RECORDS

of the

INDIAN MUSEUM

(A JOURNAL OF INDIAN ZOOLOGY)

Vol. XXXVI, Part I

MARCH, 1934

Calcutta:
PUBLISHED BY THE DIRECTOR, ZOOLOGICAL SURVEY OF INDIA

1934

Price Rupees Two and annas twelve or five shillings

N Z—R I/36.

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1935.

Price As. 7 or 9d.

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[1] Explanations of figures 7*a* and 7*b* of plate IX were unfortunately omitted. These should read as :—

7*a*. *Pseudodendrothrips ornatissimus* Schn. Anterior region.
7*b*. *Pseudodendrothrips ornatissimus* Schn. Antenna, segments 6-8.

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[*N.B.*—An asterisk (*) preceding a line denotes a new variety or sub-species; a dagger (†) indicates a new species; a double dagger (‡) a new genus or sub-genus; a double asterisk (**) a new family or sub-family; synonyms are printed in italics.]

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NOTES ON THE BIONOMICS OF *TROCHUS NILOTICUS* LINN.

II. On two new Limpet-like Gastropods from the Andaman waters.

By Baini Prashad, *D.Sc., F.R.S.E., F.A.S.B.*, and H. Srinivasa Rao, *M.A., D.Sc., Zoological Survey of India, Indian Museum, Calcutta.*

(PLATE I.)

In a recent paper of this series a new species of Vermetid living on the shell of *Trochus niloticus* and causing damage to the periostracal layer was described[1]. In this paper the description of two other Gastropod molluscs found on the shells of *T. niloticus* on which they had made moderately deep excavations is given. The animals were found living, and could be removed only with considerable difficulty by means of a sharp knife. Examination of the soft parts and the radula has shown that one of the Gastropods is a true Patellid of the sub-genus *Patellidea* Thiele, and the other is an undescribed genus of the family Lepetellidae described here under the name *Saptadanta*,[2] gen. nov.

Family PATELLIDAE.

Subgenus **Patellidea** Thiele.

1891. *Patellidea*, Thiele in *Troschel's Gebiss der Schnecken*, II, p. 315.
1929. *Patellidea*, Thiele, *Handbuch Syst. Weichtierkunde*, p. 40.

Thiele proposed this genus in 1891 for forms of the type of *Patella granularis* Linn. on the basis of differences in the radular teeth. In his later work in 1929, however, he considered *Patellidea* to be a group of the subgenus *Scutellastra* H. and A. Adams. In view of characteristic difference in the form and disposition of the central tooth we are of the opinion that *Patellidea* should be treated as a separate subgenus equal in rank to *Scutellastra*.

According to Pilsbry[3] the shell of the group of *P. granularis* Linn. is " oval, sculptured with numerous granulose riblets, none of them notably larger. Central tract of the inside and border generally dark ", while Thiele only remarks under the subgenus *Scutellastra* that the inner surface of the shell is porcellanous and not iridescent.

Patella (Patellidea)[4] tara, sp. nov.

The shell is of small size, ovoid in outline, star-shaped, solid, slightly conical with the apex subcentral. It is 14 mm. long. 12 mm. broad, and 3·5 mm. high. The sculpture consists of 9 main groups of somewhat raised, radial ridges, each with 5-6 radial subgranulose riblets, and 3-5

[1] *Rec. Ind. Mus.* XXXV, p. pl.X (1933).
[2] From the Sanskrit words *Sapta* seven, and *Danta* teeth.
[3] *Man. Conch.* XII, p. 102 (1891).
[4] From the Sanskrit word *Tara* meaning a star.

low ridges in the interspace between two main ridges, which give the shell a star-like appearance. The colour is a dull greyish brown on the outside, and white porcellanous with a large orange-yellow central tract on the inside, with 2 or 3 rows of elongated black spots along the periphery of this tract.

The radula is a narrow ribbon with 13 teeth in each row with the formula 3·3·1·3·3. The disposition and form of the teeth in one half of each row are shown in pl. I, fig. 2, and it is only necessary to direct attention to the following peculiarities of the dentition: (1) the central tooth is very narrow and inconspicuous being wedged in between the inner laterals; its cutting margin is at a distinctly lower level than that of the inner lateral, (2) the inner laterals have simple, sickle-shaped hooks on their cutting margin, (3) the single outer lateral has a broad cutting margin with 4 denticles and lies at a much lower level than the inner laterals, (4) the outermost of the three marginals is broad and short while the innermost is broader in the middle with its outer margin reflexed in the form of an elongated cusp in addition to the usual cusp of the cutting margin.

Holotype M. $\frac{14308}{2}$ on *Trochus niloticus* from S. Corbyn's Cove, Port Blair, Andamans, in the collection of the Zoological Survey of India, Indian Museum, Calcutta.

Remarks.—Although described from a single specimen we have no hesitation in giving it a new name, as our careful comparison with the descriptions and figures of known species belonging to the *P. granularis* or any other allied group shows it to be quite distinct, both in anatomical and shell characters, from any of the previously described species.

Family LEPETELLIDAE.

The characters of the four genera included in the family are dealt with in detail by Thiele in his monograph in the *Conch. Cab.*[5], and in his recent *Handbuch.*[6] Opinion is divided as to whether the genus *Lepetella* Verrill should be included in this family, on account of the character of the radula, but we have no doubt that the form from the Andamans which we described below under a new generic name is very closely allied to *Lepetella* in the form of the radula.

Genus **Saptadanta,** gen. nov.

The form from the Andamans has quite a different type of shell from that of any of the previously described genera, and although it resembles *Lepetella* Verrill in the number of teeth in each row of the radula, there are several distinctive features in the form and disposition of the individual teeth. The central tooth is not merely a broad quadrate plate with traces of two denticles near the outer margin as in *Lepetella*, but has a distinct broad cutting margin with five well-developed and two rudimentary denticles.

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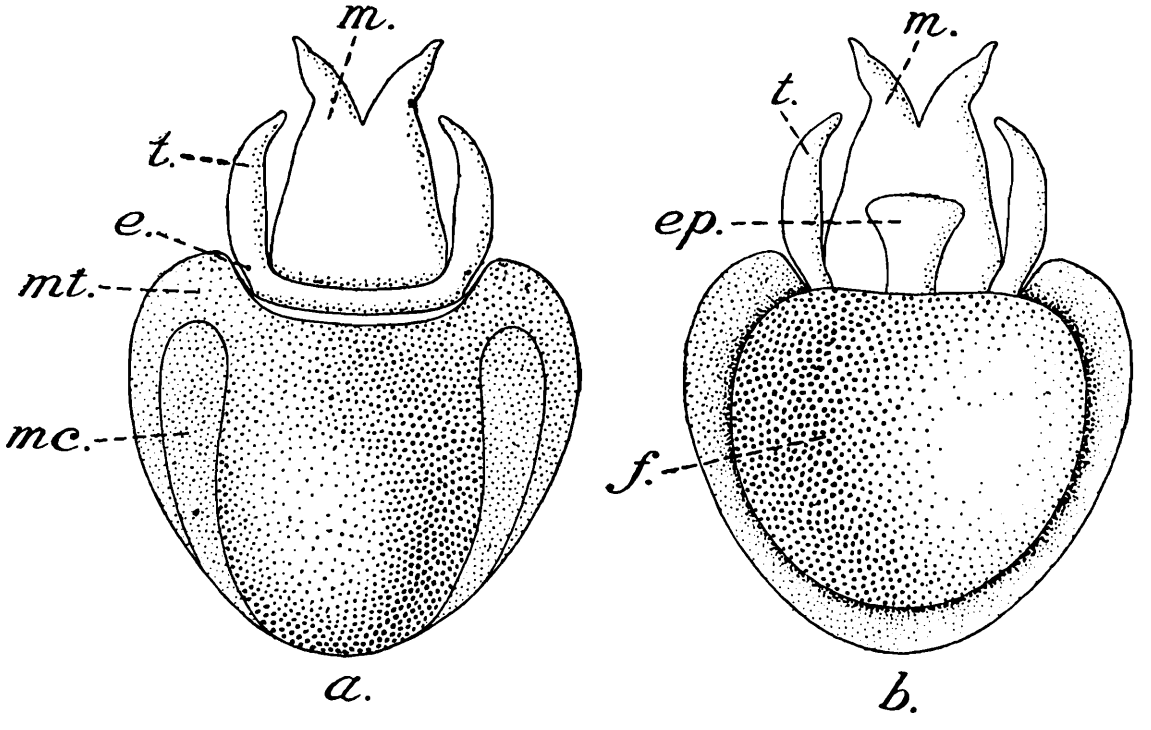
[5] Thiele, J.—Martini-Chemnitz's *Conch.-Cab.* II (Heft XXXIII), *Cocculinoidea*, p. 21 (1909).

[6] Thiele, J.—*Handbuch Syst. Weichtierkunde*, p. 93 (1929).

Saptadanta nasika[1], gen. *et* sp. nov.

The shell is moderately thick, irregularly, oblong or oval, conical with the more or less well-marked recurved obtuse apex placed in the posterior third of the length of the shell, and has 19 distinct convex, radiating ridges some of which are forked near the outer margin of the shell. The ground colour of the shell is white to dirty yellowish brown. The interspaces between the ridges at the anterior end are brownish in colour. The peripheral margin of the shell is comparatively thin and is separated from the rest of the shell by a shallow groove, and when viewed from the sides exhibits distinct lines of growth at the thickened outer ends of the radiating ridges. The inner surface of the shell is smooth, porcellanous, with the central tract distinctly whiter than the rest of the area. The inter-spatial brown markings between the ridges on the outer surface are seen as radiating bands which end peripherally in yellowish spots. Owing to the worn condition of the outer surface of the shell, which also bears traces of minute excavations by boring organisms, the sculpture is not evident, but on the smooth inner surface the minute irregularly concentric impressed lines and the radiating lines outside the central tract are very clearly seen under a fairly high magnifying lens. The dimensions of the shell are 8 mm. long, 6-7 mm. broad, and 3 mm. high.

The muzzle is more or less triangular in form, stout, compressed from above downwards, forked at the distal extremity, each prong of the fork being leaf-shaped with its tip acuminate. The tentacles arise from the outer side of the muzzle, and are elongate, broad at the base and tapering



TEXT-FIG. 1.—*Saptadanta nasika*, gen. et. sp. nov. *a* and *b* dorsal and ventral views of the animal (× *ca* 10); *e.* eye; *ep.* epipodium; *f.* foot; *m.* muzzle; *mc.* muscle; *mt.* mantle.

[1] The specific name in Sanskrit meaning nose has reference to the nose-shaped projecting apex of the shell.

gradually towards the extremity. A dark circular spot at the outer base of each tentacle represents the eye. On the underside of the muzzle, between it and the foot lies a fan-shaped lamellar structure which probably represents an epipodium.

The radular formula is 2·1·1·1·2. The central is much broader than high; it bears a strongly reflected cutting edge with seven cusps, and is produced into a narrow process at the base of each side. The median cusp is nearly as long as the tooth is high, the two cusps on each side of the median are half as long as the median, while the outermost cusp at each end of the cutting margin is rudimentary. The single lateral, as we think it should be called, has a characteristic bow-shape and lies at right angles to the long axis of the lingual ribbon, and bears on the first third of its cutting margin a series of well-developed cusps, 8 or 9 in number. The 3rd or 4th cusps from the inner end of the tooth is enlarged, much longer and sharper than the cusps on either side of it. The series outside the enlarged cusp usually consists of five cusps, progressively smaller as the base of the tooth is reached. The cusps on the inner side of the enlarged one are usually relatively larger than those on the outer side. The marginals are shorter than the lateral and lie parallel to the latter, and have sharp and narrow cusps on both edges of the tooth, those on the outer edge being slightly more numerous.

Holotype. M. $\frac{14310}{2}$ Zoological Survey of India, Indian Museum, Calcutta.

Remarks.—The only representative of the species was found living firmly attached to the shell of *Trochus niloticus* collected at N. W. Ross, Port Blair, Andamans. The removal of the animal without damage, to it from the shell of *T niloticus* was attended with considerable difficulty and it was found that a saucer-shaped excavation corresponding in outline to that of the shell, and about 2 mm. in depth had been made on the periostracal layer by the close apposition of this Gastropod to the outer surface of the shell of *Trochus niloticus*. The commercial value of *Trochus* is diminished by the excavations in the periostracal, and more rarely, in the ostracal layers of the shell made by such epizoic forms as *Vermetus* (*Spiroglyphus*) *andamanicus* Prashad and Rao and the species described in the present paper.

EXPLANATION OF PLATE I.

Patella (Patellidea) tara, sp. nov.

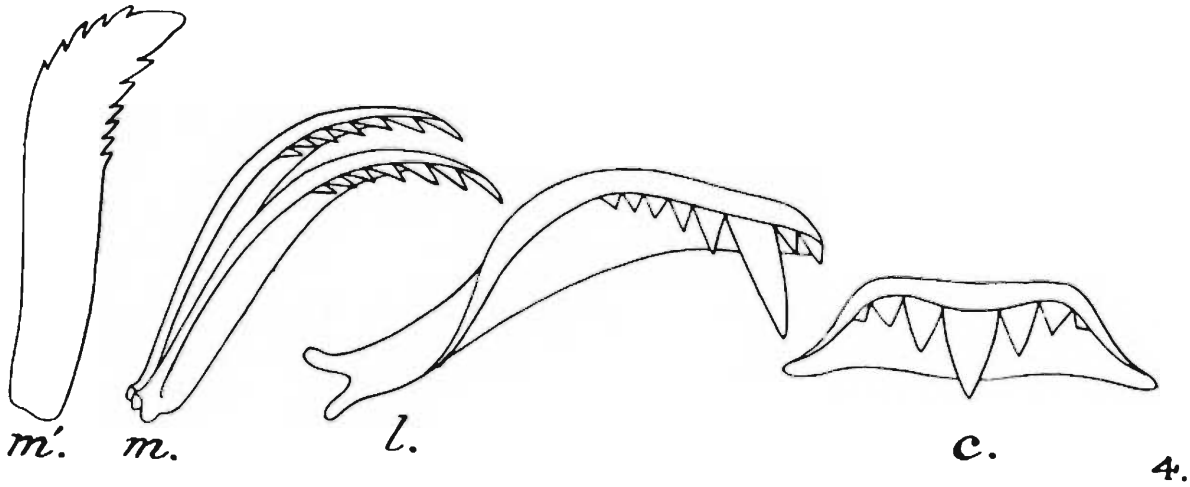
FIGS. 1*a*-1*c*, dorsal, ventral, and lateral views of the holotype (×2½).

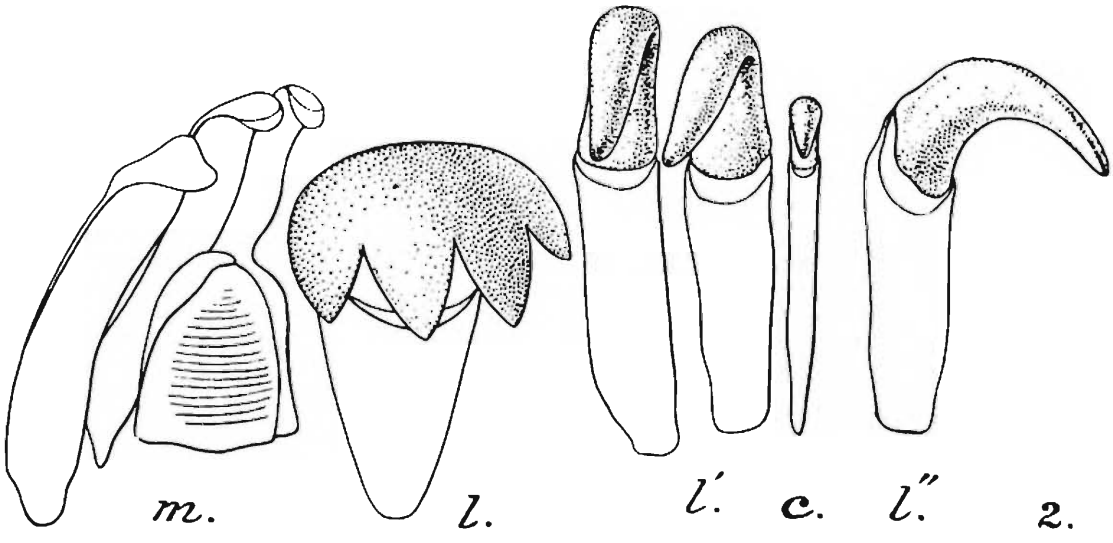
FIG. 2.—Radular teeth—*c*. central; *l*. outer lateral; *l'*. inner laterals; *l''*. side view of an inner lateral; *m*. marginals. (×250).

Saptadanta nasika gen. *et.* sp. nov.

FIGS. 3*a*-3*c*, dorsal, ventral, and lateral views of the holotype. (×2½).

FIG. 4.—Radular teeth—*c*. central; *l*. lateral; *m*. marginal; *m'*. side view of outer marginal (×250).





New Limpet-like Gastropods.

ON A NEW SPECIES OF THE GENUS *SEPTARIA* FER. FROM VALLAR RIVER, S. INDIA.

By B. PRASHAD, *D.Sc., F.R.S.E., F.A.S.B., Director, Zoological Survey of India.*

(PLATE II.)

Recently Mr. R. V Seshaiya, Lecturer in Zoology of the Annamalai University, sent me for identification two specimens of a *Septaria* from the Vallar River, about two miles from the sea at Porto Novo. These specimens do not agree with any previously known species of the genus and are described below under the name *Septaria dravidica*, sp. nov.

In his valuable monograph[1] of the genus *Navicella=Septaria*, the late Prof. E. von Martens recorded from the Indian area the following 3 species: *Navicella suborbicularis* Sow. (with *N squamata*[2] Dohrn from Andamans, Nicobar and Ceylon as a synonym), *N reticulata* Reeve from Ceylon (with *N livesayi* Dohrn from Ceylon as a synonym) and *N caerulescens* Sowerby (with *compressa* Benson as a variety) from the River Ganges. Preston[3] considered all the species as distinct and recorded *Septaria reticulata* (Reeve), *S. livesayi* (Dohrn) and *S. squamata* (Dohrn) from Ceylon and *S. compressa* (Benson) and *S. caerulescens* (Sowerby) from the River Ganges and its tributary Hughli in Bengal.

As is clear from the above references, no species of the genus has so far been recorded from Peninsular India and it is, therefore, of special interest to find a species living near Porto Novo in the Vallar River. The new species, as noted above, does not agree with any of the previously known Indian forms, but it differs in so far the shape of its septum is concerned, from all other known species of the genus.

Recluz[4] in his account of the genus divided the species into 3 groups, (i) Sommet saillant au-delà de la marge, souvent corrodé; (ii) A sommet submarginal entier; (iii) A sommet situé un peu avant le bord postérieur. The brother Adams[5] adopted for these groups the name *Catillus* Humphrey and the subgeneric names *Septaria* Fér. and *Elara* H. and A. Adams. Gray[6] taking into consideration the form of the operculum and the septum divided the family Navicellidae as he designated it, into 3 tribes and 4 genera—*Catillus*, *Paria*, *Stenopoma* and *Orthopoma*. E. von Martens[7] arranged the species of the genus into three groups, and these groups have been adopted by Thiele[8] in his valuable "Handbuch" The three groups are (i) *Septaria* s. s., with an elongated,

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[1] Martens, E. von—Navicella in *Martini and Chemnitz Conch.-Cab.* (N. F.), II (10), pp. 1-40, pls. i-vi (1881), pp. 41-56 (1882). The dates of publication of the last two plates, vii, viii, are not definite, but they were probably issued in 1882.

[2] *N. squamata* is wrongly spelt as *N. squamala* on p. 31 of von Martens' monograph.

[3] Preston, H. B.—*Fauna Brit. Ind., Freshw. Moll.*, pp. 6-8 (1915).

[4] Recluz, C.—*Journ. Conchyliol.* I, pp. 375, 376 (1850).

[5] Adams, H. and A.—*Gen. Moll.* I, p. 387 (1856).

[6] Gray, J.—*Proc. Zool. Soc. London*, pp. 993-1000 (1867).

[7] Martens, E. von.—*op. cit.*, p. 8 (1881).

[8] Thiele, J.—*Handbuch Syst. Weichtierkunde*, I, p. 76 (1929).

rather strongly arched shell, thick periostracum, apex prominent, projecting beyond the posterior margin of the shell,—Type *S.* (*S.*) *borbonica* Bory St. Vincent; (ii) *Sandalium* Schumacher, shell greatly arched nearly circular, periostracum thin, with distinct markings, apex somewhat raised, hardly projecting beyond the shell margin,—Type *S.* (*S.*) *orbicularis* (Sowerby), and (iii) *Navicella* Lamarck, shell, flat, thin, elongate periostracum, thin; apex sharp, lying mostly in front of the posterior margin of shell,—Type *S.* (*N.*), *tessellata* Lam.

In reference to the septum (Scheidewand) von Martens remarked that its free anteriorly directed edge is often more or less, but generally very slightly, arched backwards in the middle; in *N freycineti* Sowerby, however, it projects somewhat forwards in the middle line as in most species of the genus *Crepidularia*. In *S. dravadica*, which belongs to the *Navicella* group, on the other hand, the septum is very narrow and its middle region is broadly arched in the form of a semi-circular bay.

It is of interest to remark here that the late Dr. von Martens in his otherwise valuable monograph referred to above has in his descriptions of several species confused the anterior end of the shell with the posterior.

Septaria dravadica, sp. nov.

Shell ovoid; moderately arched; distinctly narrower anteriorly than posteriorly, lateral sides slightly arched; average index of length to breadth 4:3—3:2, height to breadth 1: 3; apex situated near but not projecting beyond the posterior margin. Shell of a yellowish colour cut up by rectangular black spots forming a chequered pattern; in the paratype the dark olive spots are smaller and more numerous and almost obliterate the ground-colour; apex dark violet. Septum comparatively very narrow, less than $\frac{1}{5}$ the length of shell, cut up in the middle along a semicircular area; of a light creamy colour; inner surface of shell light bluish with the pattern of colour-marking shining through it. Operculum (figs. 3, 3*a*) longer than broad, shell-white in colour, rib, narrow, elongated, marginal; lateral area broad, channelled; diagonal process not distinctly marked.

Measurements (in millimetres).

	Holotype.	Paratype.
Length	18	16·2
Maximum breadth	12·5	12
Maximum height	4	4

Holotype No. M. $\frac{14373}{2}$, Paratype No. M. $\frac{14374}{2}$ in the collection of the Zoological Survey of India (Indian Museum), Calcutta.

Locality.—*S. dravadica* was collected from the Vallar River, about two miles from the sea at Porto Novo, South India. The species is common about February.

The radula (fig. 4) resembles that of *S. tessellata* (Lam.) figured by von Martens (*loc. cit.*, pl. i, fig. 3).

EXPLANATION OF PLATE II.

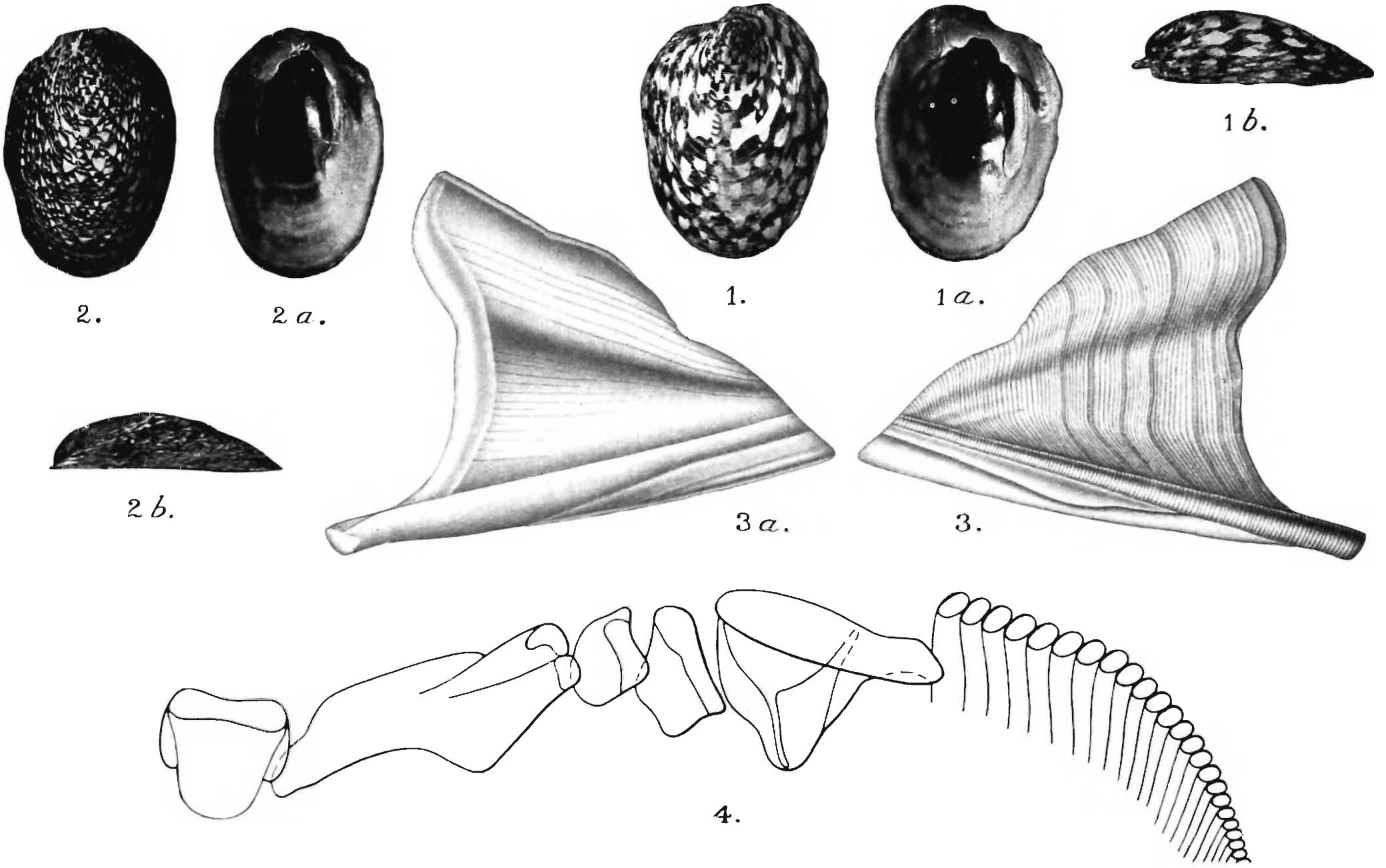
Septaria dravadica, sp. nov.

FIGS. 1, 1*a*, 1*b*.—Dorsal, ventral and lateral views of the Holotype × *Ca.* 2½.

FIGS. 2, 2*a*, 2*b*.—Dorsal, ventral and lateral views of the Paratype × *Ca.* 2½.

FIGS. 3, 3*a*.—Dorsal and ventral views of the operculum × 22.

FIG. 4.—One half row of the radular teeth ; only a few of the marginal teeth are shown × 250.



S. Mondul. delet Photo.

Septaria dravadica, sp. nov.

SOME NEW SPECIES OF AVIAN CESTODES FROM INDIA WITH A DESCRIPTION OF *BIUTERINA INTRICATA* (KRABBE 1882).

By M. A. MOGHE, *M.A., M.Sc., F.Z.S.*, AND N. B. INAMDAR, *M.Sc.*, *Department of Zoology, College of Science, Nagpur, C. P., India.*

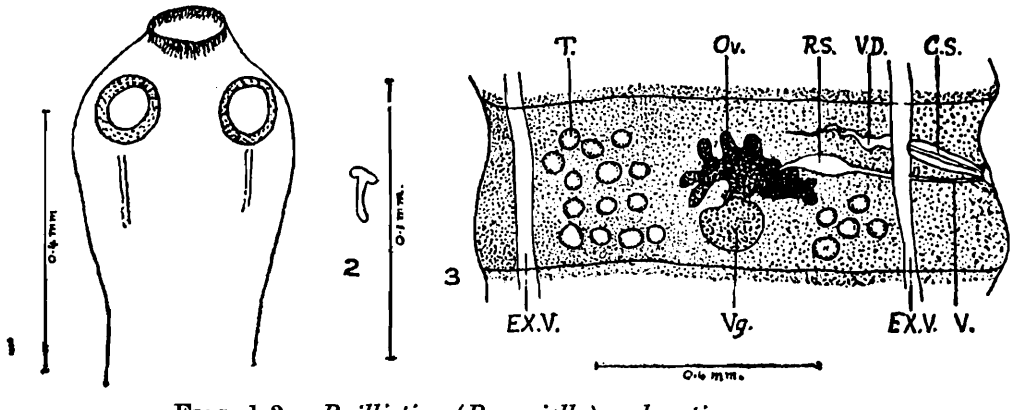
The present paper deals with five new species of cestodes collected from birds in the Central and United Provinces. A detailed description of *Biuterina intricata* (Krabbe 1882) is also appended.

We are greatly indebted to Dr. F. J. Meggitt for helping us with advice and literature for the preparation of this paper, and to the authorities of the Zoological Survey of India, for lending us the necessary references. The type-slides of the various cestodes described in this paper are deposited in the Indian Museum, Calcutta.

Raillietina (Paroniella) molpastina, sp. nov.

Several specimens of this worm were obtained from the intestines of two specimens of the Red-vented Bulbul, *Molpastes haemorrhous* (Gmelin).

Anatomy.—Maximum length of worm about 50-55 mm.; maximum width (posteriorly) about 1·5 mm. All proglottids much wider than long, varying in size from 0·1—0·6 mm. × 0·3—0·5 mm. in various regions of the strobilus. Scolex (fig. 1) 0·3 mm. × 0·35 mm.; rostellum 0·108 mm. in diameter, armed with a double crown of about 180 hooks of the



FIGS. 1-3.—*Raillietina (Paroniella) molpastina*, sp. nov.
FIG. 1.—Scolex.
FIG. 2.—Rostellar hook.
FIG. 3.—Entire mature proglottid.

Davaineid type. The shape of the hooks is shown in fig. 2; each hook is 15μ in length. Suckers 113μ × 93μ; armed with three rows of minute hooks. There is a short unsegmented neck region behind the scolex. Genital pores unilateral, situated a little anteriorly to the middle point of lateral proglottid margin. There are about 19 testes (fig. 3, *T.*) in each proglottid, arranged in two groups, one on either side of the ovary;

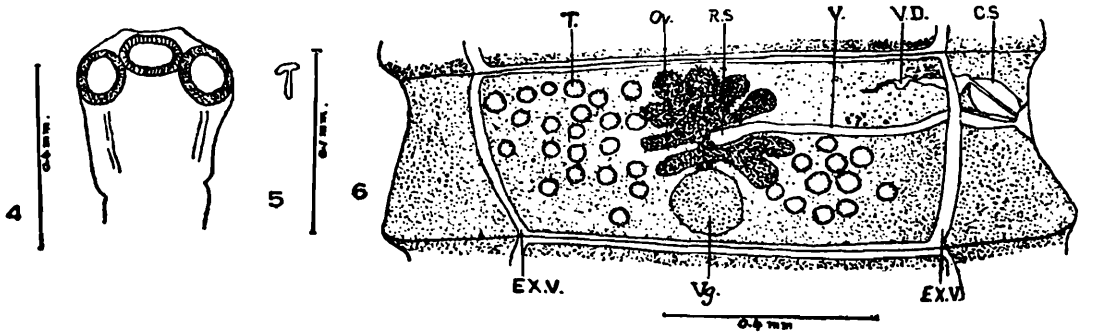
NOTE.—Explanation of lettering of text-figures *C. S.* Cirrus sac; *Ex. V.* Excretory vessel; *Ov.* Ovary; *P. U.* Paruterine organ; *R. S.* Receptaculum seminis; *T.* Testis; *U.* Uterus; *V.* Vagina; *V. D.* Vas deferens; *Vg.* Vitelline gland.

poral group consisting of 5 and aporal of 14 testes; diameter of each testis is 46μ. Cirrus sac (*C. S.*) cylindrical, not extending beyond the lateral excretory vessel of the poral side; 0·14 mm. in length and 0·04 mm. in width at its base; cirrus and its sac both unarmed. Vas deferens (*V D.*) a straight, slightly coiled tube. Ovary (*Ov.*) slightly poral, lobed. Vagina (*V.*) posterior to the cirrus sac, forming a dilated receptaculum seminis (*R. S.*) near its junction with the ovary. Vitelline gland (*Vg.*) rounded, situated posteriorly to the ovary. Shell gland small. The uterus first appears as an elongated sac on the poral side round about the receptaculum seminis but later includes the sex glands; in fully gravid proglottids it disintegrates into egg capsules, 44μ×33μ, each of which has a single egg; the capsules extend beyond the excretory vessels. Eggs (in canada balsam) have a diameter of about 21μ.

Raillietina (Paroniella) duosyntesticulata, sp. nov.

A few specimens, mostly in pieces, were obtained from the intestine of a specimen of *Xantholaema haematocephala* (Müller).

Anatomy.—The largest piece is 40 mm. long and probably the total length of the worm would be about 60 mm., the maximum width is 2·1 mm. All proglottids wider than long, varying in size from 0·058—0·264 mm.×0·29—2·1 mm. in different regions of strobilus. Genital pores unilateral, situated in the anterior third of the lateral margin of the proglottid. The genital ducts pass between the longitudinal excretory vessels. Scolex (fig. 4) measures 0·68 mm.×0·4 mm. Rostellum 114μ long, with a double crown of 234 Davaineid hooks. The form of the hooks is T-shaped (fig. 5). Each hook 17μ in length. Suckers 140μ ×120μ, armed with 5 rows of minute hooks. The unsegmented neck region is very short. 32-37 testes (fig. 6, *T.*) in each proglottid, situated



FIGS. 4-6.—*Raillietina (Paroniella) duosyntesticulata,* sp. nov.
FIG. 4.—Scolex.
FIG. 5.—Rostellar hook.
FIG. 6.—Entire mature proglottid.

laterally and posterior to the ovary; the poral group consists of 9-14 and the aporal of 23 testes; diameter of each testis 21μ. Cirrus sac (*C. S.*) 96μ×47μ, extending three-fourths the distance between lateral proglottid margin and the poral excretory vessel. Cirrus and its sac both unarmed. Vas deferens (*V D.*) in the form of a straight coiled tube. Ovary (*Ov.*) slightly aporal, deeply lobed. Vagina (*V.*) only slightly dilated near its junction with the ovary. Vitelline gland (*Vg.*) large, round. Shell gland small. The uterus makes its appearance as a sac round the ovary but later fills the entire proglottid extending

beyond the excretory vessels and breaking up into egg capsules, 11μ ×8μ, and containing a single egg measuring 10μ×7μ (in canada balsam).

Systematic Position.—Both the worms described above belong to the genus *Raillietina* Führmann 1920, since they possess a rostellum armed with numerous T-shaped hooks, and in both the uterus breaks into egg capsules. The genital pores are unilateral and each of the egg capsules contains a single egg. They, therefore, belong to the subgenus *Paroniella* Führmann 1920. A list of the species of this subgenus was recently published by Führmann (1932); *R. acanthovaginata* Purvis 1932 from a fowl is not included in this list and *Raillietina rangoonica* Subramaniyam (1928), should, in our opinion, also be referred to this subgenus. On referring to the key to the species of *Davainea* by Meggitt (1921) and the descriptions of these species given by Lopez-Neyra (1931) while proposing a new classification for this group of cestodes which, however, is not accepted by Baer (1931) and Führmann (1932), it is found that *R.* (*P.*) *sphecotheridis* has accessory rostellar spines, *R.* (*P.*) *magninumida* and *R.* (*P.*) *urogalli* both possess an armed cirrus, *R.* (*P.*) *reynoldsae* has a spiny collar on the scolex, the rostellar hooks in *R.* (*P.*) *rhynchota* form a rosette with eight limbs, *R.* (*P.*) *facile* has a very small number (9) of testes, *R.* (*P.*) *numida*, *R.* (*P.*) *compacta*, *R.* (*P.*) *cruciata* have a relatively longer cirrus sac, *R.* (*P.*) *fecunda* has a larger number of rostellar hooks of a smaller size, *R.* (*P.*) *paradisea* has a larger number of testes, the cirrus sac is relatively smaller in *R.* (*P.*) *corvina* and a smaller number of rostellar and a larger number of acetabular hooks, *R.* (*P.*) *rangoonica* has smaller rostellar hooks and fewer testes and finally *R.* (*P.*) *acanthovaginata*[1] has a larger number of rostellar hooks of a smaller size and a larger cirrus sac. It is, therefore, evident that the two worms described above differ from all other known species of this subgenus. Unfortunately we have not been able to consult the descriptions of *R.* (*P.*) *conopophilae* and of *R.* (*P.*) *polycalcaria*, both from Passeriform birds.

SPECIFIC DIAGNOSES.

Raillietina (Paroniella) molpastina, sp. nov.

Length 50-55 mm., maximum width 1·5 mm.; scolex with a double crown of 180 hooks on the rostellum, length of each hook 15μ; suckers armed with three rows of minute hooks; testes 19 in number, each 46μ in diameter; cirrus sac just reaching the lateral excretory vessel of the poral side; eggs (in canada balsam) 21μ×20μ.

Host.—Red vented Bulbul, *Molpastes haemorrhous* (Gmelin).

Habitat.—Intestine.

Locality.—Nagpur, C. P., India.

Raillietina (Paroniella) duosyntesticulata, sp. nov.

Length about 60 mm., maximum width 2·1 mm.; rostellum armed with 234 hooks, each 17μ in length; suckers armed with 5 rows of minute hooks; cirrus sac extends to a distance equal to three-fourths the dis-

[1] We are indebted to Dr. F. J. Meggitt for furnishing us with a description of *R.* (*P.*), *acanthovaginata* Purvis 1932.

tance between the lateral proglottid margin and the poral lateral excretory vessel ; eggs (in canada balsam) 10μ×7μ.

Host.—*Xantholaema haemacephala* (Müller).

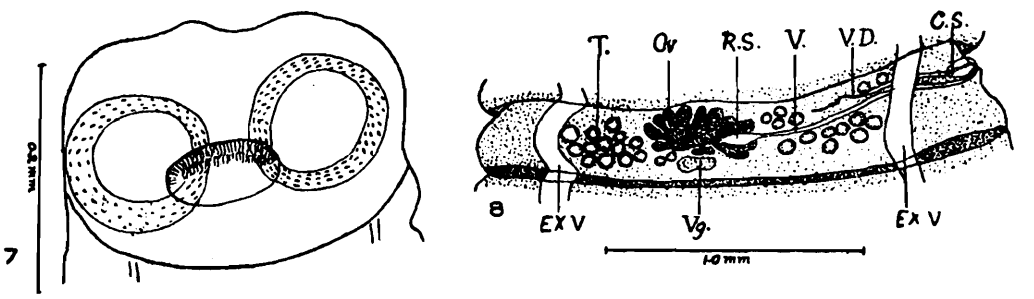
Habitat.—Intestine.

Locality.—Nagpur, C. P., India.

Ophryocotyloides monocantis, sp. nov.

One flattened and six unflattened specimens of this cestode collected from a Tree Pie, *Dendrocitta rufa* (Scop.). We are indebted to Mr. S. C. Verma of the Zoological Department, University of Allahabad, for this material.

Anatomy.—Total length of the worm 40 mm. with a maximum width 2·42 mm. The entire strobilus consists of about 500 proglottids varying in size from 0·024—0·701 mm.×0·22—1·5 mm. in different regions of the strobilus. All proglottids wider than long. Genital pores unilateral. Scolex (fig. 7) of the Davineid type ; 0·2 mm. in length, with a maximum width of 0·285 mm. Rostellum, 0·1 mm.×0·043 mm., armed with two rows of minute hooks, each hook being 8μ in length. Suckers, 0·122 mm.×0·108 mm., armed with three rows of minute hooks. 30 to 35 testes (fig. 8, *T*), of a diameter of 60μ, in each proglottid, situated laterally



FIGS. 7-8.—*Ophryocotyloides monocantis*, sp. nov.
FIG. 7.—Scolex.
FIG. 8.—Entire mature proglottid.

and posteriorly to the ovary. There is approximately an equal number of testes on each side of the ovary. Cirrus sac small, just reaching the nerve, 0·128 mm. long and 40μ broad at its base. It contains a straight unarmed cirrus, which is continued into a straight vas deferens (*V D.*). Ovary (*Ov.*) slightly aporal, occupying more than half the length of proglottid and almost more than a third of the width between the lateral excretory canals. In a fully mature segment, the ovary is still larger and occupies the entire length and half the width of the proglottid. Receptaculum seminis present. Vitelline gland (*Vg.*) rather small ; shell gland still smaller. Uterus sac-like, occupying the whole proglottid, extending beyond the lateral excretory vessels nearly up to the lateral proglottid margins ; persistent and not breaking into egg capsules. The eggs (in canada balsam) 27μ×21μ ; embryos 11μ×9μ.

Systematic position.—The presence of a rostellum armed with Davaineid hooks and a persistent uterus place this worm in the subfamily Ophryocotylinae Führmann 1907, and owing to the unilateral genital pores it has to be referred to the genus *Ophryocotyloides* Führmann 1920. This species differs from others (*vide* table of characters

of species by Moghe (1933) in the size of the rostellar hooks, in having hooks of one size only and in the number of testes, and we propose for it the name, *Ophryocotyloides monocantis* with the following specific diagnosis:—Length 40 mm., maximum width 2·42 mm.; restellum armed with two rows of equal hooks, each 8μ in length; suckers armed with three rows of minute hooks; testes 30 to 35 in number, each 60μ in diameter; eggs in balsam 27μ×21μ.

Host.—Tree Pie, *Dendrocitta rufa* (Scop.).

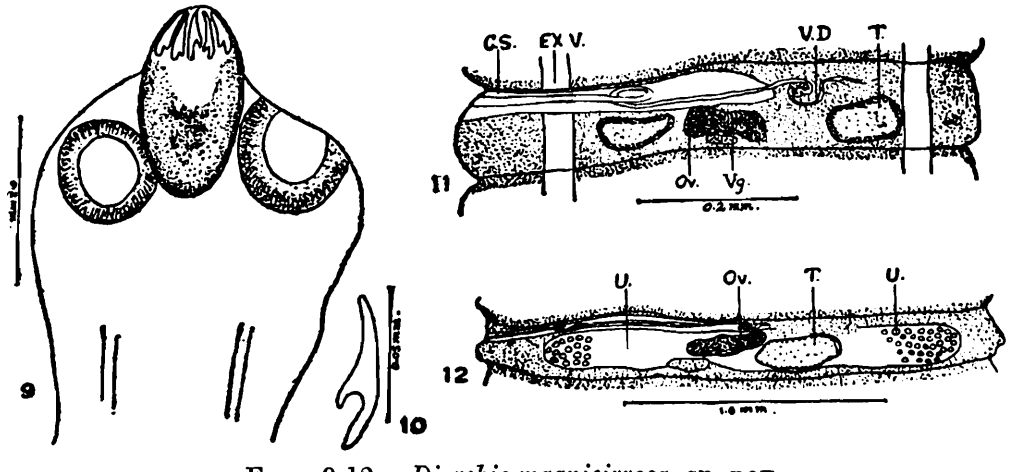
Habitat.—Intestine.

Locality.—United Provinces, India.

Diorchis magnicirrosa, sp. nov.

Three mounted slides of entire worms were given to one of us (M. A. M.) by Mr. S. C. Verma of Zoology Department, University of Allahabad. The host was described as a 'Dove' and it is not clear which particular species of the family Columbidae it represents. We are indebted to Mr. Verma for giving us this material.

Anatomy.—Total length of worm 225 mm. with a maximum width of 0·65 mm. Proglottids 0·1 to 0·15 mm. in length and 0·525 to 0·625 in width in the different regions of the strobilus. All segments wider than long. Genital pores unilateral, genital ducts passing dorsally to the longitudinal excretory vessels. Scolex (fig. 9) 0·44 mm. in length and 0·4 mm. in maximum width. Rostellum 0·224 mm.×0·165 mm. with a single row of 10 hooks; each hook is 60μ in length and has the shape shown in fig. 10. Suckers 0·16 mm.×0·128 mm., unarmed. Scolex followed by a short unsegmented region. Two testes (fig. 11, *T*)



FIGS. 9-12.—*Diorchis magnicirrosa*, sp. nov.

FIG. 9.—Scolex.

FIG. 10.—Rostellar hook.

FIG. 11.—Entire mature proglottid.

FIG. 12.—Entire gravid proglottid.

in each proglottid, one on either side of the ovary which is centrally placed; aporal testis larger of the two. Cirrus sac (*C. S.*) reaches beyond the centre of the proglottid; cirrus straight near the lateral margin, but bent on itself in the middle of the cirrus sac, inner end of cirrus sac dilated to form a vesicula seminalis. Ovary (*Ov.*) situated in the centre of proglottid between the two testes; very small in size in early mature proglottids, but in fully mature ones of the same size as

the testes. No receptaculum seminis. Vitelline gland (*Vg.*) situated posteriorly to ovary. The uterus at first appears as a narrow elongated sac round about the testes but later spreads and occupies the entire proglottid. (Fig. 12.) Eggs (in canada balsam) 21μ×20μ and the onchospheres 10μ×9μ.

Discussion.—The presence of rostellum armed with 10 hooks of the Hymnolepid type and the presence of two testes in each proglottid, place this worm in the subfamily Hymenclepidinae and in the genus *Diorchis*. A list of the species of *Diorchis* is given by Führmann (1932) while descriptions of the species except of *D. longicirrosa* Meggitt 1927, in which the hooks are absent and in which both the testes are aporal to the ovary and of *D. spiralis* Szpotanska 1931, were published by Mayhew (1929).

The species herein described resembles *D. spinata* Mayhew (1929), *D. kodonoides* Mayhew (1929) and *D. spiralis* Szpotanska (1931) in having a long cirrus sac, but it can be distinguished from *D. spinata* Mayhew, and *D. kodonoides* Mayhew in having longer rostellar hooks and from *D. spiralis* Szpotanska in the absence of a spiral sphincter muscle on the vaginal aperture. We regard it, therefore, as a new species and propose the name *Diorchis magnicirrosa*, with the following specific diagnosis :—

Length 225 mm., maximum width 0·65 mm. ; rostellum 0·224×0·165 mm., rostellar hook 60μ in length ; suckers 0·160×0·128 mm. ; ovary between the two testes ; cirrus sac reaching beyond the centre of the proglottid. Eggs (in canada balsam) 21μ×20μ.

Host.—Dove.

Habitat.—Intestine.

