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XI. NOTES ON SOME INDIAN APHIDES

By P. VAN DER GOOT, *Salatiga (Java)*.

During the latter half of 1916, I had the pleasure through the courtesy of Mr. F. H. Gravely of receiving from the Indian Museum at Calcutta a new lot of Indian Aphides, in all 27 tubes, most of them collected in the Himalayas. Amongst them were several apparently new species, the descriptions of which are given in the following pages, together with a list of the remaining species contained in the collection.

Macrosiphum gravelii, sp. nov.

Apterous viviparous female.

Measurements.

Length of body	..	..	3.95 mm.
Breadth of body	..	..	1.85 "
Length of antennae	..	..	4.05 "
Length of siphunculi	..	..	1.25 "
Length of cauda	..	..	0.68 "

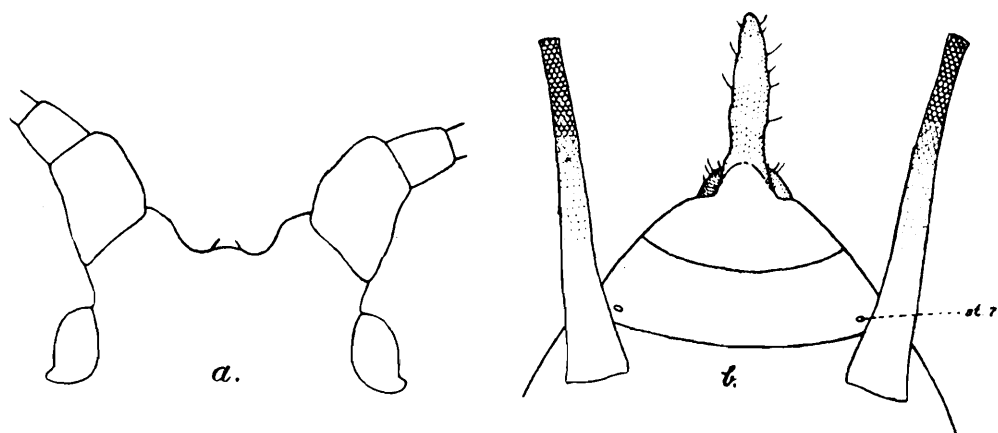


FIG. 1.—*Macrosiphum gravelii*, sp. nov.

a. Head of apterous female (dorsal view). $\times 65$.

b. Hind part of abdomen of apterous female (dorsal view). $\times 35$.

Colour.—Body light yellow or light brownish. Eyes red. Antennae light yellowish-brown, the last three joints brownish-black. Legs yellowish-white, tarsus black. Siphunculi dark brown. Cauda light yellow. (Notes from specimen in alcohol).

Morphological characters.—Body elongate-ovate, slightly arched; the dorsum with transverse rows of very short spiny hairs.

Antennae slightly longer than the body; relative lengths of the five last antennal joints about as: 59. 52. 40. 10. 53. The third joint bears on its basal fourth some 3-5 circular sensoriae. Frontal tubercles well developed, not gibbous or protruding on the innerside; frons slightly arched.

Rostrum reaching to the second pair of coxae.

Siphunculi very long, thin, cylindrical, but distinctly expanded towards the base; the apex with a distinct reticulation, the remainder very faintly imbricated. Cauda elongate, ensiform, about half as long as the cornicles.

Legs long and thin, with small but strong spiny hairs. (Described from numerous wingless specimens).

Food-plant unknown.

Locality.—Soom (Darjiling district), 4,000—5,000 feet, 16-vi-1914 (*F. H. Gravely*).

Types in the collection of the Indian Museum, Calcutta; No. 5597/H. 1.

***Rhopalosiphum indicum*, v. d. G.**

Alate viviparous female.

Measurements.

Length of body	4.70 mm.
Breadth of body	2.25 „
Length of antennae	4.85 „
Length of siphunculi	1.00 „
Expanse of wings	13.50 „
Length of cauda	0.43 „

Colour.—Head and thorax yellowish-brown; abdomen dirty yellowish. Eyes and antennae black. Legs black, base of femur light yellow. Siphunculi dark brown. Cauda light yellowish. Pterostigma of forewing and all veins with a brownish tinge. (Notes from specimen in alcohol).

Morphological characters.—Body broadly ovate, nearly naked.

Antennae a little longer than the body; relative lengths of the five last antennal joints about as: 60. 42. 33. 12. 65. The third joint bears on its whole length some 65 small circular sensoriae; the fourth joint shows from 0-3 sensoriae. Frontal tubercles small, slightly protruding on the inner side.

Rostrum reaching to the second pair of coxae.

Siphunculi moderately long, thick, only slightly swollen in the middle but considerably constricted at the apex, with a distinct reticulation at the tip. Cauda club-shaped, about half as long as the cornicles.

Wings with normal venation; the second fork of media 1 fairly long. Hooking-hairs 4 in number. (Described from 3 partly damaged winged females, in separate tubes).

Food-plant unknown.

Localities.—Birch Hill (Darjiling district), 6,000—7,000 feet, 1-vii-1914 (*Carmichael* coll.); Soom to Birch Hill (Darjiling distr.), 5,000—6,000 feet, 2-vii-1914 (*Carmichael* coll.); Soom to Darjiling (East Himalayas), 4,500—7,000 feet, 14-vi-1914 (*F. H. Gravely*).

Types in the collection of the Indian Museum, Calcutta; Nos. 5595/H. I., 5598/H. I., 5602/H. I.

I have little hesitation in considering the winged forms described above, apparently caught on the wing, to be identical with the wingless specimen I described in an earlier paper on Indian Aphides (*Rec. Ind. Mus.*, vol. XII, 1916, pp. 1—5).

The reticulation of the cornicles is very rare in *Rhopalosiphum*, the only species showing this character being *Rh. aconiti*, v. d. G.

***Rhopalosiphum vagans*, sp. nov.**

Alate viviparous female.

Measurements.

Length of body	2.60 mm.
Breadth of body	1.08 „
Length of antennae	3.15 „
Length of siphunculi	0.54 „
Expanse of wings	7.90 „
Length of cauda	0.25 „

Colour.—Head and thorax black, abdomen brownish. Eyes dark. Antennae black. Legs yellowish; tarsus, tip of tibia and femur (except the base) blackish. Siphunculi dark brown. Cauda darkish. Pterostigma of forewings brownish. (Notes from specimen in alcohol).

Morphological characters.—Body nearly naked, without any lateral tubercles.

Antennae distinctly longer than the body; relative lengths of the five last antennal joints about as: 34. 28. 21. 9. 35. The third antennal joint bears from 21–31 circular sensoriae on nearly its whole length. Frontal tubercles fairly small, protruding on the inner side, with a few short hairs.

Rostrum reaching to the second pair of coxae.

Siphunculi moderately long and thin, distinctly swollen, with the surface quite smooth. Cauda ensiform, about half as long as the cornicles.

Wings with normal venation; the second fork of media 1 moderately large. Hooking-hairs 3 in number.

Legs long and thin, with a few short spines. (Described from a single winged female).

Food-plant unknown.

Locality.—Soom to Darjiling, 4,500–7,000 feet, 16-vi-1914 (*F. H. Gravely*).

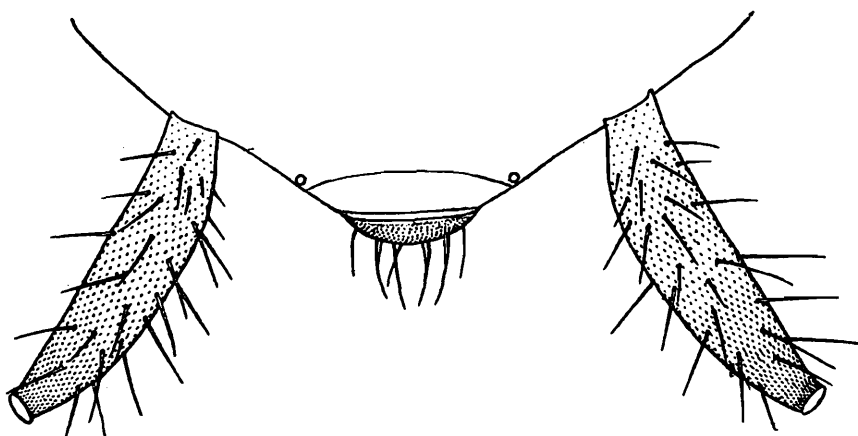
Type in the collection of the Indian Museum, Calcutta; No. 5600/H. I.

Trichosiphum dubium, sp. nov.*Apterous viviparous female.**Measurements.*

Length of body	2.88 mm.
Breadth of body	1.62 „
Length of antennae	1.26 „
Length of siphunculi	0.76 „

Colour.—Body dirty yellowish. Eyes red. Antennae light yellow, with blackish apex. Legs light yellowish-brown. Siphunculi dark brown. Cauda light brownish. (Notes from specimen in alcohol).

Morphological characters.—Body broad ovate; the whole dorsum covered with numerous strong, moderately long spines, which are always simple at the apex.

FIG. 2.—*Trichosiphum dubium*, sp. nov.Hind part of abdomen of apterous female (dorsal view). $\times 60$.

Antennae less than half as long as the body, with a few long spines, relative lengths of the five last joints about as: 29. 9. 13. 11. 24. Primary sensoriae without hair-rim.

Rostrum long, reaching to the third pair of coxae.

Siphunculi moderately short, thick, distinctly broadest towards the middle, with many fairly long bristles; the integument covered with numerous "spinule-rows." Cauda obsolete; the last abdominal segment broadly rounded, not prolonged into a distinct small point. Rudimentary gonapophyses very close together, with a few short hairs; their number not distinct, apparently 3.

Legs slender, with some long hairs. (Described from 4 apterous females, together with numerous larvae and a few nymphs).

Food-plant unknown.

Locality.—Birch Hill (Darjiling district), 6,000—7,000 feet, 30-vi-1914 (*Carmichael* coll.).

Types in the collection of the Indian Museum, Calcutta No. 5590/H. 1.

The species described above shows much resemblance to the genus *Greenidea*, Schout., especially by the broad body and the short cornicles. The absence of an acute point to the last abdominal segment, however, necessitates it being placed in *Trichosiphum* (Perg.) v. d. G.

***Trichosiphum montanum*, sp. nov.**

Alate viviparous female.

Measurements.

Length of body	3.05 mm.
Breadth of body	1.15 „
Length of siphunculi	1.98 „
Expanse of wings	8.10 „

Colour.—Head and thorax dark brown ; abdomen brownish-yellow. Eyes red (?). Antennae blackish. Legs light yellow,

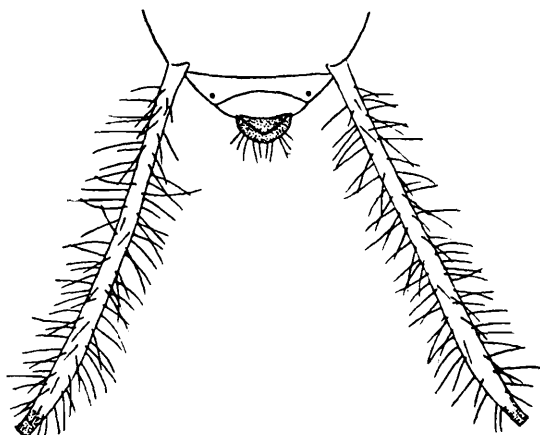


FIG. 3.—*Trichosiphum montanum*, sp. nov.
Hind part of abdomen of alate female (dorsal view). × 25.

tarsus and tibia dark brown. Siphunculi dark brown. Cauda brown. Pterostigma of forewings brown. (Notes from specimen in alcohol).

Morphological characters.—Body elongate ovate; head, thorax and margin of abdomen with long and fine hairs, the dorsum of the abdomen with shorter hairs.

Antennae broken off in the specimen examined. The third antennal joint bears some 17 sensoriae on its basal three-fourths; the sensoriae are broadly oval, occupying nearly half of the antennal circumference.

Rostrum reaching to the third pair of coxae.

Siphunculi very long, thin, cylindrical, with many long hairs and with distinct "spinule-rows" only on the extreme tip. Cauda nearly obsolete, broadly rounded, slightly conical.

Wings with normal *Trichosiphum* venation. Hooking-hairs 3-5 in number.

Legs fairly long, the tibia and femur with moderately long and fine hairs. (Described from a single winged female).

Food-plant unknown.

Locality.—Soom to Darjiling, 4,500—7,000 feet, 16-vi-1914 (F. H. Gravely).

Type in the collection of the Indian Museum, Calcutta; No. 6968/H. 1.

Although only a single damaged alate female was available, this species is sufficiently distinct from other species of *Trichosiphum* (*Tr. minutum*, v. d. G. and *Tr. querci*, v. d. G.) in the number and distribution of sensoriae on the third antennal joint.

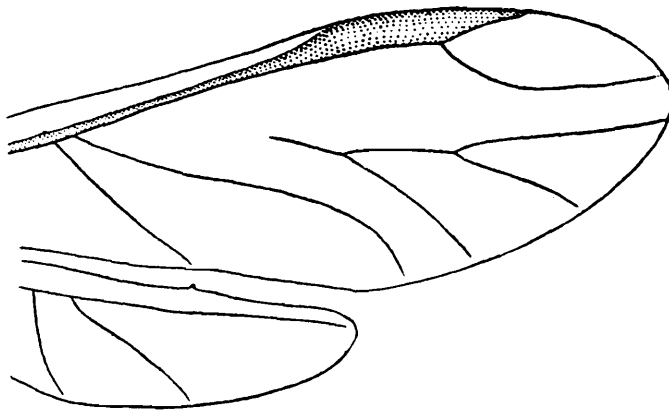


FIG. 4.—*Trichosiphum montanum*, sp. nov.
Fore and hindwing of alate female. ($\times 25$).

***Lachnus himalayensis*, sp. nov.**

Apterous viviparous female.

Measurements.

Length of body	4.50 mm.
Breadth of body	2.35 „
Length of antennae	1.80 „
Siphunculi (diam.)	0.14 „

Colour.—Body dirty grayish, without blackish spots. Eyes black. Antennae grayish-white. Legs brownish-black. Siphunculi gray, with a brownish top-rim. Cauda light brown. (Notes from specimen in alcohol).

Morphological characters.—Body broad ovate, slightly arched, covered with numerous fine, moderately short hairs.

Antennae less than half as long as the body, with numerous fine hairs; relative lengths of the four last antennal joints about as : 33. 13. 17. 12. Sensoriae are present as follows : III 0. IV 2. V 1+1. VI 1(+4). The primary sensoriae are large, the secondary ones very small and circular.

Rostrum short, reaching to the second pair of coxae.

Siphunculi scarcely elevated above the body, nearly reduced to pores. Cauda obsolete, the last abdominal segment broadly

rounded. Rudimentary gonapophyses 3 in number, the middle one often double.

Legs moderately long, covered with numerous thin, long hairs.

Alate viviparous female.

Measurements.

Length of body	:	4.95 mm.
Breadth of body	:	1.98 "
Length of antennae	:	1.85 "
Siphunculi (diam.)	:	0.13 "
Expanse of wings	:	13.15 "

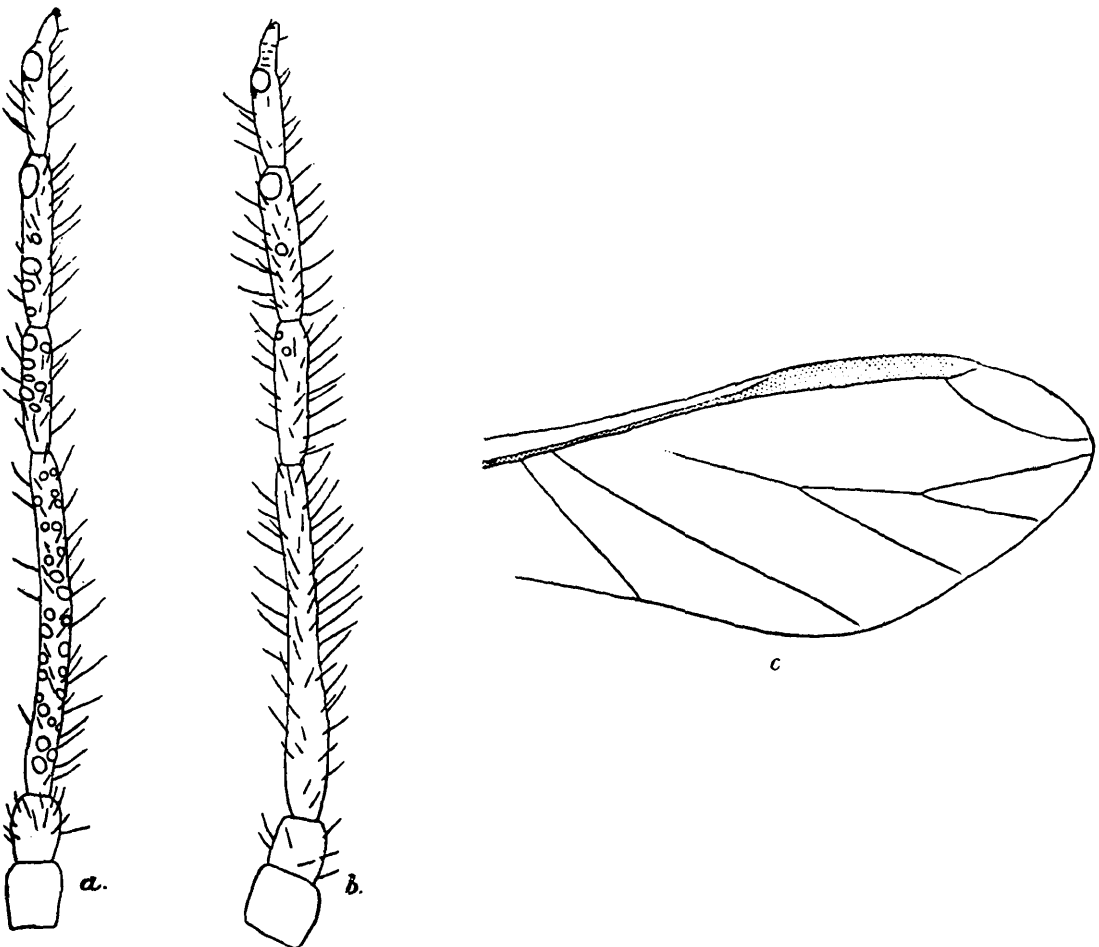


FIG. 5.—*Lachnus himalayensis*, sp. nov.

a. Antenna of alate female. ($\times 60$).

b. Antenna of apterous female. ($\times 60$).

c. Forewing of alate female. ($\times 17$).

Colour.—Body of the same colour as the apterous female; pterostigma of forewings grayish. (Notes from specimen in alcohol).

Morphological characters.—Head, thorax and abdomen covered with numerous, fine, moderately short hairs.

Antennae less than half as long as the body; relative lengths of the four last antennal joints about as: 33. 12. 16. 13. Sensoriae are present as follows: III 45. IV 10. V 7+1. VI 1(+4). Secondary sensoriae circular, moderately large, tuberculate.

Rostrum, siphunculi, etc., as in the apterous female.

Wings with normal *Lachnus*-venation; media 1 twice forked. Hooking-hairs 6 in number. (Described from a number of wingless and winged females).

Food-plant unknown.

Locality.—Birch Hill (Darjiling District), 6,000—7,000 feet, 6-vii-1914 (*Carmichael* coll.).

Types in the collection of the Indian Museum, Calcutta; No. 5601/H. 1.

The species described above is distinct from all other species of *Lachnus* known to me by the numerous sensoriae on the third antennal joint in the winged female.

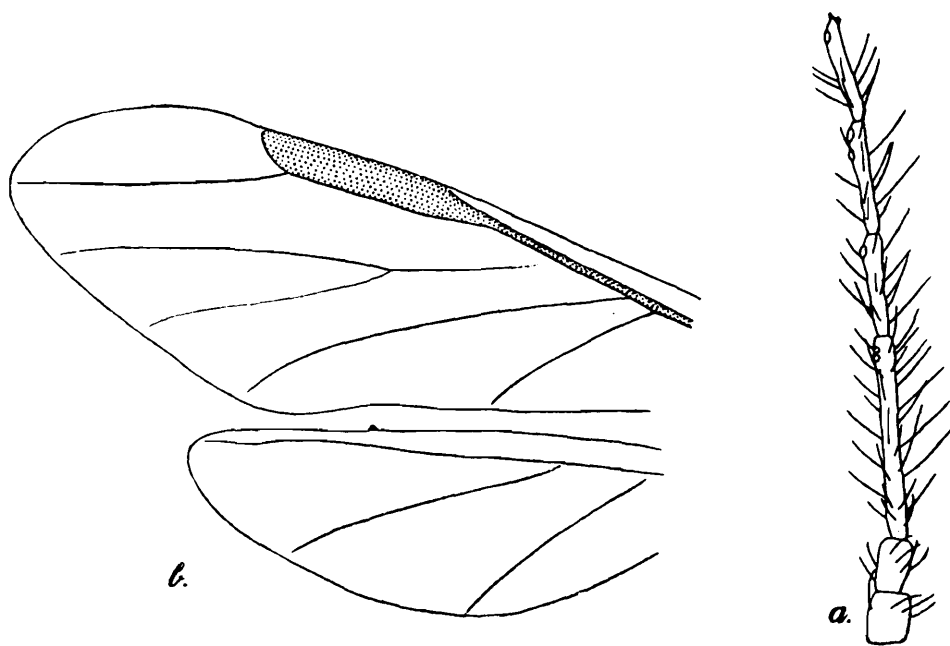


FIG. 6.—*Lachnus similis*, sp. nov.

a. Antenna of alate female. ($\times 45$).

b. Fore and hindwing of alate female. ($\times 15$).

Lachnus similis, sp. nov.

Alate viviparous female.

Measurements.

Length of body	4.70 mm.
Breadth of body	2.16 „
Length of antennae	1.65 „
Siphunculi (diam.)	0.13 „
Expanse of wings	16.20 „

Colour.—Head and thorax black; abdomen dirty grayish with four longitudinal rows of dark brown spots. Eyes red. Antennae brownish-yellow, the tips of all joints blackish. Legs light yellowish; tarsus, tip of tibia and the femur except the base brownish-black. Siphunculi black. Cauda darkish. Pterostigma of forewings dark brown. (Notes from specimen in alcohol).

Morphological characters.—Body robust, head and thorax with numerous, fine, very long hairs, the abdomen less hairy.

Antennae about $\frac{1}{3}$ the length of the body, with numerous, fine, long hairs; relative lengths of the four last antennal joints about as: 35. 17. 19. 17. Sensoriae are present as follows: III 1—2. IV 1. V 1+1. VI 1 (+4). Secondary sensoriae circular, moderately small, of about the same size as the primary ones.

