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FAUNA OF THE CHILKA LAKE

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FAUNA OF THE CHILKA LAKE.

HIRUDINEA.

By W. A. Harding, *M.A., F.L.S.*

(With 2 text-figures.)

CONTENTS.

HIRUDINEA.

By W. A. Harding.

Dr. Annandale has placed in my hands a large collection of Indian Hirudinea and my hearty thanks are due to him for the opportunity of examining so large a body of interesting material. The results of my work upon this collection will appear in due course and I confine myself here, at Dr. Annandale's request, to a report upon the leeches obtained during the investigations by Dr. Kemp and himself on the fauna of the Chilka Lake. These consist of examples of three new Rhynchobdellid species, whilst the general collection of Indian Hirudinea just referred to contains examples from this lake of another Rhynchobdellid species, a colour-variety of the widely distributed *Glossosiphonia heteroclita.* It will be convenient to deal with this leech first.

Glossosiphonia heteroclita, Linn. (1761).

This well-known leech occurs in North America and throughout the greater part of Europe and it is now recorded from India for the first time. It is not peculiar to the Chilka Lake, and in the general collection are examples from many parts of India, showing it to be widely distributed there. The Indian examples agree with the normal type, with the exception of black markings present on the pale golden-yellow dorsal surface. European specimens are generally free from black pigment, but Apâthy (1888, p. 790) describes a variety (*striata*) having black transverse stripes, more or less broken, on every third ring.

Castle (1900, p. 42, pl. viii, fig. 38) finds in the United States various gradations between the typical yellow form, and a form with transverse striae and an irregular longitudinal mid-dorsal band. The Indian examples have the black pigment disposed in a broken mid-dorsal line and further investigations may prove that they represent a new variety.

The examples of this species, collected by Dr. Annandale at Lake Chilka in March, 1910, are accompanied by the following notes: —

(*a*) Found "among weeds in pond. Rambha, S. end of Chilka Lake."
(*b*) From "S. end of Chilka Lake."

[This leech appears to be very common on freshwater molluscs of the genera *Vivipara* and *Pachylabra* all over India. In the Chilka Lake it is only found in flooded areas of fresh or practically fresh water.—*N.A.*]

Piscicola olivacea, n. sp.

(FIG. 1.)

FORM, SIZE, COLOUR.

The circular and exceedingly long and slender body of this little leech resembles in general form that of the *Piscicola geometra* of Europe. It is about half the size of the European species, the largest example measuring, when fairly extended, approximately 10·75 mm. in total length, the greatest width of the body being about 1·50 mm.

For information as to colour, I am dependent upon Dr. Annandale, who has been good enough to send me notes upon the external features of several different individuals. From these notes it appears that the general colour of the body varies from bright to pale olive green, minutely speckled with black, or with a darker shade of green. A series of conspicuous white spots occur, one on either side of each somite, on the margins of the body, and these are connected across the dorsal surface by whitish and often indistinct bands.

Another series of somewhat irregular elongated spots or blotches lie in the mid-dorsal line, one in each somite (on a level with the marginal spots) and these median spots, which may or may not be joined together at their extremities, give the appearance of a somewhat ill-defined whitish mid-dorsal streak.

Anterior sucker circular, whitish, with three brownish bands on the dorsal surface; one band following the junction with the body, one near the anterior tip and a third and broader one between the two, in the posterior part of the sucker, which contains the eyes. The mouth-opening is situated in the centre of the interior cup.

Posterior sucker somewhat heart-shaped, of the same green colour as the body, with seven pairs of whitish rays, corresponding to the seven somites xxviii-xxxiv of which it is composed.

Several individuals examined showed traces of the original dorsal pattern, and from one of these the arrangement of spots and bands shown in Fig. 1 was drawn. It is to be understood that the arrangement indicated is schematic and subject to a good deal of variation in its details.

RINGS, SOMITES, GENITAL ORGANS, EYES.

The complete somite is formed of 14 annuli.

The transverse middle line of the complete somite passes through a ventral ganglion, and also through the middle of the white mid-dorsal and marginal spots. The ganglion occupies two rings (7 and 8) of the complete somite.

The pulsating vesicles have collapsed in the specimens examined, but traces of them occasionally may be seen, and their presence is placed beyond doubt by Dr. Annandale, who has noted that they occur in the whitish spots on the margins of the body. The first pair lie in somite xiii, and there appear to be eleven pairs, the last pair lying in somite xxiii.

The male genital orifice lies in somite xi, and the female orifice in somite xii.

There are two pairs of eyes on the anterior sucker, one pair on either side of the mid-dorsal line. The component eyes of each pair are linear in form and inclined together at an acute angle in such a way as to resemble the equal sides of an isosceles triangle lying horizontally, with its apex pointing towards the margin of the sucker.

The eyes in each pair do not actually touch at the point of inclination; they may be somewhat curved outwardly or, again, so closely approximated as to give, at first sight, the appearance of one linear eye.

Hosts, Habitat.

This leech is a fish parasite and has been recorded from *Hypolophus sephen*, *Tetrodon reticularis* and *Dorosoma indicum* (*Chatoessus chacunda*). It has so far only been found in the Chilka Lake. The following examples from this lake were examined :—

(*a*) "Station 52. 4 mi. E.½N. of Patsahanipur. On *Hypolophus sephen* (Forsk.) found crawling on lower surface of body, in the gill-slits, near the anus and within the mouth on the palate. Sp. gravity of water 1·007—1·011."

(*b*) "Station 22. E. side of Rambha Bay, base of Ganta Sila. Sp. gravity of water 1·007—1·011. Found on a man's foot after wading."

(*c*) "Station 49. 4-9 mi. E. ½ S. of Barkul bungalow."

(*d*) "Station 85. Satpara. On *Tetrodon reticularis* (Bl.). Sp. gravity of water about 1·026."

(*e*) "Station 14. E. side of Rambha Bay. Sp. gravity of water 1·007—1·011."

(*f*) "Station 55. 2-8 mi. N.E. ½ E. of Kalidai."

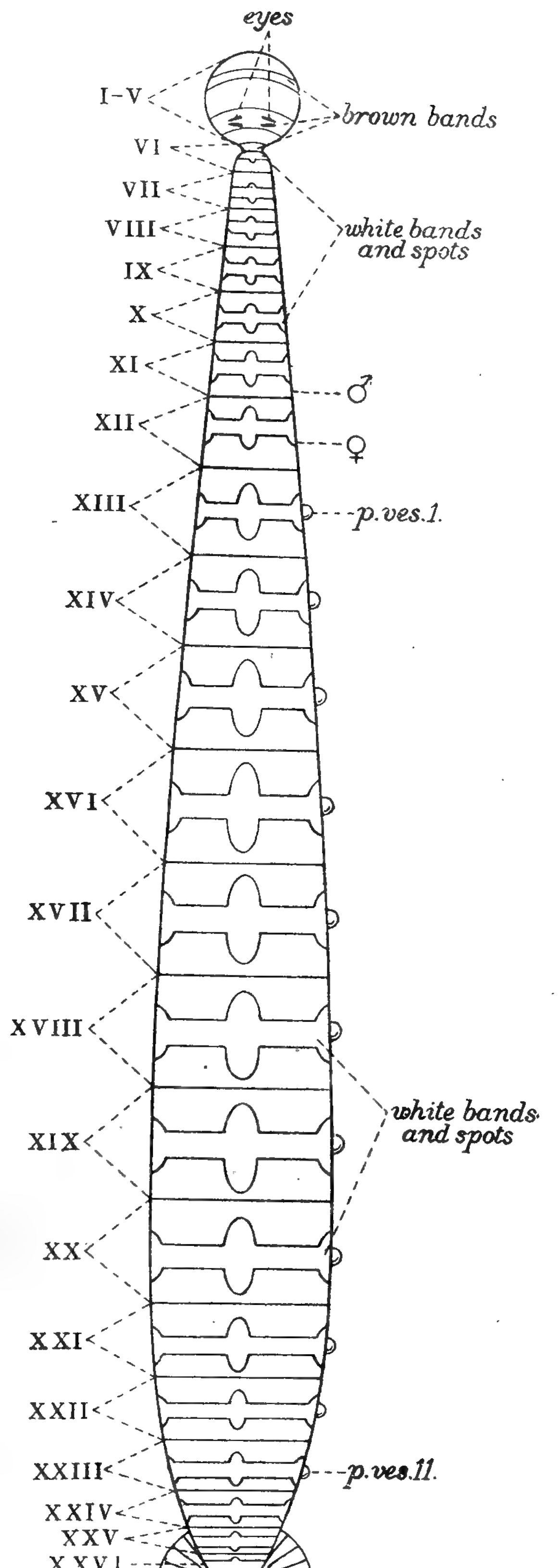

FIG. 1.—*Piscicola olivacea*, n. sp. Diagram showing dorsal pattern, somites (numbered in Roman figures), eyes, etc.

An, Anus; *p. ves.* I and *p. ves.* II, Pulsating vesicles (shown only on one side, for the sake of clearness) of first and eleventh pairs.

(*g*) "Rambha Bay. Among weeds."
(*h*) "Station 51. 5-7 mi. E. by N. of Patsahanipur."
(*i*) "Station 64. Ghiakhala headland and neighbouring islands."
(*j*) "Station 73. 7-4 mi. E.½S. of Patsahanipur. On *Hypolophus sephen* (Forsk.)"
(*k*) "Station 54. 2 mi. N.E. by N.½N. of Kalidai.
(*l*) "Off Barkul. From *Chatoessus chacunda*."

[A leech apparently identical with *Piscicola olivacea* is very abundant among algae on the shore of Barkuda Island, Chilka Lake, and I have also obtained specimens from a small pool of almost fresh water on the same island. In this pool the only vertebrates were frogs (*Rana cyanophlyctis*).—*N. A.*]

Additions to this preliminary description of *P. olivacea* will, it is hoped, appear at a later date.

N.B.—Along with the examples of *P. olivacea* were several specimens of another and apparently new species of leech closely resembling the former in size and form, without eyes and having at least fourteen rings to the complete somite. I give here Dr. Annandale's notes upon it, and it is doubtful if the material will yield much more information; the muscular expansion of the margins of the body giving the fin-like appearance described below is not evident after death.

"Leeches on lips of *Hypolophus sephen* (Forsk.) .. attached outside, close to junction of skin and teeth on both upper and lower jaws. No visible eye spots. Specimens seem to have a lateral fin on anterior two-thirds of body. Colour whitish .. Occasionally minute spots of faint pink on dorsal surface." Collected at "Station 43. 8 mi. S. S.W. of Kalidai, Chilka Lake. Sp. gravity of water 1·007—1·011."

Placobdella emydae, n. sp.

(FIG. 2).

EXTERNAL FEATURES—FORM, SUCKERS, ANNULI, SOMITES, EYES.

Body flattened, in extension elliptic-lanceolate, with the head region slightly dilated.

Dorsal surface with a roughened appearance due to the presence on each annulus of numerous small papillae.

Ventral surface without papillae and smooth.

The dorsal papillae vary in size and arrangement. A row of about 16-20 papillae are present on the first and third ring of the complete somite, whilst about twelve are more regularly disposed upon the middle ring. The middle ring of the somite (which lodges a ganglion of the ventral chain) has, amongst the others, three pairs of metameric papillae; a paramedian, an intermediate and a paramarginal pair, the intermediate pair being the largest.

N.B.—All papillae tend to disappear and may even be absent in improperly preserved specimens.

Anterior sucker pierced on its anterior lip by the mouth-opening; with a shallow imperforate interior cup having a finely ribbed surface somewhat resembling that of the tip of the human finger.

Posterior sucker circular, centrally attached, narrower than the greatest width of the body, broader in proportion to the body-width in immature than in adult examples. Annuli 71, two being pre-ocular. The second and third annuli may show some division at their margins : the fifth is confluent with the free ventral edge of the anterior sucker: annuli 6 and 7 are separate above but sometimes so slightly divided as to appear as one ring: annulus 6 disappears ventrally, leaving the seventh (distinguished by papillae) to form the first ventral annulus following the anterior sucker.

Complete somite formed of three annuli. Somites i, ii and iii uniannulate; iv, xxv, xxvi and xxvii biannulate. The twenty somites v-xxiv are complete with three rings.

Eyes, one pair, closely approximated, situated normally in the third annulus, but sometimes between the third and second rings.

Reproductive Organs, Digestive Tract, Nephridiopores.

Male genital orifice situated between annuli 26 and 27, that is, between somites xi and xii; female genital orifice situated two rings behind the male, between annuli 28 and 29, being the second and third rings of somite xii.

Epididymis large, long and thrown into complex coils and loops, the last loop extending as far down as the xvth somite, and returning upwards through two somites before again turning down to join the vas

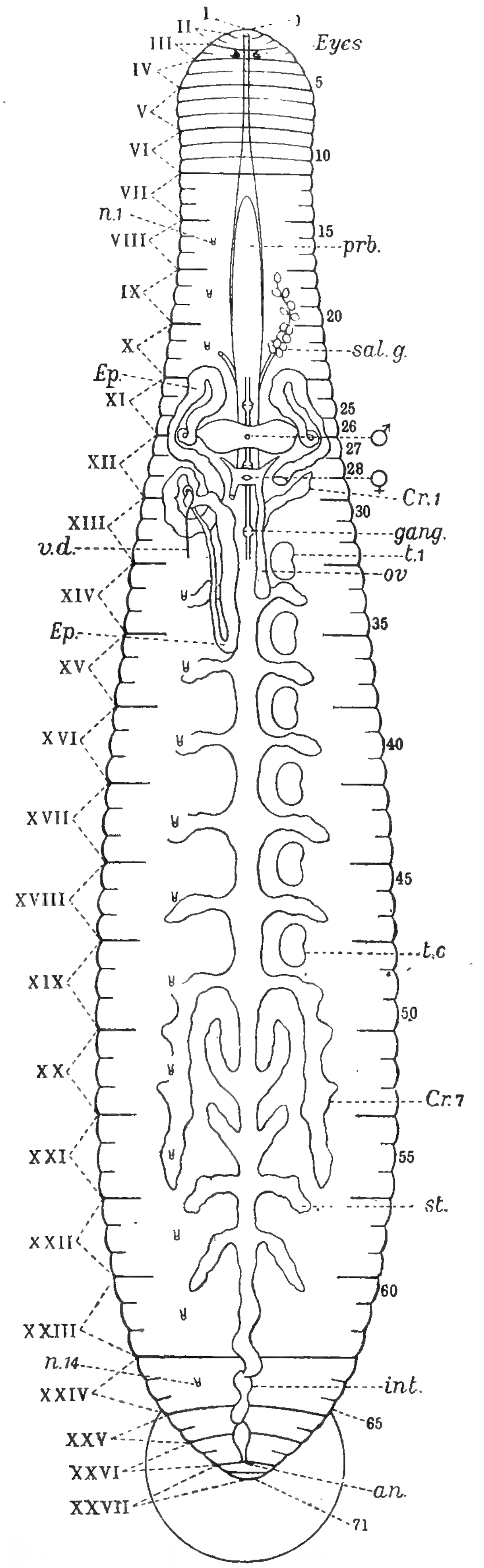

FIG. 2.—*Placobdella emydae*, n. sp. Diagram showing annulation, genital organs, digestive tract and other internal and external features. The testes are shown on one side only, and the nephridiopores on the other for the sake of clearness, and other organs have been treated in the same manner and for the same reason. Somites numbered in Roman, and rings in ordinary figures.

prb. Proboscis. *sal. g*, Salivary glands. *Cr.* 1 and 7, First and seventh diverticula of Crop. *St*, Stomach. *int*, Intes tine. *an*, anus. *gang*, one of the ventral ganglia. *n.* 1 *and n.* 14, Nephridiopores of the first and fourteenth pair. *Ep*, Epididymis. *vd*, vas deferens. *t.* 1and t. 6, Testes of the first and sixth pairs. *ov.* ovary.

deferens. The large epididymes form a characteristic feature of the species and are not apparently symmetrical: one is usually shorter than the other. Testes 6 pairs, of kidney-like form. The ovaries are a pair of simple sacs prolonged anteriorly into horn-like processes.

Crop with seven pairs of lateral diverticula of fairly simple form and all posterior to the male genital orifice: the first pair reflected anteriorly, the last and longest pair reflected posteriorly. Stomach with the usual four pairs of lateral diverticula. Extensive salivary glands are present and the mouth, as already noted, occupies the nearly terminal position characteristic of the genus.

Nephridiopores, 14 pairs, situated upon annuli 16, 19, 22, 34, 37, 40, 43, 46, 49, 52, 55, 58, 61, and 64. A pair thus occurs upon the middle ring of somites viii-x and xiv-xxiv, none being present in somites xi-xiii. Each pore perforates the middle part of the ring in which it is located and lies about midway between the ventral margin and middle line.