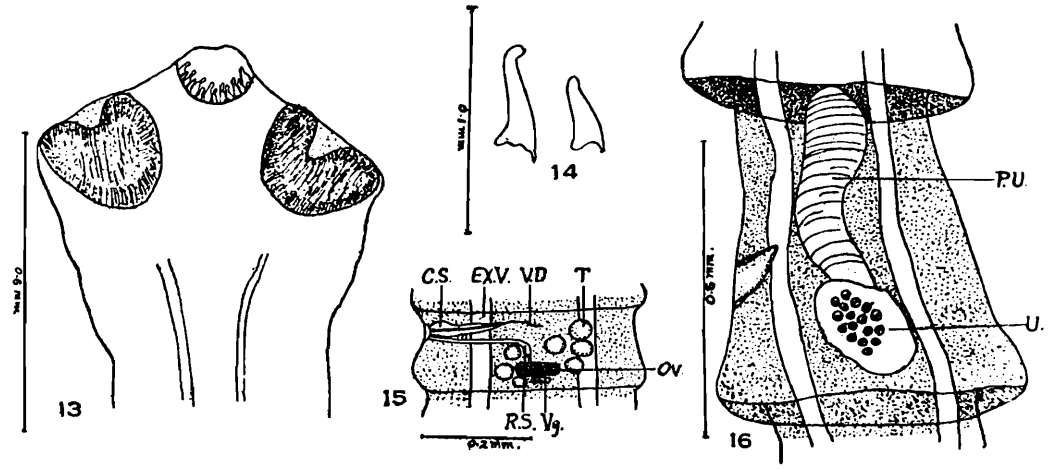
Locality.—United Provinces, India.

Paruterina septotesticulata, sp. nov.

Five scolices and several pieces were found in the intestine of *Coracias indica* (Linn.). These on examination proved to be a new species of the genus *Paruterina* Führmann 1906. No species of this genus has so far been recorded from Coraciiformes (*vide* list by Führmann 1932), and no species has so far been recorded from India (Southwell 1930).

Anatomy.—Total length of worm probably 55 to 60 mm. with a maximum width of 0·638 mm., approximately 200 proglottids. The gravid proglottids are the longest, 0·695×0·537 mm., while the early gravid proglottids are the widest, 0·221 mm.×0·638 mm., the measurements of mature proglottids are 0·157 mm.×0·406 mm. Scolex (fig. 13) 0·429 mm. in length and 0·663 mm. in maximum width, forms the broadest part of the entire worm. Rostellum, 0·132 mm. in diameter, armed with 32 hooks arranged in two rows. The hooks of the two rows have the shape shown in figure 14, and measure 43μ and 31μ respectively. Suckers nearly globular, 0·246 mm. in diameter. The scolex is followed by an unsegmented region, 0·472 mm. in length. Genital pores irregularly alternating, genital ducts lying between the longitudinal excretory vessels. Seven testes (fig. 15 *T*) in each proglottid, arranged in two groups situated laterally and posteriorly to ovary ; three testes poral, four aporal, each 37μ in diameter. Cirrus sac (*C. S.*) 0·151 mm. in length and 31μ in width at its base, extending beyond the poral lateral

excretory vessel. Vas deferens (*V D.*) simple, narrow, wavy. Vagina a narrow tube opening into a genital atrium, near the ovary slightly dilated to form a small receptaculum seminis (*R. S.*). Ovary (*Ov.*) slightly aporal. Small vitelline gland (*Vg.*) situated posterior to ovary. The uterus commences to appear as a sac round the female complex and in its fully formed condition, forms a spherical sac in the middle of the proglottid nearer its posterior border and is anteriorly attached to a paruterine organ (fig. 16, *P. U.*) in which the eggs finally pass. The



FIGS. 13-16.—*Paruterina septotesticulata*, sp. nov.
FIG. 13.—Scolex.
FIG. 14.—Rostellar hook.
FIG. 15.—Entire mature proglottid.
FIG. 16.—Entire gravid proglottid.

eggs, in the paruterine organ, are all stored up at one place, forming a compact mass, round which the paruterine organ is specially dilated. This dilatation is near the uterus and thus is not an anterior dilatation as in *Sphaeruterina* Johnston 1914. The eggs (in canada balsam) are 23μ in diameter and the contained onchosphere 14μ in diameter.

Discussion.—The presence of a rostellum armed with a double row of Hymenolepid hooks and a longitudinally elongated paruterine organ places this worm in the subfamily Paruterininae Führmann 1907, and in the genus *Paruterina* Führmann 1906. A list of the species of this genus is given by Führmann (1932) and a table of characters of most of these species by Skrjabin (1914). *P. angustata* Führmann 1906, and *P. guinensis* Joyeux & Baer 1928, have unilateral genital pores and thus form a group by themselves. Of the remaining species of *Paruterina* with irregularly alternating genital pores, *P. melierax* (Woodland 1929) Johri (1931), has an unarmed rostellum and a large number of testes (50 to 60). *P. candelabraria* (Goeze 1782) Führmann 1906, *P. meggitti* Johri 1931, *P. cholodkowskii* Skrjabin 1914, *P. sinensis* (Ransom 1909) Linton 1927, *P. otidis* Baczynska 1914, *P. bucerotina* Führmann 1909, are all characterised by the possession of a larger number of hooks and a larger number of testes than found in the species described in this paper. We could not get any reference to the number of testes in *P. parallelipipeda* (Rudlophi 1810) Führmann 1908, and *P. vesiculigera* (Krabbe 1882) Führmann 1926, but in the former the number of hooks is fewer (19), while in the latter it is larger (50) than in the species described here. *P. fuhrmanni* Baczynska 1914 has been transferred to the genus *Sphaeru-*

terina Johnston 1914, by Führmann (1932) because of a distinct anterior dilatation of the paruterine organ. The species described above thus differs from other species of *Paruterina* and we propose for it the name *Paruterina septotesticulata* with the following specific diagnosis :—

Length 55 to 60 mm. ; maximum width 0·638 mm. ; scolex 0·429 mm. × 0·663 mm. ; diameter of rostellum 0·132 mm., armed with 2 rows of 32 hooks, each 43μ and 31μ in length respectively ; diameter of sucker 0·246 mm. ; testes 7, each 37μ in diameter. Eggs (in canada balsam, 23μ and onchospheres 14μ in diameter.

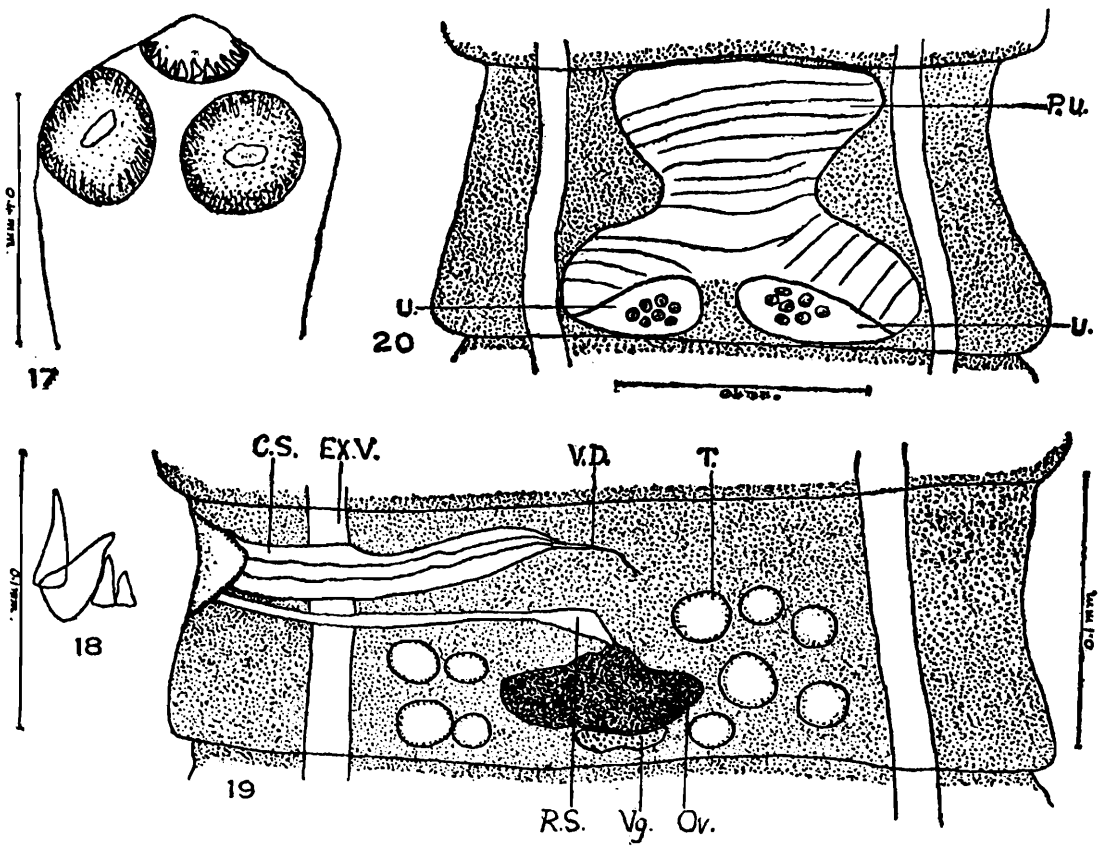
Host.—*Coracias indica* (Linn.)

Habitat.—Intestine.

Locality.—Nagpur, C. P., India.

Biuterina intricata (Krabbe 1882).

The description of *Biuterina lobata* Führmann (1908) was based on material which contained only gravid proglottids. According to him the uterus consists of two portions, a character which is common to all the species of the genus. He further suggested, though querying



FIGS. 17-20.—*Biuterina intricata* (Krabbe 1882).
FIG. 17.—Scolex.
FIG. 18.—Rostellar hook.
FIG. 19.—Entire mature proglottid.
FIG. 20.—Entire gravid proglottid.

Krabbe's description, that *Taenia intricata* Krabbe 1882 was probably identical with *Biuterina lobata* Führmann 1908. Krabbe's species is characterised by having four rows of rostellar hooks and was found parasitic in an Upupiformes bird, *Upupa epops* Linn. which is the identical host for *Biuterina lobata*. Our material was also obtained from

the same host and consists of about 7 complete worms. We give below a complete description of this worm.

Anatomy.—Total length of worm about 50 to 55 mm. with a maximum width of 0·3 mm. All proglottids broader than long; mature proglottids 0·1 mm.×0·22 mm. Genital pores irregularly alternating, genital ducts pass between the longitudinal excretory vessels. Scolex (fig. 18) 0·43 mm. wide at its base. Rostellum 0·102 mm.×0·203 mm. with four rows of 64 hooks of different lengths; they measure: 0·052 mm., 0·036 mm., 0·030 mm., and 0·0196 mm. in diameter. A considerable portion of the strobilus behind the scolex is unsegmented. Ten testes (fig. 19, *T*) in each proglottid: 4 poral, six aporal of the ovary. Cirrus sac (*C. S.*) 0·107 mm. in length, with a straight unarmed cirrus. Vas deferens (*V D.*) a very compact coiled mass. Ovary (*Ov.*) situated centrally towards the posterior end of the proglottid. Vitelline gland (*Vg.*) compact, in close neighbourhood of the ovary posteriorly. Vagina (*V.*) a straight canal, opening in genital atrium posterior to cirrus sac; near the ovary it is dilated into a small bulb-like receptaculum seminis. Uterus (fig. 20) in all gravid proglottids appears as a double sac near the posterior border of the proglottid. The eggs pass into a paruterine organ which has the same appearance as that which is figured by Führmann (1908). Eggs (in canada balsam) 27μ×22μ.

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ON THE STOMATOPOD CRUSTACEA COLLECTED BY THE BENGAL PILOT SERVICE OFF THE MOUTH OF THE RIVER HUGHLI, TOGETHER WITH NOTES ON SOME OTHER FORMS.

By B. CHOPRA, D.Sc., *Zoological Survey of India, Calcutta.*

Since the publication of the paper entitled " Notes on Stomatopoda "[1] by Kemp and myself in 1921, a considerable number of specimens have accumulated in the collection of the Zoological Survey of India, and as a large number of these have been collected by members of the Bengal Pilot Service at the Sandheads, off the mouth of the Hughli River, it has been thought desirable to publish a short note on this collection. Most of these specimens belong to species already known to live in this area, but there are some that are being recorded from this locality for the first time. Though none of the latter records materially extend the geographical range of the species, those of the comparatively rarer forms are of interest. Opportunity has also been availed of to include observations on some other species (pp. 31-43), examples of which have recently been acquired by the Zoological Survey of India. Most of these have been collected by the R. I. M. S. " Investigator " in the Bay of Bengal. No mention is made of the commoner forms in this collection; only those species being noticed that are either somewhat rare, or the fresh records of which are remarkable from the point of distribution, etc. I have also examined two small collections sent to me for identification by the Raffles Museum, Singapore. These, for the most part, consist of very common species, chiefly belonging to the *nepa* group of *Squilla*, which do not require any special mention, but one rather uncommon form, *Squilla lirata* Kemp and Chopra, has been noticed.

The physical conditions prevailing at the Sandheads have been briefly mentioned in an earlier paper[2]. This area lies roughly in 21°N. and 88°E., and though for all practical purposes is a part of the open sea, the salinity is somewhat lower than that of the outlying parts of the Bay of Bengal. The depth in most places is about 20 fathoms, and the bottom consists of soft mud, or, in some places, of sand and mud.

Several species of Stomatopoda have already been recorded from the Sandheads by Wood-Mason[3] and Kemp[4]. All these species belong to the genus *Squilla*; none of the other genera have been collected, until recently, in this locality. The following species are mentioned in Kemp's memoir as having been obtained at the Sandheads :—

Squilla latreillei (Eydoux and Souleyet).
Squilla scorpio var. *immaculata* Kemp.
Squilla nepa Latreille.

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[1] Kemp and Chopra, *Rec. Ind. Mus.* XXII, pp. 297-311 (1921).
[2] Chopra, *Rec. Ind. Mus.* XXXV, pp. 25, 26 (1933).
[3] Wood-Mason, *Figs. and Desc. of nine Squillidae*, pp. 1-11, pls. i-iv (Calcutta : 1895).
[4] Kemp, *Mem. Ind. Mus.* IV, pp. 1-217, pls. i-x (1913).

Squilla holoschista Kemp.
Squilla oratoria var. *inornata* Tate (=var. *perpensa* Kemp).
Squilla interrupta Kemp.
Squilla wood-masoni Kemp.
Squilla raphidea Fabricius.

All these species, with the exception of *Squilla scorpio* var. *immaculata*, are represented in the present collection. Besides these the following species, not hitherto recorded from the Sandheads, are also in the collection :—

Squilla decorata (Wood-Mason).
Squilla gilesi Kemp.
Squilla annandalei Kemp.
Lysiosquilla maculata (Fabricius).
Lysiosquilla acanthocarpus Miers.

The Stomatopod fauna of the Sandheads, as known at present, thus consists of thirteen species ; eleven of these belong to the genus *Squilla*, while two are referable to *Lysiosquilla*. No representatives of *Pseudosquilla* Dana, *Hemisquilla* Hansen, *Gonodactylus* Latreille, *Odontodactylus* Bigelow, *Cornida* Brooks and *Cornidopsis* Hansen have hitherto been collected, and judging from the fact that members of at least the four first mentioned of these genera prefer a rough ground, like oyster beds and coral reefs, it seems probable that they do not inhabit this locality at all. The habits of *Cornida* and *Cornidopsis* are very little known, and it is difficult to say anything about the likelihood or otherwise of the species of these genera ever being collected at the Sandheads. Of the species of *Squilla* that live in this locality *S. interrupta* Kemp is the form most commonly met with, the next two in the order of abundance being *S. raphidea* and *S. nepa*. The remaining eight species are only occasionally met with in this area, and are represented in the collections by one or two examples of each. The two species of *Lysiosquilla* are also, in point of numbers, poorly represented in the collections from the Sandheads, but as members of this genus usually live in deep burrows out of which they do not go very far, it is possible that their scarcity is more apparent than real.

There are two larval forms also included in the collection from the Sandheads, but as I am unable to refer them to their species with any degree of certainty, I have not mentioned them in the following account.

There has been a considerable difference of opinion regarding the advisability of using the generic designation *Squilla* in the Stomatopoda, *Chloridella* Miers having been suggested in its place, chiefly by some American zoologists, headed by the eminent carcinologist Miss Mary Rathbun. The principal argument in favour of abandoning the former name is that the first post-Linnean use of *Squilla* as a generic designation appears to have been in a group other than the Stomatopoda. Even if this view is found to be correct—though most of the recent workers, including Stebbing, Kemp, Hansen and Bigelow, have not subscribed to it—it is difficult to justify the employment of *Chloridella* in place of *Squilla*.

Eydoux and Souleyet[1] in 1841 separated the small-eyed group of Squillas under the name of *Clorida* (not *Chlorida*), but as Miers[2] in 1880 found that the designation *Chlorida* had already been used in the Coleoptera, he suggested the name *Chloridella* to replace the one employed by Eydoux and Souleyet. The reference to the use of *Chlorida* in the insecta is no doubt due to Audinet-Serville[3], who, in 1834, had set up a genus of Cerambicidae, with *Chlorida costata* as the type-species. According to Brooks[4] and all later workers, however, *Chloridella* Miers (or *Clorida* Eydoux and Souleyet) could not be maintained as distinct from *Squilla*, and it, thus, became a synonym of the latter. Miss Rathbun[5] in 1902 pointed out that as the first use of *Squilla* as a generic name after 1st January, 1758, was for an Amphipod, the retention of this name in the Stomatopoda could not be permitted under Article 26 of the International Code, and suggested the use of Miers' *Chloridella* in its place. But in view of the Recommendations under Article 36 of the Code (see also Opinion 25) *Clorida* cannot be rejected on account of a somewhat similar name, *Chlorida*, having been pre-occupied, and if it was found necessary to discard *Squilla*, the name to replace it should have been *Clorida*, and not *Chloridella*.

Bigelow[6] has recently given a very clear exposition of the whole case, and I quite agree with him that even though by the strict application of the laws of priority there may be some justification for abandoning *Squilla* as a generic designation in the Stomatopoda, such a course will only result in greater confusion rather than in uniformity. The retention of this name for the present, at any rate, is especially to be commended in view of the fact that Bigelow states that he is presenting a petition to the International Commission on Zoological Nomenclature to declare *Squilla* as a *nomen conservandum*. If by an adverse decision of the Commission this old and well-known name has after all to be given up, *Clorida* Eydoux and Souleyet should, in my opinion, take its place.

In the present paper I have followed the arrangement of species, etc., as given by Kemp[7] in his well-known monograph on the Indo-Pacific Stomatopoda, which still remains the most standard work on this group. In giving synonymies also I have mostly cited this work alone, giving, wherever necessary, references to some later important works only. Among these may be mentioned Komai's[8] valuable contribution on the Japanese forms, and Bigelow's[9] recent masterly work on the Southern and Eastern Pacific Stomatopoda. Hansen's[10] excellent account of the Stomatopods collected by the Siboga Expedition also deserves special mention.

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[2] Miers, *Ann. Mag. Nat. Hist.* (5) V, p. 13, foot-note (1880).
[3] Audinet-Serville, *Ann. Soc. ent. France* III, p. 31 (1834).
[4] Brooks, *Challenger Stomatopoda* (Zool. XVI), pp. 22, 23 (1886).
[5] Rathbun, *Proc. U. S. Nat. Mus.* XXVI, p. 54, foot-note (1902).
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[9] Bigelow, *Bull. Mus. Comp. Zool. Harvard* LXXII, pp. 103-191, pls. i, ii (1932).
[10] Hansen, *Siboga Exped. Rep.* XXXV, pp. 1-48, pls. i, ii (1926).

Squilla latreillei (Eydoux and Souleyet).

1913. *Squilla latreillei*, Kemp, *Mem. Ind. Mus.* IV, pp. 24-27, pl. i, figs. 1-4.
1927. *Squilla latreillei*, Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, pp 308, 309.
1930. *Squilla latreillei*, Gravier, *Bull. Mus. nat. Paris* (2) II, p. 524.

I refer to this species one female specimen collected by the Pilot Vessel " Lady Fraser " at the Sandheads in 1923. It agrees very closely with Kemp's description of the species, as also with named examples in the collections of the Indian Museum. The carapace, as mentioned by Kemp, and as shown in the figures given by Eydoux and Souleyet[1] and Wood-Mason[2] is of a triangular shape. In the Sandheads example the length of the carapace, excluding the rostrum, is 7·8 mm., while its breadth at the antero-lateral angles, which are produced into sharp spines, is only 4·2 mm. The carapace is, however, broadest a little in front of the rounded postero-lateral angles, where the breadth equals almost exactly the length. In some other examples in the Museum collection that I have examined the proportions are also more or less similar. The carinae on the carapace are very poorly developed, and are as described by Kemp.

In the specimen from the Sandheads the raptorial claw of one side is missing, the dactylus of the other side has only four teeth, including the terminal one.

The telson is as described and figured by Kemp and other authors, but the tubercles and ridges on the dorsal surface are almost as well developed as shown in Kemp's figure of the Persian Gulf female, and not like those shown in Wood-Mason's figure. Of the two other females from the Sandheads in the Museum collection, one, acquired after the publication of Kemp's memoir, has the tubercles well developed, while in the other the condition is like that shown in Wood-Mason's figure.

The colour of the specimen is as described by Komai, except for the fact that the mottling on the carapace is more extensive and the posterior border of the fifth thoracic somite is not bordered with black. The black border on the posterior margin of the last abdominal somite is very inconspicuous.

The species was originally described from Singapore, and besides the localities mentioned by Kemp, has now been recorded from the coast of Annam and Nagasaki in Japan. The species has thus a very wide range of distribution, having been met with in the Persian Gulf on the west to as far east as the south of Japan. At the Sandheads it appears to be not uncommon, having been collected there on four different occasions. The single specimen in the present collection is registered as under :—

C 1652/1	Sandheads, off the mouth of the Hughli River.	" Lady Fraser ", 5.xi.1923.	1 ♀, 46 mm.[3]

[1] Eydoux and Souleyet, *Voyage " Bonite"*, Zool. Crust., p. 265, pl. v, figs. 2-5 (1841).
[2] Wood-Mason, *Figs. and Desc. of nine Squillidae*, pl. iv, figs. 6-13 (Calcutta : 1895).
[3] The length of specimens given is from the tip of the rostrum to the posterior extremity of the telson.

Squilla decorata (Wood-Mason).

1913. *Squilla decorata*, Kemp, *Mem. Ind. Mus.* IV, pp. 27, 28, pl. i, figs. 13-16.

One large female specimen from the Sandheads is referred to this rather rare species.

C 1653/1	Sandheads, off the mouth of the Hughli River.	"Lady Fraser", June, July, 1927.	1 ♀, 77 mm.

Except for one or two minor differences the present specimen agrees closely with the mutilated type-specimen and with other named examples in the Museum collection. In the Sandheads specimen the following carinae end in spines :—

Carinae.	Abdominal somites.
Submedian	6.
Intermediate	2, 3, 4, 5, 6.
Lateral	3, 4, 5, 6.
Marginal	2, 3, 4, 5.

It is thus seen that in the Sandheads specimen more carinae end in spines than is typically the case. In other examples in the Indian Museum collection, as shown in the table given by Kemp, the intermediate carina of the second abdominal somite never ends in spine, while that of the third sometimes does so ; in the Sandheads example the intermediate carina terminates in spine on both these somites. Similarly the lateral and the marginal carinae of the third and the second abdominal somites respectively end in distinct spines in my specimen from the Sandheads.

As mentioned by Kemp and shown in his figure, as also in those given by Wood-Mason[1], the marginal teeth of the telson are without any serrations on their edges. In the example from the Sandheads the outer edge of the intermediate tooth on the margin of the telson is distinctly serrate. The serrations are not quite so well developed as those in *Squilla latreillei*, but they can be seen quite distinctly, especially on the basal half of the tooth. Another specimen in the Museum collection, from off the Irrawady Delta, also shows faint indications of similar serrations.

Squilla decorata is so far known from the Bay of Bengal only. The type-specimen, from which Wood-Mason described the species, was collected in the Andamans, and Kemp recorded three other examples from off the Burma coast. One of the latter, from off Akyab, was included in the species somewhat doubtfully. Another specimen from Jack and Una Island, Mergui Archipelago, was referred to the species by Kemp and myself[2] in 1921. All the specimens so far known are females.

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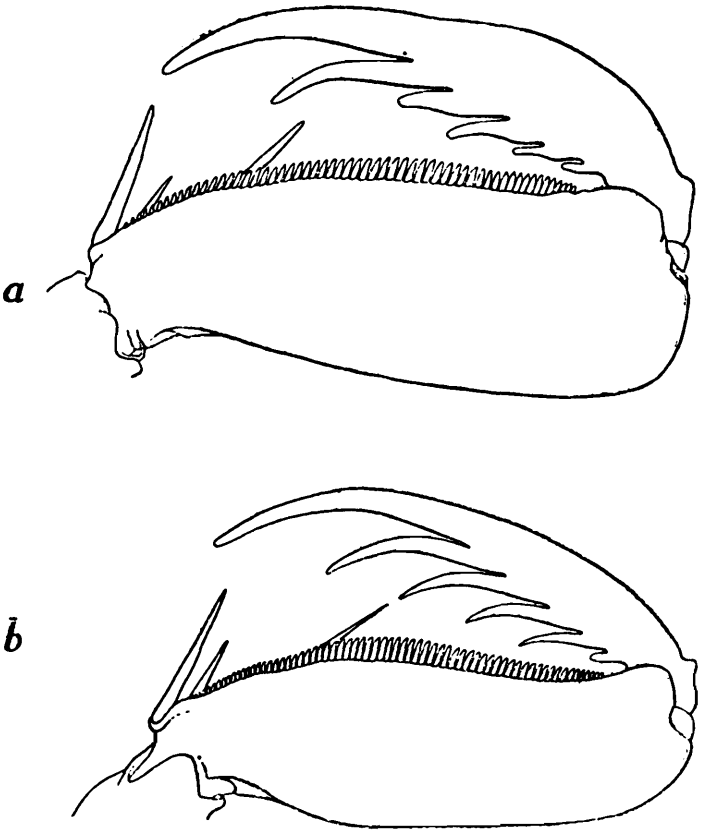
[1] Wood-Mason, *Figs. and Desc. of nine Squillidae*, p. 9, pl. iv, figs. 14-17 (Calcutta : 1895).

[2] Kemp and Chopra, *Rec. Ind. Mus.* XXII, p. 295 (1921).

Squilla gilesi Kemp.

1913. *Squilla gilesi*, Kemp, *Mem. Ind. Mus.* IV, pp. 39, 40, pl. ii, figs. 25-27.

As pointed out by Kemp, *Squilla gilesi* resembles very closely *Squilla lata* Brooks[1], but with the help of the characters given by Kemp the two can be specifically distinguished without much difficulty. In *S. gilesi* the submedian carinae are present on the last thoracic and all the abdominal somites, and the inner margin of the bifurcate process of the



TEXT-FIG. 1.—*Squilla gilesi* Kemp.

Two terminal segments of raptorial claw of

a. male, *b*. female.

uropod bears only a series of serrations, instead of the well-developed spines that are present in Brooks' species; these two characters alone, apart from the others mentioned by Kemp, are sufficient to recognise the present species.

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[1] As pointed out by Kemp it is somewhat doubtful whether the Indian specimens referred by him to *S. lata* Brooks really belong to this species. The Indian examples show some fairly important differences from Brooks' description of the species, and if these are found to be constant on an examination of further material, it will probably be necessary to give a new name to the Indian form. Komai [*Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, pp. 310, 311, pl. xiv, fig. 1 (1927)] has recently shown that in a Japanese example that he referred to Brooks' species, the mandibular palp is completely suppressed, the post-anal carina is absent, and, as in Brooks' examples, none of the carinae on the thoracic and first four abdominal somites (first five in the case of Brooks' specimens) ends in a spine. If Komai's example has been correctly identified, the Indian specimens certainly represent a distinct species. A re-examination of the Challenger material with reference to the mandibular palp and the post-anal carina can only clear this point.

I refer to this species three specimens from the Sandheads :—

C 1654/1	Bay of Bengal, between Pilot Ridge Light Vessel and Eastern Channel Light Vessel ; 10 miles N. and S. of Eastern Channel Light Vessel.	" Fraser ", Nov., 1923.	1 ♂, 82 mm.
C 1655/1	Sandheads, off the mouth of the Hughli River.	" Lady Fraser ", Feb., March, 1928.	1 ♂, 1 ♀, 66 and 68 mm.

The smaller male is without raptorial claws, but the secondary sexual characters on the telson, mentioned by Kemp, are very clearly seen. The proximal tooth on the dactylus of the raptorial claw is greatly reduced in both the other examples, and the claw in the male shows the secondary characters very distinctly.

Squilla gilesi is so far known from the Indian waters only, from both the Bay of Bengal and the Arabian Sea. The types, from off the Madras coast, were collected at a depth of 80-110 fathoms.

Squilla nepa Latreille.

1913. *Squilla nepa*, Kemp, *Mem. Ind. Mus.* IV, pp. 60-64, pl. iv, fig. 49.
1926. *Squilla nepa*, Hansen, *Siboga Exped. Rep.* XXXV, pp. 10, 11.
1927. *Squilla nepa*, Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, p. 314.

Squilla nepa appears te be a fairly common species at the Sandheads, 14 specimens of it, collected between the years 1923 and 1932, having been brought back by members of the Bengal Pilot Service. Of these five are males and nine females, and, excluding a very young female 23 mm. long, range in size from 51 to 76 mm. Besides these there are a number of specimens from the same locality in the older collections also.

The species occurs commonly in Indian coastal waters, having been extensively met with both in the Arabian sea and the Bay of Bengal. It has a very wide range of distribution over the Indo-Pacific area, extending, according to Kemp, from Honolulu to Madagascar and Durban. Komai has recorded it from Formosa, which he believes " may be almost the northern limit of distribution of the species" The occurrence of this species in brackish waters, as recorded by Kemp[1] and Komai, is of interest.

Squilla holoschista Kemp.

1913. *Squilla holoschista*, Kemp, *Mem. Ind. Mus.* IV, pp. 64, 65, pl. iv, figs. 50-53.
1921. *Squilla holoschista*, Kemp and Chopra, *Rec. Ind. Mus.* XXII, p. 301.

I refer to this species four specimens from the Sandheads. Of these two are males and two females, and in size range from 64 to 77 mm.

Except for the specimens recorded by Sunier[2] from the Sunda Straits, the species is so far known to occur only along the east coast of India, where it is met with extensively from the Delta of the Ganges to Ceylon.

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[1] Kemp, *Mem. As. Soc. Bengal* VI, p. 297 (1918).
[2] Sunier, *Contrib. Faune Indes Neerland.* IV, p. 69 (1918).

Squilla oratoria var. **inornata** Tate.

1883. *Squilla inornata*, Tate, *Trans. Roy. Soc. S. Aust.* VI (for 1882), p. 51, pl. ii, figs. 3*a*, *b*, *c*.
1913. *Squilla oratoria*, var. *perpensa*, Kemp, *Mem. Ind. Mus.* IV, pp. 66-68, pl. v, figs. 57-59.
1924. *Squilla oratoria*, var. *inornata*, Hale, *Rec. S. Aust. Mus.* II, pp. 495, 496.
1926. *Squilla oratoria*, var. *perpensa*, Hansen, *Siboga Exped. Rep.* XXXV, p. 11.
1927. *Squilla oratoria*, var. *perpensa*, Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, pp. 318, 319.

From an examination of Tate's type-specimens, preserved in the South Australian Museum, Hale came to the conclusion that the varietal form separated by Kemp, under the name of *perpensa*, from typical examples of *Squilla oratoria* could not be distinguished from Tate's species. This view does not appear to have been accepted by later workers, as Kemp's name still continues to be extensively employed for this form. Through the courtesy of Mr. H. M. Hale, Curator, South Australian Museum, I have been able to examine one of the two type-specimens from which Tate originally described this species. This specimen, though broken in two parts, is in a good state of preservation, and shows clearly all the important characters. On comparing this specimen with the types of Kemp's *perpensa* from Tuticorin, South India, preserved in the collection of the Indian Museum, no doubt is left in my mind that Kemp's form is identical with *S. inornata*, and that the name of *perpensa* employed by him should, therefore, give place to the earlier designation of Tate. The two characters emphasized by Kemp for the separation of his variety from the *forma typica*, namely, the interrupted median carina of the carapace, and the presence of a sharp, elevated carina on the dorsal aspect of the raptorial carpus, terminating abruptly before reaching the anterior margin, are very clearly seen in the specimen from South Australia that I have seen. The median carina of the carapace is wholly absent for a short distance at the base of the anterior bifurcation and the carpus of the raptorial claw has a very distinct unbroken dorsal carina, exactly as in the type-specimens of Kemp's variety, and as shown in his figure (Plate V, fig. 58). In other characters also Tate's specimen agrees closely with the Indian Museum examples.

There are, however, a few minor differences between the Australian specimen and the Indian examples. In the former the margins of the rostrum are somewhat more upturned than is usually the case, and the carinae of the carapace, especially the median, are a little more upraised. These differences may, however, be due to the Australian specimen being dry. The rostrum is also truncate anteriorly, as is the case in some of the Indian Museum types, though in a large number of these, the anterior border is more or less rounded; further it is also slightly longer and narrower than is generally the case. The shape of the anterior lateral lobe of the sixth thoracic somite appears to be somewhat variable in the variety; in some cases it is almost straight and rather sharply pointed terminally, in others it is distally curved and bluntly pointed, while in some specimens it is almost truncated. In the Australian example it is somewhat curved and bluntly pointed.

Another point worth mentioning is that in the Australian type the lateral carina of the second abdominal somite ends on each side in a small, but distinct spine. In his description of the variety *perpensa* Kemp gives the following spine-formula :—

Carinae.	Abdominal somites.
Submedian	5, 6.
Intermediate	4, 5, 6.
Lateral	3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

An examination of the large type-series has, however, shown that though in a number of specimens the lateral carinae of the second abdominal somite do not end in spines, as described by Kemp, in others a distinct spine can be seen on each side.

It is thus seen that the few differences that have been noticed between Tate's type of *inornata* and Kemp's types of *perpensa* are of a very minor importance and do not justify the retention of Kemp's variety as distinct from Tate's form.

The Australian specimen that I have examined is a female and is approximately 65 mm. long. It was collected, along with the second syntype, in the Gulf of St. Vincent in South Australia, and is registered under number C180 in the registers of the South Australian Museum.

I refer to this variety two small female examples, 45 and 52 mm. long, collected by " Lady Fraser " at the Sandheads in 1928. One of these has both the raptorial claws missing, but the other characters mentioned by Kemp and Komai for the recognition of the variety are very clearly seen[1].

The variety has a very wide range of distribution over the Indo-Pacific area. The types are from the Gulf of St. Vincent in South Australia ; its northern range does not appear to extend beyond Formosa, while on the west it has been collected in the Persian Gulf. In the Indian waters the variety has been met with very extensively to the total exclusion of the *forma typica.*

Squilla interrupta Kemp.

1913. *Squilla interrupta,* Kemp, *Mem. Ind. Mus.* IV, pp. 72-74, pl. v, figs.63-65.
1927. *Squilla interrupta,* Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, p. 319.
1929. *Chloridella interrupta,* Schmitt, *Lingnan Sci. Journ.* VIII, p. 140.

As stated by Kemp, *Squilla interrupta* is one of the commonest species of *Squilla* in the Indian waters ; at the Sandheads also this species appears to be the most abundant, there being 47 specimens of it from this locality. Of these 21 are males and 26 females, and these range in size from 50 to

[1] One large specimen sent to me by the Raffles Museum, Singapore, while agreeing with typical examples of *S. oratoria* var. *inornata* in most characters, differs from these in having the median carina of the carapace entire and uninterrupted. In this respect it resembles the *forma typica,* but in having the dorsal carina of the raptorial carpus entire, as also in all the other characters mentioned by Komai, the specimen appears to be referrable to Tate's variety.

105 mm. They agree in every respect with typical examples of the species in the Museum collection. One specimen, a male 77 mm. in size, is, however, abnormal, in so far as the basal process of the uropod of one side has a large spine arising from near its base. The spine runs outwards and somewhat backwards and bifurcates into two in its distal portion, more or less like the bifurcate process of the basal segment itself. The other uropod is quite normal, as is also the specimen itself in every other respect.

The colour of this species has been described by Schmitt, as observed by Dr. S. F. Light in living specimens. In the Indian examples, that are all preserved in spirit, the chocolate-brown and red-brown noted by Dr. Light, is not seen, but in freshly-preserved specimens the posterior margins of the last two thoracic and all the abdominal tergites are streaked with green, as are also most of the carinae on the carapace and the submedian and the intermediate carinae of the abdominal somites. The median carina of the telson and the bases of the lateral spines are also green. The patch at the proximal end of the median carina of the telson appears to be, as remarked by Komai, a very constant character of the species. The tips of the bifurcate process of the uropod are pink in comparatively fresh examples.

Squilla interrupta has a wide range of distribution over the Indo-Pacific region, having been recorded from several localities from Formosa to the Persian Gulf. Its occurence in the brackish waters at Talé Sap[1], Siam, is noteworthy.

Squilla wood-masoni Kemp.

1913. *Squilla wood-masoni*, Kemp, *Mem. Ind. Mus.* IV, pp. 74-76, pl. v, figs. 63-65.
1926. *Squilla wood-masoni*, Hansen, *Siboga Exped. Rep.* XXXV, p. 12.
1927. *Squilla wood-masoni*, Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, p. 320.

I refer to this species one female specimen about 80 mm. long, collected by the "Lady Fraser" at the Sandheads in May, 1928. It agrees closely with the type-specimens of the species in the Indian Museum collection. A few minor differences are, however, seen when the specimen is compared with Kemp's description of the species. In the Sandheads example the anterior lateral process of the fifth thoracic somite, though shorter than in the allied species *S. oratoria*, with its variety *inornata* and *S. interrupta*, is proportionately longer than it is shown in Kemp's figure 63. Further, the lobe on the outer face of the longer spine of the bifurcate process of the uropod is also better developed than is shown by Kemp. In most of the examples of this species in the Museum collection, including a number of type-specimens also, the anterior process of the fifth somite and the lobe of the bifurcate process of the uropod, however, show a condition very similar to that in the specimen from the Sandheads[2]. The anterior bifurcate portion of the median carina of the carapace is, as stated by Kemp, obsolete in this

[1] Kemp, *Mem. As. Soc. Bengal* VI, p. 297 (1918).

[2] Three examples of this species from Singapore, that I have examined for the Raffles Museum, also differ from Kemp's description and figures in these particulars.

species, though in some cases traces of it are observable, and in almost all the specimens examined there is a narrow and fairly deep depression between the anterior limbs.

The single female specimen collected by the Siboga Expedition and referred by Hansen, with some reservation, to the present species shows a close resemblance to the Sandheads example, as also to a large number of other specimens in the Museum collection, and there does not appear to be any doubt about its specific identity. In one respect, however, the Siboga example differs from the Indian specimens ; a small, but quite distinct, median point on the anterior margin of the ophthalmic somite is present in all the Indian examples that I have seen, whereas in the specimen examined by Hansen it is said to be absent.

Squilla wood-masoni closely resembles *S. oratoria*, with its variety *inornata*, and *S. interrupta*, but can be easily distinguished from these with the help of the characters mentioned by Kemp, especially by its shorter and broader carapace.

Squilla wood-masoni is a fairly common species in the Indian waters. According to Kemp it is distributed " over an area ranging from Hong-kong and the Australian Coast to the Persian Gulf, Aden and Zanzibar." Komai has recorded the species from Formosa also.

Squilla raphidea Fabricius.

1913. *Squilla raphidea*, Kemp, *Mem. Ind. Mus.* IV, pp. 88-92, pl. vii, fig. 77.
1927. *Squilla raphidea*, Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, p. 323.

I refer to this common Indo-Pacific species 19 examples collected at the Sandheads. Of these only 2 are males and 17 females ; in size they range from 106 to 280 mm.

Squilla raphidea has been recorded from a large number of localities from Japan to the east coast of Africa. It occurs very commonly in the Indian coastal waters.

Komai has described the colour of fresh specimens.

Squilla annandalei Kemp.

1913. *Squilla annandalei*, Kemp, *Mem. Ind. Mus.* IV, pp. 92, 93, pl. vii, figs. 78, 79.
1921. *Squilla annandalei*, Kemp and Chopra, *Rec. Ind. Mus.* XXII, p. 307.

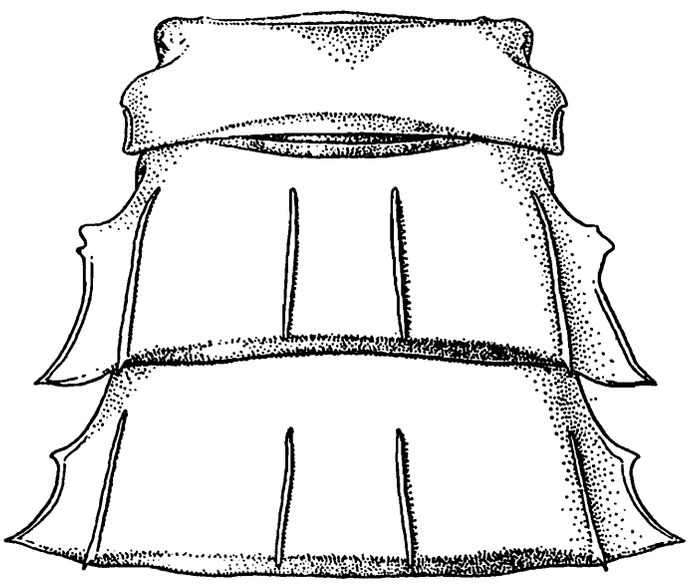
Squilla annandalei appears to be a somewhat rare species. Kemp recorded four examples of it from the Gulf of Martaban, Sunier[1] two from the Java Sea, and Kemp and I one from the Mergui Archipelago. All these specimens were obtained at depths varying from 30 to 67 fathoms. I refer to this species one more example from the Sandheads, collected at a depth not exceeding 20 fathoms.

C 1656/1	Sandheads, mouth of the River Hughli.	" Fraser ", 22. iii. 1923.	1♀, 96 mm.

The specimen from the Sandheads agrees in all particulars with Kemp's account of the species, as also with named examples in the

[1] Sunier, *Contrib. Faune Indes Neerland*, IV, p. 70 (1918).

Museum collection. The anterior lateral process of the sixth thoracic somite is, as mentioned by Kemp, prominent and acute in this species, but there appears to be a tendency for this to become secondarily bilobed. In two of the specimens from the Gulf of Martaban in the Museum collection there are slight indications of this bilobing visible; on one side of each of these specimens the anterior lateral process of the sixth somite has a minute projection on its anterior face, while on the other side of one of these, two small lobes can be somewhat indistinctly made



TEXT-FIG. 2.—*Squilla annandalei* Kemp.
Dorsal view of fifth, sixth and seventh thoracic somites of specimen from Sandheads.

out. In the example from the Sandheads there are two distinct lobes seen on the left side, while on the right also a minute lobe can be made out on the anterior edge of the lateral process.

The colour of the species has been briefly described by Kemp. The posterior borders of the last three thoracic and all the abdominal somites are prominently edged with dark brown. This is clearly seen in the type-specimen, as also in one or two other examples in the collection. The dark transverse patch, sometimes broken into four separate spots, on the second abdominal somite, and the two black spots near the proximal edge of the telson are very characteristic of the species.

Squilla annandalei is known from the Java Sea, Mergui Archipelago, Gulf of Martaban, and mouth of the Hughli River.

Lysiosquilla maculata (Fabricius).

1913. *Lysiosquilla maculata*, Kemp, *Mem. Ind. Mus.* IV, pp. 111-116, pl. viii, figs. 86-91.
1926. *Lysiosquilla maculata*, Hansen, *Siboga Exped. Rep.* XXXV, p. 18.
1927. *Lysiosquilla maculata*, Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, p. 330.
1932. *Lysiosquilla maculata*, Bigelow[1], *Bull. Mus. Comp. Zool. Harvard* LXXII, pp. 169-173.

I refer to this species two male examples from the Sandheads, measuring 117 and 142 mm. in length. They agree in every detail with

[1] For references subsequent to the publication of Kemp's memoir in 1913 Bigelow's work may be consulted.

Kemp's description of the species and also with named examples in the Museum collection.

Monod[1] and Bigelow have suggested that the single male individual on which Kemp[2] based his variety *sulcirostris* probably represents only an abnormal individual of the typical form. Kemp gives two important characters by which his variety may be distinguished from typical examples of *L. maculata.* The rostrum in the variety " is triangular, widest at the base, and is produced to a much sharper point than in typical *L. maculata* ", also in the anterior part it has " on each side a sharply-defined and deep groove running parallel to the lateral margin " Also the dactylus of the raptorial claw has eight teeth instead of 9-11 that characterise the *forma typica.* Both these characters, especially the shape of the rostrum, appear to be somewhat variable in specimens of *L. maculata.* In a male example from off the Atlantic Coast of Africa, examined by Monod, and referred by him to Kemp's variety, the rostrum is more or less like that of *sulcirostris*, but the dactylus has 11 teeth. In the nine specimens from Samoa and Honolulu, seen by Bigelow, the rostrum shows a considerable range of variation (p. 171, fig. 9-A, 9-B), from a shape more or less like that of a typical *L. maculata* to almost the shape of *sulcirostris.* The number of teeth on the dactylus also varies in most specimens from 9 to 11, though in one large female there are only eight short, stout teeth. It seems likely, therefore, that these two characters, as suggested by Monod, vary independently.

I have taken this opportunity to re-examine all the specimens of *L. maculata* in the collection of the Indian Museum, with special reference to the shape of the rostrum and the number of teeth on the raptorial dactylus. Most of the specimens have 10 or 11 teeth, but the rostrum shows a considerable range of variation from a typical condition as figured by Kemp to a shape almost like that seen in Kemp's variety. In some specimens with a rostrum like that of *sulcirostris*, faint grooves can also be made out on either side of the median carina. The shape of the rostrum approaching the *sulcirostris*-type is, as already suggested by Bigelow, seen in most of the male specimens only. It may, however, be noted that in no specimen of the typical form in the Museum collection is the shape of the rostrum exactly like that in the variety, in so far as in the latter the greatest breadth of the rostrum is at the base, while in the *forma typica* the rostrum is broadest a little in advance of the base. In the single specimen seen by Monod, as also in those examined by Bigelow, the rostrum is not widest at the base. The rostral grooves are also much better developed in the variety than in any of the examples of the typical form that I have examined.

Komai[3] has recently obtained two male specimens from Japan that appear to agree exactly with Kemp's description of *sulcirostris.* The rostrum in these specimens is, according to Komai, triangular in shape, has well-defined grooves, and there are only eight spines on the dactylus of the raptorial claw. The association of the *sulcirostris*-type of rostrum with a smaller number of teeth on the claw is noteworthy.

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[1] Monod, *Bull. Sci. Nat. Maroc* V, pp. 88, 89, pl. xxi, figs. B-F (1925).
[2] Kemp, *Mem. Ind. Mus.* IV, p. 116, pl. viii, figs. 92, 93 (1913).
[3] Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, pp. 330, 331 (1927).

It thus seems fairly evident that even though the shape of the rostrum alone may not afford a very satisfactory character for the separation of Kemp's variety from typical examples of *L. maculata*, the association of the shape of rostrum as seen in Kemp's type-specimen of the variety *sulcirostris* with the presence of only eight teeth on the raptorial dactylus should be sufficient to distinguish between the two. The only specimen of *L. maculata* with eight teeth on the raptorial claw so far recorded is one of the two females from Samoa mentioned by Bigelow, but in this the rostrum is of the typical kind.

The pale eye-spot in the dark band close to the anterior margin of the carapace, mentioned by Bigelow and shown in his figure 9, is present in the Sandheads specimens and the other examples in the collection of the Indian Museum. In other respects the colour of my examples agrees with Kemp's account of it.