Rostrum reaching to the third pair of coxae.

Siphunculi broadly conical, but little elevated above the level of the body. Cauda obsolete.

Wings with the typical *Lachnus*-venation; media 1, however, only once forked.

Legs fairly long, with numerous fine hairs. (Described from a single winged female with damaged hind-wings).

Food-plant unknown.

Locality.—Phagu, 9,000 feet, Simla Hills, W. Himalayas; 18-v-1916 (N. Annandale and S. Kemp).

Type in the collection of the Indian Museum, Calcutta; No. 3825/H. 1.

Although described from a single specimen only, I feel little hesitation in considering this a distinct species. It shows some resemblance to *Lachnus pineti*, Koch, but is sufficiently different in the distribution of the sensoriae on the antennal joints, as well as by media 1 being only once forked.

LIST OF REMAINING SPECIES IN THE COLLECTION EXAMINED.

Macrosiphoniella sanborni, Gill.; Calcutta.

Toxoptera aurantii, Boyer; Darjiling, Birch Hill; Calcutta.

Aphis gossypii, Glov. (?); Salt Lakes, Calcutta.

Aphis medicaginis, Koch.; Dinapore, Bihar; Calcutta (maidan).

Aphis malvacearum, Das; Soom (Darjiling District).

Aphis malvae, Koch (?); Calcutta.

Aphis merri, Boyer (= *A. asclepiades*, Pass.); on *Callotropis gigantea* and *Tylophora asmatia* (?); Calcutta; Barkuda Island, Chilka Lake (Madras).

Siphonaphis midis, Fitch; on maize flowers; Siripur, Bihar.

Siphonaphis nymphaeae, L.; on water-hyacinth; Rambha, Madras.

Siphonaphis padi, L. (?); in grass; Paksey, Bengal.

Siphocoryne pseudobrassicae, Davis; Dinapore, Bihar.

Pterocomma populea, Kalt (?); Bhim Tal, W Himalayas (4,500 feet).

XII INDIAN FLIES OF THE SUBFAMILY RHINIINAE

By CHARLES H. T. TOWNSEND, *Ph.D.*,
Custodian of Muscoid Diptera, U.S. National Museum.

The family Muscidae (syn. Calliphoridae) divides into two subfamilies, the Muscinae and the Rhiniinae. The Muscinae are numerous represented in all habitable parts of the globe; but the Rhiniinae are strictly confined to the Old World, with the sole exception of *Pollenia* which has reached America almost certainly through the agency of man.

The material considered in this paper was submitted to me for determination by the Indian Museum. The following synoptic table will enable the identification of the genera of this subfamily known to me, a few genera not represented in the Indian collection being included with their localities. In order to complete this survey of the Rhiniinae, there are appended at the end of the table notes on seven genera probably belonging to this subfamily but not known to me in material, some of which may be found to occur in the Indian region.

GENERA OF RHINIINAE.

1.	Epistoma <i>Rhinia</i> -like, strongly warped forward	2
	Epistoma <i>Phasia</i> -like, projected downward	
	rather than forward...	11
2.	Arista plumose, ciliate both above and below	3
	Arista ciliate only above	6
3.	Mesoscutum and abdomen finely pubescent,	
	the disk of former without macrochaetae ...	<i>Borbororhinia</i> , gen. nov.
	Mesoscutum with macrochaetae on disk	4
4.	Apical cell widely open	<i>Cosmina</i> , R. D.—Africa.
	Apical cell closed or extremely short-petiolate	5
5.	Arista long-plumose to tip; frontalia of male	
	pinched out by the nearly contiguous eyes,	
	the parafrontalia reduced to a line	<i>Synamphoneura</i> , Big.
	Arista plumose on basal two-thirds or so, but	
	tip bare; frontalia of male reduced to a line,	
	the parafrontalia broadly present and eyes	
	well separated	<i>Eusynamphoneura</i> , gen. nov.—Africa.
6.	Apical cell petiolate	7
	Apical cell not petiolate	9
7.	Petiole of apical cell rather long and practically	
	in line with third vein	8
	Petiole of apical cell short, in line with final	
	course of fourth vein	<i>Idielliopsis</i> , gen. nov.
8.	Abdomen as broad as long; male hypopygium	
	large	<i>Chlororhinia</i> , gen. nov.
	Abdomen longer than broad; male hypopy-	
	gium small	<i>Rhinia</i> , R. D.

9.	Apical cell widely open ...	10	<i>Stomorhina</i> , Rdi.
	Apical cell closed or very narrowly open ...	10	
10.	Facial carina rather narrow; male frontalia broadly present throughout ...		<i>Idiella</i> , B. B.
	Facial carina broad, tubercular, fading below; male frontalia pinched out ...		<i>Euidiella</i> , gen. nov.
11.	Arista bare or at most only microscopically pubescent ...	12	
	Arista plumose or long-pubescent, ciliate above and below ...	16	
12.	Facial carina weak but distinct ...		<i>Metallea</i> , Wulp.
	Facial carina quite absent ...	13	
13.	Apical cell widely open ...	14	
	Apical cell closed or very narrowly open ...	15	
14.	Disk of mesoscutum with macrochaetae ...		<i>Trichometallea</i> , gen. nov.
	Disk of mesoscutum without macrochaetae; male scutellum greatly swollen, far over-reaching the base of abdomen ...		<i>Stegosoma</i> , Lw.—Africa.
15.	Preacrostichals present; frontals descending below base of antennae (see note below) ...		<i>Rhyncomya</i> , R. D.—Mediterranean Region.
	No preacrostichals; frontals stopping at base of antennae ...		<i>Rhynchomyiopsis</i> , gen. nov.
16.	No discals on anal segment ...	17	
	Erect or suberect, short or long discals on anal segment, at least laterally ...	18	
17.	Epistoma very narrow; hypopygium of moderate size... ...		<i>Thoracites</i> , B. B.
	Epistoma not unusually narrowed; hypopygia of both sexes greatly enlarged ...		<i>Chloroidia</i> , gen. nov.
18.	Fourth vein evenly rounded at bend, more or less like that of <i>Muscina</i> ...		<i>Strongyloneura</i> , Big.
	Fourth vein not evenly rounded (see <i>S. viridana</i> , sp. n.) ...	19	
19.	Arista pubescent about two-thirds way ...		<i>Metalliopsis</i> , gen. nov.
	Arista plumose practically to tip ...	20	
20.	Facial carina absent ...	21	
	Facial carina present ...	22	
21.	Epistoma of ordinary width ...		<i>Synamphoneuroopsis</i> , gen. nov.
	Epistoma very narrowed ...		<i>Nitellia</i> , R. D.—Europe.
22.	Epistoma very broad ...	23	
	Epistoma narrow ...	24	
23.	Short straight erect spines on scutellum ...		<i>Apollenia</i> , Bezzi.—Africa.
	No spines on scutellum ...		<i>Thelychaeta</i> , B. B.
24.	Facial carina narrow, sharp ...		<i>Pollenia</i> , R. D.
	Facial carina rather broad, flattened ...	25	
25.	Lateral discals on all abdominal segments ...		<i>Dexopollenia</i> , gen. nov.
	Lateral discals not present on all segments ...		<i>Polleniopsis</i> , gen. nov.

NOTES.

Rhyncomya, R. D.—The characters in the table are drawn from *impavida*, Rossi (syn. *columbina*, Meig.). The genotype is *Musca ruficeps*, Fab., with which *impavida* seems to be congeneric. The main characters of *impavida* are: Facial carina absent; epistoma rather *Phasia*-like, broad and rather strongly protuberant; arista microscopically pubescent; apical cell very narrowly open, almost closed; male eyes nearly contiguous, frontalia pinched out; male hypopygium rather large, claws not very long; bristles on

margin of last two segments; front tarsi of female slightly widened; palpi subphylliform; no differentiated proclinate fronto-orbitals in female.

Strongyloneura, Big.—The characters in the table are drawn from *S. nepalana*, sp. n. The genotype is *S. prasina*, Big., Japan, with which *nepalana* seems to be congeneric. The main characters of *nepalana* are: Facial carina absent; epistoma *Phasia*-like, quite broad; arista long-plumose nearly to tip; apical cell open, fourth vein evenly rounded at bend like *Muscina*; macrochaetae marginal, short erect discals in transverse row on anal segment; front tarsi of female moderately widened; palpi club-shaped; female vertex less than eye-width, two strong proclinate fronto-orbitals; strong preacrostichals present; male hypopygium not extremely large but rather conspicuous and elongate; male eyes not contiguous, but frontalia nearly or quite pinched out.

Arrhinidia, B. B.—The genotype is *Rhyncomya aberrans*, Sch., China. Would run out at couplet 12 of the table, on character of the arista. Facial carina present; epistoma apparently *Phasia*-like, but little projected; arista short-ciliate above only; apical cell open; male eyes practically contiguous; male hypopygium large; macrochaetae marginal; front tarsi widened; palpi phylliform.

Stomina, R. D.—The genotype is *S. rubricornis*, R. D., Europe. A probable synonym is *Gymnostylina*, Mcq. Would run out with *Metallea*. Facial carina weak but probably broad, as description states that the antennae of female are separated thereby; epistoma probably *Phasia*-like, stated to be somewhat rostriform; arista pubescent; apical cell open; macrochaetae of abdomen weak or absent; thorax villous, without macrochaetae on disk.

Beria, R. D.—The genotype is *B. inflata*, R. D., Africa. Would run to 14, and probably out with *Stegosoma*. Head inflated somewhat after the style of *Salmacia* (*Gonia*); facial carina absent; epistoma *Phasia*-like; arista bare; apical cell open; male eyes nearly contiguous; macrochaetae weak; palpi subphylliform, widened at tip.

Pararhynchomyia, Becker.—The genotype is evidently *P. varifrons*, Beck., Africa, but I have been unable to find the original reference in the literature and get my information from Bezzi's 1911 paper on African "Miodarii Superiori." Would run out at 16 on apical cell petiolate. Facial carina not developed; epistoma *Phasia*-like; arista bare; apical cell petiolate; further characters not stated by Bezzi.

Idiopsis, B. B.—The genotype is *I. prasina*, B. B., Mediterranean Region. Would run to 18 apparently. Facial carina absent; epistoma *Phasia*-like, moderately broad; arista long-plumose; apical cell open; male eyes nearly contiguous, the upper facets enlarged; male hypopygium large, claws not very long; macrochaetae marginal on segments one to four; front tarsi of female scarcely widened; palpi club-shaped, probably widened; four or more short, equal proclinate fronto-orbitals in female; female vertex wide.

Anastellorhina, Big.—The genotype is *A. bicolor*, Big., Australia. Said by Brauer to be near *Idiopsis*. Would probably run to 18 with *Idiopsis*. Facial carina not developed at all; epistoma probably *Phasia*-like, though face is stated to be strongly concave; arista long-plumose to tip; apical cell open; long marginal macrochaetae on third and anal segments; female with two proclinate fronto-orbitals; very long lower border of head.

Tricyclopsis, T.—The genotype is *Rhyncomya dubia*, Mcq., Australia. Placed by Brauer near *Thelychaeta*. Would probably run to 22. Facial carina absent; epistoma probably *Phasia*-like; arista very long-plumose; facialia ciliate over half way up; para-facialia with short bristly hairs; palpi club-shaped. This and the preceding are doubtful members of this subfamily.

DESCRIPTIONS AND RECORDS.

The Indian Museum collection sent me contains 243 specimens of Rhiniinae, which are here reported on. The diagnoses of all the genera that follow have been drawn from the genotypes, personally studied by me in material, only five of these genera not being represented in the Indian collection.

***Borbororhinia*, gen. nov.**

Genotype, *Borbororhinia pubescens*, sp. n.

Facial carina very weak, showing only as a low knife-like edge between antennae; epistoma *Rhinia*-like, but projected only a little below vibrissae; arista thinly plumose, ciliate above and below; apical cell narrowly open, very narrowed on terminal portion; male eyes widely separated, the frontalia wide and continuing full width throughout, the parafrontalia narrow but distinct; male hypopygium moderately large, extruded posteriorly, giving tip of abdomen a tapered form; male claws elongate; thorax and abdomen finely pubescent, abdomen with very fine hair-like marginals; disk of mesoscutum without chaetae, one postsutural behind with a shorter one just in front of it, and one postacrostichal behind; front tarsi of male very slightly widened; palpi phylliform.

***Borbororhinia pubescens*, sp. nov.**

Length of body, 5 to 6 mm.; of wing, 4 to 4.5 mm. Two males, Parambikulam, Cochin State, 1,700-3,200 ft., Sept. 16-24, 1914 (*F. H. Gravely*).

Pallid testaceous. Frontalia, first two antennal joints and palpi obscure fulvous; third antennal joint pale fulvous. Parafrontalia and upper half of parafacialia thinly silvery, lower half of latter shining black. Facial plate and facialia polished, the latter with large shining black area confluent with that of parafacialia. Epistoma shading to brown on sides. Cheeks with shining dark brown or black area. Sternum, pleurae and anterior half

or so of venter very pale yellowish or straw-colour; mesoscutum, scutellum, abdominal tergum and posterior half of venter fulvous, shaded more or less with fuscous; mesoscutum showing thinly silvery, with four brown or black vittae, the two inner ones widely separated. Legs pale fulvous, the tarsi dusky except the whitish-yellow metatarsi. Pile of body short, black, very soft and fine. Wings slightly tinged with smoky-yellow, more so on costal portion. Tegulae smoky-yellow.

Holotype in Ind. Mus. Paratype, No. 21022 U.S. Nat. Mus.

Two apparently new genera near *Borbororhinia* are represented in the Indian collection by two male specimens from Margherita, Assam, and Mergui, Lower Burma (*W. Doherty*). They are not in sufficiently good state of preservation to serve as holotype specimens; hence I do not name them.

Cosmina, R. D.

(Syn. *Seseromya*, Rdi.)

Genotype, *Musca punctulata*, Wied.—Africa, (syn. *Cosmina fuscipennis*, R. D.).

Facial carina present but weak; epistoma *Rhinia*-like but not very strongly projected; arista plumose on both sides, tip more or less bare; apical cell widely open; male eyes nearly contiguous, the frontalia completely pinched out; male hypopygium large; weak macrochaetae on anal segment, practically only marginal.

I am unable to refer any of the forms in the Indian collection to this genus. Indian and East Indian species have been referred here by Walker and Bigot, probably incorrectly.

Synamphoneura, Bigot.

Genotype, *S. cuprina*, Big.—Java.

Facial carina not developed; epistoma *Rhinia*-like, broad; arista long-plumose; apical cell closed in margin or extremely short-petiolate; male eyes nearly contiguous, frontalia pinched out; male hypopygium rather large, claws elongate but not very strong; strong macrochaetae on margin of anal segment, weak ones on margins of other segments; front tarsi not widened in either sex, female claws very short and weak; palpi phylliform but not very wide.

Synamphoneura cuprina, Big.

Fourteen specimens, both sexes, from Java, Assam and Burma.

Eusynamphoneura, gen. nov.

Genotype, *Idia seriepunctata*, Lw.—Mozambique, (syn. *Cosmina depressa*, Karsch).

Facial carina very weak in the male, almost undeveloped in the female; epistoma *Rhinia*-like, broad; arista plumose on both

sides, except tip; apical cell closed in the margin or very short-petiolate; male eyes not contiguous, well separated, the parafrontalia broad, the frontalia reduced to a line; male hypopygium not large, of moderate size; weak marginal macrochaetae on anal segment, and bristle rows on margins of second and third segments.

This genus appears to be confined to East Africa.

Idielliopsis, gen. nov.

Genotype, *Idielliopsis similis*, sp. n.

Facial carina broadly developed, widely separating the antennae; epistoma *Rhinia*-like; arista ciliate on upper side only; apical cell short-petiolate, the petiole about half as long as small crossvein and in line with final course of fourth vein; male eyes nearly contiguous, the frontalia completely pinched out; male hypopygium small; weak bristle-like macrochaetae on margin of anal segment; female vertex about one-fifth of head-width.

Idielliopsis similis, sp. nov.

Length of body, 9 to 9.5 mm.; of wing, 6.5 to 7 mm. Three males: Dhikala, Naini Tal District, United Provinces of Agra and Oudh, April 22, 1908 (*R. H.*); Mazbat, Mangaldai District, Assam, Oct. 11-15, 1910 (*S. Kemp*); Paresnath, Chota Nagpur, 4,000-4,400 ft., April 13, 1909 (*N. Annandale*); one female, Katihar, Purneah District, Bihar, March 23, 1909 (*C. Paiva*).

Differs in coloration from *Idiella mandarina*, Wd. practically only as follows: Less black on abdomen, male showing same on anal segment and posterior third to half of preceding segment in addition to the median vitta; the female lacks the black entirely, even the median vitta being lost. The red of abdomen is somewhat darker, rather reddish-orange. Mesoscutum and scutellum quite distinctly dark green. Tegulae deeper yellowish. Legs wholly brown to black, only the metatarsi lighter; the bases of tibiae light brown.

Holotype (male) and allotype (female) in Ind. Mus. Paratype, No. 21023 U.S. Nat. Mus., male.

Rhinia, R. D.

(Syn. *Beccarimya*, Rdi.)

Genotype, *R. testacea*, R. D.—Mauritius, (syn. *Becc. glossina*, Rdi.).

Facial carina broad; epistoma strongly warped forward, well projected; arista ciliate above only; apical cell petiolate, the petiole rather long and about in line with third vein; male eyes nearly contiguous, the frontalia practically pinched out, and the parafrontalia reduced almost to a line; male hypopygium small; no abdominal macrochaetae, only bristles; front tarsi widened in both sexes; palpi phylliform.

***Rhinia testacea*, R. D.**

Four specimens, from Bombay, Puri, Malavni, and Ceylon (5,291 ft.). The species occurs from North Africa through the Orient to the Pacific Is.

***Chlororhinia*, gen. nov.**

Genotype, *Chlororhinia viridis*, sp. n.

Facial carina narrow, weak; epistoma *Rhinia*-like, but produced beyond vibrissal angles only about as far as length of second antennal joint; arista very short-ciliate, merely pubescent, on upper side only; apical cell petiolate, the petiole as in *Rhinia*; male eyes nearly contiguous, the frontalia pinched out, the parafrontalia reduced to a line; male hypopygium rather large, abdomen rather wider on first two segments than its length on median line; no abdominal macrochaetae; front tarsi not widened; pollinose-pilose band of cheeks and pleurae wanting.

***Chlororhinia viridis*, sp. nov.**

Length of body, 4 mm.; of wing, 3 mm. One male, Shillong, Khasi Hills, Assam (*H. H. Godwin-Austen*); also a specimen with head and abdomen missing, but evidently this species, Ukhrul, Manipur, 6,400 ft. (*W. Pettigrew*).

Wholly bright metallic green in body and head integument, including clypeus and epistoma. Frontalia black, antennae pale fulvous, palpi blackish, base of haustellum metallic green. Parafacialia silvery pollinose on upper end, opposite second antennal joint. A thin beard, some pleural hair and hairs on edge of scutellum tawny. Mesoscutum, scutellum and tergum of abdomen blackish-punctate, the dots marking origins of microchaetae; no thoracic vittae. Abdominal tergum blackish on disk, extended widely along the three segmental incisures and more or less confluent; the hairs of this region smaller and more closely placed, the blackish dots on sides of abdomen larger and less closely placed. No dot-punctuation on head. Legs very pale fulvous, the femora brownish except front pair which are metallic green. Wings faintly tinged with smoky-yellowish throughout. Tegulae a little more deeply tinged with fuscous.

Holotype in Ind. Mus.

***Stomorhina*, Rdi.**

(Syn. *Idia*, Wied. preocc.)

Genotype, *Musca lunata*, Fab.—Madeira, (syns. *Idia cinerea*, R. D., *I. fasciata*, Meig., *Stomorhina maculata*, Rdi.).

Facial carina broadly developed; epistoma *Rhinia*-like; arista ciliate above only; apical cell widely open; marginal bristles on last two abdominal segments; male eyes actually contiguous; male mesoscutum, scutellum and abdomen with thin erect black

pile, that of scutellum longer than that of thorax, the female lacking such pile; male hypopygium not large, claws not very long; parafacialia hairy.

***Stomorhina lunata*, Fab.**

Three males and eight females, from Darjiling (7,000 ft.), Sukhwani (Nepal), Coonoor (Nilgiris), Horai (Naini Tal, west base of Himalayas), and Maritime Alps.

***Idiella*, B. B.**

Genotype, *Idia mandarina*, Wied.—China, (syn. *Idia nigricauda*, Bigot).

Facial carina well developed, sharp; epistoma *Rhinia*-like; arista long-ciliate on upper side only; apical cell closed or narrowly open; male eyes well separated, the frontalia broadly persistent throughout; male hypopygium large, claws long; weak macrochaetae on margin of anal segment.

***Idiella mandarina*, Wied.**

Twenty-six specimens, both sexes, from Burma, Cochin State, Assam, Calcutta, and various localities in India from sea-level up to 6,400 feet.

***Euidiella*, gen. nov.**

Genotype, *Musca discolor*, Fab.—Java, (syns. *Stomorhina muscina*, Rdi., *S. scalaris*, Big.).

Facial carina developed, broad, tubercle-like, widely separating the antennae, fading out below; epistoma *Rhinia*-like, broad; arista thinly long-ciliate above only; apical cell closed in margin or narrowly open; male eyes contiguous, even the parafrontalia practically pinched out; male hypopygium small, claws short; abdominal macrochaetae not developed; front tarsi widened in both sexes.

***Euidiella discolor*, Fab.**

Twenty-seven specimens, both sexes, from Java, Lower Burma, Assam, Nepal, Western Ghats, Sind, and various localities in India from sea-level at Calcutta up to 7,000 feet in the Himalayas. One male was taken at light, and two males were taken hovering in the air.

The yellow of second abdominal segment may be either uninterrupted on the median line, as described by Rondani under the name *muscina*, or rather broadly interrupted on same.

***Euidiella quadrinotata*, Big.**

(*Idia quadrinotata*, Big.—Borneo).

Two females, Mujang, Sarawak, Borneo, July 12, 1910 (C. W. Beebe). This is evidently a good species. It is closely allied

to *discolor*, F., from which it differs in having the abdomen black except the narrow base and the restricted lateral spots on second and third segments. It is also a little more narrowed in form.

***Euidiella unicolor*, sp. nov.**

Length of body, 5.5 to 6.25 mm.; of wing, 4 to 4.5 mm. Three females, Mujang, Sarawak, Borneo, July 12, 1910 (C. W. Beebe); Parambikulam, Cochin State, 1,700-3,200 ft., Sept. 16-24, 1914 (F. H. Gravely); and Mangaldai District, N.E., Assam-Bhutan Frontier, Dec. 26, 1910 (S. W. Kemp).