HABITAT, HOSTS.

This little species has so far been found upon Mud-turtles of the genus *Emyda* and is not peculiar to Lake Chilka. In addition to (a) four individuals from this lake taken from *Emyda granosa*, Günth., subsp. *intermedia*, Annandale, I have the examples detailed below. (Information from notes enclosed with the material.)

(*b*) "From *Emyda granosa*, Günth. Outskirts of Calcutta."

(*c*) "From carapace of *Emyda granosa*, Günth. Gatiagurh, Dist. Hughly, Bengal.

(*d*) "From carapace of *Emyda granosa*, subsp. *intermedia*, Annandale. R. Mahanaddi, Sambalpur, Orissa."

(*e*) "From *Emyda granosa*, subsp. *intermedia*, near Purulia, Chota Nagpur Div., Bihar."

(*f*) "From the turtle *Emyda vittata*, Nagpur, C.P." Dr. Annandale adds "The mud-turtle that occurs at Nagpur is probably *E. granosa intermedia*, and not *E. g. vittata*."

The examples from Lake Chilka, according to Dr. Annandale's notes, were collected at "Station No. 52, 4-9 mi. E.½N. of Patsahanipur .. sp. gravity of water 1·007—1·011." This leech, therefore, is able, like its hosts, to accommodate itself to water of a certain degree of brackishness.

COLOUR AND SIZE.

For information as to the colour of this species, I am dependent upon Dr. Annandale who has provided me with notes taken from five different living individuals. From these notes, I am enabled to state that the ground colour varies from greyish green to pale olive brown or pale brown, the gorged crop appearing dull green through the semi-transparent body.

Dorsal surface with a distinct white median line, closely speckled with white and a darker green, the white specks being prominent on the margins of the body. Ventral surface olivaceous. Posterior sucker with whitish radiating lines, the interspaces sometimes minutely speckled with grey-green. One of my examples in alcohol shewed that the speckled or tessellated appearance of the dorsal surface was due to the numerous small papillae covering it, which were tipped with white.

Size of the largest specimen examined: total length 13·5 mm., greatest width 9 mm.

LITERATURE.

APATHY, S. (1888). Süsswasser-Hirudineen. *Zool. Jahrb.* III, p. 790.

CASTLE, W. E. (1900). Some North American Fresh-water Rhynchobdellidae, and their parasites. *Bull. Mus. Zool. Harvard*, XXXVI, No. 2, pp. 42-43, pl. viii, fig. 38.

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FAUNA OF THE CHILKA LAKE.

AMPHIPODA.

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CONTENTS.

AMPHIPODA.

By CHAS. CHILTON.

INTRODUCTION.

The number of species of Amphipoda collected from Chilka Lake is not great, comprising only seventeen (17) species, but the collection is nevertheless of very considerable importance and interest. Most of the species were gathered at many different localities and often in very great numbers. They are nearly all of small size and in several cases the task of sorting them out and of distinguishing allied species was somewhat laborious. Most of the specimens have been referred to species already known, but I have had to establish three new species. A considerable amount of additional information is also given with regard to species previously described.

Several questions of interest arise with regard to the distribution of the species. Thus *Ampelisca pusilla* Sars, which was originally described from deep waters in Arctic Seas, is found in great abundance in the Lake. It also occurs in the river Ganges at Buxar about six hundred miles from the mouth and had previously been recorded from the east coast of Australia by Stebbing. The Indian specimens differ from the Arctic in having corneal lenses present, but in all other respects agree very closely with the Arctic forms.

Quadrivisio bengalensis Stebbing, originally described from Port Canning, Lower Bengal, evidently occurs in great abundance in some parts of the lake. It is found also in the island of Zanzibar, East Africa, and Dr. Annandale has sent me specimens from four different localities in the Talé Sap, Siam.

Grandidierella megnae (Giles) seems hardly distinguishable from *G. mahafalensis* Coutière from Madagascar. The original specimen from which Dr. Giles described the species was taken at Megna Shoals, Bay of Bengal. In this species there appear to be two forms of the male, differing from one another in the characters of the first gnathopod. An allied form which agrees with most of the characters of *Grandidierella megnae* except in the second gnathopods, is described below as a new species, *G. gilesi* sp. nov.

Melita inaequistylis (Dana) is a very widely distributed species occurring in India, South Africa, New Zealand, etc.

Perhaps the most striking example as regards the geographical distribution of the Chilka Lake Amphipoda is the species *Paracalliope fluviatilis* (G. M. Thomson). This species was described many years ago from New Zealand, where it is the common form occurring in nearly all freshwater streams, though it is also found in brackish waters and sometimes in water that is perfectly salt. It is evidently abundant in

Chilka Lake and in the collection there are also specimens from the lower reaches of the river Adyar near Madras. The species is almost certainly identical with *Pherusa australis* Haswell described from Botany Bay, New South Wales, and this helps to connect the extreme points at which the species is found.[1] This case forms a parallel to that of *Melita inaequistylis*, which is found in brackish waters in New Zealand and in India and Ceylon, but the latter species has been recorded from a greater number of marine localities.

Discussion of the importance of the distribution of the species, as mentioned above, must be held over for a later occasion, but it may be mentioned in connection therewith that *Xiphocaris*(=*Paratya*) *curvirostris* (Heller), the freshwater shrimp common in New Zealand streams, also occurs in Assam and that *Paracorophium excavatum* (G. M. Thomson), an Amphipod which occurs in brackish and fresh water on the coast of New Zealand, has recently been found in similar localities in Brisbane river, Queensland.[2]

One of the most interesting Amphipods in the Chilka Lake fauna is *Niphargus chilkensis* sp. nov. This form was found at various localities apparently under the same conditions as the other species. It possesses eyes, though these seem to be somewhat imperfect. It differs in several points from the species of *Niphargus* found in Europe and Northern Africa. A closely related species has recently been sent to me from the underground waters in the Philippine Islands.

Under each species I have given only those synonyms and references that appear to be of importance in connection with the present paper.

The names of authors followed by a date refer to the bibliographical list on p. 556.

I wish to express my grateful thanks to Dr. Annandale for the opportunity of examining and reporting upon this fine collection and to Miss E. M. Herriott, M.A., Assistant at the Biological Laboratory of Canterbury College, for preparing the figures and assisting me in other ways.

LIST OF SPECIES, WITH DISTRIBUTION.

1. *Ampelisca pusilla* Sars. Chilka Lake; Buxar, R. Ganges; Arctic Seas; North Atlantic; East coast of Australia.
2. *Amphilochus brunneus* Della Valle. Chilka Lake; North Sea; Mediterranean.
3. *Idunella chilkensis* sp. nov. Chilka Lake.
4. *Perioculodes longimanus* (Bate & Westw.). Chilka Lake; Ceylon; Arctic Ocean; North Sea; North Atlantic; Mediterranean.
5. *Synchelidium haplocheles* (Grube). Chilka Lake; Ceylon; North Sea; North Atlantic; Mediterranean.
6. *Paracalliope fluviatilis* (G. M. Thomson). Chilka Lake; Philippine Islands; New Zealand; Australia; (in fresh and brackish water).
7. *Niphargus chilkensis* sp. nov. Chilka Lake.

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[1] Since this was written the species has been found in the Philippine Islands.

[2] See also S. Kemp's remarks on the distribution of certain Onychophora and other terrestrial animals (*Rec. Ind. Mus.*, Vol. VII, p. 491).

8. *Melita inaequistylis* (Dana) Chilka Lake; Ceylon; South Africa; New Zealand.
9. *Maera othonides* Walker. Chilka Lake; Ceylon.
10. *Quadrivisio bengalensis* Stebbing. Chilka Lake; Port Canning, Gangetic Delta; Zanzibar Island; Talé Sap, Siam.
11. *Orchestia platensis* Kröyer. Chilka Lake; Philippine Islands; widely distributed on warmer shores of America; Mediterranean; Hawaiian Islands; Tonga, Low Archipelago, etc.
12. *Talorchestia martensii* (M. Weber). Chilka Lake; Flores in Malay Archipelago.
13. *Hyale brevipes* Chevreux. Chilka Lake; Ceylon; Laccadive Archipelago; Seychelles.
14. *Grandidierella megnae* (Giles). Chilka Lake; Bay of Bengal; Madagascar.
15. *Grandidierella gilesi* sp. nov. Chilka Lake.
16. *Photis longicaudata* (Bate & Westw.). Chilka Lake; Philippine Islands; North Atlantic; North Sea; South Africa.
17. *Corophium triaeonyx* Stebbing. Chilka Lake; Ceylon.

Ampelisca pusilla Sars.

Ampelisca pusilla Sars, 1891, p. 181, pl. 63, fig. 2.
Ampelisca pusilla Stebbing, 1906, p. 105; 1910, p. 576.
Ampelisca chevreuxi Walker, 1904, p 254, pl. 3, fig. 15.

Localities :—

1 mile S. of Kalidai. Several.
3 to 2 miles S.E. by E. ½ E. of Patsahanipur. Several.
2 to 8 miles N.E. ½ E. of Kalidai. Many.
2 to 1 miles S.E. by S. of Patsahanipur. Several.
4 miles N.E. by ½ E. of Kalidai. Many.
2 to 1 miles S.E. by S. of Patsahanipur. Several.

These specimens are all small, not more than about 5 mm. in length. I feel pretty confident in referring them to *Ampelisca pusilla.* Both male and female agree closely with the figures given by Sars in the proportions of the antennæ and the shape of the appendages and particularly in the fact that the fourth segment of the pleon is scarcely carinate in the female but is distinctly carinate in the male, the projection agreeing closely with Sars' figures. The specimens differ, however, from Sars' description in having corneal lenses present in the normal manner.

Stebbing has identified this species from Australia and remarks that in his specimen also the corneal lenses are present. Sars says that the species occurs off the coasts of Norway in considerable depths. The absence of corneal lenses in his specimens is doubtless due to a degeneration of the eyes caused by the depth at which it lives. I have little doubt that *A. chevreuxi* Walker should also be referred to this species. The Chilka Lake specimens agree closely with Walker's description except in having the first antenna about as long as the second, while he describes it as reaching to one-third the length of the last joint of the peduncle of the lower antenna. The two antennæ are subequal in the female specimens I have examined, but the upper one is shorter than the lower in the male. In some other species the upper one varies much in length at different stages of development. As regards the telson the various descriptions agree as to its being divided almost to the base and having the divisions pointed. Walker states that there are three spines before the point on the outer margin. Sars gives two and Stebbing says that there is only one apical spinule in the Australian specimen; there is only one in the Chilka Lake specimens that I have examined. Sars says the telson is without dorsal denticles; in one female examined I found one minute dorsal denticle on one lobe but none on the other.

These and other points in the structure of various species of *Ampelisca* have been dealt with by myself in another paper.[1] Stebbing says *Ampelisca pusilla* closely approaches *A. rubella* A. Costa which has been described from the Mediterranean, and Sars says it is nearly allied to *A. amblyops* which again somewhat resembles *A. anomala* but differs in the absolute want of any corneal lenses. *A. anomala* has been recorded from South Africa by Stebbing (1910A, p. 450).

Dr. Annandale has sent me specimens from the River Ganges, Buxar, 600 miles up the river, which seem to be the same as the Chilka Lake specimens; in some the first antenna is shorter in comparison with the second antenna; the eyes are distinctly red, in some the whole eye is red, in others patchy.

[Taken commonly in the main area on or just above a muddy bottom in 4 to 8 feet of water some distance from shore. *N.A.*]

Amphilochus brunneus Della Valle.

Amphilochus brunneus Della Valle, 1893, p. 596, pl. 4, figs. 5; pl. 29, figs. 1-15.
Amphilochus brunneus Stebbing, 1906, p. 151.
Amphilochus brunneus Chevreux, 1911, p. 192.
Amphilochus neapolitanus Walker (part), 1901, p. 301.
Amphilochus neapolitanus Walker, 1904, p. 255.
Amphilochus melanops Walker, 1895, p. 298, pl. 18, fig. 12 and pl. 19, figs. 13-15.

Localities:—

2-8 miles N.E. $\frac{1}{2}$ E. of Kalidai. Several.
1 mile E. by N. of Patsahanipur. One.
2-6 miles E. by S. $\frac{1}{2}$ E. of Patsahanipur. Several.
Near Samal Island. Several, from Medusa.
Barkul. Several, from large Medusa.

I have no hesitation in referring these specimens to the species named above. They agree closely with the description and figures given by Della Valle and Walker. Walker has united both *A. melanops* and *A. brunneus* with *A. neapolitanus* Della Valle, but in that species as described by Della Valle the process of the fifth joint of the

[1] The identity of the two Amphipods, *Ampelisca eschrichtii* Kröyer and *A. macrocephala* Liljeborg. *Jour. Zool. Research*, Vol. II, p. 75.

second gnathopod overlaps the palm and Chevreux, who was able to examine a large number of specimens, found this to be the case in all his specimens of *A. neapolitanus*, even those only 1 mm. long, while in *A. brunneus* it varied between the half and two-thirds and did not overlap the palm. Hence I refer the Chilka Lake specimens to *A. brunneus*, for in none of them does the process overlap the palm. Walker's specimen from Ceylon doubtfully referred to *A. neapolitanus* is probably the same.

[This species was habitually taken on the subumbrella and among the tentacles of the only large medusa found in the lake, *Acromitus rabanchatu*, Annandale. The amphipods were almost invariably present in this situation in adult medusae. *N.A.*]

Idunella chilkensis sp. nov.

(Text-fig. 1).

Localities:—

1 mile E. by N. of Patsahanipur. Five males, one female.

2-6 miles E. by S. ½ S. of Patsahanipur. One male, one female.

Specific Diagnosis.

Male. Pleon segments 2, 4 and 5 produced into minute dorsal teeth. Rostrum short or absent. First side plate large, broadly rounded in front, side plates 1 to 3 with minute denticle at lower hind corner. Postero-lateral angle of third pleon segment acute, a small sinus between the point and the convex hind margin.

Antenna 1 (fig. 1*a*) about three-fourths as long as the body, stout; first joint of peduncle about as long as the second but much stouter, third joint very short, not longer than first joint of flagellum; flagellum stout, consisting of about 35 joints, accessory flagellum small, of two slender joints.

Antenna 2 (fig. 1*a*) shorter than the first antenna, ultimate and penultimate joints of peduncle subequal, flagellum stout, about as long as peduncle.

Mouth parts closely resembling those of *I. aequicornis.*

First gnathopod (fig. 1*d*) large, basis slender, with two or three long setules near base of hind margin and a large group about the middle of anterior margin: ischium and merus short, subequal, two long setules at distal angle of merus; carpus very short, triangular, propod very large, longer than the rest of the limb, broadly oval, anterior margin regularly convex and without setae, palm very oblique, irregularly defined by 3 or 4 stout setules, having near the finger a prominent lobe ending in two or more blunt teeth, a depression near the lobe followed by a convex serrated and setulate portion leading to the defining setules; hind margin much shorter than palm, convex, fringed with minute setules; finger long and strongly curved, having a concavity near the base followed by a slight prominence, inner concave margin slightly irregular.

Second gnathopod much smaller, carpus produced near the antero-distal angle; propod oval, longer and broader than carpus, anterior margin convex, bearing tufts of slender setules; palm not very oblique, convex, with minute setules; hind margin longer than palm, with 4 or 5 tufts of setules; finger strongly curved, fitting closely on to the palm.

Peraeopods 1 and 2 as in *I. aequicornis,* slender, with long slender dactyls.

Peraeopods 3 to 5 increasing in length posteriorly, basal joint not greatly expanded, its hind margin straight and sharply serrate.