Lysiosquilla maculata is one of the most widely distributed species of Stomatopoda. It has been recorded from a large number of widely-separated localities over the entire Indo-Pacific area, and has also been collected in one or two places in the Atlantic.

Lysiosquilla acanthocarpus Miers.

1913. *Lysiosquilla acanthocarpus*, Kemp, *Mem. Ind. Mus.* IV, pp. 120-122.
1927. *Lysiosquilla acanthocarpus*, Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, pp. 231, 232.
1930. *Lysiosquilla acanthocarpus*, Komai and Tung, *Annot. Zool. Japon.* XIII, pp. 14, 15.

One specimen of this somewhat uncommon species has been collected at the Sandheads. It agrees in almost every particular with Kemp's excellent and very detailed description of the species, as also with examples named by him and preserved in the collection of the Indian Museum.

Komai in 1927 referred two female examples to the present species. Of these, one from Formosa is said to "agree very well with Kemp's description of the species," though it had seven teeth on the raptorial dactylus, instead of six as is generally the case in the species. The other example from the Pacific coast of Honsyu shows still greater differences. The rostrum is broader than long, there are nine spines on the raptorial dactylus, the tubercle at the base of the dactylus, so characteristic of the species, is obsolete, and there are four marginal spines on one side of the telson and three on the other. From a consideration of these characters it appears almost certain that the Pacific coast specimen at least cannot be referred to Miers' species. The examples from Suruga Bay, a male and a female (Komai and Tung), are referable to the present species.

Excluding the Sandheads example, there are at present nine specimens of this species in the Museum collection; of these there are two males and seven females. In one specimen only are there five teeth on each raptorial dactylus; all the others have six on each side. The rostrum is always longer than broad, the prominence at the base of the dactylus is well marked, and the marginal teeth of the telson are quite normal in number and disposition.

The Sandheads example is a female and is registered as under :—

C 1657/1	Sandheads, mouth of the River Hughli.	"Lady Fraser", April, May. 1932.	1 ♀, 81 mm.

Lysiosquilla acanthocarpus has been recorded from Formosa, North Australia, Penang, Andaman Islands, both the coasts of Peninsular India and Trincomali in Ceylon. Komai's record of the species from the Pacific coast of Japan is, as mentioned above, somewhat doubtful.

Squilla kempi (Schmitt).

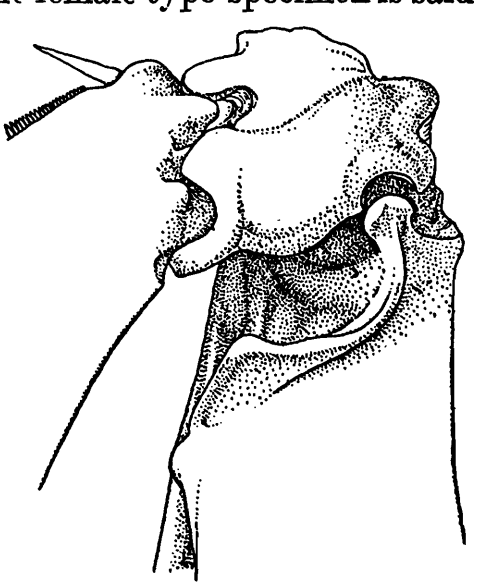
1913. *Squilla oratoria*, Kemp, *Mem. Ind. Mus.* IV, p. 69, pl. v, fig. 56 (*partim*)[1].
1927. *Squilla oratoria*, "*Southern forms*," Komai, *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) III, pp. 315, 316.
1929. *Chloridella kempi*, Schmitt, *Lingnan Sci. Journ.* VIII, pp. 135-140, pls. xvii, xviii.

Schmitt, in the paper cited above, described *Squilla kempi* as a new species from Dr. S. F. Light's collection from Southern China, basing the specific name on the manuscript name given by Dr. Light in honour of the famous carcinologist and monographer of the Indo-Pacific Stomatopoda—Dr. Stanely Kemp. The Light collection, as remarked by Schmitt, was first submitted for study to Dr. Kemp, who was at the time connected with the Indian Museum, but on account of other engagements Dr. Kemp could not complete the work before his taking over charge of the "Discovery" Expedition, and the collection was, therefore, sent on to Dr. Schmitt with all the notes, etc., that Dr. Kemp had already made on the collection. From his correspondence with Dr. Light in this connection, copies of which are on the files of the Zoological Survey of India, it appears that Kemp, in view of the differences that exist between typical specimens of *Squilla oratoria* and those of the form later described by Schmitt as *S. kempi*, had at first suggested calling the latter as a variety of the former, but on reconsideration he agreed with Dr. Light that the two were specifically distinct. Through the generosity of Dr. Light the Indian Museum possesses two fine specimens, a male and a female, of Schmitt's species, and a careful examination of these has shown that the form is undoubtedly distinct from *S. oratoria*, and the differences between the two warrant a specific distinction. Komai had also noticed these differences, but he separated examples of *S. kempi* from typical specimens of *S. oratoria* under the name of "Southern forms." Komai's description of this form agrees almost exactly with the specimens of *S. kempi* that I have examined, as also with Schmitt's description of the species, except for the fact that Komai has omitted to make a mention about the presence or absence of a spine on the outer inferior angle of the raptorial merus. A re-examination of Komai's specimens on this point, as suggested by Schmitt, would be very desirable, though it is likely that the spine would be found wanting. In the same way the two examples from Amoy, belonging to the British

[1] Only the examples from Amoy, described by Kemp, are referable to Schmitt's species.

Museum, that Kemp provisionally included in his account of *Squilla oratoria* are also most likely referable to Schmitt's species; the correspondence referred to above indicates that Kemp, while in England in 1923, re-examined these specimens and found them to be identical with the form later designated as *S. kempi*[1].

As pointed out by Schmitt, *Squilla kempi* resembles *Squilla oratoria* in several important respects, but the table given by Komai for the separation of his "Northern" and "Southern" forms of *S. oratoria* can be very usefully employed for distinguishing the two species. I give below a somewhat amplified table for separating these rather very similar species. The characters mentioned in my table are all included in Schmitt's excellent description of the species, and have been verified by me with the help of the specimens in the Indian Museum collection. The statement made by Dr. Light regarding the anterior bifurcation of the median carina of the carapace—mentioned in Schmitt's description of the species—is not borne out by an examination of the Indian examples. The median carina is entire in both the specimens that I have seen, but in view of Dr. Light's observations, and of the fact that in one of the two Amoy specimens included in Kemp's account of *S. oratoria*, the anterior bifurcation is said to be interrupted, it is likely that there is some variation in the species in this respect. Further the carina on the raptorial carpus also appears to show a considerable range of variation. Out of the three specimens examined by Schmitt only the right carpus of the female type-specimen is said to have three sharply-



TEXT-FIG. 3.—*Squilla kempi* Schmitt.
Raptorial carpus showing the dorsal carina with three weak lobes.

marked tubercles on the dorsal carina; in four of the six carpi examined the tubercles are weak and lobiform; while in the remaining sixth carpus —the left one of the single male example—there is a continuous ridge, more or less like that of the variety *inornata* (=*perpiensa*) of *S.*

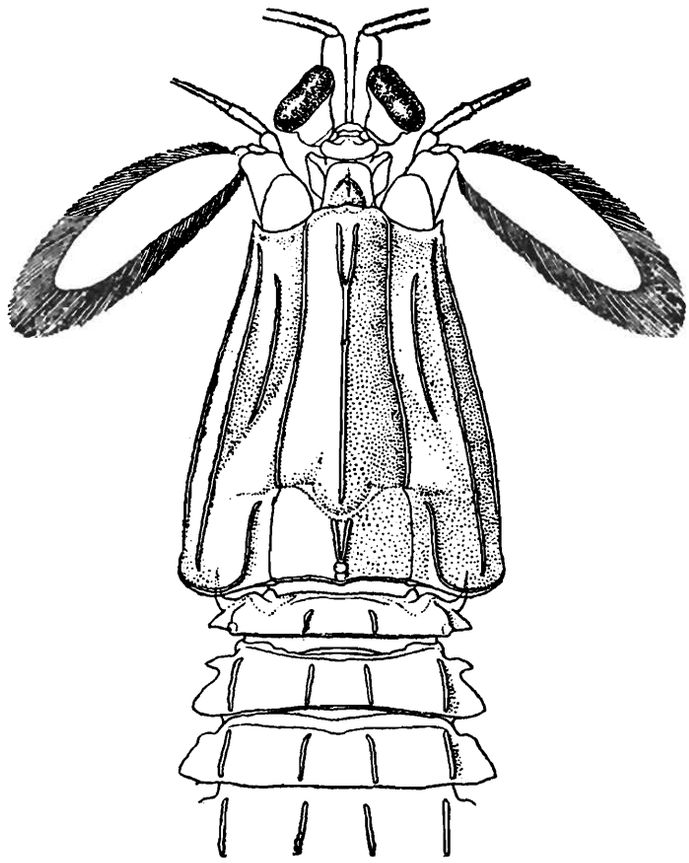
[1] Since the above went to the press, Dr. Kemp has, at my request, once again examined these specimens and compared them with Schmitt's description of the species. He has no doubt that the Amoy specimens are referable to *Squilla kempi* and that the latter is a valid species. He has also sent me a list of characters which distinguish *S. kempi* from *S. oratoria*; most of these characters are included in the table on p. 33. I am very grateful to Dr. Kemp for the valuable help he has given me in this matter.

oratoria, but with three small thickenings or tiny tubercles on the outer side. In the two specimens seen by me also the carina of the raptorial carpus shows variation. In the male the carina is broken up into three distinct, though weak, lobes, but in the female it is a more or less continuous ridge, with very slight indications of three lobes; the ridge terminates abruptly before reaching the anterior margin. It thus appears that typically the dorsal carina of the raptorial carpus is broken up into three somewhat weak tubercles or lobes, but sometimes these are more or less obsolete and the carina is practically entire, as in the variety *inornata* of *Squilla oratoria*. It must, however, be pointed out that in typical examples of *oratoria* also the carina, as mentioned by Kemp, shows a considerable amount of variation, and that in large specimens only the tubercles are well developed.

Squilla oratoria	**Squilla kempi**
1. Dorsal surface of carapace and abdomen strongly punctate.	1. Dorsal surface of carapace and abdomen sparsely and finely punctate, smooth and shining when dry.
2. Median carina of carapace entire.	2. Median carina of carapace entire, rarely interrupted at base of anterior bifurcation.
3. Anterior spine on lateral margin of fifth thoracic somite somewhat curved, the tip pointing forward and outward; posterior spine somewhat bluntly pointed.	3. Anterior spine on lateral margin of fifth thoracic somite more strongly curved, the tip pointing forward and slightly inwards; posterior spine sharply pointed (text-fig. 4).
4. Anterior lobe on lateral margin of sixth thoracic somite only slightly shorter than posterior and more or less parallel-sided.	4. Anterior lobe on lateral margin of sixth thoracic somite much shorter than posterior, and somewhat triangular in shape.
5. Anterior lobe of seventh thoracic somite acutely produced.	5. Anterior lobe of seventh thoracic somite only a minute rounded projection.
6. Lateral process of eighth thoracic somite acutely pointed anteriorly.	6. Lateral process of eighth thoracic somite rectangular or a little obtuse anteriorly.
7. Outer inferior angle of merus of raptorial claw with a distinct spine or a sharply-pointed angle.	7. Outer inferior angle of merus of raptorial claw bluntly rounded, without an indication of a spine or a sharply-rounded angle (text-fig. 3).
8. Dorsal carina of raptorial carpus with 3-5 sharp tubercles.	8. Dorsal carina of raptorial carpus generally with 3 weak tubercles or lobes; tubercles or lobes sometimes almost obsolescent.
9. Carina on ventral surface of telson behind anal opening strongly developed.	9. Carina on ventral surface of telson behind anal opening rather feebly developed.
10. No distinctive colour markings on dorsal surface of body; first segment of exopodite of uropod uniformly light green.	10. In spirit specimens second and fifth abdominal somites with conspicuous patches of dark colour; distal part of first segment of exopodite of uropod also coloured black.

Squilla kempi occurs commonly along the coasts of Southern China, Dr. Light having collected numerous specimens of it at Hoihow, Amoy, Dodd Island Lighthouse, Chin Bay and several other localities. It has also been recorded from Foochow (Kellog, see Schmitt), Formosa, Ryûkyû, Kyûshû, Inland Sea and some other places (Komai). It is commonly taken in the company of *Squilla oratoria*, but does not extend to the northern range of this species. It lives in shallow water and prefers a muddy bottom. Dr. Light, in his correspondence with Dr. Kemp,

gives some very interesting particulars about this species. Mentioning the localities from which he collected *S. kempi*, Dr. Light says : " I have



TEXT-FIG. 4.—*Squilla kempi* Schmitt.

Dorsal view of the anterior part of the body. The lateral lobes of the fifth, sixth and seventh thoracic somites are very clearly seen.

large series of the typical form (*S. oratoria*) from the same localities and there are no signs of intergradations either in color or in the morphological characters noted. The typical form is generally lighter in color and without any striking color blotches, while the variety under description (*S. kempi*) is generally browner and has a broad dark chocolate brown band across the centre of the 2nd abdominal segment and an area of the same color marking the distal part of the inner segment of the exopodite of each uropod. It also seems to be typically larger, broader and heavier." Further on he states : " The proportional frequency of the different species of *Squilla* in a collection made from the debris from the shrimp nets[1] at Tsimei may be of interest to you. Of the 233 specimens collected 5 were *S. scorpio*, 2 were *S. faveolata* (more common in Amoy Harbour[2]; apparently more of an open sea species), 16 were *S. interrupta* and the remaining were *S. oratoria* s. lat., of which 133 were *S. oratoria*, var. *perpensa*, 43 typica, 21 doubtful or intermediate and 13 of the variety I propose to consider *S. kempi*. The individuals of the last named form reach the largest size of any taken here as yet. They are readily separable at once from any other of the local forms by color and it seems to

[1] Schmitt has given a description of these nets, *vide* p. 129 of the paper cited above.

[2] There are in the Indian Museum three specimens of *S. faveolata* from Amoy Harbour presented by Dr. Light.

me by shape. The posterior end of the abdomen gives the impression of being considerably broader and flatter than in the case of *S. oratoria typica* and var. *perpensa.*"

In the Indian Museum there are two specimens from Tsimei :—

C 955/1 From nets at Tsimei, China. S. F. Light. 1 ♂, 1 ♀, 125 and 88 mm.

As in *S. oratoria* the mandibular palp is well developed and epipodites are present on the first four thoracic limbs. The corneal index in the male specimen I have seen is about 4·8, while in the other example the cornea is proportionately broader and the index is about 3·9 only.

Squilla indica Hansen.

1926. *Squilla indica,* Hansen, *Siboga Exped. Rep.* XXXV, pp. 12-14, pl. i, figs. 4*a*-4*c*.

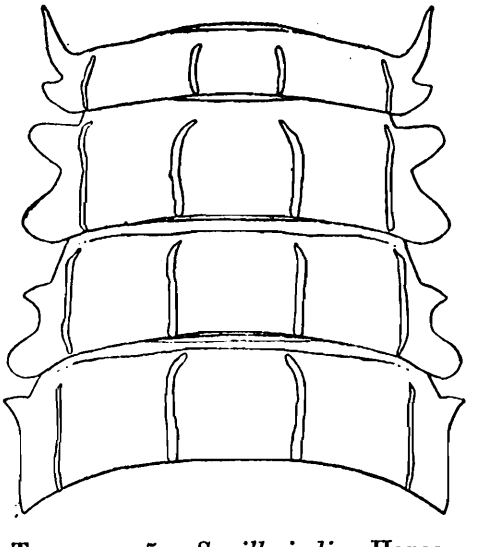
As pointed out by Hansen, *Squilla indica* belongs to the group of species in which *S. oratoria* and its allies are placed, but that it can be easily separated from the other species in this group is clear from Hansen's description of it.

One female specimen, collected by the R. I. M. S. " Investigator " in the Nicobar Islands, agrees very closely with Hansen's description of the species, and is no doubt referable to it.

The median carina of the carapace is altogether obsolete in the anterior part (considerably more so than in Kemp's *Squilla wood-masoni*). The anterior breadth of the carapace at the level of the base of the antero-lateral spines is markedly less than half the length of the carapace and rostrum, and is even less than the length of the carapace alone.

The rostrum is as described by Hansen, and is distinctly longer than its breadth at the base. No trace of the median keel is visible in my specimen.

There are seven well-developed, long and slender spines (including the terminal one) on the dactylus of the raptorial claw, but the rounded



TEXT-FIG. 5.—*Squilla indica* Hansen.
Dorsal view of the first four exposed thoracic somites.

protuberance near the base of the dactylus is hardly conspicuous. The outer margin of the dactylus is evenly rounded. The carina on the dorsal

aspect of the carpus is as described by Hansen, and the inferior margin of the merus is angular and does not carry a spine.

The lateral processes of the first three exposed thoracic somites differ considerably from those of the allied species. The anterior lateral process of the fifth somite is a narrow elongated, spine-like structure, strongly curved at the base in a forwardly direction and running more or less parallel with the long axis of the body. The posterior process of this somite is a somewhat large truncate lobe, with the anterior angle rather acute. The margin of the sixth somite has two subequal rounded lobes, the anterior pointing somewhat forwards and the posterior directed slightly backwards. The anterior lobe of the seventh somite is shorter than the posterior, is considerably narrower and is acutely pointed; the posterior lobe is broadly rounded. The 8th somite is provided with a fairly large, more or less acutely-pointed anterior lobe (text-fig. 5).

The carinae on the last three thoracic and all the abdominal somites are well developed. There are four pairs of carinae on the first five abdominal somites and three pairs on the sixth, but most of these do not end in spines. The spines on the abdominal carinae are disposed as follows:—

Carinae.	Abdominal somites.
Submedian	5, 6.
Intermediate	5[1], 6.
Lateral	5, 6.
Marginal	5.

It is thus seen that only the fifth and sixth abdominal somites bear any spines, the other somites being altogether unarmed.

The telson has a high and sharp median carina, with a slight proximal notch, and an overhanging spine at the distal end. The carina, or its posterior spine, does not extend up to the posterior margin of the telson. The marginal teeth are well developed, but on one side the submedian and the intermediate are broken. The marginal denticles are, as observed by Hansen, acutely pointed and somewhat spine-like. On the unbroken side of the telson there are six submedian denticles, of which the proximal five have acute tips—in one or two even bifid; the sixth is very much larger than the others and is broadly rounded. There are eight sharply-pointed intermediate denticles, and one large lobe-like process on the inner side of the intermediate tooth. The single lateral denticle is also acutely pointed. The ventral surface of the telson is smooth.

The peduncular segment of the outer uropod is provided with a single spine near its articulation with the exopodite, while the outer margin of the basal segment of the exopod has seven, somewhat flattened and curved movable spines, the last of which is very much larger than the rest and overhangs the basal part of the terminal segment. The inner spine of the bifurcate process is much longer than the outer spine, and has its inner margin serrate. The lobe on the outer margin of this spine is, as described by Hansen, uncommonly large, and the margin anterior to the lobe is deeply concave.

---

[1] The spine is clearly seen only on one side of this segment.

The colour of the single specimen I have seen is not characteristic, but on the posterior half of the carapace there is a dark patch in the median line. The posterior margins of the last two thoracic and all the abdominal somites are narrowly edged in dark-brown, and there are traces of a patch of the same colour on the dorsal surface of the second abdominal somite. The distal segment of the exopod of the uropod is dusky, and the distal half of the endopod is also similarly bordered.

In the Indian Museum example the mandibular palp is altogether absent, and epipodites are present on the first two thoracic limbs only ; the epipodite at the base of the raptorial claw is of about the same size as that of the first leg.

The specimen in my collection has yielded the following measurements :—

Total length of body	41 mm.
Length of carapace (excluding rostrum)	9·7 mm.
Breadth of carapace at antero-lateral angles ..	4·0 mm.
Length of rostrum ..	1·8 mm.
Breadth of rostrum	1·3 mm.
Breadth of cornea	2·5 mm.
Corneal index	3·88
Breadth of telson	7·2 mm.
Median length of telson (excluding spines)	6·4 mm.

The Indian example is registered as under :—

C 1658/1	Octavia Bay, Nancoury Harbour, Nicobars ; 13 fathoms.	Marine Survey, 23 Nov., 1922.	22, 1 ♀, 41 mm.

Besides the specimen now recorded, the species is known from two examples only, a male and a female, collected by the Siboga Expedition, one in the Celebes Sea and the other in the Buton Straits. Of the two specimens, the male shows some slight differences from the female, which is considered as the type. The Indian example agrees closely with the Siboga female.

Though *Squilla indica* has a superficial similarity with the species in the *nepa* group of the genus, it differs from all the members of this group in a number of very well-marked characters. The total suppression of the mandibular palp, the presence of epipodites on two legs only, and the possession of seven (or eight) teeth on the raptorial dactylus clearly separate this species from all its allies ; while the longer and more sharply-pointed rostrum, the different shape of the lateral processes of the thoracic somites and the uncommonly large lobe on the outer face of the longer spine of the bifurcate process of the uropod are all characters that are not shared by any other species in this group. Besides these characters the absence of spines at the posterior extremities of the dorsal carinae on the first four abdominal somites is noteworthy. Within the group, *Squilla indica* shows some resemblance to *S. wood-masoni* Kemp in the, more or less, total suppression of the anterior part of the median carina of the carapace, and the lateral processes of the free thoracic somites show a slight similarity to those of *S. interrupta* Kemp, but the differences enumerated above far outweigh these isolated points of resemblance. *S. indica* thus appears to be a species of very uncertain affinities. The total suppression of the mandibular palp, and the great

reduction in the number of epipodites on the thoracic legs are very remarkable characters of this species, in so far as these characters are not found in any other species of the *nepa* group.

The only Indo-Pacific species known[1] to me that have epipodites present on the first two legs only are *S. gibba* Nobili, *S. supplex* Wood-Mason and *S. scorpio* Latreille (with its variety *immaculata* Kemp), and all these except Wood-Mason's species are further characterized by the total absence of the mandibular palp. *S. indica* also, as stated above, shows these characters, but there does not appear to be any close similarity or affinity between it and the species mentioned above[2].

The facts stated above lend support to the opinion that Kemp and I[3] expressed in 1921 regarding a reduction in the number of epipodites in the genus *Squilla*. From an examination of the large collections preserved in the Indian Museum we were led to remark " that a reduction in the number of epipods has taken place in the genus *Squilla* on several different occasions and that the character, though possessing a definite specific value, cannot be used as a guide to the affinities of the different forms. In this it resembles the mandibular palp, which appears and disappears throughout the genus, apparently without any regard to the affinities of the species concerned."

Squilla lirata Kemp and Chopra.

1921. *Squilla lirata*, Kemp and Chopra, *Rec. Ind. Mus.* XXII, pp. 303-307.

Two fine female specimens of this apparently rare species are in the present collection. They were collected at Singapore by Mr. M. W. F. Tweedie, and have been presented to the Indian Museum by the Raffles Museum, Singapore. The species was described in 1921 from two examples only from Singapore, and does not appear to have been recorded so far from any other locality. The present specimens agree closely with the published description, as also with the type-specimens preserved in the Indian Museum.

The two specimens examined in 1921 differed from one another in the nature of the anterior bifurcation of the median carina of the carapace. In one example the whole of the carina from the mid-dorsal pit to the anterior margin of the carapace was bifurcated, but it was distinctly interrupted at the point of bifurcation ; in the other specimen the carina was entire, and was bifurcated for little more than half the distance between the dorsal pit and the anterior margin. In the two specimens now examined the carina is entire, there being no interruption at the point where it divides, but the bifurcation extends for the whole distance from the mid-dorsal pit to the anterior end of the carapace.

Another point worth mentioning is that in the specimens described in 1921 the first two abdominal somites were found to have only three

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[1] Kemp and Chopra, *Rec. Ind. Mus.* XXII, p. 298 (1921).

[2] Bigelow has recently described another species, *S. mauiana*, sp. nov. in which only two pairs of epipodites are present and the mandibular palp is also absent. This species was taken in the Hawaiian group of islands in the Pacific, and does not appear to show any marked similarity or affinity to *S. indica*. For a description of this species see Bigelow, *Bull. Mus. Comp. Zool. Harvard* LXXII, pp. 177-182 (1932).

[3] Kemp and Chopra, *Rec. Ind. Mus.* XXII, p. 299 (1921).

carinae between the submedians, thus differing from examples of *S. multicarinata* White, in which there are five such carinae. In the specimens now before me the position is slightly different. On the first somite there are three well-marked carinae between the submedians, as described before, but on either side of the middle one of these three, there is a short low carina on the posterior half of the segment. These low carinae are better developed on the second somite, where they extend on about the three-fourths of the dorsal surface, and though lower than the principal carinae are still quite sharp and are distinctly seen.

Apart from these minor differences the specimens agree in every respect with the types.

C 1659/1 Siglap, Singapore. M. W. F. Tweedie, June, 1933. 2 ♀♀, 73 and 74 mm.

The species is so far known from Singapore only.

Pseudosquilla ciliata (Fabricius).

1913. *Pseudosquilla ciliata*, Kemp, *Mem. Ind. Mus.* IV, pp. 96-100.
1932. *Pseudosquilla ciliata*, Bigelow, *Bull. Mus. Comp. Zool. Harvard* LXXII, pp. 152-160.

One specimen is referred to this species :—

C 1660/1 Southern Point, Outram Island, Andamans. Marine Survey, 5.ii.1924. 1 ♂, 22 mm.

The specimen, though small and with a carapace length (excluding the rostrum) of only 4·2 mm., shows practically all the characters of the adult. The submedian carinae on the telson are, however, absent, and the copulatory organs appear to be somewhat weakly developed. The teeth on the raptorial dactylus are quite large. The postero-lateral angle of the fourth abdominal somite bears a short, but distinct spine. In all other characters the specimen agrees exactly with Kemp's description of the species. A small but distinct spine, as mentioned by Bigelow, can be seen on the distal end of the raptorial propodus. The presence of this spine has not been noticed by Kemp, but it is present in all the specimens in the Indian Museum collection.

The species has a wide range of distribution in the Indo-Pacific and the Atlantic Oceans.

Pseudosquilla oculata (Brullé).

1913. *Pseudosquilla oculata*, Kemp, *Mem. Ind. Mus.* IV, pp. 102, 103.
1921. *Pseudosquilla oculata*, Edmondson, *Occ. Papers Bishop Mus.* VII, pp. 290-292.
1925. *Pseudosquilla oculata*, Edmondson, *Bull. Bishop Mus.* XXVII, pp. 59, 60.
1932. *Pseudosquilla oculata*, Bigelow, *Bull. Mus. Comp. Zool. Harvard* LXXII, pp. 165-168.

One specimen from the Maldive group of islands agrees closely with the published descriptions of the species, as also with the small and somewhat broken example from the Society Island in the Museum collection.

C 1661/1 Reef on the north side of Fuladu Island, Goifurfehendu Atoll, Maldives. Marine Survey, 10.xii.1923. 1 ♂, 42 mm.

The specimen has a carapace length of 10 mm.

P. oculata, like the preceding species, is also known to live both in the Atlantic and the Indo-Pacific Oceans. In the latter its range extends from the Society Islands, Hawaii and Samoa to Mauritius on the western side.

Gonodactylus glabrous Brooks.

1913. *Gonodactylus glabrous*, Kemp, *Mem. Ind. Mus.* IV, pp. 167-169, pl. ix, fig. 113.

1932. *Gonodactylus glabrous*, Bigelow[1], *Bull. Mus. Comp. Zool. Harvard* LXXII, pp. 127-135.

Bigelow, in the paper cited above, gives a very detailed description of the species, mentioning a number of points that had been overlooked by most of the previous workers. The specimens of this species mentioned by Kemp, as also those now examined by me, agree with Bigelow's account in almost every particular, though in a variable species like the present, there are bound to be considerable differences of a minor importance between specimens from different localities. The sexual dimorphism, pointed out by Bigelow, is very clearly seen in the large number of specimens of both sexes that I have examined. In young examples the sculpturing of the sixth abdominal somite and of the telson is similar in both sexes, but in specimens of about 40 mm. and over, one can almost invariably separate the two sexes by examining the keels on the telson and on the last abdominal somite. Another point that I have noticed is that whereas in young examples and in most of the female specimens examined all the six keels on the last abdominal somite and the three central keels on the telson end in spines, in large males generally these spines are missing. In the latter case in several specimens a careful examination reveals signs of the breaking off of the spines, but it is noteworthy that this breaking off seems to take place more often in the males than in the females. I have examined 68 large specimens from our collection with special reference to the presence or absence of these spines, and they have yielded the following results :—

Out of 49 females examined
- 30 had spines well developed,
- 13 had spines present on some keels, broken or missing on others, and
- 6 had no spines.

Out of 19 males examined
- 2 had spines well developed,
- 4 had spines present on some keels, broken or missing on others, and
- 13 had no spines.

The uropods in *G. glabrous* present certain peculiar features, which have been fully described by Bigelow. The specimens examined by me closely agree with Bigelow's description. The tip of the dactylus of the raptorial claw is also as described and figured by Bigelow, though a breaking off of the tip is noticeable in several instances.

[1] This paper contains a complete synonymy since the publication of Kemp's monograph.

The colour in comparatively fresh specimens is as described by Kemp. The minute spots on the telson, in addition to those on the sixth somite, that Bigelow has mentioned, are also clearly seen in a large number of the Indian examples.

Gonodactylus glabrous has a very wide range of distribution over the Indo-Pacific area. Kemp and Bigelow have given a number of localities from which the species has been recorded. It is known to occur in the Mediterranean Sea also. The additional specimens now seen by me are mostly from localities already mentioned by Kemp.

One female specimen from the Andamans is abnormal in so far as the median carina of the telson is much shorter than the others, the first submedian carinae are arched and converging posteriorly approximate toward one another in the median line, so as to partly encircle the median carina. The bifurcate process of the uropod of one side in this example is also abnormal, as the spines are very short, and the lobe or tooth at the base of the outer spine is missing. This is perhaps a result of regeneration. The process of the other side is quite normal.

Gonodactylus pulchellus Miers.

1913. *Gonodactylus pulchellus*, Kemp, *Mem. Ind. Mus.* IV, pp. 177-179, pl. x, figs. 117, 118.
1921. *Gonodactylus pulchellus*, Kemp and Chopra, *Rec. Ind. Mus.* XXII, p. 311.
1921. *Gonodactylus pulchellus*, Tattersall, *Journ. Linn. Soc.* (Zool.) XXXIV; pp. 364, 365.
1926. *Gonodactylus pulchellus*, Hansen, *Siboga Exped. Rep.* XXXV, p. 38.
1929. *Gonodactylus pulchellus*, Hale, *Trans. Roy. Soc. S. Australia* LIII, p. 34.

With the help of the table given by Kemp [1] in 1915, *G. pulchellus* can be easily distinguished from *G. trispinosus, G. nefandus* and other allied species, with which it has a very close resemblance. I refer to this species a single specimen collected in the Nicobars in 1922. Even after immersion in spirit during all these years the dark patches of colour mentioned by Kemp in 1913 can be clearly made out.

C 1662/1	East coast of Camorta Island, Nicobars.	Marine Survey, 23.x.1922.	1♀, 34 mm.

The species is known from a number of localities in the Indo-Pacific region, from North Australia to East Africa.

Gonodactylus nefandus Kemp.

1913. *Gonodactylus nefandus*, Kemp, *Mem. Ind. Mus.* IV, pp. 179, 180, pl. x, figs. 119, 120.
1921. *Gonodactylus nefandus*, Kemp and Chopra, *Rec. Ind. Mus.* XXII, p. 311.
1926. *Gonodactylus nefandus*, Hansen, *Siboga Exped. Rep.* XXXV, p. 32.

I refer to this species two specimens that agree closely with Kemp's type-specimens in the Indian Museum.

C 1663/1	Nancoury Harbour, Nicobars: 19-30 fathoms.	Marine Survey, 19.xii.1922.	1♀, 33 mm.
C 1664/1	Ross Channel, Port Blair, Andaman Islands : 2-9 fathoms.	S. W. Kemp, March, 1921.	1♀, 28 mm.

[1] Kemp, *Philippine Journ. Sci.* X, p. 185 (1915).

G. nefandus is known to occur commonly in the Andamans; it has also been recorded from the Arakan coast, Malacca Straits, the Philippines (Kemp and Chopra), and a number of localities in the Indian Archipelago (Hansen).

As stated by Kemp, the spirit specimens of *Gonodactylus nefandus* have no characteristic colouration, there being only a dark and inconspicuous mottling on the carapace and abdomen. Fresh examples, however, appear to have a very striking colour. Dr. Kemp has described in his Station Book the colour of the specimen that he collected in the Ross Channel, Andamans (C 1664/1) as follows:—

"Carapace and abdomen dorsally mottled with brown and red on a pale ground, the brown mottling tending to form two transverse bars on carapace. Last somite and telson dull green. A white spot at base of central rostral spine. Antennular flagella red. Thoracic appendages bright red terminally, except raptorial claw, which is mottled at base, with white terminal segments. Uropods red at base, verging to sulphur yellow or orange yellow distally."

No trace of this colouring can now be seen on this specimen, only an inconspicuous mottling, chiefly on the abdominal somites, being left after long preservation in spirit. On the first abdominal somite a short and broad transverse band can be seen in this example, as also in a number of other specimens.

Gonodactylus glaber [1] (Lenz).

1913. *Gonodactylus glaber*, Kemp, *Mem. Ind. Mus.* IV, pp. 182, 183, pl. x, fig. 121.

1915. *Gonodactylus glaber*, Kemp, *Philippine Journ. Sci.* X, p. 186.

I refer to this rather rare species two specimens collected by the R. I. M. S. "Investigator" in the Nicobars. These agree closely with Kemp's excellent and detailed description of the species, as also with named examples in the Museum collection. The differences noticed by Kemp between his smaller and larger examples are seen in my specimens also. In the smaller example the antero-lateral borders of the carapace are less acute, the eye-stalks are proportionately longer, and the feeble corrugations on the margins of the lateral lobes on the dorsal surface of the telson, that Kemp noticed in the larger example examined by him, cannot be seen.

The greatly reduced inner spine of the bifurcate process of the uropod is very characteristic of this species. The peduncular segment of the uropod terminates in a large dorsal spine, that overhangs the proximal part of the basal segment; the latter also has a small spine on its outer distal angle. Further, the bosses on the telson have a very characteristic appearance, as also the notch near the posterior end of the outer margin of the raptorial dactylus. The inner edge of the dactylus is minutely serrate.

[1] Tattersall's *Gonodactylus glaber* [*Journ. Linn. Soc.* (Zool.) XXXIV, p. 362 (1921)] is not included in this synonymy; it is really *G. glabrous* (Brooks).

C 1665/1	Camorta Island (west of Jetty), Nicobars.	Marine Survey, 13.xii.1921.	1 ♂, 27 mm.
C 1666/1	Small Coral and Rock Reef on west side of Camorta, north of entrance to Expedition Harbour, Nicobars.	Marine Survey, 3.iii.1922.	1 ♀, 18 mm.

The following measurements are taken from the two Nicobar specimens, and the large female examined by Kemp :—

	C 1665/1	C 1666/1	2690/7
Total length of body	27·0	18·0	26·0
Length of carapace and rostrum ..	8·3	5·0	7·7
Length of carapace	6·2	3·5	5·6
Breadth of carapace	4·5	3·0	4·2
Length of eye-stalk	2·4	1·9	2·3
Length of telson	4·1	2·4	4·0
Greatest breadth of telson	5·0	3·0	4·6

The smaller specimen from the Nicobars is more or less uniformly pale in colour, but the other example has brownish chromatophores scattered all over its surface, with a tendency, as mentioned by Kemp, to form bands or patches on the posterior part of the carapace, on the sixth and seventh thoracic, and on the first, fourth and fifth abdominal somites.

The species has previously been recorded from the Andamans, Ceylon and Zanzibar. Kemp recorded it from the Philippines also, but the specimens from that locality differed so much from the Indian Museum examples that he had previously examined, that he had some doubts regarding the identity of the Philippine specimens.

A STUDY OF THE FAUNA OF THE SALT LAKES, CALCUTTA.

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I. Introduction and general account of the area.

The study of the fauna of the Salt Lakes and the Deltaic region of the Ganges has from time to time attracted the attention of zoologists in Calcutta, and sixty-four years ago Stoliczka (1869) gave an account of certain researches that he had made during the previous year or two. No systematic study of this region was, however, undertaken till Annandale in 1907 commenced his studies of the "Fauna of Brackish Ponds at Port Canning, Lower Bengal" which were published in the *Records of the Indian Museum* in the next two years.

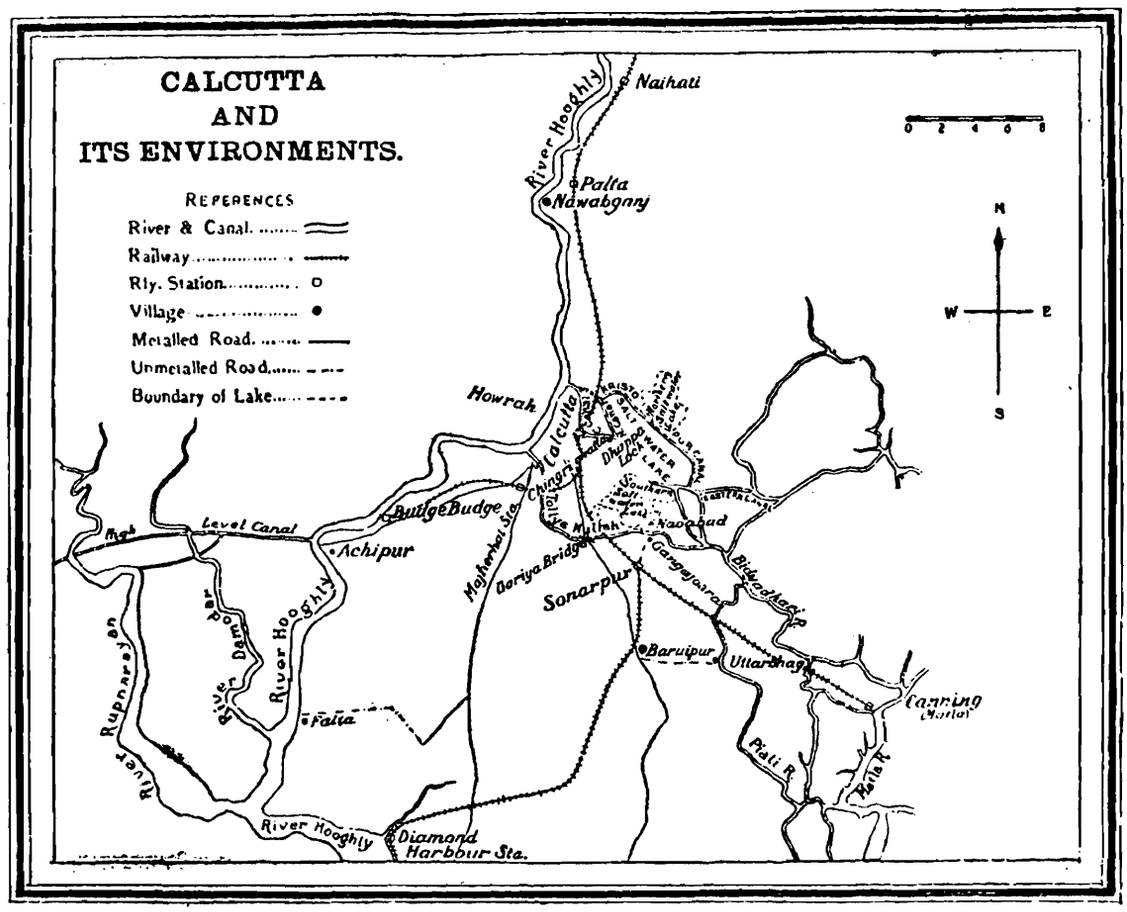
In 1926 the Zoological Survey of India established a camp, on the Kristopur Canal at the north end of the Salt Lakes, for a short period for the purpose of investigating the fauna of this area and the work was repeated in 1928.

During the past few months, owing very largely to the great curtailment in the field activities of the Survey rendered necessary by the drastic retrenchment that has been imposed on the Survey by the Government as part of their economy campaign, advantage has been taken of the close proximity of these Salt Lakes to our Headquarters in the Indian Museum to study some of the problems presented by the fauna of this area.

The Geography of the Area.

The Salt Lakes and their associated canal system are bounded on the west by the Hooghly River and are in direct communication with it by means of the Chitpore canal that leaves the Hooghly about two miles above Howrah Bridge. This canal after a course of about a mile bifurcates into two, one branch running towards the south for about two miles before it turns east past Chingrighatta and runs to Dhappa Lock; the other branch runs first east and then south-east for about a mile and then again bifurcates, the main line of the canal being continued towards the south-east to meet the Chingrighatta canal just north of Dhappa Lock; the second branch is termed the Kristopur canal and runs at first towards the north-east, but after a course of about two miles bends round and runs in a south-easterly direction for about six miles, finally turning southwards and entering the Bamonghatta canal at right angles about a mile east of Bamonghatta Lock. Dhappa Lock and Bamonghatta Lock are connected by the Central Lake channel, into which the sewage and storm-water outflow from Calcutta is poured, and this channel continues past Bamonghatta Lock to join the Bidyadhari River, that at Port Canning becomes continuous with the Matla River. Running roughly from east to west across the southern side of the Salt Lake area is Tolly's Nullah that connects the Hooghly and

Bidyadhari rivers, leaving the former about two miles below Howrah Bridge and entering the latter about four miles below Bamonghatta



TEXT-FIG. 1.—Plan of Calcutta and its environment showing the localities in which collections were made.

Lock. About three miles below the entrance of Tolly's Nullah into the Bidyadhari River a branch from the latter takes off and runs south ; this branch is known as the Piali River or *Piali naddi*. Alongside most of the canals and separated from them by banks of varying height, occasionally perforated by sluice-gates, are wide expanses of water forming the Lakes proper and connected with these lakes are numerous smaller pools and creeks that at some time of the year are directly connected with the rest of the expanse of water or with the canals but that during the dry season become isolated and, finally, in the majority of instances completely dry up. The level of the water in the canals is carefully maintained by means of the locks in order that they may serve as highways for water-borne traffic. To the south of the canal system lies a wide expanse of low-lying country that during the rains is flooded with water that is slightly brackish, and this area is for the most part utilised for the growing of a particular variety of rice. As these areas dry up during the hot season the surface mud gradually hardens and becomes covered with a fine white salt deposit ; and eventually it cracks into numerous separate blocks.

For several years past there has been a steady change in the conditions existing in and the general character of some of the rivers in Lower Bengal, and these changes have had a profound effect on the Salt Lakes and the associated streams and thus indirectly on the general character

of the fauna of certain areas. For our knowledge of the river changes we are indebted largely to Mr. A. N. Banerjee (1931), the River Surveyor to the Corporation of Calcutta, who has recently compiled an account of these changes. The chief changes, with which we are concerned in our study of the Salt Lakes and their fauna, are those that affect the rivers of the Matla Series, especially those of the Central Lake Channel and the Bidyadhari River, and to a less extent those that affect the Piali and Matla Rivers on the south and south-east and the Hooghly River on the west.

The Bidyadhari River "is fed by tides of two important rivers, *viz.*, the Piali and the Matla, the former joining the Bidyadhari about five miles below Shamookpota, and the latter, which may be called the outfall of the Bidyadhari, below Port Canning" (Banerjee, p. 7). The upper reaches of the Bidyadhari river commence at Dhappa Lock, that at one time formed the connection between the Salt Lake Canal system and the Central Lake Channel. Regarding the changes that have taken place in the past in this region Banerjee gives a series of figures of the range of the tide at Dhappa in the dry season, commencing as far back as 1830; I have tabulated these figures below:—

Year.	Range of Tide.	High water.	Low water.
1830 .	2·53 ft.	1·50 (average)	—1·25 (minimum).
1865 . .	4·67 „	4·90 „	—4·30 „
1881 *	11·0 „	7·40 (maximum)	—3·60 „
1901	12·58 „	8·75 „	—3·83 „
1920 .	8·34 „	9·17 „	0·83 „

* In this year Dhappa Lock was constructed.

As the above figures clearly show, there was a steady increase in the amplitude of the tide up to 1901, but shortly after this date there was a decrease, that was due in the main to the rise in the height of low water. Banerjee (p. 8) goes on to point out that "the present-day condition of the tide is totally different. The tidal impulse is steadily receding off the upper reaches of the Bidyadhari and during neap tides the tidal impulse does not even reach up to Bamonghatta now-a-days." He further states that "the Bidyadhari generally carries fine sand and as such its section, according to some authorities should be narrow and deep and should approach more closely the section of those carrying clear water. The river lost this characteristic in about the year 1904" These changes are attributed to the silting up of the rivers and canals, and an attempt was made to counteract the gradual silting up of the river and especially of the upper reaches and the Central lake channel by dredging, but it was found that the process of silting was so rapid that the dredger was unable to keep pace with it and the attempt was given up. The final effect of the silting is very clearly seen in its effect on navigation. "The Bidyadhari formed a part of the inner and outer boat routes for a long time. Although the first reach of the Central Lake Channel and the Bidyadhari between Dhappa and Shamookpota was not navigable by boats of heavy drafts, yet boats of all

drafts could ply the Bidyadhari at high water upto the year 1915. Now-a-days only boats of 6″ to one foot drafts can come up to the Dhappa Lock and that only during high spring tides of monsoons " (*loc. cit.*, p. 11). Since this was written an earth ' bund ' has been constructed across the channel just to the south of Dhappa Lock, so that this is now useless and is rapidly silting up.

A study of both the Piali River and the Matla River indicates that here too we can trace the slow progress of deterioration. Banerjee (*loc. cit.*, p. 14) remarks " very little is known about the past history of the Piali, but there is no doubt about the fact that the river is deteriorating and that several shoals have formed, which were not in existence before. The rise of high and low water lines, though slow, is steady. The river presents a flat " U " section almost throughout its length and the bed consists of fine sands with occasional hard lumps of blue clay, the typical soil of the Sundarbans" One of the causes of this deterioration is said to be the artificial interference caused by the construction of the Piali Bridge : " the choking effect of this bridge has been very clearly demonstrated by the fact that there is frequently an afflux of more than 14 inches within a length of 1,000 feet near the bridge, and the scouring depression below the bridge is over 50 feet at low water against 5 to 10 feet at 1,500 feet up or down the bridge" Banerjee concludes that " The river being embanked on both sides has no available natural spill area for it, and, therefore, depends for its conservancy partly on its own reservoir capacity and partly on the Bidyadhari, which being situated at its head-end provides a good spill area for it. It is, therefore, very probable that the upper portion of the Piali river will die as soon as the Bidyadhari is dead " (*loc. cit.*, p. 13).

The Matla River is a tidal creek that runs up from the sea as far as Port Canning and " now-a-days it is no longer a river mouth and is mainly kept open by the ebb and flow of the tides. The Central Lake Channel and the Bidyadhari are practically dependent for their conservancy on the tides of the Matla and Piali rivers " (*loc. cit.*, p. 15). The first survey of the Matla river was made in 1839 and since then it has been resurveyed in 1855 and in 1862-63 ; up to this date there appears to have been little or no change, but still more recently in 1913 sections taken in the vicinity of Port Canning show that deterioration has set in, the tidal range has increased from 12 feet to about 21 feet within the last 60 years and the Government embankments are now 8 feet high against " slight embankments " on the banks of the Matla in 1853.