Differs from *quadrinotata*, Big., by the still more narrowed form, and the wholly dark green abdomen. The legs and antennae are darker also. The second and third specimens mentioned above have the front appreciably shorter and broader than in the Bornean specimen.

Holotype in Ind. Mus., Sarawak. Paratype, No. 21025 U.S. Nat. Mus., Assam-Bhutan Fr.

***Euidiella purpurea*, sp. nov.**

Length of body, 8 to 9 mm.; of wing, 6 to 7 mm. Three males and two females: Three on board ship, 10 miles off Masulipatam, Madras Coast, June 4-5, 1908 (C. Paiva); one Sukna, Eastern Himalayas, 500 ft., July 1, 1908 (N. Annandale); and one Kurseong, Eastern Himalayas, 5,000 ft., August 13-15, 1909 (J. T. Jenkins).

Shining black, with greenish thorax. Parafrontalia honey-combed with yellowish pollen. Parafacialia with silvery or yellowish bar across upper end, extending over upper part of facialia, and a yellowish fleck below on cheek-grooves next eye. Antennae light brownish. The usual broad stripe of pale yellow pollen and pile on cheeks and pleurae. Mesoscutum and scutellum metallic greenish-cupreous, light golden pollinose, punctate with blackish. Abdomen with decided purplish-cupreous shade on sides and covering whole of anal segment. Venter pollinose, with punctations. Legs subfulvous; femora black with purplish tinge, especially front ones; tips of tarsi dusky. Wings nearly clear, base and especially tips smoky. Tegulae smoky-yellow.

Holotype (male) and allotype (female) in Ind. Mus. Paratypes, No. 21026 U.S. Nat. Mus., male and female.

This species is evidently similar to *Idia cervina*, O.S., of Amboyna.

***Metallea*, Wulp.**

Genotype, *Metallea notata*, Wulp.—Java, (syn. *Rhyncomya diversicolor*, Big.).

Facial carina but little developed, flat and weak; epistoma *Phasia*-like, not very broad, not strongly protuberant; arista finely pubescent; apical cell well open; male eyes nearly contiguous, the

frontalia completely pinched out; male hypopygium rather large; marginal row of macrochaetae on last three segments.

***Metallea notata*, Wp.**

Twenty-four specimens, both sexes, from Java, Puri, Shillong, Port Blair, and other Indian localities including on board ship 10 miles off the Madras coast. East African specimens appear to be conspecific with the Indian specimens.

***Trichometallea*, gen. nov.**

Genotype, *Trichometallea pollinosa*, sp. n.

Facial carina absent; epistoma *Phasia*-like; arista bare; apical cell widely open; male eyes nearly contiguous, the parafrontalia reduced to a line; male hypopygium small; abdominal macrochaetae bristle-like, suberect, marginal on last two segments, at sides of other segments, some discals on anal segment; front tarsi of female slightly widened, those of male not so; palpi phylliform, not very broad; mesoscutum, scutellum and abdomen pilose in male, but not in female.

***Trichometallea pollinosa*, sp. nov.**

Length of body, 5.25 to 6.5 mm.; of wing, 5.75 to 6 mm. Two males and one female: One male Songara, Gonda District, United Provinces, March 3-5, 1907; the others Umballa, North-west India, 900 ft., May 8-13, 1905 (*E. Brunetti*).

Pale yellowish, thinly silvery pollinose. Head pale luteous; antennae, frontalia and palpi fulvous. Thorax greenish-cupreous, pleurae thickly pale yellowish pollinose. Mesoscutum and scutellum rather thickly silvery pollinose. Abdomen pale yellowish; median vitta and hind margins of segments blackish, either broadly, narrowly or irregularly, the whole more or less thickly silvery pollinose shading to pale golden. Legs blackish or brownish, hind tibiae fulvous. Wings clear. Tegulae nearly white.

Holotype (male) and allotype (female) in Ind. Mus. Paratype, No. 21027 U.S. Nat. Mus., male.

***Stegosoma*, H. Loew.**

Genotype, *Stegosoma vinculatum*, H. Loew.—Orange Free State, Africa.

Facial carina absent; epistoma *Phasia*-like, not very broad; arista bare; apical cell widely open; male eyes contiguous, the parafrontalia nearly pinched out; male hypopygium of moderate size, the scutellum greatly swollen and over-reaching the two basal segments of abdomen; no abdominal macrochaetae, the abdomen swollen, the anal segment bare on disk; front tarsi widened; palpi phylliform.

This genus appears to be confined to Africa.

Rhynchomyiopsis, gen. nov.

Genotype, *Rhynchomyiopsis indica*, sp. n.

Facial carina not developed; epistoma *Phasia*-like; arista practically bare; apical cell practically closed in margin quite far before wing-tip; weak bristles on margins of third and anal segments; front tarsi not widened; palpi phylliform; female vertex wider than eye; no fronto-orbitals in female save small reclinate ones; no preacrostichals; all head and other macrochaetae very weak; frontals stopping at base of antennae; costal spine strong; two sternopleurals, and only one postsutural. Male not known.

Rhynchomyiopsis indica, sp. nov.

Length of body, 6 mm.; of wing, 4.5 mm. One female, Karachi, Sind, Western India, July 28, 1889 (*Cumming*).

Head, scutellum, abdomen and legs rather pale fulvous, including frontalia, antennae and palpi; the abdomen subrufous from hind half of second segment to tip. Parafrontalia, parafacialia and cheeks very thinly silvery; three polished subround black spots near eye on each side; the largest about middle of parafacialia, one on front half of parafrontalia, the smallest one on cheeks. Thorax light metallic gold-green, the humeri fulvous. Wings scarcely infusate. Tegulae nearly white.

Holotype in Ind. Mus.

Thoracites, B.B.

Genotype, *Musca abdominalis*, Fab.—East Indies.

Facial carina absent; epistoma *Phasia*-like, very narrow, the vibrissal angles constricting the facial plate far above oral margin; arista long-plumose to tip; apical cell narrowly open; male eyes not contiguous, about or fully as far apart as length of second antennal joint; male hypopygium rather large, claws very elongate; macrochaetae strong, suberect, on margins of last two segments, discal and marginal on sides of second and third segments, marginal on sides of first segment; palpi phylliform, but rather narrow; very strong, long costal spine; female with very narrow frontalia, male with same scarcely or not at all showing; female with two strong proclinate fronto-orbitals and one reclinate, male with none of either; female anal segment with close-set row of strong marginal spines, in addition to the regular marginals which thus become practically submarginal.

Thoracites abdominalis, Fab.

Twenty-one specimens, both sexes, from Ceylon, Puri and Madras. The species may be known by the green thorax and fulvous to rufous abdomen, with the under edges of the intermediate abdominal segments more or less widely black.

Chloroidia, gen. nov.

Genotype, *Chloroidia flavifrons*, sp. n.

Facial carina not developed; epistoma *Phasia*-like, rather narrow; arista ciliate on both sides nearly to tip; apical cell very narrowly open, almost closed, the tip of cell narrowed; male eyes nearly contiguous, the frontalia pinched out; male hypopygium extremely large, that of female large and broad; macrochaetae bristle-like on margins of last two segments; front tarsi of female widened, those of male not so; intermediate abdominal segments of male extremely shortened, the two hypopygial segments greatly enlarged and almost as long as the four preceding segments; fifth sternite of male with spine-brush, the sixth sternite excessively broadened and with spine-brushes on each side.

Chloroidia flavifrons, sp. nov.

Length of body, 5 to 5.5 mm.; of wing, 4 to 4.5 mm. One male, Mergui, Lower Burma (*W. Doherty*); one female, Chalakudi, Cochin State, Sept. 14-30, 1914 (*F. H. Gravely*).

Head light golden pollinose, parafrontalia more deeply golden; frontalia and large spot on each cheek black; antennae and palpi fulvous-yellow. Facial plate and facialia not pollinose, shining, tinged black in centre of clypeus and on vibrissal angels. Thorax and scutellum a very bright burnished emerald-green, thinly yellowish pollinose. Abdomen nearly as bright green; in female shading to cupreous at tip and more or less blackish on disk of tergum, in male dusky on tergal disk. Male hypopygium wholly purplish-brown; that of female nearly black, with some purplish tinge. Legs subfulvous; front femora bright green, others more black; tarsi darker distally. Wings faintly infusate, or at least so on costa and tip. Tegulae tawny-whitish to yellowish.

Holotype in Ind. Mus., female; allotype, male.

Strongyloneura, Big.

The main characters of this genus as interpreted by me have been already given. My reference of the following species to *Strongyloneura* is provisional. They seem almost certainly, however, to be congeneric with the genotype (*prasina*, Big.—Japan), which I cannot identify positively in material but which, according to the description, is a member of the *Rhyncomya* group with strongly rounded fourth vein. The supplementary characters given by Brauer (*Sitz. Ak. Wiss., math.-nat. Cl., CVIII, 519*) also agree.

Strongyloneura nepalana, sp. nov.

Length of body, 8.5 mm.; of wing, nearly 7 mm. One female, Thamaspur, Nepal, Feby. 18-20, 1908.

Metallic green; slightly cupreous, especially on abdomen. Parafrontalia, parafacialia and cheeks pale golden pollinose. Fron-

talia brown; antennae and palpi rufofulvous; clypeus and facialia shining yellowish-fulvous. Thorax and scutellum brighter green than abdomen, all with thin coat of silvery pollen. Legs brownish; tibiae tinged with fulvous; femora black, front pair greenish. Wings clear; apical cell rather widely open, though much narrowed at tip. Tegulae nearly white. Parafacial hairs yellowish, thick.

Holotype in Ind. Mus.

A male from Bhim Tal (4,500 ft.) seems to belong here; it is certainly congeneric, and I have drawn the male characters from it as already given, but the apical cell is more narrowly open, and the hairs of parafacialia are blackish. Also fifteen other specimens, both sexes, from Calcutta, Sukna, Assam and Burma appear to be this species, though the fourth vein is not so broadly rounded in all of them. Some have the wings lightly infusate, and the hairiness of the parafacialia is variable in degree, though quite uniformly yellowish.

***Strongyloneura nebulosa*, sp. nov.**

Length of body, 7 to 7.5 mm.; of wing, 6 to 6.5 mm. One male and one female, Margherita, Assam; and Mergui, Lower Burma (*W. Doherty*).

Differs from *nepalana* as follows: Whole body dark cupreous-purplish, with more or less green reflections. The female shows more green. Head testaceous, antennae and palpi fulvous. Parafrontalia and parafacialia pale yellowish to golden pollinose. Wings strongly smoky-infusate across apical half and on extreme basocostal region. Tegulae yellow, upper scale more whitish. Apical cell narrowly open. Parafacial hairs sparse, blackish.

Holotype in Ind. Mus., male; allotype, female.

***Strongyloneura viridana*, sp. nov.**

Length of body, 7 to 10.5 mm.; of wing, 6 to 8.5 mm. Five females: one Sadiya, North-east Assam, Nov. 27, 1911 (*S. Kemp—Abor Exped.*); four Calcutta, Aug. 27, Sept. 26, Oct. 2, 1907.

Entire body except head brilliant metallic green, with cupreous reflections especially on thorax. Head yellowish; pale golden pollinose on parafrontalia, parafacialia, facialia, cheeks and orbits; occiput more ashy. Frontalia brown; antennae, facial plate and palpi fulvous. Thorax thinly silvery pollinose, the scutellum and abdomen showing rather less so except on venter. Legs brownish-rufous; femora black, the front and middle pairs decreasingly green. Wings and squamae usually infusate with smoky-yellow, the anal region less so, the squamae whitish. Fourth vein less evenly rounded. The abdomen shows a faint purplish median vitta; and is more or less tinged with cupreous, sometimes wholly so. Parafacial hairs partly or wholly blackish.

Holotype in Ind. Mus. Paratypes, No. 21028 U.S. Nat. Mus.

Thirty-five other specimens, both sexes, from Calcutta, Sikkim and Assam (Sylhet), appear to be this species, but show fourth vein often bent rather suddenly and not evenly rounded. The parafacial hairs are quite uniformly blackish.

It is quite impossible to decide the distinctness of these specimens and those mentioned under *nepalana* without investigation of the forms in their native habitats and dissections of fresh material. The genitalia can not be satisfactorily prepared in the material before me.

***Strongyloneura coerulana*, sp. nov.**

Length of body, 8.5 mm.; of wing, 6.75 mm. One female, Port Blair, Andaman Is., Feb. 15 to Mch. 15, 1915 (*S. Kemp*).

Differs from *viridana* as follows: Face and antennae rather testaceous; the pollen of head grayer, less golden. Disk of abdominal tergum broadly purplish-blue; the scutellum same colour, also the humeri and the central hind portion of mesoscutum. Wings clear, fourth vein broadly rounded. Tegulae nearly pure white. Parafacial hairs rather blackish.

Holotype in Ind. Mus.

***Metalliopsis*, gen. nov.**

Genotype, *Metalliopsis setosa*, sp. n.

Facial carina weak, flat, separating antennae; epistoma *Phasia*-like, rather narrow; arista very short-plumose or long-pubescent about two-thirds way; apical cell widely open; macrochaetae marginal on last two segments, with irregular discals on anal segment; front tarsi a little widened; palpi phylliform, moderately wide; female front rapidly widening from vertex, parafrontalia thickly bristled outside of frontal row; parafacialia hairy above. Male unknown.

***Metalliopsis setosa*, sp. nov.**

Length of body, 7 (abdomen recurved) to 8.5 mm.; of wing, 7 to 7.5 mm. Three females: Kurseong, Eastern Himalayas, 5,000 ft., July 6, 1908 (*N. Annandale*); and Siliguri, base of Eastern Himalayas, July 18-20, 1907.

Head rufofulvous, the parafrontalia showing obscurely green beneath the yellowish pollen; a black spot on parafacialia; third antennal joint and extreme tips of palpi dusky. Thorax and scutellum bright metallic green, with thin coat of silvery pollen; some thin long yellow pile on pleurae and humeri. Abdomen fulvofulvous, with black median vitta; anal segment metallic cupreous-green. Edge of third segment and spot on side of second segment metallic greenish. Legs brownish-rufous; femora black with metallic green tinge, especially front ones. Wings and tegulae yellowish-infusate.

Holotype in Ind. Mus. Paratype, No. 21029 U.S. Nat. Mus.

Synamphoneuropsis, gen. nov.

Genotype, *Synamphoneuropsis viridis*, sp. n.

Facial carina absent; epistoma *Phasia*-like, not very wide; arista long-plumose nearly to tip; apical cell open; male eyes not contiguous, separated by distance equal to half or more of the length of second antennal joint, the frontalia reduced to a line; male hypopygium moderately large, claws moderately elongate; macrochaetae not very strong, marginal on last three segments, with irregular suberect discals on anal segment; front tarsi of female a little widened, those of male not so; palpi phylliform, moderately wide; abdomen broader than in *Synamphoneura*.

Synamphoneuropsis viridis, sp. nov.

Length of body, 6 to 8 mm.; of wing, 4.5 to 6.5 mm. Eighteen specimens, both sexes: nine from Sukhwani, Nepal Frontier, Feb. 15-16, 1908; three from Muttra, United Provinces, July 24, 1905 (*E. Brunetti*); two from Allahabad, United Provinces, August 12-13, 1909 (*B. Lord*); one from Motisal, Garhwal District, base of Western Himalayas, March 5, 1910; one from Amangarh, Bijnor District, United Provinces, Feb. 24, 1910; and two from Anwarganj, Cawnpore District, United Provinces, Oct. 1-13, 1911 (*J. W. C.*).

Metallic cupreous-green; the coppery showing on dorsal portions, and especially on tip of abdomen. Front and face silvery-yellow pollinose; a shining brown spot near middle of parafacialia, a dusky area on cheeks, and another at front end of parafrontalia. Pollen of head of female more golden. Frontalia light brown; antennae and palpi fulvous to rufous. A thin silvery bloom over the metallic green of body. Obscure dark median vitta on abdomen. Legs brownish-rufous; femora blackish, more or less metallic green especially the front ones. Wings and tegulae distinctly smoky-yellowish, often the costal border of wing more infusate.

Holotype (female) and allotype (male) in Ind. Mus. Paratypes, No. 21030 U.S. Nat. Mus., male and female.

Nitellia, R. D.

Genotype, *Musca vespillo*, Fab.—Europe.

Facial carina absent; epistoma *Phasia*-like, very narrowed; arista long-ciliate above, with only a few cilia below in middle; apical cell closed or very short-petiolate; male eyes nearly contiguous, the frontalia reduced to a line or nearly pinched out; male hypopygium rather large; macrochaetae like *Pollenia*; mesoscutum without yellow pile, and with pronounced flat discal impression.

This genus appears not to reach India.

Apollenia, Bezzi.

Genotype, *Pollenia nudiuscula*, Big.—Port Natal, Africa.

Facial carina flattened, wide, weak, broadly separating the antennae; epistoma *Phasia*-like, broad; arista long-plumose to

tip; apical cell widely open; macrochaetae marginal on last three segments, with irregular discals on anal segment; front tarsi of female widened; palpi phylliform, but not very broad; scutellum with erect short straight spines.

This genus appears to be confined to Africa.

Thelychaeta, B. B.

Genotype, *Thelychaeta chalybea*, B. B.—Borneo.

Facial carina broad, but flattened; epistoma *Phasia*-like, broad and very long; arista wholly long-plumose to tip; apical cell widely open; male eyes almost contiguous, the frontalia nearly or quite pinched out, the parafrontalia reduced to a line; male hypopygium not very large, claws not very long; macrochaetae like *Pollenia*; front tarsi of female much widened, those of male scarcely so; palpi phylliform; female with two strong proclinate fronto-orbitals and one reclinate, male with none of either. No straight erect spines on scutellum.

Thelychaeta chalybea, B. B.

One female, labelled "no history." This specimen differs from the description by the third antennal joint being scarcely twice the length of the second. It is strongly bluish, and the abdomen shows practically no pollen. The tegulae are strongly infusate with brownish, the wings but faintly so. The form is evidently congeneric with *viridaurea*, Wd., and is doubtfully referred to *chalybea*, B. B.

Thelychaeta viridaurea, Wied.

One male and six females of this interesting species are from Mergui, Lower Burma; Ghumti, Eastern Himalayas, 1,800-3,500 ft.; Sadiya, North-east Assam; and Soondrijal, Nepal; three others being labelled "no history." Wiedemann's characterization, though very brief, seems quite unmistakable. Brauer and Bergenstamm have given additional characters (*Musc. Schiz.*, III, 179). Wiedemann's specimen was evidently an undersized female. The present specimens measure 10 to 11 mm. The colour is golden-green, more or less cupreous; the abdomen with changeable pollen like *Pollenia rudis*, F., but greenish-gold. The male generic characters above are drawn from this species.

Pollenia, R. D.

Genotype, *Musca rudis*, Fab.—Europe, Asia, North America (evidently introduced in last).

Facial carina acute, sharp, narrow; epistoma *Phasia*-like, very narrowed; arista plumose to tip; apical cell widely open; male eyes not contiguous, but rather closer together than length of second antennal joint, the frontalia practically pinched out;

male hypopygium not large, claws not long; macrochaetae bristle-like, long, suberect, marginal on last three segments, irregularly discal on anal segment; front tarsi of female widened, those of male not so; palpi club-shaped, not much flattened and not very stout; female with two proclinate and one reclinate fronto-orbitals, male with none of either.

***Pollenia rudis*, F.**

Two males, one between Yanghissar and Sinkol (Yarkand Exped.); the other Styria.

This species has been demonstrated by Keilin to be parasitic in earthworms in France. It has recently been reared by the U.S. Bureau of Entomology from earthworms in America.

***Dexopollenia*, gen. nov.**

Genotype, *Dexopollenia testacea*, sp. n.

Facial carina strong, wide and depressed, merged widely into epistoma; vibrissae but little above oral margin, the epistoma *Pollenia*-like, narrow; arista moderately plumose; apical cell narrowly open, the fourth vein curved much like that of *Pyrellia*; male eyes practically contiguous, the parafrontalia reduced to a line; male hypopygium rather large; macrochaetae bristle-like, erect, marginal on last three segments, lateral discals on all; front tarsi not widened in either sex; palpi subcylindrical; thorax with yellowish crinkled pile; parafacialia wide and bare.

***Dexopollenia testacea*, sp. nov.**

Length of body, 5.5 mm.; of wing, 6 mm. One male and one female, Assam-Bhutan Frontier, Mangaldai District, N.E., Jany. 1-2, 1911 (*S. W. Kemp*).

Fulvotestaceous, shaded to brown. Head with pale brown shading over face and cheeks; the parafrontalia dark brown, thinly silvery pollinose, leaving three main darker areas on vertex, middle, and opposite base of antennae, the vertical area not showing in male. Thorax and scutellum mostly brown; the scutum blackish, but showing some silvery pollen. Abdomen with hind borders of segments brown, the third and anal brown on posterior half, or anal wholly brown. Legs testaceous, tinged with brown; tarsi blackish. Wings clear. Tegulae smoky.

Holotype in Ind. Mus., female; allotype, male.

***Polleniopsis*, gen. nov.**

Genotype, *Polleniopsis pilosa*, sp. n.

Facial carina broad, flattened, rounded, reaching nearly to epistoma, the latter *Pollenia*-like, narrow and short; arista thickly plumose; apical cell moderately open, the fourth vein bent sud-

denly; male eyes nearly contiguous, the frontalia pinched out or only very narrowly showing; male hypopygium not very large, claws moderately elongate; macrochaetae bristle-like, much as in *Pollenia*; short straight pile of thorax black, longer on pleurae; no crinkled yellow pile; front tarsi normal in male; palpi subcylindrical; parafacialia moderately wide, more or less pilose above.

***Polleniopsis pilosa*, sp. nov.**

Length of body, 5 to 8 mm.; of wing, 5 to 8 mm. Two males: Darjiling, 6,000 ft., Sept. 21, 1908 (*E. Brunetti*); and Purneah, Bihar, August 5, 1907 (*C. Paiva*).

Brown to blackish, more or less silvery or ashy pollinose. Head pale brownish, the front darker; pollen silvery to ashy. Palpi fulvous to fulvorufous; third antennal joint subfulvous; frontalia light to dark brown. Mesoscutum with five black vittae, the middle one obsolete before suture in posterior view; the two inner ones before suture narrow in posterior view, but forming one wide vitta in anterior view. Abdomen tessellate much as in *Pollenia rudis*. Legs brown. Wings nearly clear, faintly tinged with smoky-yellowish especially on costa. Tegulae yellowish-smoky.

Holotype in Ind. Mus. Paratype, No. 21031 U.S. Nat. Mus.