Third uropods (fig. 1*g*) with the inner branch much larger and broader than the

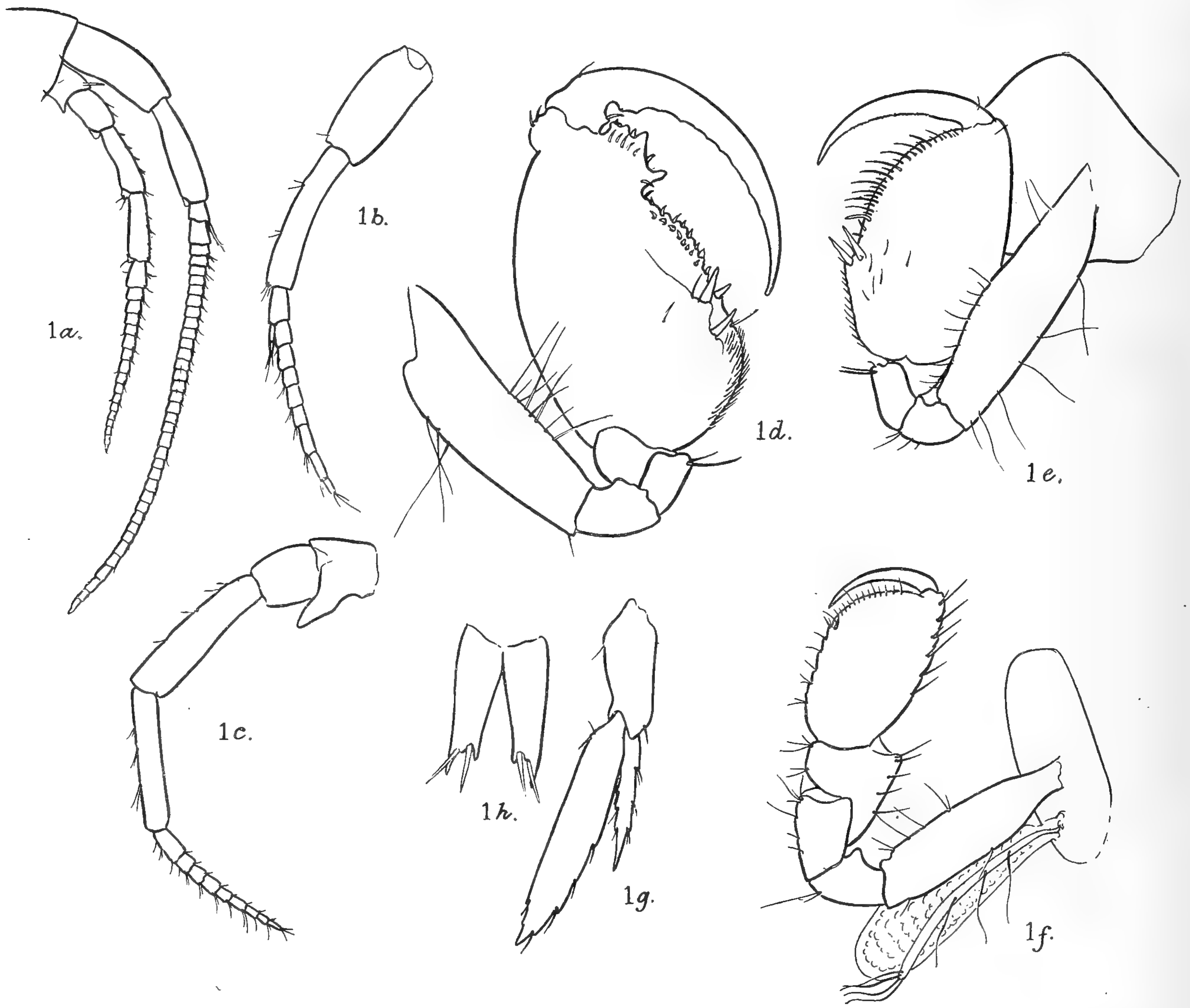

FIG. 1.—*Idunella chilkensis* sp nov.

a. Antennæ of male.
b. Upper antenna of female.
c. Lower antenna of female.
d. First gnathopod of male.
e. First gnathopod of female.
f. Second gnathopod of female.
g. Third uropod of female.
h. Telson of female.

outer, outer with tufts of setules on both margins, inner one with fewer setules and these confined to the outer margin and apex.

Telson cleft to the base, each lobe narrow with outer angle strongly produced into a sharp tooth, two stout setules arising from the concave extremity.

Female, similar to the male except in the antennæ and gnathopods.

Upper antenna (fig. 1*b*) shorter, subequal with the lower (fig. 1*c*), flagellum not so stout as in the male.

First gnathopod (fig. 1*e*) much larger than the second, but not so large as in the male; propod oval, palm regularly convex, fringed with stout setules, hind margin not so abundantly fringed with setules as in the male; finger smaller, inner margin regularly concave and bearing a few minute setules.

Second gnathopod (fig. 1*f*) as in the male, but with propod rather smaller.

Length of body, 4 mm.

Colour. Pale yellow, with a few darker markings.

Remarks. This species agrees well with the characters of the genus and evidently comes pretty close to *I. aequicornis* Sars, from Arctic Seas. It differs in the male chiefly in the greater length of the antennæ, especially of the upper, and in the shape of the first gnathopod. In both sexes it differs also in the smaller accessory flagellum, the shape of the carpus of the second gnathopod and in the unequal branches of the third uropod.

The sexual differences appear to be confined to the antennæ and the gnathopods. In the male specimen examined the third uropods also differed from those of the female shown in fig. 1*g* in having both margins of the inner branch free from setae except for the small tuft near the base of the inner margin and the two or three towards the apex on each margin.

[Only taken in the main area of the lake on a muddy bottom some distance from shore in 4½ to 5½ feet of water. *N.A.*]

Perioculodes longimanus (Bate and Westw.).

(Text-fig. 2.)

Perioculodes longimanus Stebbing, 1906, p. 237.
Perioculodes longimanus Sars, 1892, p. 313, pl. 110, fig. 2; pl. 111, fig. 1.
Monoculodes megapleon Giles, 1888, p. 235, pl. 7, fig. 12.
? *Oedicerus puliciformis* Giles, 1888, p. 248, pl. 7, fig. 5 and 6.

Localities :—

2 to 4 miles N.E. ½E. of Gunta Sila. Many.
1 mile N.N.E. of Breakfast Island. Several.
1 to 9 miles N.E. ½E. of Breakfast Island. Several.
2 to 8 miles N.E. ½E. of Kalidai. Several.
1 mile E. by N. of Patsahanipur. Several.
2 to 6 miles E. by S. ½S. of Patsahanipur. Several.
4 miles N.E. ½E. of Kalidai. Several.
1 to 2 miles S.E. by S. of Patsahanipur. Several.

This species was obtained in great abundance at some of the stations, the male specimens, however, being very rare. I refer them to *Perioculodes longimanus* (Bate and Westw.) with some hesitation. They agree on the whole well with Sars' figures except as regards the antennæ (fig. 2), which in both sexes have the third joint of the peduncle of the upper antenna considerably shorter than the second and the flagellum rather stout and usually with 8 or 9 joints; the second antenna has the last two joints of the peduncle somewhat thickened and provided with long setae; the flagellum in the female is shorter than the peduncle and consists of four joints; in the male it is very slender and very long, the whole antenna being about three-fourths the length of the body. The branches of the uropods are slender, subequal, and with the extremities very acute; a few setules are present on the peduncles and sometimes also on the branches, particularly on those of the third; Sars says those of the third are quite unarmed.

Walker says that his *P. serra* from Ceylon much resembles *P. longimanus* but he describes the rostrum as being much longer than it is in the Chilka Lake specimens. The differences in the proportions of the segments of the peraeon are perhaps not important but he describes the outer ramus of the first uropod as half as long as the inner and the upper margins of the rami in adults strongly serrate. In my specimens the branches are subequal and though there may be a slight appearance of serration formed by the shallow notches from which the setules arise these are much less numerous and less conspicuous than in his figure.

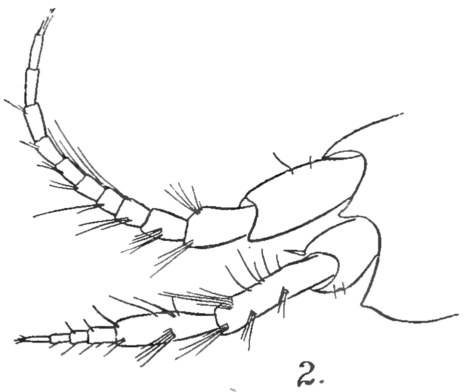

FIG. 2.—*Perioculodes longimanus*, antennæ of female.

Monoculodes megapleon Giles was described from a single specimen obtained off Chittagong. From Dr. Giles' description it seems to be the same species as the Chilka specimens and in some points to agree better with *P. longimanus*. Stebbing (1906, p. 238) says of it "perhaps identical with *P. longimanus*."

Oedicerus puliciformis Giles (1888, p. 248) is merely mentioned by Stebbing (1906, p. 742); if we disregard the difference in the description of the eyes, which may be due to the condition of the specimens, there does not seem to be anything in the figure to prevent Dr. Giles' specimen being a male of the species now under consideration, *i.e. P. longimanus*, the enlarged figure he gives of the terminal portion of the gnathopod agrees precisely with that of the Chilka specimens. Unfortunately for this suggestion, however, his specimen was described as a female carrying ova, though it was only 2 mm. long.

[A very abundant species in the main area on a muddy bottom some distance off shore. *N.A.*]

Synchelidium haplocheles (Grube).

Synchelidium haplocheles Stebbing, 1906, p. 242.
Synchelidium haplocheles Chevreux, 1911, p. 206.
Synchelidium brevicarpum Walker, 1904, p. 263.

Locality:—2 to 8 miles N.E. ½E. of Kalidai. A few specimens.

I think these specimens must be referred to the species named above. The male specimen dissected has the rostrum and antenna agreeing exactly with the description given by Stebbing and with Sars' figures, except that the first joint of the flagellum of the first antenna is not densely clothed with fine hairs; perhaps the specimen is not fully matured, though the second antenna has the long slender flagellum characteristic of the male. The gnathopods are in minute agreement, even as regards the armature of the palm of gnathopod 1. So are the peraeopods, uropods and telson.

The other specimens also agree, but in some of them, which have not the characteristic second antenna of the male, this appendage is distinctly longer than antenna 1. Stebbing says, "Antenna 2 in the female shorter than antenna 1." Possibly my specimens are immature males.

Walker has recorded this species from Ceylon saying that his single specimen agrees with British examples even to the dark brown blotches on the fifth and sixth segments of the peraeon. My specimens are whitish with irregular reticulate patches of black on various parts of the body and appendages, the colour being well retained in the spirit specimens; the eye is black.

[Taken among filamentous algae on a muddy bottom in 5 to 6 feet of water. *N.A.*]

Paracalliope fluviatilis (G. M. Thomson).

(Text-fig. 3.)

Calliope fluviatilis G. M. Thomson, 1879, p. 240, pl. 10c, fig. 4, 4a-c.
Paracalliope fluviatilis Stebbing, 1906, p. 297.
Paracalliope fluviatilis Chilton, 1909A, p. 55.
Pherusa australis Haswell, 1880, p. 103, pl. 7, fig. 1.

Localities :—

Off Samal Island, 8-15 ft., 22-ix-13. Several.
Off Barkul, 3-4 ft., 21-31-vii-13. Several.
Off Barkul, at edge of lake, 21-vii-13. Several.
Barkul, 18-iv-05. Several.
East side of Rambha Bay. Several.
Adyar River, outskirts of Madras town, 3-4 ft. Several.

However unlikely it may at first appear these specimens agree in size, structure and colour with the species, *Paracalliope fluviatilis* (G. M. Thomson), which is the common one inhabiting freshwater streams in New Zealand. When first sorting out the Chilka Lake specimens I was struck by the superficial resemblance of some of the specimens in the pale orange colour and the long terminal peraeopods to the form I was familiar with in New Zealand and careful comparison of specimens has convinced me that they must be referred to the same species. I have previously pointed out (1909A, p. 55) that the New Zealand species, in addition to inhabiting the fresh-water streams, is also to be found in brackish water and at times in water that is quite salt. It is found all over New Zealand and I have recently had specimens sent to me from Cape Maria van Diemen in the very north. I have also specimens collected in quite salt water in Auckland Harbour as well as those previously recorded from Dunedin Harbour. Stebbing (1906, p. 297) referred to this species the form described under the name *Pherusa australis* by Haswell from Botany Bay, New South Wales. Unfortunately I have been unable to secure specimens from Australia and the types of Haswell's species are no longer available, but after carefully going through Haswell's description I am convinced that Mr. Stebbing is right; the description on the whole agrees well with the specimens and seems to be confirmed by the statement and by the figure showing that there are three spines on the inner border of the inner ramus of the third uropod; for these are certainly present as shown in Haswell's

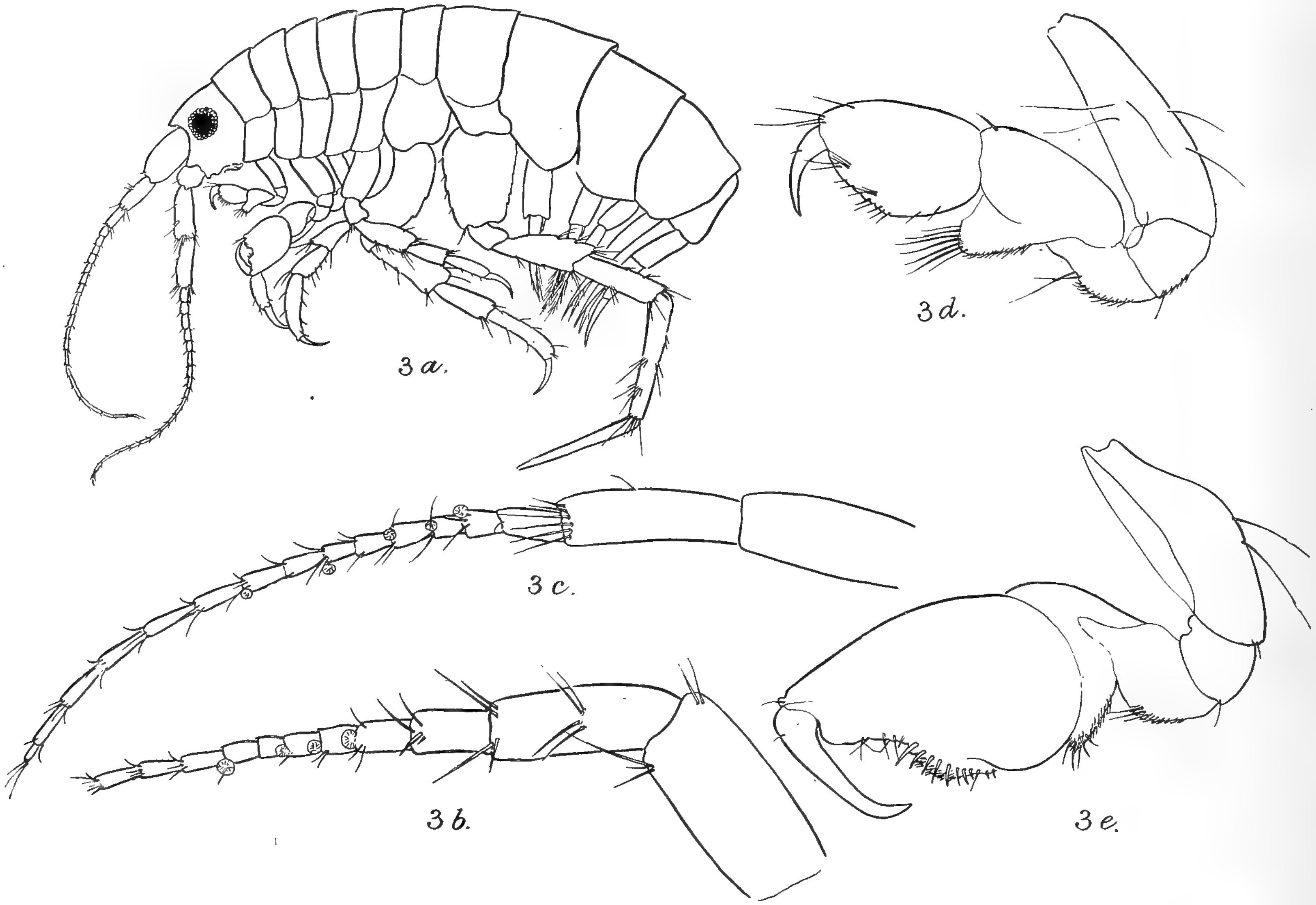

FIG. 3.—*Paracalliope fluviatilis.*
a.—Whole animal, side view. *c.*—Lower antenna.
b.—Upper antenna. *d.*—First gnathopod of male.
e.—Second gnathopod of male.

figure in ordinary fully adult specimens, though the number may sometimes be greater or less than three. Probably the species will be found to occur in other fresh-water or brackish localities on the east coast of Australia or between Australia and India.[1]

[1] Two or three weeks after posting the MS. containing the remarks made above I received from Professor C. F. Baker of Los Banos, Philippine Islands, a few amphipods from Nasugbu, south coast of Luzon, most of which proved to be specimens of *Paracalliope fluviatilis* (G. M. Thomson) quite

Paracalliope fluviatilis was described by Thomson as long ago as 1879. Unfortunately his figures were so greatly reduced in reproduction that they do not show clearly the structure of the various appendages and no other figures have yet been published. I have, however, the tracings that were made of Mr. Thomson's original figures for the purpose of reproduction and find that the main points in the structure of the gnathopods and of the telson and uropods are quite clearly shown. A description was given by Stebbing in 1906 and on the whole agrees well with the specimens. In 1899 Stebbing had established the genus *Paracalliope* for the species. There is one point in his generic diagnosis that requires alteration, for calceoli are certainly present in the males on some of the basal joints of the flagellum in both upper and lower antennæ. The species can generally be easily recognised by the greatly elongated fifth peraeopods and by the peculiar inverted position of the second gnathopod; this appendage seems to have a very loose articulation between the ischium and the carpus, so that the distal portion of the limb often faces in the direction opposite to the normal one (see fig. 3*a*). Stebbing has pointed out that this recalls the curious torsion in the first gnathopod of *Trischizostoma nicaeense*.

