm. ; carapace 4-5 mm.

Lycosa khudiensis, sp. nov.

General colouration of the body is light yellowish and abdomen is mottled dorsally. The legs are marked with blackish annular rings. The fourth pair of legs is the longest and the anterior line of eyes is recurved. The posterior median eyes (4D in diameter) are separated from each other by a space equal to their own diameter and from the posterior lateral eyes by a space of 5 D. The posterior eyes are not much broader posteriorly.

The median piece of vulva (Text-fig. 1*d*.) is narrower anteriorly and is much broader posteriorly. There are also two pores one on either side of median piece of vulva.



Text. fig.—1.-*a*—*Hippasa nilgiriensis*. Grav. Vulva × 50., *b. Lycosa catula* Simon Vulva × 50; *c. L. bistriata* Grav. Vulva of *Lectotype* × 50; *d. L. khudiensis* sp. nov., vulva × 50.

The species is close to *L. bistriata* Grav. from which it differs in the shape of the vulva, in the character of anterior row of eyes which is recurved and in the character of the posterior median eyes which are separated from each other only by a space equal to their own diameter.

Locality.—Found under stones on the bank of Khudi river, 1½ miles south of Nirsa market, Dist. Manbhum, Bihar (T. B. Sinha, 10. xi. 1948).

Holotype.—Reg. No. $\frac{2273}{18}$, ♀ with cocoon and Paratypes, Reg. No. $\frac{2274}{18}$, Zoological Survey of India from the above locality.

Measurements.—Body 6 mm.; carapace 3 mm.

Lycosa prolifica Pocock.

1901. *Lycosa prolifica*, Pocock, *Jour. Bombay Nat. Hist. Soc.* XIII, p. 485 [*Type-locality*: Eastern district of Poona. *Type-specimen* in B. M. (N. H.) 1899. 11.2.1368146 B. M. (N. H.)].

1924. *Lycosa prolifica*, Gravely, *Rec. Ind Mus.* Arach. XXVI, p. 600.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5199 —— H_3	Kas, Satara Dt., 3,700 ft., Bombay Precy.	23-26. iv. 1912 (F. H. Gravely).	1♂, 2♀♀.
2389 —— H_2	Poona, Bombay Precy.	Wroughton in Exchange from B. M. (N.H.).	4♀♀.
2254 —— 18	Nurpore, (understones on hill side) Kangra Valley, Panjab.	21. v. 1926 (S. L. Hora).	1♀.

The species has been previously recorded from Pimpalner and west Khandesh, and is now recorded from the Panjab.

Measurements.—Body 13½-15 mm. ; carapace 6-7 mm.

Lycosa nigrotibialis Simon.

1884. *Lycosa nigrotibialis*, Simon, *Ann. Mus. Stor. Nat. Genova*, XX, p. 330, fig. 1 (*Type-locality*: Minhla, Burma).

1887. *Tarentula nigrotibialis*, Thorell, *Ann. Mus. Stor. Nat. Genova*, XXV, p. 305.

1895. *Tarentula nigrotibialis*, Thorell, *Descriptive Catalogue of Spiders of Burma*, p. 236.

1900. *Lycosa nigrotibialis*, Pocock, *Faun. Brit. Ind.* Arach. p. 253.

1924. *Lycosa nigrotibialis*, Gravely, *Rec. Ind. Mus.* XXVI, pp. 600-601, fig. 3*a-b*.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5201 —— H_2	Taloshi Koque, *ca.* 2,000 ft., Satara Dt., Bombay Precy	27-28. iv. 1912	1♀.
5197 —— H_2	Medha, Yenna valley, *ca.* 2,200 ft., Satara Dt., Bombay Precy.	17-33. iv. 1912 (F. H. Gravely).	1♀.
7658 —— H_2	Kas, *ca.* 37,000 ft., Satara Dt., Bombay Precy.	23-24. iv. 1942 (F. H. Gravely).	2♀♀.
5206 —— H_2	Khandla, *ca.* 2,500 ft., Poona Dt., Bombay Precy.	6-10. iii. 1918 (N. Annandale).	1♂.
5200 —— H_2	Zangi Nawar, 20 miles West of Nushki, Baluchistan.	25-29. xii. 1918	1♀.

Material examined—contd.

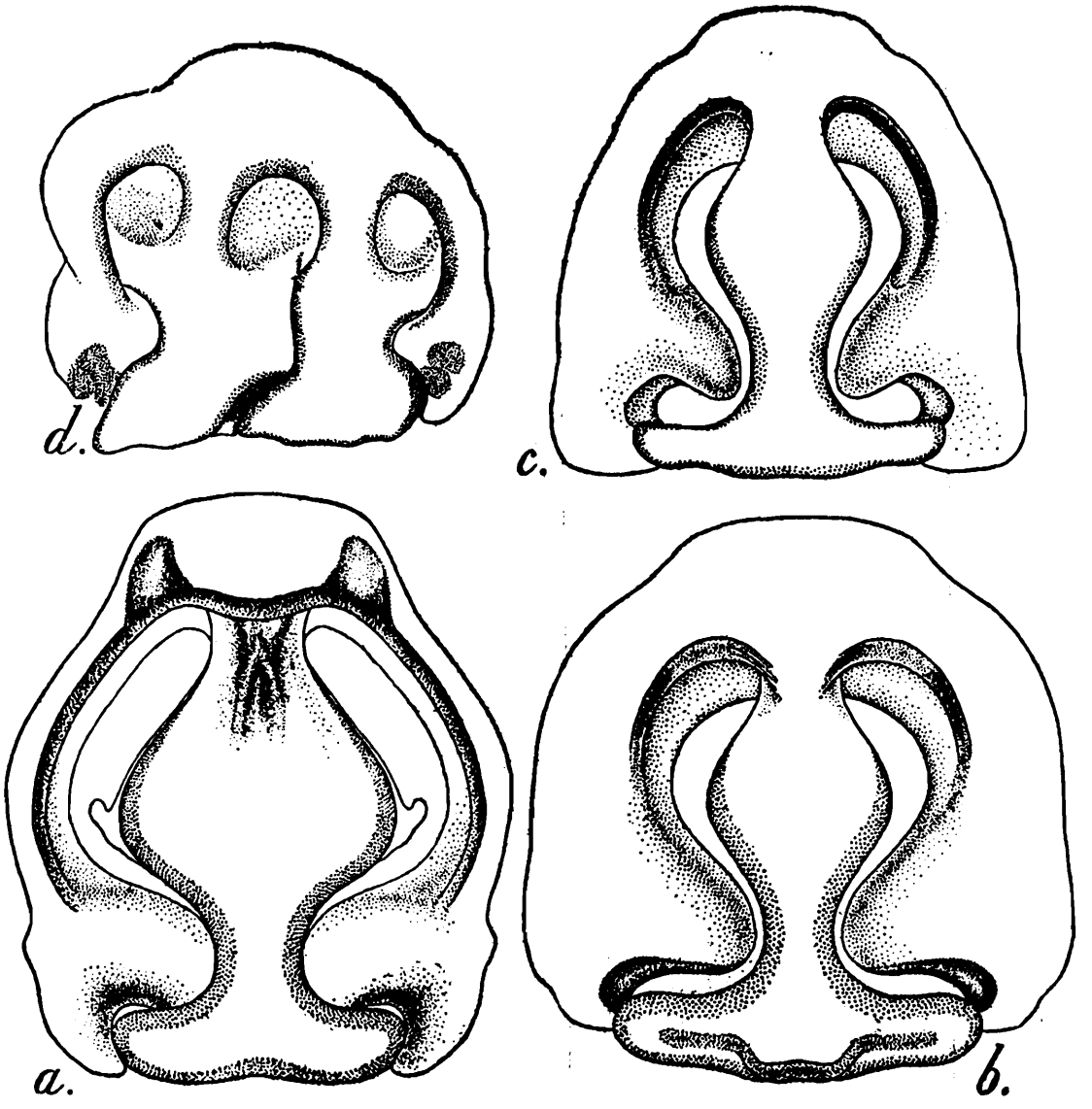
Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
5194 / H_2	Afghanistan.	—	1♀.
5198 / H_2	Taru, Peshawar, Pakistan, (under wheat stock on Ground eating, *Agrotis* moth.).	28. iv. 1916 ..	1♀.
5202 / H_2	Rawalpindi, W. Panjab.	vii-viii. 1917 (Hodgart.)	2♂♂, 2♀♀.
7661 / H_2	Dharampur, *ca.* 5,000 ft., W. Himalayas, India.	16. v. 1913 (Phaku Ram).	3♀♀.
7659 / H_2	Simla, W. Himalayas, India.	..	1♀.
5219 5214 / H_2 H_2	Pusa, Bihar.	21. vii. 1915 (T. B. Fletcher).	2♀♀.
5207 / H_2	,,	1-4. viii. 1914 (C. Ghosh.)	1♀.
5193 / H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie.)	2♂♀, 6♀♀.
5195 / H_2	Katihar, Purnea Dt., Bihar (on a plant in flower Garden).	8-13. viii. 1910 (C. Paiva).	2♀♀.
7656 / H_2	Gmatia, Birbhum Dt.	..	1♂, 5♀♀.
5216 / H_2	Indian Museum compound, Calcutta.	..	1♂, 3♀♀.
5215 / H_2	,,	21. iii. 1915 (F. H. Gravely).	1♀.
5203 5211 / H_2 H_2	Nepal valley, alt. 4,500-6,500 ft., E. Himalayas, India.	21. iii. 1915 (Manners Smith).	1♀♀.
5221 / H_1	Sukna, alt. 1,000 ft., Darjiling Dt., E. Himalayas, India.	iv-v. 1913 (Lord Carmichael).	1♂, 1♀.
7660 / H_2	,,	v. 1913, (Lord Carmichael).	1♀.
5212 / H_2	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	(Lord Carmichael's Colln.).	6♂♂. 6♀♀.

Material examined—contd.

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7664 / H_2	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	iv. 1913. (Lord Carmichael's Colln.).	1♀.
5218 5211 / H_2 H_2	Kalimpong, alt. 2,000-4,500 ft., Darjiling Dt., E. Himalayas, India.	? (S.W. Sutherland).	7♀♀.
5210 / H_2	Kalimpong, Darjiling Dt., E. Himalayas, India.	1914 (S. W. Sutherland).	2♀♀.
5209 / H_2	Darjiling Dt., alt. 1,000-3,000 ft., E. Himalayas, India.	v, vi. 1912 (Lord Carmichael's colln.).	5♀♀.
5205 / H_2	Sikkim.	—	5♀♀.
5220 / H_2	Assam-Bhutan frontier, Mangaldai Dt., Assam.	27-xii. 1910 (S. W. Kemp).	1♀.
5222 / H_2	Podaspur, India.	—	3♂♂.
8582 / H_2	Sibsagar, Assam.	—	1♀.
5223 / H_2	Garo Hills, Assam.	(Godwin-Austin).	1♂.
5213 / H_2	Arakan, Burma.	(F. Stoliczka).	1♂. 2♀♀.
5192 / H_2	Rangoon, Burma.	(J. C. Blight).	1♀.
5915 / H_2	Outline spurs, Kakhyin Hills, Burma.	11. ii. 1875 (J. Anderson).	1♀.
7663 / H_2	Second defile, Irrawady, Burma.	5. iii. 1875 (J. Anderson).	1♀.
5204 / H_2	Kosi Hah, Talé Sap, Singgora Province, Siam.	17. i. 1916 (N. Annandale).	1♀.

Remarks.—The female specimen from Baluchistan is mottled and ash coloured while only two of the specimens from Gmatia have the venter of the body marked with more prominent black striations and dorsal surface of the abdomen has the normal coloration.

The shape of the epigyneal plate is very variable as has been already pointed out by Gravely *op cit.* In the specimens from Pusa (Bihar) anterior part of the median piece of vulva gradually widens from its basal part, whereas the anterior part of the vulva in the specimens from Kakhyin Hills and Sibsagar (Text-fig. 2*c.*) is expanded into a circular plate filling a major portion of the anterior part of the cavity. In the specimens from Kalimpong, Kosi Hah, Assam-Bhutan frontier (Mangaldai district) and Nepal Valley the anterior part of the median piece is expanded as seen in the (Text-fig. 2*b*) and the shape of the vulva in these specimens presents an intermediary stage between the two extremes. In the specimens from Second defile, Irrawady (Text-



Text. fig.—2.-*a*—*Lycosa nigrotibialis* Simon, Vulva from second defile Irrawady × 80 ; *b. L. nigrotibialis* Smon, Vulva from Nepal × 110 ; *c. L. nigrotibialis* Simon, vulva from Sibsagar × 110 ; *d. L. kempi*, Grav. vulva of one abnormal female from *Paralectotypes.*

fig. 2*a*) anterior part of the median piece of vulva is so much expanded into a circular plate as to practically fill the anterior part of the cavity. The specimens from Kakhyin Hills, Second defile, Irrawady or Sibsagar cannot be defined as local races, because the condition of vulva in the specimens from the above mentioned localities has probably reached through a gradual change and more over there are also not many

examples and the specimens from Nepal Valley (Text. fig. 2*b*), Kalimpong, Kosi Hah and Assam-Bhutan frontier evidently indicate the intermediary stage between the two extremes.

The species has been previously recorded from Jalarpet (Salem district), Bangalore, Poona (India), Yunnan (China), Thayetmyo, Tenasserim, Burma.

Measurements.—Body 8-23 mm. ; carapace 4-10½ mm.

Lycosa madani Pocock.

1901. *Lycosa madani*, Pocock, *Jour. Bombay Nat. Hist. Soc.* XIII, p. 486 [*Type-locality*: Chopda, E. Khandesh, India. *Type-specimens* in B. M. (N. H.) 1899-9-21, 385-388].

1928. *Lycosa madani*, Gravely, *Rec. Ind. Mus.* XXVI, p. 602.

1935. *Lycosa madani*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* I, p. 140.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7724 / H_2	Kavalai, *ca.* 1,300-3,000 ft., Cochin State, S. India.	24-27. ix. 1914 (F. H. Gravely).	1♀.
2255 / H_2	Eastern Ghats, (under stones) at Nadur, 1,800 ft., Javadi Hills, S. India.	26-30. vi. 1929 (H. S. Pruthi).	2♀♀.
7702 / H_2	Bangalore, *ca.* 3,000 ft., Mysore, S. India.	6-12. v. 1921 (Madras Mus.).	3♀♀.
7735 / H_2	Barkuda Id., Chilka Lake, Orissa.	25. vii-4. viii (N. Annandale).	1♀.
7708 / H_2	Siripur, Saran, Bihar.	vii. 1913 (Mackenzie).	1♀.

Venter of abdomen in the specimens from Bangalore is marked with white striations, while in the specimens from Barkuda Island body is black ventrally and mottled with white dots dorsally.

The species has been recorded from Horsleykonda (Chittoor district), *ca.* 3,000-4,000 ft., Lahore (West Panjab) and has been reported to be common in Lahore.

Measurements.—Body 9-14 mm. ; carapace 5-7 mm.

Lycosa kempi Gravely.

1924. *Lycosa kempi*, Gravely, *Rec. Ind. Mus.* XXVI, p. 602, fig. 3 (*Type locality*: Assam-Bhutan frontier, *Lectotype* Reg. No. 2270/18, Zoological Survey of India).

1935. *Lycosa kempi*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* I, p. 141, pl. XIII, fig. 42.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7718 / H_2	Assam-Bhutan frontier, Mangaldai Dt., Assam.	25-26.xii.1910 (S. W. Kemp).	1♂, 19♀♀. (*Paralectotype*).
2270 / 18	Ditto	Ditto	1♀. (*Lectotyps*).
7707 / H_2	Darjiling Dt., 1,000-3,000 ft., E. Himalayas, India.	v-vi. 1912 (Lord Carmichael's colln.).	2♀♀.
7730 / H_2	Darjiling Dt., 6,000 ft., E. Himalayas, India.	iv. 1914 (Lord Carmichael's colln.).	1♀.
7723 / H_2	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	(Lord Carmichael's colln.).	2♂♂.

Remarks.—In one specimen (Body 15 mm.; carapace 7 mm.) of the syntypic series an additional median epigyneal plate has been observed as seen in the Text fig. 2*a*. The specimen seems to be abnormal but at this stage nothing can be said emphatically until some more material of the kind is available. For the present it has been separated in a small tube from the lot and kept in the same tube containing the remaining specimens of the type series. It has only been recorded so far from Lawrence Gardens (West Panjab).

Measurements.—Body 18 mm.; carapace 9 mm.

Lycosa stictopyga (Thorell).

1895. *Tarentula* (*Trochosa*) *stictopyga*, Thorell, *Descriptive Catalogue of spiders of Burma*, pp. 232-234 [*Type-locality*: Rangoon and Tharrawaddy, *Type-specimen* in B. M. (N. H.) 1895-9-21, 770-773].

1924. *Lycosa stictopyga*, Gravely, *Rec. Ind. Mus.* XXVI, p. 602.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No of specimens.
2267/18	Bangalore, S. India.	6-12. v. 21.	1♀.
2265/18	Chitral, 5,000 ft., Kashmir.	Gilgit Mission colln.	1♀.
2247/18	Nasratabad, Pakistan.	25. xi. 1916	1♂.
2248/18	Lahore, W. Panjab, Pakistan.	(K. Narayan).	1♀.
7609/H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie).	1♀.
7605/H_2	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	iv. 1913 (Lord Carmichael's colln.).	1♂, 8♀♀.
7607/H_2	Kalimpong, alt. 2,000-4,500 ft., Darjiling Dt., E. Himalayas, India.	(S. W. Sutherland).	1♀.
7604/H_2	Calcutta.		2♂♂, 7♀♀.
2264/18	Mowplon near Dak Bungalow, Khasi Hills, Assam.	12. x. 1927 (Mus. coll.).	2♂♂, 1♀.
7606/H_2	Garo-Hills, Assam.	(Gowdin—Austin).	1♀.
2266/18	Namkhan, N. Shan States, Burma.	xii. 1926 (H. S. Rao).	1♀.
7608/H_2	Singapore.	..	1♀.

The anterior row of eyes is slightly recurved.

Measurements.—Body 7½—9 mm. ; carapace 4 mm.

Lycosa himalayensis Gravely.

1924. *Lycosa himalayensis*, Gravely, *Rec. Ind. Mus.* XXVI, p. 603, fig. 3*g* (*Type-locality*: Kalimpong, Darjeeling district, India, *Lectotype*. Reg. No. 2271/18, Zoological Survey of India).

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7632 —— H_2	Kalimpong, Darjiling Dt., E. Himalayas, India.		2♂♂, 6♀♀. (*Paralectotype*).
2271 —— H_2	Ditto	Ditto	1♀. (*Lectotype*).
7630 —— H_2	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	iii. 1913 (Lord Carmichael's colln.).	1♂, 2♀♀.
7636 —— H_2	Ghumti, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	iv. 1914 (Lord Carmichael's colln.).	1♂, 2♂♀.
7629 —— H_2	....	vi. 1914 (Lord Carmichael's colln.).	1♀.
7644 —— H_2	Ghumti, alt. 2,500 ft., Darjiling Dt., E. Himalayas, India.	27. iii. 1910 (F. H. Gravely).	1♀.
7642 —— H_2	Pashok, alt. 2,500 ft., Darjiling Dt., E. Himalayas, India.	26. v. 1914. vi. 1916 (F. H. Gravely).	1♂.
7640 —— H_2	Pashok, alt. 3,000 ft., Darjiling Dt., E. Himalayas, India.	(F. H. Gravely).	2♀♀.
7637 —— H_2	Pashok, alt. 3,500 ft., Darjiling Dt., E. Himalayas, India.	26. v. 1914. vi. 1916 (F. H. Gravely).	2♂♂, 1♀.
7635 —— H_2	Soom, alt. 4,000-5,000 ft., Darjiling Dt., E. Himalayas, India.	9. vii. 1914 (Lord Carmichael's Colln.).	1♀.
7631 —— H_2	Sitong Ridge, ca. 4,700 ft., Darjiling Dt., E. Himalayas, India.	22-28. x. 1919 (F. H. Gravely).	1♀.
7641 —— H_2	Nam Ting Pokari, Sitong Ridge, Darjiling Dt., E. Himalayas, India.	(S. W. Kemp).	1♀.
7638 —— H_2	Darjiling Dt., alt. 1,000-3,000 ft., E. Himalayas, India.	(Carmichael's colln.).	1♀.
7633 —— H_2	Sonarpur, Assam.	(L. W. Middleton).	1♀.

Measurements.—Body 10-13 mm. ; carapace 5-6½ mm.

Lycosa leucostigma Simon.

1885. *Lycosa leucostigma*, Simon, *Bull. Soc. Zool. Fr.* X, p. 10, (*Type-locality*: Gunktal, India).

1924. *Lycosa leucostigma*, Gravely, *Rec. Ind. Mus.* XXVI, p. 603, fig. 3 *h*.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7601 / H_2	Cochin States, S. India.	ix. 1914 (F. H. Gravely).	1♂.
7597 7599 / H_2 H_2	Barkuda Id., Chilka Lake, Orissa, India.	(F. H. Gravely).	1♂, 2♀♀, (1♂ under weed or stone).
7600 / H_2	Siripur, Saran, Bihar.		1♂.
7598 / H_2	Gmatia, Birbhum Dt., Bengal.	..	3♀♀.
7603 / H_2	Calcutta.	(F. H. Gravely).	1♀.

The species has been recorded from Trivandrum, Ennur Kambakam Hill, 200-800 ft. (Chingleput district), Madras City; and also E. Khandesh.

Measurements.—Body 7¼—10 mm. ; carapace 3½—5 mm.

Lycosa punctipes Gravely.

1924. *Lycosa punctipes*, Gravely, *Rec. Ind. Mus.* XXVI, pp. 603, 604, fig. 3*i* (*Type-locality* : Ulsoor tank, Bangalore, S. India, *Type-specimen* : Reg. No. 7736 Zoological Survey of India).

——, / H_2

Specimens of this species are intensely hairy and are generally yellowish in colour, some of them, however, are greenish. Vulva is provided with a pair of small circular plates, having an aperture slightly towards their inner side. Besides the characters already mentioned by Gravely *op. cit.* there are two pairs of longitudinal rows of brownish spots on the venter of the abdomen.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7736 / H_2	Bangalore, *ca.* 3,000 ft., Mysore, S. India.	6-12. v. 1921 (F. H. Gravely).	2♀♀ (♂1♀ Types).
7712 / H_2	Lucknow, U. P.	29-30. iv. 1911 (S. W. Kemp).	1♀.
7740 / H_2	Ballia village tank, Lalganj, Mirzapur, U. P.	18. viii. 1913 (Johnstone).	1♂.
7739 / H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie).	1♂, 2♀♀.
2251 / H_2	Bijalia band, 1 mile from Ramgarh Post office, Bihar.	3. x. 1928 (M. Sharif).	2♀♀.
7728 / H_2	Museum tank, Calcutta.	30. v. 1907 (N. Annandale).	1♂, 1♀.

The species has been also recorded from Ennur, Chingleput district, S. India and Behrampur Court (Bengal), India.

Measurements.—Body 8 mm. ; carapace 4½ mm.

Lycosa moulmeinensis Gravely.

1924. *Lycosa moulmeinensis*, Gravely, *Rec. Ind. Mus.* XXVI, p. 604, fig. 4*a* (*Type-locality* : Moulmein, Lower Burma).

Remarks.—The species is represented by one male and two female specimens (Reg. No. 7705/H_2). The posterior medians are not more than a diameter apart. The sternum of female is marked with a mid-longitudinal blackish band, which has not been noticed in the specimens of other species of *Lycosa*. The male specimen is, however, devoid of the black median band on the sternum.

The species is known only from its type locality.

Measurements.—Body 7 mm. ; carapace 3½ mm.

Lycosa carmichaeli Gravely.

1924. *Lycosa carmichaeli*, Gravely, *Rec. Ind. Mus.* XXVI, p. 604, fig. 4*b* (*Type-locality* : Sevoke, 1,000 ft., Darjeeling district, E. Himalayas, India. *Type-specimen* : Reg. No. 7737, Zoological Survey of India, *Cotype-specimens* : Reg. No. 7725, Zoological Survey of India).

—— / H_2, —— / H_2,

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7737 / H_2	Sevoke, 1,000 ft., Darjiling Dt., E. Himalayas, India.	iii. 1914 (Lord Carmichael's colln.).	1♀ (*Type*).
7725 / H_2	....	..	1♂, 1♀ (*Cotype*).
7738 / H_2	Amangarh, Bijnoor Dt., U. P.	24. xi. 1910 (Mus. coll.).	1♂, 3♀♀.
7721 / H_2	Kathgodam, 1,200 ft., Kumaon, W. Darjiling Dt., Himalayas, India.	2. v. 1911 (S. Kemp).	1♀.
7727 / H_2	Darjiling Dt., 6,000 ft., E. Himalayas, India.	(Carmichael's colln.).	1♀.
7701 / H_2	Sukhwani, E. Himalayas, India.	16. ii. 1908	1♀.
7710 / H_2	Assam-Bhutan frontier, Mangaldai Dt., Assam.	26. xii. 1910 (S. W. Kemp).	26♂♂, 30♀♀.

The species has not been recorded from elsewhere.

Measurements.—(Type) Body 19 mm. ; carapace 8½ mm.

Lycosa sumatrana Thorell.

1890. *Lycosa sumatrana*, Thorell, *Ann. Mus. Stor. nat. Genova* (2) X (=XXX), pp. 136-137 (*Type locality* : Sumatra).

1924. *Lycosa sumatrana*, Gravely, *Rec. Ind. Mus.* XXVI, pp. 604, 605, fig. 4*c-e*.

General coloration is dull brownish and the sternum of male specimens is often dark, but of females it is usually paler, except in the E. Himalayan specimens in which it is blackish and mottled with white patches.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7697, 7693 / H_2 H_2	Prambikulam, alt. 1,700-3,200 ft., Cochin State, S. India.	16-24. ix. (F. H. Gravely).	2♂♂, 3♀♀.
7665 7677 / H_2 H_2	Chalakudi, Cochin State, S. India.	14-30. ix. 1914 (F. H. Gravely).	4♂♂, numerous♀♀.
7682 / H_2	Stillbrook Garden, Conoor, S. India.		2♂♂, 2♀♀.
7692 / H_2	Bangalore, *ca.* 3,000 ft., Mysore, S. India.	6-12. v. 1921 (F. H. Gravely).	11♂♂, many ♀♀.
7691 / H_2	Madras, S. India.	.. (Madras Mus.)	1♀.
7671 / H_2	Bombay.	..	1♀.
7689 / H_2	Saugor, C. P.	19-20. iii. 1919 (F. H. Gravely).	1♀.
7683 / H_2	Simla, W. Himalayas, India.	..	1♀.
7618 / H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie).	1♀.
7686 / H_2	Kierpur, Purnea, Bihar.	9. ix. 1915 (C. Paiva).	2♀♀.
7617 7687 / H_2 H_2	Gmatia, Birbhum Dt., W. Bengal.		5♀♀.
7688 / H_2	Nepal valley, alt. 4,500-6,500 ft., E. Himalayas, India.	.. (Manners-Smith).	1♂, 3♀♀.
7690 / H_2	Darjiling Dt., 1,000-3,000 ft., E. Himalayas, India.	v—vi. 1912 (Lord Carmichael's colln.).	5♀♀.
7679 / H_2	Sukna, alt. 1,000 ft., Darjling Dt., E. Himalayas, India.	iv. 1913 (Lord Carmichael's colln.)	2♂♂, 1♀.

Material examined—contd.

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7669 —— H_2	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	iii/iv. 1913 (Lord Carmichael's colln.).	1♂, 14 ♀♀.
7670 —— H_2	Ghumti, alt. 1,500-5,000 ft., Darjiling Dt., E. Himalayas, India.	iv. 1914 (Lord Carmichael's colln.).	1♀.
7685 7696 ——, —— H_2 H_2	Tindharia, Darjiling Dt., E. Himalayas, India.	9. x. 1915 (Mrs. Drake)	3♀♀ with 1 Cocoon
7674 —— H_2	Rangheet Tea Estate, alt. 4,500-5,000 ft., Darjiling Dt., E. Himalayas, India.	ii—iii. 1916 (Lord Carmichael's colln.).	1♀.
7666 —— H_2	Pashok, alt. 3,000 ft., Darjiling Dt., E. Himalayas, India.	26. v-14. vi. 1916 (F. H. Gravely).	1♀.
7678 —— H_2	Kalimpong, Darjiling Dt., E. Himalayas, India.	1914 (S. W. Sutherland).	1♂, 9♀♀.
7684 —— H_2	Kalimpong, alt. 600-1,500 ft. Darjiling Dt., E. Himalayas, India.	—(S.W. Sutherland).	2♂♂, 6♀♀.
7676 —— H_2	Kalimpong, alt. 2,000-4,500 ft., Darjiling, Dt., E. Himalayas, India.	(S.W. Sutherland).	1♂, 1♀.
7675 7677 ——, —— H_2 H_2	Suriel, alt. 5,000 ft. Darjiling Dt., E. Himalayas, India.	11-31. x. 1917 (N. Annandale & F. H. Gravely).	1♂, 11♀♀.
7681 —— H_2	Sitong Ridge, alt. ca. 4,700 ft., Darjiling Dt., E. Himalayas, India.	22-28. x. 1917 (N. Annandale & F. H. Gravely).	1♂, 2♀♀.
7672 —— H_2	Calcutta, India.		Many ♂♂, many ♀♀.
7680 —— H_2	Dum-dum near Calcutta.	v. 1912 ..	1♂.
7691 —— H_2	Rangamati, Hill tracts, Chittagong, E. Pakistan.	11-16. v. 1915 (R. Hodgart).	1♀.
7695 —— H_2	Garo Hills, Assam.	.. (Godwin-Austin).	2♂♂, 5♀♀.