XIII NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM

IX. *LEANDER STYLIFERUS*, MILNE-EDWARDS, AND RELATED FORMS.

(Plates VIII—X).

By STANLEY KEMP, B.A., *Superintendent, Zoological Survey
of India.*

One of the most conspicuous features of the fauna of the silt-laden waterways of the Gangetic delta and other estuarine regions of the Indian coast is the enormous abundance of prawns belonging to the genus *Leander*. In general appearance the forms that frequent these localities differ widely from the marine species on which our conception of the genus is primarily based; the rostrum is much longer, with an elevated dentate crest at its proximal end, the second legs are very slender, often with the palm of the chela inflated, and the last three legs are attenuated. *Leander styliferus*, described by Milne-Edwards eighty years ago from specimens obtained at the mouth of the Ganges, is typical of the species that exhibit these characteristics.

The group of species, though it appears to be a natural one, is by no means clearly defined, for it grades almost imperceptibly into the more normally constituted elements of the genus, through such forms as *Leander concinnus*, de Man, and *L. indicus*, Heller. It is, however, of particular interest in the study of the brackish water fauna of Eastern Asia in that it includes a number of abundant species that migrate annually from the sea into estuaries and tidal rivers, as well as others that have succeeded in establishing themselves in pure fresh water.

Some of the forms are of considerable economic importance in India and China, and probably also in other countries. Vast quantities of *Leander styliferus* and *L. tenuipes* are caught in the Gangetic delta and sold in those markets frequented by the poorer classes of the population, while in the Kiangsu province of China *L. modestus* is captured in large numbers, especially in the Tai Hu Lake. To a European palate these species of *Leander* are lacking in flavour and seem greatly inferior to the Penaeidae that frequent the same waters.

Among the Carids that have been accumulating in the Indian Museum for the past thirty years, the species of *Leander* allied to *L. styliferus* are well represented and the collection has recently been enriched by the acquisition of a number of specimens, comprising several forms of great interest, obtained by Dr. Annandale in China and in the Malay Peninsula.

Including the new forms described below, ten species showing affinity with *L. styliiferus* are now known; seven of these are dealt with in detail below. I have added an account of a very remarkable allied form which occurs in great abundance in Indian estuaries in company with *Leander*. According to the methods at present in vogue this species must be referred to the genus *Palaemon*, but it bears such an exceedingly close resemblance to *L. styliiferus* that it may be doubted whether there is not some error in our scheme of classification. I have called this species *Palaemon mirabilis*.

The principal characters of *Leander styliiferus* and the related species may be expressed in the following way:—

- I. Dactylus of last three peraeopods very long and slender, that of fourth and fifth pairs at least as long as propodus; pleopods very long, those of first pair much longer than carapace [carapace with branchiostegal spine; palm of second peraeopods much swollen].
 - A. Last two pairs of peraeopods excessively long, flagelliform, with dactylus much longer than carapace; carpus of second peraeopods much more than half as long as palm.
 1. Basal crest of rostrum with at most 7 teeth; fingers of second peraeopod more than twice as long as carpus ... *tenuipes*, Henderson.
 2. Basal crest of rostrum with 8 teeth; fingers of second peraeopod twice or less than twice as long as carpus ... *hastatus*, Aurivillius.¹
 - B. Last two pairs of peraeopods not excessively long, dactylus much shorter than carapace; carpus of second peraeopods less than half the length of palm ... *annandalei*, sp. nov.
- II. Dactylus of last three peraeopods not abnormal in length, shorter than propodus; pleopods normal in length, those of first pair shorter than carapace.
 - A. Carapace with branchiostegal spine; carpus of second peraeopods less than one and a half times as long as chela.
 1. Palm of second peraeopods much swollen in large specimens, carpus much shorter than chela.
 - a. One or more subapical dorsal teeth on rostrum; carpus of second peraeopods shorter than merus or than fingers; last abdominal somite in adults not more than half length of carapace.
 - i. Dactylus of third peraeopod more than three quarters length of propodus, that of fifth peraeopod nearly half length of propodus: last four abdominal somites sharply carinate dorsally ... *carinatus*, Ortmann.
 - ii. Dactylus of third peraeopod scarcely half length of propodus, that of fifth peraeopod at most one third length of propodus;

¹ I have not seen specimens of this species.

- last four abdominal somites at most very bluntly carinate dorsally *styliferus*,
Milne-Edwards.
- b. No subapical dorsal tooth on rostrum; carpus of second peraeopods as long as merus or fingers; last abdominal somite nearly two thirds as long as carapace *japonicus*,
Ortmann.¹
2. Palm of second peraeopods little if at all swollen, carpus at most only a trifle shorter than chela [at most 5 teeth on lower border of rostrum].
- a. One or two small subapical dorsal teeth on rostrum *mani*, Sollaud.¹
- b. No subapical dorsal teeth on rostrum *modestus*, Heller.
- B. Carapace without branchiostegal spine; carpus of second peraeopods at least one and a half times as long as chela.
1. Rostrum shorter, with 3 to 5 inferior teeth; last three peraeopods shorter, fifth pair extending beyond antennal scale by little more than length of dactylus *fluminicola*,
sp. nov.
2. Rostrum longer, with 6 to 10 inferior teeth; last three peraeopods longer, fifth pair extending beyond antennal scale by dactylus and at least one half of propodus *potamiscus*,
sp. nov.

These species form, I believe, a natural group, though some of them possess very unusual characters. *Leander tenuipes*, together with a related but imperfectly known W. African species, described by Aurivillius as *L. hastatus*, exhibits in the excessive length and slenderness of the last three thoracic legs a feature paralleled among *Macrura* only in the deep-sea *Nematocarcinidae*.² A link between these species and more normal types is, however, afforded by *L. annandalei*, a most interesting form obtained by Dr. Annandale near Shanghai.

The two last species mentioned in the key differ, so far as I am aware, from all described representatives of the genus in the complete absence of the branchiostegal spine. This character might, indeed, be held to possess generic value; but the spine in question is not infrequently very small in other species of *Leander* and the affinities of the forms in which it is absent appear to be unmistakably with the more normally constituted *L. mani* and *L. modestus*.

Of the seven species that I have myself examined, *L. styliferus* and *L. tenuipes* are apparently seasonal immigrants to brackish water, ascending estuaries and tidal rivers, possibly for breeding purposes, when the monsoon floods are abating. The two species

¹ I have not seen specimens of this species.

² In the *Nematocarcinidae*, however, the extreme length of the legs is due to the lengthening of the merus, ischium and carpus, whereas in *Leander tenuipes* and its ally the merus and ischium are nearly normal in length and the carpus quite short, the propodus and dactylus being the segments that are attenuated.

are often found together. *L. potamiscus* has been found only three times, on each occasion in water that was fresh but subject at times to tidal influence: *L. annandalei* and *L. modestus* appear to be inhabitants of pure fresh water. The most remarkable species from the point of view of habitat is *L. fluminicola*, which although occasionally taken in water of slight salinity, also occurs in rivers far above tidal influence and has even been found at Mirzapur in the United Provinces at a distance of fully 700 miles by river from the coast.

All the species here referred to the genus *Leander* possess a mandibular palp of three segments. The maxillae and maxillipedes are remarkably uniform in structure, differing little if at all from those of *L. serratus* (Pennant).

***Leander tenuipes*, Henderson.**

(Plate viii, fig. 1.)

1893. *Leander tenuipes*, Henderson, *Trans. Linn. Soc., Zool.* (2), V, p. 440, pl. xl, figs. 14, 15.

1903. *Leander tenuipes*, Nobili, *Boll. Mus. Torino*, XVIII, no. 452, p. 7.

The rostrum is variable in length, extending beyond the apex of the antennal scale by a proportion varying from one fifth to nearly one half of its length. The basal crest is well elevated and bears from 5 to 7 teeth,¹ of which from 2 to 4 are situated on the carapace behind the orbit. The teeth increase in size from behind forwards, the hindmost being as a rule quite rudimentary. The foremost tooth of the series does not reach the end of the first segment of the antennular peduncle. In front of the basal crest, the rostrum trends downwards, but before reaching the end of the antennular peduncle is reflected strongly upwards and is continued almost in a straight line from this point to the apex. On the dorsal edge near the tip there is, almost without exception, a single tooth. The lower margin is provided with from 2 to 6 teeth, nearly always 4 or 5²; the teeth are small and widely spaced and the proximal one is well in advance of the foremost of those that constitute the basal crest (pl. viii, fig. 1).

The antennal and branchiostegal spines are about equal in length; the latter is flanked by a short carina and is placed on the extreme frontal margin of the carapace, *not* a little distance behind it as in some other species of the genus. In the eyes the breadth of the cornea is about equal to the length of the stalk; there is no visible ocellus.

The spine forming the lateral process of the basal antennular segment is very inconspicuous. The second peduncular segment, measured dorsally, is exceedingly short, much less than half the length of the third. The short ramus of the outer antennular

¹ Of 42 specimens, eight have 5 teeth on the basal crest, twenty-one have 6 teeth and thirteen have 7 teeth.

² Of 42 specimens, two have 2 inferior teeth, three have 3 teeth, sixteen have 4 teeth, nineteen have 5 teeth and two have 6 teeth.

flagellum reaches barely to the apex of the antennal scale ; it is fused with its fellow for some 7 or 8 segments, the fused portion being about two fifths the length of the entire shorter ramus and a little less than the length of the ultimate peduncular segment. The basal portion of the inner flagellum is swollen. The antennal scale is rather strongly narrowed anteriorly ; its length is about three and a third times its greatest breadth and the distal portion of the lamella extends far beyond the spine that terminates the outer margin.

The oral appendages and maxillipedes do not differ markedly from those of *L. serratus*. The mandibular palp is composed of three segments, of which the third is scarcely longer than the second. The anterior lobe of the epipod of the first maxillipede is not pointed as in Sollaud's *L. mani*. The antepenultimate segment of the third maxillipede is considerably expanded distally, the exopod reaching only a little beyond the middle of its length. The ultimate segment is only about one eighth shorter than the penultimate.

The first peraeopods reach a little beyond the apex of the antennal scale. The carpus is a trifle shorter than the merus and is about one and a half times the length of the chela. The fingers are fully one and a half times the length of the palm.

The second peraeopods in most cases reach beyond the antennal scale by at least the length of the chela, sometimes by that of the chela, carpus and a small portion of the merus. Measurements (in mm.) of the separate segments in seven specimens are as follows :—

Serial Number.	Locality.	Sex.	Total length. ¹	Length of carapace & rostrum.	Length of carapace. ²	Total length of 2nd leg. ³	2nd Peraeopod : length of				
							Ischium.	Merus.	Carpus.	Palm.	Dactylus.
1	Chennia, Gangetic delta.	♀ ovig.	63	27.2	12.5	34.7	4.4	11.3	4.0	5.0	8.9
2		♀ ovig.	62	26.1	12.0	34.2	4.4	11.4	3.4	4.5	9.1
3		♀ ovig.	60	27.3	10.4	30.0	4.0	10.2	2.8	4.0	8.4
4	Port Canning, Gangetic delta.	♀	65	28.4	12.2	31.9	4.4	10.0	3.2	4.2	8.0
5		♂	63	28.8	10.9	31.0	4.2	10.2	2.5	3.5	8.4
6		♂	61	26.9	11.1	28.3	3.6	9.3	2.5	3.7	7.8
7	Green I., Amherst, Tennasserim.	♂	56	23.2	11.0	31.0	4.1	10.6	2.8	3.6	8.0

¹ Measured from the tip of the rostrum to the tip of the telson, with the animal extended as nearly as possible in a straight line.

² Measured from the back of the orbit to the posterior mid-dorsal point.

³ Measured from the basis to the tip of the fingers.

It will be noticed that the merus is the longest segment and that the carpus is distinctly shorter than the palm and is less than half the length of the fingers. The palm is strongly swollen and the fingers are straight with conspicuously inturned tips that cross one another when the claw is closed.

The last three legs are of extraordinary length and slenderness and are usually found broken in preserved material. In a few individuals in which they are present they yield the following measurements (in mm.):—

Serial Number. ¹		Sex.	Length of				
			Ischium.	Merus.	Carpus.	Propodus.	Dactylus.
4	} Third peraeopod ... }	♀	4.3	8.9	3.2	9.1	4.7+
7		♂	3.9	7.9	2.8	8.0	11.4+
2	} Fourth peraeopod ... }	♀ ovig.	5.5	9.7	3.1	17.7	36.8+
4		♀	5.5	9.3	3.4	17.9	34.5+
1	} Fifth peraeopod ... }	♀ ovig.	6.1	8.7	3.8	17.4	...
3		♀ ovig.	5.5	7.3	3.2	17.9	28.3+
4		♀	5.8	7.9	3.2	17.8	36.6+
7		♂	5.0	7.3	3.0	16.3	37.5+

The extreme length of these legs² is due in the main to the lengthening of the propodus and dactylus; the carpus in all cases is quite short. The third legs are at least two thirds the entire length of the animal; the fourth and fifth pairs are much longer, considerably exceeding the total length. The dactylus is broken in all the specimens examined; when complete it is evidently much longer than the combined lengths of the rostrum and carapace and more than twice the length of the propodus. Henderson notes that the dactylus of the last legs (in a specimen measuring 55 mm. from the orbit to the apex of the telson), though broken at the tip, was 45 mm. in length.

Except for the first pair the peraeopods are entirely devoid of hairs.

¹ The specimens measured are the same as some of those in the table previously given. The serial numbers afford individual reference.

² I understand that the figures illustrating Dr. Henderson's valuable "Contribution to Indian Carcinology" were not drawn under the author's supervision, but were executed after his return to India. In the figure of *L. tenuipes* the proportions of the segments of the last three legs are wholly erroneous.

The abdomen, though compressed, is not dorsally carinate. The pleura of the fifth somite are narrowed and drawn out posteriorly. The sixth somite, measured dorsally, is a trifle more than half the length of the carapace. The pleopods are exceptionally long, those of the first pair being about one and a half times the length of the carapace.

The telson reaches only a little beyond the middle of the outer uropod. It is rounded above and sometimes bears a pair of small spinules near the distal end. The apex, when perfect, is seen to bear a single pair of lateral spinules which extend considerably beyond the rounded median prominence. The outer uropod is long and narrow; its outer margin in front of the subterminal spine is distinctly concave.

Large specimens of *L. tenuipes* reach a total length of 65 or 70 mm. The eggs are small, about 0.55 mm. in length and 0.44 mm. in breadth.

In examples from 15 to 30 mm. in length the rostrum is very much shorter than in adults, not reaching beyond the middle of the last segment of the antennular peduncle and with at most only faint traces of teeth on the lower margin. The last abdominal somite is proportionately much longer, being scarcely shorter than the carapace in the smallest examples. In a specimen only 22 mm. in length the second peraeopods already closely resemble those of adults, reaching beyond the antennal scale by almost the entire length of the chela. The great length of the last three legs is a conspicuous feature even in the smallest individuals.

Leander tenuipes is evidently a very close ally of *L. hastatus* (Aurivillius)¹ from the Cameroons. Aurivillius does not refer in his description to the great length and slenderness of the last three pairs of peraeopods, but it is clear from his figure that the species possesses this character. A further examination of West African specimens is necessary before the distinctions between *L. hastatus* and *L. tenuipes* can accurately be determined. The African species appears to differ in having 8 teeth on the basal crest of the rostrum, in the shorter fingers of the second legs which are usually less than twice the length of the carpus, and in the greater length of the sixth abdominal somite which is fully two thirds as long as the carapace. According to Aurivillius' measurements the segments of the second peraeopods show far greater variation in length than in *L. tenuipes*.

Living specimens of *L. tenuipes* are for the most part translucent with a slightly milky tinge. In adults the mandibular region is bright red and the rostrum is dotted with carmine. The lower antennular flagellum is carmine at the base changing to deep mauve nearer the tip. There are a few very small red chromatophores on the segments of the large chelipede. On either side of the abdomen there are red flecks at the points where the somites

¹ *Palaemon (Leander) hastatus*, Aurivillius, *Bihang till K. Svenska Vet.-Akad. Handl.*, XXIV, Afd. iv, no. 1, p. 27, pl. iv, figs. 3-6.

are hinged and there are also small red chromatophores on the pleura and dorsally at the distal ends of the last three segments. The lateral margins of the telson and the outer edge of the external uropod are deeply stained with red; on the internal uropod there are scattered red chromatophores. The eggs are bright gamboge yellow. Very young individuals are almost wholly transparent.

In specimens kept alive in an aquarium it was found that the ischial and meral segments of the last three legs were held forwards, downwards and a little outwards. The filiform terminal segments were trailed from the distal end of the merus in much the same manner as if the lash of a whip were drawn through the water from the end of a stiff handle. The legs were evidently not used in progression and it may be surmised that they have taken on a sensory function.

The specimens examined are from the following localities:—

$\frac{3271.2}{7}$	Madras ...	Purchased.	Several.
$\frac{167.90}{7}$	Tanda, about 30 miles S. of Coconada, 4-5 fms.	Investigator.'	Several.
$\frac{1171}{7}$	4 miles off Vizagapatam Coast, Madras Pres., 7½-9½ fms. ...	Investigator.	One.
$\frac{9152}{10}$	} Puri, Orissa Coast (from fishermen's nets)	T. Southwell, S. Kemp.	Many.
$\frac{9723}{10}$			
$\frac{3148.56}{7}$	} Gangetic delta (many localities) ...	A. J. Milner, R. Munro, W. T. Blanford, J. Wood-Mason, J. T. Jenkins, T. Southwell, S. Kemp.	Many.
$\frac{9515.21}{10}$			
$\frac{9717.22}{10}$			
$\frac{9522}{10}$	Mouth of Rangoon R., Burma ...	Investigator.'	Three.
$\frac{9523}{10}$	Moulmein R., Burma ...	„	One.
$\frac{9524}{10}$	Bassein R. Estuary, Burma ...	„	Two.
$\frac{9514}{10}$	Green I., Amherst, Tennasserim ...	„	Several.

In addition there are a large number of specimens, unquestionably belonging to *L. tenuipes*, labelled "Lyttleton Harbour, New Zealand; W. Guyes Brittan." I can find no reason to distrust the label, but the record seems to require verification before such a great increase in the range of the species can be accepted.

Leander tenuipes was described by Henderson from the Gulf of Martaban and Madras and has since been recorded by Nobili from Bombay. It is frequently found in company with *L. styliferus* and has occasionally been caught in surface nets near the shore. Though often taken in the open sea, it is evidently far from uncommon in brackish water, probably migrating to estuaries and up rivers at the close of the monsoon. I am not aware that it has even been found in pure fresh water.

***Leander annandalei*, sp. nov.**

When describing *L. tenuipes*, Henderson noted that the species was so peculiar in character that he was at one time inclined to create a new genus for its reception. The new form obtained by Dr. Annandale in China is proof that he was wise in adopting a

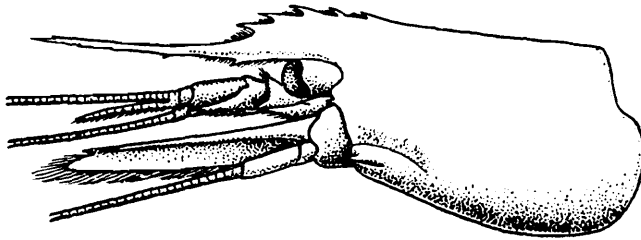


FIG. 1.—*Leander annandalei*, sp. nov.
Carapace, rostrum, etc., in lateral view.

conservative policy: it forms a link between Henderson's species and more normal members of the genus and affords most interesting evidence of the manner in which such an extreme type as *L. tenuipes* has been evolved.

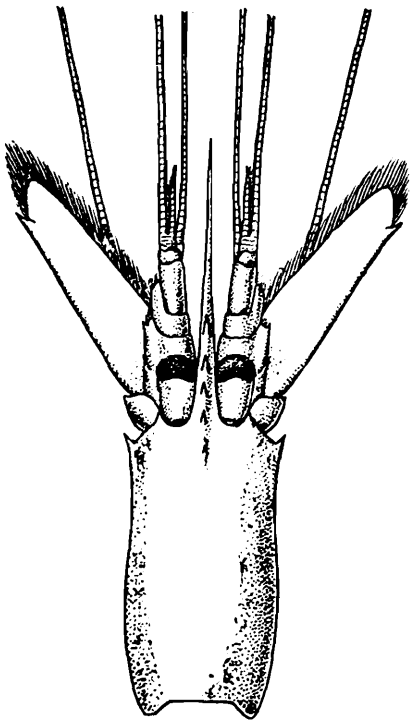


FIG. 2.—*Leander annandalei*, sp. nov.
Carapace, rostrum, etc., in dorsal view.

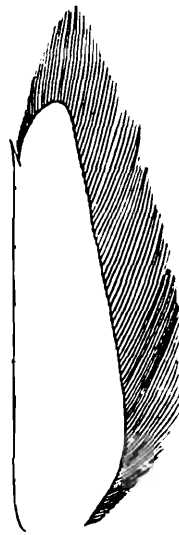


FIG. 3.—*Leander annandalei*, sp. nov.
Antennal scale.

Unfortunately only a single specimen of *L. annandalei* was obtained.

The rostrum is similar to that of *L. tenuipes*, but is shorter, reaching beyond the antennal scale by only about one tenth of its

length; the distal portion trends only a little upwards. The basal crest bears 5 equally separated teeth, increasing in size from behind forwards; the hindmost alone is situated on the carapace behind the orbit and the foremost is placed over the articulation between the first and second segments of the antennular peduncle (text-fig. 1). There is a single small sub-terminal dorsal tooth and four small, widely separated teeth on the lower margin.

The branchiostegal spine is fully as large as the antennal; it is situated a little behind the frontal margin, thus differing from *L. tenuipes*. The eyes resemble those of the allied species, the stalk being proportionately a trifle larger. The antennular peduncle does not show any marked peculiarities; the second segment is very short (text-fig. 2). The shorter ramus of the outer flagellum is nearly as long as the peduncle; it is fused basally with its fellow for a distance not greater than one third the dorsal length of the ultimate peduncular segment. The antennal scale is narrowed anteriorly and is a trifle more than four times as long as broad (text-fig. 3).

The oral appendages resemble those of *L. tenuipes*; the mandibular palp is composed of three segments.