I give figures of the whole animal (fig. 3*a*) and of the antennæ (figs. 3*b*, *c*) and the gnathopods (figs. 3*d*, *e*) which will render a detailed description unnecessary. It is difficult to represent the gnathopods accurately, for as Stebbing points out there are two margins to the palm and the outline therefore varies according to the position in which the gnathopod is mounted.

Stebbing places the genus under the family Calliopiidae, and this is probably its proper position, though the elongated fifth peraeopods are peculiar and the characters of the family are somewhat indefinite. It was doubtless from the elongated fifth peraeopods that Stebbing suggested that the species *Oedicerus novi-zealandiae* Dana was probably identical with *Paracalliope fluviatilis.* I have, however, pointed out elsewhere that *Oedicerus novi-zealandiae* is a distinct species and is in all probability identical with the species afterwards described by Stebbing as *Carolobatea schneideri* (1909, p. 620).

[Not uncommon on a muddy bottom off shore in the main area. *N.A.*]

Niphargus chilkensis sp. nov.

(Text-fig. 4.)

Localities :—

Off Samal Island, 3-15 ft., 22-ix-13. One.
Off Barkul, 21-vii-13. Two.
One mile S. of Kalidai. Several.
4 to 9 miles E.½S. of Barkul bungalow. Several.
3 to 2 miles S.E. by E.½E. of Patsahanipur. Four.

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similar to those from Chilka Lake and New Zealand. These are stated to have been collected in "shallow water," but there is nothing said as to whether the water was fresh, brackish or marine. Along with them was a single specimen which, though small and perhaps immature, appears to be *Photis longicaudata* (Bate and Westw.).

1 mile E. by N. of Patsahanipur. Five.
2 miles E. by S.½S. of Patsahanipur. Several.
1 to 9 miles N.E. by E. of Kalidai. Several.

Specific Diagnosis:—

Body long and narrow, side plates small, much shallower than the segments. Pleon segment 3 with the postero-lateral angle quadrate. Eyes small, irregular, apparently imperfect. Upper antenna about three-fourths the length of body, first and second joints of peduncle subequal, elongate; third short, flagellum slender, longer than peduncle, accessory flagellum of two slender joints. Lower antenna a little longer than peduncle of upper, last two joints of peduncle subequal, flagellum shorter than last joint, consisting of one long joint followed by two or three indistinct ones. First gnathopod with the merus produced posteriorly into a rounded lobe, carpus much longer than the propod, with numerous tufts of setules on the posterior margin and on the surface near to it; propod widening distally, palm nearly transverse, evenly convex. Second gnathopod much larger than the first, carpus short, about one-third the length of the propod; propod irregularly oval, palm oblique, sinuous, about equal in length to the hind margin; finger strongly curved, bulging on the inner margin near its base. Third, fourth and fifth peraeopods increasing in size posteriorly, basal joint in the third narrow, slightly wider in the fourth and greatly widened and enlarged in the fifth, its posterior margin irregularly serrate, most distinctly so in the fifth peraeopod; in the fifth peraeopod the merus is dilated posteriorly. Third uropods greatly elongated, peduncle longer than the telson, outer branch formed of two subequal joints, somewhat broadened, inner branch small, tapering, tipped with one or two setae. Telson cleft to the base, each lobe narrowing posteriorly and bearing a stout setule at the extremity.

Colour (in spirit), whitish.

Length of body, about 10 mm.

I have referred this species to the genus *Niphargus* with which it agrees in most characters. It differs, however, from Stebbing's generic diagnosis (1906, p. 405) in the following points:—

1. The eyes are moderately well developed.
2. The third joint of the mandibular palp is hardly longer than the second.
3. The inner plate of the first maxilla is large and bears numerous setae.
4. The outer plate of the maxilliped bears numerous setae all of the same character, but has no spine teeth.
5. The second gnathopod is larger than the first and differently shaped.

The following are additional notes on the structure of this species. Most of the figures are taken from the type specimen which was the first one examined. Some specimens, rather larger, show slightly more developed characters in the antennae, gnathopods and in the fifth peraeopods in which the basal joint may be larger in proportion to the rest of the limb than is shown in figure 4*p*.

The basal portions of the antennæ are shown in figure 4*b* from which the proportions of the different joints can be readily seen. The tufts of setae on the second joint of the peduncle of antennæ I towards its extremity seem to be a characteristic feature and may be more developed than is shown in the figure.

The upper lip (fig. 4*c*) is regularly rounded and bears a few minute setae. In the mandible (fig. 4*d*) the molar tubercle is prominent and projecting, the cutting edge and spine row of the normal character, the palp has the first joint short, the next two joints subequal, bearing few setae except the distinct tuft at the end of the third joint. The first maxilla (fig. 4*f*) differs considerably from the generic description given by Stebbing in having the inner lobe broad and well developed and fringed with about 12 plumose setae. The second maxilla (fig. 4*g*) has the two lobes subequal, both with apical setae and the inner one with a few setae on its inner margin. The maxilliped (fig. 4*h*) has the inner lobe large with three stout spinules and a number of plumose setae, the outer lobe reaches only about half-way along the carpus and has its inner margin provided with numerous short setae, none of which are developed into spine-teeth.

In the first gnathopod (fig. 4*k*) the merus is produced posteriorly into a slight rounded lobe and appears to be covered with very minute setae, the rest of the appendage seems to be normal, having the characters already mentioned in the specific description.

The second gnathopod differs considerably from the first both in size and in structure and is rather different from the gnathopods of other species of the genus. The general character will be best learnt from the figure 4*l*; in larger specimens the propod may be somewhat larger and the swelling on the inner margin of the finger more pronounced.

The peraeopods are fully shown in the figures (figs. 4*m*, *n*, *o*, *p*) and do not call for further detailed description.

The branchiae (fig. 4*m*) are all somewhat large in size, rectangular at the base and narrowing a little towards the extremity.

In the first uropod (fig. 4*q*) the peduncle is much longer than the rami which are subequal; in the second (fig. 4*r*) the peduncle is only slightly longer than the rami; in both there are numerous spinules on the upper surface of the peduncle and the rami. The third uropods appear to vary in length in different specimens being sometimes as much as one-third of the total length of the body. In figure 4*s* they are shown in side view as attached to the animal, when viewed from above they appear somewhat broader. The telson (fig. 4*t*) is cleft to the base, each lobe narrowing posteriorly, the inner margin being nearly straight except towards the extremity, the outer strongly convex. A long spinule arises near the extremity of each lobe and on its inner side there are three minute setae; from the upper surface of each lobe towards the extremity arise two delicate sensory plumed setae.

In the large inner lobe of the first maxilla and in the gnathopods this species differs considerably from the species of *Niphargus* hitherto described. I have, however, specimens sent to me by Professor C. F. Baker from springs in the Philippine Islands which closely approach the Chilka Lake specimens in these

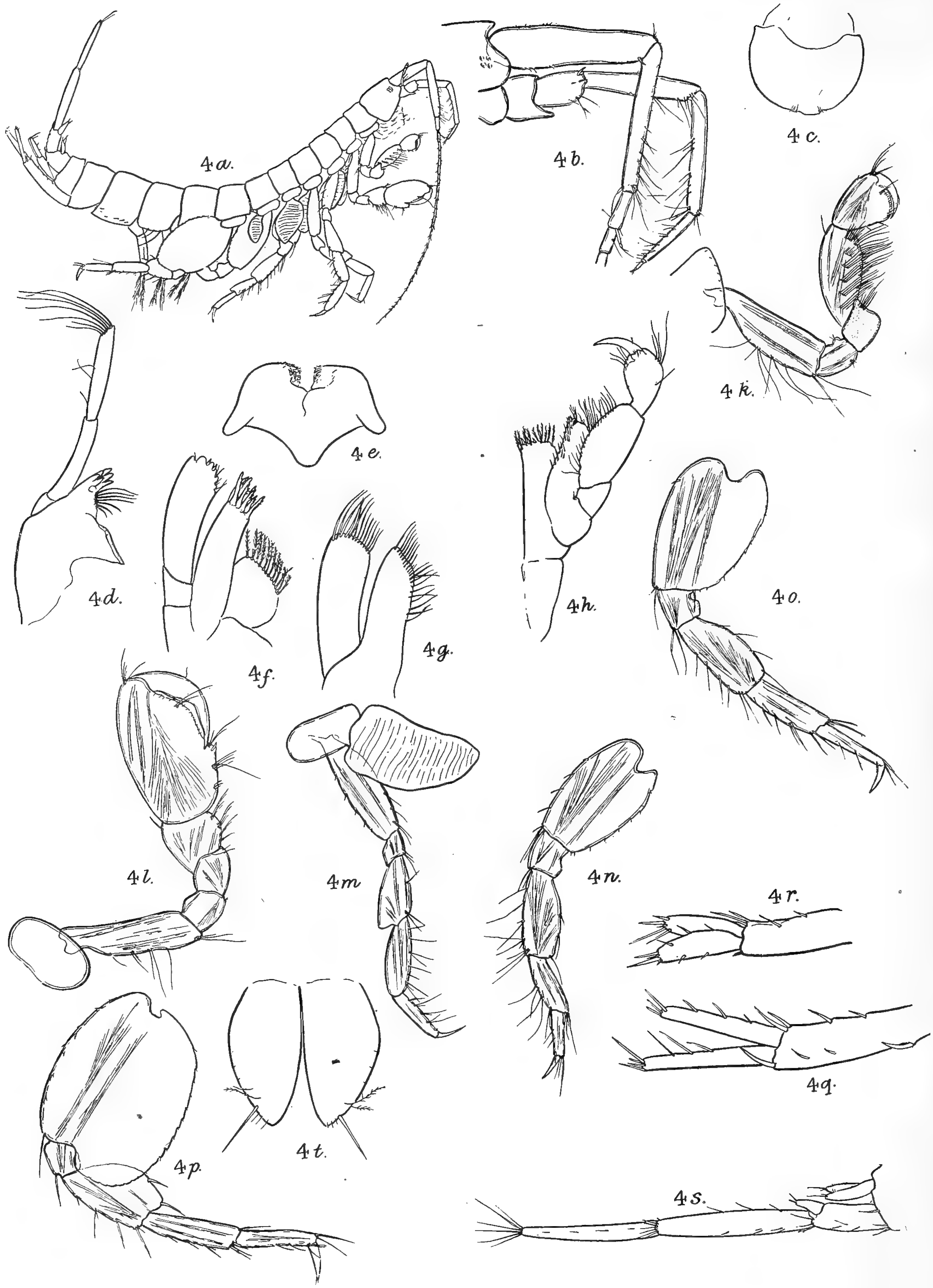

FIG. 4.—*Niphargus chilkensis* sp. nov.

a. Side view of whole animal.
b. Antennæ.
c. Upper lip.
d. Mandible.
e. Lower lip.
f. First maxilla.
g. Second maxilla.
h. Maxilliped.
k. First gnathopod.
l. Second gnathopod.
m. First peraeopod.
n. Third peraeopod.
o. Fourth peraeopod.
p. Fifth peraeopod.
q. First uropod.
r. Second uropod.
s. Third uropod and telson (side view).
t. Telson.

characters. The gnathopods of *Niphargus chilkensis* present a somewhat striking resemblance to those of *Phreatogammarus propinquus* Chilton from New Zealand. That species, however, differs very considerably in the third uropods which, though elongated, have two branches each consisting of a single joint. The third uropods in *Niphargus* and allied species are subject to special development in the different species and it is possible that the resemblance in the gnathopods is of more importance from the point of view of relationship than the differences of the uropods.

[One of the commonest bottom species in the main area. *N.A.*]

Melita inaequistylis (Dana.)

Melita inaequistylis Stebbing, 1906, p. 429.
Melita inaequistylis Chilton, 1909, p. 630 and 1911, p. 564.
Melita inaequistylis Barnard, 1916, p. 191.
Melita zeylanica Stebbing, 1904, p. 22, pl. 5.
Melita tenuicornis Walker, 1904, p. 273, pl. 5, fig. 33.

Locality. Off Barkul, in fresh water. A few specimens, males and females. All small, largest about 4 mm.

This species has already been recorded from Ceylon by Stebbing and Walker and it is interesting to find that it extends into fresh and brackish waters in India, just as it does in New Zealand. I have discussed the species to some extent elsewhere and compared it with *M. palmata* to which I referred specimens from Kermadec Islands (1911, p. 564); since then I have found that the same form occurs on the coast of New Zealand along with the typical *M. inaequistylis*. The latter species is very wide spread and has been recorded from Cape Colony by Barnard, who gives a description of his specimens and says that it will ultimately have to be united with *M. palmata* (1916, p. 192). I have little doubt that the species described by Fritz Müller from Brazil (1869, pp. 27, 28) under the names *M. messalina* and *M. insatiabilis* will also prove to be identical with one or other of these forms.

Maera othonides, Walker.

(Text-fig. 5.)

Maera othonides Walker, 1904, p. 271, pl. 5, fig. 29.

Localities :—

Off Samal Island, 8–15 ft., 22-ix-13. One.
North side Chirriya Island. One.
Chirriya Island. One.
8 miles W. by S. of Breakfast Island. Several.
Barkuda Island. One.
Chirriya Island. Three.
Maludaikuda Island. One.
Ennur backwater, near Madras town, 4–5 ft., Oct. 1913. One.

These specimens undoubtedly belong to Walker's species, though in one or two points they do not quite agree with his description which was drawn up from a specimen only 8 mm. long and probably immature.

In the third pleon segment there may be one or two teeth on the lower margin and usually there are three or four very distinct teeth on the posterior margin; the anterior portion of the lower margin bears a series of spinules.

The accessory appendage of the first antenna may contain as many as five joints. Walker describes the hand of the second gnathopod in the female as being concave. In my specimens the palm is slightly convex (fig. 5*c*); in the male the palm is slightly concave towards the defining setules as shown in figure 5*b*.

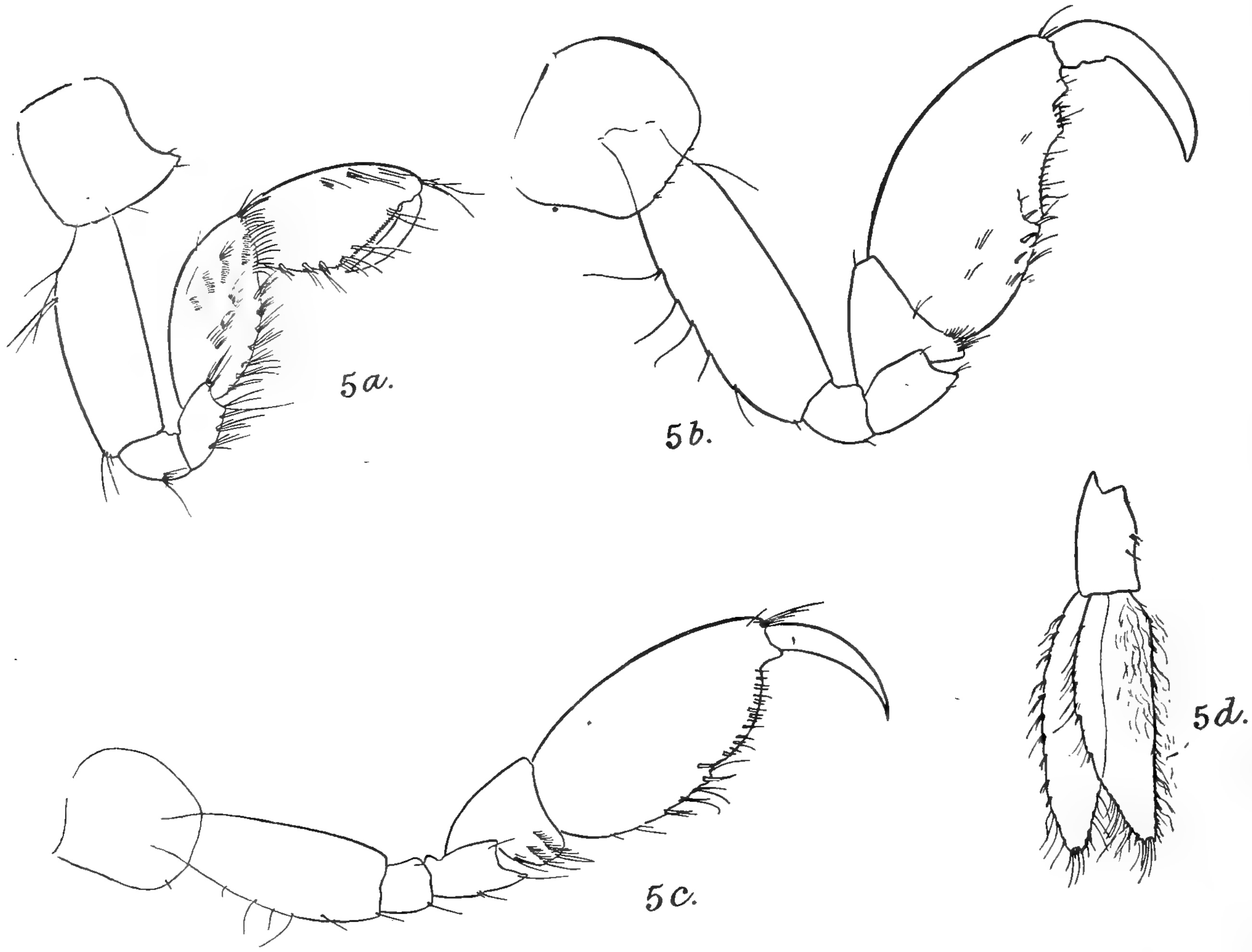

FIG. 5.—*Maera othonides* Walker.
a. First gnathopod of male.
b. Second gnathopod of male.
c. Second gnathopod of female.
d. Third uropod.