On the western side of the Salt Lake area the Hooghly River is the most important water-way. Banerjee notes that, " as appears from the past history of the river, it showed signs of severe deterioration in or about the year 1880, when it was suggested to excavate a channel from the port of Calcutta to the Channel Creek, a distance of 47 miles, or, as an alternative, to improve the river Matla for the purpose of the navigation of sea-going vessels and abandon the Hooghly in favour of the former estuary for serving the port of Calcutta." The intake of the river water for the purpose of supplying filtered water to the city of

Calcutta is situated at Palta, a distance of 14 miles above Howrah Bridge and is said to be at a distance of fifteen miles above the region of salinity. At a distance of some two miles below Howrah Bridge and, therefore, close to the region of salinity, though apparently still within the area of fresh water, Tolly's Nullah takes off from the Hooghly river and runs eastwards across to the Bidyadhari river, which it enters in the vicinity of Shamookpota. It has been stated that the western part of the Nullah represents the old course of the Ganges and it is sometimes referred to as the Adi-Ganga; the canal cut by Tolly in 1775-77 connected two natural channels and it was hoped that it would serve as a water-way for river craft between the Bidyadhari and the Hooghly, thus rendering unnecessary the long detour through the Sundarbans. Unfortunately, owing to the meeting of the tides from opposite ends of the Nullah there has been continual silting up of the channel and the construction of a sluice near Shamookpota to counteract this by regulating the flow of water has only resulted in further injury to the Bidyadhari River.

Much of this process of deterioration is probably the natural result of the formation and subsequent sea-ward extension of the deltaic area at the mouths of the Ganges and Brahmaputra Rivers, but there are certain subsidiary causes that have been operative in the particular area under discussion. One of these causes is the construction of various engineering works, such as bridges, canals, etc., that have interfered with the free flow of water. Another cause is the deposition of silt that is carried up the rivers and streams during the flood tide and is deposited at slack water; the effect of such silting is very clearly shown by the observations on the Bidyadhari River, which are quoted by Banerjee (*loc. cit.*, Appendix 1, p. 8). "The section close to and just below Bamonghatta shows very clearly what has been going on since 1883, as given below:—

Year.	Lowest below M. S. L.	Rise.
1883	—59·69 feet	1·45 ft. per annum
1904	—29·7 ,,	
1912	—12·0 ,,	2·21 ,,

The rate of silting is, therefore, doubled since 1904. The total deposit of silt in the last 30 years amounts to 53·7 feet." The immediate cause of this deposition is ascribed, at any rate in part, to "the method of fish culture in the Salt Lakes; at the present day water is fed into and drained from these fisheries only occasionally during the year. Most of the spill channels are kept closed with cross dams, so that the water in the river is almost entirely prevented from spilling in the lakes.. If the free spill had not been cut off a vast volume of water would return on the ebb tide and would prevent the deterioration of the river advancing at so rapid a rate. Another cause is the reclamation of the Salt Lakes for paddy cultivation, which reduces the area of the spill"

General Considerations.

The chief zoological interest in a brackish-water area such as that under consideration lies in the fact that it forms one of the main highways by which certain constituent elements of the marine fauna of the Indian Seas can encroach on and finally establish themselves in fresh water. Researches in other parts of the world have shown conclusively that this penetration of marine organisms into fresh water is steadily going on and especially so in those areas where large rivers enter the sea through a deltaic area. Among the best known regions of this type are the estuarine regions of the great Amazon River of South America and the Congo River of Africa that open into the Atlantic Ocean; the Yangtse-Kiang River of China that opens into the Pacific Ocean; and, finally, the combined estuary of the Ganges and Brahmaputra Rivers that opens through the Gangetic Delta into the Indian Ocean. It seems possible that one predisposing factor in the gradual penetration of marine forms into fresh water is to be found in the general conditions that prevail around the mouths of these large rivers in tropical or temperate areas. The continuous outflow of large quantities of fresh water into the sea, and especially into an area such as the Bay of Bengal which is surrounded by extensive coastal barriers on three sides, necessarily results in a very considerable lowering of the salinity of the surface water, especially at the head of the Bay, down to a depth of as much as 50 fathoms, while in and just after the rainy season in the vicinity of the estuary itself the salinity of the surface-water may be as low as 1020. Thus all the inhabitants of such a coastal region must at certain periods of the year be able to withstand such a drastic change in their surroundings that a further change into brackish-water such as that found in the pools at Port Canning, in which the water varies from 1020 during the hot weather period of the year to 1012 at or soon after the end of the rainy season, is more easily borne than would be the case were these animals not already to some extent acclimatised.

Another possible factor is the great increase in the available food supply that is found in the region of such estuaries. The flow of the river brings down with it great quantities of vegetable débris and detritus, that are available as a source of food, and at the same time large quantities of nutrient salts, derived from the land, are poured out into the sea and result in a very large increase in the Diatom flora, that in turn also serves as a food supply for the smaller marine organisms. In this connection it is interesting to note the account of the flora of the Salt Lakes given by Biswas (1927) and another of the algal flora of the Chilka Lake by the same author (1932). In this latter account Biswas notes that the cryptogamic flora, consisting in the main of algae, is to be found " growing luxuriantly and profusely on rocks, boulders and pebbles on the fore-shore, on the leaves and stems of submerged plants", and he further calls attention to the fact that in many instances there appears to be a very close association between certain animals and this algal flora.

Murray (1908) has pointed out that " it is a well known fact that the clayey matter which is carried to the ocean by rivers is nearly all precipitated to the bottom on contact with the salt-water, but a small

quantity of siliceous matter is apparently still retained in salt water of relatively low salinity. Diatoms and Radiolaria, the shells and skeletons of which are chiefly composed of silica, flourish in the surface waters of the ocean where there is reason to believe clayey matter is more abundant than elsewhere. .In the tropical Indian and Pacific Oceans, where the greatest rainfall occurs and where much detrital matter is carried into the ocean from the land; and off the mouths of great rivers both in the tropics and elsewhere, there is a great development of silica-secreting organisms in the surface waters" In consequence of these natural conditions there is a very rich and varied fauna in the estuarine regions of the tropics, and as Annandale (1922) has pointed out " we find not only a fairly large fauna of brackish-water which cannot be regarded either as strictly marine or as strictly fluviatile, but also considerable number of marine types that have established themselves permanently in fresh water far above the influence of the tides" In this paper Annandale has given an extremely interesting account of the euryhaline fauna of the brackish-water or deltaic region of the Ganges and he points out that the " Deltaic tract is tidal, even in places where the water is practically fresh, and is inhabited mainly by animals of marine origin"

With regard to the majority of the various groups of the animal kingdom that are represented in the deltaic fauna there is little to add to the account that Annandale has given. Scattered throughout the Reports on the Fauna of the Chilka Lake (*Mem. Ind. Mus.*, Vol. V, 1915-24) are numerous references by various authors to the fauna of the Gangetic Delta, and Annandale and Kemp in their introduction (*loc. cit.*, p. 15) point out that in this locality " there is also a marked faunistic element that appears to have originated actually in estuaries or backwaters subject to great changes of salinity and temperature. This element is also well represented in the Gangetic Delta and in lagoons on both coasts of Peninsular India " They further add that " perhaps the most striking feature of the biology of the permanent residents in the Lake is the extraordinary power of individual adaptability to physical changes in environment that most of them possess. It seems strange to find a Rhizostomous medusa or an Oxystome crab living in lacustrine conditions, but it is even more remarkable that individuals of such forms are able to flourish at one season in fresh water and at another in salt water"

For convenience of reference I have given below such lists of species in the various animal groups that are known to occur in the Gangetic Delta as I have been able to collate.

Several species of fresh water sponges appear to have been able to accustom themselves to life in brackish-water and Annandale (1911) mentions the following as having been found in the brackish-water pools at Port Canning and in the Salt Lakes :—

Spongilla lacustris subsp. *reticulata.*
Spongilla alba var. *bengalensis.*
Spongilla crateriformis.

In addition *Spongilla carteri* is at the present day common in those parts of the Salt Lakes that lie to the north and east of the Kristopur

canal. Annandale (1922) has also recorded the presence of "the cosmopolitan parasite *Cliona vastifica*, which is not uncommon in oyster-shells in the lower part of the Delta".

Among the Coelenterata Annandale (1915, p. 69 ; 1922, p. 147) records the occurrence of the following forms :—

Dicyclocoryne filamentata.
Annulella gemmata.
Asenathia piscatoris.
Bimeria fluminalis.
Diadumene schillerianum.
Pelocoetes exul.
Phytocoetes gangeticus.
Campanulina ceylonensis.
Acromitus rabanchatu.
Virgularia sp.

The last species has since been identified by Abdul Hamid (1931) as *V gracillima*. In the great majority of species the evidence indicates that they are able to withstand changes of specific gravity that have a range from 1000 to 1025·75 ; *Pelocoetes exul* has been taken in water having a specific gravity ranging from 1005 to 1010 and *Dicyclocoryne filamentata* in water having a specific gravity of 1015.

In the Polyzoa Annandale (1915) has recorded the occurrence of seven species from brackish-water in the Gangetic Delta, namely :—

Membranipora bengalensis.
Membranipora hippopus.
Victorella bengalensis.
Bowerbankia caudata.
Loxosomatoides colonialis.
Barentsia gracilis.
Alcyonidium mytili.

This last species was taken attached to a Sea-snake (*Enhydrina valakadien*) at Diamond Harbour on the Hooghly river.

TheAnnelida have been reported on by Southern (1921) and Fauvel (1932), who have dealt with the Polychaeta ; and Harding (1920) and Kaburaki (1921) have described the Leeches. In the former group, seventeen species are now known to inhabit the delta, namely :—

Matla bengalensis.
Spio bengalensis.
Eteone barantollae.
Lycastis indica.
Nereis glandicincta.
Nereis chingrighattensis.
Nereis cricognatha.
Nereis cavifrons.
Dendronereis aestuarina.
Dendronereis heteropoda.
Polydora (Carazzia) kempi.
Nephthys oligobranchia.
Barantolla sculpta.

Sabellaria spinulosa var. *alcocki.*
Sabellaria pectinata.
Mastobranchus indicus.
Potamilla leptochaeta.

In the Oligochaeta the only reference that I can find to any aquatic form is to *Branchiura sowerbyi*, that was taken together with *Lycastis indica* in the Belliaghatta Canal near Calcutta.

Among the Hirudinea *Placobdella emydae* occurs in the area under review. A single Echiuroid, namely, *Thalassema branchiorhynchus*[1] has been recorded by Annandale and Kemp (1915) from the Canal System of the Salt Lakes. Von Linstow (1907) has described a Nematode, *Oncholaimus indicus*, from brackish-water in Port Canning.

In the Arthropoda examples of the King Crab, *Carcinoscorpius rotundicauda*, are to be found well up the river Hooghly and even in water that is actually fresh. In the Entomostraca Gurney (1906, 1907) has recorded the presence of the following species :—

Copepoda.

Mesocyclops (*Mesocyclops*) *leuckarti.*

Cladocera.

Ceriodaphnia rigaudi.

and Annandale has reported the presence in brackish-water tanks at Port Canning of the Cirripedes :—

Balanus amphitrite.
Balanus patellaris.
Chthamalus stellatus.

Two species of Amphipoda have been taken in the Ganges and the surrounding deltaic region, namely *Ampelisca pusilla* and *Quadrivisio bengalensis*. The presence of the former is a matter of some considerable surprise, since it was originally described from the deep waters of the Arctic seas (*vide* Chilton, 1921). Two species of Mysids have been recorded by Tattersall from the Salt Lakes and the Gangetic delta, namely, *Potamomysis assimilis* and *Mesopodopsis orientalis.*

As regards the Decapod Crustacea de Man (1908) has identified the following species from brackish-water pools at Port Canning ;

Scylla serrata.
Tympanomerus stapletoni.
Pachygrapsus propinquus.
Varuna litterata.
Metaplax dentipes.
Leander sp.
Palaemon (*Eupalaemon*) *lamarrei.*
Palaemon sp.

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[1] *T. branchiorhynchus* is not a purely brackish-water species ; a large number of specimens of this interesting form were collected by Dr. F. H. Gravely from the mud-flats at Chandipore, Orissa, in 1917, and a specimen without proboscis in 1919 ; *vide* Prashad *Rec. Ind. Mus.* XVI, p. 399 (1919). Annandale proposed the new generic name *Anelassorhynchus* for this interesting group of species of *Thalassema* (Annandale, 1922, p. 148). *Editor.*

Caradina sp.
Caradina propinqua.
Caradina nilotica var. *bengalensis.*

Kemp (1915, 1917) reports that the following species are known from brackish-water of the Gangetic Delta :—

Pachygrapsus propinquus.
Varuna litterata.
Scylla serrata.
Neptunus pelagicus.
Clibanarius padavensis.
Palaemon mirabilis.
Penaeus carinatus.
Penaeus indicus.
Penaeopsis monoceros.
Penaepsis brevicornis.
Parapenaeopsis sculptilis.

Examples of the genera *Metaplax* and *Hymenicus* are common in the Delta. Alcock (1895-1900) has recorded the occurrence of *Hymenicus wood-masoni* and *H. inachoides* from Port Canning and *Metaplax intermedia* and *M. crenulata* from the Sundarbans and the mouth of the Ganges. In addition he records the following species from the Gangetic Delta and the mouth of the Hooghly river :—

Doclea ovis.
Doclea japonica.
Doclea gracilipes.
Doclea tetraptera.
Calappa lophos.
Matuta victor.
Matuta lunaris.
Leucosia craniolaris.
Philyra globosa.
Philyra globulosa.
Arcania septemspinosa.
Dorippe facchino.
Scylla serrata.
Charybdis (*Goniohellenus*) *ornata.*
Conchoecetes artificiosus.
Pinnoteres mactricola (from *Mactra violacea*).
Metapograpsus messor.
Byxidognathus fluviatilis.
Sesarma tetragonum.
Metasesarma rousseauxii.

To this list may be added a species of *Gelasimus*, probably *Gelasimus annulipes*, that has succeeded in establishing itself in a colony on the left bank of the Hooghly river at Diamond Harbour. Annandale (1922, p. 151) has pointed out that " the greater number of the euryhaline crabs belong to the family Grapsidae and to such genera as *Sesarma, Varuna, Grapsus* and *Ptychognathus*..... Next to the Grapsidae

in point of numbers come the Ocypodidae, most of which belong to the subfamily Scopimerinae." In this subfamily *Tympanomerus stapletoni* is very common on the banks of the Hooghly river at Calcutta.[1] Among fresh water species *Palaemon lamarrei* is common in both fresh and slightly brackish water; *Palaemon rudis* is not unknown in the vicinity of Calcutta and *P. mirabilis* also occurs in the rivers of the delta. *Leander styliferus*, *L. tenuipes* and *L. fluminicola* are all known from the area. Of these three species Annandale remarks that "*L. tenuipes* is distinguished from the others by the extreme length and tenuity of its walking legs, which are no longer capable of supporting it on the bottom, but have apparently assumed the function of tactile organs. This species and *L. styliferus* are anadromous, but do not migrate inland beyond the limits of brackish water. *L. fluminicola* on the other hand is equally at home in fresh and in brackish water and is common well above the upper extremity of the delta." *Caridina nilotica* and *Caradina propinqua* are common in the vicinity of Calcutta.

In their account of the Mollusca of the Chilka Lake, Annandale and Kemp (1916) record the presence in the Gangetic Delta of the following species:—

Nassa denegabilis.
Nassa orissaensis.
Hydrobia (*Belgrandia*) *myliacea.*
Stenothyra blanfordiana.
Modiola undulata.
Clementia annandalei.
Cuspidaria annandalei.

Of these the first two and the fifth are known to be able to live in water the specific gravity of which may range from 1000 to 1026·5. Preston (1915) has reported on a small collection of molluscs that was made in the Salt Lake Canal system near Chingrighatta, and in addition to the species mentioned above he records the occurrence of:—

Nassa fossae.
Tiara (*Striatella*) *tuberculata* (=*Melanoides tuberculatus*).
Tiara (*Tarebia*) *lineata* (=*Melanoides lineatus*).
Iravadia princeps.
Assiminea francesiae.
Septaria crepidularia.
Septaria depressa.
Brachydontes emarginata.
Sinodia jukes-browniana.
Cyrena bengalensis.
Macoma gubernaculum.
Anatina induta.

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[1] Two other records of the family Scopomerinae from the Gangetic Delta, that have escaped the author, are *Dotillopsis brevitarsis* (de Man) and *Tympanomerus gangeticus* Kemp (*vide* Kemp, S.—*Rec. Ind. Mus.* XVI, pp. 335, 347, 1919). *Macrophthalmus teschi* Kemp was described from a specimen collected at Port Canning; the species is also known from the Arakan Coast and Mergui (*vide* Kemp, *op. cit.*, pp. 393-394). *Editor.*

Annandale and Prashad (1919) have still further increased our knowledge of the Molluscan fauna of the Delta and added the following species to the lists of those known from this region :—

Dostia cornucopia.
Dostia depressa.
Dostia platyconcha.
Littorina melanostoma.
Littorina subintermedia.
Littorina delicatula.
Stenothyra echinata.
Stenothyra soluta.
Bithinella miliacea.
Assiminea brevicula.
Assiminea beddomiana.
Melania (Mainwaringia) paludomidea.
Nassa ennurensis.
Nassa ennurensis var. *depauperata.*
Ringicula caeca.
Auricularia auris-judae.
Auricularia gangetica.
Auricularia translucens.
Stenothyra deltae.

True marine forms, such as

Pyrazus palustris,
Potamides (Telescopium) telescopium,

make their way up the Hooghly and other branches of the Ganges, and among the truly fresh water species that have been taken in the deltaic area and the Salt Lakes are the following :—

Amnicola orcula.
Melanoides tuberculatus.
Melanoides scabrus.
Melanoides lineatus.
Pila globosa.
Viviparus bengalensis.
Limnaea ovalis.
Limnaea luteola.
Indoplanorbis exustus.

As long ago as 1869 Stoliczka recorded the presence in the deltaic region of four species of *Onchidium,* namely :—

Onchidium typhae.
Onchidium pallidum.
Onchidium tigrinum.
Onchidium tenerum.

Eliot (1916) has recorded a single Nudibranch, *Cuthona annandalei.*

It must not be supposed that the whole of this fauna is to be found at any one place in the Gangetic Delta or even that such species as are found in a given area at one time will be found there on a subsequent

occasion. I have already sufficiently indicated the great changes that are continually going on in this region and these changes have a profound effect on the fauna, while seasonal changes may cause the appearance or disappearance of species in the course of a few weeks. This is particularly well exemplified in the behaviour of *Campanulina ceylonensis*, of which Annandale (1922, p. 152) writes " Every year the lock-gates of a certain canal on the outskirts of Calcutta are opened about April and water flows in from creeks of brackish water in the delta. Shortly afterwards the water having at the time a specific gravity of about 1008·5 at 15°C., becomes alive with the medusae of this Hydrozoon, while the minute Hydroid is to be found on every submerged brick or pile in the canal. Both generations remain abundant until the rainy season commences in June or July. Then the specific gravity of the water sinks rapidly. As it does so the medusae and hydroids become scarcer. They finally disappear when it falls to about 1006·0."

I give below a note that my colleague Dr. Chopra has kindly written on the general features of the Salt Lake area in which he and some other members of the Zoological Survey of India were working in 1926 and 1928.

Some Observations on the Salt-water Lakes near Calcutta.

" A small party of the Zoological Survey of India, consisting of Dr. H. Srinivasa Rao, Mr. Mohammad Sharif and myself was sent out in May, 1926, to take preliminary observations at one end of the Salt-water Lakes. A camp was established at Dakhindari at the north end of the Lakes and a preliminary survey, lasting over a fortnight, was carried out. Some further work was also done in February, 1928, by Dr. H. S. Pruthi and myself.

At the time of our visit, the Lake at the north end consisted of a vast stretch of shallow water, with a navigation canal, the Kristopur canal, running along the north and north-east. Though the canal had high embankments along both the banks and had no direct connection with the Lake, the latter was no doubt indirectly connected with some creeks of the Hooghly, or some other branch of the river, for the water in the Lake showed a distinct rise and fall with the tidal changes. It was also distinctly, though slightly, brackish in taste. [Water-samples were obtained to measure salinity, etc., and the results obtained have been published by Biswas (1932)].

The bottom of the Lake consisted of a black, soft mud, in places forming a bed of considerable thickness. The water at the time of our visit was rather shallow, the depth being nowhere greater than a foot or 18 inches. There was a thick growth of algae, especially near the edges. The shallowness of the water, coupled with the great abundance of soft ooze-like mud made the work of investigating the outlying parts of the Lake rather difficult.

The one great fact that forced itself on our notice was the great abundance of individuals of most of the species living in the Lakes. The number of species collected by our party was rather small, but most of these species were represented by countless numbers. The Lakes are rich feeding grounds and appear to be a preserve of a

comparatively few species that have succeeded in establishing themselves in its trying and changing conditions. Thus we saw the Gastropods, *Melanoides* sp., in the mud at the bottom of the Lake, and empty shells of the same scattered about on the shores everywhere in large quantities. Another Gastropod, *Stenothyra* sp., was also found in fairly large numbers in company with *Melanoides* in the bottom mud. Similarly the Grapsid crab *Varuna litterata* was extremely common in this part of the Lake, living under half-dried mud, and its holes could also be seen on the soft shores in many places. Excepting for the Portunid *Scylla serrata*, which was quite scarce at the time of our visit, *Varuna litterata* was practically the only crab collected by our party, but it occurred in amazingly large numbers. The prawn *Palaemon lamarrei* was also common and its young ones, mixed with examples of *Caridina nilotica* were often collected in the plankton. In the same way the Mysid, *Mesopodopsis orientalis* (Tattersall), was seen swimming in vast shoals and every haul of the tow-net brought up large quantities of this. Smaller shoals of another mysid, *Potamomysis assimilis*, were also seen occasionally. An actinian, *Phyocoetes gangeticus*, was collected in large numbers in localised patches opposite Kristopur.

The canal a few yards to the north of the Lake had a fauna considerably different from that of the Lake itself. Here the current is directly connected with the main channel of the river and the level of the water, which is considerably higher than that in the Lake, is controlled by locks for purposes of navigation. The bottom, at the time of our visit, consisted of a hard sticky clay, but was considerably less muddy than that of the Lake. Here the Bivalve *Modiola striatulus* was found living at the bottom in vast numbers, mixed with comparatively fewer examples of another Lamellibranch, *Cuspidaria* sp.

Very few living *Melanoides* were collected in the canal, though they were extremely abundant in the Lake a few yards away. Another Gastropod, *Nassa* sp., was met with in the canal, but in comparatively small numbers. Living in the company of these molluscs at the bottom of the canal a long-stalked actinian was dredged out in large numbers and Polychaete worms were also quite common in this habitat. A small medusa, *Campanulina ceylonensis*, was found in the canal in such large numbers that a small tow-net kept in the water for a minute or so was always brought up containing a large quantity of a jelly-like substance that was a more or less pure culture of this medusa. Though this medusa was extremely abundant in May, 1926, I do not remember having collected any individuals at the time of our second visit in February, 1928. The crab *Varuna* was common here also and was found digging holes along the banks, but *Palaemon lamarrei* did not appear to be as common in the canal as it was in the Lake. *Caridina nilotica* appeared to be the predominant form here, as also another *Palaemon*, probably undescribed so far. The Mysid *Mesopodopsis* was collected in the canal also, but in much smaller quantities."

The Salinity of the Water.

No systematic examination of the specific gravity and salinity of the water in the Salt Lakes and the associated canals and pools has been

carried out, though from time to time certain observations have been made on this subject.

Stoliczka (1869) had a sample of water from certain ponds at Port Canning analysed and the result showed a salinity of 12·87 per mille. Annandale (1907) also examined the salinity of the water of the pools during his researches on the fauna of Port Canning and he found the salinity to vary from 12·13 per mille at the end of the rainy season to 20·22-23·16 in the month of March, at which time the water of the edge of the Matla river at Port Canning possessed a salinity of 25·46. In the rainy season the water in the pools according to Stoliczka became absolutely fresh.

From time to time observations have been carried out on the salinity of the water in various parts of the Salt Lakes and the connected waterways and most of these have already been published by Biswas (1932); and these show clearly the degree of variation in the salinity that has occurred in past years. For reference I have given below the data for four different areas in the Salt Lake system :—

Area.	1928.	
	April.	July.
Paran Chaprassi's Khal	15·48	5·97
Salt Lakes proper	14·99	4·87
Bidyadhari River	13·73	5·17
Dhappa Lock	13·53	4·67

From this it is clear that the highest salinity occurs during the month of April or early May, before the first rains come to dilute the water, and that the lowest salinity occurs during or just at the close of the monsoon rains in August. One would thus expect to find that a sample of water from any given area taken in the months of December-January would show a salinity intermediate between the two extremes. I have already called attention to the manner in which the Bidyadhari and other rivers of this region are silting up and thus preventing the salt water from extending upwards into the Salt Lake system. I have data covering several years for only a single area :

Locality.	1926.	1928.	1932-33.	1933.
	May.	February.	December to February.	March.
Z. S. I. Station 2 ; Canal off Lansdowne Jute Mill and Dakhindari village. Salinity per mille	18·48	9·60	2·20	3·60

A certain amount of this difference between different years may be attributable to seasonal changes, but as the total variation is considerably greater than that shown in the table given above, and as in March the salinity should be nearing its maximum, one is, I think, justified in reaching the conclusion that the water of this region is gradually becoming more and more fresh.

Structural Modifications.

Annandale has pointed out that "in only one species (the sponge *Laxosuberites lacustris*) can structural modification be correlated with changes in the chemical composition or specific gravity of the medium in which the animal lives. In this respect adaptation is usually physiological rather than anatomical. In most species anatomical adaptations are correlated with life in very soft mud or extremely muddy water such as are found in the bed and streams of a slow flowing silt-laden river", and he draws attention to Kemp's account (1917) of the fauna of the Matlah River and the superficial resemblance exhibited by many of the animals to the fauna of the deep-sea, especially as regards colouration and the elongation of the appendages. Among the Copepoda, however, as I have shown (*vide* Sewell, 1919, p. 17), there is in one group, namely in the genus *Acartia* and especially in the sub-genus *Acartiella* a progressive elongation of the abdominal portion of the body as we pass from the marine forms, such as *Acartia southwelli*, through the brackish-water species *Acartia chilkaensis* and *Acartia* (*Acartiella*) *major* and *minor*, to the fresh-water species *Acartia* (*Acartiella*) *tortaniformis*. Again, in the change from salt to brackish water we meet with a change in the character of the 2nd antenna in the sub-genus *Acartiella*. It seems probable that both these changes are directly correlated with a diminution in the specific gravity of the medium in which these forms are living and a consequent necessity for a greater development of the surface area in proportion to the total body mass.

Although in the main actual structural modifications are not discoverable, immigration into these estuarine regions and especially into the shallow water areas of the ponds and pools of the Salt Lakes has necessitated very great and striking changes in the physiology and the general habits of many of the inhabitants. This is particularly striking in the case of some of the fish and crabs, and my colleagues Drs. S. L. Hora and B. N. Chopra will deal with this in their accounts of the different groups: suffice it to remark here that owing to the liability of these shallow waters to extreme evaporation, by which they are at first converted from a condition of saline muddy water, through that of a thick mud, to finally a dry cracked bed, below which is only a stratum of damp hard clay, many of the fish and some crabs have developed the power of breathing atmospheric air and at the same time have acquired the habit of burying themselves at some depth below the surface, where they can aestivate until the next rains once again fill the pools with water and enable them to return to a truly aquatic form of life; and associated with this adaptation are definite modifications in some of the fish in the gills and associated respiratory apparatus.

II. THE PLANKTON, WITH SPECIAL REFERENCE TO THE COPEPODA.

In the following pages I have attempted to put together the results obtained from the examination of a number of tow-nettings that have been taken in the Salt Lakes and the associated water-ways; for those in the upper reaches of the Hooghly river above Howrah Bridge I am indebted to Dr. Pruthi and his Assistants, while the great majority of samples from the Salt Lakes, the lower reaches of the Hooghly River, Tolly's Nullah, the Piali River and the pools at Uttarbhag have been taken by Dr. Hora. Dr. Hora has also estimated the salinity of most of the samples of water that have been collected recently.

List of stations.

1. Hooghly River; Station Naihati. 16 miles above Howrah Bridge. Fresh water.

Copepoda:
Diaptomus blanci Guerne and Richard.
Diaptomus cinctus Gurney.
Diaptomus indicus, sp. nov.
Pseudodiaptomus lobipes Gurney.
Acartia chilkaensis Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Cladocera:
Ceriodaphnia rigaudi Richard.
Moina dubia Richard.

2. Hooghly River; Station Pulta, Opposite Water-works. 11 miles above Howrah Bridge. Fresh water.

Copepoda:
Diaptomus blanci Guerne and Richard.
Diaptomus contortus Gurney.
Diaptomus strigilipes Gurney.
Diaptomus viduus Gurney.
Pseudodiaptomus lobipes Gurney.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Cladocera:
Diaphanosoma excisum var. *longiremis* Ekman.
Moina dubia Richard.

3. Hooghly River; Station Nawabganj. 10 miles above Howrah Bridge. Fresh water.

Copepoda:
Diaptomus blanci Guerne and Richard.
Diaptomus cinctus Gurney.
Diaptomus contortus Gurney.
Diaptomus orientalis Brady.
Diaptomus viduus Gurney.
Pseudodiaptomus lobipes Gurney.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

Cladocera :
Diapnanosoma excisum var. *longiremis* Ekman.

4. Hooghly River ; Station Howrah Bridge. Fresh water.

Copepoda :
Diaptomus blanci Guerne and Richard.
Diaptomus contortus Gurney.
Diaptomus strigilipes Gurney.
Diaptomus viduus Gurney.
Pseudodiaptomus lobipes Gurney.
Acartia chilkaensis Sewell.
Cyclopina minuta, sp. nov.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Cladocera :
Diaphanosoma excisum var. *longiremis* Ekman.
Moina dubia Richard.
Ceriodaphnia rigaudi Richard.

5. Hooghly River : Budge Budge ; Station 1. 4. iii. 33. Midstream. Salinity 1·07 per mille.

Copepoda :
Acrocalanus inermis Sewell.
Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Acartia (*Acartiella*) *major* Sewell.

Station 2 ; near the shore.

Copepoda :
Acrocalanus inermis Sewell.
Pseudodiaptomus binghami Sewell.
Diaptomus contortus Gurney.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

6. Hooghly River ; Achipur ; 4. iii. 33. near shore. Ebb Tide. Salinity 2·23 per mille.

Copepoda :
Acrocalanus inermis Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Labidocera gangetica, sp. nov. (=*L. euchaeta* Giesbrecht, forma *major* Sewell).
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

7. Hooghly River ; Falta ; near shore, 5. iii. 1933. Ebb Tide. Salinity 5·81 per mille.

Copepoda :
Acrocalanus inermis Sewell.
Pseudodiaptomus tollingeri Sewell.
Acartia chilkaensis Sewell.

Acartia plumosa T. Scott.
Acartia (*Acartiella*) *tortaniformis* Sewell.

8. Hooghly River; Diamond Harbour. 5. iii. 33. (*a*) near shore. Last phase of Ebb Tide. Salinity 8·50 per mille. (*b*) mid stream. Tide just flooding. Salinity 7·90 per mille.

Copepoda:
Paracalanus dubia Sewell.
Acrocalanus inermis Sewell.
Pseudodiaptomus hickmani Sewell.
Pseudodiaptomus aurivillii Cleve.
Labidocera gangetica, sp. nov. (= *L. euchaeta* Giesbrecht, forma *major* Sewell).
Pontella andersoni Sewell.
Acartia chilkaensis Sewell.
Acartia plumosa T. Scott.
Acartia spinicauda Giesbrecht.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Acartia (*Acartiella*) *major* Sewell.
Oithona brevicornis Giesbrecht.

In addition the tow-netting contained a number of examples of a species of *Sagitta* and a single Rhizostomous medusa: a few larval molluscs and "Cypris" larvae were also seen.

9. Tolly's Nullah; near Magrahat Railway Station. 7. iii. 33. Salinity 0·17 per mille.

Copepoda:
Acrocalanus inermis Sewell.
Pseudodiaptomus binghami Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.

10. Tolly's Nullah; below Gariya Bridge. 2. ii. 33. Salinity 1·87 per mille.

Copepoda:
Diaptomus cinctus Gurney.
Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

Cladocera:
Diaphanosoma excisum var. *longiremis* Ekman.

In addition a few examples of a species of *Mysis*, *Mesopodopsis orientalis* Tattersall and the larvae of a species of mayfly, *Cloeon*, were present.

Among the Rotifera that were present were the following:—

Brachionus bakeri Ehrb.
Brachionus bakeri var. *brevispinus* Ehrb.
Brachionus rubens Ehrb.

11. Tolly's Nullah. Gangajoara. 2. ii. 33. Salinity 4·07 per mille.

Copepoda :

Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

In addition examples of the Mysid, *Mesopodopsis orientalis* Tattersall, were present.

Salt Lake Canal System.

12. Chingrighatta, in Canal. Surface tow-netting 19. x. 14.

Copepoda :

Pseudodiaptomus annadalei Sewell.
Pseudodiaptomus binghami Sewell.
Pseudodiaptomus tollingeri Sewell.
Diaptomus contortus Gurney.
Acartia chilkaensis Sewell.
Acartia plumosa T. Scott.
Acartia spinicauda Giesbrecht.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Oithona brevicornis Giesbrecht.
Cyclopina longifurca Sewell.
Halicyclops aequoreus (Fischer).
Halicyclops tenuispina Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.
Stenhelia longifurca, sp. nov.
Laophonte bengalensis, sp. nov.
Mesochra meridionalis Sars.

Cladocera :

Daphnia lumholtzi Sars.
Diaphanosoma excisum var. *longiremis* Ekman.
Diaphanosoma modiglianii Richard.
Moina dubia Richard.
Ceriodaphnia cornuta Sars.
Ceriodaphnia rigaudi Richard.
? *Alona quadrangularis* Müller.
Chydorus sphaericus Müller.

In addition the Mysid, *Mesopodopsis orientalis* Tattersall, was present in large numbers.

Numerous examples of the Rotifer *Brachionus urceolaris* Ehrb. were present.

The catch shows clearly that the reproductive season was in full swing ; Nauplii larvae of several kinds and immature Copepodid stages of several species were present in large numbers and in addition females of *Pseudodiaptomus* and *Cyclopina* were carrying egg sacs.

13. Salt Lake Canal System. Dhappa Lock ; Inside Lock Gates, 20. x. 30.

Copepoda :

Diaptomus contortus Gurney.
Pseudodiaptomus annandalei Sewell.

Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

Cladocera:

Diaphanosoma excisum var. *longiremis* Ekman.
Diaphanosoma modiglianii Richard.
Moina dubia Richard, in enormous numbers.

14. Salt Lake Canal System. Between Chingrighatta and Dhappa Lock. Surface tow-netting; 29. xii. 32. Salinity 1·19 per mille.

Copepoda:

Diaptomus cinctus Gurney.
Diaptomus contortus Gurney.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

In addition a species of Rotifer, *Brachionus pala* Ehrb., was present in enormous numbers.

15. Salt Lake Canal System. Kristopur canal at Mile I. 28. xii. 32. Salinity 2·20 per mille.

Copepoda:

Diaptomus cinctus Gurney.
Pseudodiaptomus annandalei Sewell.
Acartia chilkaensis Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.

Cladocera:

Moina dubia Richard, in large numbers.

In addition the following Rotifera were present:—

Brachionus pala Ehrb.
Brachionus bakeri var. *latissimus* Schm.

Both species were present in large numbers. By March 20th, 1933, the Salinity had risen to 3·60 per mille.

16. Salt Lake Canal System. Kristopur Canal at Mile 4. 28. xii. 32. Salinity 2·41 per mille.

Copepoda:

Diaptomus cinctus Gurney.
Pseudodiaptomus annandalei Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.

Cladocera:

Moina dubia Richard.

In addition the same two species of Rotifera as were present at Station 15, namely *Brachionus pala* Ehrb. and *Brachionus bakeri* var. *latissimus* Schm., were again present but in fewer numbers.

17. Salt Lake Canal System. Eastern Canal, just beyond junction with Kristopur Canal. 28. xii. 32. Salinity 2·03 per mille.

Copepoda:

Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus tollingeri Sewell.
Acartia chilkaensis Sewell.

Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.

Cladocera :

Moina dubia Richard.

18. Salt Lakes : Z. S. I. Station I. Large pond, connected with the canal of Lansdowne Jute Mill. 16-17. ii. 28. Salinity 12·74 per mille.

Pseudodiaptomus annandalei Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.

19. Salt Lakes : Z. S. I. Station 2. Near edge opposite Dakhindari. 16-17. ii. 28. Salinity (on 23. ii. 28.) 9·60 per mille.

Pseudodiaptomus annandalei Sewell.

20. Salt Lakes : Z. S. I. Station 3. Northern end. 23-24. ii. 1928. Salinity 23·66 per mille.

Pseudodiaptomus annandalei Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.

21. Salt Lakes ; Z. S. I. Station 3. Northern end. 20. iii. 33. Salinity 1·474 per mille.

Copepoda :

Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.

Cladocera :

Moina dubia Richard.
Diaphanosoma excisum var. *longiremis* Ekman.

In addition a large number of examples of a Rotifer, *Asplanchna brightwelli* Hudson and Gosse, were present as well as a few examples of *Brachionus bakeri* Ehrb.

22. Salt Lakes ; Southern end. Naoabad. 2. ii. 33. Salinity 5·54 per mille.

Copepoda :

Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.

In addition examples of the Mysid, *Mesopodopsis orientalis* Tattersall, were present.

23. Pool on Road-side near Milestone 4 on the way from Baruipur to Uttarbhag. 8. ii. 33. Salinity 9·24 per mille. A fortnight later the salinity of the water had risen to 10·05.

Copepoda :

Pseudodiaptomus tollingeri Sewell.
Acartia chilkaensis Sewell.
Cyclopina longifurca Sewell.
Halicyclops tenuispina Sewell.
Stenhelia longifurca, sp. nov.
Ectinosoma melaniceps Boeck.
Limnocletodes secundus, sp. nov.
? *Tachidius brevicornis*.

24. Pools in a drying up "Paddy" field at Uttarbhag; 2. i. 33. Salinity 4·38 per mille.

Copepoda:

Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Oithona horai, sp. nov.
Cyclopina longifurca Sewell.
Halicyclops tenuispina Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

25. Large connected pool at Uttarbhag. 2. 1. 33. Salinity 4·16 per mille.

Copepoda:

Pseudodiaptomus tollingeri Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Oithona horai, sp. nov.
Cyclopina longifurca Sewell.
Halicyclops aequoreus (Fischer).
Halicyclops tenuispina Sewell.
Halicyclops propinquus sars.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.
Laophonte bengalensis, sp. nov.
Stenhelia longifurca, sp. nov.
Parategastes sphaericus var. *similis* Sewell.

26. Piali River, at Uttarbhag. 13. iii. 33. 1st phase of High tide, after a "bore" Salinity 18·08 per mille.

Copepoda:

Paracalanus dubia Sewell.
Acrocalanus inermis Sewell.
Pseudodiaptomus tollingeri Sewell.
Labidocera gangetica, sp. nov. Juv.
Acartia chilkaensis Sewell.
Oithona brevicornis Giesbrecht.
Cyclopina longifurca Sewell.
Laophonte bengalensis, sp. nov.
Stenhelia longifurca, sp. nov.
Cletocamptus confluens (Schmeil).

III. SYSTEMATIC ACCOUNT.

ROTIFERA.

Family ASPLANCHNIDAE.

Genus **Asplanchna** Gosse.

Asplanchna brightwelli Hudson and Gosse.

Asplanchna brightwelli, Hudson and Gosse, 1889, p. 122, pl. xii, fig. 1.
Asplanchna brightwelli, Apstein, 1907, p. 209.

A large number of examples of this species were taken in a tow-netting at Z. S. I. Station 3 (Sample 21) in the northern part of the Salt Lakes

in March 1933. The species appears to be widely distributed throughout fresh water in and around Calcutta.

Family BRACHIONIDAE.

Genus **Brachionus** Ehrenberg.

Brachionus bakeri Ehrb.

Brachionus bakeri, Hudson and Gosse, 1889, II, p. 120, pl. xxvii, fig. 8.
Brachionus bakeri, Rousselet, 1897, p. 329, pl. xvi.
Brachionus bakeri, v. Daday, 1906, p. 120, pl. vii, figs. 6-8.
Brachionus bakeri, v. Daday, 1910, p. 90, pl.iv, figs. 6-14.

This species appears to be an extremely variable one and a number of varieties have been described by Rousselet and von Daday ; Rousselet (*loc. cit.*, p. 370) considered that these variations from the typical form were definitely associated with differences in the surroundings ; " he had noticed that the *Brachionus* found at the same time were usually of the same varieties, although other varieties might be found at the same place at different times." Examples of the typical form, that agreed closely with the figure given by von Daday (1906, pl. VII, fig. 6), were taken in Tolly's Nullah, (Sample 10, 2nd February 1933). Among the varieties noted in the collection were the following :—

Brachionus bakeri var. **brevispinus** Ehrb.

Brachionus bakeri var., Rousselet, 1897, pl. xvi, fig. 9.

This variety occurred associated with the typical form in Tolly's Nullah (Sample 10, 2nd February 1933).

Brachionur bakeri var. **latissimus** Schm.

Brachionus bakeri var. *latissimus*, v. Daday, 1906, p. 91, pl. iv, figs. 7, 8.

Schmarda described this form as a separate species under the name *B. latissimus* ; he obtained his examples from Egypt. Numerous examples of the form were taken in the canals of the Salt Lakes Calcutta (Samples 15 and 16, 28th December 1932).

Brachionus pala Ehrb.

Brachionus pala, Hudson and Gosse, 1889, II., p. 117, pl. xxvii, fig. 3 ; pl. xxviii, figs. 3, 4.
Brachionus pala, v. Daday, 1910, p. 93, pl. iv, figs. 17, 18, 20.

This species was extremely common and occurred in enormous numbers in the tow-netting taken in Sample 14 in the Canals of the Salt Lakes ; it was also present though in steadily decreasing numbers in Samples 15 and 16 on the previous day (28th December 1932).

Brachionus rubens Ehrb.

Brachionus rubens, Hudson and Gosse, 1889, II, p. 119, pl. xxvii, fig. 5.
Brachionus rubens, v. Daday, 1910, p. 94.
Brachionus urceolaris var. *rubens*, Sachse, 1912.

Examples were taken in Tolly's nullah (Sample 10, 2nd February 1933).

Brachionus urceolaris Ehrb.

Brachionus urceolaris, Hudson and Gosse, 1889, II, p. 118, pl. xxvii, fig. 6.
Brachionus urceolaris, v. Daday, 1906, p. 125, pl. vii, fig. 1.
Brachionus urceolaris, v. Daday, 1910, p. 94.

Examples of this species were taken in a tow-netting in the canal of the Salt Lakes, Calcutta, near Chingrighatta on 19th October 1914.

PHYLLOPODA: Cladocera.

Family DAPHNIDAE.

Genus **Daphnia** O. F. Müller.

Up to the present time I have only come across a single species of *Daphnia* in the whole collection. Hitherto the following species have been recorded from India, *Daphnia fusca* Gurney (Gurney, 1906, p. 276) from Kang Kul, Chitral; *Daphnia magna* Straus (Gurney, 1920*a*, p. 146) from Seistan; *Daphnia longispina* (O. F. Müller) from Gyantse, Tibet (von Daday, 1908, p. 330) and *D. longispina* var. *rosea* Sars (Gurney, 1920*a*, p. 146) also from Seistan. The present collection adds another species to the list of those recorded from India and the adjoining country.

Daphnia lumholtzi Sars.

Daphnia lumholtzi, Sars, 1886, p. 18, pl. i, figs. 1-10; pls. iii-iv.
Daphnia lumholtzi, Richard, 1896, p. 219, pl. xxi, fig. 7; pl. xxiv, figs. 5-7.
Daphnia lumholtzi, v. Daday, 1910, p. 147, pl. viii, figs. 11-15.
Daphnia lumholtzi, Gurney, 1911, p. 26.
Daphnia lumholtzi, Gurney, 1916, p. 334.

So characteristic is the appearance of this species that I have no hesitation in referring to it a single example that was taken in the Canals of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914.

Family SIDIDAE.

Genus **Diaphanosoma** Fischer.

Two species of *Diaphanosoma* are present in the collections.

Diaphanosoma excisum var. **longiremis** Ekman.

Diaphanosoma excisum, Sars, 1885, p. 13, pl. II.
Diaphanosoma excisum var. *longiremis*, Ekman, 1904, p. 1.

Examples of this species occur in the River Hooghly and also in the canal system of the Salt Lakes, Calcutta. In the Hooghly River they have been taken at Nawabganj, opposite the Pulta Water-works and in the vicinity of Howrah Bridge; a single specimen has also been taken in Tolly's Nullah (Sample 10, 2nd February 1933). Specimens have also been obtained at Chingrighatta in the canals of the Salt Lakes both on 19th October 1914 and again inside the Dhappa lock gates near Chingrighatta on 20th October 1930. As I have recorded elsewhere, this species occurs in the Tank of the Indian Museum.

Diaphanosoma modiglianii Richard.

Diaphanosoma modiglianii, Richard, 1896, p. 363, pl. xv, figs. 13-14; pl. xvi, fig. 22.

This species was described by Richard from Sumatra. The present examples appear to be rather larger than Richard's original specimens, being 1·156 mm. in length by 0·444 mm. in width. The head is produced in the characteristic conical shape and there is a well-marked bulge on the ventral aspect in the region of the eye. The shell-margin in my examples is armed with a number of groups of spines, in which the size of the spine deceases from before backwards; as a rule there are 5 to 6 spines in each group. The shell margin is not inturned and the antennae do not quite reach the posterior margin of the shell. Several examples of this species were taken in a tow-netting at Chingrighatta in the Salt Lakes, Calcutta, on 19th October 1914.

Genus **Ceriodaphnia** Dana.

Ceriodaphnia rigaudi Richard.

Ceriodaphnia rigaudi, Gurney, 1907, p. 21.

This species has already been recorded from the environs of Calcutta by Gurney and it appears to be an inhabitant of most of the areas of the water in the locality. As I have already recorded, it occurs in the Tank of the Indian Museum, Calcutta, and further examples have been obtained from the Hooghly River at Naihati and near the Howrah bridge, as well as from the canals of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914. Gurney (*loc. cit.*) has recorded its presence in brackish ponds at Port Canning in the Gangetic Delta, the water of which ranges in salinity from almost *nil* during the rains, through 12·13 per thousand in December to 23·16 in March (*vide* Annandale, 1907, p. 36).

Ceriodaphnia cornuta Sars.

Ceriodaphnia cornuta, Sars, 1886, p. 26, pl. v, figs. 1-3.

Examples of this form were taken in the canals of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914.

Genus **Moina** Baird.

Moina dubia Richard.

Moina dubia, Richard, 1892, p. 527, figs. 1-2.
Moina dubia, Gurney, 1911, p. 27, pl. ii, figs. 1, 2.
Moina dubia, Gurney, 1927, p. 66, text-figs. 4, e, f.