The peraeopods differ conspicuously in their proportions from those of all other known species. The measurements of the separate segments (in mm.) are as follows:—

	Ischium.	Merus.	Carpus.	Propodus.	Palm.	Dactylus.
First peraeopod	2.2	3.1	2.8	...	0.7	0.6
Second „	3.6	3.1	0.7	...	1.8	4.0
Third „	3.6	3.7	0.4	1.9	...	1.1+
Fourth „	3.8	3.9	0.6	3.0	...	3.2
Fifth „	3.1	3.2	1.0	3.4	...	3.4

It will be noticed that in all the last four pairs of peraeopods the carpus is exceedingly short. In the second legs (text-fig. 4c), which reach beyond the antennal scale by about half the length of the fingers, this feature is specially remarkable, the segment being conical, little longer than broad, recalling that of certain species of the Pontoniid section of the Palaemonidae. In this limb, also, the ischium is conspicuously longer than the merus, resembling in this respect *L. styliferus*, rather than *L. tenuipes*. The dactylus of the third peraeopod (text-fig. 4d) is incomplete; in the fourth pair (text-fig. 4e) it is longer than the propodus, while in the fifth pair (text-fig. 4f) the two terminal segments are of equal length. Very long hairs are to be found on the ischium and merus of the first, third and fourth pairs; otherwise the limbs are glabrous or with

a few short and fine hairs. The dactylus of the last pair has a slight swelling at the base which is rather thickly clothed with short hairs.

The abdomen is much compressed laterally, but is not carinate. The sixth somite, measured dorsally, is fully two thirds as long as the carapace. The pleopods, as in *L. tenuipes*, are very long, those of the first pair being nearly one and a half times the length of the carapace. The telson is rounded above and bears a single pair of dorsal spinules near the distal end. The apex is minutely pointed in the middle with a long lateral spinule on either side.

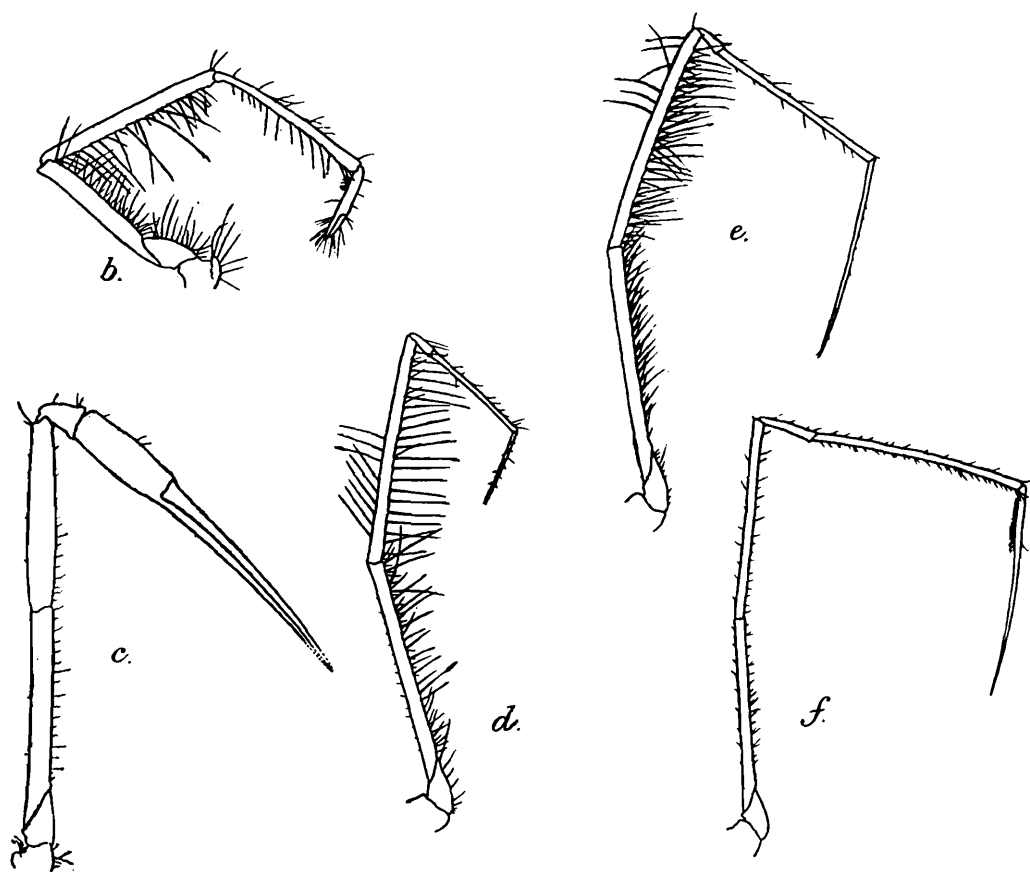


FIG. 4.—*Leander annandalei*, sp. nov.

b. First peraeopod.

d. Third peraeopod.

c. Second peraeopod.

e. Fourth peraeopod.

f. Fifth peraeopod.

The single specimen of this interesting species is a female, without eggs. The rostrum and carapace together measure about 14 mm., the carapace alone being about 6.5 mm. Owing to the fact that the specimen is strongly bent it is difficult to measure the total length in a satisfactory manner; it would probably be about 32 or 33 mm. when the animal was extended.

The type specimen (no. 9758/10, *Zool. Surv. Ind.*) was dredged by Dr. Annandale in China, in the Whangpoo River between Shanghai and Woosung, at a depth of $5\frac{1}{2}$ to $7\frac{1}{2}$ metres. It was obtained in water that was quite fresh.

Leander styliferus (Milne-Edwards).

(Plate viii, fig. 2.)

1837. *Palemon longirostris*, Milne-Edwards, *Hist. Nat. Crust.*, II, p. 394.
 1840. *Palemon styliferus*, Milne-Edwards, *ibid.*, III (errata), p. 638.
 1893. *Leander longirostris*, Henderson, *Trans. Linn. Soc.* (2), V, p. 439.
 1902. *Palaemon styliferus*, Rathbun, *Proc. U. S. Nat. Mus.*, XXVI, p. 51.
 1903. *Leander longirostris*, Nobili, *Boll. Mus. Torino*, XVIII, no. 452, p. 7.
 1908. *Leander* sp., de Man, *Rec. Ind. Mus.*, II, p. 220, pl. xviii, fig. 3.
 1915. *Leander styliferus*, Kemp, *Mem. Ind. Mus.*, V, p. 273.

The rostrum is long, reaching beyond the apex of the antennal scale by a distance varying from one third to three fifths of its length. The proximal portion

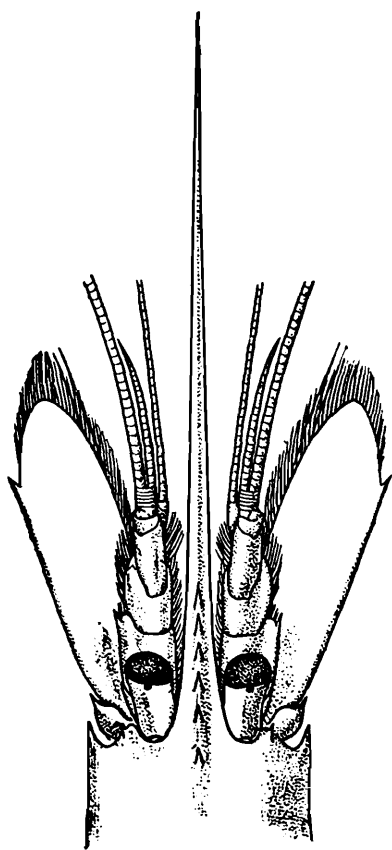


FIG. 5.—*Leander styliferus*, Milne-Edwards.

Carapace, rostrum, etc., in dorsal view.

is strongly elevated dorsally forming a well-marked basal crest which bears from 5 to 7 (usually 6)¹ procurved teeth. The teeth increase in size from behind forwards; the hindmost is frequently situated on the carapace behind the level of the orbit and the foremost reaches little if at all beyond the end of the first segment of the antennular peduncle. In front of the basal crest the rostrum is slender and up-turned; for the greater part of its length it is usually unarmed, but near the tip is as a rule provided with from 1 to 3² small widely separated teeth. The lower margin bears from 6 to 10 teeth (usually 7, 8 or 9)³; the proximal teeth are generally rather closer together than the distal and the hindmost is usually situated a little behind or a little in front of the foremost tooth of the basal crest (pl. viii, fig. 2).

The carapace bears a small and inconspicuous antennal spine; the branchiostegal is much larger, situated on the frontal margin and is flanked by a short and blunt carina. Above the branchio-

¹ Of forty specimens thirteen have 5 basal teeth, twenty-three have 6 and four have 7.

² I have seen one specimen without any teeth on the distal part of the upper margin, one with 4 teeth and one with 5.

³ Of forty specimens two have 6 inferior teeth, fourteen have 7, twelve have 8, eight have 9 and four have 10. I have seen single examples with 5 and 11 teeth and Nobili records specimens, one from Bombay and one from Borneo, with 12 and 13 inferior teeth.

stegal spine there is a finely cut groove, resembling a suture line, which extends from the anterior margin backwards for about one third the length of the carapace.

The greatest breadth of the cornea is about equal to the length of the eyestalk. A small ocellus (not found in either of the two preceding species) is visible, partly joined to the cornea (text-fig. 5).

The basal segment of the antennular peduncle bears a small spine on the lower surface near the middle of its internal margin. The outer border, in front of the short spine representing the lateral process, is sinuous and terminates in a tooth which extends but little beyond the level of the protruding, setose antero-external margin of the segment. The second segment, measured mid-dorsally, is a little more than half the length of the third. The total length of the shorter branch of the outer antennular flagellum is about equal to that of the peduncle; sometimes it is a little longer, sometimes shorter. The length of the fused portion is variable, even on the two sides of the same specimen; it consists of some 8 to 12 segments and is as a rule decidedly shorter than the last peduncular segment.

The antennal scale differs considerably from that of the two preceding species. It is broader, scarcely three times as long as wide, and the rather sharply rounded distal end of the lamella extends much further beyond the spine that terminates the outer margin.

The oral appendages do not differ in any noteworthy degree from those of *L. serratus*, Pennant. The mandibular palp is composed of three segments, the ultimate almost twice the length of the penultimate. The third maxillipedes reach about to the end of the antennal peduncle; the antepenultimate segment is less expanded distally than in *L. tenuipes* and the exopod reaches to its anterior quarter; the last segment is about two thirds the length of that which precedes it.

The first peraeopods reach almost or quite to the end of the antennal scale. The merus and carpus are about equal; the chela is barely three fifths the length of the carpus and the fingers are only a trifle longer than the palm.

The second peraeopods vary considerably in length. In large specimens of both sexes they may extend beyond the tip of the scale by the whole of the chela, carpus and a small portion of the merus; in others, also fully adult, they reach beyond the same point only by the length of the chela, in others again only by a small fraction of the finger-length. The proportions of the segments in ten large individuals are shown in the table on p. 216.

It will be noticed that the ischium, merus, carpus and palm decrease successively in length in nearly all cases, but that in very large males the carpus is sometimes equal to, or a little longer than the merus. The fingers are either a little shorter than, equal to, or longer than the ischium; the carpus in all cases is very

much shorter than the entire chela, often only about half its length. In specimens in which the limb is very long the characteristic swollen condition of the palm is most obvious, the tips of the fingers being strongly incurved and crossing each other when the claw is closed. In examples in which the limb is proportionately shorter the palm is less strongly swollen and the tips of the fingers are little, if at all, inturned.

The last three pairs of legs are slender and usually bear short setae on the posterior margins of the ischium, merus, carpus and propodus. Those of the third pair reach to, or a little beyond the middle of the antennal scale; those of the fifth pair are longer, usually reaching beyond the scale by part or all the length of the

Locality.	Sex.	Total length.	Length of carapace & rostrum.	Length of carapace.	Length of 2nd leg.	2nd Peraeopod: length of				
						Ischium.	Merus.	Carpus.	Palm.	Dactylus.
Port Canning, Gangetic delta.	♂	88	39.5	18.0	67.3	14.8	12.4	12.9	9.4	14.5
	♂	79	37.0	14.4	53.3	11.7	9.6	10.2	6.9	11.5
Off Cowcolly Lighthouse, Gangetic delta.	♀ ovig.	91	44.5	17.3	49.7	12.1	10.5	9.1	7.2	11.3
	♀ ovig.	87	41.7	17.9	34.9	8.0	7.5	5.8	4.6	7.2
Hog I., Bombay.	♂	94	50.0	16.0	48.3	11.0	10.0	9.3	7.3	11.0
Bombay.	♂	96	47.8	17.9	53.7	11.7	10.1	10.1	8.7	11.0
Keti, Karachi dist.	♀ ovig.	84	44.6	15.0	29.9	6.3	5.9	4.5	3.7	7.1
	♀ ovig.	79	39.7	13.7	24.8	5.3	5.0	3.9	2.8	4.6
Green I., Amherst, Tennasserim.	♂	81	36.8	16.6	57.4	12.4	11.3	10.3	8.7	12.4
	♂	79	36.7	15.5	53.1	11.9	10.5	10.0	7.5	11.7

dactylus. The dactylus is slender and styliform; in the third pair it is rather less than one half the length of the propodus (text-fig. 6a). In the fifth pair it is from one third to one quarter the length of the propodus, being shortest in very large specimens (text-fig. 6b).

The abdomen is smoothly rounded above in small examples, but in those of large size sometimes bears a blunt and inconspicuous dorsal ridge extending from the middle of the third somite to the end of the sixth. The sixth somite, measured dorsally, is rather less than one half the length of the carapace.

The telson reaches to about three quarters the length of the outer uropod; it is not sulcate dorsally and usually bears two pairs

of minute or semi-obsolete spinules in its distal half. The apex in large specimens is simply pointed, without trace of lateral spinules; in smaller but still adult individuals two pairs of very small spinules may be found, not reaching the tip. The outer uropod is narrow, about three times as long as broad, with the external margin in front of the subterminal tooth almost straight.

Large individuals reach a length of a little over 100 mm.; the eggs are a trifle larger than in *L. tenuipes*, from 0.65 to 0.82 mm. in length and from 0.56 to 0.61 mm. in breadth.

As regards young specimens it may be noted that the second legs are very long, extending beyond the scale by the chela and practically the whole length of the carpus in an individual less than 60 mm. in total length; this precocious development seems, however, to be unusual. A series of very small specimens from Chittagong indicates clearly that those described by de Man in 1908 as *Leander* sp., belong to this species. In individuals about 30 mm. in total length the general appearance is closely similar to that of adults; the rostrum, however, has a less elevated basal crest and is shorter, reaching beyond the antennal scale by at most one quarter its length; the second legs do not as a rule exceed the scale by more than half the length of the fingers. In still smaller examples between 15 and 20 mm. in length, the rostrum is even shorter, sometimes not reaching the end of the scale; it usually bears only a single subterminal dorsal tooth and a reduced number of teeth (from 3 to 6) on the lower border. The second legs reach little, if at all beyond the scale; the palm is as long or even a little longer than the carpus and the fingers are shorter than in adults, being indeed in very small examples only as long as the palm. The sixth abdominal somite is a little more than half the length of the carapace. The telson tip, in specimens of 30 mm. in length and under, bears two pairs of lateral spinules, the inner pair very long and far exceeding the apex.

Living specimens are translucent with a faint milky tinge. The lower antennular flagellum, which is deeply pigmented in *L. tenuipes*, is quite colourless. The dark gastric mass is frequently visible through the carapace and often the tip of the rostrum and the extremities of the telson and uropods are suffused with red.

This species was known to earlier authors as "*Leander longirostris*, Say." Miss Rathbun has pointed out that Say never described a species under such a name, the confusion having arisen from misplaced footnote references in Milne-Edwards' treatise. The latter author described two separate species as "*Palemon*" *longirostris*, but suggested the name *styliferus* for the present form in the errata at the end of vol. III.

The specimens from Amoy, recorded by de Man¹ as *L. longirostris*, Say, have since been referred by that author² to *L. longipes*, Ortmann.

¹ De Man, *Notes Leyden Mus.*, III, p. 141 (1881).

² De Man, *Trans. Linn. Soc. Zool.* (2), IX, p. 409 (1907).

Leander styliferus is closely related to *L. carinatus*, Ortmann; the distinctions between the two species are enumerated below. *L. japonicus*, Ortmann, which I have not seen, is an allied species, but according to Miss Rathbun (*loc. cit.*, 1902, p. 51) is to be distinguished by the absence of dorsal spines on the distal part of the rostrum, by the lower number of inferior teeth (4 to 6), by the greater length of the sixth abdominal somite and by the longer carpus of the second peraeopods.

The specimens of *Leander styliferus* in the Indian Museum are from the following localities:—

$\frac{32+1.50}{7}$	Keti, Karachi Dist., on the Hajamro branch of R. Indus. ...	... Karachi Mus.	Many.
$\frac{4688.9}{9}$	Bombay ...	... Purchased.	Two.
$\frac{1604}{7}$	Hog I., Bombay ...	... Investigator.	One.
$\frac{9526}{10}$	Chilka Lake, Orissa coast	Mus. staff.	One.
$\frac{3412}{5}$	} Gangetic delta (many lo- calities).	{ W. T. Blanford, J. Wood-Mason, J. T. Jenkins, R. Munro, T. Southwell, S. Kemp. }	} Many.
$\frac{9532.51}{10}$			
$\frac{9727.9}{10}$			
$\frac{9527}{10}$	Chittagong (edge of river)	N. Annandale, S. Kemp.	Many young.
$\frac{7721}{6}$	Mouth of Yé R., Burma	Investigator.'	Two.
$\frac{9528}{10}$	Mouth of Rangoon R., Burma ...	... Investigator.'	Several young.
$\frac{9529}{10}$	Rangoon market ...	N. Annandale.	Many.
$\frac{9530}{10}$	Haingyi I., Tennasserim	Investigator.'	One.
$\frac{9531}{10}$	Green I., Amherst, Ten- nasserim ...	... Investigator.'	Several.
$\frac{9278}{6}$	Mergui ...	... J. Anderson.	Two.

Specimens from the west coast of India as a rule have the rostrum markedly longer than those from the Bay of Bengal.

The species was originally described by Milne-Edwards from "l'embouchure du Gange." It is recorded by Henderson from Karachi, the Gangetic delta, the Gulf of Martaban and Mergui. Miss Rathbun has also recorded it from Karachi, and Nobili has reported specimens from Bombay and a single individual from Borneo.

The species occurs in water that is both salt and brackish and has been found at Diamond Harbour in the Gangetic delta in a freshwater creek. As in the case of *L. tenuipes*, with which it is frequently found, the species is probably migratory, entering estuaries and tidal rivers at the close of the monsoon. Capt. R. Munro, to whom we are indebted for numerous specimens, notes that in 1912 at the mouth of the Hughli river "the first appearance of cold weather shrimps" was in August.

Leander carinatus, Ortmann.

1891. *Leander longirostris* var. *carinatus*, Ortmann, Zool. Jahrb., Syst., V p. 521.
 1902. *Leander carinatus*, Doflein, Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss., XXI, p. 639, pl. iii, fig. 8.
 1914. *Leander styliiferus* var. *carinatus*, Balss, *ibid.*, Suppl. Bd. II, Abh. 10, p. 57 (? part only).

Twenty-seven specimens from N. China, all of which are unfortunately in very poor condition, appear to belong to this species. *L. carinatus* was originally described by Ortmann in the briefest possible manner from a much mutilated specimen obtained in China and was regarded by its author as a variety of Milne-

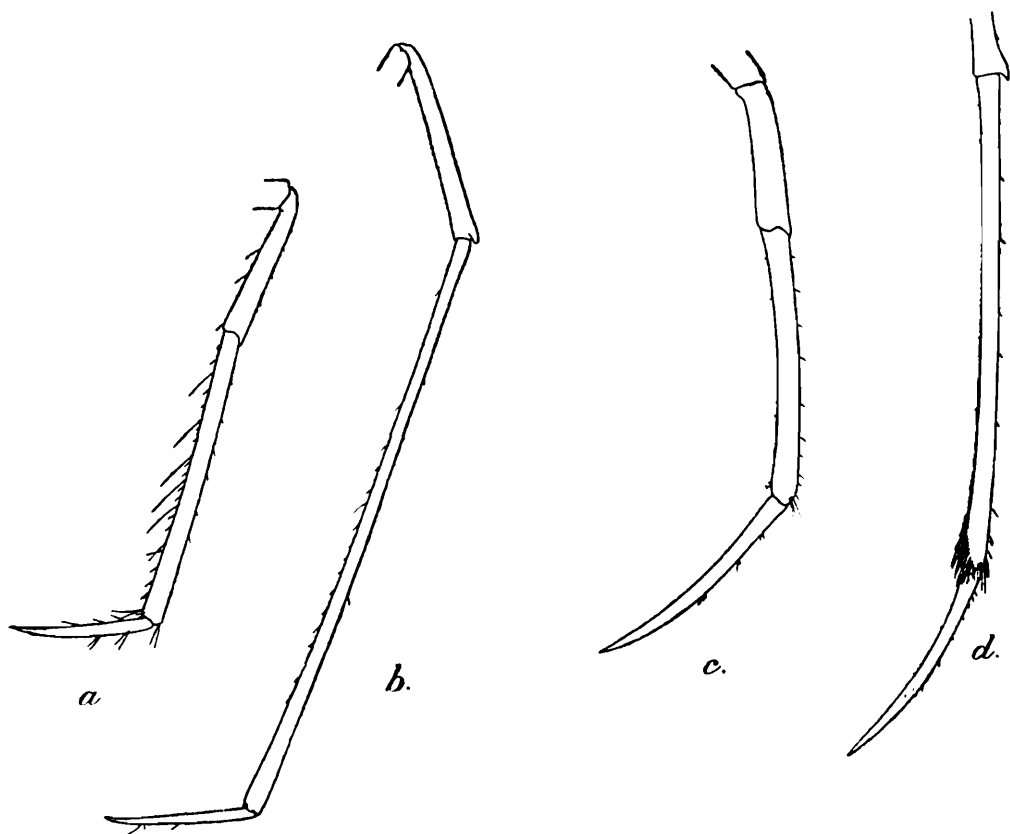


FIG. 6.—a, b. *Leander styliiferus*, Milne-Edwards.

c, d. *Leander carinatus*, Ortmann.

a, c. Third peraeopod.

b, d. Fifth peraeopod.

Edwards' *L. longirostris* (= *L. styliiferus*). If my identification is correct there can be no doubt that the form is specifically distinct, though closely related to *L. styliiferus*. *L. carinatus* may be distinguished by the following characters:—

(i) The basal crest of the rostrum bears from 6 to 9 (usually 7 or 8) teeth,¹ a number rather higher than is usual in *L. styliiferus*. The foremost of these teeth is much in advance of the hindmost tooth of the ventral series.

¹ Of twenty specimens one has 6 teeth on the basal crest, ten have 7 teeth, eight have 8 teeth and one has 9 teeth.

(ii) The fingers of the first peraeopods are a little longer, fully one and a half times the length of the palm.