Remarks.—The sternum of female specimens collected from Suriel is blackish with white patches. In one specimen from Garo Hills (Assam) the sternum is uniformly pale whereas in other specimens from the same locality it is tawny brown or blackish with a paler area in the middle.

Shape of vulva in the specimens from Simla, Stillbrook, Cochin State and Eastern localities *viz.*, Darjiling district, is exactly alike. Shape of vulva in the specimen from Bombay and Garo Hills is almost alike excepting that the median piece of epigyneal plate in the specimen from the former locality is conical. Vulva in Kierpur specimen is similar to the Garo Hills one, except for the slight minute structural details.

The species has been previously recorded from Anuradhapura (Ceylon); Gudalur, *ca.* 3,000 ft., Ootacamund, *ca.* 6,700—8,000 ft., Keti, *ca.* 6,500 ft., Nilgiris, Yercaud, Shevaroys, Bandipur (Mysore), Red Hills (Chingleput district), Horslaykonda, *ca.* 3,000—4,000 ft. (Chittoor district), Bandra, near Bombay; Camorta, Nicobars; Mt. Singalang, Sungei Balu, Ajer, and Mancior in Sumatra.

Measurements:—Body 5-10 mm; carapace 3-4½ mm.

Lycosa fletcheri Gravely.

1924. *Lycosa fletcheri*, Gravely, *Rec. Ind. Mus.* XXVI, p. 606, fig. 4*f*. [*Type locality*: Abbottabad, Hazara district, Pakistan, *Type-specimen*: Reg. No. 7743, Zoological Survey of India; Type specimen was found $\frac{\text{---}}{H_2}$ understones Gravely].

Remarks.—Abdomen is mottled with ochraceous patches along the mid dorsal line.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
$\frac{7743}{H_2}$	Abbottabad, Hazara Dt., N.W.F. Provinces, Pakistan (under stones).	12. vi. 1916 (T. B. Fletcher).	1♀ with one Cocoon (*Type*).
$\frac{2226}{18}$	Sandreh, a spring near Khewra, Salt Range, Panjab.	5. vii. 1922 (S. L. Hora).	1♀.
$\frac{2246}{18}$	Nalla below the Church at Dharamsala, 5,300 ft., Panjab.	2. vi. 1926 (S. L. Hora).	1♀.
$\frac{7729}{H_1}$	Sutlej Valley below Simla, W. Himalayas.	6. v. 1910 (N. Annandale).	1♂.
$\frac{7711}{H_2}$	Dharampur, *ca.* 5,000 ft., W. Himalayas.	16. v. 1913 ..	4♂♂, 1♀.

The species has not been recorded from elsewhere.

Measurements.—Body 10-11½ mm.; carapace 5 mm.

Lycosa sutherlandi Gravely.

1924. *Lycosa sutherlandi*, Gravely, *Rec. Ind. Mus.* XXVI, p. 606, fig. 4*g*, (*Type-locality* : Singla, alt. 1,500 ft., Darjiling district, E. Himalayas, India. *Type-specimens*: Reg. No. 7719 Zoological Survey of India ; *Cotype-specimens* : also from the above locality, Reg. No. 7709, Zoological Survey of India).

$$\frac{\text{———}}{H_2}$$

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
$\frac{7719}{H_2}$	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	iii. 1913 (Lord Carmichael's colln.).	1♂,1♀ (Type)
$\frac{7709}{H_2}$	Ditto.	v. 1913	4♀♀ (cotypes).
$\frac{7706}{H_2}$	Pashok, alt. 1,000 ft., Darjiling Dt., E. Himalayas, India.	26. v- 14. vi. 1916 (F. H. Gravely).	3♀♀ with one Cocoon.
$\frac{7700}{H_2}$	Kalimpong, alt. 2,000-4,5000 ft., Darjiling Dt., E. Himalayas, India.	(S. W. Sutherland).	3♀♀.

The species is known only from the above mentioned localities. It seems to be a Himalayan species.

Measurements.—Body 8-10 mm. ; carapace $3\frac{1}{2}$—5 mm.

Lycosa mackenziei Gravely.

1924. *Lycosa mackenziei*, Gravely, *Rec. Ind. Mus.* XXVI, p. 606, fig. 4*h* (*Type* locality ; Bangalore, *ca.* 3,000 ft., Mysore State, S. India, *Type-specimen* : Reg. No. 7716 in Zoological Survey of India).

$$\frac{\text{———}}{H_2}$$

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
$\frac{7716}{H_2}$	Bangalore, *ca.* 3,000 ft., Mysore State, S. India.	6-12. v. 1921	1♂, 1♀ (*Type*).
$\frac{2240}{18}$	Punjpur Nallah, Dalhousi, Panjab.	v—vi. 1927 (S. L. Hora).	1♀.

Material examined—contd.

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7742 7618 / H_2 H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie)	5♀♀.
7741 / H_2	Dinapore, Bihar.	16. xii-14-23. 1915 (Caunter).	1♀.
2239 / 18	Bijalia Band, a big pond near the Ranchi Hazaribagh Road and about a mile from the Ramgarh Post Office, Bihar.	3.x.1928 (M. Shariff).	2♀♀.
7717 / H_2	Calcutta.		1♂, 3♀♀.

The species has been previously recorded from Lahore (Pakistan) where it has been reported to be common.

Measurements.—Body 7-9 mm. ; carapace 3½-4 mm.

Lycosa annandalei Gravely.

1924. *Lycosa annandalei*, Gravely, *Rec. Ind. Mus.* XXVI, pp. 606, 607, fig. 4*i*, (*Type locality* : Madras City, S. India. *Type-specimen* : Reg. No. 7620 / H_2, Zoological Survey of India).

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7620 / H_2	Madras City, S. India.	..	1♂, 1♀ (*Type*).
7628 / H_2	Ootacamund, Nilgiris, S. India.	vi. 1912 (R. B. S. Sewell).	1♀.
2244 / 18	From near the source of Nerbuda River alt. 3,300 ft., Rewa State, Central India.	i. 1927 (H. S. Pruthi).	1♀.
7625 / H_2	Multan, W. Punjab.	.. (Lt. Bomford)	1♂, 2♀♀.
7673 7618 / H_2 H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie).	7♂♂, numerous ♀♀ and one cocoon.

Material examined—contd.

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
2210 / 18	From harvested rice field near Panchet Hills Manbhum Dt., Bihar.	7. xii. 1948 (Sinha, Nath & Baugh).	1 ♀.
2213 / 18	From near a pond near Inanpur Inspection Bungalow, Manbhum Dt. Bihar.	24. xi. 1948 (S. C. Baugh).	1♀.
	Sitong Ridge, alt. 4,700 ft., Darjiling Dt., E. Himalayas, India.	22-28.x.1917 (N. Annandale & F. H. Gravely).	1♂, 3♀♀.
7616 / H_2	Jor Pokhri, alt. 4,800 ft., (Sitong), Darjiling Dt., E. Himalayas, India.	22-28. x. 1917 (N. Annandale & F. H. Gravely).	1♀.
7622 / H_2	Nam Ting Pokhri, Darjiling Dt., E. Himalayas, India.	vi- viii. 1918 (S. W. Kemp).	2♂♂, 6♀♀.
7617 / H_2	Gmatia, Birbhum Dt., W. Bengal.	..	2♂♂, numerous ♀♀.
7614 / H_2	Salt Lakes near Durgapur, Calcutta.	13. iii. 1915 (F. H. Gravely).	1♀.
7615 / H_2	Dum-Dum near Calcutta.	May 1912 (M. C. Ghose).	1♀.
7624 / H_2	Behrampur Court, Bengal.	13. vi. 1910 (S. W. Kemp).	1♀.
7626 / H_2	Silicuri, Cachar, Assam.		1♀.
2227 / 18	Sibsagar, Assam.	(S. S. Peal).	2♂♂, 2♀♀.
4439 / H_2	Manipur, Assam, India.	(N. Annandale).	1♂, 5♀♀.
7621 / H_2	Chittagong, E. Pakistan.	18. i. 1913 (N. Annandale).	1♀.
2225 / 18	Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dt., U. Burma.	7-10. xi. 1926 (B. Chopra).	1♂, a few ♀♀.
2245 / 18	Stream flowing into weedy tank near the I. B. Mongyai, N. Shan States, Burma.	January 1927 (B. N. Chopra & H. S. Rao).	1♂, 2♀♀.

Remarks.—The length of body is very variable. In one female example from Siripur, the last palpal joint is swollen and a little drawn out, apparently resembling the immature male palpus. In male examples from the same locality entire palpus, sternum and the area from anterior to the posterior lateral eyes are black. Male specimen from Mongyai, N. Shan States, Burma unlike the females from the same locality, is darker in coloration and the legs are marked with black bands. In the collection males are fewer than the females.

The species has been previously recorded from Trivandrum, Travancore, Bangalore, *ca.* 3,000 ft. Mysore, Red Hills (Chingleput district) and Horsleykonda, *ca.* 3,000-4,000 ft. (Chittoor district); the above localities are in S. India. It has also been reported from E. Khandesh (Bombay Presidency). It is now recorded for the first time from Burma.

The species is chiefly found beside water along with *L. sumatrana*.

Measurements.—Body 8-13 mm.; carapace 4-5 mm.

Lycosa birmanica (Simon).

1884. *Pardosa birmanica*, Simon, *Ann. Mus. Stor. Nat. Genova*, XX, pp. 333, 334 (*Type-locality*: Minhla, Lower Burma).

1895. *Lycosa birmanica*, Thorell, *Descriptive Catalogue* of *Spiders of Burma*, pp. 242-244.

1924. *Lycosa birmanica*, Gravely, *Rec. Ind. Mus.* XXVI. pp. 607, 608, fig. 4*j*.

1935. *Lycosa birmanica*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* I, pp. 136- 137, pl. xiii, figs. 36, 37.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
2257 / 18	Panchgami, W. Ghats, S. India.	(Rev. E. Blatter, S. J.).	1♀.
7650 / H_1	Berhampore, West Bengal.	4-6. iii. 1919 (F. H. Gravely).	1♂, 2♀♀.
2256 / 18	A tributary of Nerbuda at Baratimala, 1½ miles from Amarkantak, alt. 3,300 ft., Rewa State, C. India.	ii. 1927 (H. S. Pruthi).	2♀♀.
2242 / 18	Kondho Nalla, a tributary of Nerbuda at Dione, alt. 2,650 ft., Rewa State, C. India.	iii. 1927 (H. S. Pruthi).	1♀.
2889 / H_2	Barkuda Id. Chilka Lake, Orissa.	3-19. viii. 1919 (F. H. Gravely).	1♀.
2243 / 18	Sandreh, Khewra, Salt Range, Panjab.	5. vii. 1922 (S. L. Hora).	1♂, 2♀♀.

Materials examined—contd.

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7648 / H_2	Mowai, Bara Banki, U. P.	(M. M. Khan)	1♀.
2258 / 18	Wyndham Fall Stream and its vicinity, Mirzapur Dt., U. P.	10. xii. 1946	1♀.
2241 / 18	Salebhata, from the edge of the tank, Brijal Sagar, Patna State, Orissa.	7. iii. 1946 (K. S. Pradhan).	1♂, 2♀♀.
2203 / 18	From grass, 1 mile E. of Inanpur Inspection Bungalow, Manbhum Dt., Bihar.	9. xii. 1948 (B. Nath).	2♀♀.
2202 / 18	From the bank of Nallah near Panchat Hills, 3 miles W. of Inanpur Inspection Bungalow, Manbhum Dt., Bihar, India.	25. xi. 1948 (T. B. Sinha).	1 Juv.♂, 5♀♀ + 1 Juv.♀ + 1 Cocoon.
2221 / 18	From fields near Inanpur Inspection Bungalow, Manbhum Dt., Bihar.	29. xi. 1948 (T. B. Sinha).	2♂♂, 2♀♀.
2216 / 18	From the edge of tank Sultandih, 2 miles N. of Inanpur, Manbhum Dt., Bihar.	1. xii. 1948. (Nath, Sinha & Baugh).	2♂♂, 1♀.
2223 / 18	(From under stone) Chaurasi, 3 miles W.of Inanpur Inspction Bungalow, Manbhum Dt., Bihar.	26. xi. 1948 (B. Nath).	1♀.
7652 / H_2	Purulia, Manbhum Dt., Bihar.	10. ii. 1912 (N. Annandale & F. H. Gravely).	1♀.
2217 / 18	Tal Danga, 1½ miles W. of Barakar Inspection Bungalow, Manbhum Dt., Bihar.	7. xi. 1948 (Baugh, Sinha & Nath).	1♂, 3♀♀.
2205 / 18	From the edge of a narrow nallah near Barakar Inspec. Bungalow, Burdwan Dt., W. Bengal.	5.xi.1948 (Nath, Sinha & Baugh).	1♀.
2222 / 18	From near a ditch in village Gurdanga, Kulti, 2 miles E. of Barakar Inspection Bungalow, W. Bengal.	21. xi. 1948 (Nath, Sinha & Baugh).	1♀.
7655 / H_2	Siripur, Saran, Bihar.	viii. 1913 (Mackenzie).	4♂♂, 4♀♀.

Materials examined—concld.

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7647 / H_2	Gmatia, Birbhum Dt., W. Bengal.	....	4♀♀.
7651 / H_2	Indian Museum, Calcutta.	....	5♀♀.
7649 / H_2	Dum-Dum, near Calcutta.	v. 1912 (M. C. Ghose).	3♂♂, 5♀♀.
7653 / H_2	Singla, alt. 1,500 ft., Darjiling Dt., E. Himalayas, India.	ii-v. 1913 (Lord Carmichael's colln.).	1♂, 1♀.
7645 / H_2	Sukhwani.	16. ii. 1908.	1♀.
7654 / H_2	Tavoy, Burma.	5. i. 1885 (Mus. collr.).	2♂♂, 7♀♀.

Remarks.—Carapace is uniformly dark and is devoid of pale median and submarginal bands. Sternum is almost dark and the abdomen in the anterior median area is either entirely black or marked with an ochraceous streak. Palpus of male differs in coloration from that of female. In the collection female specimens from Baratimala, *ca.* 3,300 ft. Rewa State, unlike typical specimens of the species, are interesting in having the spines on the ventral side of the first tibia abnormally long and the apices of the preceding pair overreaching the base of the succeeding pair. This is a characteristic feature of the genus *Pardosa.*

The species has been previously recorded from Ootacamund, Bangalore, *ca.* 6,700-8,000 ft., Coonoor *ca.* 5,700-6,000 ft. (Nilgiris), Enur, (Chingleput district), Horsleykonda *ca.* 3,000-4,000 ft., Madras City and also from Bandra near Bombay. It has also been recorded from Lahore (W Panjab, Pakistan) and between Chaibassa and Chakradharpur, Bihar, India ; Tharrawaddy and Rangoon, Burma and Java.

The specimens of the species are very common in damp places and are generally seen running about among dead leaves or in open grounds having crevices or fissures for concealment. The species has been reported to be very common in Lahore.

Measurements.—Body 4-8 mm. ; carapace 2-3½ mm.

Lycosa quadrifer Gravely.

1924. *Lycosa quadrifer*, Gravely, *Rec. Ind. Mus.* XXVI, p. 608, fig. 4k (*Type-locality* : Anuradhapura, *ca.* 3,000 ft., Ceylon. *Type-specimen* : No. 7745/H_2 Zoological Survey of India).

Materials examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7745 / H_2	Anuradhapura, *ca.* 3,000 ft. Ceylon.	31.iii-2.iv. 1923 (F. H. Gravely).	1♂ 1♀. (*Type*).
7746 / H_2	Peradeniya, Ceylon	....	1♀ with a Cocoon.
7727 / H_2	Prambikulam, alt. 1,700-3,200 ft., Cochin State, S. India.	(F. H. Gravely)	1♀.

The species has been reported to be very common in Ceylon where it has been observed in association with *L. birmanica.*

The species has been previously recorded from Hambantota, Ceylon and from Covelong, Enur, Kambakkam Hills, alt. 200-800 ft., Chingleput district, Mysore, Madras City and Bangalore *ca.* 3,000 ft., South India. It has not been recorded from Northern India.

Measurements.—Body 7-10 mm.; carapace 3-4 mm.

In addition to the above mentioned species of *Lycosa* there are also two extra Indian species as follows :—

(i) *Lycosa cuneata* Clerck, Reg. No. $\frac{8320}{6}$ from Europe is represented in the collection by one male and two female examples.

(ii) *Lycosa albofasciata* Biulla, Reg. No. $\frac{8319}{H_2}$ from Europe is represented in the collection by 3 male and one female examples, and

(iii) *Trochosa ruricola* (de Geer), Reg. No. $\frac{8321}{H_2}$ from Europe is represented in the collection by one female and two male examples.

Genus **Venonia** Thorell.

(*Type : V. coruscans* Thorell. *Type-locality :* Singapore).

1894. *Venonia,* Thorell, *Bull, Soc. Ent. Ital.* XXVI, p. 332.

1924. *Venonia,* Gravely, *Rec. Ind. Mus.* XXVI, p. 608.

Anterior row of eyes is strongly procurved and the anterior median eyes are smaller than the anterior laterals, while the posterior median eyes are bigger than the posterior laterals. Posterior lateral eyes are rarely less than one diameter apart and the posterior eyes form a trapezium. Cephalothorax is long and its anterior part is slightly raised. Posterior margin of the mandible is armed with three teeth and the anterior margin of the maxillary lobe is truncated. The posterior spinnerets are definitely longer than the anterior spinnerets. Superior tarsal claws are densely pectinated and the inferior tarsal claws are armed with four teeth. Legs IV, I, II, III. *i.e.*, fourth leg is longer than first and first is longer than second or third which are equal in length.

Venonia himalayensis Gravely.

1924. *Venonia himalayensis*, Gravely, *Rec. Ind. Mus.* XXVI, pp. 608, 609, fig. 4*l*, (*Type-locality* : Rangneet Tea Estate, alt. 4,500-5,000 ft., Darjiling district, E. Himalayas, India. *Cotypes* also from the above locality. *Type-specimen* : Reg. No. $\frac{7732}{H_2}$ and *Cotype* specimens, Reg. No. $\frac{7744}{H_2}$, Zoological Survey of India.

Materials examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
$\frac{7732}{H_2}$	Rungneet Tea Estage, alt. 4,500-5,000 ft., Darjiling Dt., E. Himalayas, India	Feb.-March 1914.	1♂, 1♀ (*Type*).
$\frac{7744}{H_2}$	Rungneet Tea Estate, alt. 4,500-5,000 ft., Darjiling Dt., E. Himalayas, India.	Feb.-March 1914.	1♂, a few ♀♀ (*Cotypes*).
$\frac{7747}{H_2}$	Darjiling Dt., alt. 6,000 ft., E. Himalayas, India.	1. iv. 1914 (Lord Carmichael's colln.).	1♂.

Remarks.—Abdomen is dark brownish above and marked with pale spots arranged in three rows. Males and females are alike in coloration.

The species has not been recorded from elsewhere.

Measurements.—Body 3½ mm.; carapace 1½ mm.

Genus **Pardosa** Koch.

(Type: *P. striatipes* Koch).

1848. *Pardosa*, Koch, *Die Arachniden* XIV(3), p. 100.

1924. *Pardosa*, Gravely, *Rec. Ind. Mus.* XXVI, p. 609.

1935. *Pardosa*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* I, p. 144.

The genus *Pardosa* Koch is closely allied to *Lycosa* Latr. but markedly differs from it in having the anterior part of the carapace much elevated and vertical. Eyes of the second row are broader than those of the first row. Tibial spines are very long with their apices extending beyond the base of succeeding pair of spines. Fourth metatarsus is longer than patella and tibia together.

It is a cosmopolitan genus.

Pardosa pusiola (Thorell).

1891. *Lycosa pusiola*, Thorell, *K. Svenska Vet. Akad. Handl.* XXIV(2), p. 65.

1924. *Pardosa pusiola*, Gravely, *Rec. Ind. Mus.* XXVI, pp. 609, 610, fig. 5*a*.

Materials examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
$\frac{7734}{H_2}$	Peradeniya, Ceylon.	26. vi. 1910 (E. S. J.).	1♀.
$\frac{7733}{H_2}$	Suriel, alt. 5,000 ft., Darjiling Dt., E. Himalayas, India.	....	1♀.

It has been previously recorded from Tharrawaddy, Aj Mancior and Kajee, Burma ; Nias and Pinang (Sumatra) Sarawak, Borneo and Java.

Measurements.—Body 5-8 mm. ; carapace 2-3 mm.

Pardosa atropalpis Gravely.

1924. *Pardosa atropalpis*, Gravely, *Rec. Ind. Mus.* XXVI, fig. 5*b* (*Type locality :* Madras City, S. India. *Type-Specimen :* Reg. No. $\frac{7726}{H_2}$, Zoological Survey of India).

Abdomen and the lateral sides of the carapace of the specimens examined are pale in colour.

Materials examined.--

Reg. No.	Locality.	Date and donor / collector.	No. of specimens.
7726 / H_3	Madras City, S. India.	(Madras Museum).	1♂, 1♀ (*Type*).
2887 / H_2	Barkuda Id., Chilka Lake, Orissa.	3-12. viii. 1919 (F. H. Gravely).	2♂♂, 1♀.
2214 / 18	Inanpur (from grass) Manbhum Dt., Bihar.).	25.xi.1948 (B. Nath)	1♀.
2200 / 18	½ mile S. of Inanpur, Manbhum Dt., Bihar (From grass).	24. xi. 1948 (B. Nath).	6♀♀, 3♂♂ + (Juv. 4♀♀, 1♂).
2215 / 18	Raghunathpur, Manbhum Dt., Bihar.	6. xii. 1948 (Nath Sinha & Baugh).	1♂ + 1♂ (Juv. 4♀♀, 8♀♀.).
2218 / 18	From the edge of a tank Sultandih, 2 miles. N. of Inanpur, Manbhum Dt., Bihar.	1. xii. 1948 (Nath, Sinha & Baugh).	1♂, 1♀.
2219 / 18	Durgapur, Manbhum Dt., Bihar.	20. xi. 1948 (Nath, Sinha & Baugh).	1 Juv. ♂, 1♀ + 1 Juv. ♀.
2211 / 18	From the foot of Panchet Hills, 1½ mls. S. of Inanpur, Manbhum Dt., Bihar.	10. xii. 1948 (Nath, Sinha & Baugh).	1♀ + 1♀ Juv.
2209 / 18	From the bank of Purulia Lake, Manbhum Dt., Bihar.	8. xii. 1948 (Nath, Sinha & Baugh).	1♂, 2♀♀.
2201 / 18	Collected from fields near Mugma, Manbhum Dt., Bihar.	9.xi.1948 (S. C. Baugh).	1♂, 3♀♀ + 1 Juv. ♀.
2212 / 18	From under stones, Chaurasi, 3 miles W. of Inanpur, Manbhum Dt., Bihar.	26. xi. 1948 (B. Nath).	1♀.
2224 / 18	(On ground) Kanja Pahar, Manbhum Dt., Bihar.	20. xi. 1948 (Nath, Sinha & Baugh).	1♀ + 4♀♀ Juv.
2207 / 18	From the Compound of Barakar Inspection Bungalow, Burdwan Dt., W. Bengal.	5. xi. 1948 (Sinha, Nath and Baugh).	1♂, 1♀ + 1 Juv.♀.

The species has also been recorded Bandipur, *ca.* 3,000 ft.; Mysore State. Gudalur, *ca.* 3,000 ft.; foot of Nilgiris; Horsleykonda, *ca.* 3,000-4,000 ft.; Chittoor district and Nellore in South India. It has not been reported from North India as yet.

Measurements.—(Type) Body 4¾ mm.; carapace 2½ mm.

Pardosa oakleyi Gravely.

1924. *Pardosa oakleyi*, Gravely, *Rec. Ind. Mus.* XXVI, p. 610, fig. 5c (*Type-locality* : Ootacamund, *ca.* 6,700-8,000 ft., Nilgiris, S. India. *Type-specimen* : Reg. No. $\frac{7704}{H_2}$, Zoological Survey of India).

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
$\frac{7704}{H_2}$	Ootacamund, *ca.* 6,700-8,000 ft., Nilgiris, S. India.	20-30. v. 1921 (F. H. Gravely).	1♂, 1♀ (*Type*).
$\frac{2259}{18}$	Khewra, Salt Range, Punjab.	23-30. ix. 1930 (Drs. S. L. Hora & H. S. Pruthi).	2♀♀.
$\frac{7731}{H_2}$	Siripur, Saran Dt., Bihar, India.	viii. 1913 (Mackenzie.)	2♀♀.
$\frac{2204}{18}$	Mugma, Manbhum Dt., Bihar.	9. xi. 1948 (T. B. Sinha).	4♀♀, 1♂.
$\frac{2208}{18}$	From the edge of a Nallah near the base of Panchet Hills, 3 mls. W. of Inanpur, Manbhum Dt., Bihar.	25. xi. 1948 (T. B. Sinha).	1♀.
$\frac{2206}{18}$	From the edge of Purulia Lake, Manbhum Dt., Bihar.	8. xii. 1948 (Nath, Sinha &Baugh).	1♀ + 1♀ Juv.
$\frac{2220}{18}$	Tal Danga 1½ miles W. of Barakar Inspection Bungalow, Manbhum Dt., Bihar.	7. xi. 1948 (Nath, Sinha & Baugh).	1♂, 3♀♀.

The two specimens collected from Siripur slightly differ in the structural details of vulva. The species is now recorded from the Panjab (Pakistan).

Measurements.—Body 5 mm. ; carapace 2½ mm.

Pardosa leucopalpis Gravely.

1924. *Pardosa leucopalpis*, Gravely, *Rc. Ind. Mus.* XXVI, pp. 610, 611, fig. 5d (*Type locality* : Madras City, *Type-specimen* : Reg. No. $\frac{7748}{H_2}$, Zoological Survey of India).

1935. *Pardosa leucopalpis*, Dyal, *Bull. Dept. Zool. Panjab Univ. Lahore* 1, p. 144.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7748 / H_2	Madras City, S. India.	..	1♂, 1♀ (*Type*).
2261 / 18	Chappanam Island, E. of Kumbalam and the eastern most limit of the back water, Cochin State, S. India.	6-7. i. 1928 (H. S. Rao).	2♀♀.
2260 / 18	Creak a little beyond the ferry, Vizagapatam, S. India.	v-vi. 1926 (H. S. Rao & G. Varngis).	1♀.
2888 / H_2	Barkuda Id., Chilka Lake, Orissa.	3-19. viii. 1919 (F. H. Gravely).	6♂♂, 2♀♀.

The species has been previously recorded from Galle, Ceylon ; Enur, Chingleput district, S. India and Lahore (Pakistan).

Measurements.—Body 7-8 mm. ; carapace 3-3½ mm.

There is also an extra Indian species *Pardosa armentata*, Reg. No, 8323/6, from Europe and is represented in the collection by a single female.

Genus **Evippa** Simon.

(Type *E. arenaria* (Audouin).

1882. *Evippa*, Simon, *Ann. Mus. Stor. Nat. Genova*, XVIII, p. 222.

1924. *Evippa*, Gravely, *Rec. Ind. Mus.* XXVI, p. 611.

The superior claws are long, slender and toothed only at the base. Anterior portion of carapace is somewhat abruptly elevated forming a distinct angle with its lower or posterior portion. Ventral margin of chelicerae bears only two teeth, while the dorsal margin is armed with three teeth.

The genus is distributed in Africa, Egypt, India and Ceylon.

Evippa rubignosa Simon.

1885. *Evippa rubignosa*, Simon, *Bull. Soc. Zool. Fr.* X, p. 11 (*Type-locality* : Guntakal, India).

1924. *Evippa rubignosa*, Gravely, *Rec. Ind. Mus.* XXVI, p. 611, fig. 5e.

The species is represented in the collection by only one female example from Samagooting, Assam (Reg. No. $\frac{7703}{H''}$, coll. Godwin-Austin, Date ?)

The species has also been previously recorded from Cuddapah, S. India.

Measurements.—Body 7 mm. ; carapace 3 mm.

Evippa praelongipes (Cambridge).

1870. *Lycosa praelongipes*, Cambridge, *Proc. Zool. Soc.* Lond., pp. 822, 823, pl. l., figs. 3*a-f*. (*Type-locality* : Sinai).