Examples of what I take to be this species were taken in several localities in and around Calcutta. I have elsewhere recorded its presence in the Tank of the Indian Museum, and further examples have been taken in the Hooghly River at Naihati, near the Pulta Water-works and near the Howrah Bridge. It also occurred in the tow-netting taken at Chingrighatta on the Canals of the Salt Lakes, Calcutta, on 19th October 1914 and inside the lock gates at Dhappa on 20th October 1930; as well as in Samples 15, 16 and 17 on 28th December 1932.

Family CHYDORIDAE.

Genus **Alona** Baird.

? **Alona quadrangularis** O. F. Müller.

Alona quadrangularis, Keilhack, 1907, p. 82, figs. 193, 194, 195.
Alona quadrangularis, v. Daday, 1910, p. 134, pl. vii, fig. 17.

A single example of what seems to be this species was taken in the Canal of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914.

Genus **Chydorus** Leach.

Chydorus sphaericus (O. F. Müller).

Chydorus sphaericus, Ekman, 1904, p. 26.
Chydorus sphaericus, Gurney, 1906, p. 278.
Chydorus sphaericus, Keilhack, 1909, p. 102, fig. 248.
Chydorus sphaericus, v. Daday, 1910, p. 121, pl. vi, fig. 5.
Chydorus sphaericus, Gurney, 1911, p. 30.

Two examples of this species were taken in a tow-netting at Chingrighatta in the Salt Lakes, Calcutta, on 19th October 1914.

COPEPODA: Calanoida.

Family PARACALANIDAE.

Genus **Paracalanus** Boeck.

Paracalanus dubia Sewell.

Paracalanus dubia, Sewell, 1912, p. 330, pl. xv, figs. 1-5.
Paracalanus crassirostris, forma *sewelli*, Früchtl, 1924, p. 36.
Paracalanus dubia, Sewell, 1929, p. 76, fig. 29.

This species was first described by me from the mouth of the Rangoon river in water that showed a specific gravity of 1002. In the present collections examples have been taken in the tow-netting from Diamond Harbour on the Hooghly River.

Genus **Acrocalanus** Giesbrecht.

Acrocalanus inermis Sewell.

Acrocalanus inermis, Sewell, 1912, p. 334, pl. xvi, figs. 1-9.
Acrocalanus similis, Sewell, 1914, p. 211, pl. xvii, figs. 3-5.
Acrocalanus inermis, Sewell, 1924, p. 781.
Acrocalanus inermis, Früchtl, 1924, p. 61.
Acrocalanus inermis, Sewell, 1929, p. 81.

I have already (1929) pointed out that this species is in the main an inhabitant of brackish water and is apparently confined to the coastal region. It appears to be widely distributed from the mouth of the Hooghly and the Chilka Lake on the west to the Malay Archipelago. In the present collections it occurs in tow-nettings from the lower reaches of the Hoogly River, commencing from Budge Budge, and has also made its way into Tolly's Nullah.

Family DIAPTOMIDAE.

Genus **Diaptomus** Westwood.

Diaptomus blanci Guerne and Richard.

Diaptomus blanci, Guerne and Richard, 1896, p. 53.
Diaptomus blanci, Sewell, 1924, p. 788.

Examples of this species have previously been recorded by me from the Chilka Lake. In the present collections specimens have been obtained from the Hooghly River at Naihati, at Nawabganj, near the Pulta Water-works and in the vicinity of the Howrah Bridge. It seems probable that this is a true fresh-water species and that its presence in such an area as the Chilka Lake is due to its having been washed in during the rainy season.

Diaptomus cinctus Gurney.

Diaptomus cinctus, Gurney, 1907, p. 29, pl. i, figs. 11-12.
Diaptomus cinctus, Sewell, 1924, p. 788, pl. xlv, fig. 4.

Like the last, this species occurs frequently in the Hooghly River and has been taken at Naihati and Nawabganj, while two examples, one of them an ovigerous female, were taken in Tolly's Nullah in Sample 10 (2nd February 1933). Specimens have also been obtained in the canals of the Salt Lakes, Calcutta, in samples 14, 15, and 16 on 28th-29th December 1932.

Like the last, this species appears to be a true fresh-water inhabitant and has but little power of adaptation to a brackish-water habitat.

Diaptomus contortus Gurney.

Diaptomus contortus, Gurney, 1907, p. 28, figs. 9, 10.
Diaptomus contortus, Sewell, 1924, p. 788, pl. xlv, fig. 5.

This species has been taken at Nawabganj, near the Pulta Water-works and near the Howrah Bridge in the Hooghly River; it also occurred at Chingrighatta or its vicinity on all the three occasions on which collections were made from that locality, namely at Chingrighatta on 19th October 1914, inside the lock-gates at Dhappa on 20th October 1930 and in sample 14 on 29th December 1932. While usually found in fresh water, this species would appear to be somewhat more adaptable to a brackish water habitat than the preceding two species.

Diaptomus orientalis Brady.

Diaptomus orientalis, Brady, 1886, p. 296, pl. xxxvii, figs. 21-26.

Examples of this species were obtained in the Hooghly River at Nawabganj (Sample 3).

Diaptomus strigilipes Gurney.

(Text-fig. 2 *a*.)

Diaptomus strigilipes, Gurney, 1907, p. 30, figs. 18-20.
Diaptomus strigilipes, Sewell, 1924, p. 788.

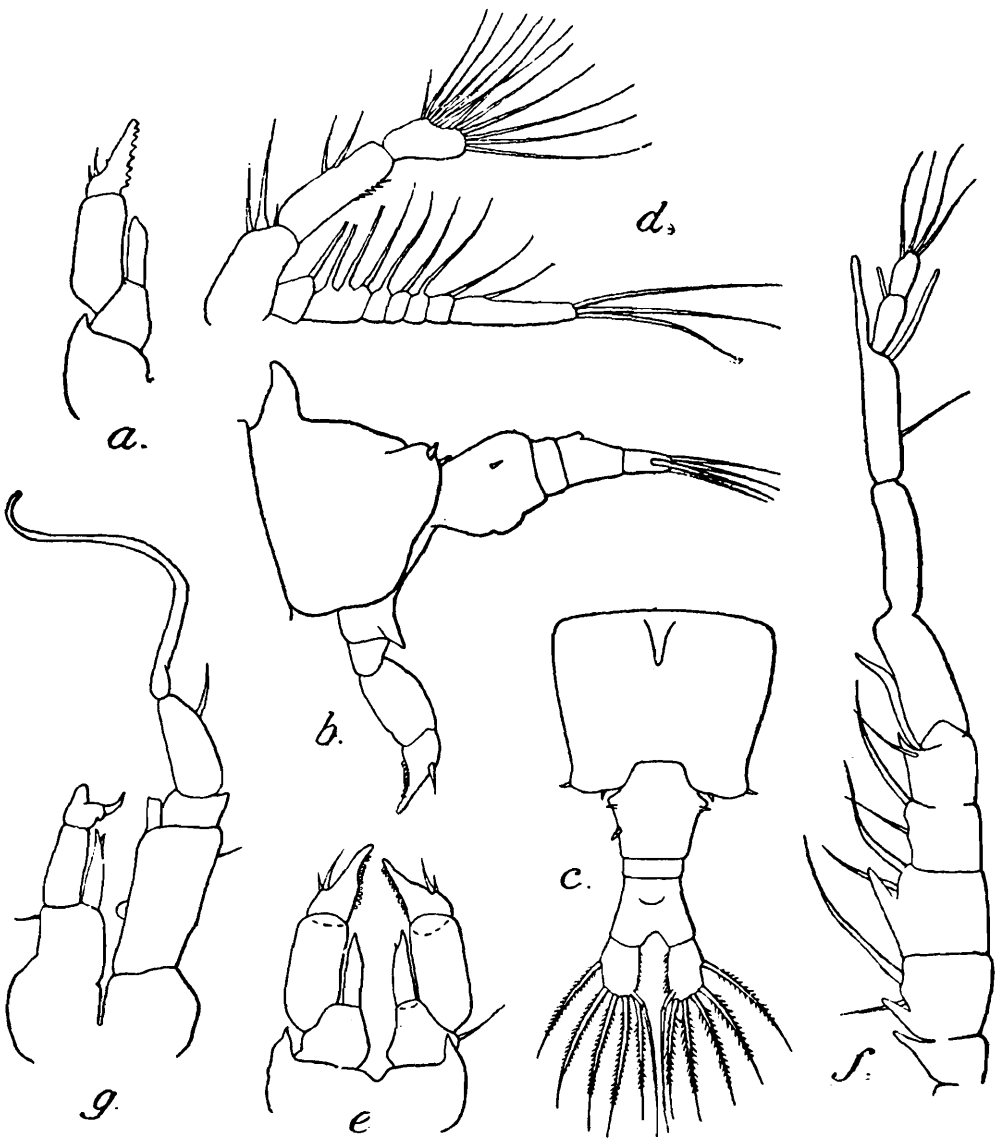
This species is now known to occur in Chakradharpur, in Chota Nagpur, and in Bankipur and Chittagong in Bengal.

A few examples of this species were taken in the Hooghly River in the vicinity of Howrah Bridge.

Diaptomus indicus, sp. nov.

(Text-fig. 2 *b-g.*)

Among the examples of *Diaptomus* from the river Hooghly were a few that appear to represent a new species, though at first sight they are liable to be mistaken for *Diaptomus chaffanjoni* or *D. sarsi,* owing to the presence on the dorsal aspect of the 4th thoracic segment in the females of a median triangular process (Text-fig. 2 *b* and *c*). This process is not



TEXT-FIG. 2.—*Diaptomus strigilipes* Gurney. *a.* 5th leg of ♀.
Diaptomus indicus, sp. nov. *b.* Lateral view of posterior end of thorax and abdomen of ♀; *c.* Dorsal view of posterior end of thorax and abdomen of ♀; *d.* 2nd antenna of ♀; *e.* 5th pair of legs of ♀; *f.* Grasping antenna of ♂; *g.* 5th pair of legs of ♂.

present, however, in all the examples from the Hooghly River, though in numerous examples of the same species from a tank in the P. W D. bungalow compound, Ghorawal, Mirzapore, it was invariably present. Another species with which this form is liable to be confused is *Diaptomus*

strigilipes Gurney, and this is especially the case in the females when the dorsal process is absent.

♀: Total length 1·083 mm.

The proportional lengths of the cephalothorax and abdomen are as 41 to 11, so that the posterior region is contained 3·727 times in the length of the anterior region. The anterior margin is rounded and there is a pair of fine, ventrally-directed rostral spines. The posterior margin of the last thoracic segment is as a rule slightly expanded and each expansion is furnished with two short stout spines. In some examples the extension of the left side is more marked than that on the right and almost approaches a wing-like structure.

The abdomen consists of three segments, that have with the furcal-rami the following proportional lengths :—

Abdominal segment	1-3	4	5	Furca.
	43	7	29	21=100.

In *Diaptomus strigilipes* the corresponding proportions are 47, 10, 23, 10. As in *D. strigilipes*, there is on the right side of the genital segment a short process that bears on its outer aspect a short stout spine, while on the left side rather nearer the posterior margin is a stout spine, that in the present form arises from the general surface of the segment, whereas in *D. strigilipes* it arises from a rounded prominence (*cf.* Gurney, 1907, Pl. ii, fig. 18).

The 1st antenna overreaches the tip of the furcal ramus by four or five segments. The proportional lengths of the segments are as follows :—

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13
	40	29	20	23	26	26	27	31	34	37	34	51	56

14	15	16	17	18	19	20	21	22	23	24	25	
56	56	53	53	55	49	44	44	44	46	40	26	=1000.

The 2nd antenna (Text-fig. 2 *d*) and mouth-parts are as in other members of the genus.

The 5th pair of legs (Text-fig. 2 *e*) closely resembles those of *Diaptomus strigilipes*. The basal segment bears a spine-like projection on its posterior face. The endopod reaches nearly to the distal end of the proximal segment of the exopod and ends in a conical point. The distal segment of the exopod is armed along its lower margin with a row of regular, rounded cusps and not an irregular row of teeth as in *D. strigilipes* (*cf.* Text-fig. 2 *a*).

♂: Total length 1·271 mm.

The proportional lengths of the cephalothorax and abdomen are as 42 to 19, so that the posterior region is contained 2·21 times in the length of the anterior region. There is no trace of any prominence in the dorsal region of the last thoracic segment in this sex ; nor are the posterior thoracic margins expanded. On each side the last thoracic segment bears a minute sensory seta laterally.

The abdomen consists of the usual five segments, that have the following proportional lengths :—

Abdominal segment	1	2	3	4	5	Furca.
	11	21	19	21	10	18=100,

The 1st segment is short and bears a single, somewhat delicate spine on its postero-lateral margin on the right side. The 4th segment is asymmetrical and is produced backwards on the right side in a rounded prominence.

In the grasping antenna (Text-fig. 2, *f*) segment 13 bears a stout spinous process; segments 14 and 15 both bear a stout process and two unequal setae, the larger of which arises from the distal angle. Segment 17 bears a narrow hyaline lamella that is produced forward over the proximal part of segment 18. Segments 18 bears a curved hyaline lamella on its anterior aspect. Segment 19, 20 and 21 are fused; a narrow hyaline lamella runs along the proximal two-thirds of the anterior margin. Segment 23 bears a long and narrow process that extends distally almost to the tip of the last segment.

In the 5th pair of legs (Text-fig. 2, *g*) the left leg is very short and hardly reaches beyond the distal end of the 2nd basal segment of the right leg. The endopod of the left leg is long and tapers to a conical point. The distal segment of the exopod is small and ends distally in a rounded prominence, while a stout but short seta springs from the inner aspect. In the right leg the endopod is very short and only reaches to the distal end of the proximal segment of the exopod. The 2nd segment of the exopod bears a curved spine that arises from about the middle of the segment. The terminal segment is slender and is much curved. In its general appearance this appendage closely resembles that of *D. strigilipes*, but the endopod of the right leg is much shorter.

Diaptomus viduus Gurney.

(Text-fig. 3, *a-d*).

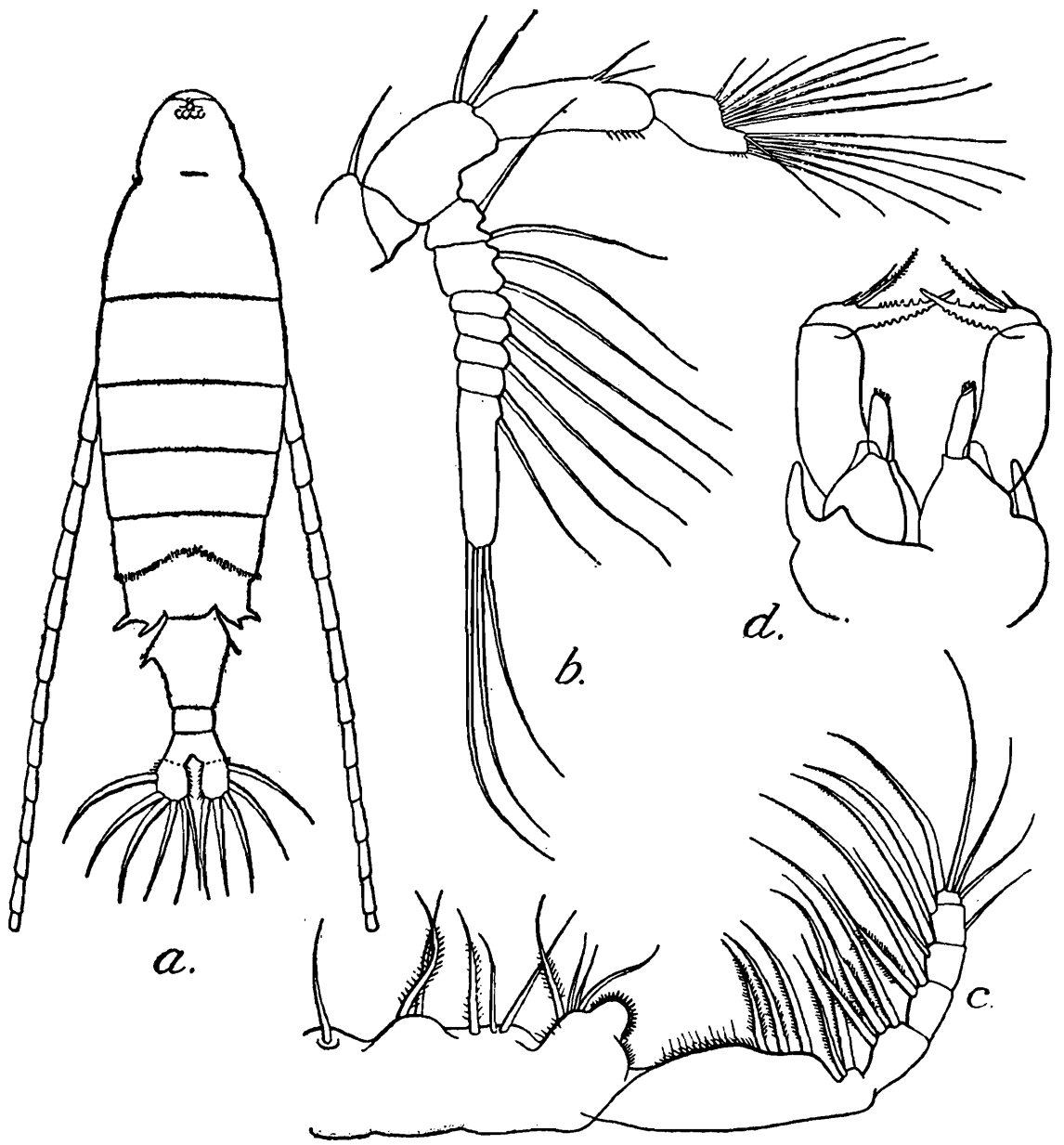
Diaptomus viduus, Gurney, 1916, p. 338, pl. II, fig. 11-14.
(*non Diaptomus viduus*, Kikuchi, 1928).

This species is widely distributed around Calcutta. Examples have been taken in the Hooghly River at Nawabganj, near the Pulta Waterworks and in the vicinity of Howrah Bridge. Up to the present time this species has been known only from the male which was described by Gurney from Ceylon. The species described by Kikuchi from Japan under this name is not the same species, though closely related to it. I give below a description of the hitherto unknown female.

♀: Total length ranges from 1·700 to 2·00 mm. The proportional lengths of the cephalothorax and abdomen are as 3·135 to 1.

The body (Text-fig. 3 *a*) is comparatively robust and tapers towards each end, the greatest breadth being in the region of the 1st thoracic segment. A well-marked groove traverses the cephalon and the 1st thoracic segment is separate, though the line of separation is not so clearly defined as in the case of the more posterior segments. The 4th and 5th thoracic segments are fused, though there is a well-marked constriction across the body at the site of fusion. The posterior margin of the 4th segment is also demarcated by a transverse row of short spines that passes across the dorsum. The posterior lateral angles are expanded

and bear on each side a pair of short and usually blunt spines that are directed outwards.



TEXT-FIG. 3.—*Diaptomus viduus* Gurney. *a.* Dorsal aspect of ♀; *b.* 2nd antenna of ♀; *c.* Maxilliped of ♀; *d.* 5th pairs of legs of ♀.

The abdomen consists of three segments and the furcal rami. These have the following proportional lengths :—

Abdominal segment	1-3	4	5	Furca
	53	12	15	20=100.

The genital segment is slightly asymmetrical; each bears a short spine, that on the right side being situated somewhat more anteriorly than that on the left. The segment is itself slightly produced at the point of origin of the latter spine and the spine is bifid, a small accessory spine arising near the base. The furcal rami are short and broad, the relative dimensions being in the proportion of 9 in length to 8 in breadth. The inner margins and the proximal part of the outer margin are fringed with delicate hairs. The furcal setae are short and stout.

The 1st antenna overreaches the tip of the furcal ramus by the last three or four segments. The proportional lengths of the segments are as follows :—

Segment	1-2	3	4	5	6	7	8	9	10	11	12	13	14
	87	22	22	24	25	29	33	37	36	36	53	58	57

15	16	17	18	19	20	21	22	23	24	25	
57	55	53	50	48	41	41	39	39	35	23	= 1000.

The 1st and 2nd segments are fused together but all the remaining segments are separate.

In the 2nd antenna (Text-fig. 3*b*) the exopod is half as long again as the endopod. Basal 1 bears a single seta and Basal 2 has two setae at its distal external angle. The 1st segment of the endopod bears two setae at about two-thirds the length of its external margin and there is a comb of curved needle-like spines along the distal third of the inner surface ; the terminal segment is also armed with a group of spines on its inner aspect and distally bears 7 and 8 setae on its outer and inner lobes respectively. In the exopod the 1st and 2nd segment each bears two setae ; segments 3-6 each carry a single seta, whereas segment 7 has a single seta arising near the base and three from its distal end.

The mandible and maxilla closely resemble those of *Diaptomus castor* (Jurine) as figured by Sars (1901-3, Pl. lviii). The maxilliped (Text-fig. 3*c*) is more slender than the corresponding appendage in *Diaptomus castor*. In the 1st basal segment the proximal lobe bears a single seta, the 2nd, 3rd and 4th lobes bear respectively two, three and four setae ; the distal anterior angle is produced in a rounded prominence and is provided with a row of short needle-like spines. In the 2nd basal segment the anterior margin is armed in its proximal half with a row of fine curved spines and a number of long hairs also arise from this part of the surface ; the distal part of this border bears three setae and a further pair of unequal setae arise from the distal angle. The endopod consists of five segments ; of these the 1st bears one long, curved seta and two shorter setae that are thickened in their basal two-thirds and are finely serrated ; segments 2 and 3 each bear two setae, of which the distal is long and serrated ; the proximal seta on the 2nd segment is, like the shorter setae on segment 1, swollen in its basal half and is serrated on both margins ; segment 4 bears a single long seta on its inner margin and a small seta arises from its outer aspect ; segment 5 bears one large stout seta and three smaller and more delicate ones.

In the 1st swimming leg the proximal basal segment bears a number of fine scattered needle-like spines on its outer aspect, and a single seta arises from its distal inner angle. The 2nd basal segment bears a small tuft of fine hairs on its proximal outer angle. The exopod consists of three segments, of which the 2nd is without a marginal spine. The endopod is composed of two free segments only.

The 2nd, 3rd and 4th pairs of legs resemble those of other members of the genus.

The 5th pair of legs (Text-fig. 3*d*) are as figured. The 1st basal segment bears a stout spine-like process at its distal external angle. The 2nd basal segment bears the endopod at its inner distal angle and

close to the articulation is a rounded or somewhat truncated projection. The 1st free segment of the exopod is stout, and the 2nd segment is slightly swollen at the base and tapers to a point-in length it is but little shorter than the proximal free segment and on each side there is a row of stout teeth, the actual number of which appear to vary even in the same individual, as in the one figured in which there were eight teeth on the outer margin of one and only four on the other.

This species comes very close to *Diaptomus strigilipes* Gurney and the form described by Kikuchi (1928) under the name *Diaptomus viduus* from Japan, but the differences are sufficient to warrant their being regarded as distinct species.

Genus **Pseudodiaptomus** Herrick.

Pseudodiaptomus annandalei Sewell.

Pseudodiaptomus annandalei, Sewell, 1919, p. 5, pl. x, fig. 9.
Pseudodiaptomus annandalei, Sewell, 1924, p. 787, pl. xliv, fig. 2.
Pseudodiaptomus annandalei, Sewell, 1932, p. 240.

This species was first described by me from the Chilka Lake and has since been obtained at Quilon, Travancore and in the Kuran River, Perak. It has been taken in the Canals of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914, and inside the lock-gates at Dhappa Lock on 20th October 1930, but it had completely disappeared from the Locality on 29th December 1932. It was, however, taken in samples 15-20 in the Canals and the Salt Lakes proper in 1928-32 and in the Salt Lakes near Naobad (Sample 22) on 2nd February 1933. There seems but little doubt that this is a brackish-water form (*vide* Sewell, 1932, pp. 233, 234).

Pseudodiaptomus binghami Sewell.

Pseudodiaptomus binghami, Sewell, 1912, p. 337, pl. xvii, figs. 8-11.
Pseudodiaptomus binghami, Sewell, 1919, p. 7.
Pseudodiaptomus binghami, Sewell, 1924, p. 876, pl. xlv, fig. 2.
Pseudodiaptomus binghami, Sewell, 1932, p. 240.

This species was first described from the estuary of the Rangoon River and was later taken in the Chilka Lake. It has been taken in Tolly's Nullah in sample 10 (2nd February 1933) and at Gangajoara (Sample 11, 2nd February 1933); it occurred in the Canals of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914 and inside the lock-gates at Dhappa on 20th October 1930; but had disappeared from this locality on 29th December 1932. It was taken in samples 5 from Budge Budge in the Hooghly River and has been taken in the Salt Lakes themselves at Naoabad (2nd Februàry 1933) and at Uttarbhag (2nd January 1933). This species is frequently associated with *Pseudodiaptomus annandalei* Sewell and, like it, is a denizen of brackish water. The range of specific gravity of water in which it has been taken extends from 1002 in the Rangoon River Estuary and 997·0 at 28·5°C in the Chilka Lake to 1026·25 at 15·0 C in the latter area. It thus possesses a wide range of adaptation.

Pseudodiaptomus lobipes Gurney.

Pseudodiaptomus lobipes, Gurney, 1907, p. 27, figs. 3-8, 23-24.
Pseudodiaptomus lobipes, Sewell, 1924, p. 786, pl. xlv, fig. 1.

This species was described by Gurney (1907) from specimens taken in certain Tanks in Calcutta and I have since recorded its presence in the Chilka Lake. It has also been taken in the Mahanaddi River. In the present collections it occurs in all tow-nettings from the upper or fresh, water reaches of the Hooghly River, namely from Naihati, Nawabganj, near the Pulta Water-works and in the vicinity of the Howrah Bridge. It would appear to be a purely fresh-water form.

Pseudodiaptomus tollingeri Sewell.

Pseudodiaptomus tollingeri, Sewell, 1919, p. 2, pl. x, fig. 8.
Pseudodiaptomus tollingeri, Sewell, 1924, p. 787, pl. xlv, fig. 3.
Pseudodiaptomus tollingeri, Sewell, 1932, p. 241.

This species has now been taken in the Chilka Lake, and in the Canals of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914, and in Sample 17 on 28th December 1932 as well as in samples 23, 25 and 26 from Uttarbhag. It appears to be essentially a brackish-water form with only a moderate range of adaptability to fresh-water conditions.

Pseudodiaptomus hickmani Sewell.

Pseudodiaptomus hickmani, Sewell, 1912, p. 364, pl. xxii, figs. 1-7.
Pseudodiaptomus hickmani, Sewell, 1924, p. 786.
Pseudodiaptomus hickmani, Sewell, 1932, p. 235.

A single examples of the female of this species was taken in the tow-netting at Diamond Harbour on the Hooghly River (Sample 8).

Pseudodiaptomus aurivillii Cleve.

Pseudodiaptomus aurivillii, Cleve, 1901, p. 48, pl. vi, figs. 11-22; pl. vii, figs. 1, 2.
Pseudodiaptomus aurivillii, Sewell, 1924, p. 240.
Pseudodiaptomus aurivilli, Früchtl, 1924, p. 51.

Several examples of the female of this species were taken in a tow-netting at Diamond Harbour (Sample 8).

Family PONTELLIDAE.

Genus **Labidocera** Lubbock.

Labidocera gangetica, sp. nov.

Labidocera euchaeta, Stage I, Sewell, 1912, p. 339, pl. xviii, figs. 1-9.
Labidocera euchaeta, forma *major*, Sewell, 1932, p. 361.

This form was first described by me from the Rangoon River estuary; it has also been taken in the Ramree River and at Chittagong. I have hitherto been inclined to regard it as a large dimorphic form of *Labidocera euchaeta* Giesbrecht with which in previous collections it was associated, though in my last paper (1932, p. 362) I pointed out that a comparison

of the segmental lengths in this form and in *Labidocera euchaeta* Giesbrecht showed distinct differences from what one would expect if they were two forms of the same species, and I then remarked that " such a difference from the normal leads one to suspect that one is not dealing with two stages in the same life history " In the present collections a number of examples of this form were taken at Diamond Harbour and associated with adults of both sexes were numerous immature forms. It thus seems certain that this is a different species from *L. euchaeta* and I, therefore, give it the name *L. gangetica*. It was taken in the Hooghly River at Diamond Harbour and Achipur and in the Piali River at Uttarbhag (Samples 6, 8 and 26), and appears to be an estuarine form.

Genus **Pontella** Dana.

Pontella andersoni Sewell.

Pontella andersoni, Sewell, 1912, pp. 323, 344, and 370, pl. xx, figs. 1-6.
Pontella andersoni, Sewell, 1932, p. 375.

This species was first described from the coast of Burma off Chittagong. Since then it has been taken at several stations in the Mergui Archipelago. Its presence at Diamond Harbour on the Hooghly River (Sample 8) is interesting, as it clearly indicates that the species possesses a considerable degree of adaptation to brackish-water conditions.

Family ACARTIIDAE.

Genus **Acartia** Dana.

Sub-genus **Acanthacartia** Steuer.

Acartia (Acanthacartia) chilkaensis Sewell.

Acartia chilkaensis, Sewell, 1919, p. 9, pl. ix, figs. 1-5.
Acartia (Acanthacartia) chilkaensis, Sewell, 1932, p. 395.

This species was first described from the Chilka Lake from water the density of which ranged from 997·5 at 28·6°C to 1003·25. In the present collections examples have been taken in the Hooghly River at Naihati, at Nawabganj and in the vicinity of the Howrah Bridge ; in Tolly's Nullah in sample 10 (2nd February 1933) and at Gangajoara (2nd February 1933). In the Canal system of the Salt Lakes it is found in tow-nettings 15, 16 and 17 (28th December 1932), but not in Sample 14 from Chingrighatta, though it was present in the near vicinity of this area in previous years, as is shown by its presence at Chingrighatta on 19th October 1914 and inside the lock-gates at Dhappa on 20th October 1930. In the Salt Lakes themselves it has been taken at Naoabad and in pools at Uttarbhag (Samples 22-24).

Acartia (Acanthacartia) plumosa T. Scott.

Acartia (Acanthacartia) plumosa, Steuer, 1923, p. 112, figs. 110-114.
Acartia (Acanthacartia) plumosa, Sewell, 1932, p. 395.

In other parts of the world this species has been recorded from salt or brackish water, namely from Loanda Harbour in the Gulf of Guinea

(T. Scott, 1894, p. 66, Pl. VII, figs. 22-32) and in Banana Creek, Congo River, where the specific gravity of the water was 1008·7. Examples were taken in the Canals of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914, and from the Hooghly River at Falta and Diamond Harbour (Samples 7 and 8).

Sub-genus **Odontacartia** Steuer.

Acartia (Odontacartia) spinicauda Giesbrecht.

Acartia (Odontacartia) spinicauda, Steuer, 1923, p. 27, figs. 130-133.
Acartia spinicauda, Sewell, 1924, p. 789.
Acartia (Odontacartia) spinicauda, Sewell, 1932, p. 397.

Examples of this species have been recorded from the Chilka Lake in water the density of which ranged from that of the Bay of Bengal to as low as 1010·0 at 26·5°C. A single example was taken in the tow-netting from the Canal at Chingrighatta, Salt Lakes, Calcutta on 19th October 1914 while numerous examples occurred in the Tow-netting from Diamond Harbour on the Hooghly River (Sample 8).

Sub-genus **Acartiella** Sewell.

Acartia (Acartiella) tortaniformis Sewell.

Acartia tortaniformis, Sewell, 1912, p. 346, pl. xxi, figs. 1-10.
Acartia (Acartiella) tortaniformis, Steuer, 1923, p. 100.
Acartia (Acartiella) tortaniformis, Sewell, 1932, p. 393.

This species was first recorded from the region of the Rangoon estuary, in water that had a density of 1002; and I have since obtained specimens from tow-nettings off Hainguy Island on the Burma Coast and from the river at Chittagong. Unfortunately I have no records of the salinity of the water in these two latter localities. In the present collections specimens occur in the Hooghly River from Nawabganj and near the Pulta Water-works as far down as Diamond Harbour. It also occurs in Tolly's Nullah at Magrahat (Sample 9, 7th March 1933) and at Gharia Bridge and Gangajoara, Samples 10, 11 (2nd February 1933). In the Canal system of the Salt Lakes, Calcutta, it was present in samples 16 and 17 (28th December 1932), though in fewer numbers at the latter station; it was present at Chingrighatta on 19th October 1914, but appears to have disappeared from that locality in 1930. In the Salt Lakes themselves it has been taken at Uttarbhag in pools (Samples 24 and 25).

Acartia (Acartiella) major Sewell.

Acartiella major, Sewell, 1919, p. 15, pl. ix, fig. 8; pl. x, figs. 2, 3, 6.
Acartia (Acartiella) major, Sewell, 1932, p. 393.

Originally described from the Chilka Lake collections, this species is common in the lower reaches of the Hooghly River at Budge Budge and Diamond Harbour, where it occurs in association with *Acartia (Acartiella) tortaniformis* Sewell.

CYCLOPOIDA.

Family OITHONIDAE.

Sub-family OITHONINAE.

Genus **Oithona** Baird.

Oithona brevicornis Giesbrecht.

Oithona brevicornis, Sewell, 1924, p. 792.
Oithona brevicornis, Kiefer, 1929, p. 8.

This species has previously been obtained from brackish-water areas, such as a brackish-water lake in Verlaten Island, Sunda Straits, and in the Chilka Lake. In this latter region it occurred in water having a density ranging from 1015·0 at 15°C. to 1003·25. Examples were taken in the Canal system of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914, but it has since disappeared from this locality. It was abundant in the lower reaches of the Hooghly River and in the Piali River (Samples 8 and 26.).

Oithona horai, sp. nov.

(Text-fig. 4, *a-j*.)

♀: Total length 0·521 to 0·604.

The proportional lengths of the anterior and posterior regions of the body are as 1·07 to 1.

The anterior end is somewhat truncated. A rostrum proper appears to be absent and the antero-ventral part of the cephalon is produced downwards in a rounded prominence, very similar to that of *Limnoithona sinensis* Burckhardt. The widest part of the anterior region of the body is at the posterior margin of the cephalon. The line of segmentation between the cephalon and the 1st thoracic segment of the body is less marked than the following divisions. The posterior margin of the cephalon is somewhat convex so that the 1st thoracic segment appears to be narrow in the mid-dorsal line. The posterior margins of the 4th thoracic segment are rounded.

The abdomen consists of four free segments and the furcal rami ; segments 1 and 2 being fused. The proportional lengths of the segments are as follows :—

Abdominal segment . . .	1-2	3	4	5	Furca	
	32	15	20	14	19	=100

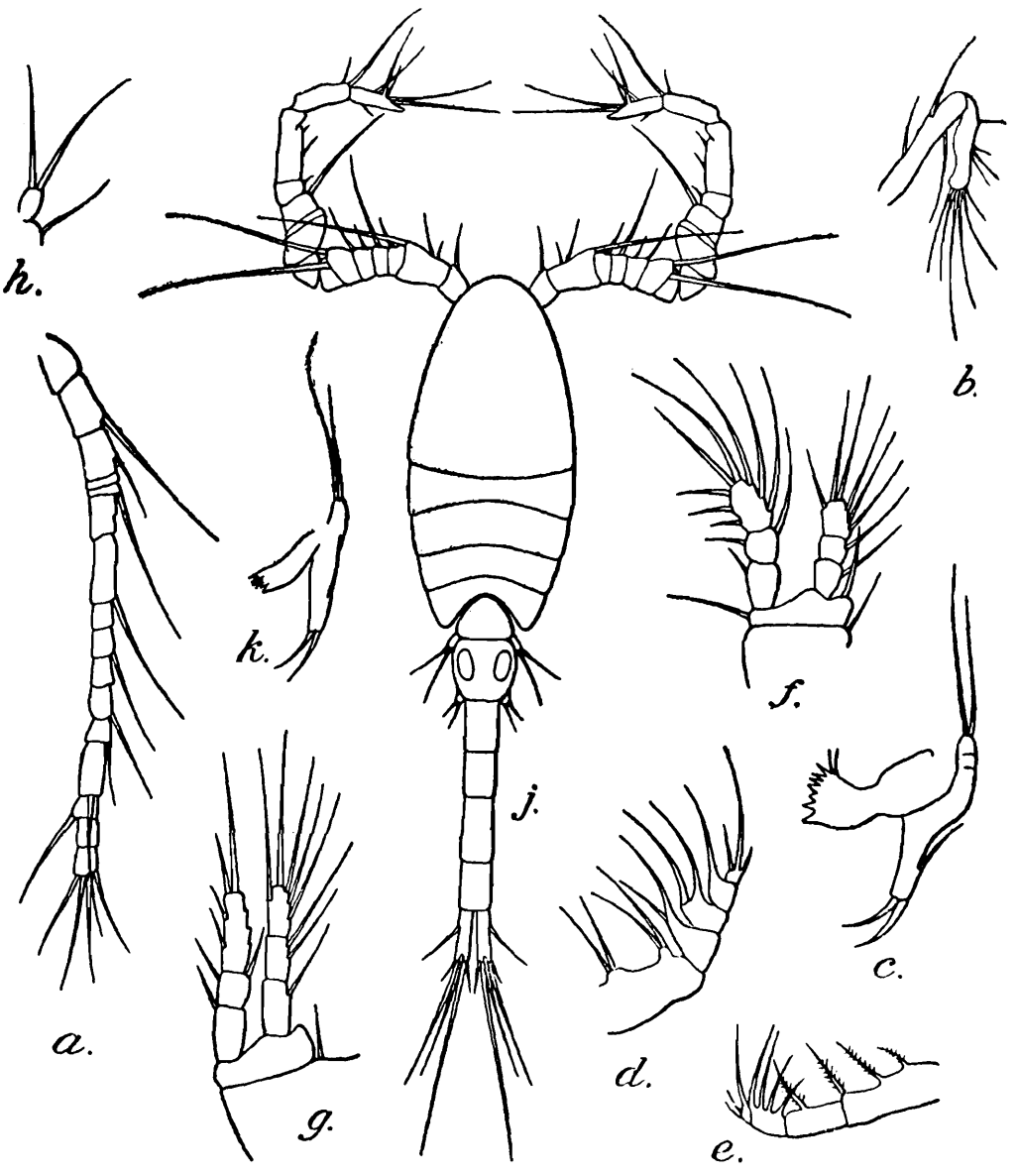
The furcal ramus is long and closely resembles that of *Limnoithona sinensis* in that it is almost exactly one-twelfth of the whole body length. The outer furcal seta (seta 5) arises from the external border at the junction of the proximal and 2nd quarter. The distal setae closely resemble those of the genus *Oithona* in that the inner and outer (setae 1 and 4) are quite small. The dorsal accessory seta is long. The proportional lengths of these setae are as follows :—

Seta 1	5
Seta 2	46
Seta 3	27
Seta 4	5
Seta 5 .	10
Dorsal Seta . .	29

The 1st antenna (Text-fig. 4*a*) reaches back to the posterior margin of the anterior region of the body. It consists of 16 free segments that have the following proportional lengths :—

Segment	1	2	3	4	5	6	7	8	9
	114	86	100	14	14	86	114	43	50
	10	11	12	13	14	15	16		
	43	43	57	100	36	57	43	= 1000	

As in the genus *Oithona* the setae arising from the segments are longer and slightly stouter than the terminal setae.



TEXT-FIG. 4.—*Oithona horai*, sp. nov. *a*. 1st antenna of ♀; *b*. 2nd antenna of ♀; *c*. Mandible of ♀; *d*. 2nd maxilla of ♀; *e*. maxilliped of ♀; *f*. 1st swimming leg of ♀; *g*. 2nd swimming leg of ♀; *h*. 5th leg of ♀; *j*. Dorsal view of male; *k*. Mandible of ♂.

The 2nd antenna (Text-fig. 4 *b*) consists of two joints only; the distal two segments being fused together. In this respect the present species closely resembles *Limnoithona sinensis*, but differs in that a single stout seta arises from the inner margin of the proximal segment.

The mandible (Text fig. 4*c*) possesses a stout tooth-plate armed with short but stout teeth of which the first is separated slightly from the rest and is somewhat stronger; the third tooth is small. The 2nd basal segment carries two equal stout setae. I have been unable to detect the presence of an inner ramus and this appears to be reduced and represented by a single seta. The outer ramus bears five setae that are long and slender.

In the maxilla the tooth-plate bears several long stout spines; the 3rd lobe bears three setae, of which the middle one is stout, as in the genus *Oithona*.

The 2nd maxilla (Text-fig. 4*d*) and maxilliped (Text-fig. 4*e*) are of the *Oithona* type.

In the swimming legs (Text-fig. 4*f*,*g*) the exopods of all four pairs bear 1, 1, 3 marginal spines.

The 5th leg (Text-fig. 4*h*) consists of a basal segment that bears a long seta and a single small free segment carrying two setae.

While closely resembling in its external appearance *Limnoithona sinensis* Burckhardt, there can be no doubt that this form belongs to the genus *Oithona*.

♂: Total length 0·542 mm.

The proportional lengths of the anterior and posterior regions of the body are as 1·048 to 1.

The body (Text-fig. 4*j*) is slightly smaller and is considerably more slender than in the female. The widest part of the anterior region is at the posterior margin of the cephalon. This margin is somewhat convex, so that the 1st thoracic segment appears to be narrow in the mid-dorsal line. The posterior thoracic margins are rounded.

The abdomen consists of five free segments, that have the following proportional lengths:—

Abdominal segment . .	1	2	3	4	5	Furca.
	19	16	15	21	14	15=100

Both the 1st antennae are modified into the usual grasping organ and in their general structure agree with those of other members of the genus *Oithona*.

Examples of this new species were taken from isolated pools at Uttarbhag (Samples 24 and 25). I have much pleasure in dedicating this species to Dr. S. L. Hora, Zoological Survey of India, who has been associated with me in the present study and who made a number of collections of plankton for me.

CYCLOPOIDA.

Family CYCLOPINIDAE.

Sub-family CYCLOPININAE.

Genus **Cyclopina** Claus.

Cyclopina longifurca Sewell.

Cyclopina longifurca, Sewell, 1924, p. 794, pl. xlvii, fig. 2.
Cyclopina longifurca, Kiefer, 1929, p. 16.

Originally described from specimens taken in the Chilka Lake in water that had a density of 997·0 at 31·5 C. Further examples have

been obtained from weed-washings in the sea at Tuticorin, South India, and also in the Canal system of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914.

Cyclopina minuta, sp. nov.

(Text-fig. 5, *a-f.*)

Examples of both sexes of a species of *Cyclopina* that appears to be new, were taken in the Hooghly River in water that was absolutely fresh.

♀: Total length: 0·433 to 0·500 mm.

The proportional lengths of the anterior and posterior regions of the body are as 5 to 4. The anterior end (Text-fig. 5*a*) is rounded. The cephalon and 1st thoracic segment are separate and the cephalon is equal in length to the whole five thoracic segments. The lateral margins of the thoracic segments are rounded and are not produced.

The abdomen consists of four free segments; segments 1 and 2 are fused together in the genital segment. The proportional lengths of the segments are as follows:—

Abdominal segment .	1-2	3	4	5	Furca.	
	39	14	12	18	17	=100

The anterior part of the genital segment is somewhat swollen and is grooved on the lateral margins. The anal segment is armed with a row of needle-like spines along the articulation of the furcal rami. The furcal rami are about twice as long as broad. Of the furcal setae four arise from the distal end and the 5th from about the middle of the outer margin. The inner seta is small and delicate and the 2nd seta is nearly twice as long as the third. The 4th and 5th setae are subequal and are about one-third the length of the 3rd.

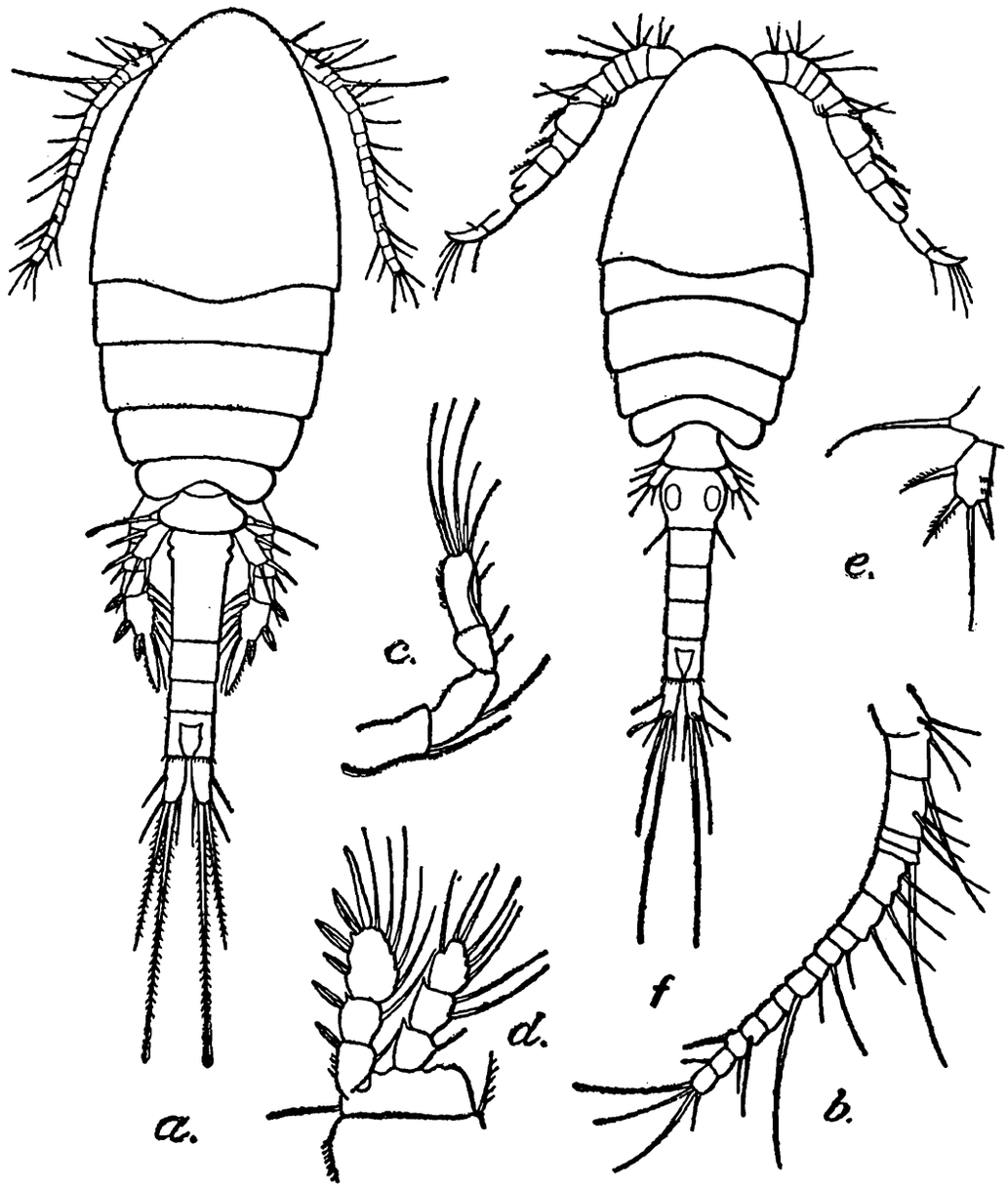
The 1st antenna (Text-fig. 5*b*) is only as long as the cephalic segment and consists of 17 segments, thus resembling *Cyclopina belgica* Giesbrecht and *C. pusilla* Sars. The three proximal joints are moderately long. Segments 1 and 2 appear to be fused. The second joint consists of the fused segments 3 and 4 and the 3rd of segments 5, 6 and 7 The next two joints are short, representing segments 8 and 9. The sixth joint is formed by the fusion of segments 10, 11 and 12. The seventh joint is about equal to the sixth, but is composed of only two segments, namely 13 and 14. Segments 15 to 23 are separate and segments 24 and 25 are fused.