The third uropods (fig. 5*d*) especially in the older specimens bear a number of delicate woolly hairs and similar hairs are found on the dorsal surface of the posterior portion of the pleon. In the telson each lobe narrows greatly towards the acute extremity which bears one long setule and two or more smaller ones; in my specimens I cannot make out the second notch on the inside of each division which is described and figured by Walker; it is probably present only in immature specimens.

[Usually taken under stones just below water level, but also among algae off shore. *N.A.*]

Quadrivisio bengalensis, Stebbing.

(Text-fig. 6.)

Quadrivisio bengalensis Stebbing, 1907, p. 159, pl. 7.
Quadrivisio bengalensis Chevreux, 1913, p. 15, fig. 1.

Localities:—

Off Samal Island, 8–15 ft., 22-ix-13. Many specimens, males and females, the largest about 12 mm. in length.
Off Barkul, 3–4 ft. Two specimens.
Off Satpara, 4–5 ft., 17-ix-13. One specimen.
Ghiakhala Headland and neighbouring island. Four specimens.
Main Channel, W. of Satpara Island. Four specimens.

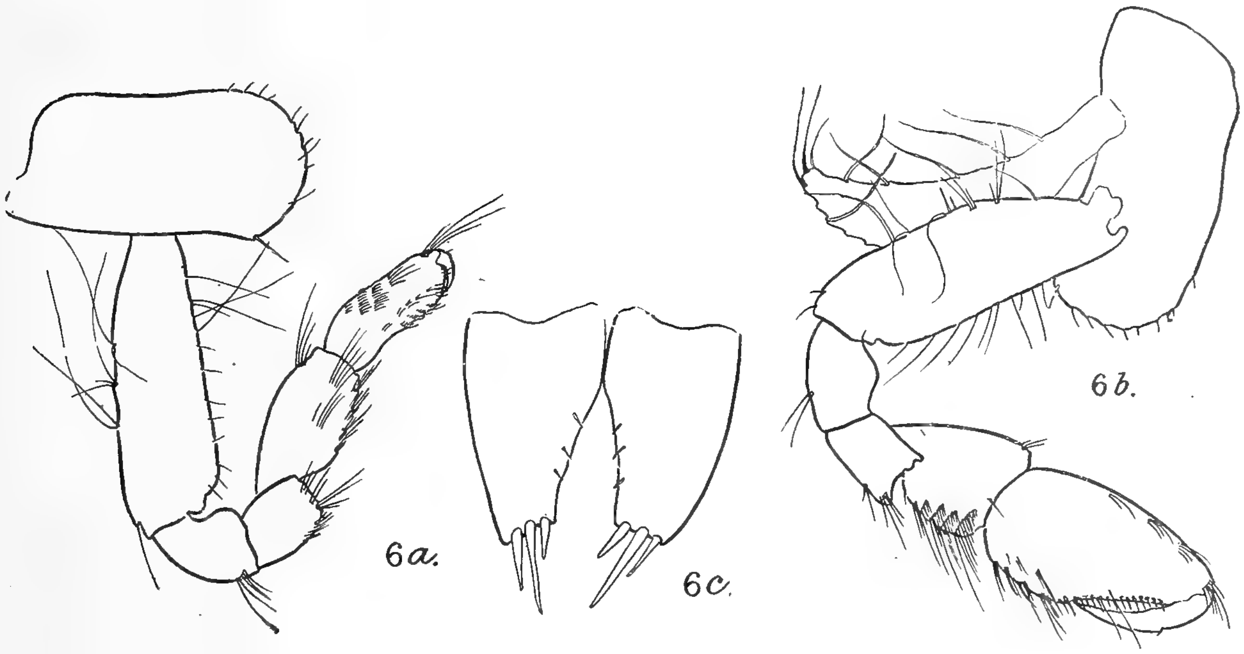

FIG. 6.—*Quadrivisio bengalensis.*
a. First gnathopod of female. *b.* Second gnathopod of female.
c. Telson.

I have compared these specimens both with Stebbing's description and with a co-type of his species from Port Canning, and consider that they should be referred to the same species although in one or two points they show slight differences. The antennæ differ very much in the two sexes, the peduncle of the lower one in particular being greatly elongated in the adult males. The widely spaced pair of denticles on the dorsal surface of the pleon segments are quite distinctly to be made out in adult specimens from Chilka Lake; in Stebbing's specimens they are said to be very small and difficult to observe. The main difference appears to be in the telson, Stebbing's figure is probably from a slightly abnormal specimen for it shows the two halves distinctly unlike, the right being shorter and more rounded at the end than the left half and with a different armature of setae. In specimens I have examined both halves are alike (fig. 6*c*) and in general shape resemble the left half of Stebbing's figure, narrowing towards the extremity, but they bear fewer setae, namely three large ones at the apex and three minute ones on the inner margin of each lobe.

Chevreux has recently (1913, p. 15) recorded the occurrence of *Quadrivisio bengalensis* in the island of Zanzibar; his specimens are found in a cave and have the eyes imperfect. He does not state whether there are any differences between his specimens and the description given by Stebbing.

Dr. Annandale has sent me specimens from four localities in the Talé Sap, Siam, which appear to be quite the same as the Chilka Lake specimens.

The peculiar character of the eye by which it is divided on each side into two separate pigmented portions is best marked in adult specimens. In one small specimen, 2 mm. in length, the eye on each side is single, being somewhat irregularly rounded and situated in the usual position slightly below the base of the upper antenna; in another specimen, slightly larger, the main portion of the eye corresponds with that in the first specimen, but it is continued upwards towards the dorsal surface of the head as a narrow pigmented projection. In older specimens this portion becomes enlarged, at first remaining connected with the older part of the original eye but later on becoming quite distinct. The appearance of the eyes in adults as seen from above is well shown by Stebbing (1907, pl. VII *oc*).

[Common under stones just below water-level all round the lake. Also seen swimming in pairs at the edge. *N. A.*]

Orchestia platensis Kröyer.

(Text-fig. 7).

Orchestia platensis Kröyer, 1845, Naturh. Tidskr. ser. 2, v.1, p. 304, pl. 2, f. 2.
Orchestia platensis Stebbing, 1906, p. 540.
Orchestia platensis Stebbing, 1900, p. 527, pl. 21a.
Orchestia platensis Chevreux, 1908, p. 494, fig. 14.
Orchestia agilis Kunkel, 1918, p. 118, fig. 31.
Orchestia pickeringii Dana, 1852, p. 882, pl. 59, fig. 9.
Orchestia pickeringii Stebbing, 1900, p. 528.
Orchestia pickeringii Stebbing, 1906, p. 538.

Localities:—

Barkul. Several specimens, males and females.
Chirriya Island. Several.

After much consideration I am referring these specimens to *Orchestia platensis* Kröyer, a species which according to Stebbing has a very wide distribution. Kröyer's original specimens were from the Rio de la Plata, north-west of Monte Video, and Stebbing records the species from the Atlantic Coast of North America (where it has long been known as *Orchestia agilis* S. I. Smith), the Bermudas, the Mediterranean, Lake Tiberias and also from the Hawaiian Islands where it was obtained at two localities at heights of 3,000 and 2,000 ft. respectively.

I had first identified the Chilka Lake specimens with *O. pickeringii* Dana which had been recorded from Hawaiian Islands, California and from New South Wales.

In the short antennæ (figs. 7*a*, *b*) thickened in the males, and in the gnathopods (figs. 7*c*, *d*) and other appendages they seem to agree very closely with Dana's species as described by Stebbing in 1906, and they certainly correspond with other specimens in my collection from Tonga which I had also referred to this species. Among the Chilka Lake specimens there were only a few males and probably not more than one quite fully developed; the second gnathopod of the largest and presumably the oldest one is represented in figure 7*d* and shows two low convex spinulose processes as described by Dana, though these are both about the same breadth. Stebbing in his figure of a male of *O. pickeringii* from the Hawaiian Islands shows the processes on the palm more separated and more pronounced, with the finger thickened about the middle, but as he points out, in younger specimens the inner margin of the finger is smoothly concave.

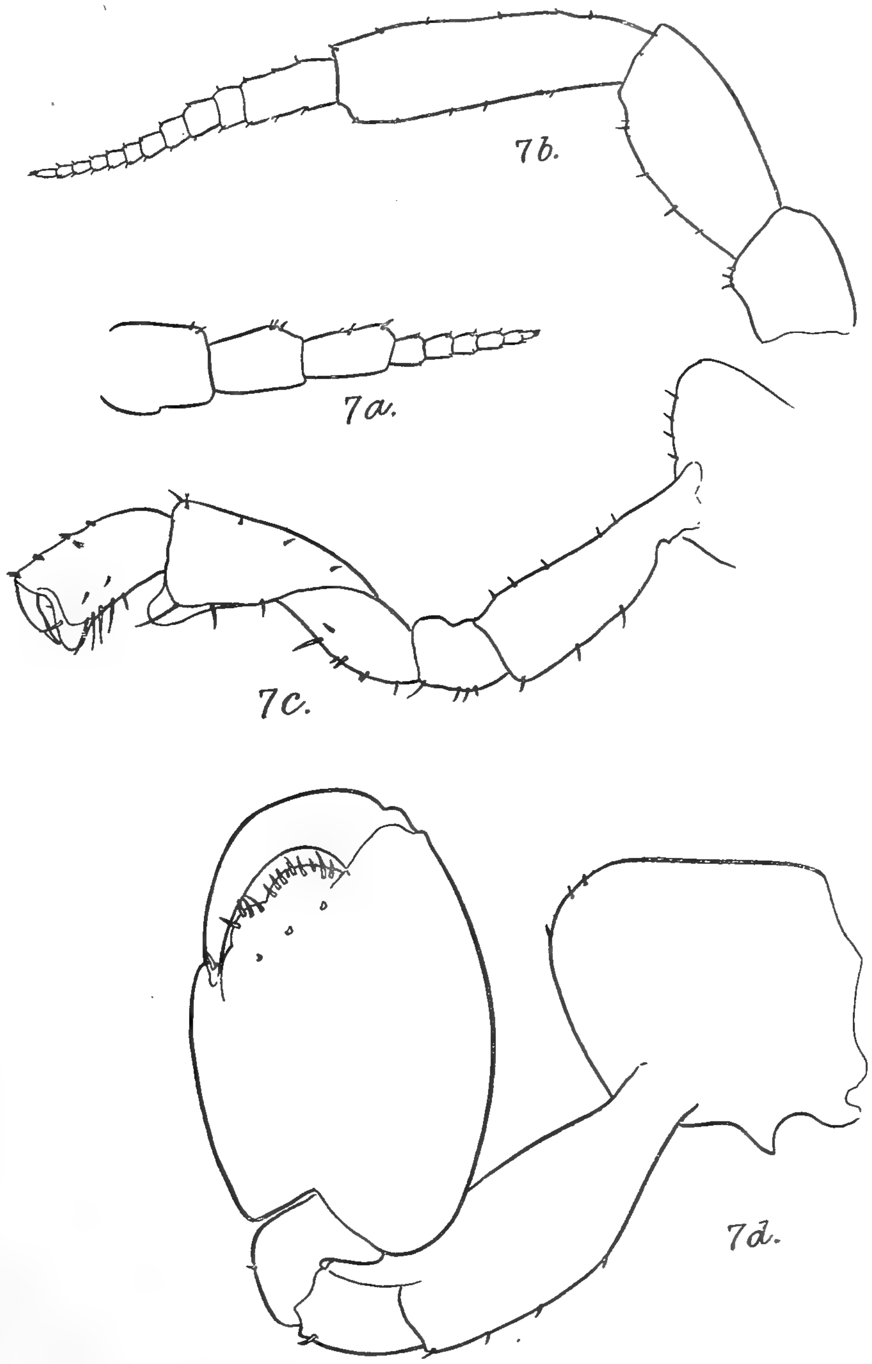

FIG. 7.—*Orchestia platensis*, male.

a. First antenna. *c.* First gnathopod.
b. Second antenna. *d.* Second gnathopod.

Later on I had occasion to examine and mount some specimens sent to me from Cold Spring Harbor, U.S.A. as *O. agilis* S. I. Smith, a species which Stebbing unites with *O. platensis*, and I was struck by the resemblance of them to the Chilka Lake specimens. After careful comparison I can find no difference between the Cold Spring Harbor and the Chilka Lake specimens except in the character of the palm of the second gnathopod in the adult male and I therefore feel pretty confident that the Chilka specimens should be referred to *O. platensis* and that the two species *O. platensis* and *O. pickeringii* will have to be combined. After coming to this conclusion, I looked up Stebbing's report on the Amphipoda in the Fauna Hawaiiensis, and found that the specimens he had referred to *O. pickeringii* were taken at the same locality, on the same date, and at the same height as specimens he referred to *O. platensis.* He separates these two sets of specimens because of certain points in the number of joints in the second antennae, etc., but I doubt if these are sufficient to be of specific importance. Apparently he had no male specimens of *O. platensis* fully mature and he draws the palm of the second gnathopod evenly convex as it is in most of the Chilka Lake specimens. In his figure too he shows the second antenna more slender than in some of the Chilka Lake specimens, and this again probably indicates that the figure was taken from a male not fully developed and suggests the probability that the specimens he referred to *O. pickeringii* were only more developed examples of the same species.

I have been able to compare the Cold Spring Harbor specimens (*O. agilis*) with a specimen of *O. incisimana* Chevreux from the Mediterranean and agree with Stebbing that both of these should rightly be referred to *O. platensis.* In the Cold Spring Harbor specimens the carpus of the fifth peraeopod is slightly broadened, while in the Mediterranean specimens (*O. incisimana*) it is considerably broader. Apparently no one of the Cold Spring Harbor specimens that I have examined is quite fully developed, for Kunkel states that the merus and carpus of the fifth peraeopod in the adult male are greatly swollen. Stebbing, however, says of *O. platensis* "5th joint of peraeopods 4 and 5 also thick but without great widening," and these joints are not broadened in any of the Chilka Lake specimens. It is probable, therefore, that the broadening of these joints occurs only in very old males and that the animals may reach sexual maturity without any broadening, just as happens in *O. tucurauna* F. Müller and other species.

Chevreux (1908, p. 494) records *O. platensis* Kröyer from the Marutea du Sud and Taravai Islands in the Low Archipelago in the South Pacific. The description he gives of these specimens agrees very closely with those from Chilka Lake. He had been able to compare his specimens with some from Monte Video and states that the indentation in the palm of the second gnathopod of the male is less marked in the Monte Video than in the Mediterranean specimens, while it is hardly noticeable in his specimens from the Low Archipelago and apparently completely absent in those from the Hawaiian Islands referred to *O. platensis* by Stebbing. To this it should be added that the male specimen from the Hawaiian Islands which Stebbing refers to *O. pickeringii* has the palm distinctly divided into two lobes. Walker records *O. platensis* from Mahlosmadulu Atoll in the Indian Ocean; the brief description he gives agrees well with the Chilka Lake specimens. He states (1905, p. 119) that the specimens were obtained at a depth of 20 fathoms, but it is to be presumed that there was some error in the locality label.