1924. *Evippa praelongipes* ?, Gravely, *Rec. Ind. Mus.* XXVI, p. 611.

Material examined.—

Reg. No.	Locality.	Date and donor/ collector.	No. of specimens.
7749 / H_2	Kachh.	....	3♀♀.
2262 / 18	Rawalpindi, W. Pakistan.	vi-vii. 1917 (R. Hodgart).	1♀.

Remarks.—The superior claws in the specimen from Rawalpindi are slightly shorter than that of the typical specimen. Though the character of the tarsal claw is a generic character, even then the specimen has been assigned to this species as in all the other characters excepting that of the superior claw, the specimen confirms to the description given by Cambridge (1870).

In India the species was known only from Assam, and is now recorded for the first time from the Panjab, Pakistan.

Measurements.—Body 11 mm.; carapace 5 mm.

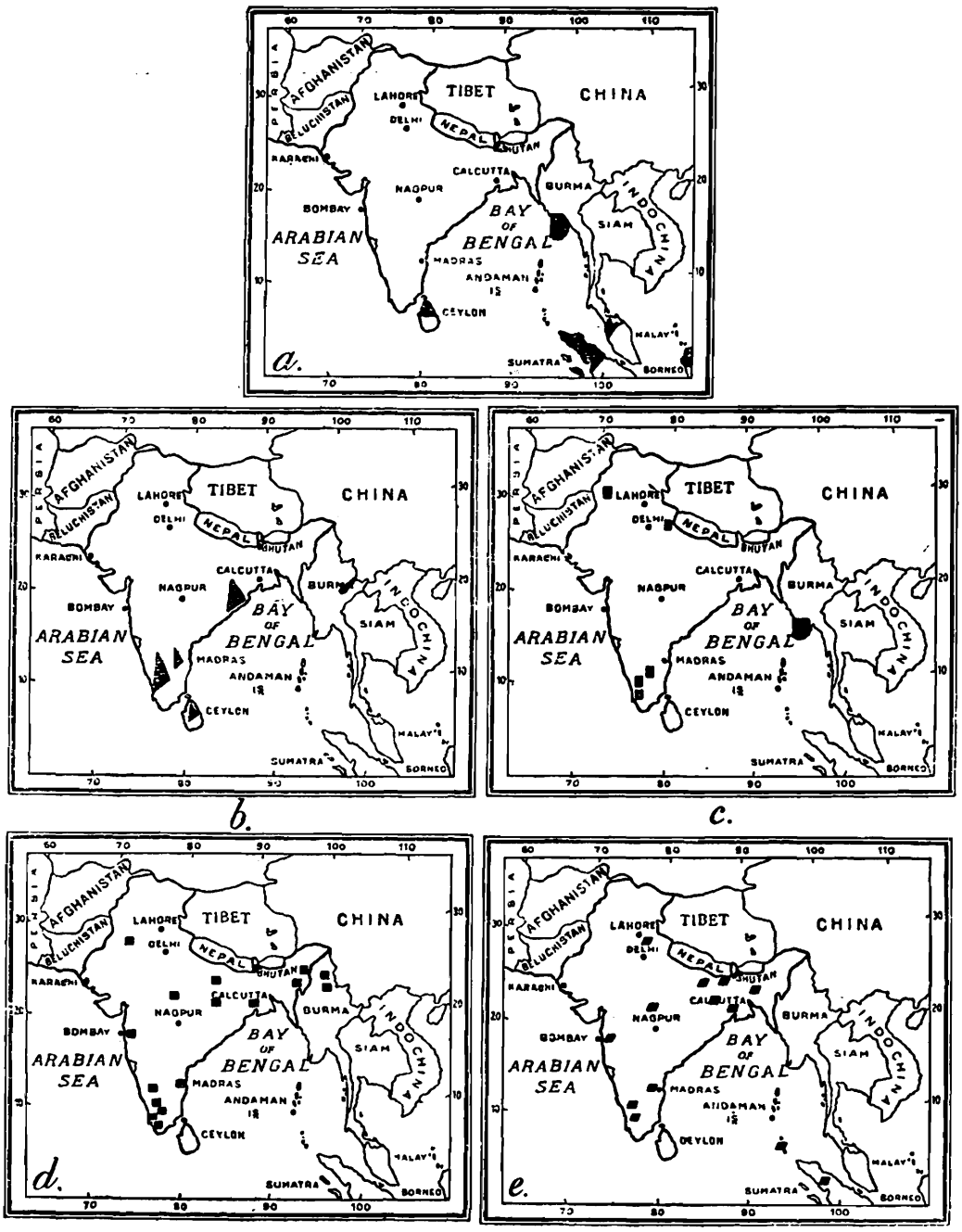
SUMMARY OF GEOGRAPHICAL DISTRIBUTION.

The geographical ditribution of the species given below is very interesting and they need explanation for their discontinuous occurrence in Sumatra, Borneo, Java, Malaya, Burma and South India and their absence from the intervening areas. These anomalies in distribution can very well be accounted for by the Vindhya-Satpura hypothesis advanced by Hora (1949).

Pardosa pusiola (Thor.) This spider is known from Java, Borneo, Sumatra, Malaya, Lower Burma, Darjeeling, district of E. Himalayas and Ceylon, but is not recorded from Peninsular India. This leads one to the belief that there was at one time a land connection between the Malayan region on one side and Ceylon on the other though, of course, no such connection ever existed as enunciated by the "Continuous Range Theory" The other probable route of the migration of this spider from the Malayas to Ceylon seems to be *via* the Satpura trend of mountain ranges. It is evident that the species has died out in the intervening areas or has changed into other species due to isolation and segregation.

Hippasa pantherina Pocock is now recorded from the Darjiling district while it was hitherto known from Barkuda Islands, Western Ghats, Madras and Ceylon. This is very closely allied to *H. agelenoides* Simon recorded from Lower Burma, Dehra Dun, North-West Frontier Provinces (W Pakistan), Western Ghats, and Shevaroy Hills. It seems

that *H. agelenoides* might have given rise to *H. pantherina* whose occurrence in the E. Himalayas shows the connecting link. The occurrence of this species in Barkuda and upper eastern areas can be well assumed to be the results of some off-shoots or migration of some stock over the eastern ghats. The latter proposition is highly improbable and needs further confirmation.



TEXT. FIG. 3.-*a*.—Map of India, Burma and Ceylon showing the distribution of *Pardosa pusiola* Koch ; *b*. Map of India, Burma and Ceylon showing the distribution of *Hippasa pantherina* Pocock. *c*. Map of India, Burma and Ceylon showing the distribution of *Hippasa agelenoides* Simon. *d*. Map of India, Burma and Ceylon showing the distribution of *Lycosa annandalei* Grav. *e*. Map of India, Burma and Ceylon showing the distribution of *Lycosa sumatrana* Thorell.

Lycosa annandalei Gravely is recorded from upper Burma, Darjiling district, Calcutta, Chota Nagpur, Multan, Rewa, Bombay, Western Ghats and Madras, while an allied species *L. sumatrana* Thor. is known from Sumatra, Assam, Darjiling district, Chota Nagpur, Bihar, Bombay, Western Ghats and Madras. The occurrence of these closely allied species, which may be said to be a bit widely distributed, in somewhat discontinuous areas is puzzling. It is likely that the more widely distributed *L. sumatrana* has given rise to *L. annandalei* and if this is so the paths of migration might have been over the Vindhya, Satpura and Himalayas. Parallel evolution also cannot be ruled out in this case.

The distribution of the remaining species which, however, does not seem to be of much zoogeographic importance, is as follows: Seven species are recorded from South India, one from Peninsular India, one from North-West India (W Pakistan), seven from the North-East Himalayas including Burma. There are two species which also extend into the Paleartic region. The remaining are widely distributed in the Indian region.

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ON SOME FREE-LIVING CILIATES FROM BANARAS CANTT., U.F

By H. KHAJURIA, *M.Sc., Zoological Survey of India, Indian Museum, Calcutta.*

INTRODUCTION.

On the kind suggestion of Dr. S. L. Hora, Director, Zoological Survey of India, the present work was undertaken in December, 1947 with a view to survey the free-living protozoan fauna of Banaras. Unfortunately, it has not been possible to do full justice to the work, partly because the Head Quarters of the Zoological Survey were shifted from Banaras to Calcutta just after a few months since the work was begun and partly because the work was carried out only during spare time obtained after my official duties. Sixteen species of ciliates, including one new species, have been recorded in the following account. Only new or controversial variations as noted in comparison with original descriptions or with those given by Bhatia (1936) have been elucidated in the case of old species. Observations recorded here were mostly made on the living organisms as facilities for their proper fixation and staining were not available in the Zoological Survey.

MATERIAL AND METHOD.

Samples of water from the Varuna River and the various ponds were brought to the laboratory, centrifuged for about ten minutes in a hand-centrifuge, and examined in a hanging-drop-preparation. To slow down the active movements of the organisms, osmic vapour, Indian ink, a weak solution of iron alum, and that of cocaine hydroxide were used with some success. The actual concentration and the time of reaction of these chemicals is different in different cases and can only be established by trial. The muscilage obtained from the seeds of *ispaghul* (*Plantago ovata*) recommended by Bhatia (1936) for this purpose was not found to be helpful. Indian ink and iron alum solution also help to show the characters of cytostome and cilia or flagella respectively. When the organisms were available in abundance, smears were allowed to dry on the coverslips; and the cilia and the flagella were rendered clearer and clearer as the water dried up probably due to the expansion of these structures as a result of disintegration.

For permanent preparations, a very small drop of water, concentrated with the organisms, was placed on a coverslip coated with a thin film of Mayer's albumen, and the drop spread afterwards into an even film. The coverslips with smears downward and still wet were dropped in alcoholic Bouin's fluid and left there from 10 minutes to ½ an hour. Occasionally, the fixation in Bouin's fluid was preceded by the exposure of the smear to osmic vapour for a few seconds. Sometimes a drop of the fixative was placed on the smear which was allowed to dry along with the fixative. Hot fixative was also used in certain cases to avoid

the washing-away of the material by immediate and effective coagulation of Mayer's albumen. Iron haematoxylin and Delafield haematoxylin were used as stains.

Cultures of *Urotricha, Enchelis, Coleps, Paramecium, Colpidium* and *Stylonychia* were successfully maintained in the laboratory for several days by the simple addition of natural food material and frequent renewal of water.

LIST OF SPECIES WITH THEIR INDIAN DISTRIBUTION.

Family HOLOPHRYDAE

1. *Urotricha bhatiai*, sp. nov.—Banaras, U. P.
2. *Lacrymaria vermicularis* (O. F. Müller).—Lahore, Punjab ; Banaras, U. P.
3. *Enchelis arcuata* C. & L.—Lahore, Punjab ; Banaras, U. P.

Family COLEPIDAE

4. *Coleps hirtus* (O. F. Müller).—Sirinagar, Kashmir ; Lahore, Punjab ; Banaras, U. P. ; Calcutta, Bengal.

Family AMPHILEPTIDAE

5. *Litonotus fasciola* (Ehrenberg).—Sirinagar, Kashmir ; Lahore, Punjab ; Bombay ; Banaras, U. P.; Calcutta, Bengal.
6. *Litonotus pleurosigma* Stokes.—Lahore, Punjab ; Banaras, U. P.

Family TRACHELIDAE

7. *Dileptus anser* (O. F. Müller).—Lahore, Punjab ; Banaras, U. P.

Family NASSULIDAE

8. *Nassula stamphii* (Ehrenberg).—Lahore, Punjab ; Banaras, U.P.

Family PARAMECIIDAE

9. *Paramecium caudatum* Ehrenberg.—Sirinagar, Kashmir ; Lahore, Punjab ; Lucknow, Banaras, U. P. ; Calcutta, Bengal.

Family FRONTONIDAE

10. *Colpidium colpoda* (Ehrenberg).—Lahore, Punjab ; Banaras, U. P.

Family SPIROSTOMIDAE

11. *Spirostomum ambiguum* Ehrenberg.—Sirinagar, Kashmir ; Lahore, Punjab ; Calcutta, Bengal ; Banaras, U. P.

Family STENTORIDAE

12. *Stentorella polymorphus* (O. F. Müller).—Sirinagar, Kashmir ; Lahore, Punjab ; Banaras, U. P. ; Calcutta, Bengal.

Family HALTERIIDAE

13. *Halteria grandinella* (O. F. Müller).—Lahore, Punjab ; Banaras, U. P.

Family OXYTRICHIDAE

Subfamily *Pleurotrichinae*

14. *Stylonychia pustulata* Ehrenberg.—Sirinagar, Kashmir ; Lahore, Punjab ; Banaras, U. P.

Family VORTICELLIDAE

15. *Vorticella companula* Ehrenberg.—Lahore, Punjab ; Banaras, U. P.

Family EPISTYLIDAE

16. *Epistylis* sp.—Banaras, U. P.

SYSTEMATIC ACCOUNT.

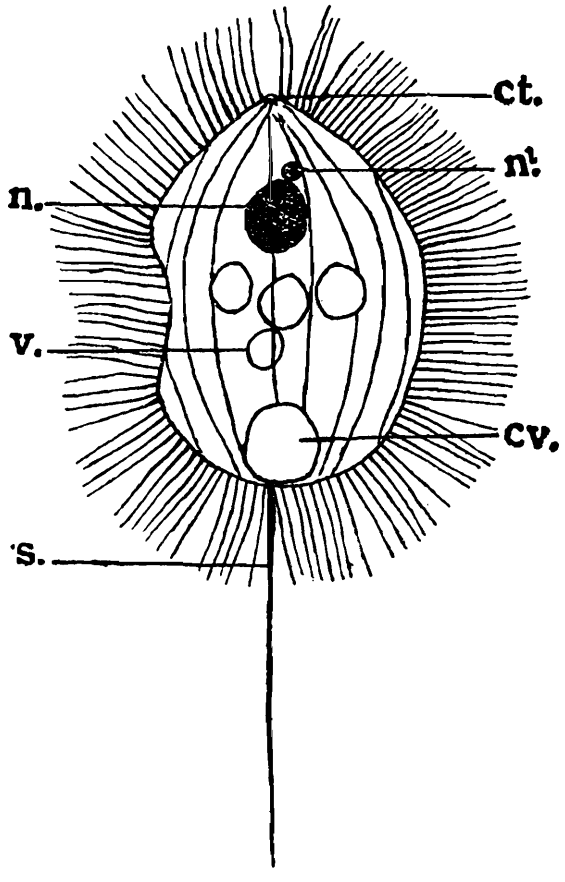
Urotricha bhatiai, sp. nov.

Body form more or less egg-shaped, about two times as long as broad and frequently attenuated towards anterior end ; but rarely globular, globular forms often with wavy uneven contour. One side

either straight or with prominent curvature which rarely appears in fixed preparations. Cilia very long, uniformly covering whole body. A single seta directed straight backwards at posterior end. Mouth anteriorly situated leading into a protrusible cytopharynx. Macronucleus spherical or oblong accompanied by a micronucleus and placed anteriorly. Contractile vacuole placed in median line at extreme posterior end, its posterior margin almost one with that of body. Food vacuoles always fewer (3 to 5) but larger than those of *U. globosa* Schewiakoff. Movements leaping and restless marked by sudden change of direction.

Measurements in microns of Type Specimen.—Body : 27·1 × 14·7 ; macronucleus (diameter), 5·2 ; micronucleus (diameter), 1·2 ; seta, 26·3.

Variations.—In some cultures the organisms underwent an interesting change. Characteristic restless movements changed into slow undulating movements ; body became very much elongated ; ciliary lines so faint



TEXT-FIG. 1.—*Urotricha bhatiai*, sp. nov. ×1400 (approx.). *ct.*, cytostome ; *cv.*, contractile vacuole ; *n*, macronucleus ; *n1*, micronucleus ; *s*, seta ; *v*, food vacuole.

in an ordinary individual almost changed into prominent cuticular creases ; and the contractile vacuole expanded so as to occupy nearly one-half of the body. In short, the organisms appeared to belong to a different species. But there are reasons to believe that the change was environmental, probably due to some basicity in the contents of the culture.

Measurements in microns of 60 individuals.—Body : 35·24 × 20·13 ; mean, 27 × 17 ; macronucleus (mean diameter), 5 ; micronucleus (mean diameter), 1·5 ; seta, 25 (mean).

Habitat.—Pond water and the Varuna River.

KEY TO THE SPECIES OF *Uotricha* WITH ONE SETA.

A. Seta at posterior end directed straight backward. No oblique striations

a. Cilia uniformly distributed all over body .. *U. bhatiai*, sp. nov.

b. Arrangement of cilia otherwise . ..

c. Cilia scantier or absent at posterior end, shorter and finer near mouth *U. globosa* Schew.

d. Cilia longest in anterior region *U. lagenula* Kent.

B. Seta at posterior end directed obliquely to one side. Striations oblique . . **U. farctá* C. & L.

Relationships.—Of all the species of *Urotricha*, *U. bhatiai* is most closely allied to *U. globosa* with which it shares a number of important characters, though, at the same time, clearly distinguishable from it. An analysis of the characters of both species is given in the following table :—

U. bhatiai	*U. globosa*
1. CONTRASTING CHARACTERS.	
1. Cilia uniformly distributed all over the body.	Cilia santier or absent in posterior region, shorter or finer near mouth.
2. One side markedly convex, the other straight or concave.	Both sides equally convex.
3. Food vacuoles fewer (3-5), but larger	Food vacuoles numerous, but smaller.
2. OVERLAPPING CHARACTERS.	
4. Posterior end with one seta	Posterior end with one or two setae.
5. Contractile vacuole always in median line.	Contractile vacuole median or lateral in position.
6. Body form egg-shaped	Body form spherical or egg-shaped.

Characters No. 1 to 3 are of sufficient specific value to distinguish the new species from *U. globosa*. In other characters the two species overlap. It appears that the two species have a closely approximated evolutionary history, and originally two races of one and the same species have now developed important specific characters. It is also clear from the above table that *U. globosa* has got much greater range of variations and is, thus, probably more primitive.

Bhatia (1916) came across a species of *Urotricha* and, though he noted a few points of difference from *U. globosa* (position of the contractile vacuole, presence of the cilia on the posterior part), he ultimately referred the species to *U. globosa*. There are reasons to believe that he might have ment the species under consideration. Partly for this and partly for many a contributions he made to the Indian Protozoa, I name the species after him.

* The characters of *U. farctá* given here are given by Kent (1880-1882). It is rather strange to note that the figure of this species produced by Kudo (1946) shows entirely different characters : there are cilia only in the anterior region ; the springing bristle is not oblique, and there are no oblique striations.

Lacrymaria vermicularis (O. F. Müller).

Body cylindrical, about four times as long as broad. Ciliary girdle at the base of very small apical portion with cilia usually directed forward. Body surface smooth (without cilia). No spiral striations as noted by Kahl (1930-5). Scarce.

Measurements in microns of 6 fully expanded individuals.—Body : 125-100×40-20 ; mean, 112×26.

Habitat.—Pond water kept in a glass tube for a week.

Enchelis arcuata C. & L.

Ciliary coat uniform without longer cilia surrounding oral region as noted by Bhatia (1916). Contractile vacuoles appeared to be seven in number.

Measurements in microns of 20 individuals.—Body : 98-38×36-32 ; mean, 90×36.

Habitat.—Pond water in which some wheat flour was added.

Coleps hirtus (O. F. Müller).

Cilia uniformly distributed and not arising in pairs as shown in the diagram by Noland (1925) ; no attenuation towards the posterior end as shown by him. Probably a new race.

Measurements in microns of 23 individuals.—Body : 46-38×35-20 ; mean, 41×21.

Habitat.—Pond water and stagnant Varuna River water.

Litonotus fasciola (Ehrenberg).

S-shaped curvature well-marked. Cilia situated along the mouth cleft were not sharply marked off from those on rest of body. Forms with sharply pointed posterior end were also found. Contractile vacuole closely approximated towards posterior end. Scarce.

Measurements in microns of 10 individuals.—Body ; 95-86×38-32 ; mean, 90×35.

Habitat—The Varuna River and pond water.

Litonotus plearosigma Stokes.

Cilia on neck region not distinguished from those on rest of body. Posterior end generally obtusely pointed. Number of contractile vacuoles in a row 6 to 8. Scarce.

Measurements in microns of 5 individuals.—Body : 250-200×50-40 ; mean, 220×42.

Habitat.—Pond water and standing Varuna River water.

Dileptus anser (O. F. Müller).

Colour whitish ; posterior end not much pointed ; trichocysts not noticed. No longitudinal striations. Very scarce.

Measurements in microns of 6 individuals.—Body : 260-200×70-45 ; mean, 200×45.

Habitat.—Varuna River.

Nassula stamphii (Ehrenberg).

Anterior flexible prolongation $\frac{1}{3}$ of the whole body. Contractile vacuole almost touching posterior margin of body. Other vacuoles absent or rarely one. Macronucleus oval and central.

Measurements in microns of 20 individuals.—Body : 75-60×48-38 ; mean, 65×40.

Habitat.—Pond water in association with green algae.

Paramecium caudatum Ehrenberg.

Tuft of longer cilia at posterior end absent. No extra contractile vacuoles as noted by Bhatia (1916).

Measurements in microns of 25 individuals.—Body : 280-200×74-50 ; mean, 240×60.

Habitat.—Infusions of leaves prepared from Varuna River and pond water.

Colpidium colpoda (Ehrenberg).

Only central region of body convex. No longer cilia on posterior extremity ; anterior end with longer cilia in addition to normal ones. Contractile vacuole posteriorly situated and on left side of nucleus which is postero-terminal and sublateral. Cytopharynx not noticed. Vacuoles other than contractile one 1 to 3. Subsidiary vacuoles not observed. Ciliary striations only noticeable on margins. Mouth in middle of anterior portion.

Measurements in microns of 35 individuals.—Body : 160-90×90-40 ; mean, 130×60.

Habitat.—Varuna River and pond water.

Spirostomum ambiguum Ehrenberg.

Posterior end rounded. Ratio between length of body and that of peristome 7 : 4. Scarce.

Measurements in microns of one individual.—Body : 3050×300.

Habitat.—Pond water.

Stentorella polymorphus (O. F. Müller).

Colourless and solitary. No strong bristles on body. Macronucleus zigzag Anal aperture not noticed. Radiating canals not clearly seen.

Measurements in microns of 5 individuals.—Body : 1300-1190×88-70 ; mean, 1200×74.

Habitat.—Pond water.

Halteria grandinella (O. F. Müller).

Body rounded, not with posterior rounded point. Macronucleus oval or rounded. Number of larger cilia at anterior end quite numerous and not 6 to 7 as recorded by Bhatia (1920).

Measurements in microns of 15 individuals.—Body : 45-28 (diameter) ; mean, 32.

Habitat.—Varuna River and pond water.

Stylonychia pustulata Ehrenberg.

Four of anal styles projecting backward. Undulating membrane not noticed. Caudal styles short. Two parts of macronucleus not overlapping. Cytoplasm bounded up by a very thin membrane which allows the protoplasm to flow out as soon as the movements stop at the time of death.

Measurements in microns of 15 individuals.—Body : 180-160×85-70 ; mean, 174×75.

Habitat.—Pond water.

Vorticella companula Ehrenberg.

In ordinary expanded position, the maximum width is in the middle, but several phases of contraction and expansion are present. Ciliary wreath forms two spiral convolutions. Pellicular striations not noticed, A few granules in the stalk present.

Measurements in microns of 5 individuals.—Body : 140-80×100-50 ; mean, 105×75.

Habitat.—Pond water. Rarely in Varuna River.

Epistylis sp.

One small colony met with for a short time and detailed observation were not possible. Body globular, cuticular sufrace smooth. Pedicle seemed to be dichotomous, thick, and without longitudinal striations.

Measurements in microns.—Length approximately 80.

Habitat.—Pond water.

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A NOTE ON THE SYSTEMATIC POSITION OF THE TWO GASTROMYZONID GENERA *PROTOMYZON* HORA AND *PARAPROTOMYZON* PELLEGRIN AND FANG (FISHES: CYPRINOIDFA).

By SUNDER LAL HORA, *D.Sc., F.R.S.E., C.M.Z.S., F.R.A.S.B., F.N.I., Director*, and K. C. JAYARAM, *B.Sc., Assistant, Zoological Survey of India, Indian Museum, Calcutta.*

In his monograph on the Homalopteridae, Hora[1] proposed a new genus *Protomyzon* to accommodate Vaillant's[2] *Homaloptera whiteheadi* from Mount Kina Balu, Borneo. The genus was referred to the subfamily Gastromyzoninae and was characterized by the following combination of characters:—

i. Gill-openings of moderate size, extending to ventral surface for short distance.

ii. Absence of any rostral groove and rostral fold.

iii. Two pairs of rostral barbels fully exposed on ventral surface.

iv. Snout broad and rounded and mouth slightly arched.

v. Eleven rays in the pelvic fin.

Under the description of the genus, it was noted that—

> "In general build and facies the new genus resembles certain torrent-inhabiting species of *Nemachilus*, but is distinguished from them by the possession of a large number of rays (22) in the pectoral fin. It seems to me probable that *Protomyzon* may have evolved from *Nemachilus*-like ancestors under the influence of swift currents."

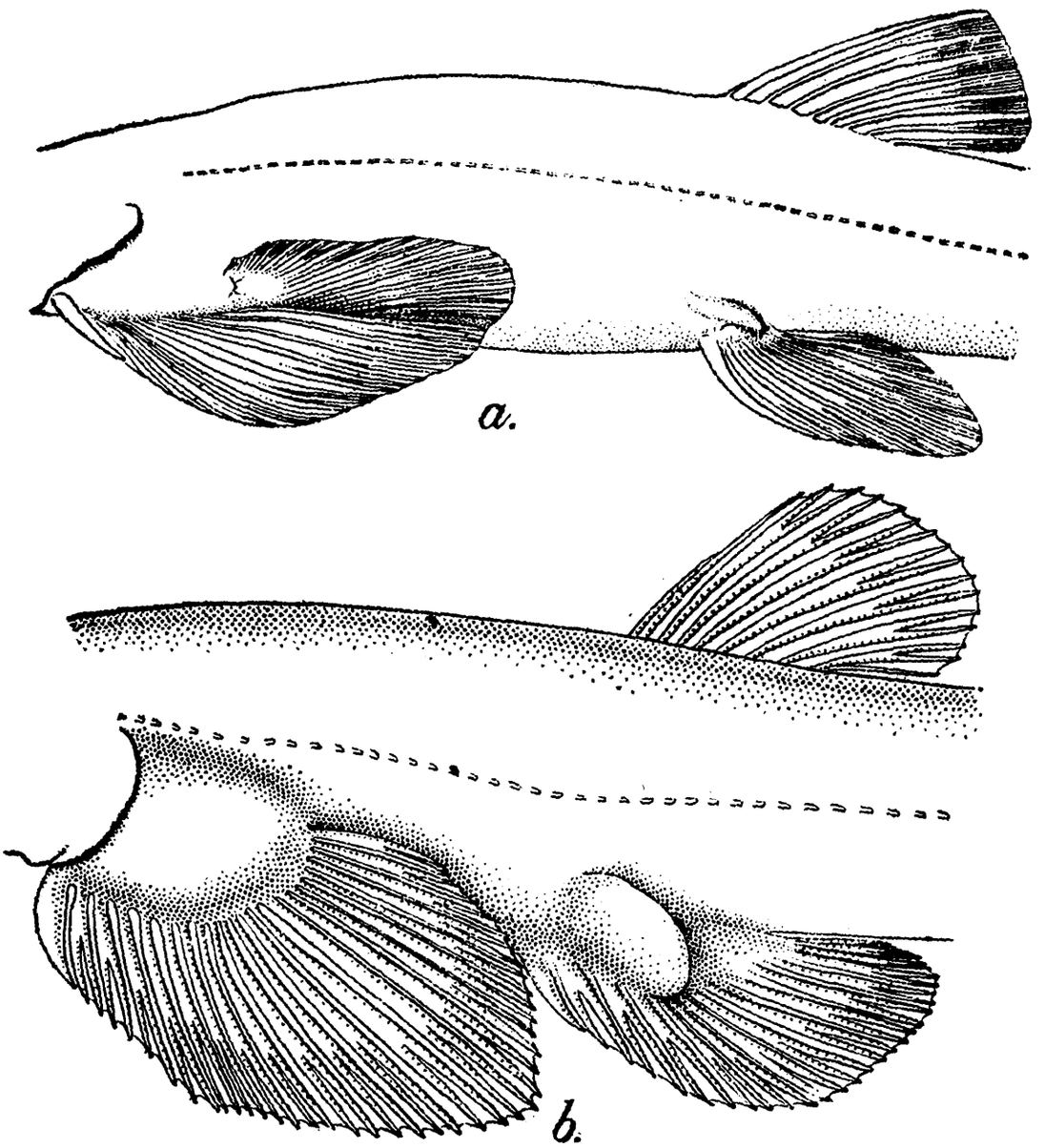
It is still a monotypic genus and the only material examined by Hora comprised of 2 large and 5 young specimens in the Paris Museum and these he found to be "very soft" and "not in a good state of preservation" The same material was re-examined by Pellegrin and Fang[3] in 1935, when they described another new genus *Paraprotomyzon* from Kwai-show, Eastern Szechuan. They corrected Hora's description with regard to the extent of the gill-openings and observed (p. 102):

> "Practically, *Protomyzon whiteheadi* is distinctly possessing the gill-opening, although elongate, but pertaining on the dorsal side of head. His description of *Protomyzon* as having the gill-opening extending a short distance to the ventral surface is merely based upon the injured side of one specimen of the two, now preserved in the Paris Museum."