In the 2nd antenna (Text-fig. 5*c*) the third segment is about half the length of the second; the terminal segment is considerably longer than the 3rd and is fringed along the distal half of its lower border with fine needle-like spines.

The mouth-parts and swimming-legs are similar to those of other members of the genus.

The 5th leg (Text-fig. 5*e*) consists of a basal segment that is fused with the thoracic segment and bears a long seta on its outer border; the free segment is comparatively short and stout and bears two spines

with a single seta between them on its distal margin and a third spine about the middle of the length of the outer margin; two short rows of fine needle-like spines run transversely across the inner aspect.



TEXT-FIG. 5.—*Cyclopina minuta*, sp. nov. *a*. Dorsal view of ♀; *b*. 1st antenna of ♀; *c*. 2nd antenna of ♀; *d*. 2nd swimming leg of ♀; *e*. 5th leg of ♀; *f*. Dorsal view of ♂.

Ovigerous females were carrying two egg-sacs each containing 6 or 7 ova.

♂: Total length 0·467 mm.

The proportional lengths of the anterior and posterior regions of the body are as 7 to 6.

As in the female, the anterior end is rounded and the cephalon is separate from the 1st thoracic segment (Text-fig. 5*f*).

The proportional lengths of the posterior regions of the body are as follows :—

Abdominal segment .	1	2	3	4	5	Furca.	
	22	15	15	13	17	18	=100

Family CYCLOPIDAE.

Sub-family HALYCYCLOPINAE.

Genus **Halicyclops** Norman.

Halicyclops aequoreus Fischer.

Halicyclops magniceps, Sars, 1913-18, p. 29, pl. xv.
Halicyclops magniceps, Sewell, 1924, p. 796.
Halicyclops aequoreus, Kiefer, 1929, p. 24, fig. 9.

I recorded the presence of this species, under the name *Halicyclops magniceps*, in the Chilka Lake. Examples have been taken in the present collections in the Canal system of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914, and at Uttarbhag (Sample 25) on 2nd January 1933.

Halicyclops propinquus Sars.

Halicyclops propinquus, Sars, 1905, p. 395, pl. xviii, figs. 135-149.

Several examples of a female *Halicyclops* that appears to agree exactly with Sars' species were taken in some of the pools at Uttarbhag (Sample 25) on 2nd January 1933.

Halicyclops tenuispina Sewell.

Halicyclops tenuispina, Sewell, 1924, p. 796, pl. xlvii, fig. 3.

This species was first described by me from the Chilka Lake. Examples have been taken in the present collections from a series of pools at Uttarbhag (Samples 23, 24 and 25) in January 1933, and also in the Canal system of the Salt Lakes at Chingrighatta on 19th October 1914.

Sub-family CYCLOPINAE.

Genus **Cyclops** Müller.

Sub-genus **Metacyclops** Kiefer.

Cyclops (Metacyclops) dengizicus Lepeschkin.

Cyclops buxtoni, Gurney, 1921, p. 840, pl. l.
Cyclops buxtoni, Sewell, 1924, p. 798.
Cyclops dengizicus, Gurney, 1927, p. 173.
Cyclops dengizicus, Kiefer, 1929, p. 73.

A single example of this species was taken in the Salt Lakes, Calcutta. I have previously recorded its occurrence in the Chilka Lake. According to Gurney (1921, p. 840) "the second joint of the exopodite of the first leg bears 3 spines, while that of each of the three following pairs bears four." In the present example the second joint of the exopod of the 4th leg bears only three spines, two marginal and one distal.

Genus **Mesocyclops** Sars.

Sub-genus **Mesocyclops** Kiefer.

Mesocyclops (Mesocyclops) leuckarti Claus.

(Text-fig. 6, *a-k.*)

Mesocyclops obsoletus, Sars, 1913-18, p. 58, pl. xxxv.
Cyclops aspericornis, v. Daday, 1906, p. 181, pl. xiv, figs. 1-6.
Mesocyclops obsoletus, Sewell, 1924, p. 798.

This species was comparatively common in the collection. Although the general structure of this species is well known, there are a number of subspecies that have been recorded from various parts of the world and it seems advisable, therefore, to give a fairly comprehensive account of the form from the Museum Tank.

♀: Total length : this varies from 1·022 mm. to 1·289 mm.

The specimens appear at first sight to fall into two quite distinct groups according to the general shape of the body ; in the first group, that are slightly less in length, the anterior region of the body is of an oval shape that agrees well with the figure given by Schmeil (*loc. cit.*, Pl. iii, fig. 1) and Sars and there is a fairly well marked line of demarcation between the anterior and posterior regions of the body. In the second group, that is slightly longer, the body is much more gradually tapered and there is less distinction in the transverse diameters of the body and tail regions, the two passing gradually into each other. I have been completely unable to detect any structural differences, sufficiently great to warrant their separation, between the two forms and this difference of shape would appear to be due entirely to the degree of contraction of the body muscles.

The proportional lengths of the anterior and posterior regions of the body are as 1·421 to 1·00 while the proportion of the cephalic segment to the whole body is as 34 to 81.

The posterior region of the body consists of five segments, of which the most anterior belongs to the thorax. The proportional lengths of the various segments of the abdomen are as follows :—

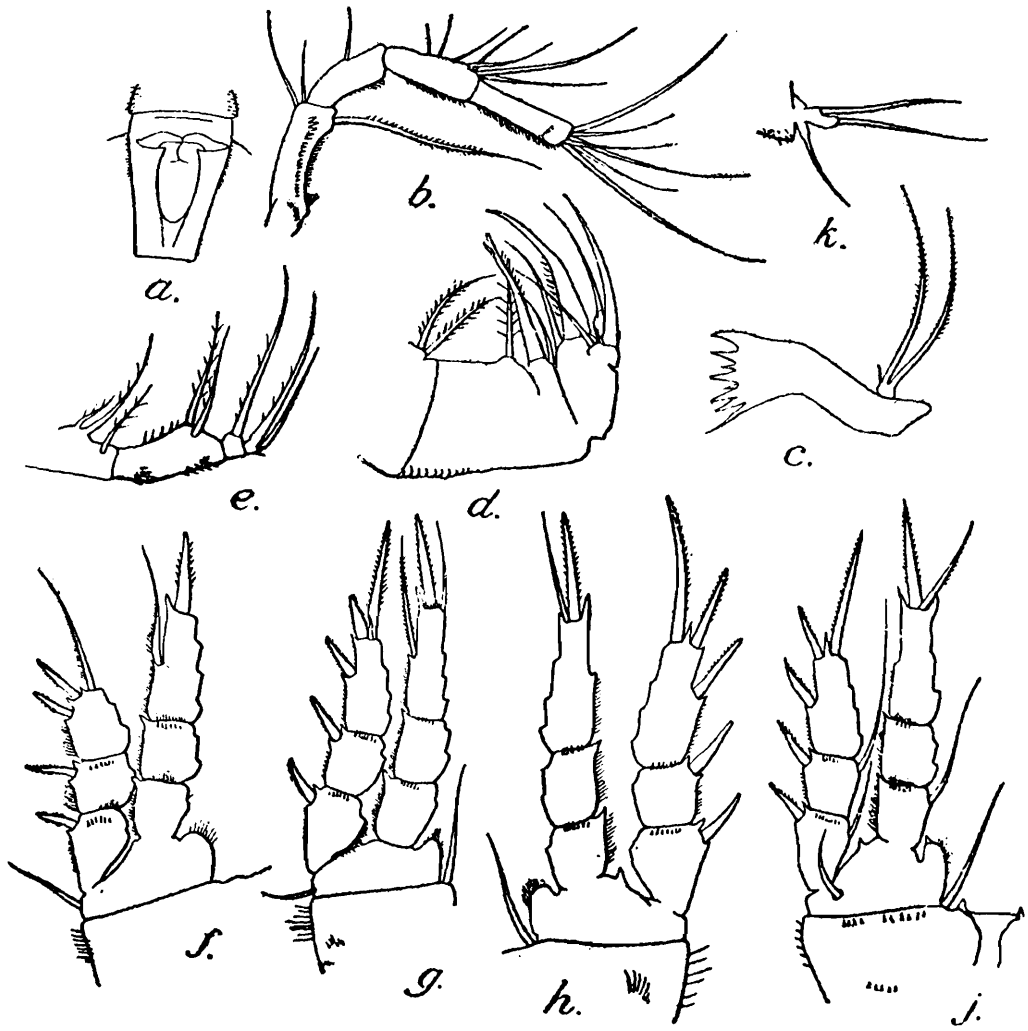
Abdominal segment .	1-2	3	4	5	Furca.	
	37	17	14	11	21	=100

The lateral regions of the 5th thoracic segment bear a number of small spines. The lateral aspect of the genital segment (Text fig. 6 *a*) is fringed with fine hairs and the posterior margin of the 5th abdominal segment, where it articulates with the furcal rami, is armed with a row of small spines.

The 1st antenna reaches back as far as the posterior margin of the 4th thoracic segment in the smaller and more rounded form, and to the posterior margin of the 3rd segment in the more elongate form. In both cases the appendage consists of seventeen free segments. The proportional lengths are as follows :—

Segment	1	2	3	4	5	6	7	8	9	
	156	42	15	71	48	23	69	33	40	
	10	11	12	13	14	15	16	17		
	42	42	54	44	42	65	111	103		=1000

The first three segments are devoid of any spinous armature but segments 4 to 14 all carry a number of minute spines; these are arranged transversely, either in bands or lines on segments 4-6 and the proximal half of 7; on segments 7 (distal half) to 12 there is on each segment a



TEXT-FIG. 6.—*Mesocyclops* (*Mesocyclops*) *lenckarti* (claus), ♀; *a*. Genital segment of abdomen; *b*. 2nd antenna; *c*. Mandible; *d*. 2nd Maxilla; *e*. Maxilliped; *f*. 1st swimming leg; *g*. 2nd swimming leg; *h*. 3rd swimming leg; *j*. 4th swimming leg; *k*. 5th leg.

broad patch composed in the main of transverse rows of spines and a transverse row of spines along the distal margin; on segments 13 and 14 there is a longitudinal row of spines and a small transverse row along the distal margin. Segments 16 and 17 each bear a transparent lamella, that on the terminal segment showing very clearly the characteristic semilunar break in the contour. The margin of this lamella on the terminal segment is not plain, as figured by most previous workers, but is finely crenated. Schmeil (*loc. cit.* p. 63) has called attention to this feature and in his description states "der des siebzehnten dagegen ist fein gesagt und zeigt zu Beginn des letzten Drittels einen bei allen Individuen anzutreffenden brosseren Ausschnitt"

The 2nd antenna (Text-fig. 6*b*) is long and slender. The lst segment is armed with several rows of spines, of which three are composed of fine

needle-like spines and the fourth that runs along the lateral aspect is composed of triangular spines that increase in size distally. The 2nd and 3rd segments are both armed with a row of needle-like spines along their posterior margins. In the 4th segment there are two such rows ; the proximal is by far the longer and passes along the proximal three-fourths of the posterior margin and then turns across the face of the segment in a transverse direction. The smaller distal row commences in the posterior fourth of the segment and after a short course turns across the face of the segment near the distal margin.

The labrum is bordered with a row of teeth-like processes ; commencing from the outer margin of one side, there is a rounded process separated by a small gap from the others, then comes a small process that is followed by a process that is about twice the size of the others ; between these two large processes are six smaller processes.

The mandible (Text-fig. 6*c*) closely resembles that of *Cyclops strenuus* Fischer as figured by Sars (1913-18. Pl. xvi).

The 1st maxilla is as figured.

The 2nd maxilla (Text-fig. 6*d*) shows an interesting difference in the two types. In the smaller form with the characteristic oval body the crenulations on the posterior margin are very inconspicuous or absent altogether, being only indicated by a series of parallel markings near the margin ; in the larger and more tapering form the crenulations are present and well marked. In all other respects the appendages are identical.

The maxilliped (Text-fig. 6*e*) bears two patches of triangular spines on the posterior margin of the 2nd segment, as indicated by Schmeil (*loc. cit.* 1892, P. iii, fig. 4).

In the 1st swimming leg (Text-fig. 6*f*) the 1st basal bears a single inner seta and is fringed on its outer margin with a number of fine hairs. The 2nd basal segment carries an outer seta and internally is produced in a rounded lobe that is fringed with hairs ; on its posterior aspect are two rows of spines, one running along the margin of the articulation with the 1st segment of the endopod and the second in a curve near the articulation of the basal segment of the exopod. Each ramus consists of three segments and the exopod only reaches as far as the level of the point of origin of the outer seta on the terminal segment of the endopod. In the exopod the segments bear 1, 1, and 2 marginal spines that, though serrated, are less strongly developed than those of the posterior pairs ; the end spine is long and slender and is finely serrated along its outer margin. Exopod 1 and 2 each bear a row of small triangular spines across the posterior aspect near the articulation with the next segment. Exopod 1 is fringed along its outer margin with fine spines, while exopod 2 and the proximal part of exopod 3 are fringed with hairs.

In the 2nd swimming leg (Text-fig. 6*g*) the 1st basal segment bears two short rows of small spines on the surface near the proximal part of the outer margin, and the distal part of the margin is fringed with scattered long fine hairs. A single seta arises from the distal inner angle. The 2nd basal segment bears a single external seta and the inner margin is produced distally in a rounded eminence that is fringed with delicate

hairs. In the 1st segment of the exopod the inner margin is fringed with delicate hairs and the outer margin with minute spines; a row of small triangular spines runs across the surface near the distal margin and the margin itself is fringed with delicate hairs. The 2nd segment is also fringed along its outer margin with fine spines, and bears a row of small triangular spines across its surface distally. In the endopod both the 1st and 2nd segments bear a row of small spines across the surface near the distal margin.

The 3rd swimming leg (Text-fig. 6*h*) closely resembles the 2nd.

In the 4th swimming leg (Text-fig. 6*j*) the 1st basal segment bears a short row of small triangular spines on the proximal part of its surface, and an interrupted row near the distal margin. The 1st and 2nd segments of both the exopod and endopod bear a row of small spines near the distal margin.

The 5th leg (Text-fig. 6*k*) is of the type figured by Sars and others.

Sub-genus **Thermocyclops** Kiefer.

Mesocyclops (Thermocyclops) rylovi Smirnov.

(Text-fig. 7, *a-d.*)

Mesocyclops rylovi, Smirnov, 1929, p. 38, figs. 1-5.
Mesocyclops oithonoides, Sewell, 1924, p. 799.
Mesocyclops (Thermocyclops) rylovi, Kiefer, 1929, p. 85.

In the *oithonoides-hyalinus* group of species of the genus Mesocyclops, that Kiefer has created into a separate sub-genus *Thermocyclops*, are at least fourteen species that differ from one another only in minute details of structure.

I have carefully examined the present form and compared it with the description and figures given by previous authors. Kiefer (1929, p. 397) has stated that so far as his experience goes he has never seen *Cyclops oithonoides* in any collection from South Africa, India, the Sunda Islands and New Zealand that he has examined; in every case the species present has been either *Mesocyclops hyalinus* or some species very nearly related to it. In my account of the Copepoda of the Chilka Lake (Sewell, 1924) I recorded the presence there of *Mesocyclops oithonoides*, as I followed the nomenclature given by Sars in his account of the Crustacea of Norway (1914, p. 59) in which he gives *Mesocyclops hyalinus*, as a synonym of *M. oithonoides*. A further study of these specimens has shown that they undoubtedly belong to the *hyalinus* group.

The present form possesses the following characters:

♀: Total length about 1·0 mm.

The proportional lengths of the anterior and posterior regions of the body (Text-fig. 7 *a*) are as 1·528 to 1.

The proportional lengths of the abdominal segments are as follows:—

Abdominal segment .	1-2	3	4	5	Furca.	
	37	17	14	11	21	= 100

The furcal rami are slightly divergent and are 3½ times as long as wide. The outer furcal seta arises at the junction of the middle and distal

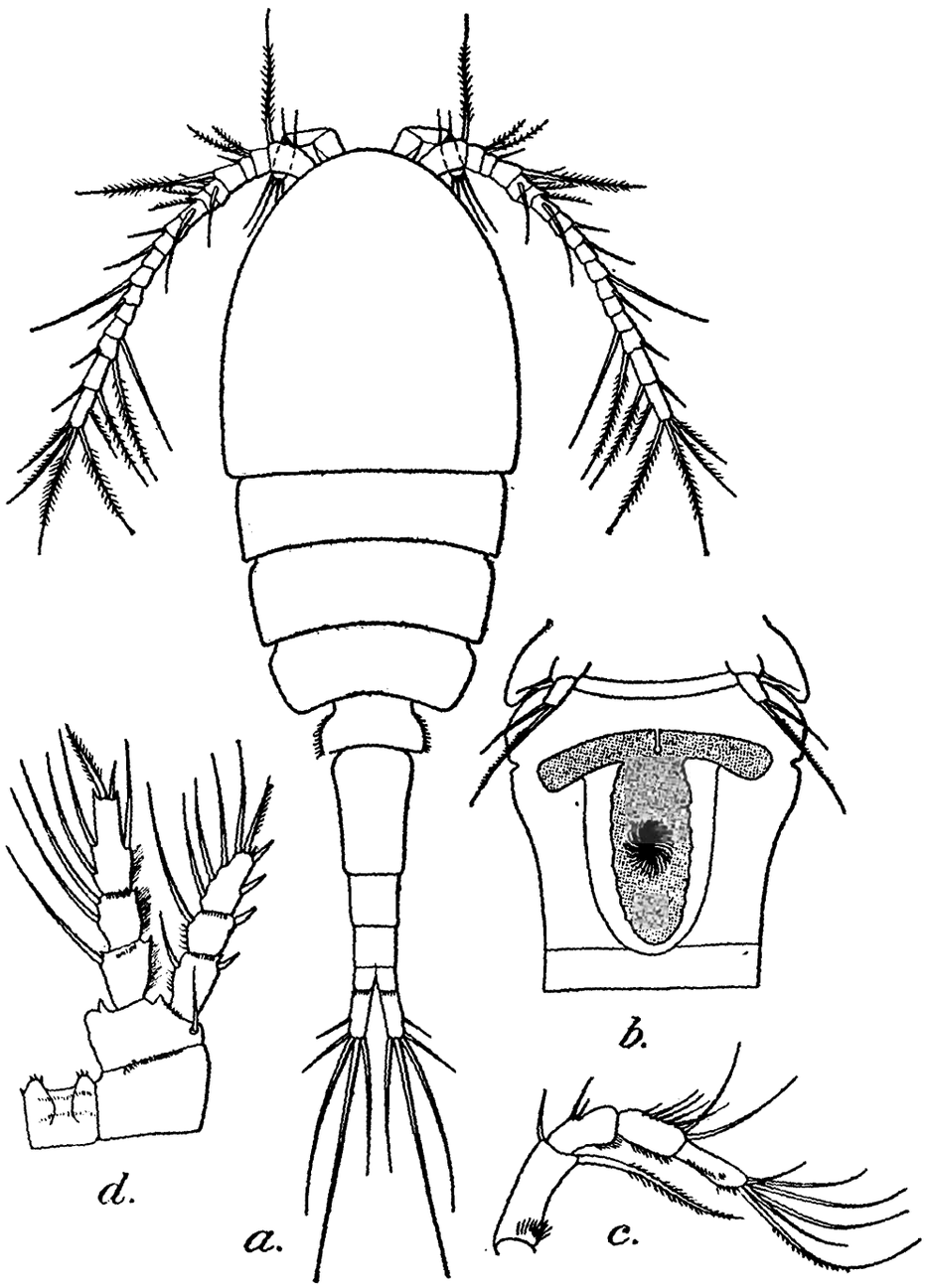
thirds of the ramus. The proportional lengths of the furcal setae are as follows :—

Seta.	1	2	3	4	5	Dorsal Accessory.
	32	57	50	13	6	15

The proportion of the 1st to the 3rd being as 1 : 1·562.

The lateral margins of the 5th thoracic segment are covered with fine hairs.

The 1st antenna consists of 17 segments of which the last bears several transverse rows of minute spinules.



TEXT-FIG. 7.—*Mesocyclops (Thermocyclops) rylovi* Smirnov, ♀; *a*. Dorsal view ; *b*. ventral view of genital segment ; *c*. 2nd antenna ; *d*. 4th swimming leg.

The swimming legs appear to resemble exactly those of *M. rylovi*. The 1st swimming leg is comparatively robust. The connecting lamella

is provided with a rounded eminence on each side, which bears four or five small spines. The 1st basal segment bears an inner seta on a slight projection at its distal inner angle, and there is a patch of hair on the outer margin towards the proximal end. The 2nd basal segment bears an inner and an outer seta of about equal length; the rounded inner margin is fringed with hairs and there is a row of five or six small spines along the articulation for the endopod. Exopod 1 bears a single inner seta that is somewhat shorter than the inner setae of the succeeding segments. The outer margin is fringed with minute spines and a row of small spines runs across the surface parallel to the articulation with exopod 2. There is a similar row of small spines across the surface in exopod 2. All the marginal spines are subequal.

In the 4th swimming leg (Text-fig. 7*d*) the connecting plate is traversed by two rows of minute spinules and on each side there is a rounded prominence that bears three small spines. A row of spines runs along the line of articulation with basal 2. This latter segment is produced on its inner distal part in a rounded swelling that is further produced into a sharp spinous process; a row of minute spinules runs along the articulation with exopod 1 and the external marginal seta is short. In the exopod both the 1st and 2nd segments carry a row of minute spines along the articulation with the distal segment. In the endopod there is also a row of even more fine spines along the distal margins of segments 1 and 2. The two end spines are markedly unequal, though not as much so as in *Mesocyclops oithonoides*; the outer spine is slightly less than half the length of the inner.

In the 5th leg the seta on the basal segment is short and the outer seta on the free segment is considerably shorter than the inner spine.

These examples appear to agree with the form described by Smirnov under the name *Mesocyclops rylovi*. This species is widely distributed around Calcutta and occurs in samples 9, 12, 15-18, 20, 21, and 25. It has previously been recorded by me from the Chilka Lake. It appears to be an inhabitant of slightly brackish water, though occasionally occurring in water that is absolutely fresh, as the Tank in the Indian Museum.

HARPACTICOIDA.

Family ECTINOSOMIDAE.

Genus **Ectinosoma** Boeck.

Ectinosoma melaniceps Boeck.

Ectinosoma melaniceps, Sewell, 1924, p. 809.

This species was recorded by me from the Chilka Lake, so that its occurrence in the Salt Lakes, Calcutta, is not a matter for surprise. As Sars (1905, p. 380) has pointed out there is a very close resemblance between this species and the Southern form, *Ectinosoma australe* Brady (=*E. antarctica* Giesbrecht) and I am not by any means certain that these Indian examples should not be referred to the Southern form.

Family TEGASTIDAE.

Genus **Parategastes** Sars.

Parategastes sphaericus var. **similis** Sewell.

Parategastes sphaericus var. *similis*, Sewell, 1924, p. 815, pl. li, fig. 2; pl. lii, fig. 2.

A single example of what I take to be this species was found in the tow-netting from a large pool at Uttarbhag (sample 25). Up to the present time this variety has only been taken in the Chilka Lake.

Family DIOSACCIDAE.

Genus **Stenhelia** Boeck.

Stenhelia longifurca, sp. nov.

(Text-fig. 8, *a-j*).

Specimens of a *Stenhelia*, that appear to represent a new species, were taken in pools at Uttarbhag in samples 23 and 25 and one example, a female, at Chingrighatta on 19th October 1914. Several examples occurred in sample 26 from the Piali river.

♀: Total length 0·708 mm.

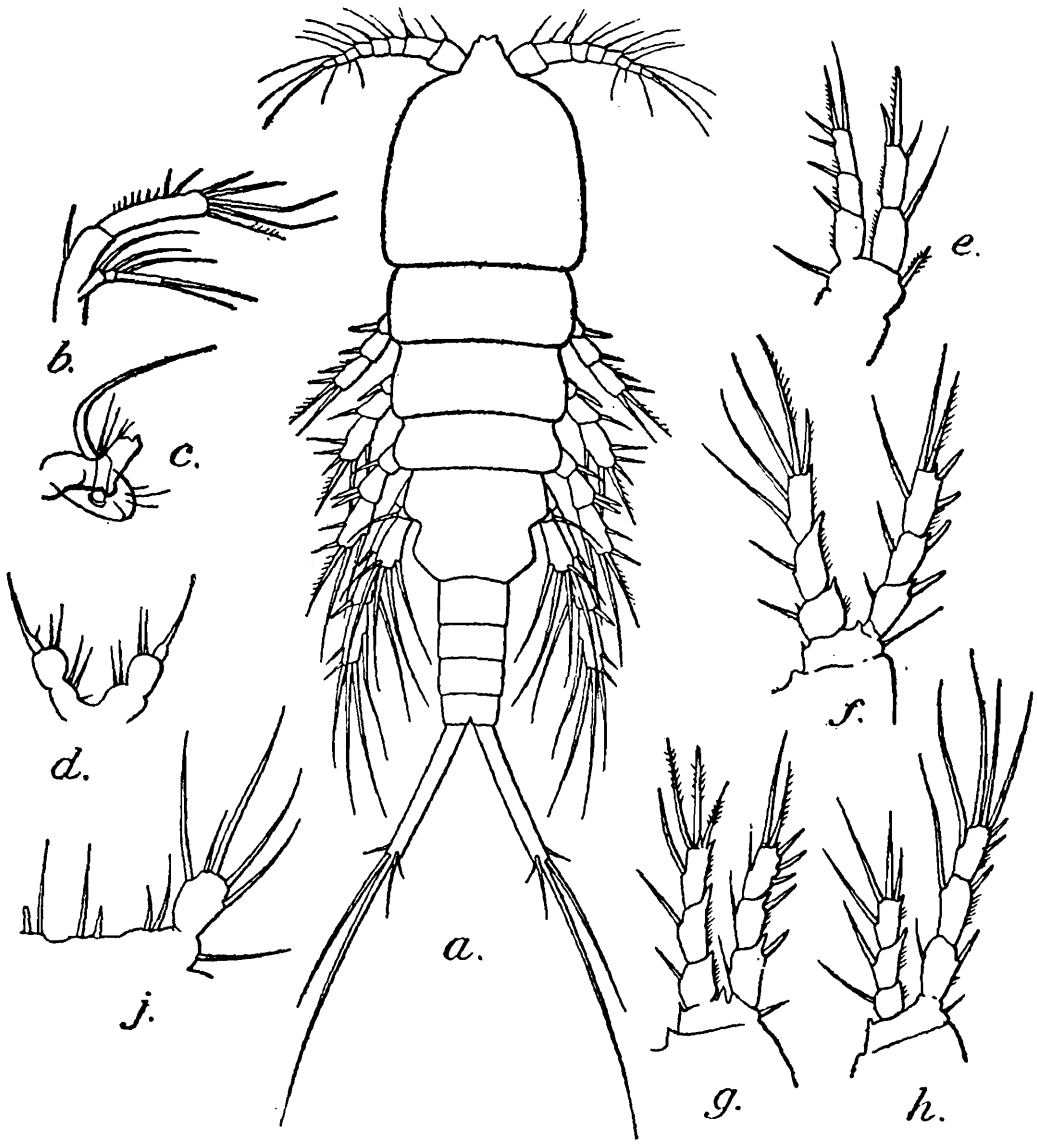
The proportional lengths of the anterior and posterior regions of the body are as 1·045 to 1. The anterior region of the body (Text-fig. 8 *a*) is comparatively robust. The cephalic segment bears anteriorly a broad rostrum that terminates anteriorly in a pair of rounded protuberances. The urosome is much shorter than the anterior region of the body and is much narrower; it tapers somewhat towards the posterior end and posteriorly bears a pair of elongate and divergent furcal rami. The furcal rami are long, being almost equal in length to half the length of the abdominal segments. In its general appearance this species closely resembles *Stenheliopsis divaricata* Sars, but the structure of the appendages clearly demonstrates that it is a member of the genus *Stenhelia*.

The 1st antenna consists of 8 segments, bearing a number of setae; the appendage is short and reaches back but a little beyond the middle of the cephalic segment.

The 2nd antenna (Text-fig. 8 *b*) possesses the structure found in other members of the genus; the two rami are markedly unequal. The outer ramus is slender and is about equal in length to the distal segment of the inner ramus; it consists of three segments, of which the middle one is small. The basal segment bears a single seta; the middle segment also carries a single seta and the terminal segment bears one seta near the base and a pair of setae arise from the distal extremity. The two segments of the inner ramus are of about equal length. The proximal segment bears a single seta on its outer margin. The distal segment bears two short spines on its anterior border, arising close together at about the junction of the middle and distal thirds of the joint, and at the distal end are two spines, two geniculate setae and a single straight seta. The anterior margin, proximal to the origin of the two spines, is armed with a row of six or seven needle-like spinules.

The mandible (Text-fig. 8*c*) exhibits the structure characteristic of the genus.

The 1st and 2nd maxillae are of the usual type.



TEXT-FIG. 8.—*Stenhelia longifurca*, sp. nov. ♀. *a*. Dorsal view; *b*. 2nd antenna; *c*. Mandible; *d*. Maxilliped; *e*. 1st swimming leg; *f*. 2nd swimming leg; *g*. 3rd swimming leg; *h*. 4th swimming leg; *j*. 5th leg.

The maxilliped (Text-fig. 8*d*) closely resembles that of *Stenhelia gibba* Boeck, as figured by Sars (1903, pl. cxix, mp_2) and of *Stenhelia inopinata* (A. Scott), as figured by me (1924), pl. liii, $2mp^2$)

In the 1st swimming leg (Text-fig. 8 *e*) the second basal segment bears a slender seta externally and a stout spine on its inner margin. The exopod consists of three segments, of which the 1st and 2nd each bear a marginal spine externally but no seta on the inner margin. The 3rd segment bears two spines on its outer margin and a spine and seta distally. The endopod consists of only two segments; the proximal bears a single seta internally and the distal segment bears one seta on its inner margin and two distally of which the inner is stout and spine-like.

The rest of the swimming legs (Text-figs. 8*f*, *g* and *h*) all have a three-jointed exopod and endopod. In the 2nd leg the 1st basal segment is

produced at its inner distal angle in a rounded prominence. The 2nd basal segment bears a spine-like process on its inner margin and a second spine-like process is situated between the articulation of the two rami; a slender seta arises from the outer margin. In the exopod the 1st and 2nd segments each bear a single marginal spine and a slender seta arises from the inner border; this seta is especially delicate in the 1st segment. The 3rd segment carries two marginal spines and an end-spine, two setae arise from the segment, one from the inner margin and one distally. In the endopod the segments bear 1, 1, and 5 setae respectively.

The 3rd leg (Text-fig. 8*g*) resembles the 2nd, except that the 3rd segment of the exopod bears three marginal spines instead of only two and all three inner setae are delicate. The segments of the endopod bear 1, 1, and 4 setae, all of which are stout and spine-like.

In the 4th leg (Text-fig. 8*h*) the exopod is nearly twice the length of the endopod; segment 1 bears a single marginal spine and a very delicate inner seta; segment 2 bears one spine externally and a well developed seta on its inner border; segment 3 has two marginal spines and a stout end-spine, while two setae arise from the distal margin and one from the inner border. In the endopod the segments bear 1, 1, and 4 setae, all of which are stout and spine-like.

In the 5th leg (Text-fig. 8*i*) the basal segment bears a slender seta on its outer margin and four setae arise in two pairs from the posterior border; the free segment bears five setae, of which one arises from the outer margin, three from the distal margin and one from the inner border; of the three arising from the distal margin the innermost is much smaller and more delicate than the other two.

Family CANTHOCAMPTIDAE.

Genus **Mesochra** Boeck.

Mesochra meridionalis Sars.

(Text-fig. 9, *a-f*.)

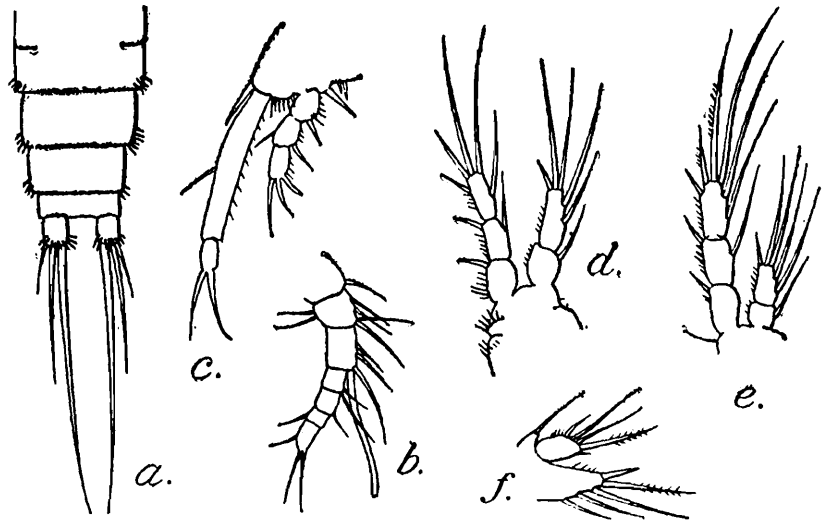
Mesochra meridionalis, Sars, 1905, p. 389, pl. XVII, figs. 87-102.

Two examples of a species of *Mesochra*, that appears to be so similar to the species described by Sars from the brackish water of Chatham Island that I have little doubt that they are the same, were taken in the Salt Lake Canal System at Chingrighatta on 19th October 1914.

♀: Total length 0·375 mm. This is somewhat smaller than Sars' examples, which measured 0·48 mm.

In the general shape and proportions of the body the present examples agree closely with Sars' description. The genital segment of the abdomen (Text-fig. 9*a*) is considerably longer than the following segments and is indistinctly subdivided near the lateral margin. The anal segment is much the shortest. The furcal rami are about as broad as long and are fringed along their distal margin with a row of delicate spines. Of the furcal setae the outer is quite small and of the two distal setae the inner is twice the length of the outer and is as long as the abdomen.

The 1st antenna (Text-fig. 9*b*) is short and is composed of seven segments, of which the proximal three are considerably stouter than the



TEXT-FIG. 9.—*Mesochra meridionalis* Sars, ♀. *a*. Dorsal view of abdominal segments; *b*. 1st antenna; *c*. 1st swimming leg; *d*. 2nd swimming leg; *e*. 4th swimming leg; *f*. 5th leg.

distal four. The 1st and 2nd segments are of about equal length and the 3rd is considerably longer. The 3rd segment bears a long sensory filament. The 2nd antenna appears to resemble the figure given by Sars (*loc. cit.*, pl. xvii, fig. 91); the 2nd segment of the endopod bears two spines on its anterior margin and a longer spine arises from the distal anterior angle, two geniculate setae and a single straight seta arise from the distal end. I was unable to see the exopod.

The mouth-parts appear to resemble the description given by Sars.

The 1st swimming leg (Text-fig. 9*c*) closely resembles that of *Mesochra meridionalis* and *M. timsae* Gurney (1927, p. 540, fig. 151, C) so far as the proportions of the endopod and exopod are concerned, but differs from both in that the 3rd segment of the exopod bears only three spines and appears to be devoid of the inner seta which in the other species arises from the distal inner angle.

The 2nd, 3rd and 4th swimming legs (Text-fig. 9 *d*, *e*) agree closely with the description given by Sars and the exopod presents the following formula :—

	Exopod.		
Joints	1	2	3
Leg 2	0	1	1·1·3
Leg 3	0	1	2·1·3
Leg 4	0	1	2·1·3

As Gurney has pointed out (*loc. cit.*, p. 540, 541) the form described by him under the name *Mesochra timsae* from the Suez Canal differs from *M. meridionalis*, and, therefore, from the present examples, in that the exopod of each of the swimming legs 2-4 bears four spines, three marginal and one distal, on the 3rd segment.

The 5th leg (Text-fig. 9*f*) closely resembles the description given by Sars (*loc. cit.*, p. 390 and fig. 100). The basal segment bears a fine seta

on its outer margin. The free segment is somewhat more pyriform than as figured by Sars, but the number and arrangement of the spines and setae that arise from the distal end are exactly similar. Two fine setae arise between two stout spines, of which the outer is much the shorter. The prolongation of the basal plate extends as far as or slightly further than the end of the free segment and bears five spines, of which two arise from the distal margin and three from the inner border. The innermost spine is considerably shorter than the next and is even shorter than is figured by Sars.

Although the present specimens differ in one or two small details of structure from Sars' specimens, the general resemblance is so close that I have little hesitation in referring them to the same species.

CHIROGNATHA.

Family LAOPHONTIDAE.

Genus **Laophonte** Philippi.

Laophonte bengalensis, sp. nov.

(Text-fig. 10, *a-k.*)

♀ Total length 0·563.

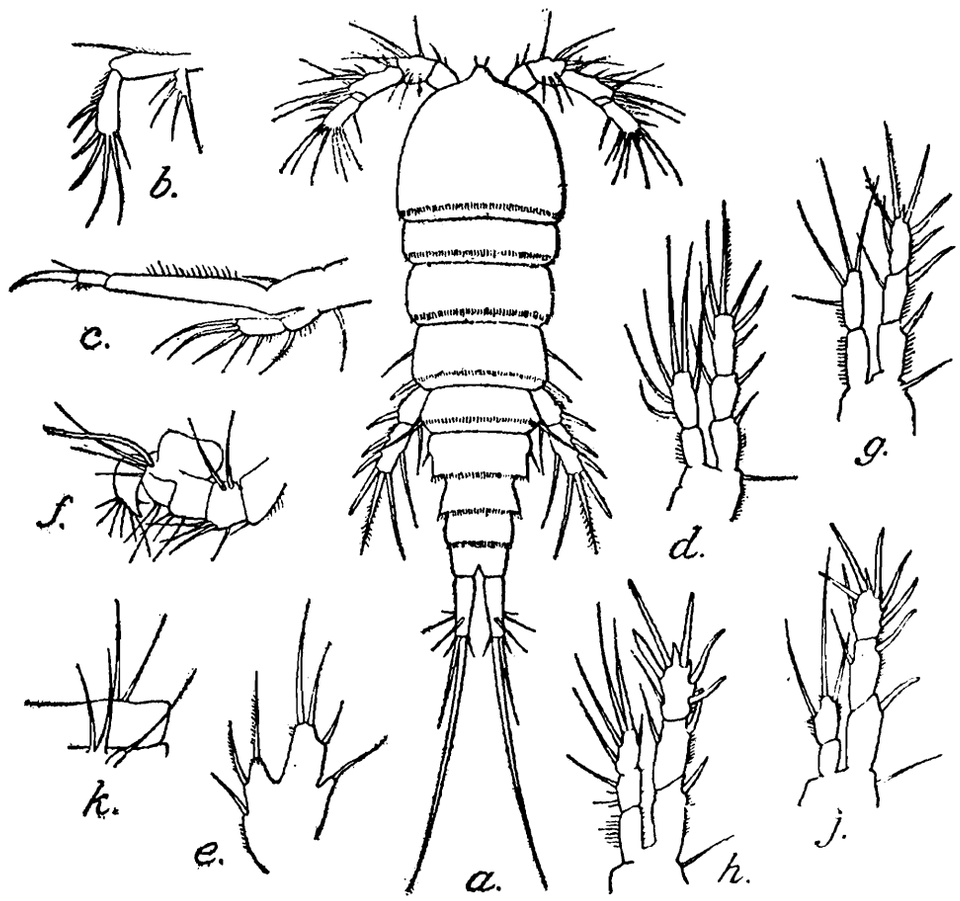
In all the specimens that I have examined the segmentation of the body is complete ; there are four free thoracic segments present but the abdomen consists of four segments only.

The anterior margin of the cephalon (Text-fig. 10*a*) is rounded and bears in the middle line a somewhat truncated rostrum, that carries a pair of extremely small setae. The lateral margins of the thoracic segments are parallel or slightly divergent ; each segment is widely separated from the segment immediately following it. The posterior thoracic margins are unarmed with rows of minute spines.

In the abdomen the 1st segment is produced into sharp points and so also is the 2nd. The anterior three segments are all provided along their posterior margins with a row of minute spinules. The anal segment narrows somewhat towards the posterior end. The furcal rami are about one-and-a-half times as long as the anal segment. The margin seta arises a little beyond the middle of the segment. Of the four distal setae the outer and inner are small, the 3rd seta is about two-and-a-half times as long as the 4th, and the 2nd seta is stout and is at least as long as the whole abdomen.

The 1st antenna consists of five segments only ; of these the 1st and 2nd are of approximately equal length ; the 3rd segment is the longest and is produced at its anterior distal angle in a stout process bearing a delicate seta and a sensory filament ; the 4th segment is small and the line of demarcation from the 5th is not very clearly marked. The terminal segment is about as long as the third. In its general characters the antenna closely resembles the corresponding organ in *Laophonte mohammed* Guerne and Richard and *Laophonte chathamensis* Sars.

The 2nd antenna (Text-fig. 10*b*) is also very similar to this organ in the same two species. The outer ramus is short and bears four setae



TEXT-FIG. 10.—*Laophonte bengalensis*, sp. nov. *a*. Dorsal view of ♀; *b*. 2nd antenna of ♀; *c*. 1st swimming leg of ♀; *d*. 3rd swimming leg of ♀; *e*. 5th leg of ♀; *f*. Grasping antenna of ♂; *g*. 2nd swimming leg of ♂; *h*. 3rd swimming leg of ♂; *j*. 4th swimming leg of ♂; *k*. 5th leg and genital armature of ♂.

of approximately equal length. The inner ramus consists of two joints; the distal is of moderate length and bears four spines on its margin, of which the proximal two arise close together. Two geniculate setae arise from the distal end and a smaller simple seta from the distal lower angle. The inner margins of both segments are provided with a row of spines.

The mouth-parts, so far as I have been able to examine them, appear to resemble those of other members of the genus. The maxilliped bears a stout claw-like distal segment that reaches back to the end of the preceding segment.

In the 1st pair of legs (Text-fig. 10*c*) the exopod consists of only two segments and reaches to about the junction of the proximal and 2nd quarter of the length of the proximal segment of the endopod; the 1st segment carries three spines and two geniculate setae. The endopod consists of two segments of which the proximal is long, the distal segment is small and bears a stout claw-like spine.

All four pairs of swimming legs (Text-fig. 10*d*) consist of a three-jointed exopod and a two-jointed endopod. The arrangement of the

setae and spines on the various segments of the limbs is as follows :—

	Endopod.		Exopod.		
	1	2	1	2	3
P. 2	0	4	0	1	1·1·4
P. 3	0	6	0	1	1·1·4
P. 4	0	3	0	1	1·1·4

Thus in the endopod there is no seta on the 1st segment in any leg ; the second segment bears 4 setae in the 2nd leg, 6 in the third and 3 in the fourth. In the exopod the 1st segment is without a seta in all the legs ; the second segment in all bears a single seta on its inner margin and one at the distal end while in each leg there are three marginal spines and an end-spine making a total of four. There is a slight difference between this arrangement and that seen in *Laophonte chathamensis* in which the formula for the 3rd leg is

	Endopod.		Exopod.		
	1	2	1	2	3
P. 3	0	6	0	0	1·1·4

In the 5th pair of legs (Text-fig. 10*e*) the segmentation of the appendage is not complete ; the two rami being fused into a single plate. The basal portion bears three setae on its inner margin and a single seta arises from a prominence on the outer margin. The projecting portion of the appendage, that corresponds to the usual free segment, bears three setae, two from the distal end and one from the outer margin.

♂ Total length, 0·479 mm.

The general form of the body closely resembles that of the female ; there are five segments in the abdomen.

The anterior antennae (Text-fig. 10*f*) are modified into grasping organs that closely resemble those of other members of the genus.

The 3rd pair of swimming legs (Text-fig. 10*h*), as usual in this genus, differs from that of the female in that the endopod consists of three segments instead of two ; in this sex the second segment bears a single inner seta and the terminal segment carries 5. In the 3rd and 4th pairs of legs (Text-fig. 10*j*) the exopods are more stoutly developed than in the female and the terminal segment tends to bend inwards towards the middle line.

The 5th pair of legs (Text-fig. 10*k*) appears to be reduced to a small projection near the posterior margin of the segment, that bears internally two setae and at the external angle of the plate a short process from which a single seta arises. The posterior margin of the 1st abdominal segment is armed with a pair of setae.

Family CLETODIDAE.

Genus **Limnocletodes** Borutzky.

This genus was created by Borutzky (1926) to accommodate a new species that he obtained from the Volga River and its delta. Unfor-

tunately Borutzky's paper is in the Russian language; he, however, gives a summary in German and a perusal of this and a comparison of the present form with his figures leaves no doubt that in the collection from the Salt Lake system we have a second and very closely allied species to *Limnocletodes behningi* Borutzky.

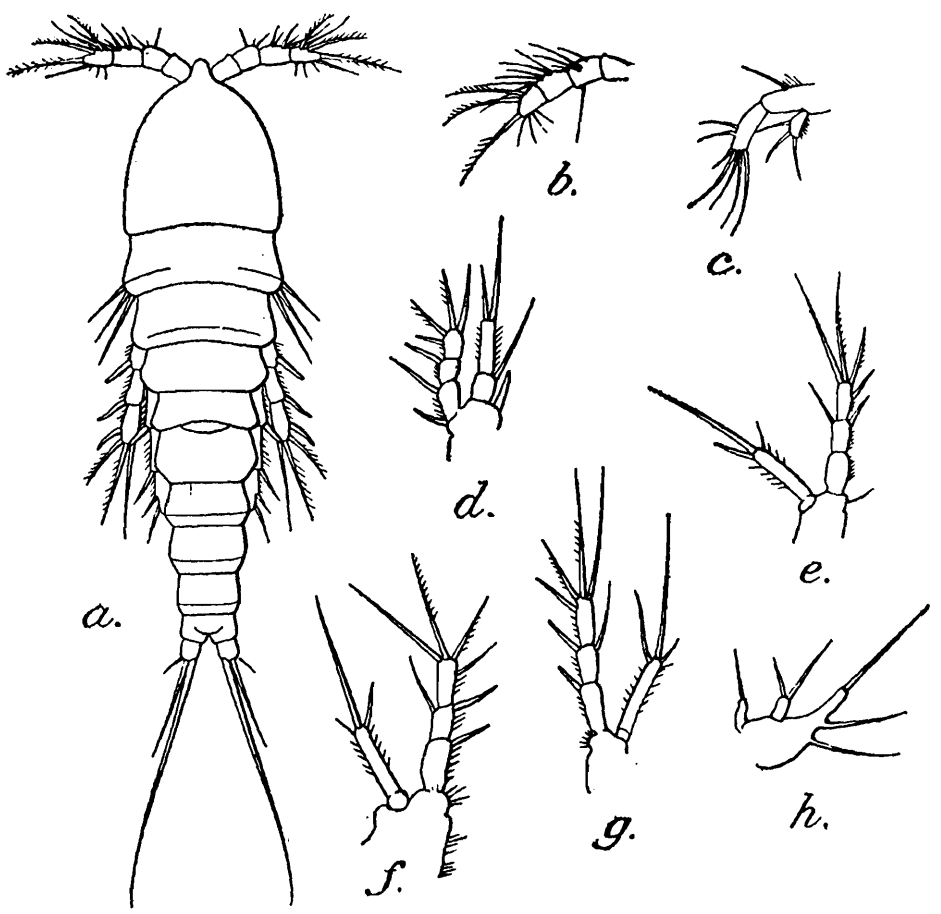
Limnocletodes secundus, sp. nov.