Walker says that *O. anomala* Chevreux, from the Seychelles, appears to differ from *O. platensis* only in the averted point of the dactyl of the second gnathopod of the male, but in *O. anomala* the palm is much more oblique and the finger longer, and Chevreux makes no mention of the thickened character of the second antenna and of the posterior peraeopoda found in typical specimens of *O. platensis.*

[A very abundant sand-hopper all round the lake wherever the shore is sandy. It remains concealed in burrows in the sand, especially under decaying weed, in the heat of the day but is abroad in the evening and early morning. Many animals feed upon it, including a pigmy shrew (*Pachyura hodgsoni*), geckos (*Hemidactylus frenatus* and *H. brookei*) and a dragonfly (*Brachythemis contaminata*), which catches it on the wing as it hops in the evening. We have never found it except on the foreshore. *N.A.*]

Talorchestia martensii (M. Weber).

(Text-fig. 8.)

Orchestia martensii M. Weber, 1892, p. 564, fig. 13—16.
Talorchestia martensii Stebbing, 1906, p. 553.

Localities:—Barkul, Chilka Lake. "Living in holes in mud under dead leaves and weeds," Dr. N. Annandale, 21-vii-13. Several specimens, in association with *Orchestia platensis.*

Off Barkul, 3–4 ft. One large male.

Satpara, edge of lake. One male, one female.

Barkuda Island. Several.

Specific Diagnosis:—

Male. Pleon segment 3 having postero-lateral corner with produced point. Antenna 1, second joint of peduncle the longest, flagellum shorter than peduncle, 5-jointed. Antenna 2, ultimate and penultimate joints of peduncle subequal and long, especially in fully developed males; flagellum nearly as long as peduncle, with about 20 joints. Gnathopod 1 with carpus much longer than the propod, produced distally into a narrow but well marked lobe; propod very slightly widened distally, distal lobe rounded, slightly shorter than the lobe on the carpus; palm short, concave; finger long, reaching far beyond the rounded lobe. Gnathopod 2 with basal joint and ischium grooved anteriorly for reception of propod when reflexed; the anterior margin of the basal joint with a regular row of about 10 distinct spinules in slight serrations; posterior margin with a smaller number of similar spinules; propod ovate, palm oblique, slightly convex, a little longer than the straight hind margin and marked with a double row of stout spinules, between which the finger lies when closed; a few small spinules on the hind margin; anterior margin convex and free from spinules; finger with inner margin concave near the base, followed by a rounded enlargement, whole inner margin with minute spinules. Basal joints of the 3rd–5th peraeopods well expanded, anterior margin convex, fringed with spinules; posterior margin straight with rounded corners and also fringed with spinules; none of the more distal joints specially enlarged. Telson narrowing towards the extremity, divided by a shallow emargination at the end into 2 small lobes, each bearing 3 spinules at the extremity, 3 or 4 other spinules being placed laterally on the telson itself.

Female. Resembling the male except in the gnathopods and in having the last two joints of the peduncle of antenna 2 less elongated. The first gnathopod differs from that of the male in having the carpus slightly shorter and without the rounded lobe; the propod more than half the length of the carpus, narrowing slightly distally so that there is no palm; finger slender, fully half as long as the propod.

In the second gnathopod, the basal joint is much broadened especially in the middle, having the anterior margin very convex and fringed with a number of short spinules; the carpus has the posterior margin produced into a rounded or somewhat angular lobe and the lobe of the propod extends far beyond the diminutive finger.

Length of body of the largest males, about 10 mm.; the females are slightly smaller, one ovigerous one, however, measured 9 mm.

These specimens agree so closely with the description and figures given by Weber that I have no hesitation in referring them to his species, while the structure of the first gnathopods, the dactyl of the second peraeopod and other characters show that Stebbing was right in transferring the species to the genus *Talorchestia.* The type specimens were taken under stones in and at the margin of the rivulet Lella on the south coast of East Flores in the Malay Archipelago, being found in association with *Orchestia floresiana,* and, as the description of the locality given for that species shows, the specimens were taken near the mouth of the stream, where the conditions would probably be brackish as at Lake Chilka.

In addition to the brief description given above, the following additional description of some of the appendages may be given:—

The length of the *second antennæ* (fig. 8*b*) varies considerably with the sex and with the stage of development. In fully developed males they are nearly as long as the body, the elongation being especially marked in the last two joints of the peduncle. In females and in younger males they are much shorter, often not more than one-third the length of the body. On the inner side the third joint of the peduncle is produced along the side of the 4th joint into a distinct lobe similar to that which is found in *Talorchestia brito* Stebbing; 4th and 5th joints subequal, slender, with spinules; flagellum 20-jointed, rather shorter than peduncle.

The *first gnathopod* of the male (fig. 8*c*) has the side-plate produced somewhat anteriorly with the lower margin fringed with rather stout spinules; the anterior surface of the basal joint is grooved to receive the distal portion of the limb when reflexed; the carpus is nearly twice as long as the propod and is produced into a narrowly rounded lobe at the postero-distal angle; the propod is only slightly widened at the end, but is produced into the usual narrow rounded lobe; the dactyl is long and slender, reaching far beyond the rounded process of the propod. The various joints are rather plentifully supplied with stout spinules, the distribution of which is shown in the figure (fig. 8*c*).

In the *second gnathopod* of the male (fig. 8*d*) the basal joint is of approximately the same breadth throughout except at the narrow base, the anterior margin is serrated and bears a regular row of numerous spinules, some also present on the posterior margin; the propod is large, oval, with the palm oblique, slightly convex,

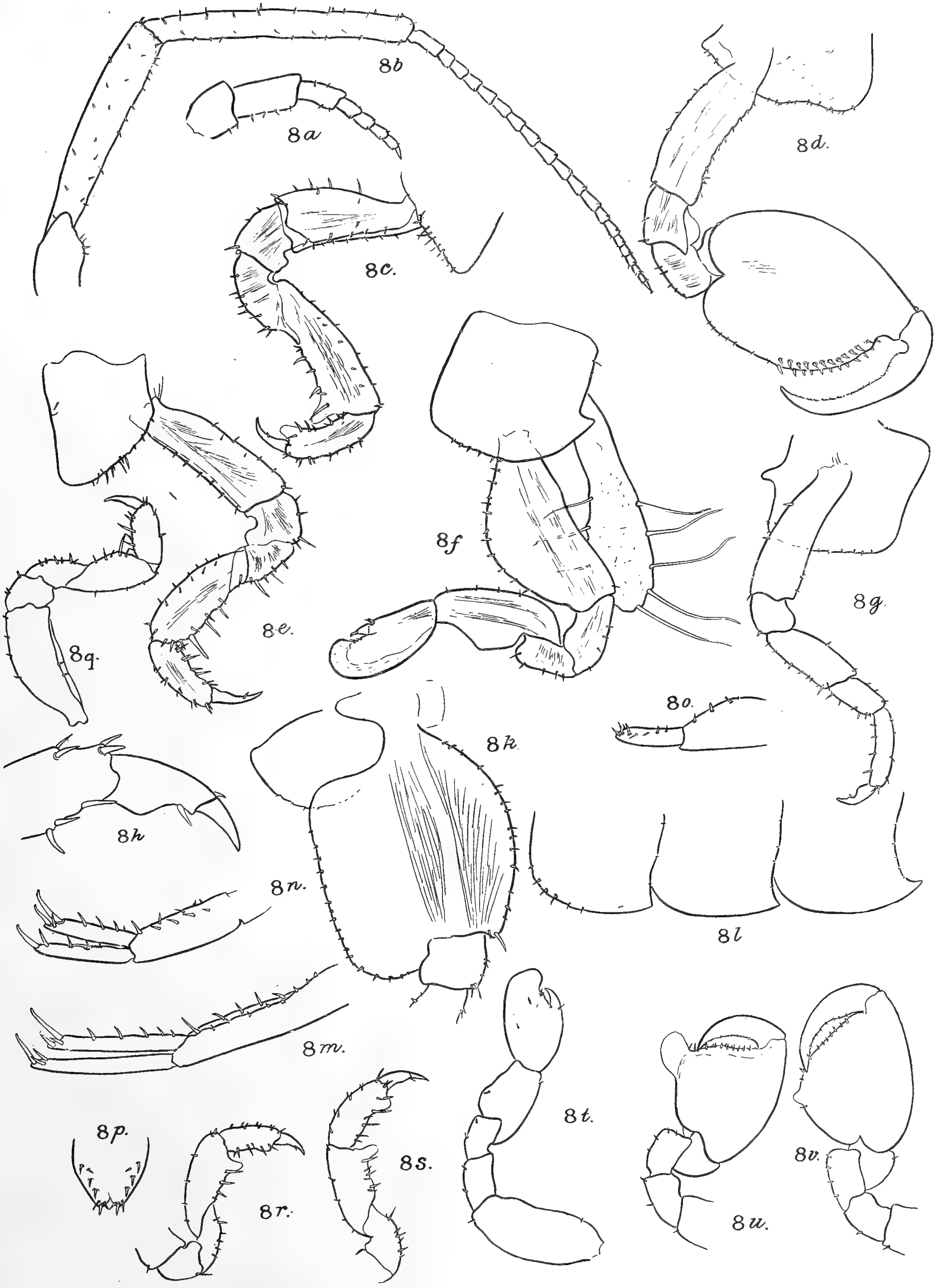

FIG. 8.—*Talorchestia martensii.*

a. First antenna of male.
b. Second antenna of male.
c. First gnathopod of male.
d. Second gnathopod of male.
e. First gnathopod of female.
f. Second gnathopod of female.
g. Second peraeopod.
h. Extremity of same, more highly magnified.
k. Basal joints of fifth peraeopod.
l. Lower margins of pleon segments 1 to 3.
m, n, o. First, second and third uropods.
p. Telson.
q, r, s. Three successive stages in development of first gnathopod of male.
t, u, v. Three corresponding stages in development of second gnathopod of male.

not distinctly marked off from the straight hind margin; the palm is armed with two rows of about a dozen spinules each, between which the dactyl fits when closed; the dactyl is long and curved, with a rounded projection on the inner margin near the base, separated from the base by a somewhat deep concavity. The inner margin of the dactyl bears a number of minute spinules.

The *second peraeopod* (figs. 8*g*, *h*) is a little shorter than the first, and its dactyl is irregularly shaped, showing an enlargement on the posterior margin towards the base.

In the *third*, *fourth* and *fifth peraeopods*, the basal joint is well developed and broad. In the *fifth* (fig. 8*k*) the anterior margin is convex and bears numerous setules, the posterior margin is straight with the upper and lower corners broadly rounded.

The inferior margin of the three pleon segments (fig. 8*l*) is rounded anteriorly and in the first segment bears 5 or 6 spinules, while in the second and third segments there are no spinules; the posterior angle in the third is produced into a subacute point and there are a few minute spinules on the posterior margin.

The *uropoda* (figs. 8*m*, *n*, *o*) are of the usual shape. In the first (fig. 8*m*) the outer ramus bears spinules only at the apex, while the inner has them also on the inner margin; in the third (fig. 8*o*) the peduncle is longer than the ramus and is somewhat broadened so that the upper margin is convex and bears three spinules.

The *telson* (fig. 8*p*) narrows to the distal end at which there is a narrow emargination; each lobe bears spinules along the posterior part of its lateral margin and at the extremity.

The female is of about the same size as the male, though specimens bearing eggs are often shorter than the largest males, and have the body rather less slender. The second antennæ are considerably shorter than in fully developed males, the last two joints of the peduncle being much less elongated; in this respect the females resemble the younger males. The differences in the first and second gnathopods are described below.

The *first gnathopod* of the ovigerous female (fig. 8*e*) has no process on either the carpus or the propod. The propod is shorter than the carpus, being about two-thirds its length and narrows slightly distally, so that there is no trace of any palm. The spinules on the various joints are numerous and rather conspicuous.

In the *second gnathopod* (fig. 8*f*) the basal joint is greatly broadened, so that the anterior margin is very convex, the greatest breadth being about the middle of the joint, the anterior margin bears numerous spinules; the carpus shows the shape described by M. Weber, with the rounded or somewhat angular enlargement on the posterior margin, and the broadly rounded lobe of the propod extends far beyond the end of the diminutive finger.

As the collection contained numerous specimens of various sizes, I have been able to trace out some points in the development of the gnathopods of the male. In very young specimens, about 6 mm. long, the first gnathopod is almost the same as in the female (fig. 8*q*), except that the carpus is slightly shorter in proportion to the other joints and the whole appendage bears fewer spinules; at this stage there is no trace of the rounded lobes on the carpus or propod. In older specimens, about 7–8 mm. long, the rounded lobe on the carpus is fairly well developed (fig. 8*r*), but there is only a slight indication of the corresponding lobe on the propod. In still older specimens, 9 mm. long, both lobes are apparent (fig. 8*s*), though not quite so fully developed as in the adult male and the carpus has not yet attained its full length, being only slightly longer than the propod.

In the second gnathopod much greater differences are noticeable as the appendage develops. In a specimen which I take to be a very young male (fig. 8*t*) it has the same general shape as in the female, with the pellucid rounded lobe of the propod well developed and the finger quite small; the propod is, however, less elongated and broader in proportion than in an adult female.

In a specimen 8 mm. long the appendage has acquired quite a different appearance and resembles that of the mature males (fig. 8*u*), except that the propod still bears at the postero-distal end a large rounded lobe, evidently corresponding to the one found in the female and in the young male just described. The whole propod, however, is much broadened, and the finger much larger and better developed; the palm is, however, transverse or only slightly oblique.

In another male, 9 mm. long, the lobe on the hinder margin of the propod has almost disappeared, there being left only a small trace of it at the end of the palm (fig. 8*v*); the whole appendage and particularly the propod has increased in size and the palm is more oblique, so that the characters of the adult male have been nearly acquired.

[Common with the preceding species, but never so abundant. *N. A.*]

Hyale brevipes Chevreux.

(Text-fig. 9).

Hyale brevipes Chevreux, 1901, p. 400.
Hyale nilssoni (Rathke), var. *kuriensis*, Walker, 1904, p, 238.
Hyale nilssoni (Rathke), Walker, 1905, p. 925.
Hyale brevipes Walker, 1909, p. 337.

Localities :—

Off Samal Island, 8–15 ft. Several specimens, about 7 mm. long.
Off Barkul. Several.
8 miles W. by S. of Breakfast Island. One.
2 to 8 miles N.E. ½E. of Kalidai. Two.
Ghiakhala Headland and neighbouring island. Several.
Main channel W. of Satpara Island. Several.

These specimens agree well with Chevreux's description except that the antennæ are shorter and the eyes are round rather than pyriform. There is no doubt also that they belong to the same form as the one described by Walker from

Ceylon as *O. nilssoni* (Rathke) var. *kuriensis,* and from Lagoon Minikoi, near the Maldive Archipelago which was afterwards referred by him to *H. brevipes,* Chevreux. They agree with his specimens in most of the points which he mentions as being different from those of the typical *H. nilssoni* (Rathke), a species which has since been united by Stebbing with *H. prevostii,* Milne-Edwards.