Pellegrin and Fang were correct in their account of the gill-openings of *Protomyzon*, but it must be noted that gill-openings in both *Protomyzon* and *Paraprotomyzon* are not as restricted as in *Gastromyzon*. Though they are restricted to the dorsal surface, they almost extend to the base of the pectoral fin dorsally. If Hora had evaluated this character correctly for his *Protomyzon*, he would have placed this genus in group

[1] Hora, S. L., *Mem. Ind. Mus.* XII, p. 306 (1932).
[2] Vaillant, M. L., *Nouv. Arch. Mus.* V, p. 92 (1893).
[3] Pellegrin, J. & Fang, P. W., *Sinensia* VI, p. 99 (1935).

II of his key on page 304 along with such genera as *Pseudogastromyzon*, *Sewellia*, *Beaufortia*, *Neogastroymzon* and *Gastromyzon*. This group is aptly described by Pellegrin and Fang as the Gastromyzonian-group, as against the Crossostomanian-group of the genera *Annamia*, *Crossostoma*, *Vanmanennia*, *Formosania*, *Parhomaloptera*, etc. *Paraprotomyzon* also pertains to the Gastromyzonian-group, but it has been distinguished from *Protomyzon* by the extent of the pectoral fins (extending beyond bases of



Text-Fig. 1.—Lateral view of body, with parts of head and tail regions in *Protomyzon* Hora and *Paraprotomyzon* Pellegrin & Fang $\times 2\frac{2}{3}$.

a. *Protomyzon whiteheadi* (Vaillant).

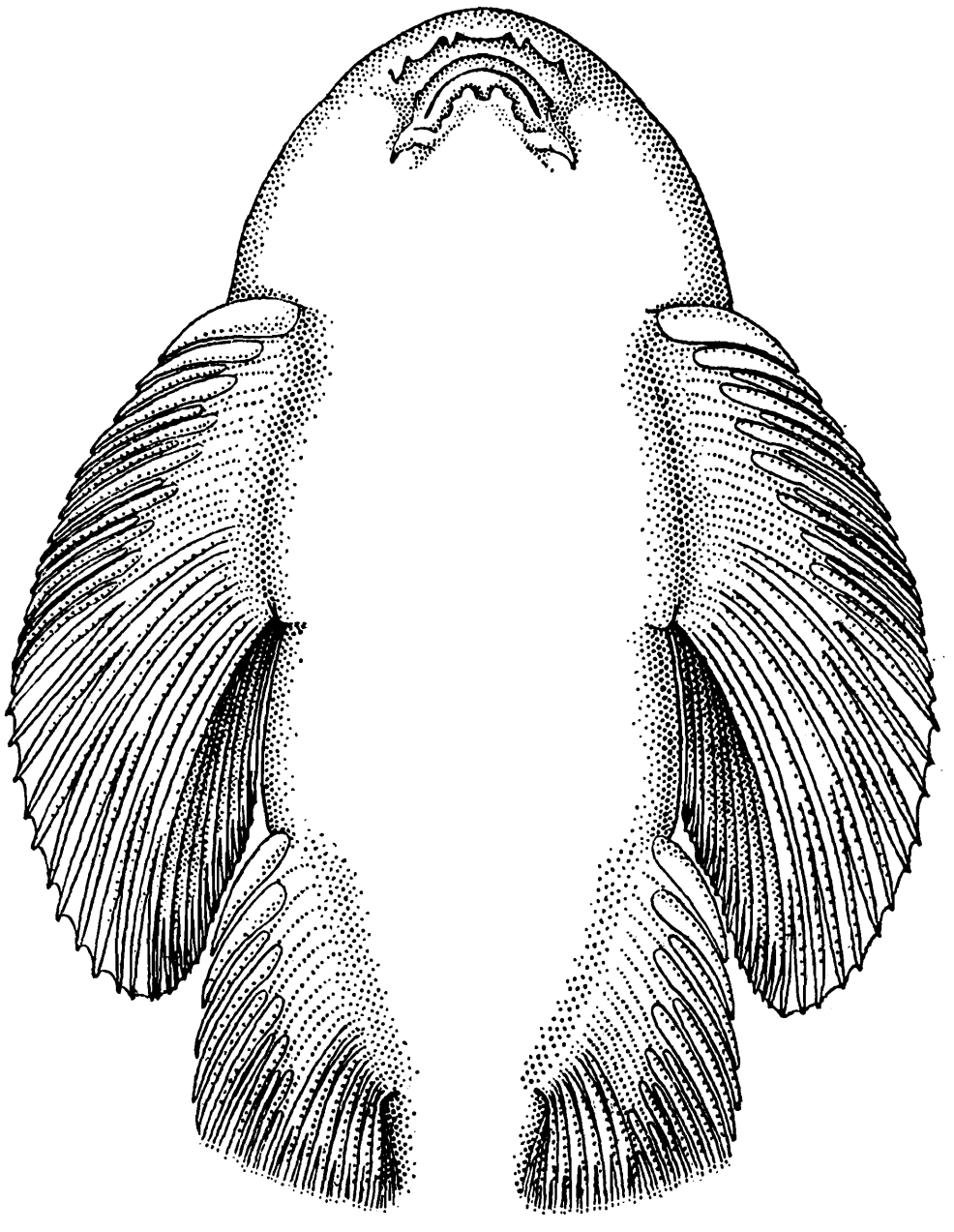
b. *Paraprotomyzon multifasciatus* Pellegrin & Fang.

Notice the similarity in the extent of the gill-openings in both and the dissimilarity in the extent of the pectoral fin in relation to the position of the pelvic fins. Special attention is also invited to the nature of the appendage at the base of the pelvic fins in the two genera.

pelvics *versus* remote from bases of pelvics), number of rays in the pelvic fins (1/14 *versus* 1/7) and lepidosis (ventral surface naked before pelvics *versus* naked thorax region and a small portion behind it). Relying

mainly on the number of fin rays in the pelvic fin, and comparing in this respect their *Paraprotomyzon multifasciatus* with the known species of *Pseudogastromyzon*, they observed:

> "It may be that *Paraprotomyzon* is a genus intermediate between *Protomyzon* and *Pseudogastromyzon*, or it may be a genus in parallel development with the latter and having *Protomyzon* as their common ancestor. For the first conception, it will be better to consider *Paraprotomyzon multifasciatus* as a more specialized species in the genus *Paraprotomyzon*."



TEXT-FIG. 2.—Ventral surface of head and body of *Paraprotomyzon multifasciatus* Pellegrin & Fang × $3\frac{1}{5}$.

In a recently published synopsis of all the known Chinese Homalopteridae, Chen and Liang[1] have included *Paraprotomyzon* in their list next to *Pseudogastromyzon* without any comments but distinguished the two genera by the number of rays in the pelvic fins (8-11 in *Pseudogastromyzon versus* 15 in *Paraprotomyzon*).

During his recent visit to the U.S.A., Hora found a big collection of fishes from Mount Kina Balu, Borneo, in the Museum of Comparative Zoology at Harvard College, Cambridge, Mass. This collection was made

[1] Chen, J. T. F. & Liang, Y., *Quart. Journ. Taiwan Mus.* II, p. 161 (1949).

by Mr. J. A. Griswold, now of the Zoological Society of Philadelphia Pa. Among these, there is a lot of about 100 specimens labelled as Homalopteridae (CMZ. Nos. 34794, 34800, 34801, 34806, 34833, 37038). On a casual examination in the Museum, they were provisionally referred by Hora to *Protomyzon whiteheadi* (Vaillant). Forty-five specimens of this lot have now become available in Calcutta for detailed study through the kindness of Dr. William C. Schroeder. Several other species of fish and some tadpoles have been found associated with *Protomyzon*. Dr. P. L. Bertin of the Museum National D'Histoire Naturelle, Paris, has very kindly sent a co-type of *Paraprotomyzon multifasciatus* in exchange. This material has enabled us not only to assess correctly the systematic position of the two genera but also to redescribe *Protomyzon whitehcadi* and to give some of the salient internal characters of the fish.

If one studies Hora's key to the genera of the *Gastromyzoninae* one will notice that the *Gastromysonian*-group is sub-divided on the basis of (i) the union or separation of the pelvic fins, (ii) form and extent of mouth, (iii) extent of the pectoral fin in relation to the pelvics and (iv) the presence or absence of the flap of skin between the bases of the pelvic and pectoral fins. Judged on these characters, both *Protomyzon* and *Paraprotomyzon* fall in the subgroup characterized by the presence of free pelvic fins, *i.e.*, not united to form a disc-like structure. In the two other genera of this subgroup, namely *Pseuodgastromyzon* and *Sewellia*, the pectoral fins extend considerably beyond the origin of the pelvics. In this respect, *Paraprotomyzon* is allied to them while *Protomyzon* diverges from them. If we now examine the members of the second subgroup, in which the pelvics are united to form a disc-like structure, we get the same two divisions on the basis of the extent of the pectoral fins—*Beaufortia*, in which the pectorals extend beyond the origin of the pelvics, and *Neogastromyzon* and *Gastromyzon*, in which they do not reach the bases of the pelvics but the middle portion of the body between their bases is laterally stretched into skin flaps.

The geographical distribution of the Gastromyzonian-group of genera also shows that the extention of the pectoral fins beyond the origin of the pelvics is characteristic of the forms found in China and Cochin China and that in all the three Bornean genera, the pectorals do not reach the pelvics. It would thus appear that the union of the pelvic fins into a disc-like structure has probably occurred independently in China (*Beaufortia*) and in Borneo (*Gastromyzon* and *Neogastromyzon*) and that there is no direct genetic affinity between the groups of genera from these distant regions.

If the above argument is tenable, it then follows that *Protomyzon*, *Neogastromyzon* and *Gastromyzon* provide one evolutionary series, whereas *Pseudogastromyzon*, *Paraprotomyzon* and *Beaufortia*, with *Sewellia* as a side branch, form another series of progressive evolution. There is no doubt that the ancestors of all these forms were *Nemachilus*-like fishes, which in stronger and stronger currents, became more and more flattened and used the anterior rays of the pectoral fins for adhesion while the posterior rays were kept in motion to expell the water entering underneath the fish as has already been observed in the case of *Balitora*

and *Hemimyzon*[1]. This habit must have gradually led to an increase in the number of rays in the pectoral fins to subserve dual functions, and this is actually the case in more highly specialized genera.

The water pumped out by the pectoral fins would flow with greater speed at the sides of the fish and would no doubt affect the pelvic fins. Usually, in most of the hillstream fishes, even when the form is subcylindrical and not greatly depressed or flattened, an appendage of varying length and form is developed in the axils of the pelvic fins so as to give the side a streamline revetment to the current. In these forms, in which the pelvics were only slightly removed from the pectorals, as must have been the case with the ancestral form of the Chinese genera, and the form became depressed for adhesion the pectorals extended over the bases of the pelvics. In such cases, the appendage became attached to the side and extended backwards to provide a streamline revetment to the current. In those forms, in which the pectorals were removed from the pelvics by a considerable distance, as must have been the case with the ancestral form of the Bornean genera, and the body form in the initial stages continued to be subcylindrical, as flattening of the ventral surface for adhesion proceeded, skin flaps developed between the two fins to prevent the scouring action of the currents produced by the pumping movements of the posterior, vertically directed rays of the pectorals.

Both from the point of view of functional morphology and geographical distribution, we are of the opinion that there is no direct relationship between *Protomyzon* of Borneo and *Paraprotomyzon* of Sze-Chuan. It is probable, however, that in both subgroups more primitive forms, linking these genera with *Nemachilus*, may yet be discovered.

As a large number of topo-types of *Protomyzon whiteheadi* are now available, it is proposed to redescribe the species so as to facilitate reference in future.

Protomyzon whiteheadi (Vaillant).

1893. *Homaloptera whiteheadi*, Vaillant, *Nouv. Arch. Mus.* V, pp. 92-94.

1916. *Homaloptera whiteheadi*, Weber & de Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 13.

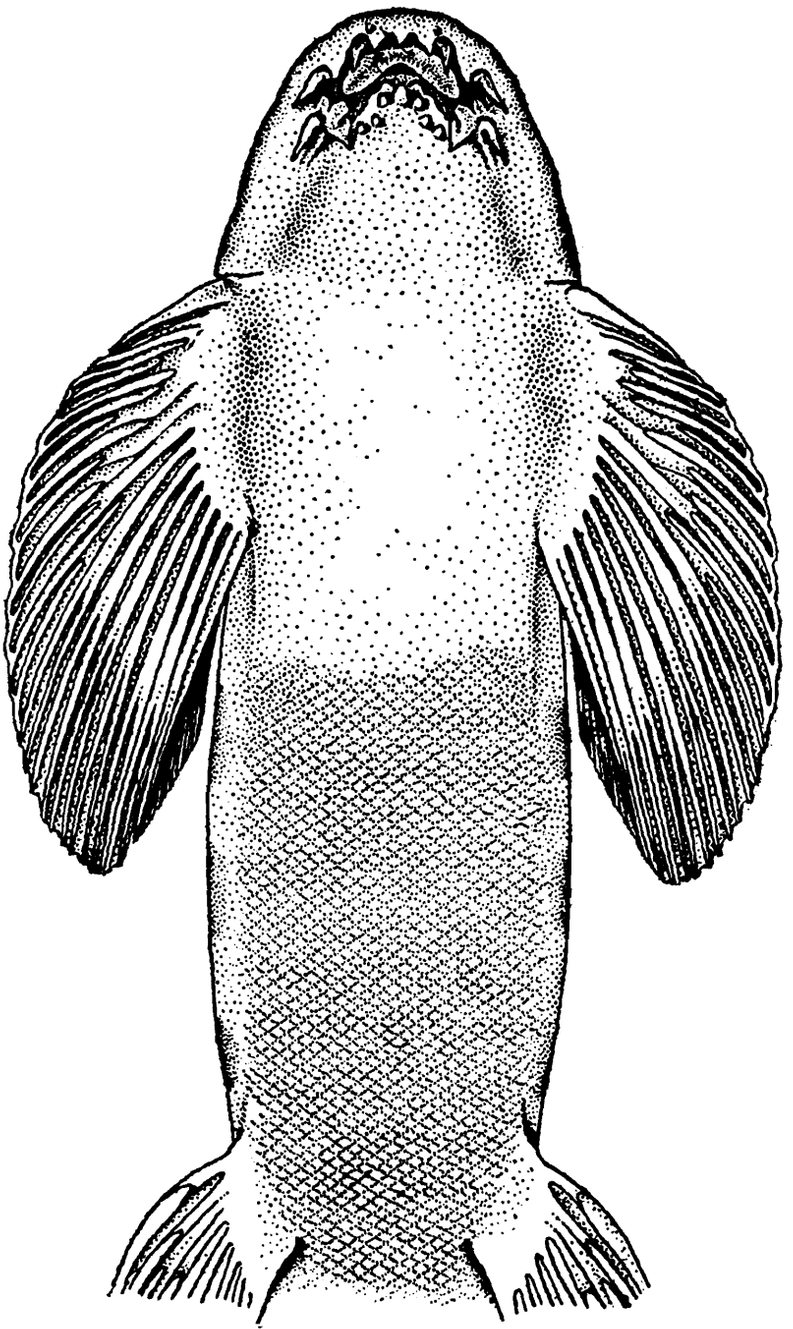
1932. *Protomyzon whiteheadi*, Hora, *Mem. Ind. Mus.* XII, p. 306.

D. 1/7 ; A. 1/6-7 ; P. 1/21-22 ; V 1/9-10 ; C. 15-16.

Protomyzon whiteheadi is a loach-like fish with the head and the anterior part of the body depressed and ventrally flattened. The dorsal profile is but little arched. The length of the head is contained 5·5 to 6 times in the total length and its height is slightly less than that of the length of the snout. The snout is broad and rounded and is free from any tubercles. In some young and badly preserved specimens, the snout is a bit sharp and angular towards the tip. The eyes are placed dorsolaterally and are small. They are in the middle of the head and are not visible from the ventral surface ; they are contained 2·5 to 3 times

[1] Hora, S. L. *Mem. Ind. Mus.* XII, p. 323 (1932).

from the tip of the snout and are 2 to 2·5 diameters apart. The nostrils are placed just in front of the eyes. The mouth is placed on the ventral surface and is bordered by fleshy lips; the upper lip is curved. The lower lip is beset with ten small papillae, which are not so clear in some young specimens. The rostral fold is produced into small fleshy prolongations. There are 2 pairs of rostral barbels and a pair of maxillary barbels, all of which are very small. At each angle of the mouth, there

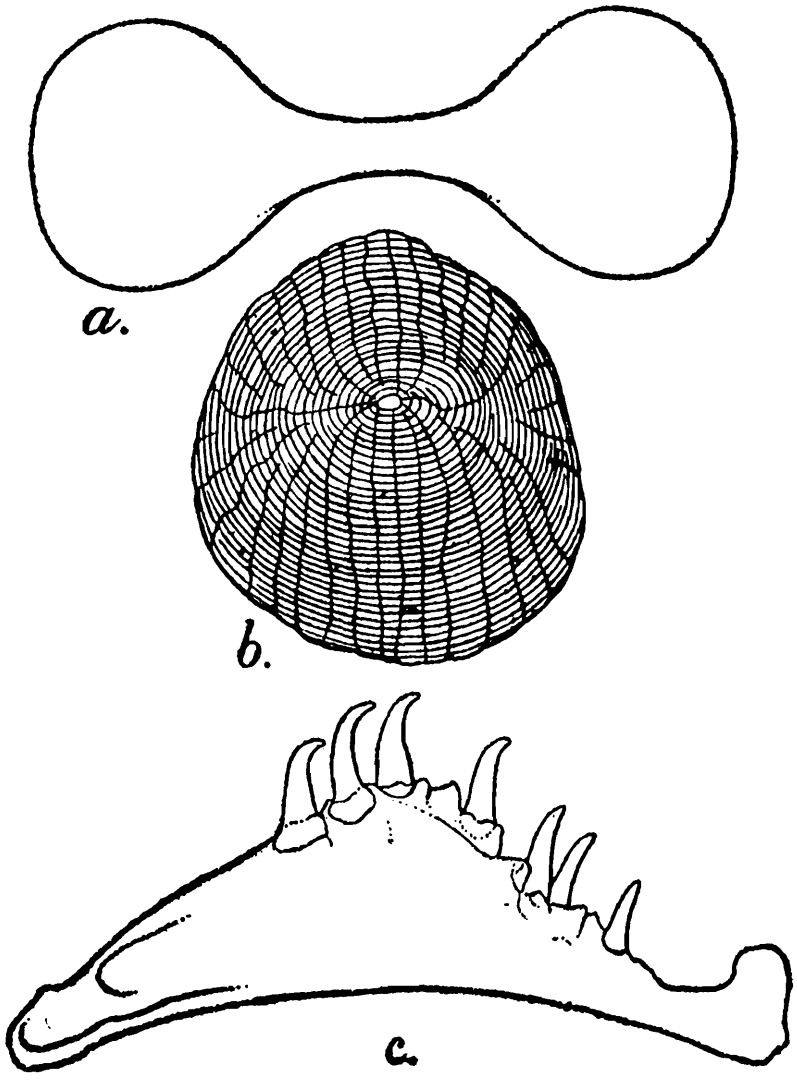


Text-fig. 3.—Ventral surface of head and body of *Protomyzon whitehcadi* (Vaillant. ×3½)

are small fleshy prolongations, papilla-like in appearance. The gill-openings are small and do not extend to the ventral surface.

The origin of the dorsal fin is usually just above the origin of the insertion of the pelvics, and is nearer to the base of the caudal fin than to the tip of the snout. The pectoral fins are horizontally inserted and are provided with muscular bases; the inner rays being longer than the outer ones. Each fin possesses only one undivided ray. The outer rays are provided with pads on the ventral surface for adhesion while

the inner rays are directed upwards for pumping out the leakage water from underneath the ventral surface of the fish. The pelvics are also horizontally placed and do not reach the anal fin ; each fin is provided with about 9 to 10 rays of which one outer ray is simple. As in the case of the pectoral fins, some of the outer rays are padded for adhesion. The pelvics extend beyond the anal opening and are not united. In the axil of the pelvics, there is a small scaly appendage. The length of the pelvic fin is nearly equal to that of the longest ray of the dorsal fin. The anal fin is small and is inserted a short distance from the pelvics ; it just reaches the base of the caudal fin. The longest ray of the anal fin is 3 times the length of its base. There is no anal papilla. The



TEXT-FIG. 4.—Air-bladder, scale and pharyngeal teeth of *Protomyzon whiteheadi* (Vaillant).
a. Air-bladder × 22 ; *b*. Scale from below the dorsal fin × 57 ; *c*. Pharyngeal bone and teeth × 44.

least height of the caudal peduncle is about $1\frac{1}{2}$ times its length. The caudal fin is emarginate with the lower lobe slightly longer.

The body is loach-like, its depth is contained about 8 times in the total length. The body is covered with small scales, except on the ventral surface as far as the anal opening. The lateral line is complete.

A scale from below base of dorsal fin is oval and marked with numerous circuli and radii. The nucleus is eccentric and disorganised. There are sixteen complete circuli, and seventeen radii all round the scale. The base of the scale is lobed and the top is broad.

In spirit specimens, the colour is dark brown marked with some irregular white patches in some specimens. The ventral surface is brownish. The dorsal and the caudal fins are brown or greyish, the base of the anal fin being provided with a dark spot.

The air bladder is bilobed and the two lobes are connected by a transverse tube. All the structures are enclosed by bone.

Measurements in millimetres.

Standard length	80	73	55	49	46	42	32
Length of head	12	12	10	9	8	8	7
Height of head at occiput	6	7	5	4	4	4	4
Width of head ..	10	11	8	7	7	6	5
Length of snout	6	6	5	5	5	4	3
Diameter of eye	2	2	2	2	2	2	1
Interorbital width	5	5	4	4	4	3	3
Depth of body	11	9	7	6	6	6	5
Length of caudal peduncle	7	7	5	4	5	5	2
Least height of caudal peduncle	5	5	4	4	3	4	3
Longest ray of dorsal fin	11	12	8	8	7	7	6
Length of pectoral fin	18	18	17	12	11	10	9
Length of pelvic fin	12	11	8	7	6	7	6
Longest ray of anal fin ..	9	9	6	6	6	6	4
Length of base of anal fin ..	3	3	2	2	2	2	2

THE SCALES OF THE HOMALOPTERID FISHES[1].

By NIRMAL CHANDRA LAW, *M.Sc., Calcutta.*

(Plates II-IV.)

CONTENTS.

[1] Part of the thesis approved for the degree of the Doctor of Philosophy of the Calcutta University.

Introduction.

In 1932, Hora gave a comprehensive account of the " Classification, Bionomics and Evolution of Homalopterid Fishes " and subdivided the family into two groups characterised by a number of well-defined morphological characters. From a detailed study of the material available to him in the various Museums of Europe and the Indian Museum at Calcutta, he was led to conclude that the family is polyphyletic in origin, Homalopterinae having been evolved from the Cyprinidae and the Gastromyzoninae from the Cobitidae. This view has been generally accepted by later workers such as Smith (1945, p. 273).

Chang (1945) made a comparative study of the girdles and their adjacent structures in the Chinese Homalopteridae, but as I have not seen his paper I am not in a position to say whether or not he expressed an opinion on the phylogeny of the family. Hora (1932, p. 273) had found structural differences in the basipterygium of the Homalopterinae and the Gastromyzoninae.

Ramaswami (1948, p. 531), after a detailed study of the skull of *Balitora* and *Bhavania* of the Homalopterinae and of the *Gastromyzon* of the Gastromyzoninae has listed as many as thirteen differences which help to differentiate the skulls of these two groups of fishes.

Since it has now been generally recognised that, like all other structures scales also vary and present characters of all degrees of significance and stability, for a further elucidation of this view, Dr. Hora entrusted me with the work of the scales of the Homalopterid fishes. The material of this family available in the Zoological Survey of India has been used for this purpose. In all cases, the scales were taken from below the base of the dorsal fin and treated with a weak solution of caustic potash (KOH) and then cleaned with fine needles under a binocular microscope. Canada Balsam mounts were then prepared and microphotographs taken for detailed study.

I am grateful to Dr. S. L. Hora, Director, Zoological Survey of India, for suggesting me this problem and for affording me facilities to work in the Laboratories of the Zoological Survey of India. I am also obliged to him for constant help and guidance in carrying out this work.

Historical Review.

The Homalopterid scales were first described by Cockerell (1909, pp. 205-207), who considered these fishes " as very aberrant Cobitids " and assigned them to Homalopterinae, which he regarded as a subfamily of Cobitidae. He described without figures scales of three species, *viz.*, *Gastromyzon borneensis* from Sarawak (Borneo), *Homaloptera maculata* from the Khasi Hills (Assam), and *Homaloptera brucei* from Meekalan (Tenasserim). The last two species belong to *Balitora* Gray and their correct identification would be *Balitora brucei brucei* Gray, and *B. b. burmanicus* Hora.

Commenting on the Cobitid and Homalopterid scales, Cockerell observed that " The scales, all of essentially the same type, are more or less degenerate, but hardly specialized. They appear to represent the

earlier type of Cyprinoid scale in a weak form, and that is why they remind one of certain scales of various genera of true Cyprinidae"

In 1912, Cockerell published a figure (Plate xxxiv, fig. 17) of the scales of *Homaloptera maculata* (=*Balitora brucei brucei*) from the Khasi Hills.

In 1920, Hora revised the Indian Homalopteridae and recognised three genera, *Balitora* Gray, *Bhavania* Hora and *Homaloptera* v. Hass. He published the figures of the scales of *B. maculata*, *B. brucei* and *Bhavania annandalei*. His account shows that he was not familiar with Cockerell's work on the *Homalopterid* scales but his description of the *Balitora* scale agrees with that of Cockerell. He described the scales of two more genera, *Bhavania* and *Homaloptera* without attaching any taxonomic significance to the structure of the scales in different genera

In 1931, Fang published figures of scales of three species of *Sinohomaloptera* to show the development of keel in the three forms but did not refer to the structure of the scales.

Description of Scales.

Fortunately the collection of the Zoological Survey of India contains a fair proportion of the genera and species described in the family Homalopteridae. In the first instance, descriptions with brief comments, where necessary, will be given, and then the significance of scale structures in the elucidation of inter-relationships between the various genera in each subfamily and finally the phylogeny of the family will be discussed.

Sub-family *Homalopterinae*.

It has been possible to study the scales of the genera *Homaloptera*, *Balitora*, *Bhavania*, *Sinohomaloptera*, *Sinogastromyzon* and *Hemimyzon*. In the case of the generalized genus *Homaloptera*, scales of eleven species are described and figured here. Similarly, scales of three species of *Balitora* are described. The material has helped to evaluate evolutionary trends within the members of the *Homalopterinae*.

Homaloptera ocellata van der Hoeven.

(Plate II, fig. 1.)

The scale of *Homaloptera ocellata* is somewhat irregularly oval in shape with a well-defined nucleus, situated almost at one-third of the distance between the base and the apex. It is almost one and a half times as long as broad, and is sculptured with well-marked radii and circuli. There are about 28 circuli, more widely spaced in the apical region but very closely packed in the basal region. There are about 8 complete radii going to the apex in two batches of 4 each with a wide space in between the batches. There are one or two incomplete radii at the sides also. There are about 17 basal radii almost equally spaced

Homaloptera bilineata Blyth.

(Plate II, figs. 2 & 3.)

The scale of *Homaloptera bilineata* has already been described by Hora (1920) without figures; it is three-fourth as broad as long with a bluntly pointed apical region and a broad basal region. In the scale figured here the outline of the base is irregularly crenulated, but this character varies considerably. The nucleus is a fairly defined, structureless area situated considerably nearer the base than the apex. There are 24 to 26 circuli, more widely spaced in the apical area. No complete radii, either in the apical or basal region, can be made out, but in plate II, fig. 3 there are indications of a few incomplete basal radii. The lateral sides may be parallel or convex but in spite of differences in shape, the characteristic features of the scale are fairly constant. The identity of the broken type specimen can thus be fully established with that of a fresh specimen.

It may be noted that this scale differs markedly from that of *H. ocellata* not only in its pointed apical region but also in the absence of any well marked radii, either apical or basal. It may here be recalled that Vinciguerra (1890) had proposed a separate genus *Helgia* for this species along with his *H. modesta* and though Hora (1932) had merged it in the synonymy of *Homaloptera*, the structure of the scale would, at any rate, justify the separation of the two genera.

Homaloptera rupicola (Prashad & Mukerji).

(Plate II, fig. 4.)