(iii) The carpus of the second peraeopods is proportionately shorter; except in very large males it is shorter than the palm and little more than half the length of the fingers.

(iv) The dactyli of the last three peraeopods are proportionately much longer. In the third pair (text-fig. 6c) the propodus is only one and a fifth times and in the fifth pair (text-fig. 6d) only two and a fifth times as long as the dactylus.

(v) The last four abdominal somites are sharply carinate dorsally.

The rostrum is broken in all except two of the specimens. In these there are respectively 7 and 8 ventral teeth¹ and in both there appears to have been a single small subapical dorsal tooth.

Doflein appears not to have seen any fully developed males. In large examples of this sex the second peraeopods may reach beyond the antennal scale by the whole of the carpus and chela; the degree of development of these limbs is, however, as in *L. styliferus*, subject to much variation. Five specimens yield the following measurements (in mm.):—

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	2nd Peraeopod: length of				
				Ischium.	Merus.	Carpus.	Palm.	Dactylus.
♂	77+	17.0	47	10.3	9.7	7.4	7.2	10.5
♂	71+	15.0	42	9.8	8.7	5.5	6.3	10.3
♂	76+	16.2	34	8.2	6.8	4.0	4.8	8.9
♂	85+	17.2	32	7.2	6.8	4.4	4.7	7.8
♀	?	14.0	25	5.4	5.3	3.3	3.7	6.1

The second peraeopods as a whole bear a close resemblance to those of *L. styliferus*; in specimens in which the limb is relatively long the carpus is swollen at its distal end and the palm inflated. The proportionate length of the segments is variable, but the carpus appears always to be shorter than in the related species.

The best distinctive character is to be found in the great relative length of the dactylus of the last three pairs of peraeopods. In these limbs the length of the dactylus, compared with that of the propodus, is nearly twice as great as in *L. styliferus* (text-fig. 6). The third peraeopods reach almost to the end of the antennular

¹ Ortmann states that there are 5 ventral teeth and Doflein that there are 4 or 5. Balss has, however, remarked that the rostrum was incomplete in all the specimens seen by Doflein.

peduncle; the fifth are longer and sometimes extend to the tip of the antennal scale.

The dorsal carination of the last four abdominal somites—the chief character mentioned by Ortmann—is very conspicuous in all the specimens; it cannot be confounded with the low and very blunt dorsal ridge sometimes found in large examples of *L. styliferus*.

The sixth abdominal somite, as in the related species, is less than half the length of the carapace. I have not found any differences in the telson or uropods.

The specimens, none of which are ovigerous, were obtained at Ningpo in China by Dr. B. Sing; they appear to have been found in brackish water.

Ortmann described the species from "China"; Doflein's specimens were from Tsingtau. The record by Balss from Singapore appears to me doubtful.¹

Leander modestus, Heller.

(Plate ix, fig. 1.)

1865. *Leander modestus*, Heller, *Reise Novara'-Exped., Crust.*, p. iii, pl. x, fig. 6.

The rostrum reaches beyond the antennal scale by at most one fifth of its length. The basal crest is strongly elevated and is furnished with from 8 to 10 evenly spaced teeth² of which one or two are situated on the carapace behind the orbit; the foremost of the series reaches to or beyond the articulation between the second and third segments of the antennular peduncle. In front of the basal crest the rostrum is straight or very slightly upturned, the upper margin being invariably unarmed. On the lower margin there are from 2 to 4 small teeth³ which are restricted to the middle third of the rostral length (pl. ix, fig. 1).

The branchiostegal spine is somewhat larger than the antennal and is situated on the frontal margin of the carapace. Above it there is a rather conspicuous longitudinal depression in which a finely-cut groove, similar to that found in the preceding species, may usually be detected.

The cornea of the eye is rather strongly swollen; a small ocellus is present.

The basal segment of the antennular peduncle is rather broad and bears the usual tooth on the inferior surface; the outer margin is convex, terminating in a spine which does not reach as far forward as the protruding setose antero-external portion of the

¹ Balss' record of *L. japonicus* from Hankow in China also seems to require confirmation.

² Of thirty-one specimens eight have 8 teeth on the basal crest, eighteen have 9 and five have 10.

³ Of thirty-one specimens three have 2 inferior teeth, twenty-four have 3 and four have 4.

segment. The second segment, measured dorsally, is shorter than the third. The accessory antennular ramus is shorter than the peduncle and is fused with its fellow for a length considerably less than that of the last peduncular segment, the fused portion consisting only of some 5 or 6 segments.

The antennal scale is broadly rounded apically, the lamella extending much beyond the spine that terminates the straight external margin. It is about three times as long as wide.

The mandibular palp is composed of three segments, the third nearly twice the length of the second. The third maxillipedes reach to the end of the antennal peduncle; the terminal segment is about two thirds the length of that which precedes it.

The first peraeopods reach the end of the antennular peduncle. The carpus is about one fifth longer than the merus and is a little more than twice the length of the chela; the fingers are longer than the palm.

The second peraeopods may reach beyond the tip of the antennal scale by nearly the whole length of the chela. The ischium is equal to or a little shorter than the merus and the carpus is between $1\frac{1}{4}$ and $1\frac{1}{5}$ times as long as the ischium. The chela is about equal to (sometimes a trifle shorter than, sometimes a trifle longer than) the carpus; the palm is not swollen as in the preceding species and is from one fifth to one tenth shorter than the fingers. The latter are straight with short, inturned corneous tips and are without teeth on the inner margin.

The last three pairs of peraeopods are slender; the third pair is the shortest, not quite reaching the end of the antennal scale; the fourth and fifth pairs are longer, extending beyond the scale by a portion of the length of the dactylus. In the third pair the propodus is less than twice the length of the carpus and is about one and a third times the length of the dactylus. In the fourth pair the propodus is longer, from two to two and a quarter times the length of the carpus, the dactylus being longer than the latter segment. In the fifth pair the dactylus is longer than the carpus and the carpus is about three sevenths the length of the propodus. The propodus of all three pairs is provided with a bunch of setae at its distal end and, in the case of the fifth pair, is thickly set with short hairs on the distal half of its inferior margin. The dactylus in each pair is without teeth, slightly curved, with some long setae on its upper border.

The abdomen is compressed but not carinate above. The sixth somite, measured dorsally, is rather more than half the length of the carapace. The pleopods are short, those of the first pair being shorter than the carapace.

The telson reaches to rather more than two thirds the length of the outer uropod. It bears two pairs of dorsal spinules distally; the apex is produced to a sharp point with two plumose setae beneath and two spinules on either side, the inner pair of the latter extending considerably beyond the tip. The outer uropod is about three times as long as broad. There is a movable

spinule on the inner side of the tooth that terminates the straight or slightly convex outer border.

Large specimens reach a length of about 60 mm. None of the females in the collection are ovigerous.

Young examples, from 15 to 25 mm. in total length, differ from adults in possessing a shorter rostrum, often not reaching beyond the end of the antennular peduncle and in the proportionately greater length of the sixth abdominal somite.

The colour of living specimens was translucent white, with sparsely scattered minute reddish-brown pigment cells, not arranged to form a definite pattern.

L. modestus is very closely related to *L. mani*, Sollaud,¹ from Tonkin, a freshwater species described as possessing large eggs. The most conspicuous character in which *L. modestus* differs from the southern Chinese form is the complete absence of teeth at the distal end of the upper border of the rostrum, a feature which is unquestionably of high specific value in other species of the same group of the genus. The first maxillipede differs from the figure given by Sollaud in the greater proportionate length of the basipodite, while the distal lobe of the epipod, though apically pointed, is not drawn out to the triangular process to which Sollaud has directed attention. The description of *L. mani* is preliminary; other distinctions will probably be found when the full account is published.

The specimens of *L. modestus* in the Indian Museum were all obtained by Dr. Annandale in China, in the neighbourhood of Shanghai. The species is common at the margins of the Tai Hu Lake, and is caught in large numbers in basket traps set among weeds. A few individuals were dredged from a bare muddy bottom in the middle of the lake and others were obtained in the Whangpoo River, between Shanghai and Woosung at depths of $5\frac{1}{2}$ to $7\frac{1}{2}$ metres. Young examples are common in ditches and ponds in the neighbourhood of Shanghai. All the specimens were obtained in pure fresh water.

The species was described by Heller from Shanghai in 1865, since which date it does not appear to have been recorded.

Leander fluminicola, sp. nov.

(Plate ix, fig. 2.)

This species bears a close general resemblance to the preceding, differing from it only in the following particulars:—

(i) The rostrum exceeds the antennal scale by one sixth or one quarter of its length. The basal crest is less elevated and bears from 7 to 11 teeth (usually 8 or 9)² of which 1 or 2 are placed behind the level of the orbit. The distal part of the rostrum is

¹ Sollaud, *Bull. Soc. Zool. France*, XXXIX, p. 315, text-figs. (1914).

² Of forty specimens one has 7 teeth on the basal crest, twelve have 8, twenty-three have 9, three have 10 and one has 11.

more strongly upturned and is provided with one or two teeth on its upper edge near the tip¹ and sometimes with another between this point and the foremost tooth of the basal series. The lower margin bears from 3 to 5 teeth (usually 4),² which are spread out along its distal two-thirds and not restricted to the middle third as in *L. modestus* (pl. ix, fig. 2).

(ii) The branchiostegal tooth of the carapace is entirely absent.

(iii) The tooth that terminates the outer margin of the basal segment of the antennular peduncle extends much beyond the produced, setose, antero-external portion of the segment.

(iv) The accessory antennular ramus is very long, between one and a quarter and one and a half times the length of the peduncle.

(v) The antennal scale is a little more narrowed apically and is a trifle broader, less than three times as long as wide.

(vi) The first peraeopods reach a little beyond the end of the antennular peduncle; the carpus varies from two to nearly two and a half times the length of the chela.

(vii) The carpus of the second peraeopods is much longer, about one and a half times the length of either the ischium or the chela. The fingers are about as long as the palm. The chela is distinctly spooned in appearance; when viewed from its inner face the fingers are seen to be hollowed longitudinally, meeting only along their outer edges. When the chela is examined in dorsal and ventral views, the fixed finger and dactylus appear considerably broader near the apex than at their junction with the palm.

(viii) The last three pairs of peraeopods are very slender, but in their proportionate lengths similar to those of *L. modestus*. The dactylus in all three pairs is much shorter than the carpus, that of the fifth pair being scarcely half its length and only about one fifth the length of the propodus (*cf.* pl. ix, figs. 1 and 2). There are fewer hairs on the propodus of the fifth leg and the dactylus in all three pairs is without setae on its upper edge.

Large specimens reach a length of about 45 mm. The eggs are numerous and are comparatively small, from 0.74 to 0.87 mm. in length and from 0.57 to 0.65 mm. in breadth.

The species resembles *L. mani* in the presence of teeth at the distal end of the upper margin of the rostrum, but is readily distinguished by the absence of the branchiostegal spine and the greater length of the carpus of the second peraeopods.

The specimens in the Indian Museum are from the following localities:—

$\frac{9570}{10}$	R. Ganges, Mirzapur, United Provinces ...	R. B. S. Sewell.	Many.
			TYPES.
$\frac{9573}{10}$	Podhua Nala, Rajmahal, Bengal ...	B. L. Chaudhuri.	Two.

¹ I have seen a single specimen without any dorsal teeth on the distal part of the rostrum.

² Of forty specimens four have 3 ventral teeth, twenty-nine have 4 and seven have 5.

$\frac{9577}{10}$	Kanaigunge, Backergunge Dist., Bengal ...	...	H. E. Stapleton.	Six.
$\frac{9578}{10}$	R. Hughli, Calcutta ...	...	?	Several.
$\frac{9575}{10}$	Dhappa, near Calcutta ...	...	S. Kemp.	Many.
$\frac{9574}{10}$	Chingrighatta, near Calcutta ...	...	Mus. staff.	One.
$\frac{9579}{10}$	Karnaphuli R., Rangamati, Chittagong Hill Tracts ...	...	Mus. collr.	Eight.
$\frac{9571}{10}$	Pazudaung and Dala Creeks, Rangoon, Burma ...	...	N. Annandale.	Many.
$\frac{9576}{10}$	Moulmein R., Burma. ...	...	'Investigator.'	Three.
$\frac{9572}{10}$	Gying R., nr. Moulmein, Burma ...	...	N. Annandale.	Several.

The species occurs in water that is quite fresh as well as in that of low salinity. At Chingrighatta it was obtained in water of specific gravity 1.0015 and it is evidently not uncommon in the Gangetic delta, occurring also in the estuaries of the Sitaung and Moulmein rivers in Burma. It has, however, been taken at places far remote from tidal influence. Rajmahal is some 350 miles by river from the sea, while Mirzapur in the United Provinces is 700 miles by river from the coast and nearly 400 miles in a direct line from the sea.

***Leander potamiscus*, sp. nov.**

This species resembles *L. fluminicola* in the absence of the branchiostegal spine and in the great length of the carpus of the second peraeopods; it may be distinguished by the following characters:—

(i) The rostrum is longer extending beyond the tip of the antennal scale by two fifths or one half of its length. The basal crest is low and bears from 7 to 10 teeth,¹ the hindmost being situated on the carapace behind the level of the orbit. On the upper side of the apex there are from 1 to 3 small teeth, usually 2, and there is not infrequently an additional tooth between these and the foremost of those that form the basal crest. The teeth on the lower margin are more numerous, from 6 to 10² (text-fig. 7).

(ii) The finely-cut longitudinal groove on the carapace, just above the position usually occupied by the branchiostegal spine, is particularly well defined.

(iii) The peraeopods are all more slender. The first pair reaches about to the end of the antennal scale, the carpus being two and a quarter or two and a half times the length of the chela.

(iv) The second peraeopods reach beyond the scale by the chela and a portion (sometimes as much as one third the length) of the carpus. The chela is one fifth shorter than the ischium and about one half (sometimes a little more, sometimes a little

¹ Of twenty-two specimens five have 7 teeth on the basal crest, twelve have 8, four have 9 and one has 10.

² Of twenty-two specimens one has 6 inferior teeth, five have 7, ten have 8, five have 9 and one has 10.

less) the length of the carpus. The fingers are not markedly spooned and are much shorter than in *L. fluminicola*, scarcely more than two thirds the length of the palm.

(v) The last three pereopods are very long and slender. The third pair reach beyond the antennal scale by more than the length of the dactylus, the fifth by the dactylus and one half or two thirds the length of the propodus. The dactylus in all three pairs is very short. In the fifth pair the dactylus is considerably less than half the length of the carpus; the propodus is twice the length of the carpus and about one-sixth longer than the merus.

(vi) The spinules on the upper surface of the telson are rather differently placed. In *L. fluminicola* the first pair is placed behind the middle of the telson, and the second pair is little if at all nearer

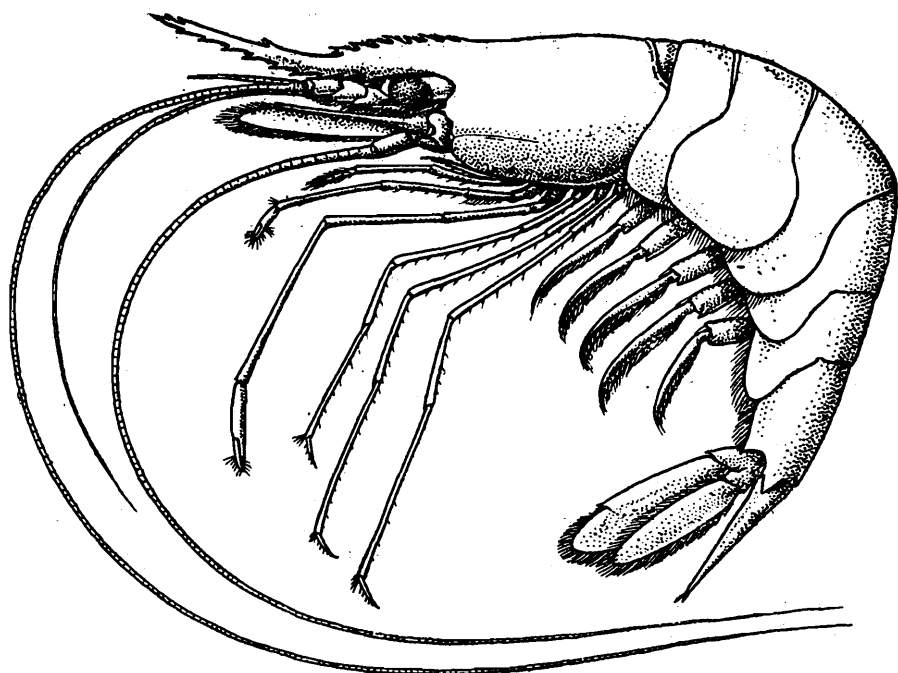


FIG. 7.—*Leander potamiscus*, sp. nov.

to the first than to the tip. In *L. potamiscus* the first pair is almost in the middle of the telson and the second is placed much in advance of a point midway between the first pair and the tip.

In all other respects *L. potamiscus* bears the closest resemblance to *L. fluminicola*. The antennules and antennal scale are almost exactly similar. The first maxillipede is nearly the same as in Sollaud's figure of *L. mani*, the distal lobe of the epipod being more sharply pointed than in other species. The spines at the tip of the telson are rather longer than in allied forms.

Large specimens reach a total length of about 48 mm. The eggs borne by ovigerous females are small, about 0.54×0.44 mm. in longer and shorter diameter.

Dr. Annandale notes that most of the specimens he collected, were practically colourless when alive, though not transparent.

A few of the largest, however, probably adult males, had several longitudinal black lines on each side of the carapace which converged forwards slightly. They had also a small black spot on the side of each abdominal somite. The fingers of the second legs were scarlet and the palms of the chelae opaque shining white; there were also opaque shining white spots on the other segments of the chelae.

The specimens collected by Dr. Annandale were caught in February 1916, in the Patani River, below the town of Patani in the Siamese Malay States and at Telok Tikus on Penang Island in a small stream near the sea. A number of other examples¹ are in the Indian Museum, obtained by Col. C. G. Rogers in a small creek at the south-eastern corner of Middle I. in the Andamans. The largest of these specimens is 38 mm. in length, the collection, which was made in April 1911, not comprising any ovigerous females. In all three localities the specimens were found in fresh water, the situation in which they were taken being, however, subject to tidal influence.

The type specimens, from the Patani River, bear the number 9552/10 in the register of the Zoological Survey.

***Palaemon mirabilis*, sp. nov.**

(Plate x.)

A very remarkable *Palaemonid*, represented in the Indian Museum by a number of specimens from the Rangoon and Moulmein Rivers and from various localities in the Gangetic delta, apparently belongs to a species hitherto undescribed. In the peculiar form of the rostrum and the extreme slenderness of the legs the species differs widely from typical members of the genus *Palaemon* and bears a curious and perhaps significant resemblance to *Leander styliferus*.

The rostrum is short and does not quite reach the end of the antennular peduncle. On the upper side of the lateral carina it consists of a thin lamella—in height greatly exceeding that of any other species of *Palaemon* known to me—with a strongly convex

¹ Since the above account was written I have obtained about thirty-five additional specimens of *L. potamiscus* in Portuguese India. A number were found in the Sanguem R. at Sanvordem and one, presented by Capt. F. de Vasconcellos, was taken in the Tuari R. near Cortalim. These records, being from the west coast of India, indicate a considerable extension in the known range of the species. The specimens agree closely with the types, but possess on the whole fewer rostral teeth; on the upper margin at the base there are 7 or 8, rarely 9, and on the lower margin only 6 or 7. In the single individual from the Tuari R. the basal crest is composed of 6 teeth, while there are 8 on the lower margin. The specimens differ from *L. fluminicola* in all the points noted above. When living they were semi-transparent, with a few very small chromatophores scattered on the body; the rostrum in front of the basal crest was deeply pigmented. The colouration thus differs conspicuously from that noted by Dr. Annandale in the case of large Patani R. examples. As in the case of the other records, the specimens from Portuguese India were found in fresh water, but in places subject to tidal influence. A number of individuals harbour Bopyrid parasites.

upper border bearing many close-set teeth. The rostrum begins as a carina in the middle of the carapace and its upper border is sharply ascendant up to a point immediately over the eye; in front of this it drops steeply to the apex, which is straight, narrow and produced. The margin between the highest point and the apex is concave. The teeth on the upper border vary in number from 13 to 16,¹ of which from 4 to 6 (usually 4 or 5) are situated on the carapace behind the level of the orbit. The teeth are fixed and evenly spaced and the interstices between them are filled with hairs. The lower margin is convex, but is not greatly expanded: the depth of the inferior portion of the blade is considerably less than half the depth of the upper portion. The lower margin bears 1, very rarely 2 teeth² in the distal half of its length.

The carapace is smooth. The antennal tooth is well-formed and from its base a strong carina runs backwards and downwards to the base of the hepatic tooth. The latter is large and beneath and behind it there is a shallow groove. A depression defines the upper posterior limits of the branchial region and there is a faint longitudinal groove on either side of the cardiac area.

The eye is short and somewhat depressed. The "ocellus" is rather large and is broadly in contact with the cornea (pl. x, fig. a).

The antennular peduncle does not differ materially from that of typical *Palaemon*. The basal segment is rather slender and the keel near the inner edge of its lower surface bears the customary tooth in its proximal half; the outer margin terminates anteriorly in a sharp tooth extending far beyond the produced lateral portions of the segment. The second segment is less than two thirds the length of the third. The accessory flagellum is conspicuously serrate externally and is about as long as the peduncle; it is fused basally with the outer branch for a distance not equal to half the length of the last peduncular segment.

The antennal scale (pl. x, fig. b) is about three times as long as wide. Its outer margin is straight and ends in a sharp tooth which does not reach nearly as far forwards as the apical portion of the lamella.

The oral appendages do not appear to differ in any noteworthy feature from those of *Palaemon* or *Leander*. The mandible bears a three-segmented palp, the last segment being almost as long as the two basal ones combined; the incisor-process ends in three large teeth. In the second maxilla the two lobes that form the distal lacinia are rather narrower than is usual. The first maxillipedes possess a bilobed epipod and the second an epipod with a podobranch attached. The third maxillipedes reach about to the middle of the antennal scale. The exopod

¹ Of fifty specimens five have 13 dorsal teeth, thirteen have 14, twenty-three have 15 and nine have 16.

² Of fifty specimens forty-eight have a single ventral tooth, while two have 2 teeth.

extends nearly to the end of the antepenultimate segment, which is conspicuously flattened and dilated distally; the terminal segment is about three quarters the length of the penultimate.

The first peraeopods reach the tip of the antennal scale. The carpus is rather less than twice the length of the chela; the fingers bear tufts of setae and are a little longer than the palm.