(Text-fig. 11, *a-h.*)

Several examples of what appears to be a new species of the genus *Limnocletodes* were taken in a shallow pool, almost dried up, alongside the road at mile 4 from Baruipur on the way to Uttarbhag (Sample 23).

♀ Total length, 0·458 mm. to 0·427 mm.

The body (Text-fig. 11*a*) is slender and tapers towards the posterior end. At the anterior end in the middle line is a small rounded rostal



TEXT-FIG. 11.—*Limnocletodes secundus,* sp. nov. ♀. *a.* Dorsal view; *b.* 1st antenna; *c.* 2nd antenna; *d.* 1st swimming leg; *e.* 2nd swimming leg; *f.* 3rd swimming leg; *g.* 4th swimming leg; *h.* 5th leg.

projection. The genital segment is large and has the appearance of being divided into two by a tansverse suture; the furcal rami are shorter than the anal segment and bear a minute seta at the distal outer angle, while two unequal setae spring from the distal margin.

The 1st antenna (Text-fig. 11*b*) appears to consist of four segments only. The 3rd and 4th segments are thickly fringed with setae and from the terminal segment spring three comb-like setae.

The 2nd antenna (Text-fig. 11*c*) differs from that in the genus *Cletodes* in that the outer ramus is present and bears three setae.

The mouth-parts appear to be feebly developed.

The 1st swimming leg (Text-fig. 11*d*) consists of a two-jointed basal portion, a three-jointed exopod and a two-jointed endopod. The second basal segment bears a stout spine-like seta externally and a stout spine internally. Exopod 1 and 2 each bear a marginal spine, but are without an inner seta. Exopod 3 bears two marginal spines and an end-spine and a single seta arises from the distal border. The endopod is about as long as the exopod but owing to the projection of the basal segment appears to be longer ; it consists of two segments, of which the proximal is comparatively stout and bears a single inner seta ; the distal segment is long and cylindrical and is fringed on both borders with fine hairs ; it carries two unequal setae at its distal end.

In the 2nd, 3rd and 4th swimming legs (Text-fig. 11, *e*, *f* and *g*) the structure is identical. Each appendage consists of a three-jointed exopod and a slender cylindrical endopod having two segments of which the proximal is very short. In each case the 1st segment of the exopod and the proximal segment of the endopod are devoid of setae. The distal segment of the endopod bears terminally three setae of which the inner and outer are short and the middle seta long and spine-like.

The 5th pair of legs (Text-fig. 11*h*) appears to be quite characteristic, the basal segment bears externally a single seta mounted on an elongate process ; the plate itself is almost pyriform in outline and bears two setae on its inner margin and a single spine-like seta distally. The free segment is considerably reduced and bears distally two unequal setae.

An interesting feature of this species is its susceptibility to infection by a protozoan that appears to be a species of *Acineta*. At least nine out of ten examples are infected with this symbiont. In some cases the *Acineta* arose separately from a short stem, while in other instances there was a common delicate stalk from which a number of individuals arose.

Genus **Cletocamptus** Schmankewitsch.

Cletocamptus confluens (Schmeil).

Cletocamptus confluens, Gurney, 1927, p. 563, fig. 164.
Cletocamptus confluens, Borutzky, 1931, p. 88, fig. 25.

Several examples of the female of this species were taken in the Piali River.

As Gurney has pointed out, the closely allied species, *C. retrogressus* Schmankewitsch, " is a species of extreme tolerance of varying salinity, characteristic of inland pools of moderately high salinity, it has been taken in water of almost maximum density and even, as here, in almost fresh water." It would seem that *C. confluens* (Schmeil) also possesses a high degree of adaptability to varying salinity.

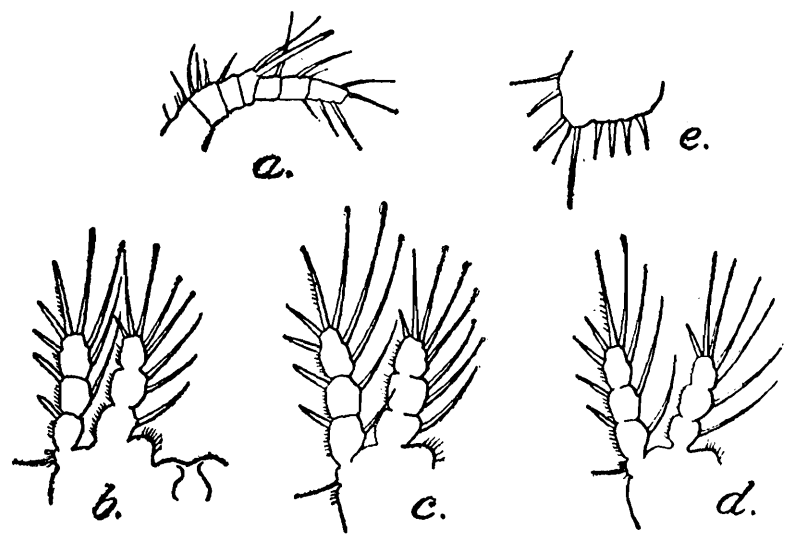
Family TACHIDIDAE.

Genus **Tachidius** Lilljeborg.

Tachidius sp.

(Text-fig. 12, *a-e.*)

A few examples of a species of *Tachidius* were taken in a road-side pool at mile 4 on the way to Uttarbhag (Sample 23). In their general structure they appear to come very near to, if they are not actually identical with, *Tachidius brevicornis.*



TEXT-FIG. 12.—*Tachidius* sp. *a.* 1st antenna; *b.* 2nd swimming leg; *c.* 3rd swimming leg; *d.* 4th swimming leg; *e.* 5th leg.

Origin of and changes in the Copepod Fauna.

In attempting to reach any conclusions regarding the origin of the fauna of such an area as this, one must bear in mind that the presence of any given species at the present day may have been the result of passive persistence in contradistinction to active migration. In times past there can be but little doubt that this region was actually a part of the Bay of Bengal and that with the gradual extension of the Delta seawards the water of the rivers and lakes gradually became less and less salt, though the actual process must have been extremely slow. A certain number of marine species that had established themselves within the area during the early stages of the formation of the Delta would doubtless be able to acclimatise themselves to the gradually changing conditions and thus equally be able to persist in their original habitat and form a relict fauna. Annandale (1922, p. 152) has pointed out that " the number of species of marine origin that have established themselves permanently in fresh water above the limits of tidal influence in the Ganges since the old immigration of the cosmopolitan freshwater fauna is small. Most of these species belong, however, to genera no longer found in the sea and probably of relatively ancient origin. The marine fauna of the Delta, on the other hand, is rich and includes not only many peculiar genera, but others, and even species, which also live in the sea. I cannot, however, find any definite dividing line between these two faunas. The relict fauna consists merely of organisms that have proved more capable of establishing themselves in abnormal circumstances,

and, therefore, more successful in the peculiar line of life adopted by them." On the other hand a large percentage of the species that constitute the plankton may have been brought into the area by the action of the tidal currents ; in many of the rivers of the Delta the flood stream is extremely powerful and in the Matla and Hooghly rivers, especially at times of spring tides, forms a " bore " that sweeps up the river carrying with it a large planktonic population. Month after month, therefore, examples of the common inhabitants of the marine littoral zone and of the lower estuarine regions will be passively swept high up the river and should they possess the necessary degree of adaptability to changes in the salinity or specific gravity of the water there seems to be but little difficulty in the way of the establishment of a permanent domicile in the higher reaches of the delta or in the associated pools and lakes.

As the deltaic region has extended seawards and the influence of the tidal flood on the salinity has become less and less, with the result that the water has become more and more fresh, a number of genera and species, whose normal habitat is fresh water, will automatically be carried into the lower reaches and through the canals into the Salt Lakes and again with but a slight degree of adaptation will be able to establish themselves in areas that only a few years ago were inhabited entirely by a brackish water or even a marine fauna.

In only a comparatively few instances does there seem to have been a definite attempt to migrate upstream from the sea into the freshwater areas above the influence of the tides ; and even in these cases it is difficult to decide whether the apparent migration has been the result of the acquisition of a true anadromic habit, such as is found in some of the prawns and fish, or whether it is to be attributed to a passive distribution either of adults or of larval stages in which there was an unusual range of adaptability. In a deltaic region such as this, that is subject during the rainy season to wide-spread floods, a wide dispersal of aquatic forms is bound to occur frequently.

A comparison of the Copepod fauna of the Calcutta Salt Lakes and their associated canals and pools with that of the Chilka Lake reveals a very close agreement, especially among the Calanoida and Cyclopoida, and in the following lists I have given the different species in these two groups that have been taken in the two localities :—

Chilka Lake.

Calanoida.

Paracalanus crassirostris.
Acrocalanus inermis.
Isias tropica.
Pseudodiaptomus annandalei.
Pseudodiaptomus binghami.
Pseudodiaptomus hickmani.
Pseudodiaptomus lobipes.
Pseudodiaptomus serricaudatus.
Pseudodiaptomus tollingeri.
Diaptomus cinctus.
Diaptomus blanci.
Diaptomus contortus.
Diaptomus pulcher.
Diaptomus strigilipes.
Labidocera pavo.
Acartia chilkaensis.
Acartia centrura.
Acartia southwelli.
Acartia spinicauda.
Acartiella major.
Acartiella minor.

Cyclopoida.

Oithona brevicornis.
Oithona nana.
Cyclopina intermedia.
Cyclopina longifurca.
Halicyclops aequoreus.
Halicyclops tenuispina.
Cyclops bicolor.
Cyclops dengizicus.
Cyclops leuckarti.
Cyclops rylovi.

Hooghly River and Calcutta Salt Lakes.

Paracalanus dubia.
Acrocalanus inermis.
Pseudodiaptomus annandalei.
Pseudodiaptomus aurivillii.
Pseudodiaptomus binghami.
Pseudodiaptomus hickmani.
Pseudodiaptomus lobipes.
Pseudodiaptomus tollingeri.
Diaptomus cinctus.
Diaptomus blanci.
Diaptomus contortus.
Diaptomus orientalis.
Diaptomus strigilipes.
Diaptomus viduus.
Labidocera gangetica.
Pontella andersoni.
Acartia chilkaensis.
Acartia plumosa.
Acartia spinicauda.
Acartiella major.
Acartiella tortaniformis.
Oithona brevicornis.
Oithona horai.
Cyclopina longifurca.
Cyclopina minuta.
Halicyclops aequoreus.
Halicyclops propinquus.
Halicyclops tenuispina.
Cyclops dengizicus.
Cyclops leuckarti.
Cyclops rylovi.

Thus out of thirty species recorded from the Salt Lake System twenty, or 67 per cent., have been taken in the Chilka Lake. A number of species have been taken in the Chilka Lake that have not so far been detected in the Calcutta Salt Lake system and I give a list of these below :—

Paracalanus crassirostris
Isias tropica
Diaptomus pulcher
Labidocera pavo
Acartia centrura
Acartia southwelli
Acartiella minor
Oithona nana
Cyclopina intermedia
Cyclops bicolor

Of these no less than nine are marine forms that undoubtedly are able to make their way into the Chilka Lake through the very short entrance channel, through which at certain seasons of the year there is a strong inflowing current that will naturally assist the entrance of such forms. It is hardly a matter for surprise that such forms should be absent from the Salt Lake system, and especially from that area of it that we have examined for the distance from the sea proper is in the neighbourhood of some ninety miles in the straight line and very considerably more through the tortuous windings of the river and nullah connections. Furthermore, in the Chilka Lake the salinity of the water during the hot months of the year and especially in the proximity of the entrance channel is but little less than that of salt water, whereas in the Salt Lake Canal system the salinity, so far as we have evidence, is now but little above that of fresh-water and never remotely approaches that of salt water.

A study of the distribution of the planktonic fauna of the Salt Lake system reveals several interesting features. In the Hooghly River above the level of Howrah Bridge we got a number of species that we may definitely consider to be true fresh-water forms, since all observations on the salinity of the water in this area have shown that it is completely fresh and, although within the limit of influence of the tides, since there

is a regular tidal rise and fall accompanied by a complete reversal of the flow, is yet so far removed from the sea that salt-water cannot penetrate sufficiently far up the river to affect the salinity of the water.

In this area we get the following species :—

Copepoda :—

Diaptomus blanci.
Diaptomus cinctus.
Diaptomus contortus.
Diaptomus indicus.
Diaptomus orientalis.
Diaptomus strigilipes.
Diaptomus viduus.
Pseudodiaptomus lobipes.
Acartia (Acartiella) tortaniformis.
Mesocyclops (Mesocyclops) leuckarti.
Cyclopina minuta.

Cladocera :—

Ceriodaphnia rigaudi.
Diaphanosoma excisum var. *longiremis.*
Moina dubia.

On the other hand we find in the Salt Lakes and associated pools and canals a number of species that must equally definitely be considered to be normal inhabitants of brackish-water. Species that I class in this group are the following :—

Pseudodiaptomus annandalei.
Pseudodiaptomus binghami.
Pseudodiaptomus hickmani.
Pseudodiaptomus tollingeri.
Acartia chilkaensis.
Acartia plumosa.
Acartia (Acartiella) major.
Oithona horai.
Halicyclops aequoreus.
Halicyclops propinquis.
Halicyclops tenuispina.
Cyclopina longifurca.
Cyclops dengizicus.
Mesocyclops (Thermocyclops) rylovi.

and possibly in the same category should be placed

Paracalanus dubia.
Acrocalanus inermis.
Laophonte bengalensis.
Stenhelia longifurca.
Parategastes sphaericus var. *similis.*
Limnocletodes secundus.

Associated with these latter species, especially in the lower reaches of the canals and rivers, we may get an admixture of species that are definitely marine in their origin, though they may now be undergoing acclimatisation and be establishing a habitat in brackish-water areas, such as :—

Pseudodiaptomus aurivillii.
Acartia spinicauda.
Labiodocera gangetica.
Pontella andersoni.
Oithona brevicornis.

As we pass from the fresh water of the river system along the canals of the Salt Lakes we get a gradual change in the composition of the planktonic fauna, although there is little or no accompanying change in the specific gravity of the water. This change is particularly well seen in the catches made at four stations on the Canal system on the 28th and 29th of December, 1932, and in the accompanying table I have tabulated the results obtained, commening with station 17 which is furthest removed from the Hooghly river and working nearer through stations 16 and 15.

	Sample.			
	17	16	15	14
Species.	28th December 1932.	28th December 1932.	28th December 1932.	29th December 1932.
Diaptomus contortus	—	—	—	+
Diaptomus cinctus	—	+	+	+
Pseudodiaptomus annandalei	+	+	+	—
Pseudodiaptomus tollingeri	+	—	—	—
Acartia (Acartiella) tortaniformis	+	—	—	—
Acartia chilkaensis	+	+	—	—
Mesocyclops rylovi	+	+	+	—
Mesocyclops leuckarti	—	—	—	+
Moina dubia.	+	+	++	++
Brachionus pala	—	+	++	+++
Brachionus bakeri var. *latissimus*	—	+	++	+

— absent.
\+ present.
\++ common
\+++ in enormous numbers

In sample 17, although the salinity of the water was only 2·03 per mile, we find a typical brackish-water fauna, including two species of *Pseudodiaptomus*, two species of *Acartia* and the brackish-water Cyclops, *Mesocyclops* (*Thermocyclops*) *rylovi*; we also get the Cladoceran *Moina dubia* but no other fresh-water form. As we pass to sample 16 one species of *Pseudodiaptomus*, *P. tollingeri*, disappears, as well as one species of *Acartia*, *Acartia* (*Acartiella*) *tortaniformis*; and one species of fresh-water copepod, *Diaptomus cinctus*, and two species of Rotifers, *Brachionus pala* and *B. bakeri* var. *latissimus*, make their appearance although the salinity is actually slightly higher than in the former locality, namely 2·41 per mille. In sample 15 the second species of *Acartia*, *A. chilkaensis*, has disappeared and the Cladoceran, *Moina dubia*, and the two species of Rotifers have become more numerous, though the salinity is actually higher than in the more distant station, being still 2·20 per mille. Finally, as we come to Sample 14, from the canal near Chingrighatta which, though no nearer to the Hooghly river than the locality from which sample 15 was taken, is now completely cut off from the canal system that connects with the Bidyadhari river, we get the disappearance of the second species of *Pseudodiaptomus*, *P. annandalei*, and of the brackish-water inhabiting *Mesocyclops* (*Thermocyclops*) *rylovi*, and the appearance of two more fresh-water inhabiting forms, namely *Diaptomus contortus* and *Mesocyclops* (*Mesocyclops*) *leuckarti*. In this last locality the salinity had fallen to 1·19 per mille.

I have already pointed out that changes have been taking place in past years in the character of certain of the canals owing to silting up, and associated with this there has been a very interesting change or series of changes in the character of the fauna. In 1908 Annandale called attention to the presence in brackish-water pools at Port Canning of the Medusa, *Campanulina ceylonensis* (Browne), and in 1912 (*Rec. Ind. Mus.*, Vol. XII) the same species was discovered in large numbers in the Canals of the Salt Lake system. In 1926 the Zoological Survey party found the medusa still present in the Kristopur Canal but during the past few months no sign of its presence has been detected in any tow-netting from the canals either in this part or in any other: this may be due to the fact that it is not the proper season for it, but it appears not improbable that with the lowering of the salinity of the water it has died out owing to the changed conditions since, as Annandale noted (*vide supra* p. 57), it is killed off when the salinity falls below 1006. Another change that has taken place between 1926 and the present day in the plankton of the western portion of the Kristopur Canal is indicated by the comparison of two tow-nettings from the same locality. In the earlier one taken in 1926—the whole catch consisted of a pure culture of *Pseudodiaptomus annandalei*, which as I have indicated, is a brackish-water form; but in 1932 a tow-netting in the same area contained, in addition to *Pesudodiaptomus annandalei*, examples of *Acartia chilkaensis* and *Mesocyclops* (*Thermocyclops*) *rylovi*, which I regard as brackish-water forms, and specimens of *Diaptomus cinctus*, which is definitely a fresh-water form. This gradual change in the plankton is still more clearly brought out by a comparison of three tow-nettings which I am fortunate enough to have before me, and which

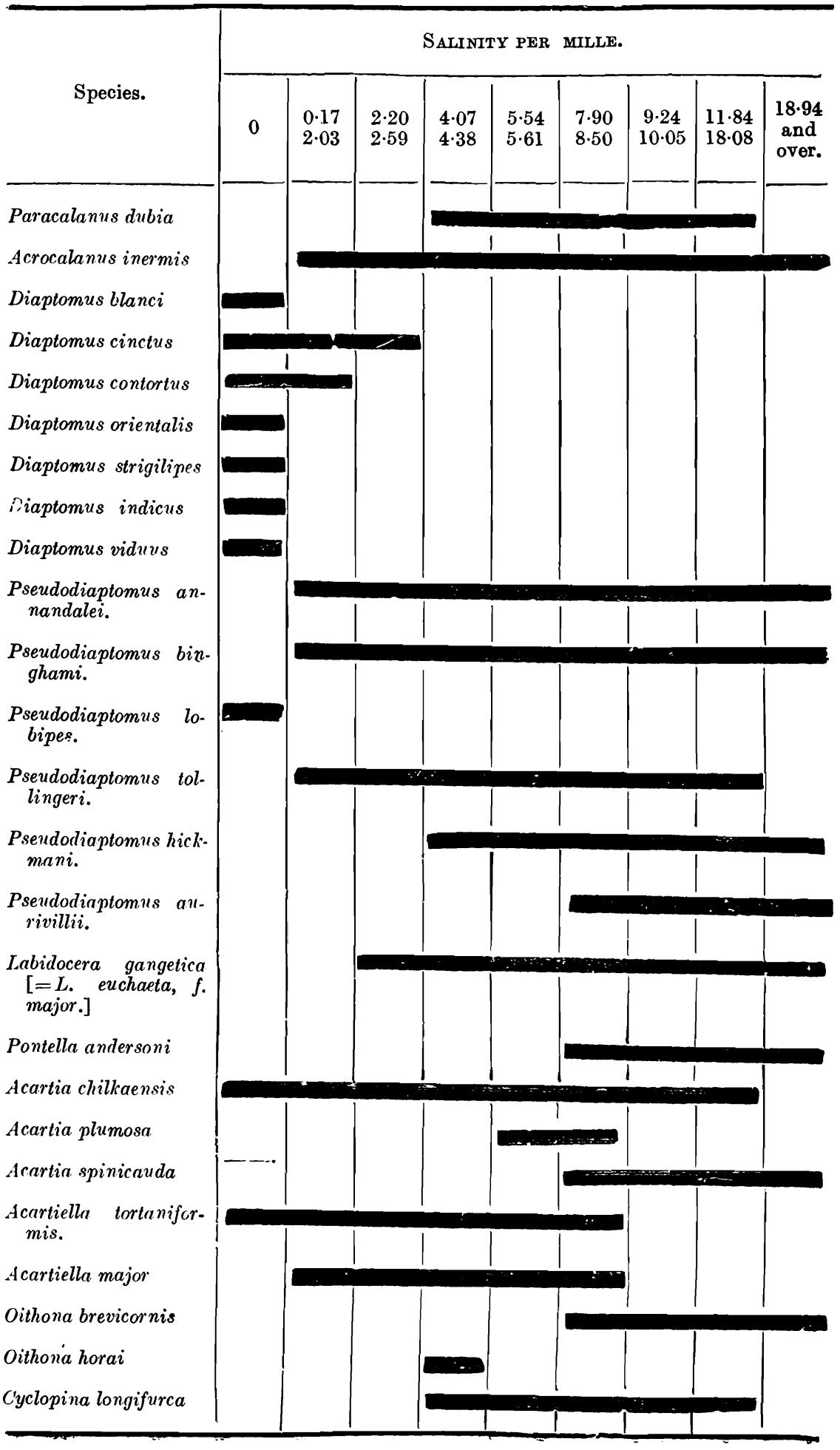
were taken in 1914, 1930 and 1932 respectively; the composition of these tow-nettings is given below:—

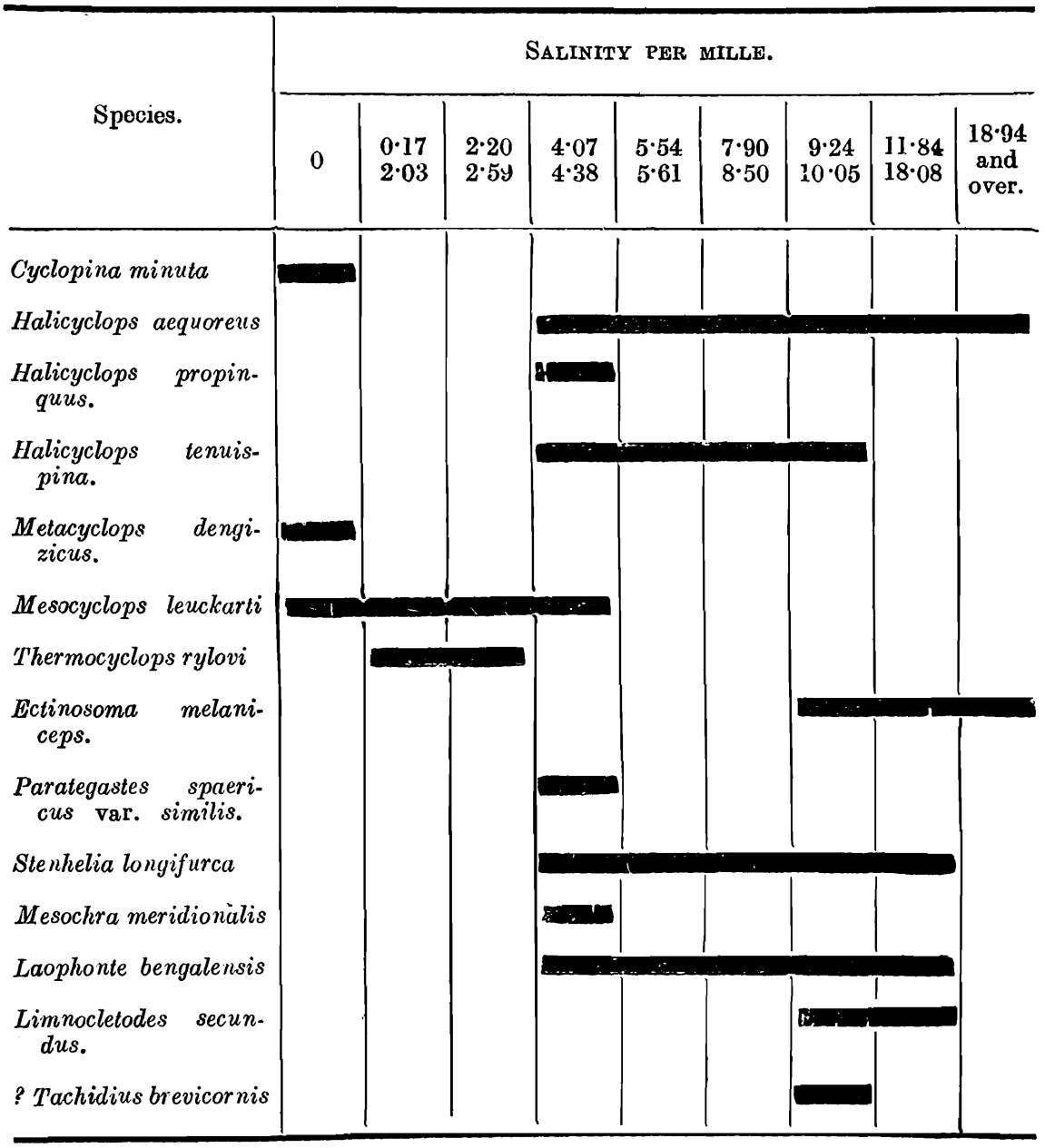
Station—Chingrighatta—Dhappa Canal.

Species.	19th October 1914.	20th October 1930.	29th December 1932.
Diaptomus contortus	+	+	+
Diaptomus cinctus	—	—	+
Pseudodiaptomus annandalei	+	+	—
Pseudodiaptomus binghami	+	+	
Pseudodiaptomus tollingeri	+	—	—
Acartia chilkaensis	+	+	—
Acartia plumosus	+	—	—
Acartia (Acartiella) tortaniformis	+	—	—
Oithona brevicornis	+	—	—
Cyclopina longifurca	+	—	—
Halicyclops aequoreus	+	—	—
Halicyclops tenuispina	+	—	—
Mesocyclops (Mesocyclops) leuckarti	+	+	+
Mesoscyclops (Thermocyclops) rylovi	+	—	—
Mesochra meridionalis	+	—	—
Laophonte bengalensis	+	—	—
Stenhelia longifurca	+	—	—

From this we see that in 1914, out of a total of 16 species of Copepoda 14 definitely belong to the group of brackish-water forms and 2 to fresh-water species, these latter being *Diaptomus contortus* and *Mesocyclops (Mesocyclops) leuckarti*. By 1930, 11 of these brackish-water species had disappeared from the locality leaving only three of the more adaptable forms, namely *Pseudodiaptomus annandalei*, *P. binghami* and *Acartia chilkaensis*. Finally in 1932 these three brackish-water forms have now disappeared and an additional fresh-water species of Copepod, namely *Diaptomus cinctus*, has made its appearance, as well as enormous numbers of the Rotifer *Brachionus pala*. Unfortunately I have no record of the salinity of the water in the two earlier observations, but there can be but little doubt that the water was originally markedly brackish and in 1922 the specific gravity was high as 1006·0—1008·5 (*vide supra*, p. 59) whereas at the present time it is as low as 1000·9 (Salinity 1·19).

In the following table I have attempted to indicate, so far as our knowledge at present extends, the range of salinity within which each species in the collection can exist. In a number of instances and especially in the case of new species our knowledge is admittedly incomplete and further researches may greatly increase the range of salinity that such species can tolerate.


Species.
SALINITY PER MILLE.
0
0·17 2·03
2·20 2·59
4·07 4·38
5·54 5·61
7·90 8·50
9·24 10·05
11·84 18·08
18·94 and over.
Paracalanus dubia
Acrocalanus inermis
Diaptomus blanci
Diaptomus cinctus
Diaptomus contortus
Diaptomus orientalis
Diaptomus strigilipes
Diaptomus indicus
Diaptomus viduus
Pseudodiaptomus annandalei.
Pseudodiaptomus binghami.
Pseudodiaptomus lobipes.
Pseudodiaptomus tollingeri.
Pseudodiaptomus hickmani.
Pseudodiaptomus aurivillii.
Labidocera gangetica [=L. euchaeta, f. major.]
Pontella andersoni
Acartia chilkaensis
Acartia plumosa
Acartia spinicauda
Acartiella tortaniformis.
Acartiella major
Oithona brevicornis
Oithona horai
Cyclopina longifurca



In the family Paracalanidae examples of both *Paracalanus* and *Acrocalanus* occur in brackish water. In the former genus Dahl (1893) recorded the occurrence of *Paracalanus crassirostris* from the delta of the Amazon River in water that showed a salinity of 11·8-12·8 per mille. T. Scott (1894) recorded the presence of *Paracalanus pygmaeus* (Claus) from the Gaboon River and Banana Creek, Congo River, in West Africa. Subsequently it was pointed out by Giesbrecht and Schmeil that the species with which T. Scott was dealing was not *Paracalanus pygmaeus* (Claus), but was probably *Paracalanus crassirostris* Dahl. In 1912 I described a form of *Paracalanus*, under the name *P. dubia*, from the mouth of the Rangoon River in water the density of which was 1002. In 1924 I further pointed out that it was possible that all three forms might be representatives of the same species, and Früchtl (1924) in the same year reached the same conclusion and termed *Paracalanus crassirostris* Dahl from the Amazon River forma *typica*, the form described by T. Scott from the mouth of the Congo river as forma *scotti* and *Paracalanus dubia* mihi from the mouth of the Rangoon River as forma *sewelli*. Without accepting this terminology, it is certain that all three

forms are closely related to each other and I am inclined to believe that the form described by T. Scott from the mouth of the Congo River may be the same as the form that I have called *Paracalanus dubia*; but I consider that *Paracalanus crassirostris* Dahl is in all probability a different species. Be that as it may, it is interesting to note that the form of *Paracalanus* found in the Hooghly River is the same as that found in the mouth of the Rangoon River but differs from that present in the Chilka Lake. The specific gravity of the water in which *Paracalanus crassirostris* Dahl (*sensu stricto*) has been taken ranges from 1028·5 to 1001·93, which corresponds to a range of salinity from 37·94 to 3·59. *Paracalanus dubia* Sewell has up to the present time only been taken within a range of salinity of 4·07 to 12·30.

Acrocalanus inermis Sewell appears to be more tolerant of low salinity and has been taken in water with as low a salinity as 0·17, though never in absolutely fresh water.

It seems probable that both these species, namely *Paracalanus dubia* and *Acrocalanus inermis*, should be regarded as examples of a relict (marine) fauna, that has been left behind and has gradually become acclimatised to life in only slightly brackish water.

In the case of the genus *Pseudodiaptomus* there can be but little doubt that the estuarine region of the Gangetic Delta is one extremely favourable for existence and at the same time, from its wide variations in salinity, temperature and other conditions, is one in which the evolution of new species would be stimulated. In the Indian region the known distribution of the species of this genus is as follows:—

(*a*) Forms known only from the sea:—

Pseudodiaptomus clevei A. Scott.
Pseudodiaptomus burckhardti Sewell.
Pseudodiaptomus salinus Giesbrecht.
Pseudodiaptomus masoni Sewell.

(*b*) Forms known from estuarine and brackish water, as well as from the sea:—

Pseudodiaptomus aurivillii Cleve.
Pseudodiaptomus mertoni Früchtl.
Pseudodiaptomus serricaudatus (T. Scott).

(*c*) Forms known from estuarine and brackish water:—

Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus binghami Sewell.
Pseudodiaptomus dauglishi Sewell.
Pseudodiaptomus hickmani Sewell.
Pseudodiaptomus tollingeri Sewell.

(*d*) Forms known from fresh water only:—

Pseudodiaptomus lobipes Gurney.

In a widely-distributed genus such as this the question naturally has arisen, whether migration has been from the sea into fresh water or *vice versa* or again whether the genus may not have arisen in brackish water and have migrated equally in both directions. Tollinger (1911)

and Burckhardt (1913) have both studied this problem in the Diaptomidae and they have reached the conclusion that in the genus *Pseudodiaptomus* migration must have been from the sea through the brackish water areas into pure fresh water. Furthermore, this migration must have been carried out independently in both eastern and western hemispheres, and in the former from the Atlantic on the west coast of Africa, from the Indian Ocean, where it has given rise to *Pseudodiaptomus lobipes* Gurney, and from the Pacific Ocean, where it has caused the appearance of *Pseudodiaptomus forbesi* Poppe, *P. inopinus* Burckhardt, and *P. japonicus* Kikuchi. Burckhardt (1913, p. 392) has given a geneological tree of the relationships of various species of this genus and in this he shows the close relationship between *Pseudodiaptomus lobipes*, *P. poppei*, *P. forbesi* and *P. opinus*. Stillman Wright (1928, p. 596) points out that " by modifying the conformation of the tree somewhat, the species described since 1913 can be placed in their proper places. It is obvious that *P. tollingeri* should be placed near *P. poppei*. *P. smithi* may be placed on a branch coming off between the last two species, while a form similar to *P. smithi* may be considered ancestral to *P. forbesi* and *P. inopinus*. While *P. annandalei* cannot be properly considered a member of the group, it has certain characters which indicate that it may have a common ancestor with the group members." Gurney (1927, p. 140) on the other hand would appear to have reached the conclusion that the migration of the various species of the genus has been from fresh to salt water; he remarks that " *Pseudodiaptomus salinus* belongs to a genus which is characteristic of fresh-water or of estuarine regions where salinity is low. Yet here we have a species living in Suez Bay (not in the sea to the South) and able to establish itself in the very high salinity of the Bitter Lakes." The view that this genus is characteristic of fresh water is contrary to all the evidence and I entirely agree with Burckhardt that the genus is of marine origin and that there has been and doubtless still is a tendency towards migration into brackish and on into fresh water, though but few species have actually been able to penetrate beyond the brackish-water regions.

Among the Pontellidae, in the genus *Labidocera* the majority of species are definitely marine in their habitat, but a few have become acclimatised to life in brackish waters. *Labidocera lubbocki* Giesbrecht was recorded by Lubbock under the name *L. darwinii*, from the mouth of the Guayaquil River and T. Scott under the same name, *L. darwinii*, described a form from the Gaboon River in West Africa; this latter species was subsequently named *L. scotti* by Giesbrecht. *Labidocera fluviatilis* Dahl occurs in the estuary of the Amazon in water having a salinity ranging from 11·8 to 12·8 per mille. *Labidocera euchaeta* which was described by Giesbrecht from the Straits of Formosa, has frequently been taken in Indian waters and appears to be " essentially a brackish-water inhabitant and occurs in the estuarine regions of most, if not all, of the main rivers " (Sewell, 1932, p. 360) and in the case of the Rangoon River, where it was common, the salinity was only 3 per mille. In the present collection adult examples, as well as numerous young stages, of *Labidocera gangetica* were taken in a tow-netting in Diamond Harbour on the Hooghly River, in water that has a salinity of

only 7·90 to 8·50 and young stages were obtained as high up as Achipur in water of a salinity of only 2·23. It thus seems clear that there is a distinct tendency for examples of this genus to extend their habitat upstream in most, if not in all, of the large rivers of the world.

The genus *Pontella* is almost entirely marine in its habitat. One species, *Pontella gaboonensis* T. Scott, was taken in the tow-net at the mouth of the Gaboon River, Africa, and in the present collections examples of *Pontella andersoni* Sewell were captured in Diamond Harbour, Hooghly River, in water having a salinity of 7·90 to 8·50. This latter species has previously been taken off Chittagong and in the vicinity of the Tavoy River and in the Mergui Archipelago, but never previously in water of so low a salinity.

In the family Acartiidae, the genus *Acartia* is for the most part essentially marine in its habitat; but there is a distinct tendency, especially well marked in the sub-genus *Acartiella*, for certain species to migrate into brackish water, or even into water that is absolutely fresh. In the sub-genus *Acartiura*, *Acartia* (*Acartiura*) *clausi* var. *gaboonensis* T. Scott was found living in the Gaboon River on the west coast of Africa, but, as the specific gravity of the water in which the variety was taken was as high as 1023·01, it can hardly be considered to be a true brackish-water form. *Acartia* (*Acartiura*) *simplex* Sars, however, appears to have definitely established itself in brackish water in Chatham Island in the Pacific Ocean; this species is very closely related to *Acartia* (*Acartiura*) *ensifera* Brady that is known from New Zealand and it is possible that the one has been evolved from the other or that both may have had a common ancestor. In the sub-genus *Acanthacartia* we find a tendency for certain species to be present in brackish-water areas. *Acartia* (*Acanthacartia*) *chilkaensis* Sewell and *A.* (*A*). *plumosa* T. Scott have both been taken in such a habitat. The latter was recorded by T. Scott from Loanda Harbour in the Gulf of Guinea on the west coast of Africa and in Banana Creek, Congo River, in water that had a specific gravity of 1008·7 and in the present paper I have recorded its presence in the Salt Lakes, Calcutta, in water of a specific gravity of only 1004·6 (Salinity 5·81). *A.* (*A.*) *chilkaensis* Sewell was first recorded from the Chilka Lake from water the density of which ranged, according to Kemp, from 997·5 at 28·6° C to 1003·25; since then examples have been taken in the canals of the Salt Lakes, Calcutta, in which this species appears to be a permanent inhabitant, where the specific gravity ranges from 1014·52 (Salinity 18·08) to 1001·43 (Salinity 1·87), and in the Hooghly River, where the water was absolutely fresh. Again, in the sub-genus *Odontacartia* we have two species that are capable of maintaining their existence in water that is brackish. *Acartia* (*Odontacartia*) *centrura* Giesbrecht, which is normally an inhabitant of salt-water, has been taken in the Chilka Lake (Sewell, 1924) in water the density of which ranged from 1027·0 to 1014·5; and *A.* (*O.*) *spinicauda* Giesbrecht, which is also normally an inhabitant of salt water, has been taken in the Chilka Lake in water the density of which ranged from 1010·0 to 1015·0 at 15° C, and a single specimen occurred in the Salt Lake Canal system at Chingrighatta in 1914, when the general facies of the fauna was essentially of a brackish-water type; unfortunately I have no record of the

actual specific gravity of the water here at that time and in more recent years there have been considerable changes, but it was then about 1006·0 to 1008·5. Numerous examples occur in the Hooghly River at Diamond Harbour, where the water has a specific gravity of 1006·3 to 1006·8 (Salinity 7·9-8·5).

In the sub-genus *Acartiella* the only species that has up to the present time been taken in the sea is *Acartia* (*Acartiella*) *kempi* Sewell, all the other species having been taken in brackish water and in the case of *Acartia* (*Acartiella*) *tortaniformis* Sewell in actually fresh water. There can be little doubt that the genus, and especially the sub-genus *Acartiella* is gradually making its way into the fresh waters of India and I have in a previous paper (Sewell, 1919, p. 17) called attention to the structural changes that are being undergone and that appear to be correlated with the change in habitat.

In the Cyclopoida it is but natural to expect a very considerable degree of tolerance to brackish and even fresh-water conditions. Commencing with the Family Oithonidae, sub-family Oithoninae, there are several species of the genus *Oithona* that exhibit such a tolerance. I have in a previous paper (Sewell, 1924) recorded the presence of *Oithona brevicornis* Giesbrecht and *Oithona nana* Giesbrecht from the Chilka Lake; the former was taken in water the density of which ranged from 1015·0 at 15° C. to 1003·25, while the latter appears to have been rather less tolerant and occurred in water with a density ranging from 1026·0 to only 1006. This latter species has not, so far, been recognised in the collections from the Salt Lakes and their associated waters but a species that appears to be new and to which I have given the name *horai* was found in the collections from Uttarbhag in water the specific gravity of which ranged from 1003·47 (Salinity 4·38) to 1003·29 (Salinity 4·16), while *Oithona brevicornis* has been taken in brackish water of a specific gravity of about 1006-1008·5 at Chingrighatta in 1914, and in both the Hooghly and Piali Rivers in water having a specific gravity of 1006·3-1006·8 (Salinity 7·90-8·50) and 1014·5 (Salinity 18·08) respectively. On the Atlantic coasts *Oithona minuta* T Scott has been taken in brackish water in Banana Creek, Congo River, in water having a specific gravity of 1008·7, while *Oithona amazonica* Burckhardt, as its name implies, was taken in fresh-water in the Amazon River. Burckhardt (1913) has also described a new species belonging to a closely related genus *Limnoithona*, namely *L. sinensis*, from fresh water from the Tai-hu and Yangtze Kiang Rivers, China. This latter genus has since been transferred by Kiefer (1929) to a new sub-family Limnoithoninae. Burckhardt (1913, p. 444) claims that the occurrence of these species indicates that, although the native habitat of the genus is the sea, where the majority of species are found, certain species are at the present day attempting to migrate into fresh water and that whereas *Oithona minuta* has only proceeded a little way in this migration and is still for the most part to be found in salt water, *Oithona amazonica* has penetrated entirely or almost entirely into fresh water and *Limnoithona sinensis* completely so. Rosendorn (1927, p. 55) is, however, unwilling to accept this explanation and points out that certain species, namely *Oithona nana*, *O. simplex*, *O. minuta* and

O. brevicornis are all marine and brackish-water forms, and maintains that this is not due to any tendency to actual migration into fresh water but merely to a degree of adaptability that enables them to inhabit either type of locality. The occurrence of *Oithona horai* in the Salt Lakes seems to me, however, to be in favour of Burckhardt's view that there is in certain species or group of species in this genus a distinct trend towards migration into a fresh-water habitat, accompanied by definite structural changes.

In the family Cyclopinidae the great majority of species of the genus *Cyclopina* are inhabitants of salt water and most of the species have been reported from the northern Atlantic or its offshoots, as the following list clearly shows :—

Cyclopina longifurcata Scott	North Sea.
Cyclopina longicornis Boeck	North Sea.
Cyclopina littoralis Brady . .	British Coasts.
Cyclopina dilatata Sars . . .	Coast of Norway.
Cyclopina pygmaea Sars	South and South-west coasts of Norway.
Cyclopina brachystylis Sars	South and South-west coasts of Norway.
Cyclopina norvegica Boeck	North Sea and Baltic.
Cyclopina elegans T. Scott	Firth of Forth, Norwegian Coast and Gulf of Naples.
Cyclopina gracilis Claus	Arctic Seas, the North Sea, Mediterranean Sea and Suez Canal.
Cyclopina schneideri T. Scott	Around the Lofoten Islands.
Cyclopina steueri Früchtl	Mediterranean Sea and in the Aru Archipelago, Malay Straits.
Cyclopina belgica Giesbrecht	In the Antarctic seas between Lat. 70 and 71 S.

In a previous paper (Sewell, 1924) I recorded the presence of two species of this genus in the fresh or brackish waters of the Chilka Lake, namely *Cyclopina longifurca* and *C. intermedia*, and Sars (1905) has recorded *Cyclopina pusilla* from brackish water in Chatham Island in the Pacific Ocean. *Cyclopina intermedia* was taken in water that was absolutely fresh, but *C. longifurca* exhibits a wide range of tolerance, for it has now been taken in the water of the Chilka Lake that had a density of only 997·0 at 31·5° C, in the Salt Lake Canal system of Calcutta in water the specific gravity of which ranges from 1003·29 to 1007·40 (Salinity 4·16 to 9·24), and, at the other end of the scale, in weed washings from the sea at Tuticorin. The occurrence of yet another species, *Cyclopina minuta*, sp. nov., in water that was absolutely fresh, indicates that in this genus also there is a distinct tendency to spread inland into fresh-water areas.

In the genus *Halicyclops* only one species, namely *H. aequoreus* (Fischer) has up to the present time been found living in the sea and even in this species individuals have equally been taken in brackish and even in fresh water, or in inland salt-water lakes, etc. Burckhardt (1913, p. 456-7) has called attention to the close relationship between this genus and *Cyclops fimbriatus* and, if I understand him aright, he is of the opinion that *Halicyclops* has evolved from the genus *Cyclops* (*sensu lato*) and that it is now in the process of migrating from fresh to brackish or even to salt water.

The Harpacticidae have up to the present time received but little attention in India and in consequence we are still extremely ignorant both as regards the various species that inhabit Indian waters and their natural habitat. A number of species were taken in the Chilka Lake (*vide* Sewell, 1924) and many of these in water that was brackish, but with the exception of the two species, *Ectinosoma melaniceps* Boeck and *Parategastes sphaericus* var. *similis* Sewell, the Harpacticids taken in the Salt Lakes, Calcutta, and the associated water-ways belong to different species. Chappuis (1928) has given an account of several species of Harpacticids that were taken in fresh water, but again none of these species occur in the Salt Lake collections. It is, therefore, impossible to form any very definite opinion regarding the origin of the Harpacticid fauna of the Gangetic delta. In the Family Canthocamptidae several members of the genus *Canthocamptus* have been described from India (*vide* Chappuis, 1928) from fresh water. In this family numerous species, belonging to several genera, have succeeded in establishing themselves in a fresh-water habitat and in the genus *Mesochra* species are known to occur in either salt or brackish water, at least one species having been found occasionally in water that is actually fresh. According to Gurney (1920, p. 358) *Mesochra rapiens* (Schmeil) [=*M. hirticornis* (T. Scott)] is normally found in brackish water and always not far from the sea; it has, however, been taken in absolutely fresh water in the Ekoln branch of Lake Malaren, that is considered to be the remains of a former extension of the Baltic, and its presence in this latter region suggests that it is to be regarded as a part of a relict fauna. In the present collections *Mesochra meridionalis* Sars has been found in the Salt Lake Canal system and its presence in two such widely separated localities as this and Chatham Island in the Pacific Ocean strongly suggests that in each case it is to be regarded as a relict, that has been left behind in the Salt Lakes as the deltaic area gradually extended further seawards.

Among the Laophontidae, two species belonging to the genus *Laophonte*, namely *L. chathamensis* and *L. quinquespinosa*, occur in the Chilka Lake. Of these the former had already been taken in brackish water in Chatham Island in the Pacific Ocean and in the Chilka Lake both occurred in water that had a specific gravity of 1002. In the Salt Lakes a new species, *Laophonte bengalensis*, has been taken in water having a specific gravity ranging from 1003·29 to 1014·52 (Salinity 4·16 to 18·08); but since at least one species, namely *L. mohammed*, is known to have established itself in fresh water, it is not possible to form an opinion as to whether these Indian species should be regarded as euryhaline species that have invaded this area from the sea or as marine relicts that have been able to survive the gradual diminution in the salinity of the water, or even casual visitors swept in by the flood tide.