The scale of *Homaloptera rupicola* is slightly longer than broad with the lateral borders almost straight, and the basal and apical borders somewhat arched. The nucleus is well defined and is situated in the basal half. There are about 28 circuli, more widely spaced in the apical region and more clearly marked in the lateral areas. The radii are also well marked, 12 in the apical region and 18 in the basal region, besides a few incomplete ones at the sides.

Though differing in shape, the general structural similarity of this scale with that of *H. ocellata* (Pl. II, fig. 1) may be noticed. It may here be recalled that Prashad and Mukerji (1929) had established the genus *Chopraia* for this species which Hora (1932) had merged in the synonymy of *Homaloptera*. The structure of the scale would justify such a merger.

Homaloptera smithi Hora.

(Plate II, fig. 5.)

The scale of *Homaloptera smithi* is five-sixth as broad as long with the lateral sides somewhat concave. The base as well as the apex are slightly arched. The nuclear area commences at a distance of one-fifth of the total length from the base but its boundaries are not clearly defined. There are about 30 to 40 closely set circuli in the basal region but with the exception of about 13 outer circuli the others are interrupted at

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RECORDS

of the

INDIAN MUSEUM

(A Journal of Indian Zoology.)

Vol. XLVIII, Part II.

June, 1950.

Edited by the Director, Zoological Survey of India.

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI.
PRINTED BY THE GOVERNMENT OF INDIA PRESS, CALCUTTA, INDIA,
1951.
Price *Rs. 6-10 or 10s. 6d.*

various stages by the ill-defined nuclear area. There are 28 to 30 basal radii, of which 9 reach the nuclear area while the others are reduced in size as they proceed laterally. The apical radii are not well defined and in the scale figured here there are about 6 on one side and only 2 on the other.

Though this scale differs in specific characters from the scales of *H. ocellata* and *H. rupicola*, the general pattern is very similar.

Homaloptera wassinki Bleeker.

(Plate II, fig. 6.)

The scale of *Homaloptera wassinki* is four-fifth as broad as long with the nuclear area situated at a distance of one-fifth of the length from the base. The lateral sides are slightly concave while the basal and the apical regions are curved. The apical border is broadly pointed. The circuli are very fine and closely packed in the basal region but only about 15 outer ones encircle the apical region where they are very prominent and widely spaced. There are about 7 basal radii and the same number of incomplete radii in the apical region.

In its general appearance, the scale is not unlike that of *H. ocellata* but the number of circuli as well as radii is fewer.

Homaloptera amphisquamata Weber & de Beaufort.

(Plate II, fig. 7.)

The scale of *Homaloptera amphisquamata* is almost circular in outline but its nucleus is placed very close to the base. There are about 25 circuli which are closely set in the basal region but are relatively widely spaced in the apical portion. There are about 12 radii in the basal and 12 in the apical areas while a few incomplete ones are situated laterally also.

Though, owing to the smallness of size, the shape has become circular instead of oval in this scale, the general pattern of the *H. ocellata* scale is still preserved.

Homaloptera orthogoniata Vaillant.

(Plate II, fig. 8.)

The scale of *Homaloptera orthogoniata* is very slightly longer than broad and is almost circular in appearance. The nuclear area is small and well defined ; it commences at a distance of 2/5 of the length from the base. There are about 45 circuli, which are fine and compact in the basal region and somewhat more widely spaced in the apical region. The radii are absent from the basal and the apical regions but a few incomplete ones (about 9 in number) are present at the sides.

As in *H. amphisquamata*, the general pattern of the *H. ocellata* scale is maintained in this scale though it has the circuli and the radii more disorganised.

Homaloptera gymnogaster Bleeker.

(Plate II, fig. 9.)

The scale of *Homaloptera gymnogaster* is only slightly longer than broad and is almost circular except that the sides are straight. The nuclear area which is fairly large and amorphous is almost central in position. There are about 13 circuli which are more widely spaced in the apical region. There are about 45 radii in all, of which about half the number is confined to the basal region and the others are distributed irregularly in the lateral areas. The radii of the apical area are inconspicuous.

This scale differs from all the scales described so far in the possession of a large, oval, nuclear area, otherwise the general pattern is more or less the same as in *H. ocellata.*

Homaloptera modiglianii Perugia.

(Plate II, fig. 10.)

The scale of *Homaloptera modiglianii* is somewhat broader than long and has a large eccentric, oval, nuclear area. The circuli are confined to the peripheral region of the scale and are about 12 in number. As the nuclear area is considerably nearer the base than the apex, the circuli in the basal region are finer and more compactly arranged. The radii are about 25 in number and are restricted to the base and the adjoining lateral areas; they are short and inconspicuous.

The specific characters of this scale are that (i) it is broader than long, (ii) a large, oval, structureless nuclear area, (iii) smaller number of circuli and (iv) absence of radii to the apical and adjoining lateral areas.

Homaloptera weberi Hora.

(Plate II, fig. 11.)

The scale of *Homaloptera weberi* is but very slightly longer than broad and, but for the conical apex, it is more or less circular in outline. The nuclear area is large but eccentric in position, being much nearer the base than the apex. In the basal region and at the sides, there are about 18 circuli but they are disorganised in the apical portion and can hardly be made out. The basal radii are short and conspicuous, and about 25 in number. There are a few radii going to the apex and of these 8 to 10 can be made out.

Both in regard to its conical shape and the form and extent of the nuclear area, this scale differs specifically from others described above.

Homaloptera heterolepis Weber & de Beaufort.

(Plate II. fig. 12.)

The scale of *Homaloptera heterolepis* is transversely oval in outline and is considerably broader than long; the length being four-fifth of the breadth. The nuclear area is well defined and is eccentric in position;

it is nearer to the base than to the apex. There are 24 circuli which are more completely arranged in the basal area but are more widely spaced laterally and in the apical region. There are 34 radii all round the scale, being more numerous in the basal region and sparse in the lateral areas.

This scale is specifically distinct from all other scales described above as it is much broader than long.

Balitora brucei Gray.

(Plate III, fig. 1.)

The scale of *Balitora burcei* has already been described and figured by Cockerell (1912) and Hora (1920) and there is very little further to be said about it here. It may, however, be noticed that the disorganisation of the nuclear area as already noticed in certain species of *Homaloptera*, such as *H. gymnogaster* and *H. modiglianii*, is still further accentuated in *Balitora*, showing thereby the types of *Homaloptera* species that may have given rise to *Balitora*.

Balitora maculata Gray.

(Plate III, fig. 2.)

The scale of *Balitora maculata* has already been described and figured by Hora (1920), but its general similarity in structure to the scales of *Homaloptera gymnogaster* may be noticed, though it is longer than broad.

Balitora brucei burmanicus Hora.

(Plate III, fig. 3.)

The scale of *Balitora brucei* var. *burmanicus* was briefly referred to by Cockerell (1912) but not actually described by him in detail; it is of the generalised *Homaloptera*-type, almost as broad as long with a slightly arched base and conical apex. There is a well-defined nuclear area situated entirely in the lower half of the scale. There are about 30 well marked circuli, compactly arranged in the lower portion and somewhat more widely spaced in the apical portion. Though there are 26 radii in all, only 6 of them are complete while the others are either in small bits haphazardly arranged. The basal radii are finer and more compactly arranged.

The structure of the scale of *B. b. burmanicus* supports Hora's (1949) views that this, as well as *B. b. melanosoma* Hora and *B. b. mysorensis* Hora, narrow-headed and more *Homaloptera*-like forms of *Balitora*, are more primitive than the highly specialised members now found in the Assam Hills and the Eastern Himalayas, zones of intense Himalayan movements.

Bhavania australis (Jerdon).

(=*Bhavania annandalei* Hora).

(Plate III, fig. 4.)

The scale of *Bhavania annandalei* was described by Hora (1920), but its resemblance to the generalised scales of *Homaloptera*, particularly to that *H. wassinkii*, may be noticed here. In discussing the affinities of his genus, Hora (1920; 1932, p. 277) pointed out that *Bhavania* must have evolved from *Homaloptera*-like ancestors. The structure of the scale supports such a view.

Sinohomaloptera kwangsiensis Fang.

(Plate III, fig. 5.)

The scale of *Sinohomaloptera kwangsiensis* described here differs considerably in structure from the keeled dorsal scales of three forms figured by Fang (1931). Unfortunately, the specimen from which I took the scale is now missing from the collection so I am not in a position to explain this marked deviation in structure which may be due to the separate positions of the scales on the body.

In the scale figured here, the nuclear area is small but well-defined. The circuli, about 42 in number, are well marked and there are indistinct indications of about 16 radii which are irregularly distributed all over the scale.

Though differing in form, the structural resemblance of this scale to those of *Homaloptera bilineata* with regard to the nuclear area, circulii and radii may be noted.

Sinogastromyzon sp.

(Plate III, fig. 6.)

The sculpture on the scale of *Sinogastromyzon* is very poorly developed but in general outline and the arrangement of circulii and radii recalls the scale-structure in several species of *Homaloptera*. The lower half of the scale is almost rectangular while the apical half is conical. The circulii, about 34 in number, can be made out with great difficulty, and the same is the nature of the 11 radii, except near the apex.

Sinogastromyzon is the most highly evolved genus among the Homalopterinae for life in torrential waters, and the structure of its scale seems to show the impress of the environment.

Hemimyzon sinensis (Sauvage & Dabry).

(Plate III, fig. 7.)

The scale of *Hemimyzon sinensis* is almost rectangular, much broader than long. It is rounded at the two corners. The nuclear area is eccentric and about 20 circulii can be made out with great difficulty. The radii are not clear.

This is a remarkable scale and I am unable to give its relationship with the other scales of the Homalopterinae.

RELATIONSHIPS OF THE HOMALOPTERINAE.

In the subfamily Homalopterinae, *Homaloptera* is undoubtedly a central genus which is represented by over 20 species distributed from Burma, Siam, Malay Peninsula, Sumatra, Java and Borneo. It is indeed remarkable that to the east or west of this central axis, no species of *Homaloptera sensu stricto* has so far been described though specialised genera of the Homalopterinae occur on both sides.

An examination of the species of *Homaloptera* shows great diversity in form among the members of this genus and attempts have been made in the past to distinguish them generically, such as *Helgia* Vinciguerra, *Chopraia* Prashad and Mukherji, etc. A causal glance at plate II, on which are given the scales of 11 species, will show much diversity in scale structure. In fact, the scales differ so considerably that they can be utilized for distinguishing species as the following synoptic key for the 11 species will show :—

1.	Well marked conical area at the apex ; radii absent or a few inconspicuous basal radii	*H. bilineata.*
	Well marked conical area at apex absent	**2.**
2.	Scale broader than long	**3.**
	Scale longer than broad	**4.**
3.	Length 4/5 of breadth ; nuclear area small and well defined ; conspicuous radii all round	*H. heterolepis.*
	Length slightly shorter than width ; nuclear area large ; basal and lateral radii inconspicuous ..	*H. modiglianii.*
4.	Apical area conical ; radii inconspicuous	*H. weberi.*
	Apical area crescentic ; radii conspicuous	**5.**
5.	Nuclear area large and central ; only basal radii conspicuously marked ..	*H. gymnogaster.*
	Nuclear area small and eccentric ; both basal and apical radii well marked	**6.**
6.	Scales almost circular	**7.**
	Scales almost rectangular	**8.**
7.	Conspicuous radii all round the scale ..	*H. amphisquamata.*
	Radii disorganised	*H. orthogoniata.*
8.	30 or more radii in the basal region ..	*H. smithi.*
	Less than 30 radii in the basal region ..	**9.**
9.	More than 15 basal radii	**10.**
	Less than 10 basal radii	*H. wassinki.*
10.	Scale considerably longer than broad ..	*H. ocellata.*
	Scale slightly longer than broad	*H. rupicola.*

If scale-structure can be regarded as of sufficient taxonomic value it will be obvious that the genus *Homaloptera* as constituted at present, is probably a heterogenous assemblage of forms. On the basis of the scale structure, different forms of *Homaloptera* seem to have given rise to various types of Homalopterine genera. For instance, the scale of *Balitora brucei burmanicus* is of the same type and pattern as that of *H. orthogoniata*, while the highly evolved species of *Balitora* have scales

in which a large part in the centre is disorganised and in this respect corresponds with the scales of *H. gymnogaster*, *H. modiglianii* and *H. weberi*. The scales of *Bhavania* are of the *H. wassinki*-type. The scales of *Sinohomaloptera* is generally of the *H. bilineata*-type, but without the apical cap. The scales of *Sinogastromyzon* and *Hemimyzon* are of much more specialised type but their general *Homaloptera*-like pattern is fairly obvious.

From the above discussion, one is led to conclude that the diversified forms of *Homaloptera* evolved into different genera both to the east and west of their main central range, so that the various genera become independently evolved from the *Homaloptera*-like ancestors.

Subfamily *Gastromyzoninae*

The scales of the following genera of the Gastromyzoninae have been studied and are described and figured here :—*Crossostoma* (two species), *Formosania* (one species), *Praeformosania* (one species) *Paraprotomyzon* (one species), *Protomyzon* (one species), *Beaufortia* (two species), *Pseudogastromyzon* (one species), *Gastromyzon* (one species), *Sewellia* (one species), *Parhomaloptera* (one species) and *Linparhomaloptera* (one species). According to Fang (1935), the members of the Gastromyzoninae can be readily divided into two groups—*Crossostoma* and allied genera in which the gill-openings extend to the ventral surface, and *Gastromyzon* and allied genera in which the gill-openings are restricted to above the base of the pectoral fins. The above listed genera can be grouped as under :—

Group 1.	Group 2.
Praeformosania	*Paraprotomyzon*
Formosania	*Protomyzon*
Crossostoma	*Beaufortia*
Linparhomaloptera	*Gastromyzon*
Parhomaloptera	*Pseudogastromyzon*
	Sewellia

It will be convenient to describe the members of the two groups separately and then discuss their affinities.

GROUP I.

Praeformosania pinchowensis Fang.

(Plate IV, fig. 4.)

The scale of *Praeformosania pinchowensis* is slightly longer than broad. There is a well-defined, small nuclear area which is situated near the base. The circulii and radii are clear and well-defined. There are 32 circulii which are compactly arranged in the basal area and widely spaced in the apical region. There are 19 radii, of which 8 are complete.

Formosania lacustre (Steindachner).

(Plate IV, fig. 3.)

In general appearance, the scale of *Formosania lacustre* is similar to that of *Praeformosania pinchowensis*, but differs from it in having a larger ill-defined nuclear area and innèr circulii not very clear. The scale is oval in outline, being considerably longer than broad. The nuclear area is eccentric. There are 14 circulii and 38 radii, of which 17 reach the nuclear area.

Crossostoma fascicauda (Nichols).

(Plate IV, fig. 1.)

The scale of *Crossostoma fascicauda* is similar to that of *Formosania lacustre* except in so far as the circulii and radii are better defined. It is irregularly oval, being considerably longer than broad. The nuclear area is somewhat diffuse and eccentric. There are 19 circulii and 27 radii, of which only 10 are complete.

Crossostoma davidi Sauvage.

(Plate IV, fig. 2.)

The scale of *Crossostoma davidi* is somewhat broader than long and is more or less circular in appearance. The nuclear area is small and wel-defined and is almost central in position. The circulii and radii are prominent; there are about 29 circulii and 36 radii. There are 8 complete radii and 10 very short while the others are of intermediate sizes.

Linparhomaloptera disparis (Lin.).

(Plate IV, fig. 13.)

Though smaller in size, the general structure of the scale of *Linparhomaloptera disparis* agrees with that of *Formosania*, except that the lateral and apical radii are not clearly defined or are absent. The nuclear area is only slightly eccentric. There are about 25 circulii and 26 radii. Only 10 radii are complete. The basal radii are more prominent.

The structure of the scale of this species indicates the close relationship between the genera *Linparhomaloptera* and *Formosania*.

Parhomaloptera microstoma (Boulenger).

(Plate IV, fig. 12.)

The scale of *Parhomaloptera microstoma* is irregularly circular in appearance, but with a large, eccentric nuclear area. There are about 12 circulii and the same number of radii which are irregularly distributed. Only 7 radii are complete.

This type of scale appears to have more affinities with the *Crossostoma*-type of scale rather than to those of *Praeformosania*, *Formosania* and *Linparhomaloptera*. The scale of *Crossostoma* is more primitive and generalised Cobitid type while that of *Parhomaloptera* is somewhat retrogressive in structure.

GROUP II.

Papaprotomyzon multifasciatus Pellegrin & Fang.

(Plate IV, fig. 5.)

Though the scale of *Paraprotomyzon multifasciatus* is as long as broad, it is asymetrical. The central ill-defined nuclear area is large and eccentric. There are 12 circulii in the peripheral region, more compactly arranged in the basal area and more widely spaced in the apical area. There are about 28 radii spread out in all directions and all of them reach the nuclear area.

In the Homalopterinae, it was noticed that disorganisation of the central zone was characteristic of the species adapted to a torrential environment. Using that as a criterion, it can be stated that *Paraprotomyzon* is more specialized than *Protomyzon*, and thus Pellegrin and Fang (1935) were correct in regarding their new genus more specialized than *Protomyzon*.

Protomyzon whiteheadi (Vaillant).

(Plate IV, fig. 6.)

The scale of *Protomyzon whiteheadi* is almost circular in outline with a small, well-defined central nucleus. The circulii and radii are well marked. There are about 29 circulii, concentric and equally spaced. The number of radii is 33 ; they are more numerous and conspicuous in the basal region. Almost all the radii are complete.

The general structural similarity of this scale to that of *Crossostoma davidi* may be noted.

Beaufortia leveretti (Nichols & Pope).

(Plate IV, fig. 7.)

The scale of *Beaufortia leveretti* is broadly oval in shape with an eccentric nuclear area. There are about 29 circulii and 17 radii, of which only 7 are complete. There are indications of the disorganisation of the scale particularly in the apical region.

Beaufortia pingi (Fang).

(Plate IV, fig. 8.)

The scale of *Beaufortia pingi* is quite different in shape and structure from that of *B. leveretti*. It is rhomboidal in shape with the apex circular and the base broadly pointed. The scale is longer than broad with the nuclear area situated slightly near the base. There are 27 circulii and 23 radii, of which only 5 are complete.

Gastromyzon borneensis Günther.

(Plate IV, fig. 10.)

The scale of *Gastromyzon borneensis* was described by Cockerell as early as 1909. The scale figured here agrees fairly closely with his description. There are 37 circulii and the nuclear area is small and well-defined. As many as 14 radii reach the nucleus.

Pseudogastromyzon fasciatus (Sauvage).

(Plate IV, fig. 9.)

The scale of *Pseudogastromyzon fasciatus* is elliptical in shape with its width considerably greater than its length. The disorganised nuclear area is large and eccentric. There are about 6 to 8 circulii, broad and wavy in the lateral and apical regions and compactly arranged in the basal region. There are about 47 radii, shorter and more numerous in the basal region.

This scale shows structural resemblance to that of *Paraprotomyzon*, but is more disorganised and is provided with lateral wings.

Sewellia lineolata (Cuv. & Val.).

(Plate IV, fig. 11.)

The scale of *Sewellia lineolata* is longer than broad with a slightly convex base, vertical sides and a rounded conical apex. The nuclear area is small, eccentric and well-defined. The radii and circulii are prominently marked. There are about 26 circulii, 22 radii in the basal region and 11 radii in the apical region. Of these, only 14 radii are complete.

Though *Sewellia* is a highly specialised Homalopterid genus, the structure of its scale is of the more primitive and generalized type.

INTER-RELATIONSHIPS OF THE GASTROMYZONINAE.

According to Fang (1935), the Gastromyzoninae can be readily grouped into two associations according to the nature of their gill-openings ; the *Crossostoma*-association, in which the gill-openings are in front of the pectoral fins and extend to the ventral surface for a short distance and the *Gastromyzon*-association, in which the gill-openings are restricted to above the bases of the pectoral fins which extend in front of the position of these openings. The first group comprises *Annamia* Hora, *Parhomaloptera* Vaillant, *Linparhomaloptera* Fang, *Vanmannenia* Hora, *Praeformosania* Fang, *Formosania* Oshima and *Crossostoma* Sauvage. The second group comprises *Paraprotomyzon* Pellegrin & Fang, *Sewellia* Hora, *Pseudogastromyzon* Nichols, *Beaufortia* Hora, *Protomyzon* Hora, *Neogastromyzon* Popta and *Gastromyzon* Günther.

The structure of the scale shows that the members of the first group studied here can be divided further into two groups. *Praeformosania*, *Formosania* and *Linparhomaloptera*, in which the scale is longer than broad, the nuclear area is well-marked and eccentric, the circulii and

radii are conspicuous and fully formed and the shape is more or less oval, forming a fairly homogenous assemblage of forms. The scales of *Crossostoma* and *Parhomaloptera* are circular; that of the former genus is fully sculptured and generalised while that of the latter is somewhat disorganised and, therefore, more specialized. The geographical distribution of the two genera would also indicate their distant relationship and independent specialisation after isolation.

In the group with restricted gill-openings, we have several lines of specializations. For example, the two Bornean genera, *Protomyzon* and *Gastromyzon* have scales in which the circuliiare fine and numerous and the radii fairly well-marked. Corresponding to the high degree of specialization attained by *Gastromyzon* as compared with *Protomyzon*, the scales differ markedly in shape, position of the nuclear area, etc. The scales of *Paraprotomyzon* and *Pseudogastromyzon* though differing in shape, possess a general structural similarity in so far as the nuclear area is large and disorganised and the circulii in the lateral and apical regions form broad wavy bands. *Paraprotomyzon* scale would seem to be more ancestral than the *Pseudogastromyzon* scale. The scales of the two species of *Beaufortia* differ from each other and from other scales in several important features but it is difficult to say anything at this stage about the affinities of this genus. The scales of *Sewellia* are of the generalized nature and would seem to indicate its evolution from a primitive stock independently.

From the data presented here, it would appear that more detailed comparative study of the scales from different regions of the body may reveal firm evolutionary trends in these specialised fishes and it is likely that the inter-relationship of the various genera may become clear.

Phylogenetic significance of the homalopterid scales.

Though the structures of the scales described here have proved helpful in understanding the probable affinities of the various genera within each subfamily, without a comprehensive knowledge of the Cobitid and Cyprinid scales, it is difficult to elucidate their precise systematic position. A comparison of the plates depicting the scales in the two subfamilies will show that they do differ as a lot from each other but it is difficult at this stage to tabulate the differences or to define them more precisely. The Gastromyzoninae scales are in general of the Cobitid type whereas the Homalopterinae scales are of the Cyprinid type. Since the Cobitidae and the Cyprinidae are closely related families, some genera of both have generalized scales. Cockerell (1909), who regarded Cobitid, Homalopterid and Cyprinid fishes as belonging to one family, considered the Homalopterid scales of *Gastromyzon* and *Balitora* as " of essentially the same type " as the scales of the Cobitid fishes are more or less degenerate, but hardly specialized. They appeared to him to represent the earlier type of Cyprinoid scale in a weak form and, according to him, are comparable to certain scales of various genera of true Cyprinidae. Much beyond that cannot be said even now.

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EXPLANATION OF PLATE II.

Scales of *Homaloptera* van Hass.

FIG. 1.—Scale of ***Homaloptera ocellata*** van der Hoeven × $25\frac{3}{5}$.

FIGS. 2. and 3.—Scales of ***Homaloptera bilineata*** Blyth × 56.

FIG. 4.—Scale of ***Homaloptera rupicola*** (Prashad and Mukerji) × 44.

FIG. 5.—Scale of ***Homaloptera smithi*** Hora × $25\frac{3}{5}$.

FIG. 6.—Scale of ***Homaloptera wassinki*** Bleeker × 50.

FIG. 7.—Scale of ***Homaloptera amphisquamata*** Weber & de Beaufort × 80.

FIG. 8.—Scale of ***Homaloptera orthogoniata*** Vaillant × $36\frac{4}{5}$.

FIG. 9.—Scale of ***Homaloptera gymnogaster*** Bleeker × $36\frac{4}{5}$.

FIG. 10.—Scale of ***Homaloptera modiglianii*** Perugia × 44.

FIG. 11.—Scale of ***Homaloptera weberi*** Hora × $36\frac{4}{5}$.

FIG. 12.—Scale of ***Homaloptera heterolepis*** Weber & de Beaufort × 56.

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Scales of *Homaloptera* van Hass.

EXPLANATION OF PLATE III

Scales of the Homalopterinae.

FIG. 1.—Scale of *Balitora brucei* Gray × 32.

FIG. 2.—Scale of *Balitora maculata* Gray × 32.

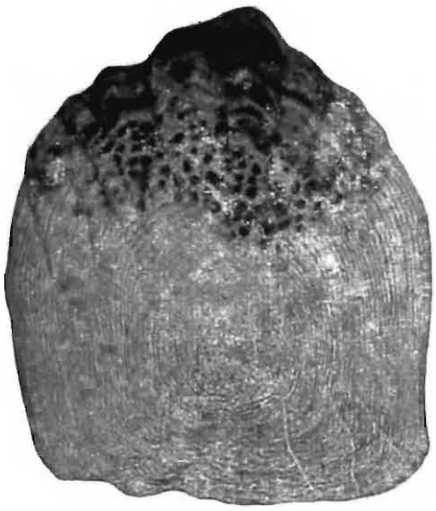
FIG. 3.—Scale of *Balitora brucei burmanicus* Hora × 46.

FIG. 4.—Scale of *Bhavania australis* (Jerdon) × 70.

FIG. 5.—Scale of *Sinhomaloptera kwangsiensis* Fang × 46.

FIG. 6.—Scale of *Sinogastromyzon* sp. × 33.

FIG. 7.—Scale of *Hemimyzon sinensis* (Sauvage & Dabry) × 55.



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Scales of the *Homalopterinae*.

EXPLANATION OF PLATE IV.

Scales of the Gastromyzoninae.

FIG. 1.—Scale of *Crossostoma fascicauda* (Nichols) × 56$\frac{4}{5}$.

FIG. 2.—Scale of *Crossostoma davidi* Sauvage × 56$\frac{4}{5}$.

FIG. 3.—Scale of *Formosania lacustre* (Steindachner) × 36$\frac{4}{5}$.

FIG. 4.—Scale of *Praeformosania pinchowensis* Fang × 56.

FIG. 5.—Scale of *Paraprotomyzon multifasciatus* Pellegrin & Fang × 63$\frac{4}{5}$.

FIG. 6.—Scale of *Protomyzon whiteheadi* (Vaillant) × 56.

FIG. 7.—Scale of *Beaufortia leveretti* (Nichols & Pope) × 50.

FIG. 8.—Scale of *Beaufortia pingi* (Fang.) × 50.

FIG. 9.—Scale of *Pseudogastromyzon fasciatus* (Sauvage) × 36$\frac{4}{5}$.

FIG. 10.—Scale of *Gastromyzon borneensis* Günther × 25$\frac{3}{5}$.

FIG. 11.—Scale of *Sewellia lineolata* (Cuv. & Val) × 36$\frac{4}{5}$.

FIG. 12.—Scale of *Parhomaloptera microstoma* (Boulenger) × 106$\frac{2}{5}$.

FIG. 13.—Scales *Linparhomaloptera disparis* (Lin.) × 56$\frac{4}{5}$.

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SCALES OF THE *GASTROMYZONINAE*

A NOTE ON THE SYSTEMATIC POSITION OF THE GENUS *GLANIOPSIS* BOULENGER (FISHES: CYRINOIDEA).

By SUNDER LAL HORA, *D. Sc., F R. S. E., C. M. Z. S., F R. A. S. B., F. N. I., Director*, and K. C. JAYARAM, *B. Sc., Assistant, Zoological Survey of India, Indian Museum, Calcutta.*

Though the genus *Glaniopsis* Boulenger has generally been included in the family Homalopteridae, Hora[1] expressed doubts about its systematic position and regarded it a Cobitid rather than a Homalopterid fish. He based his conclusions on an external examination of the only two known specimens of the monotypic genus in the British Museum. During his recent visit to the U. S. A., in the Museum of Comparative Zoology at Harvard College, Cambridge Mass., Hora found a large collection of fishes made by Mr. J. A. Griswold from Mount Kina Balu, Borneo. Several hundred specimens from this collection had been correctly identified as *G. hanitschi* Blgr. and placed in the collection among the Homalopteridae. Through the kindness of Dr. William C. Schroeder, a large number of specimens have now become available for study at Calcutta and an opportunity has, therefore, been taken not only to discuss the systematic position of the genus but also to redescribe the species from abundant material with some details of internal structures.

Glaniopsis hanitschi Boulenger.

1899. *Glaniopsis hanitschi*, Boulenger, *Ann. Mag. Nat. Hist.* (7), IV, p. 228.

1900. *Glaniopsis hanitschi*, Hanitsch, *Journ. Straits Branch Roy. As. Soc.* No. 34, p. 75, pl. ii, figs. 2, 2a.

1916. *Glaniopsis hanitschi*, Weber & de Beaufort, *Fish. Indo. Austral. Archipel.* III, p. 5.