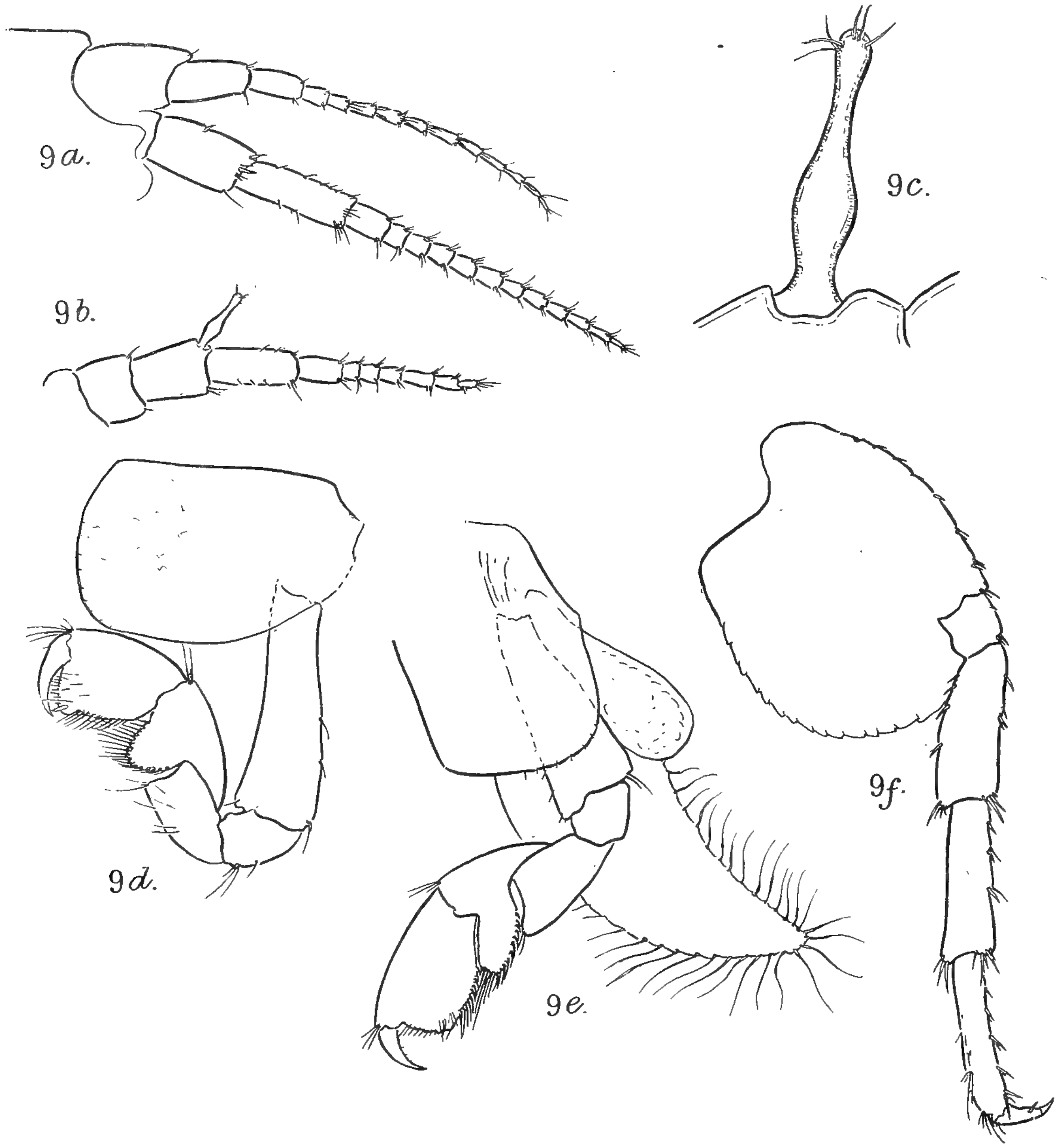

FIG. 9.—*Hyale brevipes.*

a. Upper and lower antennæ.
b. Abnormal second antenna with appendage.
c. Appendage more highly magnified.
d. First gnathopod of female.
e. Second gnathopod of female.
f. Fifth peraeopod.

The following notes had been made before I noticed that Walker had identified his specimens with *H. brevipes* and may be of sufficient value to stand.

I have been able to compare my specimens with European specimens of *H. prevostii,* identified by Mr. Stebbing and Dr. Calman respectively. The chief difference seems to be that in the European specimens the process on the carpus in the first gnathopod of the male and in both the first and second gnathopods of the female is smaller and narrower than in the Indian Ocean specimens. This is shown by Walker's figure of the first gnathopod of the male of *H. brevipes* and in those which I now give of the first and second gnathopods of the female (figs. 9 *d*, *e*). In the European specimens the setae on the hind margin of the propod form a rather distinct tuft near the middle, while in the Lake Chilka specimens they form a continuous row from the base nearly to the palm; this character is perhaps not constant, for Stebbing describes *H. prevostii* as having the hind margin of gnathopod 1 of male "with spinules from the base to a submedian spine."

Again, in the European specimen the posterior margin of the basal joint of peraeopods 3–5 is described by Stebbing as being smooth, whereas in the Lake Chilka specimens it is distinctly, though not conspicuously, serrated (fig. 9*f*). I find, however, that though the hind margin in the European specimens is on the whole smooth, there are slight indications of serrations on some of the peraeopods.

In the Lake Chilka specimens the palm of the second gnathopod of the male is slightly convex, about the same as in the European specimens, though in the Minikoi specimens, Walker describes it as being "almost straight." Another diagnostic point, not mentioned, however, by Walker, is the presence or absence of setae on the hind margin of the sixth joint of peraeopods 4 and 5. Stebbing describes *H. prevostii* as having a "group of setae and spine at middle of hind margin." In the Lake Chilka specimens there is usually one rather fine seta and sometimes more; on the other hand in the European specimens that I have at my disposal, the hind margin is quite free from setae and spines.

The specimens from the Azores described under the name of *Hyale prevostii* by Chevreux (1908, p. 7, pl. i, fig. 3) seem on the whole to be almost the same as the Chilka Lake specimens. They agree in the points mentioned above for the gnathopoda and also fairly well in the characters specially mentioned by Chevreux in connection with the antennæ, the eyes and the rigid spine on the dactyl of the last five peraeopoda. The eyes in the Chilka specimens are certainly large, especially in the male, and irregularly oval or in some cases almost reniform; the spine on the dactyl of the peraeopoda is also present, but rather less marked than is shown in Chevreux's figure. The Chilka Lake specimens are, however, all smaller than those from the Azores described by Chevreux, none of them being more than 7 mm. in length, while Chevreux's male specimens were as much as 11 mm. long.

In one male specimen examined, the second antenna (figs. 9*b* and *c*) on one side was abnormal; it had apparently been injured and was much shorter than its fellow and had only seven joints in the flagellum and these somewhat irregular. More striking, however, was an abnormal appendage at the upper distal end of the penultimate joint of the peduncle. This looked at first almost like the accessory flagellum of species in which such a flagellum occurs, but was apparently composed of a single joint only, slightly wider towards the base than near the apex, the apex being rounded, slightly enlarged and bearing two or three fine setae. The integument was chitinised like an ordinary joint of the flagellum, and the whole appendage was nearly half the length of the last joint of the peduncle. The corresponding antenna of the other side was quite normal; it is shown in figure 9*a*.

Stebbing has united *H. nilssonii* Rathke with *H. prevostii* M.-Edw. (1906, p. 565), but Chevreux (1911, p. 234) does not agree and retains *H. nilssoni* as a separate species though he unites with it *H. stebbingii* Chevreux, which he had previously described as a separate species. Chevreux says *H. prevostii* M.-E. is rather the same as *H. perieri* Lucas which is the commonest species of the genus in Western Mediterranean and accordingly he gives *H. perieri* as a synonym of *H. prevostii* M.-Edw. Stebbing kept *H. perieri* as a distinct species.

[A common bottom species in the main area. It also has the habit of congregating in enormous numbers on the upper surface of masses of drifting weed (*Potamogeton pectinatus*), to which it clings by means of its peraeopods, as a rule lying on one side. In this position it feeds on the minute algae, vorticellid Protozoa and Polyzoa (*Membranipora hippopus*) with which the weed is usually covered. *N.A.*]

Grandidierella megnae (Giles).

(Text-fig. 10.)

Microdeutopus megnae Giles, 1888, p. 243, pl. 7, figs. 1-4.
Microdeutopus megnae Stebbing, 1906, p. 592.
Grandidierella mahafalensis Coutière, 1904, p. 173, with text-figs.
Grandidierella bonnieri Stebbing, 1908, p. 119, pl. vi.

Localities:—

Off Samal Island, 8–15 ft., 22-ix-13. Several.
Off Satpara, 4–5 ft., 17-ix-13. Several, immature.
Off Barkul, 3–4 ft., 21-vii-13. One, female.
Off Barkul, at edge of lake, 21-vii-13. One male (form 1), one female, 2 immature.
Barkul, 18-iv-05. Several, male (form 1) and female, many immature.
Adyar River, outskirts of Madras. 3-4 ft. One male (form 1) and females.
East side of Rambha Bay. Three.
6 miles S. S.W. of Kalidai. Male (form 2) and female.
3–2 miles S.E. by E.½E. of Patsahanipur. Several.
5–7 miles E. by N. of Patsahanipur. Several.
1 mile E. by N. of Patsahanipur. Several, male (form 2) and female.
2–6 miles E. by S.½ S. of Patsahanipur. Several, male (form 2) and female.
4 miles N. E.½E. of Kalidai. Many, mostly immature.

This species has given rise to much consideration. The first specimen that dissected and examined was easily seen to agree closely with the description given by Giles of *Microdeutopus megnae*, a species that Stebbing in 1906 retained under the genus *Microdeutopus*. This specimen was a male, somewhat immature, and the stage appears to correspond pretty well with the one actually described by Giles. In the first gnathopod the carpus bears on its posterior margin a small tooth which was either absent from Giles' specimen or not observed by him. Giles had compared his species with *Microdeutopus gryllotalpa*, *M. websteri* and other species of the genus. The small tooth on the posterior margin of the carpus in my first specimen is quite like the one figured by Sars in *M. propinquus* and at first sight seemed to confirm the affinity of this species to *Microdeutopus*. At the time I had not looked up Stebbing's description of *Grandidierella bonnieri*, but on doing so afterwards found that the species, of which I was then about to examine further specimens, agreed very closely in the characters both of the male and the female with Stebbing's description and figures, and I feel confident that his species is the same as *Microdeutopus megnae* Giles. Stebbing referred his species to the genus *Grandidierella* which had been previously established by Coutière for a specimen from Madagascar, and following Coutière placed the genus under the Corophiidae. The general resemblance of the animals to *Microdeutopus* and to *Aora* is so great that in my opinion the genus should be placed under the Aoridae. The third uropods certainly are one-branched, but I do not consider this sufficient to outweigh the resemblance in all the other characters which, as will be seen from the following description, is very close. Stebbing distinguished his species from Coutière's by (1) the difference in the accessory flagellum in the first antenna and (2) the different proportions of the carpus of the first gnathopod of the male. From the examination of a large series of specimens I find that the accessory flagellum, though fairly distinct and perhaps sometimes nearly as long as the first joint of the main flagellum in immature specimens, becomes reduced in more adult ones to a minute lobe with one or two setae; Stebbing describes it in his specimens as being "microscopically small but carrying one or two setules." It will be seen also from the description given below that the shape and proportions of the carpus of the first gnathopod of the male vary very considerably during development, and in fully matured males the proportions come very close indeed to those given by Coutière, and I therefore consider his species a synonym of *Grandidierella megnae* (Giles). In this species the proportions of the antennæ vary according to age much as they do in the genus *Aora*. Figure 10*a* shows the antennæ of an immature male; the antennæ are seen to be subequal, the upper pair a little longer than the lower; the second joint of its peduncle is considerably longer than the first and narrower, all three joints of the peduncle being fringed below with long setae; the flagellum consists of 15 fairly slender joints, the accessory flagellum being rather more than half the length of the first joint. The lower antenna is somewhat stouter than the upper and similarly fringed with long setae. In more adult males the second joint of the flagellum of the upper antenna (fig. 10*b*) becomes more elongated, the first joint being stouter in comparison and the third slightly shorter in proportion, the flagellum is greatly elongated and more slender, the accessory flagellum being reduced to a minute lobe. The peduncle, as will be seen from the figure, bears very few setae, a small group at the end of the first joint on the lower side being the most conspicuous. The lower antennæ in the adult male (fig. 10*c*) become very stout and pediform with the last two joints of the peduncle almost free from setae. The flagellum consists of about five joints only and bears a number of stout curved spines which are hardly deve-

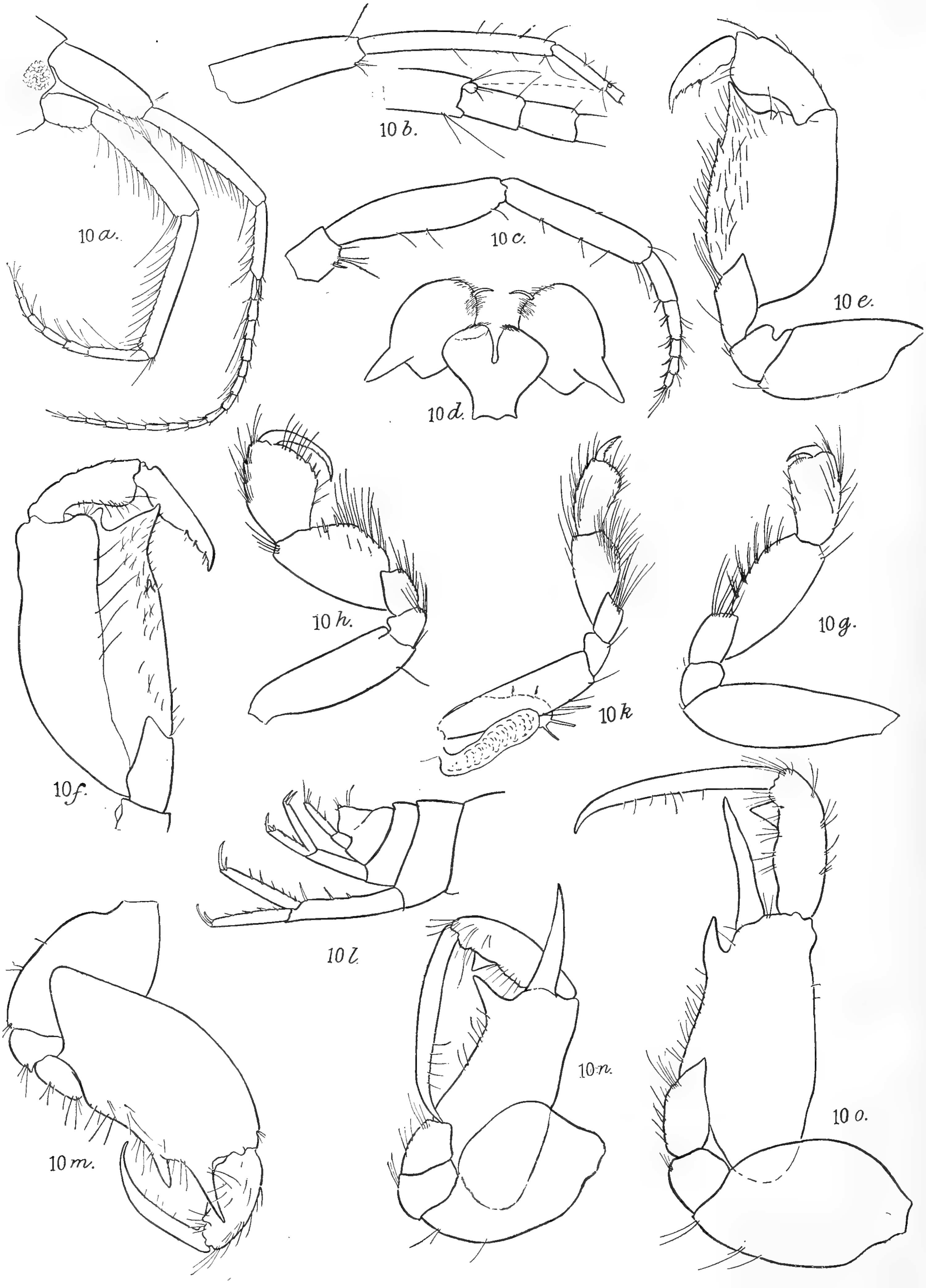

FIG. 10.—*Grandidierella megnae* (Giles).

a. Anterior portion of head of an immature male with antennæ.
b. Peduncle of upper antenna of older male with basal portion of flagellum more highly magnified.
c. Lower antenna of older male.
d. Lower lip.
e. First gnathopod of male (form 1), somewhat immature.
f. First gnathopod of male (form 1), more mature.
g. Second gnathopod of male.
h. First gnathopod of female.
k. Second gnathopod of female.
l. Terminal portion of body with uropods and telson.
m. First gnathopod of male (form 2), somewhat immature.
n. First gnathopod of fully developed male (form 2), in flexed position.
o. The same, extended to show separate joints.

loped in the more immature forms. Figure 10*b* represents the upper antenna of a male whose first gnathopod is shown in fig. 10*e*, a male which I consider to be not quite fully mature; in older males the characters of the antennæ are still more pronounced.

The mouth parts have already been described and figured by Stebbing and do not call for detailed description. The outer lobes of the lower lip (fig. 10*d*) bear on their strongly convex margin a number of fine setules, one of which is much stouter than the rest and is divided distally, giving an appearance as if several of the setae had fused at the base.

The gnathopoda of the male of this form have been described by Coutière and Stebbing and are shown in figs. 10*e*, *f*, *g*.

The gnathopods of the female are shown in figs. 10*h* and *k*, corresponding very closely with the description and figures given by Stebbing. The first gnathopod is of the same general structure as the second but considerably stouter; the carpus is wide with its posterior margin strongly convex and setose; the propod widens distally, the palm being somewhat oblique and the finger is elongated and strongly curved towards the apex, its inner margin being serrate.

The peraeopoda do not require detailed description. The posterior pairs, especially the fifth, become greatly elongated in fully adult specimens, especially in the males.