The family Cletodidae includes a number of genera that between them exhibit a wide range of habitat but which are almost entirely marine. A certain number of species, belonging to the genera *Cletocamptus*, *Nannopus* and *Enhydrosoma* have established themselves in fresh water and in 1926 Borutzky created another genus, *Limnocletodes*, in this family to accommodate a species that he had taken in the Volga River.

The occurrence of a second species in this new genus in the delta of the Ganges is of considerable interest, but at the present time we do not know enough about its distribution to be able to determine the range of salinity in which it can exist or to form an opinion as to whether it normally inhabits brackish water. The occurrence of *Stenhelia longifurca*, sp. nov. and *Laophonte bengalensis*, sp. nov. in the Piali River and the adjoining pools at Uttarbhag, as well as in the Chingrighatta-Dhappa Canal before the Central Lake channel silted up and Dhappa Lock was closed, indicates that these species have in all probability been carried into these pools and canals from the river during periods of flood tides, and the same is probably true of *Limnocletodes secundus*.

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NOTES ON FISHES IN THE INDIAN MUSEUM.

XXII. On a Collection of Fish from the S. Shan States and the Pegu Yomas, Burma.

By Sunder Lal Hora, *D.Sc., F.R.S.E., F.A.S.B.*, and Dev Dev Mukerji, *M.Sc., Zoological Survey of India, Calcutta.*

At the request of one of us Mr. V P. Sondhi of the Geological Survey of India made a small collection of fish in Burma during the field-season of 1932-33. A part of Mr. Sondhi's material was obtained in the Southern Shan States to the east of Taunggyi, but not very far from it; and the remainder from the western drainage of the Pegu Yomas. Both the areas are hilly tracts and the collection was made in small torrential streams with a rocky bed. Such streams are characterised by rapids and slow currents with pools and back-waters here and there. Some of the streams are diverted for the irrigation of " paddy " fields, and in the Southern Shan States the water is usually charged with lime to such an extent that it forms travertine dams causing small falls. Mr. Sondhi informs us that the structure of the country in the regions traversed by him is of a nature similar to that described by Annandale[1] in his account of the Inlé Lake.

The fish fauna of Burma is not well known, and our knowledge of the smaller forms, specially those inhabiting brooks, is still very imperfect. Mr. Sondhi's collection, therefore, though small, both in the number of species and individuals, is full of interesting forms, and, with its help, it has been possible to elucidate several problems of taxonomic importance. We give below a list of localities with the names of the species of fish collected therefrom.

Southern Shan States (December, 1932-April, 1933).

1. A small stream flowing out of a spring at Repiu, north of Loi-un about 6 miles from Hopong.

i. *Lepidocephalichthys berdmorei* (Blyth) . .	6 specimens.
ii. *Ophicephalus gachua* Ham. Buch. .	3 specimens.

2. A small stream at Kyouksu, 1½ miles east of Repiu.

i. *Barbus hexastichus* McClelland . .	1 specimen.
ii. *Danio (Danio) aequipinnatus* (McClelland)	1 specimen.

3. Stream below the bridge to the east of Hopong Rest House.

i. *Barbus hexastichus* McClelland	3 specimens.
ii. *Barbus sarana caudimarginatus* Blyth	1 specimen.
iii. *Nemachilus rivulicola* Hora	10 specimens.

4. Spring at mile 15¾ east of Taunggyi and 3½ miles east of Hopong.

i. *Barbus sarana sewelli* Prashad and Mukerji	1 specimen.
ii. *Danio (Brachydanio) shanensis* Hora	9 specimens.
iii. *Danio (Brachydanio) sondhii*, sp. nov.	11 specimens.

[1] Annandale, *Rec. Ind. Mus.*, XIV, pp. 4-6 (1918).

5. Stream to the west of the village of Hopong.

i. *Barbus sarana caudimarginatus* Blyth	4 specimens.

6. Tank at Pangtara.

i. *Barbus sarana caudimarginatus* Blyth	1 specimen.
ii. *Ophicephalus gachua* Ham. Buch.	1 specimen.

7. Canal issuing from a stream to the south-west of Lawksawk.

i. *Danio (Danio) aequipinnatus* (McClelland)	2 specimens.
ii. *Nemachilus rivulicola* Hora	3 specimens.

Pegu Yomas (May, 1933).

Gyobyu Chaung, west of the new dam line, western drainage of the Pegu Yomas.

i. *Amblyceps mangois* (Ham. Buch.)	1 specimen.
ii. *Clarias batrachus* (Linn.)	1 specimen.
iii. *Aoria bleekeri* (Day)	2 specimens.
iv. *Barbus sarana caudimarginatus* Blyth	1 specimen.
v. *Danio (Danio) annandalei* Chaudhuri	1 specimen.
vi. *Nemachilus multifasciatus* (Day) Vinci g.	1 specimen.
vii. *Acanthopsis choirorhynchus* (Bleeker)	1 specimen.
viii. *Ophicephalus gachua* Ham. Buch.	1 specimen.
ix. *Mastacembelus armatus* (Lacépède)	1 specimen.
x. *Ambassis ranga* (Ham. Buch.)	2 specimens.

The collection from the Pegu Yomas was made in one place by putting a dam across a small stream and allowing the bed below the dam to run dry. The fishes were picked up afterwards from underneath stones and boulders or from crevices.

In the collection dealt with here there are, as detailed above, 69 specimens, of which 57 were collected in the S. S. States area. These 57 specimens comprise representatives of 9 species and varieties, while the remaining 12 specimens from the Pegu Yomas represent 10 species. With the exception of *Barbus sarana caudimarginatus* Blyth, an endemic Burmese race of the widely distributed species, and *Ophicephalus gachua* Ham. Buch., no other species or variety is common to the two lots. The species collected in the Pegu Yomas, with the exception of *Danio annandalei* and *Acanthopsis choirorhynchus*, are fairly widely distributed both in Burma and India. Even *D. annandalei* and *A. choirorhynchus* are not endemic in the Pegu Yomas, the former was described from the base of the Dawna Hills, whereas the latter is known from Sumatra, Java, Malay Peninsula, Burma and Annam. Among the species obtained by Mr. Sondhi in the S. S. States, half the number is endemic to that region. *Danio (Brachydanio) sondhii* is a new species described here for the first time, while *Danio (Brachydanio) shanensis*, *Barbus sarana sewelli* and *Nemachilus rivulicola* are only known from the Shan States or adjacent parts of Burma.

In the following account keys are given to the species of *Danio* and *Brachydanio*. Besides the description of the new species of *Brachydanio*, the precise specific limits of *D. annandalei* are discussed and defined. From a study of extensive material it is concluded that both *Barbus caudimarginatus* Blyth and *Barbus sewelli* Prashad and Mukerji should

be regarded as varieties or subspecies of the widely distributed Indian form, *Barbus sarana*. It is also indicated that *Ophicephalus harcourt-butleri* Annandale[1] cannot be considered a distinct species from the widely distributed and variable *O. gachua*. Attention is also directed to an abnormal specimen of this species in which both the ventral fins are absent, but the basipterygia are only slightly deformed. This abnormality raises the question of the validity of the generic names *Channa* and *Ophicephalus*, but a consideration of this problem is left over for some future occasion. Further light is thrown on the variation exhibited by the Burmese and Siamese specimens of *Amblyceps mangois*.

Mr. Sondhi's collection has added materially to our knowledge of the fishes of Burma. It has to be remembered, however, that the collection seems to have been made in the steadier portions of the streams, and not in the course of very swift currents. Most of the forms represented here live in small pools or in back-waters in the course of hill streams. *Amblyceps* and *Nemachilus* are the only two genera, the members of which are found among pebbles at the bottom of small streams, but some specimens are likely to stray into pools.

We take this opportunity to offer our sincerest thanks to Mr. V P. Sondhi for affording us an opportunity to study such an interesting material. Mr. Sondhi's observations on the colouration of living specimens have been most helpful and are published here with due acknowledgment. To Dr. B. Prashad we are indebted for going through the manuscript. Mr. R. Bagchi made the drawings with his usual skill and care under our supervision and for this our thanks are due to him.

Clarias batrachus (Linn.).

1913. *Clarias batrachus*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.*, II, p. 190, fig. 74.

There is a young specimen of *Clarias batrachus* from the Pegu Yomas in Mr. Sondhi's collection.

Aoria bleekeri (Day).

1890. *Macrones bleekeri*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2), IX, p. 91.

There are two fine specimens of *Aoria bleekeri* in Mr. Sondhi's collection. They were obtained by him from the Pegu Yomas, and exhibit the colouration characteristic of the Burmese examples of the species.

Amblyceps mangois (Ham. Buch.).

1933. *Amblyceps mangois*, Hora, *Rec. Ind. Mus.*, XXXV, pp. 607-621.

Mr. Sondhi collected one young specimen of *Amblyceps mangois* in the Pegu Yomas. One of us (Hora, *op. cit.*) has so recently dealt with the classification, bionomics and evolution of the fishes of this genus that we need not refer in detail to the characteristics of the species. It

[1] Annandale, *Rec. Ind. Mus.*, XIV, pp. 54, 55, pl. ii, fig. 7, pl. iv, figs. 16, 17 (1918).

may be mentioned, however, that in the specimen under report the caudal fin is deeply forked and the lobes are pointed, but are not drawn out into thread-like processes as is the case in most of the Siamese examples. The adipose fin is long and well developed. The caudal peduncle is almost as high as long. The barbels are longer than those of the Indo-Burmese specimens and in this respect the specimen agrees with the Siamese examples. The modification of the gill-opening is intermediate between the Siamese and Indo-Burmese forms. Though the species is widely known from N. India, Burma and Siam, it has been recorded only once before by Vinciguerra[1] from Lower Burma.

Since the publication of the revision of the genus by one of us, more material from Siam (19 specimens : 16 from Pak Jong, 2 from Nakon Sritamarat and 1 from Chantabun Estuary) has become available for study through the kindness of Dr. H. M. Smith. An examination of this material has shown that in the main the Siamese specimens agree with the description already given. In some examples the lobes of the caudal fin are not drawn out into thread-like processes. The adipose dorsal also exhibits a certain amount of variation. Similarly the structure of the gill-opening and the associated parts is also subject to variation. On account of these variations it is not proposed to separate the Siamese form into a separate race or a subspecies.

Barbus sarana (Ham. Buch.).

1822. *Cyprinus sarana*, Hamilton Buchanan, *Fish, Ganges*, pp. 307-310.

Barbus sarana belongs to a group of species in which there are four barbles and the last undivided dorsal ray is osseous and serrated. The serrated spine is deeply grooved along the entire posterior border ; the serrations are short and are situated along the two edges of the groove. The species is widely distributed in India, Burma and Ceylon, and the colouration is uniform with the exception of the Burmese specimen in which the caudal fin sometimes has a black upper and lower edge and a dark mark at the base of each scale. These gorgeously coloured, Burmese specimens were described by Blyth[2] as *Barbus caudimarginatus*, but Annandale[3] regarded it as a Burmese race of the typical *B. sarana*, and later workers[4] have agreed with Annandale's conclusion. Recently Prashad and Mukerji[5] described a still more gorgeously coloured species from Northern Burma as *Barbus sewelli*, but an examination of the material in the Indian Museum has convinced us that it should also be regarded as a local race of the typical form quite distinct from *caudiamarginatus*.

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[1] Vinciguerra (*Ann. Mus. Civ. Stor. Nat. Genova*, (2), IX, p. 68, 1890) recorded a single specimen from "Meetan"—lat. 16°.

[2] Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 157 (1860).

[3] Annandale, *Rec. Ind. Mus.*, XIV, p. 46, pl. iii, fig. 3 (1918).

[4] Hora, *Rec. Ind. Mus.*, XXII, p. 183 (1921) ; Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, p. 199 (1929).

Hora pointed out that Annandale was not justified in regarding *Barbus oatesii* Boulenger (*Ann. Mag. Nat. Hist.*, (6), XII, p. 201, 1893) as synonymous with *Barbus sarana caudimarginatus*.

[5] Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, p. 197, pl. ix, figs. 1, 1*a*, 1*b*, (1929).

It would thus appear that *Barbus sarana*, a very common carp of Indian waters, has proliferated into two subspecies in Burmese waters. It is well known that several plain-looking species of India are marked with brilliant colour bands or marks in Burma. In the case of *caudimarginatus* and *sewelli*, besides the colouration, some other structural modifications have also taken place. In typical *sarana* of India, there are 32-34 scales along the lateral line and $3\frac{1}{2}$-$4\frac{1}{2}$ scales in a transverse series. In *caudimarginatus* there are only 28-30 scales along the lateral line and $4\frac{1}{2}$ scales in a transverse series. Apart from the well marked difference in colouration, *sewelli* differs from both typical *sarana* and *caudimarginatus* in having a proportionately longer head, bigger eyes and somewhat narrower caudal peduncle. The number of scales along the lateral line is 32-34 and in a transverse series $4\frac{1}{2}$. Of the two Burmese races of *B. sarana*, *caudimarginatus* is widely distributed, having been recorded from both Upper and Lower Burma, whereas *sewelli* has only been found in the Shan States so far.

In Mr. Sondhi's collection there are seven specimens of B. *sarana caudimarginatus*, and these were obtained from the following localities :—

i. One young specimen from Hopong, S. S. States.
ii. Five half-grown specimens from a stream to the west of the village of Hopong, S. S. States.
iii. One half-grown specimen from the western drainage of the Pegu Yomas.

Of *Barbus sarana sewelli* only one specimen, 78 mm. in length without the caudal, was collected by Mr. Sondhi from a spring at $15\frac{3}{4}$ miles east of Taunggyi and about $3\frac{1}{2}$ miles east of Hopong. The subspecies is recorded here from the S. Shan States for the first time.

Barbus hexastichus McClelland.

1929. *Barbus hexastichus*, Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, pp 200, 201, fig. 7.

Barbus hexastichus is represented in Mr. Sondhi's collection by four specimens. Of these, three young specimens, not exceeding 32 mm. in length without the caudal, were collected under the bridge near the Hopong Rest House. The following note on the colouration of the living specimens was made by Mr. Sondhi :

" Light brown and greenish iridescent. White metallic lustre near the eyes and upon the gill-covers. A prominent black round spot at the base of the caudal fin."

The fourth specimen is 73 mm. in length without the caudal and was obtained at Kyouksu, about $1\frac{1}{2}$ miles east of Repiu. " When fresh, it was light brown in colour with a light iridescent, ill-defined band along the sides." The species is known as " *Pa-mong* " among the Shan people.

The young specimens of this species are liable to be confused with those of *B. sarana caudimarginatus* which also have a black spot at the root of the caudal fin. The species can be readily distinguished by the nature of the dorsal spine which is smooth in *hexastichus* and denticulated in *caudimarginatus*.

Danio (Brachydanio) shanensis Hora.

1928. *Danio (Brachydanio) shanensis*, Hora, *Rec. Ind. Mus.*, XXX, p. 38, fig. 1.

Danio (Brachydanio) shanensis is represented in the collection by nine specimens which were obtained on the 27th December, 1932, from a spring about 15¾ miles east of Taunggyi or about 3½ miles east of Hopong. " The spring is perennial and must be rich in lime as it issues from limestone." These specimens are from 34 to 49 mm. in length without the caudal. Mr. Sondhi observed two colour forms in this lot. In one set of 5 specimens he found " a white metallic patch upon the gill-cover. A bluish iridescent line begins at the tail-end and ends about the middle of the body in a sharp point." In the remaining 4 specimens, which are somewhat larger in size, " the side band is made of alternate spots of dark and light towards the posterior half of the body. The darker patches are green-iridescent and lighter ones show golden colours. They tend to expand and become less defined towards the head."

The species was originally described from the Northern Shan States where it is quite common in rice fields, in pools and ditches in the bed of hill streams at Namkhan, Kutkai, Lashio and Hsipaw. Its range of distribution is extended here to the Southern Shan States.

The specimens on which the original description was based were up to 38 mm. in length excluding the caudal fin. The great variation in colouration exhibited by the species has already been indicated by one of us, and Mr. Sondhi's observations on the colouration of the species recorded above in the living specimens point to the same conclusion. Juvenile specimens are silvery, later a broad lateral band of dark colour appears which is broader anteriorly. With the growth of the fish, the anterior half of the band is broken up into a number of vertical bars with lighter spaces in between and ultimately only the narrow posterior half of the band persists.

In the specimens from the S. Shan States, the lateral line is very variable. In most of the specimens it is incomplete, terminating above or slightly behind the anal fin. In one of the specimens it is interrupted above the anal fin over three scales, but then it bends upwards and is continued to the middle of the root of the caudal fin.

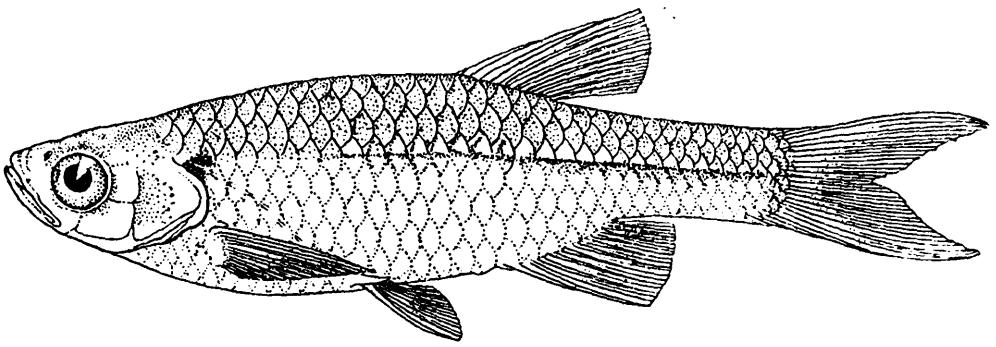
Danio (Brachydanio) sondhii, sp. nov.

D. 2/7; A. 2/10; P. 1/12-13; V. 1/7; C. 19; L l. 32-34; L, tr. 7.

With a number of specimens of the preceding species, Mr. Sondhi obtained 11 specimens of a small species of *Brachydanio*, which appears to be new to science. We have great pleasure in associating the name of this beautiful, small species with that of Mr. V. P. Sondhi. The new species may be characterised as follows :

In *Danio (Brachydanio) sondhii* the dorsal profile rises gently from the tip of the snout to the origin of the dorsal fin beyond which it slopes down to the root of the caudal fin. The ventral profile is bow-shaped. The fish is greatly compressed from side to side, specially in the posterior half, and the abdominal edge is fairly sharp. The head is small and pointed ; its length is contained from 3·6 to 4·0 times in the total length

without the caudal. The greatest width of the head is contained from 1·6 to 1·8 times and its height at occiput 1·3 times in its length. The eyes are large, dorso-lateral in position and visible from the ventral surface. The diameter of the eye is greater than the length of the snout and the interorbital width; it is contained from 2·8 to 3·2 times in the length of the head. The eye is situated almost entirely in the anterior half of the head. The interorbital space is almost flat or slightly convex.



Text-fig. 1.—Lateral view of the type-specimen of *Danio* (*Brachydanio*) *sondhii*, sp. nov. × 2½.

The mouth is directed obliquely upwards and the maxillary extends below the anterior border of the eye. Barbels are absent. No pores are noticeable on any part of the head. The depth of the body is somewhat greater than the length of the head and is contained from 3·4 to 3·7 times in the total length without the caudal. The scales are thin and firmly adherent to the body; those on the dorsal surface are fairly conspicuous, but those on the lower half of the fish are hardly distinguishable. There are 32 to 34 scales in a longitudinal series and 7 rows in a transverse series. There are 15 predorsal scales. There is a short fleshy appendage in the axil of the pectoral fin, and a thin scaly sheath at the base of the anal and caudal fins. The lateral line pierces only 8 to 10 anterior scales and is totally absent in the posterior region.

The dorsal fin commences almost in the middle of the body without the head, and its origin is 3 scales anterior to that of the anal fin; it contains two spines and seven branched rays and its height is almost equal to or slightly less than the length of the head. The pectoral fin is long and pointed; it is as long as or slightly shorter than the head and extends to the base of the ventral fin. The ventral is similar to the pectoral but is considerably shorter; it just reaches or misses the anal-opening which is situated just anterior to the anal fin. The anal fin is similar to the dorsal but it is not so deep; it is separated from the caudal fin by a considerable distance. The depth of the caudal peduncle is almost two-thirds of its length. The caudal fin is almost as long as the head; it is deeply furcate with equal pointed lobes.

Mr. Sondhi observed that in life this species is somewhat darker in colour than *D. shanensis*. The iridescent lateral band is a little broader but less defined and almost indistinguishable in the anterior part of the body. The most characteristic feature of this species is the presence of a dark spot near the upper angle of the gill-opening. The eyes are slightly metallic green in life.

In spirit specimens the edges of the scales on the back are provided with small, dark spots, whereas the sides are lightly or heavily infuscated

with small black dots. The nape is provided with a dark patch and in young specimens there is a narrow, dark band along the dorsal surface. The fins are without any colour markings.

Measurements in millimetres.

Total length without caudal .	37·0	33·0	32·0	30·0	28·0
Depth of body	10·0	9·5	8·5	8·0	7·5
Length of head	9·5	9·0	8·0	8·0	7·0
Width of head .	5·5	5·0	5·0	4·5	4·0
Height of head at occiput	7·0	6·5	6·0	6·0	5·5
Length of snout	2·0	1·75	1·75	1·5	1·5
Diameter of eye .	3·0	3·0	2·75	2·5	2·5
Interorbital width	2·5	2·5	2·5	2·25	2·0
Longest ray of dorsal	9·0	8·5	7·5	7·5	7·25
Length of pectoral	9·0	8·0	8·0	7·0	7·0
Length of ventral	6·0	5·5	5·5	5·5	5·0
Longest ray of anal	8·0	7·5	7·0	6·5	6·0
Length of caudal peduncle	6·0	6·0	5·5	5·5	5·5
Least height of caudal peduncle	4·5	4·0	4·0	4·0	3·75

Remarks.—In 1916, Weber and Beaufort[1] divided the fishes of the genus *Danio* into two subgenera as follows :—

"*a. Danio* s. str. Dorsal fin elongate, with 12-16 branched rays. Lateral line complete. Continental Asia, Ceylon.

b. Brachydanio subg. n. Dorsal fin short, with 7 branched rays only. Lateral line incomplete or absent."

During recent years several new forms of the *Brachydanio*-type have been discovered in Burma and though in all of them the dorsal fin is short, the lateral line has been found to be very variable. In the majority of forms it is either absent or extends over a few scales in the anterior region ; but there are some species in which it is fairly extensive or even complete. These small, gorgeously coloured fishes are usually found in great abundance in suitable localities and seem to be perfectly adapted for aquarium life. The Indo-Burmese species of the subgenus *Brachydanio* may be distinguished by the following key :—

Artificial key to the species of the subgenus *Brachydanio.*

I. Lateral line complete or rudimentary.

A. Lateral line complete or at least extending beyond anal fin. (Barbels absent or represented by a short maxillary pair) ; L. 1. 34 — *shanensis* Hora.

B. Lateral line incomplete, not extending to anal fin.

1. Lateral line extending beyond pectoral fin, but not reaching base of ventral. (Two pairs of well-developed barbels) ; L. 1. 31-33 — *albolineatus* (Blyth) (=*analipunctatus* Blgr.).

2. Lateral line short, not extending beyond pectoral fin.

a. Two pairs of well-developed barbels (L. 1. 28-30 ; body and caudal fin marked with four metallic blue bands) — *rerio* (Ham. Buch.).[2]

[1] Weber and Beaufort, *Fish. Indo-Austral. Archipel.*, III, p. 85 (1916).

[2] Lateral line is very variable in *D.* (*Brachydanio*) *rerio* as indicated in the remarks below the key.

b. Barbels absent.	
i. L. l. 32-34 ; a well-defined black mark near upper angle of gill-opening	*sondhii*, sp. nov.
ii. L. l. 30 ; black mark near upper angle of gill-opening absent	*acuticephala* Hora.
II. Lateral line totally absent.	
A. Two pairs of barbels.	
1. Maxillary barbels extending nearly to middle of pectoral (L. l. 28-30)	*rerio* (Ham. Buch.).
2. Maxillary barbels shorter than head (L. l. 33)	*choprae* Hora.
B. One pair of maxillary barbels (L. l. 30-32)	*nigrifasciatus* (Day).

Remarks.—All the species of *Brachydanio* described so far are very characteristic, not only with regard to the characters enumerated in the above key but also in their colouration. The colour markings of the various species appear to be specific.

Attention may here be directed to the fact that in *Danio* (*Brachydanio*) *rerio* the lateral line is very variable. Prashad and Mukerji[1] have already shown that in this species the lateral line may be distinct, piercing 2-6 anterior scales, rudimentary or totally absent. In some Burmese examples they found this structure better developed, reaching as far as the base of the ventral fin. It is due to the variation of this character that the species is included under both the main sections of the key. Apart from any other consideration, *D. rerio* can be distinguished most readily by its prominent and well marked colour bands.

Danio (Danio) aequipinnatus (McClelland).

1929. *Danio aequipinnatus*, Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, pp. 205, 206.

Mr. Sondhi's collection contains three specimens of *Danio aequipinnatus*, a widely distributed and beautiful species of the fresh waters of India and Burma. One of these was obtained in December, 1932, at Kyouksu, a village about 1½ miles east of Repiu and, when alive, was brownish in colour with " a well-defined strong band of dark blue along the sides and both above and below it are thinner-golden bands. The blue band runs along the entire length from tail to head and breaks up in a wavy line before reaching the gill-opening." The species is known as " *Nga-chhikha* " at Kyouksu, and is considered to be a larvicidal fish.

The other two specimens were collected in April, 1933, in the clear spring water of the Lawksawk Canal near the Rest House. The colouration of the smaller specimen was similar to that described above, whereas in the larger example the central blue band is broken up into three bands separated by golden lines. " The uppermost golden line is wavy but continuous, and the colour band just underneath it is greenish blue. A faint golden line extends through it for about half of its length. The lower golden line is straight and continuous."

It may not be out of place to mention here that one of us[2] has already remarked on the validity of Regan's *Danio browni*[3] from Upper Burma.

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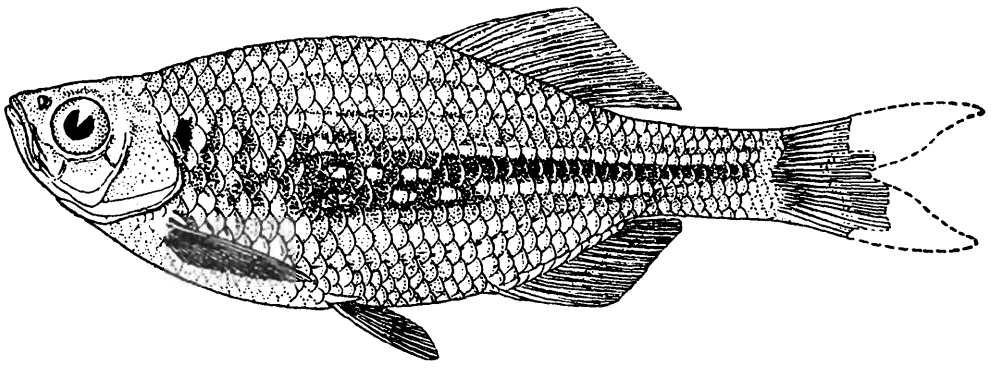
[1] Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, p. 206-208, pl. vii, fig. 5 (1929).
[2] Mukerji, *Journ. Bombay Nat. Hist. Soc.*, XXXVII, 1934 (in press).
[3] Regan, *Rec. Ind. Mus.*, I, p. 395 (1907).

The four typical specimens on which the description is based are preserved in the collection of the Zoological Survey of India. They are all young and agree in almost every respect with the young specimens of *Danio aequipinnatus*. We are, therefore, of opinion that *D. browni* cannot be regarded as a distinct species.

Danio (Danio) annandalei Chaudhuri.

1908. *Danio annandalei*, Chaudhuri, *Rec. Ind. Mus.*, II, pp. 125, 126.
1924. *Danio annandalei*, Myers, *Amer. Mus. Novitates*, No. 150, p. 2.

In Mr. Sondhi's collection there is a single specimen which, after a careful study, we have referred to *Danio annandalei*, a gorgeously coloured small fish described by Chaudhuri from a jungle stream near Kawkareik, at the base of the Dawna Hills in Tenasserim, Lower Burma. Chaudhuri gave a detailed description of the colour-pattern of the species which is not very different from that of *Danio dangila*. Superficially the two species appear identical, but they are easily distinguished by well-marked diagnostic characters. In discussing the affinities of *D. annandalei*, Chaudhuri attached considerable importance to the presence or absence of scaly or fleshy appendages at the bases of the paired fins, for he observed "Besides other apparent and conspicuous differences the new species differs from *D. spinosus* in possessing appendants to the pectoral fins (whereas *D. spinosus* has none), and from *D. dangila*, which possesses appendants to the ventral fins." Our observations on the various species of the genus show that in almost every case a scaly appendage is present above the base of the ventral fin and a fleshy appendage in the axil of the pectoral fin.



Text-fig. 2.—Lateral view of a type-specimen of *Danio* (*Danio*) *annandalei* Chaudhuri × 1⅓.

Mr. Sondhi's specimen is 58 mm. in total length without the caudal, and was taken in the western drainage of the Pegu Yomas (Gyobyu Chaung). The brilliant colour-pattern has faded away entirely, though with proper illumination four or five round, whitish markings could be made out. In every other respect, this specimen agrees with the two typical examples in our collection and with Chaudhuri's description of the species. As no figure of the species has so far been published, we give above a lateral view drawing of one of the type-specimens.

With the specimens of *D. annandalei*, several examples of *D. dangila* and *D.* (*Brachydanio*) *albolineatus* were collected by Dr. N. Annandale. We have indicated above that *D. annandalei* and *D. dangila* appear to

be similar superficially, but the salient characters tabulated below will help to distinguish the two species. We also give here a table of measurements of three specimens of each species to facilitate detailed comparison in future.

Danio annandalei.	*Danio dangila.*
1. Both pairs of barbels less than diameter of eye.	1. Both pairs of barbels at least as long as thrice diameter of eye.
2. L. tr. 15 ($11\frac{1}{2}/3\frac{1}{2}$).	2. L. tr. 9 ($6\frac{1}{2}/2\frac{1}{2}$).
3. Length of snout contained 4 times in length of head.	3. Length of snout contained 4·8-5·5 times in length of head.

Measurements in millimetres.

	D. annandalei.			*D. dangila.*		
	Upper Burma.	Dawna Hills Types.		Dawna Hills.		
Total length without caudal	58·0	55·0	56·0	61·0	57·0	45·0
Length of head	14·0	14·0	14·0	14·5	12·5	11·0
Depth of body	19·0	19·5	20·0	19·5	17·0	15·0
Width of head	8·0	8·0	8·0	9·5	8·0	6·0
Height of head at occiput	10·5	11·0	11·0	10·0	10·0	8·0
Length of snout	3·5	3·5	3·5	3·0	2·5	2·0
Diameter of eye	4·0	4·5	4·5	4·0	4·0	3·25
Interorbital width	4·0	4·0	4·5	4·5	4·0	3·0
Longest ray of dorsal	8·5	9·0	10·0	12·0	12·0	7·5
Length of pectoral	13·5	12·5	13·0	14·0	14·0	11·0
Length of ventral	8·0	8·0	8·0	10·0	9·5	6·5
Length of base of anal	12·0	11·0	11·0	12·0	11·0	9·5
Length of caudal peduncle	9·0	10·0	10·0	10·5	10·0	7·5
Least height of caudal peduncle	7·0	6·5	7·0	8·0	7·5	5·5

In 1924, Myers[1] described a new species of *Danio*, *D. strigillifer*, from Burma and gave a key to all the species of the genus *Danio*, s. str. On an examination of a large collection of Danios from India, Burma and Siam in the Indian Museum, we have found it necessary to include here an emended key of the various species. Unlike members of the subgenus *Brachydanio*, these fishes are somewhat more difficult to define, particularly as the colour-pattern is common to several of them, and the range of variation of other diagnostic features of the various species is considerable.

Artificial Key to the species of the subgenus *Danio*.

I. One or two spines along anterior margin of orbit below nostrils. [Two pairs of barbels; L. l. 33-38; L. tr. 15 ($12\frac{1}{2}/2\frac{1}{2}$)] — *spinosus* (Day).

II. Spines along anterior margin of orbit absent.

A. Barbels absent [L. l. 33-38; L. tr. 15 ($12\frac{1}{2}/2\frac{1}{2}$)] — *devario* (Ham. Buch.).

B. Barbels present.

1. A pair of short rostral barbels; maxillary barbels, if present, rudimentary.

a. L. l. 32; L. tr. 11. ("A dark line along the middle of the sides through the tail, with occasionally obscure dusky bands above and below it.") — *kakhiensis* Anderson.

[1] Myers, *Amer. Mus. Novitates*, No. 150, p. 2 (1924).

b. L. l. 35-37; L. tr. 9 (6½/2½). ("A badly marked broad, steel-blue stripe, extends from behind the eye to the caudal fin, while it is bounded above and below by a narrow yellow edging") *neilgherriensis* (Day).

2. Two pairs of well developed barbels.

a. A well-defined black mark near upper angle of gill-opening.

i. Lateral bands breaking up anteriorly to form a mottled pattern.

α. Both pairs of barbels much longer than diameter of eye [L. l. 36-42; L. tr. 9 (6½/2½)] *dangilla* (Ham. Buch.).

β. Both pairs of barbels equal to or shorter than diameter of eye.

*L. l. 37; L. tr. 10 (7½/2½). *strigillifer* Myers.

**L. l. 42-46; L. tr. 15 (11½/3½) *annandalei* Chaudhuri.

ii. Lateral bands not breaking up anteriorly to form a mottled pattern.

α. Several well marked and uniform lateral bands [D. 3/9-12; L. l. 34-36; L. tr. 10-or 11 (7½/2½ or 8½/2½)] *aequipinnatus* (McClell.) (=*browni* Regan).

β. Single lateral band well marked posteriorly [D. 3/8; L. l. 38-40; L. tr. 11 (8½/2½)] *naganensis* Chaudhuri.

b. Black mark near upper angle of gill-opening absent [middle rays of caudal fin black; barbels minute; L. l. 32-34; L. tr. 11 (8½/2½)] *malabaricus* (Jerdon).

It was pointed out by Myers (*op. cit.*) that *Danio chrysops* (Cuv. and Val.)[1] is perhaps not a *Danio*, as in this species the anal fin is stated to be entirely behind the dorsal whereas in *Danio* the hinder half of the dorsal fin is at least situated above the anal fin. We consider the position of the dorsal with relation to that of the anal a fundamental character and on this account do not regard *D. chrysops* to be congeneric with the other species. Unfortunately, from the meagre information available, it is not possible to discuss the exact systematic position of *D. chrysops*.

With the exception of *D. kakhiensis*[2] and *D. strigillifer*, we have examined the types, topotypes or a good series of specimens of all the other species.

Nemachilus rivulicola Hora.

1929. *Nemachilus rivulicola*, Hora, *Rec. Ind. Mus.*, XXXI, p. 324, pl. xv, figs. 3 and 4.

Nemachilus rivulicola was described by one of us from the clear, rocky streams in the Yawnghwe Valley and the He-Ho plain. Mr. Sondhi obtained 10 specimens from underneath the bridge near the Hopong Rest House and 3 more examples from a canal near Lawksawk Rest House. It thus appears that the species is fairly widely distributed in the Southern Shan States. The specimens in Mr. Sondhi's collection agree in almost every detail with those in the type series.

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[1] Cuvier and Valenciennes, *Hist. Nat. Poissons*, XVII, p. 308 (1844); Day, *Fish. India*, p. 596 (1878).

[2] Anderson, *Anatomical and Zoological Researches*, etc., I, *Pisces*, p. 868 (1878).

Nemachilus multifasciatus (Day) Vinciguerra.

1890. *Nemachilus multifasciatus*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2), IX, pp. 209-211.

In his revision of *Nemachilus* from Burma, Hora[1] remarked " I have not yet determined exactly the specific characters of Day's *N. multifasciatus* and have, therefore, left out of consideration Vinciguerra's specimens referred to this species" As regards the identity of Day's *multifasciatus*, the situation has not altered so far, and in spite of the extensive collections that have been made in the Darjiling Himalayas during recent years, not a single specimen of the species has been obtained. Vinciguerra's *multifasciatus* has, however, been recorded by Mukerji[2] from northern Burma and Siam, and he gives a detailed description of the species from fresh specimens. In the present state of our knowledge it is not possible to be certain whether the Burmo-Siamese form is conspecific with the Eastern Himalayan form. Until further material is obtained from the latter locality, we propose to designate the authorship of the species as noted above.

In Mr. Sondhi's collection there is only one specimen of this species obtained in the western drainage of the Pegu Yomas at Gyobyu Chaung, west of the new dam line. It is 52 mm. in total length without the caudal and is a well preserved specimen. The colouration of the body is somewhat faded, but the black vertical bar at the base of the caudal and the characteristic colour pattern on the caudal fin are well marked.

Lepidocephalichthys berdmorei (Blyth).

1929. *Lepidocephalichthys berdmorei*, Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, p. 191.

Lepidocephalichthys berdmorei is the most widely distributed loach in the Burmese waters. Six specimens of the species were obtained by Mr. Sondhi at Repiu. The fish is usually found in pools and puddles in the course of streams among debris at the bottom.

The species is known as " *Nga-tha-lay daw* " by the Guttum people.

Acanthopsis choirorhynchus (Bleeker).

1916. *Acanthopsis choirorhynchus*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* III, p. 25, figs. 8 and 9.

Acanthopsis choirorhynchus is represented by a single specimen in Mr. Sondhi's collection. It is a young specimen, 98·3 mm. in total length, and was obtained in the Pegu Yomas. Besides Burma the species is known from Malay Peninsula, Annam, Borneo, Java and Sumatra. So far it has not been recorded from India.

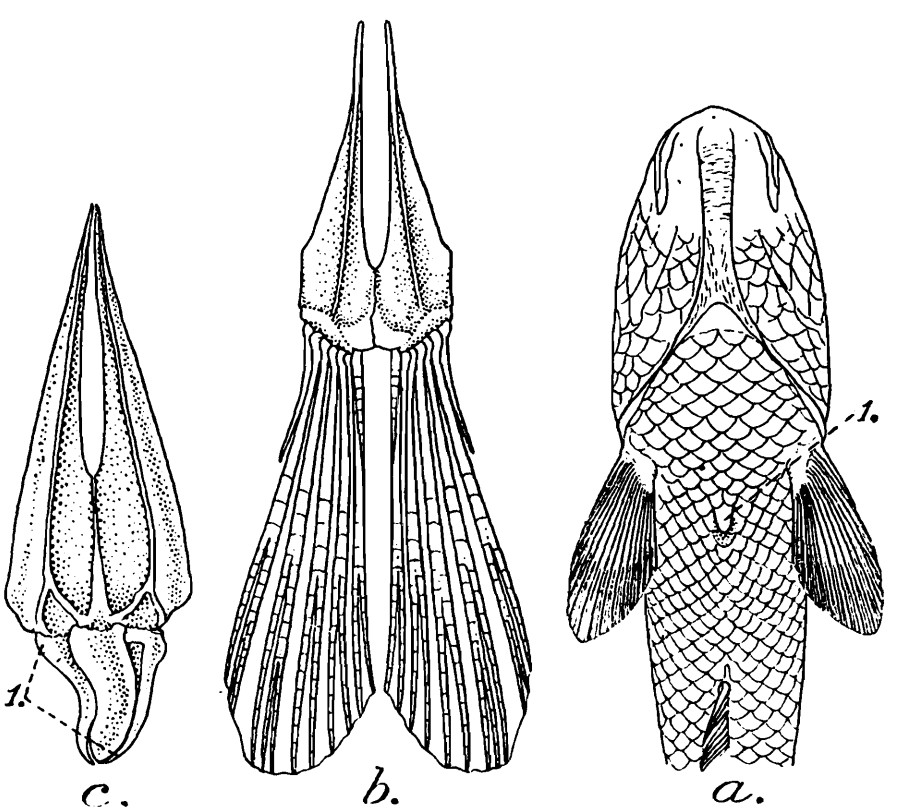
Ophicephalus gachua Ham. Buch.

1918. *Ophiocephalus harcourt-butleri*, Annandale, *Rec. Ind. Mus.*, XIV, p. 54, pl. ii, fig. 7 ; pl. iv, figs. 16, 17.
1921. *Ophiocephalus harcourt-butleri*, Hora, *Rec. Ind. Mus.*, XXII, p. 208.
1929. *Ophicephalus gachua*, Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, p. 215.

Ophicephalus gachua is a widely distributed and variable species of the Oriental Region. Its much more marked amphibious mode of

[1] Hora, *Rec. Ind. Mus.*, XXXI, p. 314 (1929).
[2] Mukerji, *Journ. Bombay Nat. Hist. Soc.*, XXXVII, 1934 (in press).

life is probably responsible for a certain amount of variation exhibited by the species. Moreover, during growth the fish undergoes considerable changes in proportions, etc. In 1918, Annandale (*op. cit.*) described a new species, *O. harcourt-butleri* from the Inlé Basin, S. Shan States, and remarked that it is a " small species resembling *O. gachua*, but distinguished by the smaller scales on the head, the longer, narrower, less flattened head, etc." According to Annandale this species " is abundant all over Yawnghwe and the neighbouring states. .Large numbers are sold in the local markets." One of us (Hora, *op. cit.*) recorded this species from the Manipur Valley where it was found to be abundant in marshy places. In 1893, Boulenger[1] had recorded *O. gachua* from Fort Stedman, and the belief has been growing with us that *O. harcourt-butleri* is probably conspecific with *O. gachua*. After an examination of a large number of specimens in the collection of the Zoological Survey of India from widely separated localities, we are now of opinion that the differences pointed out by Annandale lose all significance when large series of specimens are examined. Annandale's *O. harcourt-butleri* cannot, therefore, be regarded as distinct from *O. gachua*.



TEXT-FIG. 3.—*Ophicephalus gachua* Ham. Buch.

a. Ventral surface of head and anterior part of body of an abnormal specimen showing absence of ventral fins × $\frac{4}{5}$.

b. Skeleton of the rudiment of the pelvic fins and the basipterygia of the above × $4\frac{4}{5}$.

c. Skeleton of the pelvic fins and the basipeterygia of a normal specimen × 4.

1 = Rudiment of the pelvic fins.

Five specimens of *O. gachua* were collected by Mr. Sondhi, 4 from the S. Shan States and 1 from the Pegu Yomas. The specimen collected at Pangtara, about 145 mm. in total length without the caudal, is of special interest as it is deficient in both the pelvic fins. According

[1] Boulenger, *Ann. Mag. Nat. Hist.* (6), XII, pp. 198-203 (1893).

to Day[1] " It is not uncommon in India to find specimens of *Ophiocephalus gachua* having a ventral fin deficient but I have never observed both wanting." With the exception of the specimen under report, we have not come across any example of *O. gachua* lacking one or both the ventral fins. In the abnormal specimen the region of the origin of the pelvic fins is marked by the presence of a large scale, which on dissection proved to be a bony structure representing the two lost fins. The pelvic girdle or the basipterygia are of the normal type, except that they lie closer together and have coalesced in the basal region to form a single structure. The basipterygia are further fused with the scale-like structure noted above. The latter was partly imbedded in the skin but was free distally. It is thus seen that the remnants of the pelvic fins and their supporting bones have become fused to form a single bony mass. For convenience of reference, we reproduce (Text.-fig. 3) a drawing of the pelvic fins and the basipterygia of the normal specimen of *O. gachua* for comparison with the abnormal structure illustrated here.

In April, 1932, we received three specimens of *Channa orientalis* and three of *Ophicephalus gachua* from the Colombo Museum. We were informed that the specimens of both the species had been taken together. One of these specimens of *C. orientalis* was dissected very carefully to see if there was any rudiment left of the pelvic fins or the basipterygia, but we were unable to find any trace of either. This shows that in *Channa* the pelvic fins are totally absent, whereas in the abnormal specimen of *O. gachua*, the absence of the pelvic fins has to be regarded as a mere deformity due to some injury or pathogenic condition. On previous occasions we[2] have referred to the absence of paired fins in fishes and discussed the significance of this phenomenon in the taxonomy of the forms concerned. As regards the systematic position of *Channa* and *Ophicephalus*, Myers and Shapovalov[3] have recently given some evidence to show that *Channa* probably comprises series of anomalous specimens hardly distinguishable from species of *Ophicephalus* except on the character of the pelvic fins. We also feel that there is a great deal to be said for this view, for an examination of the material of both the genera in the Indian Museum has shown that if the absence of the pelvic fins is ignored it is very difficult to distinguish species of *Channa* from certain species of *Ophicephalus*. As an example it may be noted that we have not been able to find any distinctive feature in the type-specimens of *Channa burmanica* Chaudhuri[4] by which the species can be distinguished from the common form, *O. gachua*. The abnormal specimen reported here raises several questions of interest, but we refrain from discussing the problem as Deraniyagala[5] proposes to make an intensive study of *C. orientalis* and *O. gachua* with a view to elucidate the systematic position of the two genera.

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[1] Day, *Fish. India*, p. 368 (1878).

[2] Hora, *Rec. Ind. Mus.*, XXII, pp. 27-32, figs. 1 and 2 (1921); *Nature*, London, CXXVI, pp. 435, 436, fig. 1 (1930).
Mukerji, *Annot. Zool. Japon.*, XIII, No. 5, pp. 441-444 (1932); *Journ. Bombay Nat. Hist. Soc.*, XXXVII, 1934 (in press).

[3] Myers and Shapovalov, *Peking Nat. Hist. Bull.*, VI, pt. ii. pp. 32-37 (1931-32).

[4] Chaudhuri, *Rec. Ind. Mus.*, XVI, pp. 284-286, pl. xxii, figs. 4, 4*a*, 4*b* (1919).

[5] Deraniyagala, *Spol. Zeylanica*, XVII, pt. i. pp. 40, 41 (1932).

Mastacembelus armatus (Lacépède).

1929. *Mastacembelus armatus*, Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, pp. 213, 214.

A young specimen of *Mastacembelus armatus*, 140 mm. in total length was obtained by Mr. Sondhi in the western drainage of the Pegu Yomas. The colouration of the specimen is somewhat different from the normal type. There are two short bands in the posterior portion of the head forming a cross on the nape. A black band along the dorsal surface at the sides of the spines runs in an undulating course and the second is a much narrower band that runs along the lateral line. A still lighter and narrower band runs along the middle of the lower half of the body and is continued forwards on the gill-cover. Behind the vent all these bands break up and form the reticulated pattern characteristic of the species. In the anterior region the fish is marked with 3 lateral stripes decreasing in width from above downwards.

Ambassis ranga (Ham. Buch.).

1929. *Ambassis ranga*, Prashad and Mukerji, *Rec. Ind. Mus.*, XXXI, pp. 210, 211.

There are two young specimens of *Ambassis ranga* in the collection. They were obtained by Mr. Sondhi in the Pegu Yomas.

MGIPC—M—III-8-16—4-4-34—510.