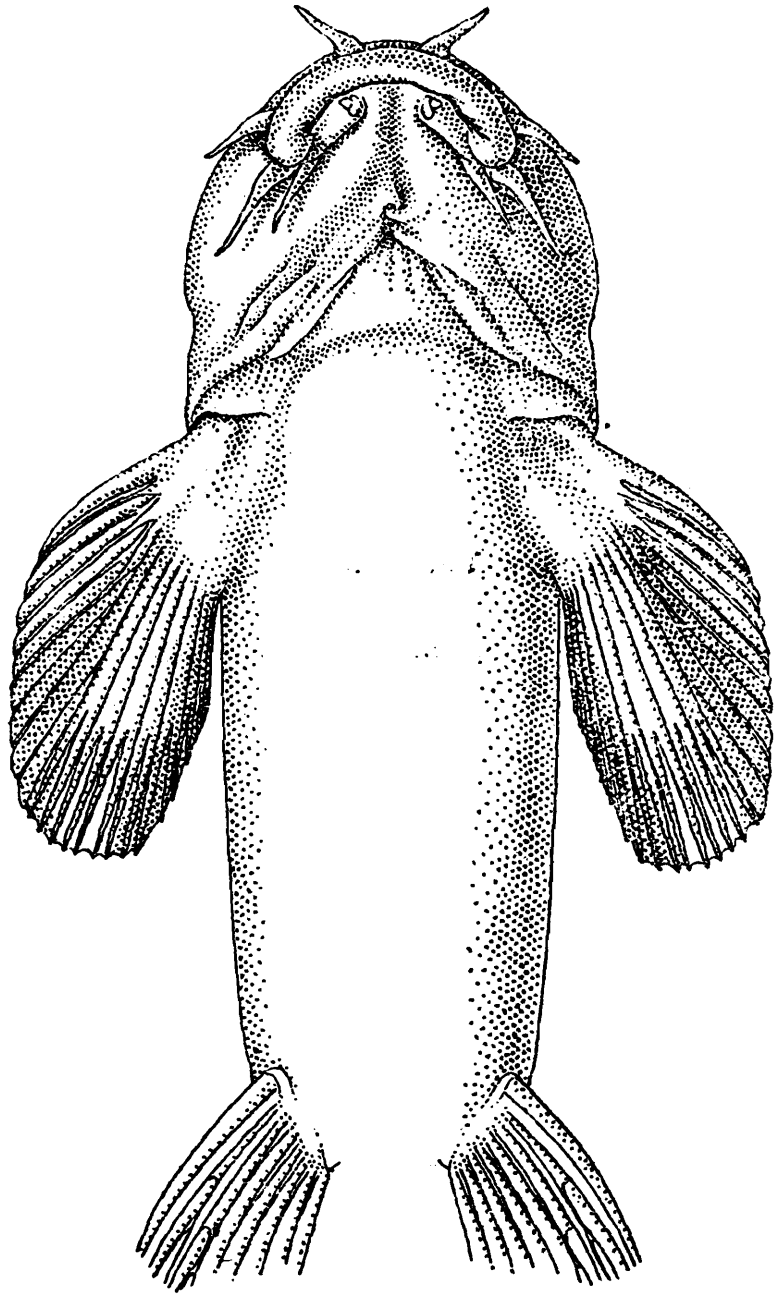
1932. *Glaniopsis hanitschi*, Hora, *Mem. Ind. Mus.* XII, p. 268 (foot-note).

D. 2/6-7 ; A. 1/6 ; P. 1/8-11 ; V 1/7-8 ; C. 16-17

In its general facies, *Glaniopsis hanitschi* is a *Nemachilus*-like loach with a broad head and slightly depressed body. The dorsal and the ventral profiles are almost horizontal or slightly arched. The head is short and broad ; it is scarcely longer than broad. The length of the head is contained from 5·0 to 5·75 times in the total length. The head is greatly depressed and smooth ; the snout is broad and rounded. The eyes are small and dorso-lateral in position ; they are in the middle of the head and are not visible from below. They are contained 5 to 8 times in the length of the head, 2 to 4 times in the snout and 2 to 3 diameters apart. The nostrils are nearer to the eye than to the tip of the snout and are separated by well-developed nasal barbels. The mouth is arched and its gape is equal to half the width of the head ; it is situated slightly behind the tip of the snout on the ventral surface

1. Hora, S. L. *Mem. Ind. Mus.* XII, pp. 267, 268 (1932).

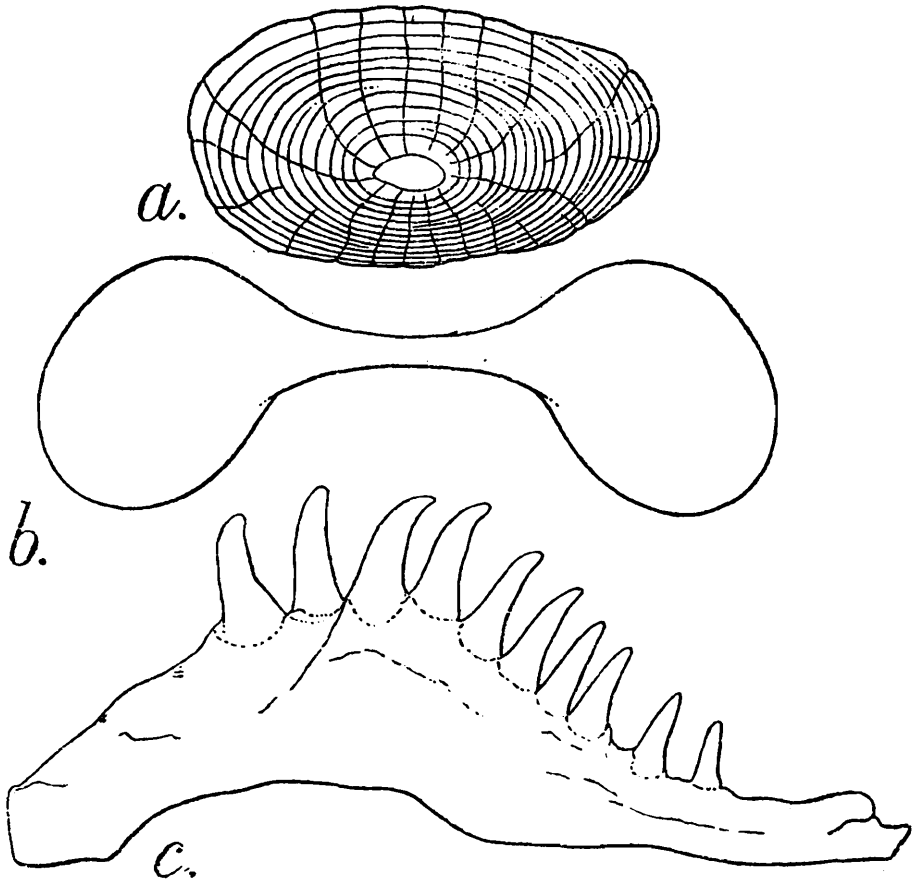
and is bordered by thick, fleshy lips. The lips are continuous at the angles of the mouth, but the lower labial fold is broadly interrupted in the middle. There is a deep groove round the corners of the mouth and there are two barbels on each side at this place. Besides, there are the usual maxillary and outer mandibular barbels. The inner edge of the labial fold of each side is also produced into a short barbel. The upper jaw is beak-like with a corresponding depression in the lower jaw. The gill-openings extend to the ventral surface for a considerable distance, the isthmus being equal to half the length of the head.



Text-fig. 1.—Ventral surface of head and body of *Glaniopsis hanitschi* Boulenger; ×3⅕.

The origin of the dorsal fin is usually slightly behind that of the pelvics and is nearer to the base of the caudal fin than to the tip of the snout; its longest ray is considerably shorter than the head. The pectoral fins are horizontally placed and are provided with muscular bases; they are as long as the head and possess only one undivided ray each. The first five rays are covered with adhesive skin pads on

their ventral surfaces, while the remaining eight rays are progressively more and more directed upwards so as to pump out water entering on the ventral surface, a feature very characteristic of the Gastromyzonid and Homalopterid fishes. The pectorals are separated from the pelvics by a considerable distance—almost half their own length. The pelvics are also horizontally placed with their posterior basal margins approaching each other. There is no free appendage in the axil of the pelvic fins. They are separated from the anal fin by a distance equal to their own length. The anal opening is situated at the tip of a papilla-like growth which lies in a depression in front of the commencement of the anal fin. The anal fin misses the base of the caudal fin. The least height of the caudal peduncle is almost equal to its length. The caudal fin is almost as long as the head, with the free posterior margin lunate ; the upper portion is slightly longer than the lower.



TEXT-FIG. 2.—Air-bladder, scale and pharyngeal teeth of *Glaniopsis hanitschi* Boulenger. *a.* Scale from below the dorsal fin : ×11 *b* ; Air-bladder : ×11 *c* ; Pharyngeal bone and teeth : ×22.

The body is loach-like ; its depth is contained from 7 to 8·5 times in the total length. The body is covered with small scales, except on the ventral surface as far as the origin of the anal fin. The lateral line is complete.

A scale from below the lateral line is oval and marked with conspicuous circuli and radii. The nucleus is eccentric, being situated nearer the base than the apex. There are nine, well-spaced circuli, and 25 radii all round the scale. The circuli and the radii form a beautiful basket-work. In their structure, the scales deviate but little from the Cobitid type.

In spirit specimens, the dorsal surface is olivaceous brown, marked with transverse dark brown bands, spots or interrupted bands. Head is dark olive above. The ventral surface is whitish. The dorsal and the caudal fins are greyish ; the latter is provided with a blackish base. There is a dark mark in the axil of the pelvic fin. The other fins are olivaceous, somewhat lighter below.

The air-bladder is bilobed and the two lobes are connected by a transverse tube. All the structures are enclosed by bone. It is of the type usually found in *Nemachilus* and other hill-stream Cobitid fishes.

Systematic Position.—In its general form and structure, *Glaniopsis* differs little from *Nemachilus* and allied Cobitid genera, but in its greatly depressed head and anterior part of body, and the division of the pectoral fin into an adhesive outer portion and a vibrating inner portion, it shows an advance over the Cobitidae and approaches the Gastromyzoninae. *Glaniopsis* could thus be considered as a less specialised genus in the Gastromyzonid group of fishes.

Table of measurements in millimeters.

Standard length	97	86	83	74	70	69	63	59	53	45	42	33
Length of head ..	18	16	16	15	12	12	12	11	11	9	8	6
Height of head at occiput	9	8	9	6	6	6	7	5	6	5	4	3
Width of head ..	16	13	13	12	11	10	10	8	8	7	6	5
Length of snout ..	9	7	7	5	5	5	5	4	5	3	3	3
Diameter of eye ..	2	2	2	2	2	2	3	2	2	1	1	1
Interobital width	7	8	7	5	5	5	5	4	5	4	4	2
Depth of body ..	11	10	10	10	10	10	10	8	7	6	5	4
Length of caudal peduncle ..	4	3	4	2	2	3	2	2	2	3	2	1
Least height of caudal peduncle	9	8	9	7	7	6	7	5	5	5	4	3
Longest ray of dorsal fin ..	16	14	18	12	12	11	11	10	9	8	7	5
Length of pectoral fin	17	15	15	12	14	12	11	11	10	9	7	5
Length of pelvic fin	15	13	11	10	11	10	9	8	8	7	6	6
Longest ray of anal fin ..	14	11	11	10	9	9	8	9	7	6	5	3
Length of base of anal fin ..	6	4	5	4	4	4	4	4	3	3	3	2

NOTES ON SOME INDIAN POTAMONID CRABS (CRUSTACEA; DECAPODA).

By G. RAMAKRISHNA, *B.Sc. (Hons.), Assistant, Zoological Survey of India, Calcutta.*

This short note deals with certain features, hitherto overlooked, in some species of Indian freshwater crabs. Some new records have also been added, and the burrowing habits of *Potamon* (*Acanthotelphusa*) *martensi* Woodmason have been described.

I am grateful to Dr. S. L. Hora, Director, Zoological Survey of India, for suggesting this problem for study, to Dr. B. N. Chopra, Deputy Fisheries Development Adviser to the Government of India, Ministry of Agriculture, for valuable suggestions, and to Mr. K. K. Tiwari, Zoologist, Zoological Survey of India, for general help and checking the manuscript.

Paratelphusa (Barytelphusa) jacquemontii Rathbun.

1910. *Paratelphusa* (*Barytelphusa*) *jacquemontii*, Alcock, *Cat. Ind. Dec. Crust.* pt. i, fasc. ii, pp. 79-82, pl. xii, fig. 55.

Alcock stated that " In the abdomen of the adult male the length of the 6th segment is equal to its greatest breadth, the segment being squarish with the sides slightly concave; the length of the 7th segment exceeds its greatest breadth." I have, however, found that in a majority of cases the length of sixth abdominal segment of an adult male is somewhat shorter than its greatest breadth, and the length of the seventh segment equals its greatest breadth. The table of measurements (in millimeters) of twenty one adult males from various localities, given on page 90 clearly indicates this feature.

The following are the additional records of the distribution of this species :—

Regd. No.	Locality.	Collector and Date of Collection.
C 2656/1	Dwaraka, Kathiawar. ..	S. P. Agarkar. 9-3-1948.
C 2903/1	Kudranaia, midway between Kudradam and Abu cart road (Rajputana)	K. S. Pradhan. 16-12-1912.
C 2904/1	River Soorpur, 3 miles from Dungarpur town, Rajputtana ..	B. N. Chopra & M. L. Roonwal. 26-10-1941.
C 2905/1	Mirzapur, U. P.	T. N. V. Nair. 12-12-1946.
C 2619/1	River Jumna, Allahabad, U. P.	A. D. Imms. 1-3-1911.
C 2604/1	Chilka Lake, Orissa	N. Annandale. 23-11-1913.

Paratelphusa (Liotelphusa) austrina Alcock.

1910. *Paratelphusa* (*Liotelphusa*) *austrina*, Alcock, *Cat. Ind. Dec. Crust.*, pt. i, fasc. ii, p. 112, pl. viii, fig. 29.

Measurements in millimeters of 21 male specimens of **Paratelphusa (Barytelphusa) jacquemonti** *Rathbun.*

Reg. No.	Locality.	Donor.	Carapace.		Abdomen 6th segment.			Abdomen 7th segment.	
			Length.	Greatest breadth.	Depth.	Length.	Greatest breadth.	Length.	Greatest breadth.
3561/34	Calicut, S. India	G, Hadfield ..	38·8	52·95	21·6	7·65	9·8	7·4	7·4
C.2602/1	Bhawani river Nilgiry hills ..	Dr. Annandale ..	34·4	47·1	18·8	7·05	8·3	6·9	6·9
C.2602/1	Ditto	Ditto ..	29·8	40·1	16·0	5·9	7·2	6·1	6·0
C.2610/1	Bhawani river Nilgiris slope ..	Dr. Annandale ..	31·5	42·2	17·8	6·3	8·1	6·6	6·6
C.2610/1	Ditto	Ditto ..	19·1	25·2	10·1	4·1	5·0	3·9	3·9
C.2610/1	Ditto	Ditto ..	24·0	31·4	12·2	4·8	5·9	5·2	5·2
4113/4	Upper Godavari	Dr. Gaffrey.. ..	50·5	69·0	28·25	9·9	10·25	9·6	9·6
..	Eastern Ghats, ...	H. S. Pruthi ..	27·6	37·4	13·9	5·8	7·2	5·4	5·4
4109/4	Nasik	Cap. Houghton ..	68·3	99·2	42·6	13·4	15·8	13·7	12·2
C.2654/1	Kurki river	R. P. Mollins ..	27·9	37·0	14·6	6·0	6·6	5·2	5·2
C.2654/1	Ditto	Ditto ..	32·1	43·45	17·8	7·0	7·8	6·0	6·0
..	Khandla, Bombay ..	B. N. H. S... ..	31·5	43·6	17·0	7·0	7·5	6·3	6·3
..	In rock pools below great-Head waters, Belgaum Dt.	Drs. Prashad and H. S. Rao.	23·2	30·2	12·6	5·1	6·1	5·0	5·0
C.2655/1	Dindori, Mandla Dt. (C. P.) ..	Dr. B. N. Chopra ..	46·3	65·8	26·8	9·8	11·6	9·5	8·9
C.2645/1	Dangarh (Rewa St.) 2800 feet ..	H. S. Pruthi ..	21·5	28·6	11·1	5·00	5·6	4·5	4·5
4034/4	Hardwar, (U. P.)	F. Day	19·5	25·2	10·2	4·8	5·6	4·0	4·0
5452/10	Manbhum, Bihar	K. Hallowes ..	22·6	30·08	11·9	4·65	5·8	4·5	4·5
5451/10	Manbhum, Bihar	K. Hallowes ..	20·02	26·8	11·2	4·2	5·2	4·25	4·25
6417/3	Parashnath hills	F. Stoliczka ..	26·8	36·45	14·6	6·1	6·7	5·7	5·7
6902/3	Birbhum	Mus. Collector ..	21·7	28·45	10·4	4·25	5·6	4·25	4·25
C.2609/1	Purnagarh	J. Taylor	31·2	41·8	16·85	6·2	8·2	6·2	6·2

Alcock described this species from a single male specimen from South India. Since then, it has not been reported from anywhere else. I refer four examples from Peradeniya (Ceylon), (Reg. No. C 6822-25/10), to this species. One of the specimens which, apparently is, an adult male, yields the following measurements :—

Carapace.

Length	14·7 mm.
Greatest breadth	19·6 mm.
Depth	9·4 mm.
Front-length	5·6 mm.

Abdomen.

6th segment.	Length	2·9 mm.
	Greatest breadth	2·9 mm.
7th segment.	Length	2·9 mm.
	Greatest breadth	2·45 mm.

Front is less than one third the greatest breadth of the carapace. Chelipeds are unequal in both sexes, more so in the males. Under surface of merus is rugulose, but the carapace and hand are smooth. Inner angle of carpus possesses a blunt spine. In the larger cheliped fingers are shorter than hand. Fixed finger is slightly broadened, and the dactylus is arched so that the fingers gape a good deal, when the tips are apposed. The teeth are not very large. Four teeth on the fixed finger, and two on the dactylus can be distinctly made out.

Abdomen of the adult male is triangular, with last three segments narrow. The sixth abdominal segment has parallel sides and is as long as its proximal breadth. Seventh segment is tongue-shaped and longer than its maximum breadth.

Potamon (Acanthotelphusa) feae de Man.

1910. *Potamon (Acanthotelphusa) feae*, Alcock, *Cat. Ind. Dec. Crust.*, pt. i, fasc. ii, p. 66, pl. xi, fig. 51.

One adult male from the river Mainimukh, Chittagong Hill tracts, (East Pakistan), (Reg. No. C. 2906/1) which is referable to this species, differs from the description in certain features which are described below :—

The antero-lateral borders of the carapace are carved out into three teeth, exclusive of the orbital tooth. They are blunt and hence not clearly marked. The carapace is more convex, specially the gastric region. The corrugations on the surface of the carapace are well pronounced, more so the transverse corrugations of the epibranchial region. Front is broader, more deflexed, and broadly bilobed. Its edges are rugose and appear beaded to the naked eye. Cervical groove can only be traced in the posterior mesogastric region, where it is slightly deep. The spine on the inner angle of carpus of the chelipeds is blunt and very short.

This species was first described by de Man[1] from Upper Irrawadi, Burma. Later, Alcock, reported it from Suddea, hill stream near Harmotti and Dafla hills in Assam. The specimens at my disposal are from these localities—Teesta valley, Girish river and Bengal duars Terai, which extends the range of distribution of this species westwards along the Eastern Himalayan region.

Potamon (Acanthotelphusa) martensi Woodmason.

1910. *Potamon (Acanthotelphusa) martensi*, Alcock, *Cat. Ind. Dec. Crust.*, pt., i, fasc., ii, p. 68, pl. xi, fig. 52.

This species had so far been recorded from Bengal, Bihar and Uttar Pradesh (U. P.). Among the examples preserved in the Zoological Survey of India, there are several specimens from Danster-Wah, a canal in Larkhana District, Sindh, (Reg. No. C 2911/1), which can be referred to this species and thus extending its range of distribution to the west for a considerable distance.

Extensive observations were made on the burrowing habits of this species at Banaras, where it was found in abundance along the right bank of the Varuna river.

The burrows were situated right from the water level up to a distance of 40 to 50 feet away from water. They were surrounded by pellets of mud heaped up, so as to give an appearance of a small mound varying in height from 2 to 5 inches. Mc Cann[2] has given an account of such mounds, (he calls them castles), ranging in height from 2 to 8 inches, with reference to one of the common land crabs of Salsette Islands, *Paratelphusa (Barytelphusa) guerini* M. Edw.

The burrows were of various depths, ranging from 6 inches to a maximum of 3½ feet. They were slanting and not vertical and sufficiently broad to allow the sideway movements of the crab. Another interesting feature is that these burrows were 6 to 7 inches in depth near the edge of the water, but they became gradually deeper at distances away from the water level. It is no doubt, in search of wet soil, as such a habitat is quite essential for purposes of respiration. I wish to mention here Hora's[3] account about two species of crabs, *Varuna literata* (Fabr.) and *Sesarma tetragonum* (Fabr.), living in burrows at great depths ranging from 4 to 8 feet.

Usually only one crab was found in each of these burrows. The burrows were never inter-connected as was noticed by Wagle[4] in the case of some land crabs from western India.

These mounds were noticed during the winter months only, *i.e.*, between November and January.

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[1] de Man, J. G., *Ann. Mus. Genoa*, (2) XIX, p. 393 (1898).

[2] Mc Cann, C., *Jour. Bombay, Nat. Hist. Soc.* XXXIX, pp. 531-542 (1937).

[3] Hora, S. L., *Proc. Zool. Soc. London*, pp. 881-884 (1933).

[4] Wagle, P. V., *Dept. Agric. Bombay, Bull.* No. 118, p. 20 1924).

CONTRIBUTIONS TO THE FAUNA OF THE MANIPUR STATE, ASSAM.

PART IV. REPTILIA.

By M. N. ACHARJI, *M.Sc., Assistant Zoologist,* and *Miss* M. B. KRIPALANI, *M.Sc., Assistant, Zoological Survey of India, Indian Museum, Calcutta.*

I. INTRODUCTION.

In 1945, during the World War II, Dr. M. L. Roonwal[1] was appointed Mammalogist to the " Field Typhus Research Team " and for the greater part of his time was stationed in Manipur (Assam). During the tenure of his field service, he conducted an intensive faunastic survey of the area in connection with " Tsutsugamushi disease (Scrub Typhus)" and collected various types of animals. Some of the scientific reports[2] on the collection have already been published while another is awaiting publication.

Twenty seven examples of Reptilia[3] were collected. They were critically examined and notes on them are recorded here.

The collection comprised 13 species and subspecies as follows :—

Serpentes : Typhlopidae 1, Anilidae 1, Colubridae 6, Elapidae 1, Viperidae 1.

Sauria : Agamidae 2, Scincidae 1.

Though the herpetology of Assam is fairly well known and scientific reports were published by Wall[4] and others, the reptilian fauna of Manipur has received very little attention so far. In 1905 Allen[5] remarked that in Manipur, Cobras or any other kind of poisonous snakes are seldom met with but non-poisonous snakes are not uncommon.

Annandale[6], while writing the report on the " Aquatic and Amphibious mollusca of Manipur," agreed with Allen and noted that " Frogs and toads are not abundant. We saw no kind of water tortoise."

In the collection brought by Dr. Roonwal, there are two specimens of a rare species of snake, *Opheodryas doriae*, which was recorded from Manipur (Assam) by R. D. Oldham. Since then, it has not been collected from that area.

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[1] Lately Major, 15th Punjab Regiment, Indian Land Force.

[2] Roonwal, M. L., *Trans. Nat. Inst. Science* III, No. 2, pp. 67-122 (1949) ; *Rec. Ind. Mus.*, XLVI, pp. 123-126 (1949*a*) ; Roonwal, M. L. & Nath, B., *ibid.* XLVI, pp. 127-182 (1949*a*) ; and Roonwal, M. L., *Rec. Ind. Mus.* XLVII, pp. 1-64 (19) (in the press).

[3] It has been stated by Roonwal (*loc. cit.*, p. 68, 1949), that " In the Transmission of scrub typhus " reptiles (Lizards, snakes) play a very important role as a " Reservoir of infection " (normal or primary host).

[4] Wall, F., *Journ. Bombay Nat. Hist. Soc.* XVII, pp. 312-337 (1937).

[5] Allen, B. C., *Assam District Gazetter* IX, p. 10 (1905).

[6] Annandale, N., *Rec. Ind. Mus.* XXII, p. 537 (1924).

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All the specimens, with the exception of two snakes obtained by Major S. L. Kalra, were collected by Dr. Roonwal. The entire collection has now been incorporated in the general named collection of the Zoological Survey of India.

We wish to express here our indebtedness to Dr. M. L. Roonwal for affording us an opportunity to examine and report on this interesting material. We are grateful to Dr. S. L. Hora, Director, Zoological Survey of India, for kindly going through the manuscript and offering helpful suggestions.

The following species are represented in the collection :—

Snakes.

Family Typhlopidæ
Typhlops d. diardi (Schlegel).
4 Specimens.

Anilidae
Cylindrophis rufus burmanus Smith.
1 Specimen.

Colubridae
Elaphe radiata (Schlegel).
1 Specimen.
Ptyas korros (Schlegel).
1 Specimen.
Opheodryas doriae (Boulgr.).
2 Specimens.
Natrix p. piscator (Schneider).
1 Specimen.
Natrix stolata (Linn.)
3 Specimens.

Elapidae.
Naja n. Kaouthia Lesson.
2 Specimens.

Viperidae.
Vipera r. russelli (Shaw).
1 Specimen.

Lizards.

Family Agamidae
Calotes mystaceus (Dum. & Bibr.).
7 Specimens.
Calotes versicolor (Daudin).
1 Specimen.

Scincidae.
Lygosoma maculatum (Dum. & Bibr.).
2 Specimens.

II. Systematic Account.

Typhlops diardi (Schlegel).

(Diard's Blind Snake.)

1943. *Typhlops diardi*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 51.

Material.—(i) 2 Specimens collected on 1st and 10th August 1945, from the following localities :—" Typhus Lab. premises, 10 miles from Imphal on Dimapur Road " Manipur, *ca.* 3,000 ft., and another " found in open ground, 8 miles from Imphal town " *ca.* 2,570 ft. (Z.S.I. Register Nos. 20498 & 20499).

(ii) 2 specimens collected on 1st and 4th September 1945, from the " Army Camp ", (Z.S.I. Register Nos. 20496, 20497).

Lepidosis.—4 adults (unsexed total length 290-330 mm.) have 26 cales in the midbody.

In the " Indian Museum " collection, there is a specimen measuring 340 mm. in the total length (Reg. No. 19189) collected from Manipur (Assam), on 25th February 1920, by Annandale having 26 scales in the midbody. The specimen is stouter and longer in the body length by 10 mm., than the longest specimen under report.

Colour.—2 specimens collected from locality (i) are brownish above and lighter below, while specimens from locality (ii) are blackish grey above and dirty white below leaving a line of demarcation between the dorsal and the ventral surfaces, but according to Smith (*loc. cit.*, p. 52.) " the two colours not strongly contrasted."

Range.—Assam and Burma. In Burma it has been recorded from *ca.* 5,000 ft.

Cylindrophis rufus burmanus Smith.

(Laurentis Earth Snake.)

1943. *Cylindrophis rufus burmanus*, Smith, *Fauna. Brit. India*, Rept. & Amph. III, p. 97.

Material.—1 specimen (total length 285 mm., tail 9 mm.) collected on 28th August 1945, from Kalewa, *ca.* 360 ft., on River Chindwin, W Burma by Major S. L. Kalra. (Z.S.I. Register No. 2050).

Lepidosis.—Midbody 19 ; ventral 210 ; subcaudal 7.

Colour.—The ventral aspect of the specimen is chocolate brown with white crossbars which extend upto the tip of the tail. In many places these bars are incomplete.

Range.—Smith (*loc. cit.*, p. 96) has recognised two distinct races of the species, *viz.*, *Cylindrophis rufus* and *C. r. burmanus* from two different ranges of distribution. They vary in size and also in lepidosis. The former is found in " Siam and French Indo-China, South of latitude 17°N.; the Malay Peninsula and Archipelago ", while the latter is confined to " Tenasserim and Burma as far north as Myitkyina " The specimen under report was obtained at Kalewa, *ca.* 360 ft. (lat. 23°13N.) and agrees with the Burmese form *C. r. burmanus.*

Elaphe radiata (Schlegel).

(The Copperhead.)

1943. *Elaphe radiata*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 146.

Material.—1 specimen (total length 1245 mm.) collected from Kanglatongbi Camp, Imphal-Dimapur Road, Manipur (Assam), Milestone 117, on 8th November 1945. (Z.S.I. Register No. 20507).

Colour.—Collector's field note on the freshly killed specimen is as follows :—

> " Dorsum olivaceous, anterior half with two broad and two narrow and a third thin broken black stripe, starting from about 90 mm. from the tip of the snout. Head with black pattern of transverse and oblique stripe. Dorsal stripe fading out in post (posterior) part of body. Venter glistering silvery blue grey."