The second peraeopods reach beyond the end of the scale by the length of the chela and are equal and equally long in both sexes. The merus is a shade longer than the ischium and is about one and a quarter times the length of the carpus. The chela is rather more than one and a half times the length of the carpus and the palm is about two thirds the length of the fingers. The whole limb bears a singularly close resemblance to that of *Leander stylijerus* and differs widely in form from that of typical *Palaemon*. The basal segments are all slender: the carpus is broadened distally where it is fully one and a half times as thick as at its proximal end; the palm is strongly inflated and much broader than the carpus, while each of the fingers is very slender, slightly curved and with an inturned claw at the apex (pl. x, fig. c). The fingers meet throughout their length when the chela is closed and are without teeth on their inner margins. The entire limb is glabrous except for a few fine and sparsely distributed hairs on the fingers.

The last three pairs of peraeopods are very slender and increase successively in length to a notable extent. The third pair reaches beyond the tip of the antennal scale by the length of the dactylus, the fourth by the dactylus and the greater part of the propodus, the fifth by the dactylus, propodus and a small portion of the carpus. The fifth leg is more than twice the length of the carapace and rostrum combined. In the third pair the carpus and dactylus are about equal in length; the propodus is nearly two and a half times as long and is a little shorter than the merus. In the fifth pair, which is excessively slender, the carpus is a good deal more than twice the length of the dactylus. The propodus is twice the length of the carpus and is one and a fifth times as long as the merus. Two or three pairs of microscopic spinules may usually be found on the propodi of the third and fourth pairs and a series of similar but more closely-set spinules at the distal end of the same segment in the fifth pair. In all three the upper surface of the dactylus is setose (pl. x, fig. d).

The abdomen is smooth. In adults the sixth somite, measured dorsally, is about one and a half times the length of the fifth; in young examples it is rather longer. The telson is much shorter than the inner uropod; it is smoothly rounded above and generally bears two pairs of minute dorsal spinules. The apex is very narrow and consists of a small median point flanked by a pair of spinules. Those of the inner pair are long and between them there are two plumose setae; those of the outer pair are quite short (pl. x, fig. e).

Large specimens reach a length of about 55 mm. from the tip of the rostrum to the apex of the telson. The eggs borne by

the females are small, about 0.56 mm. by 0.43 mm. in longer and shorter diameter.

Living specimens are transparent, the dark gastric and hepatic masses being as a rule clearly visible through the carapace. In large individuals reddish flecks and suffusions are sometimes found on the sides of the abdomen and the postero-dorsal margin of each somite is rather deeply tinged with the same colour. The eggs are pale greenish yellow. Small specimens are quite colourless.

This remarkable species shows in a new and very striking manner the close relation that exists between the genera *Leander* and *Palaemon*, and once again awakens doubts as to whether our classification is correct.

The only essential difference between the two genera rests in the hepatic spine, which is present in *Palaemon* and absent in *Leander*, and, in comparing normal forms of the latter genus with species of *Palaemon* in which the chelipedes of the male have not assumed a peculiar development, it is frequently by this point alone that the two genera can be distinguished. The value of the character has recently been much discounted by Calman's discovery that it is not, as was previously thought, absolutely constant.¹ In *Palaemon hildebrandti*, a form which is restricted to Madagascar, the hepatic tooth may be either present or absent. In all other respects this species is a typical *Palaemon*; it shows no affinity with *Leander* and cannot be regarded as establishing a link between the two genera. It indicates none the less that the hepatic tooth may occasionally prove an unreliable factor.

The existence of such a form as *Palaemon mirabilis* is both unexpected and perplexing, for, except for the presence of the hepatic tooth, its affinities seem to be unmistakably with *Leander styliferus* and its allies, a group of species which form an outstanding and apparently highly specialized section of the genus. Were it not for the tooth in question *P. mirabilis* would undoubtedly be given a place in this section of *Leander*, differing from *L. styliferus* merely in the abrupt curtailment of the rostrum and in the proportionate length of the various segments of the legs. Moreover, so far as I am aware, the species bears no resemblance to any *Palaemon* hitherto described.

We see, therefore, that if the character of the hepatic tooth be upheld as a generic determinant, a double relationship can be traced between the two genera: firstly, through the unspecialized forms of each and secondly,—if my interpretation of the facts be correct—between *Palaemon mirabilis* and the specialized *Leander* of the *styliferus*-group. If these relationships are accepted as indications of the course which evolution has taken, as I think they must be, we are forced to admit the existence of a double line of descent—which is manifestly impossible in a rational scheme of classification. It should be noted that the *styliferus*-group does not appear to be a disconnected entity, such as might have evolved

¹ Calman, *Proc. Zool. Soc. London*, 1913, p. 928.

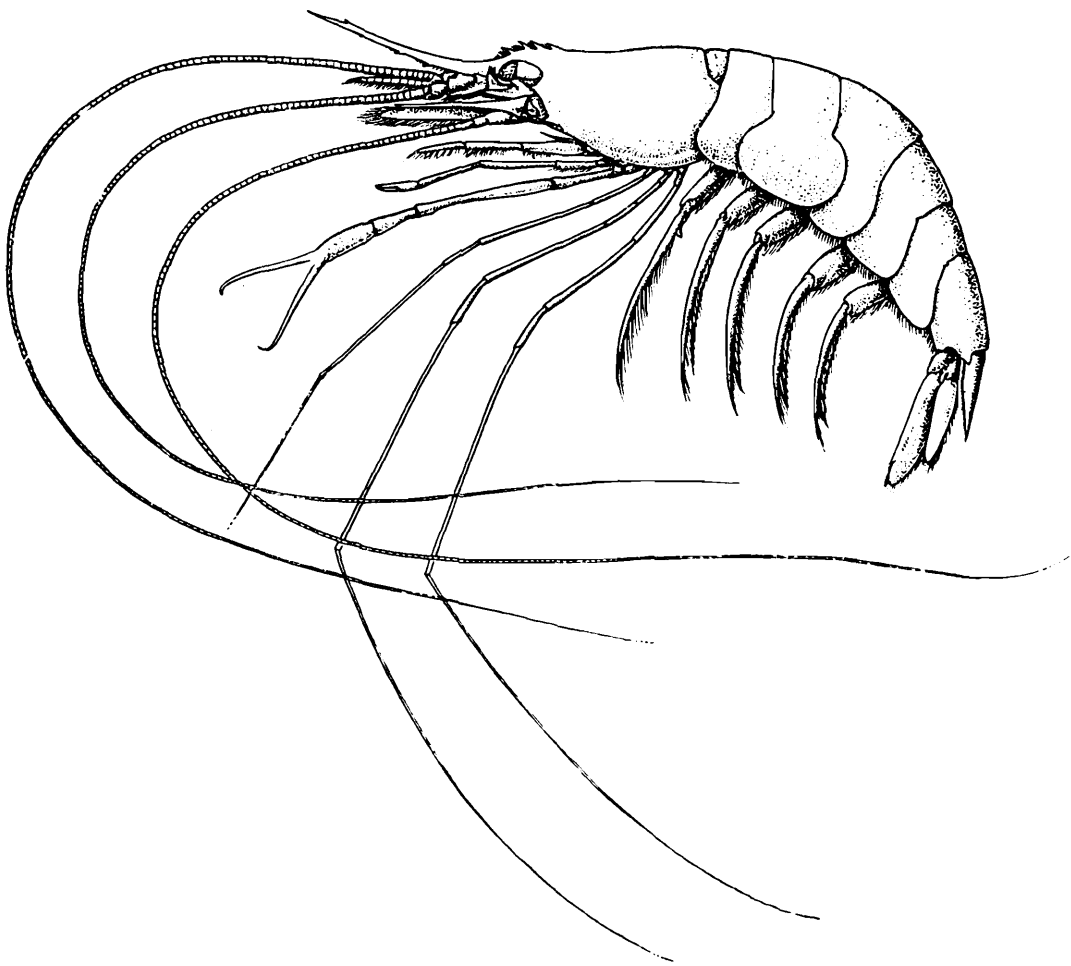
independently from some such form as *P. mirabilis*; on the contrary, it seems to grade evenly into the more normal species of *Leander* through such forms as *L. concinnus*.

Following the classification at present in vogue, I have described the species as a member of the genus *Palaemon*, though, as already pointed out, it then becomes extremely difficult to explain how the different forms have evolved. The facts of the case, in my opinion, almost compel one to regard *P. mirabilis* as a true *Leander* and lead to the conclusion that, whereas the hepatic tooth in *Palaemon hildebrandti* has sometimes become suppressed, it has actually *reappeared* in a specialized member of the related genus. My only excuse for not at once referring the species to the genus *Leander* is that I believe it unwise to alter accepted classification on theory alone, unless such theory be extremely well founded. At present, unfortunately, our knowledge of the classification and affinities of the genera of Palaemonidae is very incomplete; it may well be that further investigation will throw light on the position of the species here described.

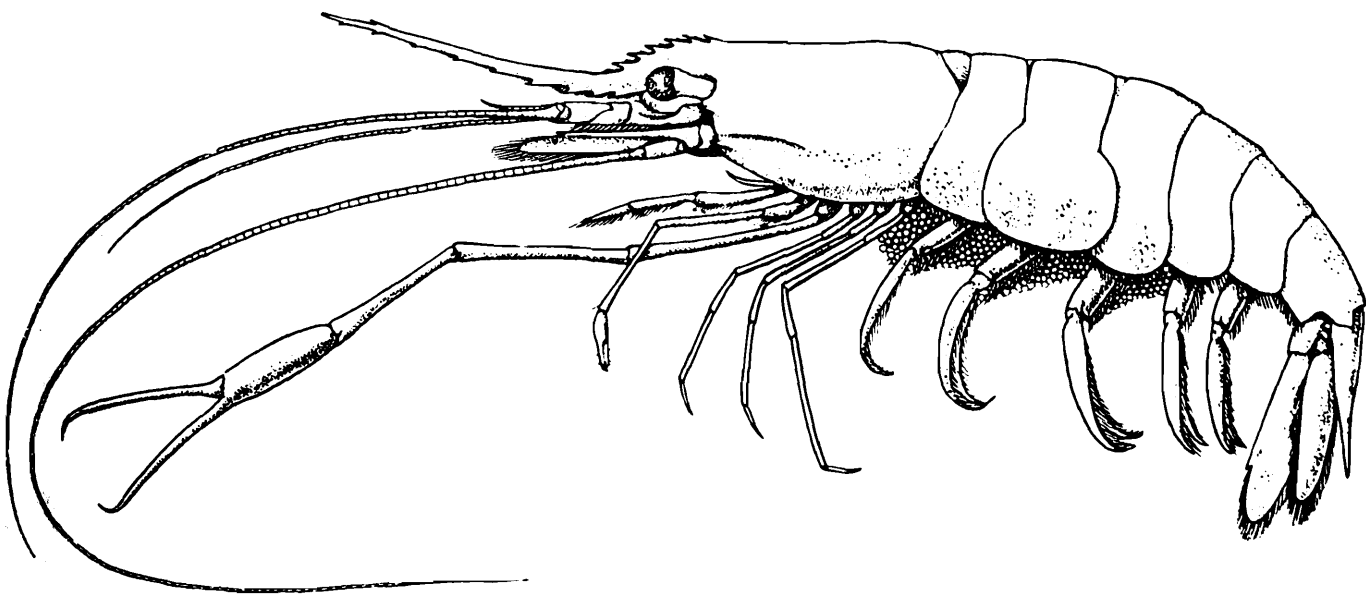
The specimens in the Indian Museum are from the following localities :—

$\frac{9633.5}{10}$	Pazudaung and Dala Creeks, Rangoon	N. Annandale.	Sixty-five.
$\frac{9431}{10}$	Moulmein R., Burma ...	Investigator.	Nineteen.
$\frac{9636}{10}$	Off Cowcolly Lighthouse, Hughli R.	J. Munro.	Six.
$\frac{9638}{10}$	Trebeni, Hughli dist. ...	B. L. Chaudhuri.	Many young.
$\frac{9637}{10}$	Sandheads, Gangetic delta ...	J. Wood-Mason.	One.
$\frac{9724}{10}$	R. Hughli, Sibpur, Calcutta ...	S. Kemp.	Many.
$\frac{9725}{10}$	Matlah R., Port Canning, Gangetic delta	S. Kemp.	Several.
$\frac{9639}{10}$	Hughli Nullah, Bosondherabad, Gangetic delta	J. T. Jenkins.	One.
$\frac{9641}{10}$	Mouth of Damodar R., Gangetic delta	T. Southwell.	Three.
$\frac{9726}{10}$	Near Shela, Khulna dist., Gangetic delta	J. T. Jenkins.	Four.
$\frac{9640}{10}$	Creek nr. Barisal, Backergunge dist.	T. Southwell.	One.

In all these localities the water is brackish, either permanently or at certain states of the tide. The type specimens are from Rangoon and bear the number 9633/10 in the register of the Zoological Survey.

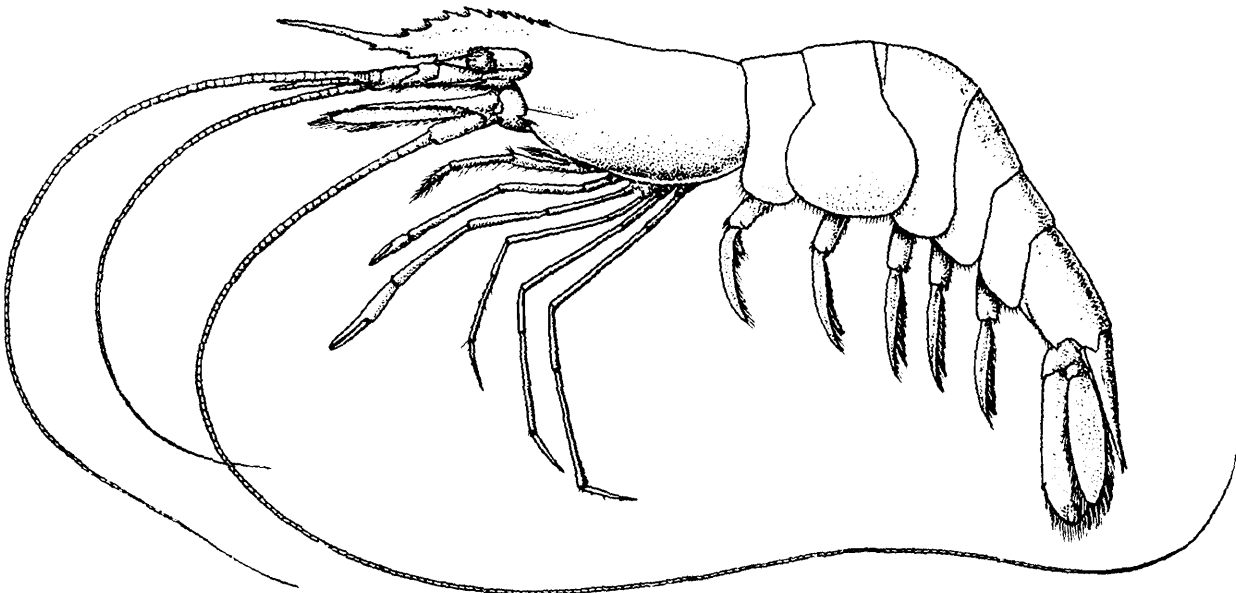


1.

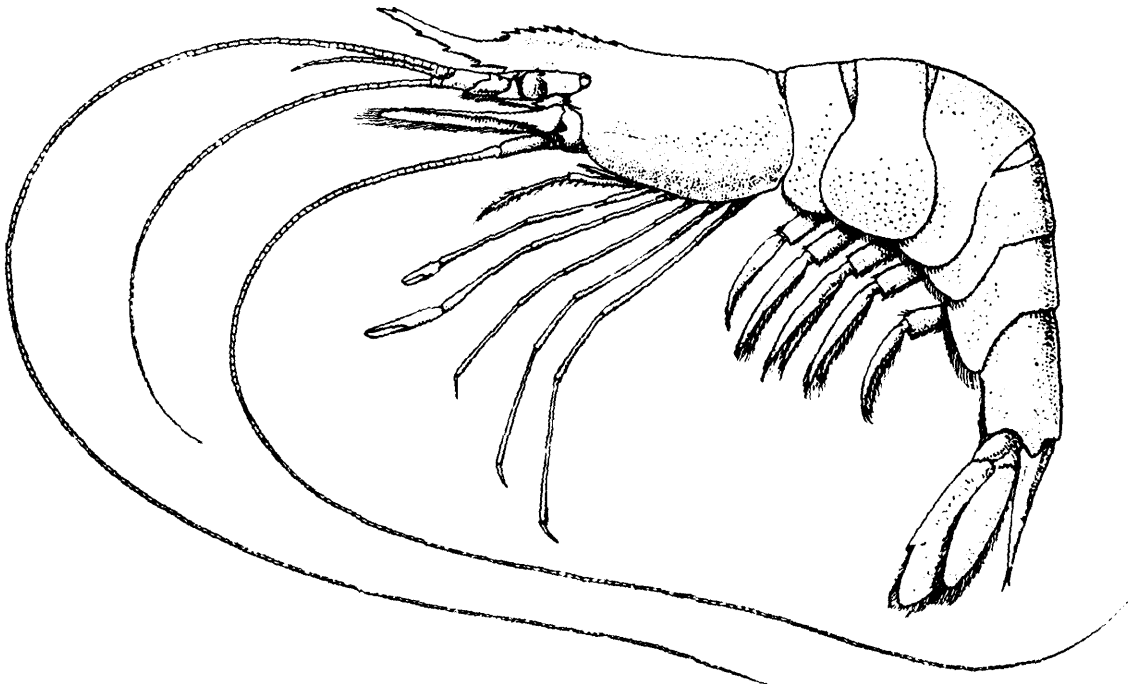


2.

- 1. *Leander tenuipes*, Henderson.
- 2. *Leander styliferus*, Milne-Edwards.

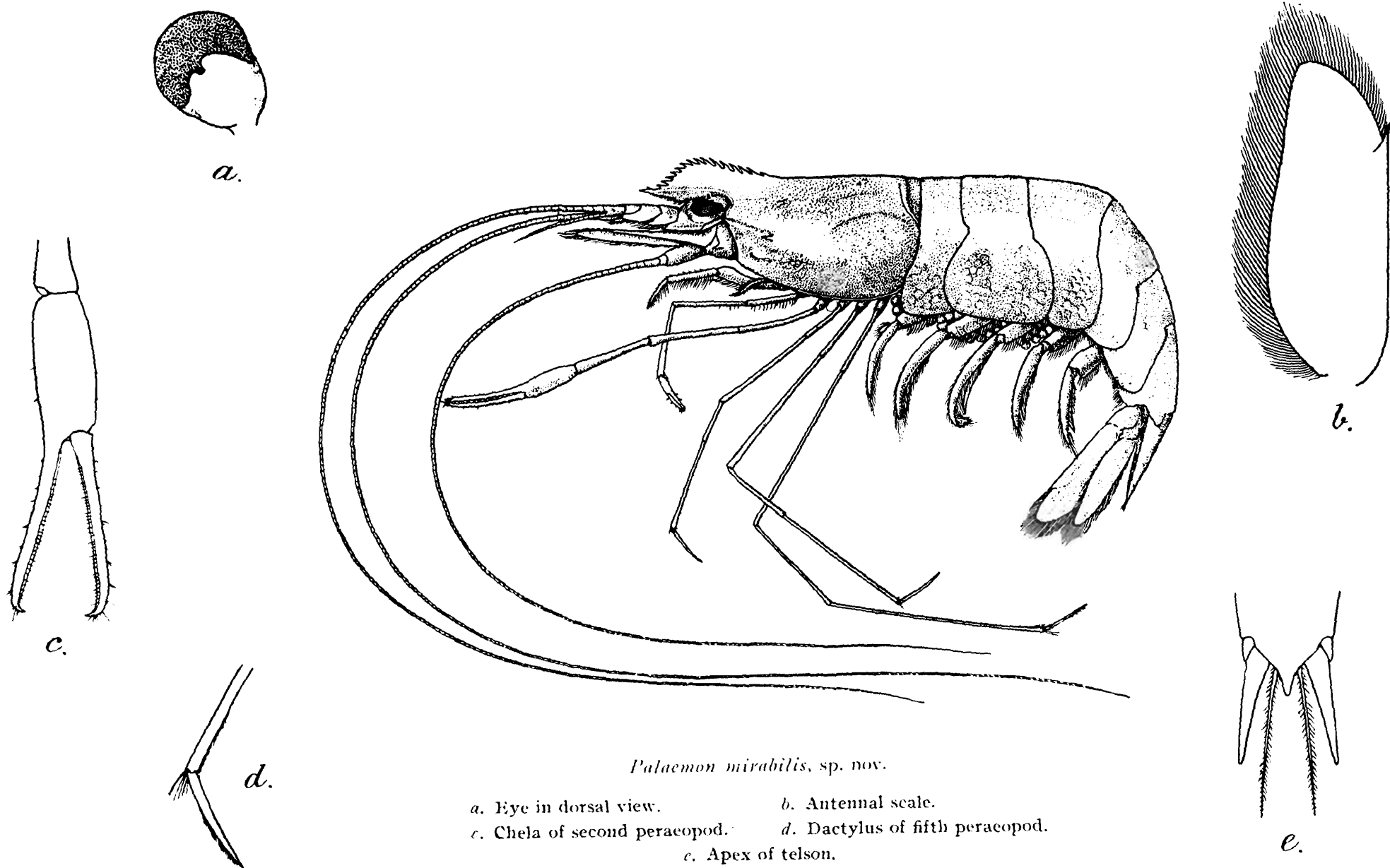


1.



2.

- 1. *Leander modestus*, Heller.
- 2. *Leander fluminicola*, sp. nov.



XIV. NOTES ON THE FAUNA OF THE MATLAH RIVER IN THE GANGETIC DELTA.

By STANLEY KEMP, B.A., *Superintendent, Zoological Survey
of India.*

In December 1915, thanks to the kindness of Mr. T. Southwell, Deputy Director of Fisheries, Bengal and Bihar, I was able to visit certain parts of the Gangetic delta in the S.L. "Kitty," a launch recently built by Government for fishery investigation. The area examined comprises the Matlah River and the channels in its vicinity, and extends from Port Canning in the north to the junction of the Matlah and Biddah rivers in the south, a distance of about 30 miles. The following note deals only with the bottom fauna of this area.

The Matlah river is one of the largest of the numerous waterways that traverse the Gangetic delta and is navigable for ships of large tonnage as far as Port Canning. It varies in depth, but in the main channel there is nowhere less than $4\frac{1}{2}$ fathoms at low spring tides; over considerable areas the water exceeds 8 fathoms and the chart published in 1855 shows that still deeper pockets exist, soundings at a point some $7\frac{1}{2}$ miles below Port Canning reaching a maximum of 27 fathoms.