Head brown (in spirit specimen). Three black stripes radiating from the eye and a black band on the occipit. Tip of the tongue is black.

Range.—It is a common species found throughout Assam and Burma and ascends to the hills up to 5,000 ft.

Ptyas korros (Schlegel.)

(The Indo-Chinese Rat Snake).

1943. *Ptyas Korros*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 162.

Material.—1 specimen adult (♂) collected on 26th September 1945, from Kanglatongbi Camp, Imphal-Dimapur Road, Manipur (Assam), Milestone 117. (Z.S.I. Register No. 20510).

Lepidosis.—In this species the scales are in 15 rows in the midbody ; ventral 183 ; subcaudal 132 ; anal 2. There are 8 upper labials of which 4th and 5th touching the eye.

Colour.—It has got the usual colouration. The tip of the tongue is black.

Opheodrys doriae (Boulenger).

1943. *Opheodrys doriae*, Smith, *Fauna Brit. India* (Rept. & Amph.), III, p. 81.

Material.—2 specimens were collected in the month of September 1945 as follows :—

(i) 1 specimen (total length 770 mm.), from Imphal Valley Manipur (Assam), *ca.* 4,000 ft., on 28th September. (Z.S.I. Register No. 20504). Collector's note on the field label " Green Snake."

(ii) 1 specimen (total length 510 mm.), collected " in the grass on a hill ", from Imphal, Manipur (Assam), on 22nd September. (Z.S.I. Register No. 20503). Collector's note in the field label " Dorsal bright golden green, ventral white with pale yellow tinge."

Lepidosis.—In both the specimens loreal absent, but in the "Indian Museum " specimen (Reg. No. 11939) one small loreal is present and is little longer than deep. Upper labials 7, 4th & 5th entering the eye ; 4 lower labials in contact with the anterior chin-shield. Scale Counts : ventral 174 & 170 ; subcaudals 76 and 74 ; anal entire.

Colour.—There is a single specimen of this species (Reg. No. 11939) in the collection which was obtained from Manipur (Assam), by R. D. Oldham in the year 1882. The specimen is in a good condition with colouration somewhat faded. The examples under report are uniform green with slight bluish tinge above, extending to the sides upto the edge of the ventrals.

Range.—Known from Assam (Manipur) and some parts of upper Burma (Kachin Hills, *ca.* 4,500 ft.).

Remarks.—It is a very rare species " only three specimens are known " from Assam and Burma. Wall[1] has stated that *doriae* is a " rare snake confined to the hills above about 4,000 ft." So far, as is known this specimen appears to be the second record from Manipur (Assam) area and has been collected from there after a lapse of about 63 years.

[1] Wall, F., *Journ. Bombay Nat. Hist. Soc.* XXX, p. 816 (1925).

Oligodon albocinctus (Cantor).

(The Light-barred Kurki Snake.)

1943. *Oligodon albocinctus*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 211.

Material.—1 specimen collected in early part of August 1945, near Army Camp, in a valley 8 miles south of Imphal Manipur State (Assam), *ca.*, 2,600—4,000 ft. (Z.S.I. Register No. 20502).

Lepidosis.—Supralabials 7, 3rd & 4th touching the eye. Scales in the midbody 19.

Colour.—The back is crossed by 25 bars having a narrow white strip in the middle bordered on the sides with chestnut black bands. There are 8 bars of the same description on the tail, situated almost at regular intervals 18 mm. apart in the whole length of the specimen. Each bar is almost of uniform width comprising 2 scales in the body length. The central stripe blends with the light coloured under parts.

Remarks.—Two distinct colour forms could be recognised. It has not been possible to separate them into two distinct species as there is no positive morphological character on which the separation could be based. The specimen under report agrees with form I as stated by Smith (*loc. cit.*, p. 213).

It is essentially a hill form but has also been recorded from plains situated near hilly area.

Natrix piscator piscator (Schneider).

(The Chequered Water Snake.)

1943. *Natrix piscator piscator*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 295.

Material.—1 specimen (total length 672 mm.), collected from "Jungle, around Kanglatongbi Camp, Imphal-Dimapur Road, Manipur (Assam) Milestone 117, on 29th October 1945." The specimen was purchased. (Z.S.I. Register No. 20508).

Lepidosis.—Scale counts: midbody 19; ventral 148; subcaudal 72.

Colour.—There are blackish spots on the dorsal surface forming "Chess board pattern." The under surface white with yellowish tinge.

Natrix stolata (Linn.).

(The Striped Keelback.)

1943. *Natrix stolata*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 303.

Material.—3 specimens collected between June to October 1945, as follows :—

(i) 2 specimens (one juv.) from Imphal Manipur (Assam), on June 1945, by Major S. L. Kalra.

(ii) 1 specimen from Imphal Valley, Manipur (Assam), on 11th October 1945. (Z.S.I. Register No. 20500).

Remarks.—The specimen collected from locality (i) could not be correctly determined as the head portion of one of them has been damaged (juveline specimen) and in the other it is lost. The second one is only a cut up skin. From the body colouration and lepidosis they however, approach to *Natrix* sp. These two specimens have not been incorporated in the " Indian Museum " collection.

Naja naja Kaouthia (Lesson).

(The Indian Cobra.)

1943. *Naja naja Kaouthia*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 431.

Material.—2 specimens collected in August and November 1945 as follows :—

(i) From Imphal town, *ca.* 2,570 ft., on 14th November 1945. (Z.S.I. Register No. 20505).

(ii) From Kalewa, *ca.* 360 ft., on River Chindwin, W Burma on 28th August 1945, by Major S. L. Kalra. (Z.S.I. Register No. 20506).

Colour.—The specimen collected from locality (i) is a full grown adult, measuring 1345 mm., in total length, brownish above with indistinct hoodmark. (ii) one juveline specimen, having a total length 445 mm., with blackish dorsal colour with bluish sheen and O-shaped (monocellate) hood mark. The centre of the design is black with amber coloured ring right round.

Smith (*loc. cit.*, p. 428) on the basis of " Hood design " separated " Indian Cobras " (*Naja naja*), in to three distinct races, which can be correlated to some extent with geographical distribution.

Wall[1] has given three coloured plates showing the different types of " Hood markings " generally found in the Indian Cobras. The " Hood marking " of the specimen under report tallys with markings as shown by Wall under the *var. fasiciata.*

Vipera russelli russelli (Shaw).

(The Russell's Viper.)

1943. *Vipera russelli russelli*, Smith, *Fauna. Brit. India* (Rept. & Amph.), III, p. 483.

Material.—1 specimen adult (total length 937 mm.) collected in the " Jungle near Modbung, *ca.* 3,750 ft., Manipur (Assam), off Milestone 117, on 12th November 1945." Collector's field number R 10/12.11.45 (Purchased). (Z.S.I. Register No. 20509).

Range.—It has got a very sporadic distribution. The typical form is distributed throughout the whole length of the Indian Empire from Ceylon to the Himalayas and from Sind to Burma. In many places within this range it is very common while in other it is rare or totally absent.[2]

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[1] Wall, F., *Journ. Bombay Nat. Hist. Soc.* XXII, p. 243, pl. xxi, (1913).
[2] Wall, F., *ibid.* XVIII, p. 16 (1907).

Lizards.

Calotes mystaceus Dum. & Bibr.

1935. *Calotes mystaceus*, Smith, *Fauna. Brit. India* (Rept. Amph.), II, p. 197.

Material.—7 specimens collected during September to November 1945, as follows :—

(i) 3 adults (♀♀) from Kanglatongbi Camp on Imphal-Dimapur Road, Manipur (Assam), *ca.* 3,000—3,500 ft., on 12th October 1945, (Z.S.I. Register Nos. 20486, 20487 and 20490). Collector's note on field labels (Reg. Nos. 20486, 20487) as " Not infrequent, seen occasionally."

(ii) 2 adults (♀♀) from Imphal Valley, Manipur (Assam), *ca.* 2,600 ft., on 18th November 1945, (Z.S.I. Register Nos. 20488, 20489). Collector's note on field labels " Change colours."

(iii) 2 juvenile (unsexed) from Kanglatongbi Camp on Imphal-Dimapur Road, Manipur (Assam), *ca.* 3,000—3,500 ft., between 14th and 19th September 1945, (Z.S.I. Register Nos. 20491, 20492).

TABLE I.

Scale counts between eye and tympanum.

	Z. S. I. Register numbers.						
	20486	20487	20488	20489	20490	20491	20492
Enlarged scales between eye and tympanum ..	4	3	4	3	3	3	3

It will be seen from the scale count chart (Table I.) that out of 7 specimens only 2 (Reg. Nos. 20486, 20488) have got 4 scales and the rest possessing 3 scales which are commonly met with examples belonging to this species.

Smith (*loc. cit.*, p. 197), has stated that the average measurement from snout to vent is 140 mm., but in the specimens[1] under report only one example (Register No. 20486) gave 130 mm., from snout to vent while rest of the measurements of the specimens tally with that of Smith.

Colour.—Three adults (Register Nos. 20486, 204888 and 20499) are brownish grey with 3 prominent brown spots on the neck and the other 2 behind them, while in 2 examples (Register Nos. 20487, 29489) brown spots are absent.

Range.—This species is chiefly distributed in Tennasserim, Burma and Siam, buthas not been recorded so far from Assam.

[1] Out of 7 specimens only measurements of 5 examples have been taken and the juvenile forms have been excluded.

TABLE II.

Measurements of adult specimens in mm.

	Z.S.I. Register Numbers.				
	20486	20487	20488	20489	20490
Length of body ..	102·0	100·0	88·0	58·0	52·0
Length of head	28·0	26·0	26·0	20·0	18·0
Total length (Snout to vent)	130·0	126·0	114·0	78·0	70·0
Width of head	15·0	18·0	17·0	13·5	13·0
Length of snout ..	11·0	12·0	11·5	9·0	8·0
Diameter of eye	8·8·0	7·5	7·0	5·5	5·0
Diameter of tympanum .	4·3·0	4·0	4·0	3·2	3·0
Distance between eye and ear ..	7·0	6·5	6·0	5·0	4·5
Length of forelimb	48·0	54·0	50·0	40·0	35·0
Length of hindlimb ..	78·0	75·0	70·0	55·0	50·0

Calotes versicolor (Daudin).

1935. *Calotes versicolor*, Smith, *Fauna. Brit. India* (Rept. & Amph.), II, p. 189.

Material.—1 adult (unsexed) specimen collected from Kanglatongbi, Imphal-Dimapur Road, Manipur (Assam), *Ca.* 3,000-3,500 ft., on 14th-19th September 1945 (Z.S.I. Register No. 20493).

Range.—It is widely distributed throughout India, Ceylon, Indo-China. Annandale[1] recorded it from an altitute of 6,000 ft.

Lygosoma maculatum (Blyth).

1935. *Lygosoma maculatum*, Smith, *Fauna. Brit. India* (Rept. & Amph.), II, p. 285.

Material.—2 specimens adult collected from two localities as follows:—

(i) From forest 6″ below damp soil near Modbung, *ca.* 3,750 ft., Manipur (Assam), on 2nd November 1945. (Z.S.I. Register No. 20495).

(ii) From Oak-Scrub Jungle near Army Camp, Kanglatongbi, Imphal-Dimapur Road, Manipur (Assam) on 15th September 1945. (Z.S.I. Register No. 20494).

Lepidosis.—According to Smith (*loc. cit.*, p. 285) there are 7 supralabials of which 5th and 6th are situated below the eye. In the specimens under report 6th and 7th supralabials are situated below the eye.

Total length (snout to vent) : 45 mm. and 50 mm. respectively. Scales round the body : 40.

Colour.—Lower parts of the flanks white and not " thickly speckled with black and white" as observed by Smith (*loc. cit.*, p. 286).

[1] Annandale, N., *Rec. Ind. Mus.* III, pp. 253-257 (1909).

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).

By K. S. PRADHAN, *M.Sc., Assistant Zoologist, Zoological Survey of India, Calcutta.*

In April 1947, a party of the Zoological Survey of India was sent out to Mirzapur district (Uttar Pradesh) in connection with the survey of the waters connected with the proposed Rihand reservoir, especially with a view to ascertaining what quantity of edible fish could be obtained if the fisheries were developed in the reservoir[1]. The party made extensive collections of various groups of animals from the Rihand river round about the Dam Site at Pipri[2], about 100 miles from Mirzapur. At the time the survey was undertaken all tributaries of the Rihand river had almost dried up and the Rihand river itself was reduced to a very shallow stream about two to three feet deep, except at certain places on the sides where the depth varied from about six to seven feet. Some more parties were subsequently sent to carry out the survey in December 1947, early March 1948 and later in April 1948. Hora[3] has given a detailed account of the topography and also of the fish fauna of the Rihand river and its Zoogeographical significance.

I had the opportunity to examine the collection of Aquatic Rhynchota made by the Survey parties and while examining the collection came across four interesting apterous female specimens of water striders belonging to the faimly Gerridae, sub-family Ptilomerinae. The specimens doubtless seemed to be new to science and are described in the present paper as a new species of *Teratobates* under the name *Teratobates rihandi*. One of the specimens was sent to Dr. W E. China of the British Museum, London, for favour of comparison with the named material and opinion. I am highly grateful to Dr. W E. China for the courtesy in sending me his opinion on the new insect sent to him for comparison with the named material in the British Museum. My sincere thanks are also due to Dr. S. L. Hora for certain valuable suggestions.

The collection made from time to time by the Survey parties from the areas surveyed by them comprises fifteen species belonging to twelve different genera of the following seven families :

Family NEPIDAE.

1. *Laccotrephes ruber* (Linn.).
2. *Ranatra elongata* Fabricius.
3. *Cercotmetus fumosus* Distant.

[1] For an article on the construction of dams and their effects on fisheries of rivers *vide* Hora, S. L., *Central Board of Irrigation Journal* IV (2), pp. 113-118 (1947).

[2] Pipri is a village in Pargana Singrauli, Tehsil Dudhi, District Mirzapur.

[3] Hora, S. L., *Journ. Zool. Soc. India* I (I), pp. 1-7 (1949).

Family NAUCORIDAE.
4. *Heleocoris bengalensis* Montandon.
Family NOTONECTIDAE.
5. *Anisops nasuta* Fieber.
6. *Anisops nivea* (Fabr.).
7. *Anisops (Anisops) varius* Fieb.
Family CORIXIDAE.
8. *Corixa (Tropocorixa) distorta* Distant.
9. *Micronecta (Dichaetonecta) prashadana* Hutchinson.
Family HYDROMETRIDAE.
10. *Hydrometra vittata* Stål.
Family VELIIDAE.
11. *Rhagovelia nigricans* (Burm.).
Family GERRIDAE.
12. *Limnogonus nitidus* (Mayr).
13. *Limnogonus parvulus* (Stål).
14. *Metrocoris stali* (Dohrn).
15. *Teratobates rihandi*, sp. nov.

With the exception of the new species described below, the other insects listed above call for no comments, being widely distributed and well known taxonomically.

The genus *Teratobates* Esaki[1] has hitherto been known only by a single species *T bilobatus* recorded from Katmandu, Nepal and Naini Tal District (Plains), U. P.

Teratobates rihandi, sp. nov.

Head pale brown and longer than the greatest width between eyes; a central longitudinal spot extending from its anterior end to the vertex and a transverse fascia present at its posterior margin, slightly emarginate in the middle, black; the central spot at its posterior margin deeply emarginate; antennal tubercles tipped with black; eyes large and prominent, dark reddish brown (when examined in spirit), moderately emarginate interiorly; portion of head in front of eyes longer than the rest of head; antennae shorter than the body, dark fuscous except for an elongate ochraceous spot on the underside of the fourth segment near the tip, the first segment much longer than the three other segments together, third and fourth subequal, second longer than each of them (Text-fig. *1d*), measurements of the four segments and inter-segmental joints between second, third and fourth as given below:—

I Antennal segment ..	3·53 mm.
II Antennal segment	0·88 mm.
Inter-segmental joint between II and III.	0·058 mm.
III Antennal segment ..	0·70 mm.
Inter-segmental joint between III and IV	0·044 mm.
IV Antennal segment	0·64 mm.

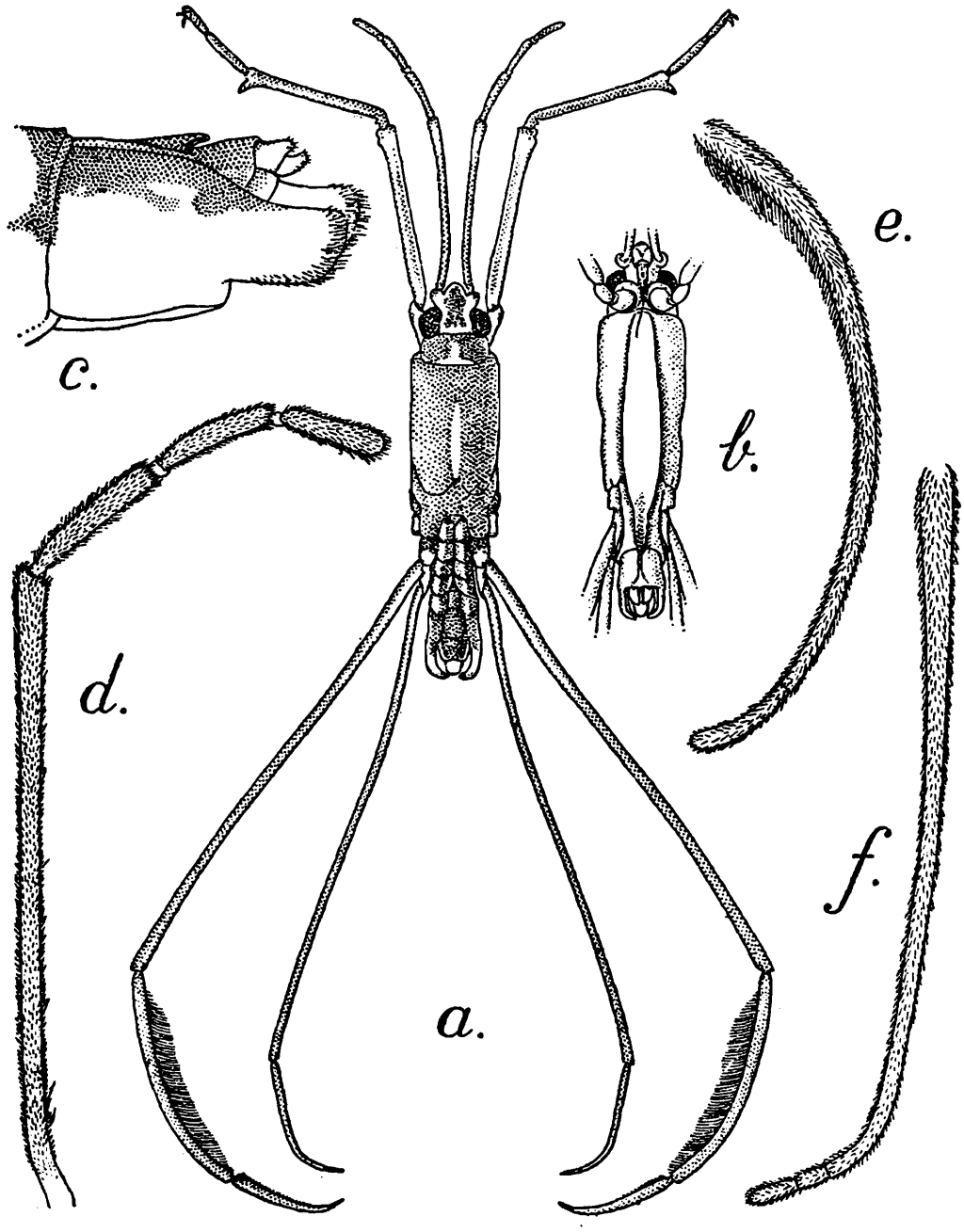
Rrostrum not passing beyond anterior coxae, third joint longest, distal one-third of the third and entire fourth joint, piceous.

Pronotum shining black except for an inverted T-shaped pale yellowish-brown mark touching the posterior margin, the vertical arm of the T, however, much reduced (Text-fig. 1*a*), anterior margin straight, posterior margin slightly sinuate, pronotum shorter than head and covered with silvery grey pubescence, prosternum pale-yellowish; meso- and metanotum shining black with silvery grey pubescence, the former provided with a central longitudinal yellowish-brown fascia in

[1] Esaki, T., *Eos* III, pp. 251-268 (1927).

the posterior three-fourths of its length, the fascia almost reaching the posterior margin of the mesonotum, a median longitudinal rather indistinct groove-like depression noticeable in the region of the fascia suture between meso- and metanotum not straight in the middle but sinuate and more or less W-shaped, meso-acetabula with a ventral longitudinal split, lateral region of meso- and metathorax black.

Abdomen above and on lateral sides black, narrower in the proximal third of its length, gradually widening from the fourth visible segment behind up to the penultimate segment, widest in the region of the sixth



TEXT-FIG. 1.—*Teratobates rihandi*, sp. nov.

a. Dorsal view of the apterous female : ×5½ ; *b*. Ventral view of a paratype female : ×5½ ; *c*. Lateral view of the terminal region of the abdomen, showing the drawn out lateral lobes of the sixth abdominal segment which are apically rounded : ×21½ ; *d*. Antenna : ×19½ ; *e*. Intermediate tarsus : ×34⅔ ; *f*. Posterior tibia and tarsus : ×34⅔.

visible segment, terminal segment pale ochraceous, short, and almost as long as broad with a few short fine bristles at its posterior margin, onnexivum in the region of the first to fifth abdominal segments very

conspicuous, fairly high or vertical, tergites of first three visible segments inconspicuous, the connexivum of either side in contact with each other along the median axis in this region, fourth tergite and the tergites of subsequent segments distinctly visible, the former appearing almost triangular in shape, sixth abdominal tergite longer than the fifth and extending over the penultimate segment for a short distance, posterior margin of the *sixth* tergite slightly sinuate or emarginate in the middle, sixth visible segment drawn out into two long, flattened, plate-like and apically rounded lateral lobes extending almost upto the posterior limit of the abdomen (exact shape of the lobes as seen in the Text-fig. *1c*); in the paratype specimens sixth abdominal tergite appears to be the longest and extends over the penultimate segment for a considerable distance leaving only a small portion of the latter visible from the dorsal side, the posterior margin of sixth tergite distinctly emarginate in the middle and the apically rounded lateral lobes of the sixth visible segment extend almost as far beyond the posterior limit of the abdomen as the length of the terminal abdominal segment; body beneath pale ochraceous and covered with silvery-grey pubescence.

Anterior acetabulae, coxae, trochanters and femora pale ochraceous, the latter with three black longitudinal lines, *viz.*, a dorsal, an outer lateral and a ventro-lateral, tibia and tarsus dark fuscous, femur distinctly longer than tibia, the latter with a distinct apical spine-like protuberance, tarsus with anteapical claws, first tarsal segment longer than the second but *not twice as long as the latter*; meso- and meta-acetabula black above, mesoacetabula with a ventral longitudinal split; intermediate and posterior coxae, trochanters and approximately basal one-third of femora, pale yellowish, distal two-thirds of femora, entire tibiae and tarsi dark fuscous, intermediate and posterior femora almost equal in length; middle femur more than twice as long as the middle tibia, the latter a little less than twice as long as the tarsus, first joint of intermediate tarsus almost six times the length of the second, intermediate tibiae with a fine fringe of long conspicuous hairs, tarsi thin and slender, tapering towards the apex and without claws, first tarsal joint with a fine fringe of short hairs in basal one-fourth, the fringe distinctly visible in the specimens preserved in spirit; posterior femur more than four times as long as the tibia and thinner than the intermediate femur, posterior tarsus very short, without claws, first segment slightly shorter than the second; measurements of the various joints of fore-, mid- and hind legs as given below :—

Leg	Femur	Tibia	Tarsus	
			First joint	Second joint
Anterior	3·5 mm.	2·9 mm.	1·14 mm.	0·73 mm.
Middle	9·7 mm.	4·41 mm.	2·05 mm.	0·35 mm.
Hind	9·9 mm.	2·24 mm.	0·11 mm.	0·17 mm.

Body widest in the anterior region of mesonotum and more than three times as long as the greatest width.

Length of body : 7·2 mm.

Greatest width : 1·67 mm.

Type-specimens.—Holotype: one female No. $6358/_{H7}$ and *Paratypes:* three females No.$6359/_{H7}$, Zoological Survey of India, Calcutta.

Locality.—Rihand river, near Dam site at an altitude *ca.* 750 ft., about one hundred miles away from Mirzapur (27-4-1947).

Remarks.—The new species is distinguished from *T bilobatus* Esaki by its characteristic apically rounded lobes of the sixth visible abdominal segment.

The four female specimens were found on a stone partly submerged in water, and an examination of the underside of the body revealed that they possess a distinctly demarcated flattened area which probably helps them in adhering to the stones and partly submerged rocky boulders lying at the edge of water or in the bed of the fast running hill streams. The modification is definitely in relation to the adaptation and probably helps the insects to climb up a stone or rocky boulder and protects them from being washed away by the rapid currents of water. This is in conformity with the observations made by Hora (1930)[1] as he writes that " In all the hill-stream animals there is a strong tendency to apply their ventral surfaces to the substratum as closely as possible, and this would necessitate the perfect smoothness of the parts of the body that come in contact with the rocks." The considerable length of the first joint of antenna and of intermediate and posterior femora has been acquired by the insect as an adaptation to the habitat. The fringe of long hairs on the intermediate tibiae is admirably suited for swimming purposes. The absence of claws in the middle and hind pair of legs, and the slender, tapering form of these appendages is an adaptation for offering minimum resistance to swift current in the hill stream. The long appendages can be used by these insects to balance the body while swaying from side to side and to adjust themselves to the changes in the velocity of the current; they also enable them to raise their body above the surface of water while making quick movements in the swift current in order to minimise the resistance due to the friction of the ventral surface of the body against the surface of the swift flowing water, the almost cylindrical body-form appears to be equally well adapted to present a stream-line to the fast flowing water.

The elongated, cylindrical body, and long, thin, tapering legs are useful adaptations for the insects living in and moving about on the surface of the swift running water. The majority of insects, nymphs or larvae which live in narrow crevices among stones on the bed of the swift flowing streams usually have their body greatly flattened or depressed and it is so modified as to present a stream-line form to the current and offer as little resistance as possible; the depressed body form is further helpful to them in their movement through narrow crevices among stones. Besides, they are generally provided with a number of spines arranged on the body to facilitate easy anchoring to the substratum as a measure of protection from being washed away by the tearing away force of the swift flowing streams. For a discussion and detailed account of the adaptive modifications of the larval and nymphal stages of various orders of insects inhabiting swift flowing hill streams of India a reference may be made to Hora (1930).

[1] Hora, S. L., *Phil. Trans. Roy. Soc. London* (B) CCXVIII, pp. 171-282 (1930).

RESPIRATORY AND OTHER ADAPTIVE MODIFICATIONS IN THE GENUS *GYRINOCHEILUS* VAILLANT AND THEIR SIGNIFICANCE IN CONSTITUTING THE FAMILY GYRINOCHEILIDAE HORA.

By K. C. JAYARAM, *B.Sc., Zoological Survey of India, Indian Museum, Calcutta.*

INTRODUCTION.

The remarkable genus *Gyrinocheilus* was established by Vaillant[1] in 1902 for *Gyrinocheilus pustulosus* from Borneo. In 1906, Berg[2] described *G. kazanakoi* from a part of South-eastern Thailand, now in Cambodia. The first fish, *Psilorhynchus aymonieri*, referable to this genus was, however, described by Tirant[3] in 1883, but as he placed it in the genus *Psilorhynchus* McClelland and gave poor description and figures, no notice of it seems to have been taken by later workers, until Hora[4] in 1935, having obtained photographs of the type-specimen, preserved in the Museum of Natural Sciences of Lyons, was able to decide that it was not a *Psilorhynchus* but a *Gyrinocheilus* identical with *G. kazanakoi* Berg.

The systematic position of the genus remained a matter of controversy for a long time. Vaillant referred it to the subfamily Homalopterinae and Boulenger [5] opined that it should represent a separate subfamily. Berg had erected a subfamily Gyrinocheilini to accommodate it, in 1906.

Regan [6], in 1911, however remarked that the place of *Gyrinocheilus* "in the system seems to be in the family Cyprinidae next to *Crossocheilus* and *Discognathus*". He also added, "to make it the type of a separate family or subfamily would merely obscure its relationships". Weber and Beaufort [7], included it in the family Cyprinidae without any comment. Hora[8], in 1923 erected the family Gyrinocheilidae for this genus and stated that:

> "There seems to be little doubt that judging from their appearance the members of the genus *Gyrinocheilus* are remarkably similar to those of the genera *Crossocheilus* and *Garra*, but this outward similarity, in my opinion, is directly correlated with the life of these fishes in moderately rapid running waters. The presence of "the slender toothless lower pharyngeals", the structure of the scales, the remarkable modification of the gill-openings to form inhalent and exhalent apertures and the

[1] Vaillant, M. L., *Notes Leyden Mus.* XXIV, pp. 107-122, figs. 30-32, pls. i-ii; *Comp. Rend. Acad. Sci.* CXXXV, p. 702 (1902).

[2] Berg, L. S., *St. Petersberg Trav. Soc. Nat. Compt. Rend.* XXXVII, pp. 305-307; *deutsches Re's* 364-366 (1906).

[3] Tirant, *Bull. Soc. Etudes Indochines*, p. 35 (1883).

[4] Hora, S. L., *Rec. Ind. Mus.* XXXVII, pp. 459-461, figs. 2 (1935).

[5] Boulenger, G. A., *Camb. Nat. Hist.* VII, p. 582 (1909).

[6] Regan, C. T., *Ann. Mag. Nat. Hist. Soc.* VIII, (8), pp. 29-30 (1911).

[7] Weber and Beaufort, L., *Fish. Indo-Austral. Archipel.* III, p. 224 (1916).

[8] Hora, S. L., *Journ. Nat. Hist. Siam Soc.* VI, p. 159, pl. xii (1925).

> structure of the mouth, lips and jaws are in my opinion better defined characters than those that seperate Cyprinidae, Cobitidae and Homalopteridae from one another."

Hora's fixation of the position of the genus has not so far been questioned and later workers, such as Berg[1] and Smith[2], have accepted the family in their systems of classification. Jordan[3], however included *Gyrinocheilus* under the family Homalopteridae.

A search through literature reveals that nothing further has been done to evaluate Hora's findings. The genus deserves thorough treatment and the elucidation of its affinities will definitely throw more light in understanding the systematics of other allied genera.

Dr. Hora placed at my disposal some specimens of this interesting genus which enabled me to work out the systematic position and details of some internal organs of *Gyrinocheilus*. A comparison of *Gyrinocheilus* with other allied genera, the respiratory and other adaptive modifications that form its family characteristics, its internal anatomy and their important details are given in the following pages.

The work was carried out in the laboratories of the Zoological Survey of India, under the guidance of Dr. S. L. Hora. I am highly indebted to him for his help, guidance, encouragement and supervision. I have examined 15 specimens of *Gyrinocheilus aymonieri* (Tirant) from Siam, now preserved in the collection of the Zoological Survey of India, Calcutta.

AIR-BLADDERS OF *Garra*, *Crossocheilus* AND *Gyrinocheilus*.

In the classification of Cyprinoid fishes, the form and structure of the air-bladder are regarded as characters of great taxonomic value. The genus *Gyrinocheilus* cannot be assigned to the Homalopteridae as it possesses a well-developed air-bladder lying free in the abdominal cavity. In this respect, it agrees with the true Cyprinid fishes, but we may compare the structure of the bladder here, in the genera *Garra*, *Crossocheilus* and *Gyrinocheilus* supposed to be closely related by Regan.

Hora (1923, *loc. cit.* p. 160), gives the following description of the air-bladder of *Gyrinocheilus* which fits in with almost all the specimens that I have examined :

> "The anterior chamber is almost circular in outline and has very thin walls, but is covered by a thick fibrous coat which attaches it firmly to the body wall; just at its termination the pneumatic duct from the oesophagus opens into the bladder. This chamber is followed by a short narrow tube, which dilates into another chamber, behind which the bladder is continued as a narrow cylindrical tube to its termination. The walls of the last three parts are moderately thick."

The narrow tube that connects the two dilated chambers is about half the length of the anterior chamber. In the case of *Garra*, the form of the air-bladder varies among its species and even among the different individuals of the same species. In all the less modified species of *Garra*, such as *adiscus*, *rossicus*, *blanfordi* and *rufus*, the bladder is of

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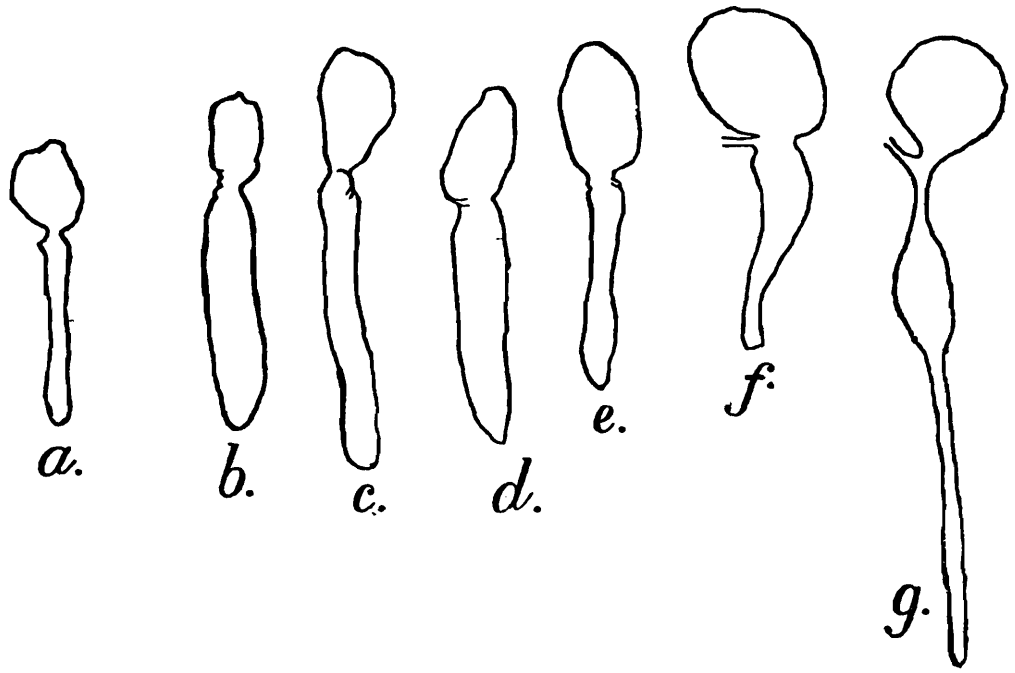
[1] Berg. L. S., *Classification of fishes both recent and fossil*, p. 269, 445 (1947). English and Russian, J. W. Edwards, Ann. Arbor, Michigan, U. S. A.

[2] Smith, H. M., *Bull. U. S. Nat. Mus.* (188), pp. 281-286 (1945).

[3] Jordan, D. S., *Stanford. Univ. Publn. Biol. Ser.*, III, p. 145 (1923).

the normal type generally present in the Cyprinidae, such as *Labeo* and *Cirrihina*. The anterior chamber is smaller than the posterior and is in the form of a short massive cylinder. The posterior chamber is almost as broad as the anterior and thence it gradually tapers to the end. But in the specialised species of *Garra* such as *gravelyi*, *jenkinsonianum* and *mullya* and in *Crossocheilus*, the posterior chamber, instead of being swollen in the middle is of uniform thickness throughout, with its wall somewhat thickened. In still more specialised forms such as *stenorhynchus*, *arabica*, *gotyla*, *nasutus* and *lissorhynchus* the whole of the bladder is greatly reduced and is covered by a thick, fibrous coat and is firmly fixed to the body wall. In some species the posterior chamber is greatly reduced and its cavity almost obliterated. (After Hora[1].)



TEXT-FIG. I.—Comparative drawings of the air-bladders of the various species of *Garra* *Crossocheilus* and *Gyrinocheilus* ("after Hora") ×⅔
a. Garra mullya; *b. Garra jenkinsonianum*; *c. Garra gravelyi*; *d. Garra mullya* hill-stream form; *e. Crossocheilus latia*; *f.* and *g. Gyrinocheilus aymonieri.*

The air-bladder of *Gyrinocheilus* would thus appear to be almost like the specialised species of *Garra* and *Crossocheilus*. In all these forms, the posterior chamber shows great reduction and the walls are thickened. The air-bladder of *Gyrinocheilus* is more reduced than that of *Crossocheilus*, but is larger than those of the more highly specialised species of *Garra*.

A comparison of the drawings of the air-bladders of the various species given here show the trend of modifications in these fishes. Judging by this character alone, *Gyrinocheilus* is definitely assignable to the true Cyprinid stock.

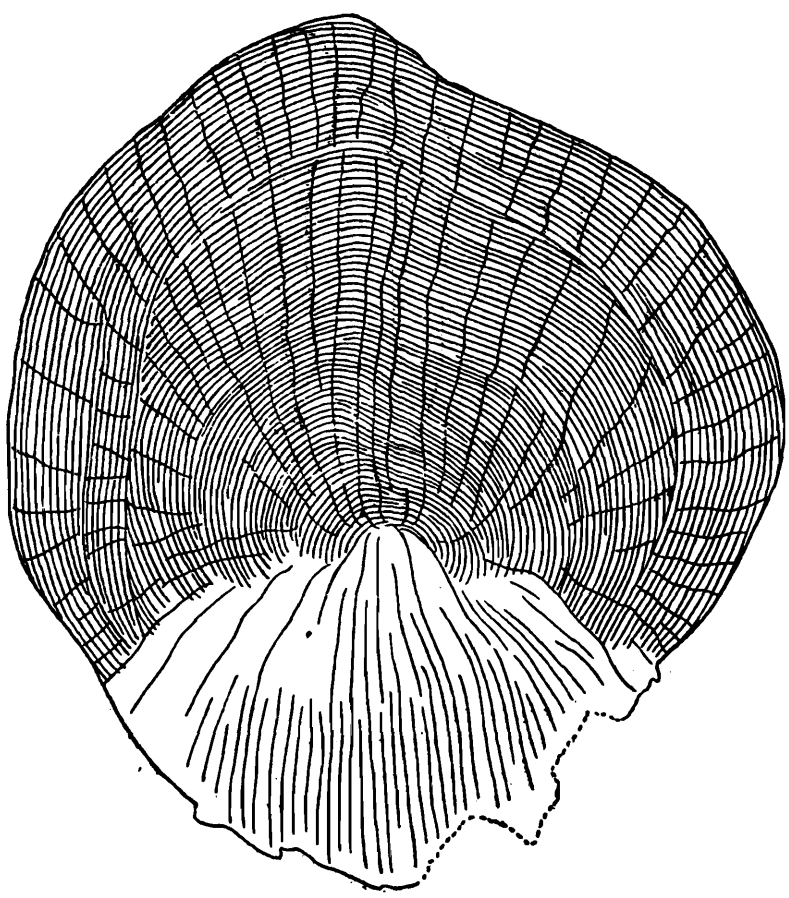
STRUCTURE OF SCALES IN *Gyrinocheilus*, *Garra* AND *Crossocheilus*.

A scale from below base of dorsal fin was taken in each case and studied. The scale of *Gyrinocheilus* is oval in shape with an undulating margin. The basal region is more conical than the top. The top portion

[1] Hora, S. L., *Rec. Ind. Mus.* XXII, p. 546 (1921).

is lobed and the scale is compressed laterally. The nucleus is in the center. There are about 40 or 50 circulii and about 40 to 45 radii. Only about 40 of them reach the center.

The scale of *Garra* resembles that of *Gyrinocheilus* in shape and structure. The nucleus is almost near the center, though not exactly so. The radii and the circulii are also disposed of as in that of *Gyrinocheilus*. The scale of *Crossocheilus* is more or less like that of *Garra* and *Gyrinocheilus* in outline but the apex is a bit conical. The nucleus is eccentric and is towards the base. The radii and the circulii are comparatively lesser in number. The scale of *Gyrinocheilus* is thus more allied to *Garra* than to that of *Crossocheilus*. Judging by this character also, the genus is assignable to the true Cyprinid stock of fishes.



TEXT-FIG. 2.—Drawing of a scale from below base of dorsal fin of *Gyrinocheilus aymonieri* × 18.

ALIMENTARY CANAL OF *Gyrinocheilus*.

The alimentary canal of *Gyrinocheilus* has been fully described and figured by Vaillant. (1902, *loc. cit.*, pl. I and II.) The oesophagus and the stomach are bent in the form of a U. The intestines are coiled up and gradually tapers towards the caecum.

The late Dr. H. M. Smith informed Dr. Hora, that the fish feeds on algae and slime and that it scrapes encrusting material with the help of its jaws. The belief that the peculiar lips are used for scooping up mud on which the fish is supposed to feed is erroneous, and actually the fish scrapes algae from rocks. The contents of stomach and intestines were found to consist of amorphous vegetable matter in a number of specimens.

THE GILL-OPENINGS AND GILL-RACKERS.

The branchial openings are modified in a remarkable way. "Each gill-opening is divided into an upper slit-like portion, which serves as an inhalent opening and communicates with the posterior part of the mouth cavity immediately in front of the gills and a lower much wider portion which serves as an exhalent aperture and is guarded by a large membranous flap," as remarked by Hora[1].

The gill-rackers of *Gyrinocheilus* are set close together and prevent the scrapped food from being carried out with the respiratory current.

RESPIRATORY AND OTHER ADAPTIVE MODIFICATIONS.

Gyrinocheilus is a herbivorous fish and its jaws are adapted for scrapping algae from stones and other submerged objects. The lips act as a sucker for the fish to maintain itself in running water by adhering to stones. It has been observed that even in an aquarium tank in still water, the fish attach themselves to the bottom or to the vertical glass front. Inasmuch as this fish uses its suctorial mouth for maintaining its position, it would seem that it has lost all its ability to breathe like ordinary fishes and always relies on its inhalent pores for the inspiratory current. For this purpose the mouth is ventral in position in order to facilitate its attachment of the lips to the substratum.

Smith[2] has observed that the amount of water which may enter the branchial opening is limited and in order to secure sufficient oxygen, the fish breathes in very rapidly. Observations made on these fishes up to 12 cm. length in a large aquarium, have proved that their respiratory rate is 230 per minute as evidenced by the movements of the opercular flaps. It is believed that the respiratory current is initiated and carried by the opercular flaps.

Gyrinocheilus lives in torrential streams as well as in swamps. This habitat might be responsible for the large eyes and better marked colouration and body form.

DISCUSSION.

The above noted details and comparisons show one particular point. The genus *Gyrinocheilus* resembles *Garra* and *Crossocheilus* in the disposition and modification of the air-bladder and the structure of the scales, thereby sharing with them the true Cyprinid characters. But it is unique in the modification of its gill-opening into an inspiratory and expiratory channels, which has not been met with in any of the Cyprinoid fish. Usually the trend in all members of the hill-stream fishes of the family Homalopteridae is the reduction of the gill-openings to a minimum but not a complete physiological severance from the mouth. Even in extreme cases, the water is sucked in through the mouth and let out through the greatly reduced gill-openings. But in *Gyrinocheilus* the mouth serves little purpose in the respiratory mechanism of the fish. This is a great modification and a remarkable characteristic feature, peculiar only to this genus among the Cyprinoid fishes.

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[1] Hora, S. L., *Jour. Bomb. Nat. Hist. Soc.*, XXXVI, pp. 549-550 (1933).

[2] Smith, H. M., *Jour. Nat. Hist. Siam Soc. N. H. Suppl.* VIII, pp. 11-14 ; 187-189 (1931).

The structure and dentition of the pharyngeal bone are characters of great taxonomic value in Cyprinoid fishes. Toothless, slender-pharyngeal bone of *Gyrinocheilus* are sufficiently diagnostic for separating it from other families of Cyprinoid fishes.

The discontinuous geographic distribution of the genus is also significant. It is found in Siam and Borneo and is absent from the Malay Peninsula, Sumatra and Java. In all probability the ancestral stock evolved on the mainland, probably in Siam and then went down to Borneo *via* the shallow South China Sea, when there was a land bridge in this region. The genus appears to be much younger than *Garra* or *Crossocheilus* in age for they are very widely distributed, even extending to Africa. Whatever may be the pattern of dispersal, it is clear that it never migrated *via* the so-called Malayan arch passing through the Malay Peninsula and Sumatra. Zoo-geographical considerations would also favour the separation of the genus from its parental stock.

In view of the various considerations advanced above, I am of the opinion that *Gyrinocheilus* should stand separate from other Cyprinoid fish as the sole representative of the family Gyrinocheilidae Hora.

NOTES ON TWO HOMALOPTERID FISHES FROM SZECHUAN, CHINA.

By K. C. JAYARAM, *B.Sc., Zoological Survey of India, Indian Museum, Calcutta.*

INTRODUCTION.

During his visit to the U. S. A. in 1949, Dr. S. L. Hora, studied the Homalopterid material preserved in several natural history museums of the U. S. A. and has already made a brief report[1] on it. Among the fishes he examined in the Museum of Zoology, University of Michigan, he found one specimen of *Hemimyzon* Boulenger and one of *Sinogastromyzon* Fang which, for want of time, he could not study in detail there, but requested their loan in order to examine them in Calcutta. Through the kindness and courtesy of Dr. Reeve M. Bailey, Curator of Fishes, these specimens were received in Calcutta, in May 1950. As Dr. Hora was then preparing for an expedition to the Western Himalayas, he very kindly entrusted the material to me for detailed investigation. He has now checked my results and helped me in the preparation of this article. I am grateful to him for his guidance and generous help.

The two specimens under report formed part of the Chinese collection of Dr. Cora D. Reeves and according to the information recently supplied by her they were purchased from the markets of Chengtu and Kiating, Szechuan. Kiating is a small city at the junction of two mountain streams to form the first branch of the Yangtse above Chungking. To Dr. Bailey she wrote :

> " I went up to Chungking on a larger river steamer for Kiating that evening and came into that port at the head of the steam-boat navigation the next day. I haunted the small fish market for a day or two and picked up the fish from there. The fish from Chengtu I also got by looking over what the fishermen found and brought into the market."

The specimens are in an excellent state of preservation. Dr. Hora had already referred the *Hemimyzon* specimen to *H. abbreviata* (Günther) provisionally and detailed examination confirms his identification. The *Sinogastromyzon* specimen was regarded by him as a likely new species. He stated :

> " 57 scales along the lateral line, 10-11 rows between the lateral line and the base of dorsal, 21 predorsal scales ; P.12/12 ; V.6/12-13 ; two rows of prominent papillae on the anterior lip, the posterior lip is crenulated there are two barbels at each angle of the mouth. " (Hora, 1950, *loc. cit.*).

When the above characters are evaluated against the known range of variation in the scale-counts and number of fin rays, the specimen falls well within the limits of *S. szechuanensis* to which Dr. Bailey had already assigned it when forwarding

[1] Hora, S. L., *Rec. Ind. Mus.* XLVIII (1), pp. 45-58 (1950).

the specimens. Both the specimens under report differ, however, from the earlier descriptions of the two species in certain respects and as very few specimens belonging to these species are known in the museum collections, notes on certain features showing variations are given below for convenience of reference in future.

Hemimyzon abbreviata (Günther).

1892. *Hemimyzon abbreviata*, Günther, in Pratt's *Snows of Tibet*, p. 248.

1932. *Hemimyzon abbreviata*, Hora, *Mem. Ind. Mus.* XII, pp. 301-302, pl. xi, fig. 8.

D.2/6; P.11/11; V.3/11; A.2/5.

Material.—One specimen collected from Szechuan, Chengtu or Loshan (Min river drainage), Cora D. Reeves, about 1940, bearing No. U.M.M.Z. 15815 of the Museum of Zoology, University of Michigan.

The specimen agrees in all important characters with the description of *Hemimyzon abbreviata* given by Hora.[1] The number of pectoral and pelvic rays and the dorsal fin formula does not quite exactly fit in with that of *H. abbreviata*. In this specimen, only 2 rays of the dorsal fin are simple instead of 3 and the pectoral and pelvic fins possess 22 (11/11) and 14 (3/11) rays respectively *versus* 24 and 15 as given by Hora in his description of the species.

Measurements in millimeters.

Total length including the caudal	103·0
Length of caudal fin	24·0
Length of head	17·0
Width of head	13·0
Height of head at occiput	7·0
Length of snout	10·0
Diameter of eye	2·0
Interorbital width	7·0
Breadth of body in front of pelvic fin	18·0
Height of body in front of dorsal fin	10·5
Length of caudal peduncle	16·5
Longest ray of dorsal fin	21·0
Longest ray of anal fin.	15·0
Length of pectoral fin	23·0
Length of pelvic fin	18·5

Sinogastromyzon szechuanensis, Fang.

1930. *Sinogastromyzon szechuanensis*, Fang, *Contr. Biol. Lab. Sci. Soc. China* (Zool. Ser.), VI, pp. 99-103 (Szechuan, no definite locality).

1944. *Sinogastromyzon szechuanensis*, Chang, *Sinensia* XV, p. 53 (Luhsien and Chengtu, Szechuan).

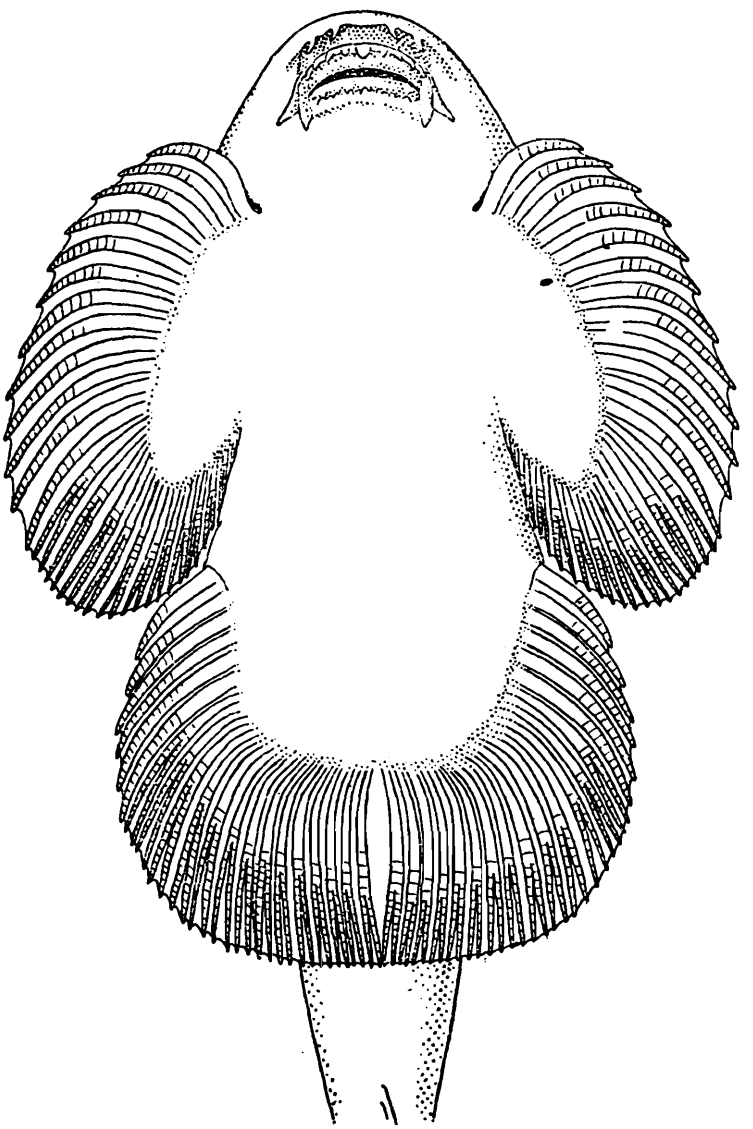
1949. *Sinogastromyzon szechuanensis*, Chen and Liang, *Quar. Journ. Taiwan Mus.* II, p. 163 (Omei, Szechuan).

As the distinguishing characters of the 5 species included under this genus very much overlap, it is proposed to describe this specimen in detail with figures so as to facilitate reference in future.

[1] Hora, S. L., *Mem. Ind. Mus.* XII, pp. 300-302 (1932).

D.3/9 ; P.12/12 ; V.6+2/12 ; A.1/5.

The head and the body are dorso-ventrally depressed with the ventral surface greatly flattened. The dorsal profile is but slightly arched. The length of the head is contained 5·3 times in the total length and its height is only half its length. The snout is broad and rounded and is free from tubercles. The eyes are placed dorso-laterally and are not visible from the ventral surface ; they are contained 3 times in the length of the snout and are about 1·5 times apart. The nostrils are placed just in front of the eyes and are fairly conspicuous. The

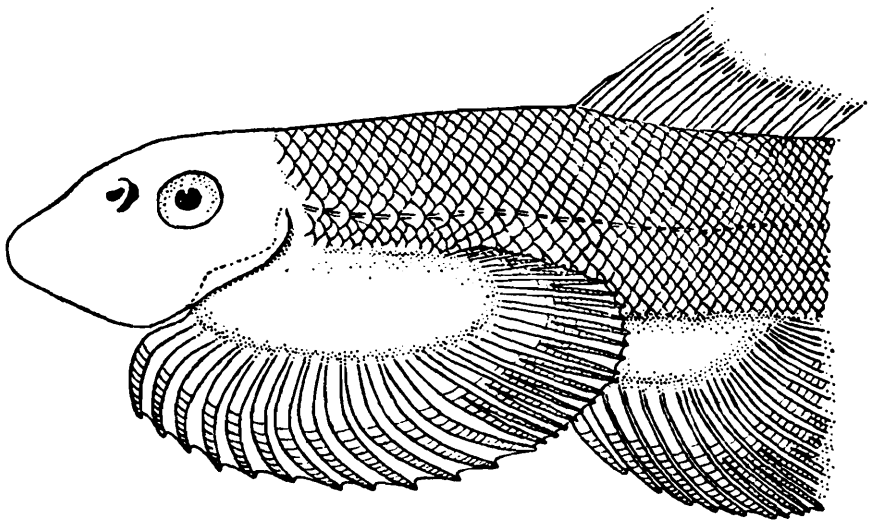


TEXT-FIG. 1.—Ventral view of *Sinogastromyzon szechuanensis*. Note the number of simple and branched rays in the pectoral and pelvic fins ×2.

mouth is placed on the ventral surface considerably behind the tip of the snout ; the jaws are bordered by papillated lips ; the upper lip has nine small papillae. There are 4 small barbels in the notches on the rostral fold, in front of the anterior lip. There is a pair of barbels at each angle of the mouth, the outer one being longer and stouter. The gill-openings are small and restricted above the bases of the pectoral fins.

The origin of the dorsal fin is just behind the insertion of the pelvics, and is nearer to the tip of the snout than to the base of the caudal fin. The pectoral fins are horizontally inserted and are provided with *muscular bases which are free from scales;* the inner rays being longer than the outer. Each fin is composed of only twelve undivided rays. The outer rays are not padded. The pelvics are also horizontally placed and form a disk-like structure on the ventral surface. They extend beyond the anal opening but do not reach the base of the anal fin. The pelvics are provided with muscular bases, which are naked. The anal fin is small and is inserted a short distance from the pelvics. It does not reach the base of the caudal fin. The longest ray of the anal fin is twice the length of its base. It is provided with a papilla. The least height of the caudal peduncle is about one-third of its length.

The depth of the body is contained about 7·3 times in the total length. The body is covered with small scales which are keeled; they are absent on the ventral surface as far as the anal opening. The lateral



Text-fig. 2.—Lateral view of *Sinogastromyzon szechuanensis*, showing the naked muscular bases of the pectoral and pelvic fins. Note the extent to which the muscular bases are naked ×2.

line is complete. A scale from below base of dorsal fin is small and oval in outline. The circulii and radii are very inconspicuous. The nucleus is eccentric and disorganised.

In spirit, the colour is brownish and is marked with irregular dark patches. The ventral surface is pale olivaceous.

The present specimen differs from Fang's description of *szechuanensis*[1], in the following characters :—

1. Vent with papilla and placed equidistant from bases of pelvics and origin of anal fin, *versus* nearer bases of pelvics than origin of anal fin.
2. The number of scales along the lateral line is 57 *versus* 64 in *szechuanensis*.
3. The pectoral fin possesses only 12 branched rays *versus* 13 in *szechuanensis*.

[1] Fang, P. W., *Contr. Biol. Lab. Sci. Soc. China* VI (9), pp. 99-103 (1930).

4. The pelvic fin possesses only 20 rays (8/12) *versus* 21 rays (6-8/15-13).

5. The upper lip has only one row of 9 papillae *versus* 11 in *szechuanensis*.

The above-noted differences would have justified the retention of the present specimen as a separate subspecies, if Chang had found these differences constant in the 4 specimens he reported upon from Luhsien and Chengtu. His specimens were 64-67 m.m. in standard length and gave the following counts for fin-rays and scales :—

D. 3/8 ; A. 2-3/5 ; P. 23-25 (11-13/12-13) ; V. 20-22 (5-6+2-3/12-13); L. 1. 61-64 ; L. tr. 11/8-9-A.

Material.[1]—A single specimen : No. U.M.M.Z. 15816, Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U. S. A.

Measurements in millimeters.

Total length including the caudal fin	80·0
Length of caudal fin	17·0
Length of head	15·0
Width of head	15·0
Height of head at occiput	7·5
Length of snout	9·0
Diameter of eye	3·0
Interorbital width	5·0
Breadth of body in front of dorsal fin	11·0
Breadth of body in front of pelvics	16·0
Length of caudal peduncle	15·0
Least height of caudal peduncle	5·5
Longest ray of dorsal fin	15·0
Longest ray of anal fin	10·0
Length of base of anal fin	5·0
Length of pectoral fin	24·0
Length of pelvic fin	23·5

[1] Fang, P. W., *Sinensia* II, (3), pp. 48-53 (1931).

MGIPC—M—3 ZSI—9-7-51—450.