The level of the water varies greatly according to tide; there is as a general rule a difference of about 10 feet between high and low water, a figure that may rise to as much as 15 feet at spring tides. Towards the close of the monsoon the average level is raised by floods and at such times the uncultivated islands (that is to say, those that are not surrounded by an embankment) are almost wholly submerged at high tide. The water is nearly always heavily laden with silt and doubtless shows great seasonal variation in salinity. On the occasion of my visit the specific gravity (corrected to a standard temperature of $15^{\circ}\text{C}.$) varied from 1.00375 to 1.01075.¹ Higher readings would almost certainly be found immediately prior to the monsoon, when the land drainage is at its minimum, and during the flood season the water at certain states of the tide is probably almost fresh.

In the area examined the river bottom appears to be composed of very finely divided mud, in character considerably softer than I have seen in any other locality. On the banks at low water a person of average weight will sometimes sink to a depth of two feet and, unless active, may require assistance to extricate himself.

¹ The specific gravity of the sea on the Orissa coast of the Bay of Bengal is much greater than the highest of these readings, varying from about 1.017 at the close of the monsoon to 1.0280 in early spring.

The mud of the river bed appears to be of a similar consistency, but in a few places near the junction of the Biddah river there is a small admixture of sand. The tidal currents run swiftly, with the result that the upper layers of mud on the river bed must always be kept in motion and partially in suspension, the actual bottom being perhaps almost impalpable.

The fauna of the river bed appears to be very limited ; but, though poor in species, it is abundant in individuals. The more characteristic of the species obtained in our small trawl¹ were the following :—

CRUSTACEA.	FISH.
Palaemonidae.	Sciaenidae.
* <i>Palaemon mirabilis</i> , Kemp.	<i>Sciaena corta</i> (Ham.-Buch.).
* <i>Leander styliiferus</i> , Milne-Edwards.	<i>Umbrina sinuata</i> , Day.
* „ <i>tenuipes</i> , Henderson.	Trichiuridae.
Penaeidae.	<i>Trichiurus haumela</i> (Forsk.).
<i>Penaeopsis monoceros</i> (Milne-Edwards).	Gobiidae.
„ <i>brevicornis</i> (Milne-Edwards).	<i>Glossogobius elegans</i> (Kuhl & Hass.).
* <i>Parapenaeopsis sculptilis</i> (Heller).	Siluridae.
	* <i>Macrones gulio</i> (Ham.-Buch.).
	<i>Pangasius pangasius</i> (Ham.-Buch.).
	Scopelidae.
FISH.	* <i>Harpodon nehereus</i> , (Ham.-Buch.).
Kurtidae.	Clupeidae.
<i>Kurtus indicus</i> , Bloch.	* <i>Coilia dussumieri</i> , Cuv. & Val.
Polynemidae.	<i>Stolephorus indicus</i> (von Hasselt).
* <i>Polydactylus paradiseus</i> (Linn.).	
Sciaenidae.	
<i>Sciaena cuja</i> (Ham.-Buch.).	

The names of the more abundant species are marked with an asterisk. For the identifications of the fish I am indebted to my colleague Dr. B. L. Chaudhuri.

The list may, I think, be taken as a fair sample of the bottom fauna of the area examined; but the larger and more active species of fish, such as *Lates calcarifer*, were not obtained in our nets. Apart from fish and Decapod Crustacea the fauna is excessively poor; it includes a Mysid, probably belonging to the genus *Gastrosaccus*, and occasional Isopods, Amphipods and Polychaetes, not more than one or two species of each. Young specimens of Portunid crabs, *Scylla serrata* and *Charybdis rostrata*, were found on a few occasions. A peculiar Medusa, *Asenathia piscatoris*, Annandale,² that appears to live at or near the bottom, was also obtained, but was extremely scarce.

¹ A beam trawl 6 feet in breadth.

² Annandale, *Mem. Asiat. Soc. Bengal*, VI, pp. 114-116, text-figs. 3-5 (1917).

The chief interest of this fauna, and the point with which this note is mainly concerned, is the extraordinary resemblance which the species bear to those inhabiting great depths of the sea. I am convinced that if anyone with experience of both deep-sea and shallow-water faunas were to have made a casual inspection of the contents of the nets we hauled in the Matlah River, he would have expressed the opinion that the catch came from water not less than 400 fathoms in depth. On closer inspection he would no doubt find reason to alter his opinion, for only one of the species is a member of a deep-sea genus and few belong even to families known from considerable depths. But in general facies the two faunas resemble one another so closely that he would almost certainly be deceived at first sight.

The bottom of the Matlah River, with its rapid currents and moving silt, affords an environment altogether unsuitable for sedentary or slow moving organisms, and it is to this feature that the predominance of Crustacea and fish must be ascribed. Conditions in the deep sea are evidently different, for fixed animals such as Hexactinellid sponges are often far from uncommon, while creatures of slow movement such as the leathery sea-urchins and Holothurians are often very abundant. It is in the fish and Decapods that the peculiar character of the Matlah fauna is exhibited and it is, moreover, in the most abundant species that the resemblance to deep-sea forms is most pronounced.

The modifications that give to the deep-sea fauna its peculiar facies may be discussed under two headings,—form and colour; and in view of what has already been said it will be sufficient to refer here only to the fish and Decapod Crustacea.

The colours of deep-sea fish are very limited. The great majority of the species are deep black, grey of varying intensity, silver, and semitranslucent or dead white. Two or more of these colours are frequently found in combination. Reddish and brownish tints are very rare and blues and yellows are almost nonexistent. In the Matlah fish there are no black forms, the majority being grey, white or silver. The *Macrones* is very deep grey above and dull white below, with black fins; the *Pangasius*, *Sciaena* and *Umbrina* are grey and silvery and the *Trichiurus* and *Kurtus* altogether silvery. *Coilia dussumieri* is white with a lateral row of brilliant silver spots, while *Harpodon nehereus* is semitranslucent milky white with minute black dots. An exception is *Polynemus paradiseus*, which though greyish above has dull golden brown sides.

The range of colour in deep-sea Crustacea is even more limited than in the case of fish. A considerable number of the species are uniformly crimson, red or pink, while in a few cases purple tones are found. Other species are ivory or milky white, frequently semitranslucent, and these are sometimes blotched or streaked with red, orange or yellow. Forms which are uniformly orange or yellow also occur, but are less common. In the great majority of cases the eggs are yellow or yellowish green.

The Crustacea found in the Matlah River most strikingly resemble deep-sea forms in their colour. *Parapenaeopsis sculptilis* is uniformly deep red, while the Palaemonidae are of a milky semitranslucency¹ with red markings. In *Palaemon mirabilis* red flecks or suffusions are found on the abdominal somites; in *Leander styliferus* the tip of the rostrum and the extremities of the telson and uropods are red. In *L. tenuipes* the mandibular region is bright red and the rostrum dotted with carmine; the lower antennular flagellum is carmine at the base, changing to deep mauve nearer the tip; there are red flecks on the abdominal somites and the telson and uropods are deeply stained with bright red. The eggs are gamboge or greenish yellow.

The peculiar character of the Matlah fauna is at first sight most forcefully brought to notice through the medium of colour, and it is unfortunate that it is not possible to do justice to this very striking feature by mere description. Several of the constituent species, however, show in their structure also a remarkable resemblance to deep-sea forms. The most notable instance is perhaps the "Bombay Duck," *Harpodon nehereus*,² which, with its gelatinous consistency and large mouth with the lower jaws loosely articulated and furnished with recurved teeth, exhibits every characteristic of a deep-sea species. *Harpodon nehereus* differs from all other forms found in the Matlah River in belonging to a family (the Scopelidae) the members of which are almost exclusively of abyssal or bathypelagic habitat; other species of the same genus are known only from considerable depths. The peculiarity of *H. nehereus* lies therefore not in its structure, but in the fact that a representative of such a typically deep-sea family should occur in shallow water. The resemblance to abyssal forms misled even so great an authority 'as Gunther; for, in reference to the two species of *Harpodon* known to him (one being *H. nehereus*), he remarks "both are evidently inhabitants of considerable depths, and periodically come nearer to the surface."³

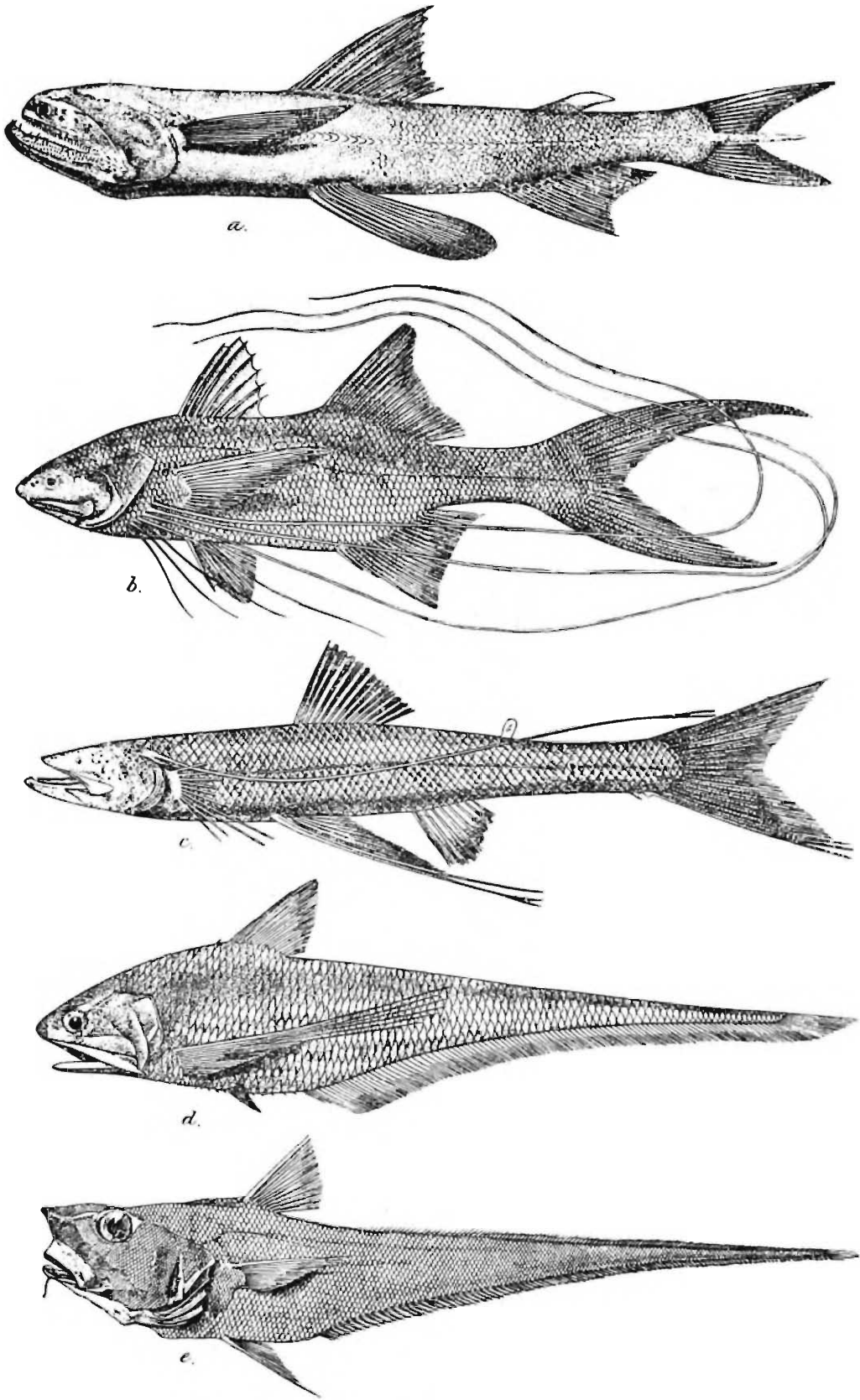
Polynemus paradiseus is remarkable for the extreme length of certain free pectoral rays and for the elongation of the upper and lower caudal rays. In general appearance it is not dissimilar to deep-sea Scopelids of the genus *Bathypterois*, in which both these modifications occur. The eyes in *Bathypterois* are small and some of the species are probably quite blind; in *P. paradiseus* the eyes are small and covered by skin.

In a number of the fish found in the Matlah River the body tends to become attenuated posteriorly. This feature, which is also found in abyssal forms, reaches an extreme development in *Coilia dussumieri*, a species which bears a strange resemblance to deep-sea fish of the genus *Macrurus*.

¹ This milky tint is also found in the bottom-living Medusa, *Asenathia piscatoris*.

² Dr. Chaudhuri informs me that Hamilton-Buchanan must have adopted the specific name of this fish from the Bengali term *nihādē*, meaning "boneless."

³ Gunther, *Study of Fishes*, p. 584 (1880).



- a. Harpodon nehereus* (Ham.-Buch.) [Matlah River].
b. Polydactylus paradiseus (Linn.) [Matlah River].
c. Bathypterois dubius, Vaillant [Deep-sea].
d. Coilia dussumieri, Cuv. & Val. [Mutlah River].
e. Macrurus wood-masoni, Alcock [Deep-sea].

FIGS. *a, b, d*, after Day, fig. *c* after Vaillant, fig. *e* after Alcock.

Among the Decapoda Macrura characteristic differences between abyssal and shallow-water forms are less evident, but in a number of species belonging to several different families the walking legs tend to become extremely long and slender. This tendency reaches its maximum development in the very peculiar forms belonging to the Nematocarinidae, a family known only from great depths of the ocean.

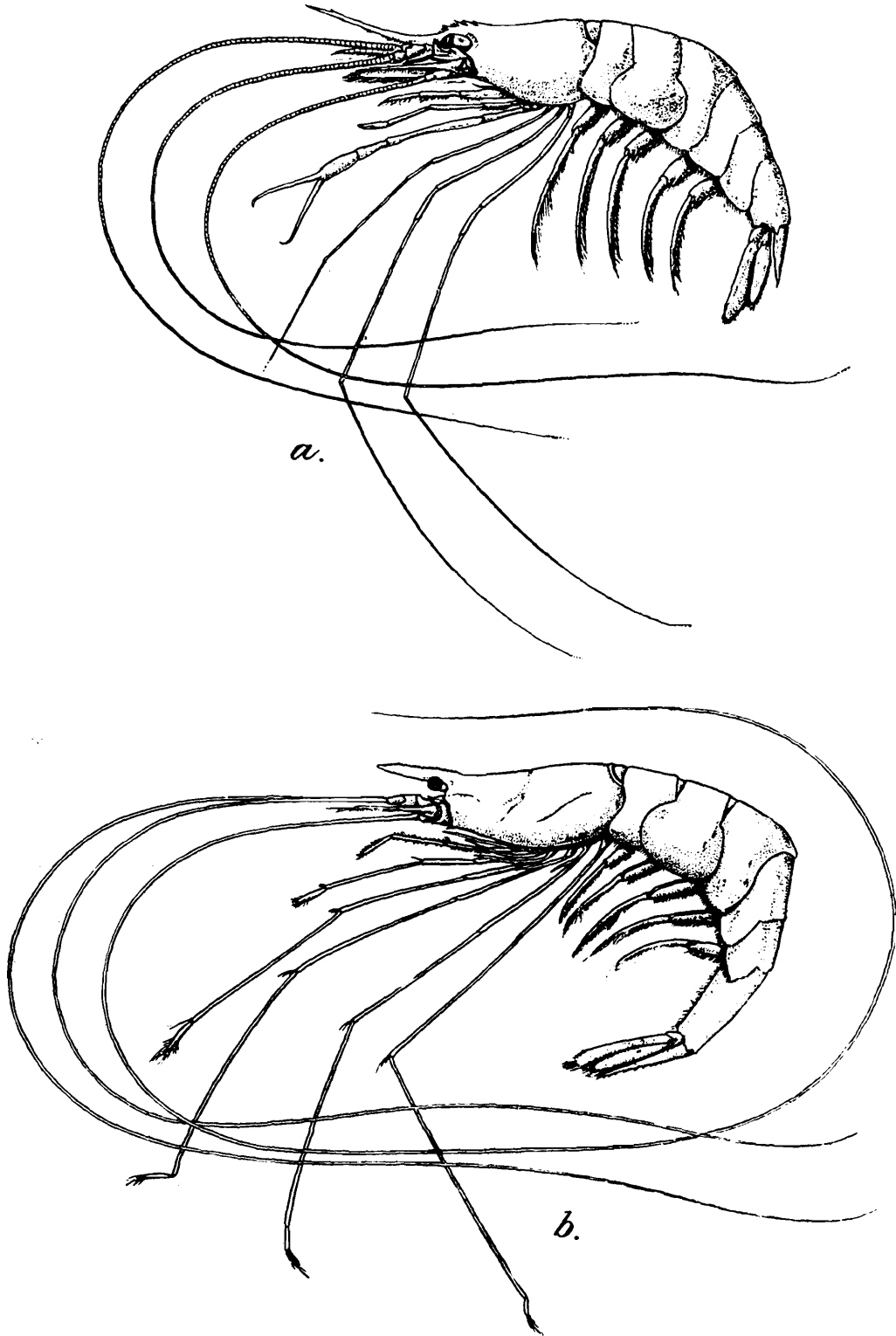
Only a few species of Macrura inhabit the bed of the Matlah River. The Penaeids do not show any special structural modifications, but in all the Carids the legs are noticeably longer and very much more slender than is customary. The most remarkable form is unquestionably *Leander tenuipes*, in which the legs are of the most extreme length and tenuity. I do not know of any shallow-water Carid¹ that is in the least degree comparable with this peculiar species; to find analogous cases we must turn to deep-sea forms and in particular to the genus *Nematocarcinus*. The modification is not effected in the same way in both cases. In *L. tenuipes* it is in the main brought about by the extreme attenuation of the propodus and dactylus; in *Nematocarcinus* these two segments are short, the great length of the leg being due to an elongation of the ischium, merus and carpus.

There are two characteristic features of a deep-sea fish and Crustacean fauna that are not met with in the Matlah River,—(i) the eyes are about normal in size and no species, except perhaps *P. paradiseus*, is even partially blind, (ii) none of the species possess luminous organs. In many deep-sea forms, however, the eyes show but little modification, and it now seems probable that all abyssal animals that possess definite luminous organs or photophores (as opposed to glands excreting a luminous fluid) are meso- or bathypelagic in habit and do not live on the bottom. *Harpodon nehereus* is said to be brilliantly luminous over its whole surface, but this is a statement that I am not able to corroborate by observation.

Summarising what has already been said, it may be stated that the comparatively small number of animals living on the bed of the Matlah River present modifications similar to those found in a deep-sea fauna. The resemblance is due largely to colour—the similarity in this respect being almost exact—, while it is enhanced in a number of instances by the presence of structural peculiarities rarely met with except in abyssal forms.

It should be noted that no single member of the Matlah fauna is restricted to the Gangetic delta; some of the species have a wide distribution and several are known to occur in the open sea. It is, moreover, probable that a number are migratory forms, visiting the Bay of Bengal during the flood season; there is, at any rate, evidence that this is the case with the two species of *Leander*.

¹ Except *Leander hastatus*, Aurivillius, from the W. African coast, a species having an extremely close affinity with *L. tenuipes*.



a. Leander tenuipes, Henderson [Matlah River].
b. Nematocarcinus exilis (Bate) [Deep-sea].

Notwithstanding these facts I am strongly of the opinion that the resemblances between the two faunas are not fortuitous; some underlying cause must be at work and there can be no reasonable doubt that this cause is to be sought in the environment. So far as I can understand, the environment appears to have exercised a selective influence on the Matlah fauna, and has in some way permitted the existence only of those species that conform to certain definite rules. That this has resulted in the existence of a fauna resembling that of the deep sea is exceedingly curious, but it affords, I think, a clue as to the factors involved.

There are few points of similarity between the environment of the species found in the Matlah River and that of those found in the ocean depths. Complete absence of light, great pressure, low temperatures, high salinities and still water characterise the latter, whereas in the former the temperatures are high, the salinities very low and the tidal currents swift. I have no precise information as to the amount of light on the bed of the Matlah River. It is no doubt greatly diminished, for the water is heavily laden with silt and, as has already been pointed out, the upper layers of mud are probably always kept in motion by the tidal currents. There can, however, be little doubt that some light penetrates to the bottom.

But there is another factor, which may or may not be dependent on the amount of light, that appears to be of considerable importance; to this factor the term visibility may be applied. Dr. Annandale and I noticed that the Palaemonidae found in the Matlah River, when placed in an aquarium with the cleanest river water we could procure, were quite invisible unless they approached within an inch or so of the glass. The lack of visibility was brought about in the main by the colour of the animals, the milky translucency of their bodies seeming to correspond precisely with the turbidity of the water. Transparency is quite ineffectual in rendering animals invisible in muddy water; I have frequently noticed that such planctonic forms as *Pleurobrachia* and the Penaeid *Acetes* are extremely conspicuous in silt-laden water, forming as it were hyaline spaces in an otherwise merely translucent medium. In aquatic forms, then, the factor of visibility seems to depend, when light is present, on a relation between the opacity of the animal compared with that of the water in which it lives. In the Matlah River visibility, in the case of a considerable part of the bottom fauna, is evidently very low and in the deep sea, unless animal or bacterial luminosity is strong, it is practically absent.

Thus in the matter of visibility there is perhaps some slight similarity between the two environments and other factors common to both are the absence of vegetation and the nature of the bottom. But weeds are in many places absent without producing the curious effects seen in the Matlah fauna, and it is probable that the character of the bottom is much the more important. The mud of the Matlah River bed is of a peculiarly soft consistency

and is perhaps the nearest approach to the deep-sea oozes that is to be found in shallow water.

A diminished supply of light, low visibility and the very soft nature of the bottom appear to me to have been the principal factors that have determined the character of the Matlah fauna. The colour phenomena seem for the most part to be controlled by the first two of these factors. The presence of red pigmentation in deep-sea Crustacea is probably brought about in some way not yet fully understood in response to a diminished supply of light and, if this is so, there is every reason to think that the red colouration so commonly met with in the Matlah prawns is precisely similar in origin. In these cases there is no evidence that the colour has any protective significance. It is otherwise, however, with the peculiar translucency of the tissues that may exist either in combination with, or in absence of red pigment. This feature is clearly of protective value in the Matlah fauna; whether it is more than fortuitous in deep-sea forms we have at present no means of ascertaining.

The structural modifications, on the other hand, more particularly the elongation and attenuation of fin-rays and appendages, appear to be correlated with the nature of the bottom, and the evidence afforded by the inhabitants of the Matlah River suggests that this factor has had a greater influence than has generally been supposed in moulding the character of many deep-sea species.