The uropoda (fig. 10*l*) are closely similar to those of *Aora* except that the third one has only one branch. This branch is about twice as long as the peduncle and does not extend beyond the end of the second uropod.

The telson is broadened above and on each side ends in a sharp curved tooth with one or two slender setules. It closely resembles that of *Aora typica*.

Besides the form described above there appears to be another form of the male with differently shaped first gnathopods. As already stated, in immature males of the first form there is often found a small tooth on the posterior margin of the carpus as shown in fig. 10*e*. In the usual form of male this tooth is not further developed, but the carpus becomes massive and more elongated and the finger thickened as shown in the figure given by Coutière. In other forms, however, the tooth becomes much more elongated and prominent and the postero-distal angle of the carpus develops into a long pointed tooth, the base of which occupies nearly the whole of the palm; at the same time the antero-basal corner of the carpus becomes produced backwards into a well marked rounded lobe, overlapped on the outer side by a wide flange developed on the basis. These points are shown in fig. 10*m*, which is a fairly young male of this second form. It will be seen that there is scarcely any palm on the carpus, that the propod is somewhat narrowed at the base, widening afterwards and that it bears on its posterior margin a stout triangular tooth about one-third of its length from the apex. The finger is long, not greatly thickened, ending acutely and overlapping the tooth on the posterior margin of the carpus. The subsequent development of this appendage can be seen by comparing figures 10*n* and *o*, with fig. 10*m*. Fig. 10*n* shows the limb folded up, when it is difficult to distinguish the different joints. In fig. 10*o* these have been partially separated so as to display them more clearly. The basis has become very greatly broadened, more than half as broad as long, this being mainly due to a flange on the outer side which appears to be for the purpose of receiving and covering the more distal part of the limb when bent back upon it. The ischium and merus are short and thick. The carpus has become much more elongated, with its antero-basal angle more produced backwards; distally it narrows, the tooth on the posterior margin is much more developed and projects out at an angle to the general plane of the carpus, while the postero-distal tooth is very greatly elongated, being nearly as long as the propod and projecting from the carpus at a different angle. The propod is narrowed, the tooth on its distal margin very prominent, while the finger is greatly elongated and narrow ensiform in shape, being much longer than the propod. The setules on the gnathopod are much fewer and less conspicuous than in the more immature forms, the finger for example bearing only a few on its concave surface. It will be seen from fig. 10*n*, that this fully developed gnathopod forms a very efficient grasping organ, the propod and finger being capable of being bent back so that the finger reaches the merus.

[Common at the edge of the lake under stones and also just above the bottom in muddy water off shore. *N. A.*]

Grandidierella gilesi sp. nov.

(Text-fig. 11.)

Localities :—

Off Samal Island, 8–15 ft. One male, two females.
Off Satpara, 4–5 ft., 17-ix-13. Five females.
8 miles W. by S. of Breakfast Island. Two males, one female.
Off north shore of Samal Island. Three females.
Barkul Point. One male.
Satpara Bay. One male and one female.

Specific Diagnosis.

In general shape of the body, antennæ, peraeopods, etc. resembling *G. megnae*, but differing markedly in the gnathopods. In the male the first gnathopod (fig. 11*a*) is complexly subchelate, having the carpus greatly dilated; the basal joint is broad but not specially dilated, the ischium and merus are short, the latter bearing on its hind margin a fringe of long plumose setae; the carpus is very large, oval, but having the postero-distal angle produced into a sharp tooth; on the palm between this tooth and the base of the propod is a triangular projection; the hind margin of the carpus bears a very distinct fringe of long plumose setae and there is another slightly oblique row on the surface of the joint; the propod is narrow at the base, widening slightly distally and bears an oblique row of long plumose setae; the finger is strong, slightly curved and, with the propod, can be bent over to meet the distal tooth of the carpus. The description of the first gnathopod just given applies to a moderately mature male; in older specimens (fig. 11*b*) the carpus is somewhat more developed, the triangular process on its palm larger and irregular and the inner or posterior margin of the propod is irregular, the central portion being produced into a blunt triangular tooth; the finger is much longer and has a projection on its outer margin near the base; the setae on the merus are still numerous, but there are comparatively few on the three terminal joints.

In the female the first gnathopod (fig. 11*c*) is of more normal shape and scarcely subchelate, the carpus is broader than the propod but not produced into a distal tooth, the propod is oblong about as long as the carpus; the four distal joints bear numerous long plumose setae as shown in the figure.

The second gnathopod in both sexes (fig. 11*d*) is somewhat similar to the first gnathopod of the female but more slender and has the merus produced distally into a lobe or scoop, something like that in *Paracorophium excavatum* G. M. Thomson, but much shorter; the length of this projection varies according to the develop-

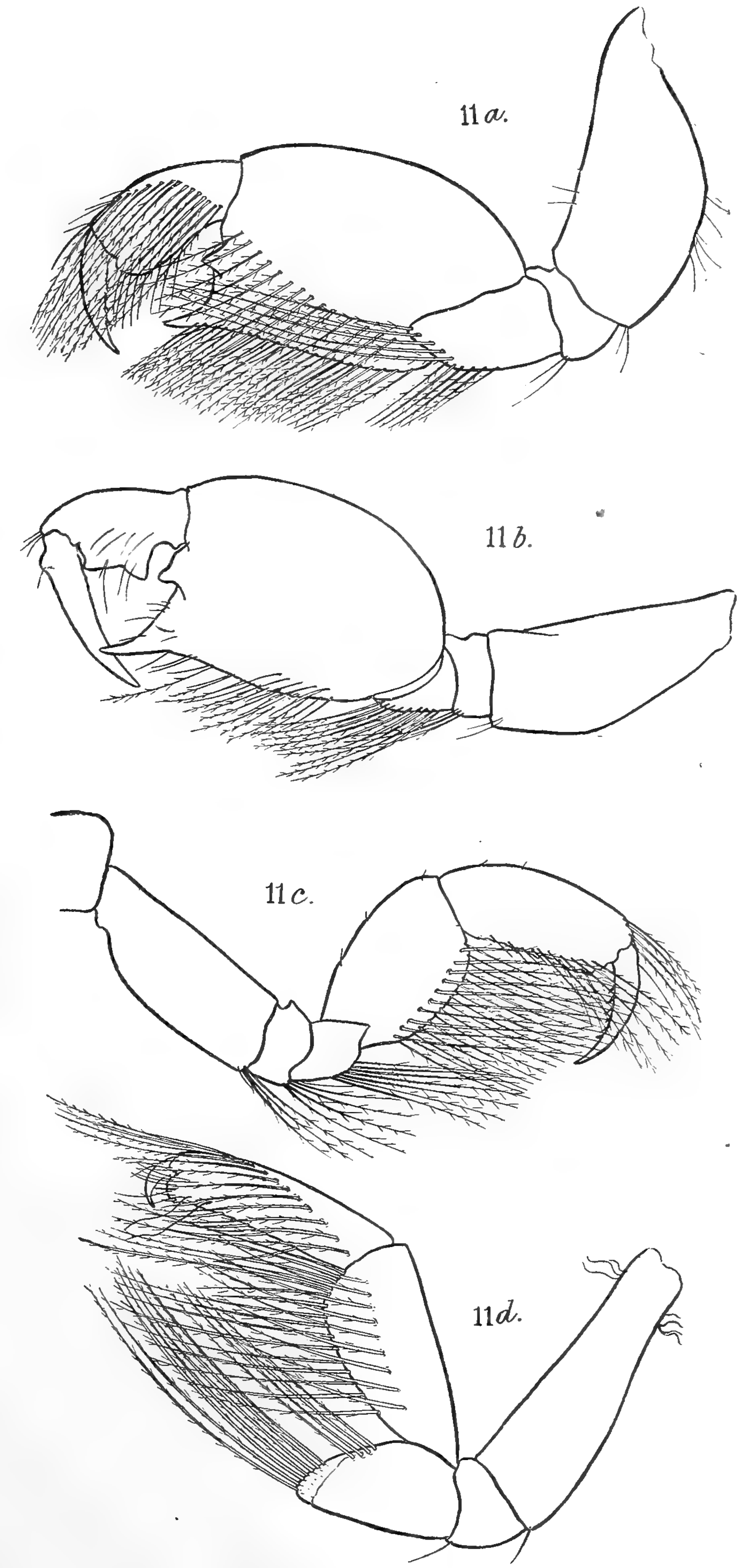

FIG. 11.—*Grandidierella gilesi.*

a. First gnathopod of male, somewhat immature. c. First gnathopod of male.
b. First gnathopod of mature male. *d.* Second gnathopod of male.

ment; the carpus and propod are similar to those of the first gnathopod of the female and are similarly armed with long plumose setae but they are considerably more slender.

The third uropod has only one branch as in *G. megnae* but in old specimens this branch becomes somewhat more elongated than in that species.

Colour. Light yellow with dark patches or reticulate markings, particularly on the dorsal surface.

Length of body, about 7 mm.

The general resemblance of this species to *G. megnae* is so great that I place it in the same genus. In the long plumose gnathopods it somewhat resembles *Xenocheira* Haswell, a genus which Chevreux rightly places in the Aoridae, but in *Xenocheira* the terminal uropoda are two-branched.[1]

Photis longicaudata (Bate and Westw.).

(Text-fig. 12.)

Eiscladus longicaudatus Bate and Westwood, 1862, Vol. I, p. 412 (text-fig.).
Photis longicaudata Stebbing, 1906, p. 608.
Photis longicaudata Walker, 1904, p. 286, pl. vi, fig. 43.
Photis longicaudata Walker, 1909, p. 339.
Photis longicaudata Barnard, 1916, p. 243, pl. 28, fig. 26.
Photis longicaudata Chevreux, 1910, p. 249.

Locality. Middle of lake N.E. ½ E. of Kalidai. A few small specimens, take in midwater.

These specimens are small, only about 3mm. in length, and I think they are the same as those of the same size referred to this species by Walker from the west coast of Ceylon. Barnard has recorded the species from Natal and other localities in South Africa, and has given a description of his specimens. The Chilka Lake specimens agree on the whole with Barnard's description, but have the ocular lobe shorter and the antennæ with fewer joints in the flagellum. The gnathopods (figs. 12*a*, *b*) are slender and agree rather with the figure given by Walker than with that given by Barnard, there being no sign of the "blunt nodiform tooth just below the apex of the emargination on the inner surface of the palm" in the second gnathopod; the carpus in the second gnathopod is produced into a narrow process extending nearly half way along the hind margin of the propod, being apparently considerably longer and narrower then in Walker's specimens. The uropods in the small Chilka Lake specimens have the branches almost free from setae.

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[1] I do not feel confident that *Grandidierella megnae* and *G. gilesi* can be retained in the same genus, but I am not attempting at the present time to discuss the validity or the affinities of the genus *Grandidierella*. The species *Hansenella longicornis*, for which Chevreux established the genus *Hansenella* in 1909, presents many resemblances in its appendages to *Grandidierella megnae*. Chevreux says that *Hansenella* is very close to *Microdeutopus* and it has the third uropod two branched as in the genus, but in *Hansenella* the first gnathopoda of the *female* have quite the same aspect as the corresponding appendages in the *males* of *Microdeutopus* and of *Grandidierella*.

In recording his specimens of *Photis longicaudata* from Ceylon Walker stated that they were remarkably variable and it was a question whether that species should not be merged with others in the oldest recorded form, *P. reinhardi* Kröyer. At the same time he described a new species, *P. longimanus*, characterised mainly by the short stout second gnathopod and the structure of its carpal joint and the oval lobe arising from it. Later on Stebbing described a new species *P. dolichommata* from the east coast of Australia which appears to be closely related, but is distinguished by the greater length of the ocular lobes and by the more numerously jointed flagella of the antennæ and the setose furniture of the limbs, etc. Barnard has since recorded *P. longimanus* Walker from Durban Bay, South Africa, but has pointed out various characters in which his specimen differed from Walker's description, describing also a form he considers to be an immature male which shows characters nearer to those of Walker's specimens. But for this intermediate form Barnard says that he would have felt bound to make a new species of his other Durban specimens. Barnard also records *P. dolichommata* Stebbing from Cape St. Blaize, South Africa.

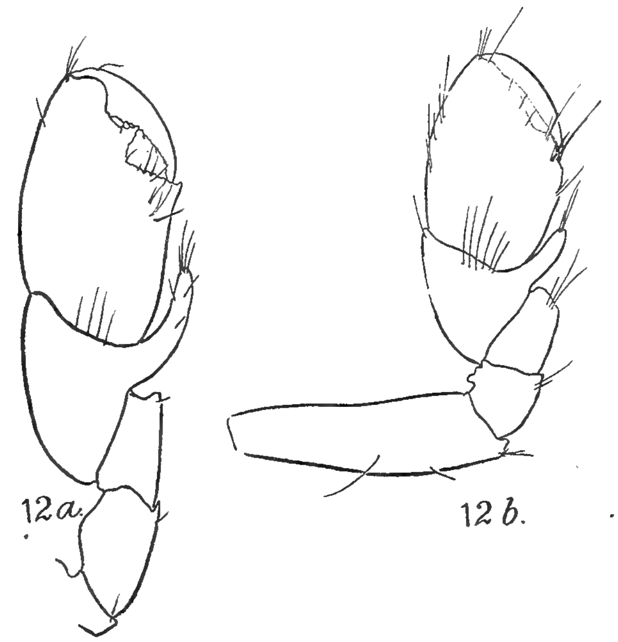

FIG. 12.—*Photis longicaudata*.
a. Second gnathopod of male.
b. Second gnathopod of female.

It seems likely from these facts that in the genus *Photis* we are dealing with forms that are very variable and that as new specimens are found, it will be increasingly difficult to divide them into separate species.

The species *P. longicaudata* as understood above is widely distributed in the North Atlantic, Mediterranean, Indian Ocean and at South Africa.

Corophium triaeonyx Stebbing.

Corophium triaeonyx Stebbing, 1904, p. 25, pl. 6a.

Locality. Manikpatna, 16-ix-13, 4ft. "Tubicolous Amphipoda from oyster shell." Several specimens.

These specimens undoubtedly belong to Stebbing's species from Ceylon. They agree well with his description and figures and also with a co-type that Mr. Stebbing has been good enough to send me. In the male the second antennæ agree closely with that of *C. crassicorne* Bruz., a species which is common in Europe, etc. It is doubtful whether *C. triaeonyx* is more than a local variety of *C. crassicorne*, but the third uropods are considerably narrower than in the latter species.

Walker (1904, p. 294) has recorded *C. crassicorne* Bruz. from Perija Paar Kerrai, Ceylon, remarking that the only difference observed between his specimens and the European form was that there are two spines on the third joint of the lower antennæ in the female instead of one. Later on he recorded the same species from Suez without comment; the name was printed in the text as *C. bonnellii* M.-Edwards (1909, p. 343) but has been corrected to *C. crassicorne* Bruz. in the author's handwriting in the separate copy he was good enough to send me. *C. crassicorne* Bruz. also occurs in New Zealand.

[Only found on oyster shells in the beds at Manikpatna in the outer channel of the lake. It inhabits small tubes made of fragments of filamentous algae agglutinated together. *N. A.*]

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FAUNA OF THE CHILKA LAKE.

ON A LARVAL CESTODE FROM THE UMBRELLA OF A JELLY-FISH.

By T. SOUTHWELL, *A.R.C.S., F.Z.S.,*
School of Tropical Medicine, Liverpool.

(With 1 text-figure).

ON A LARVAL CESTODE FROM THE UMBRELLA OF A JELLY-FISH.

By T. SOUTHWELL.

Dr. Annandale, Director of the Zoological Survey of India, has been kind enough to place at my disposal a number of parasites obtained from the umbrella of a Rhizostomous medusa (*Acromitus rabanchatu*) collected from near Barkuda Island in Lake Chilka on August 21st, 1920.

I had previously seen these parasites during inspections made of the fish fauna in the Chilka Lake, but no opportunity occurred of examining them carefully. The material was contained in three phials, preserved respectively in corrosive acetic, formalin and absolute alcohol. All the material was in excellent condition, that preserved in corrosive acetic being by far the best, and that preserved in absolute alcohol the least satisfactory of the three.

Technique.—Seven specimens were stained for two days in very dilute acetic-alum-carmine. Four of these were mounted whole, two were serially sectioned transversely, and one serially sectioned longitudinally.

Two unstained specimens were sectioned as above and afterwards stained with haematoxylin and eosin. Two unstained specimens were mounted whole.

Structural Details.—The larvae are cylindrical, with broad rounded extremities, and they measure from 2 mm. to 2.5 mm. long; the diameter is 340μ (figs. *a* and *b*). They lie in cavities in the host, but are not surrounded by a definite adventitious cyst, although there is a slightly marked condensation of host-tissue round them.

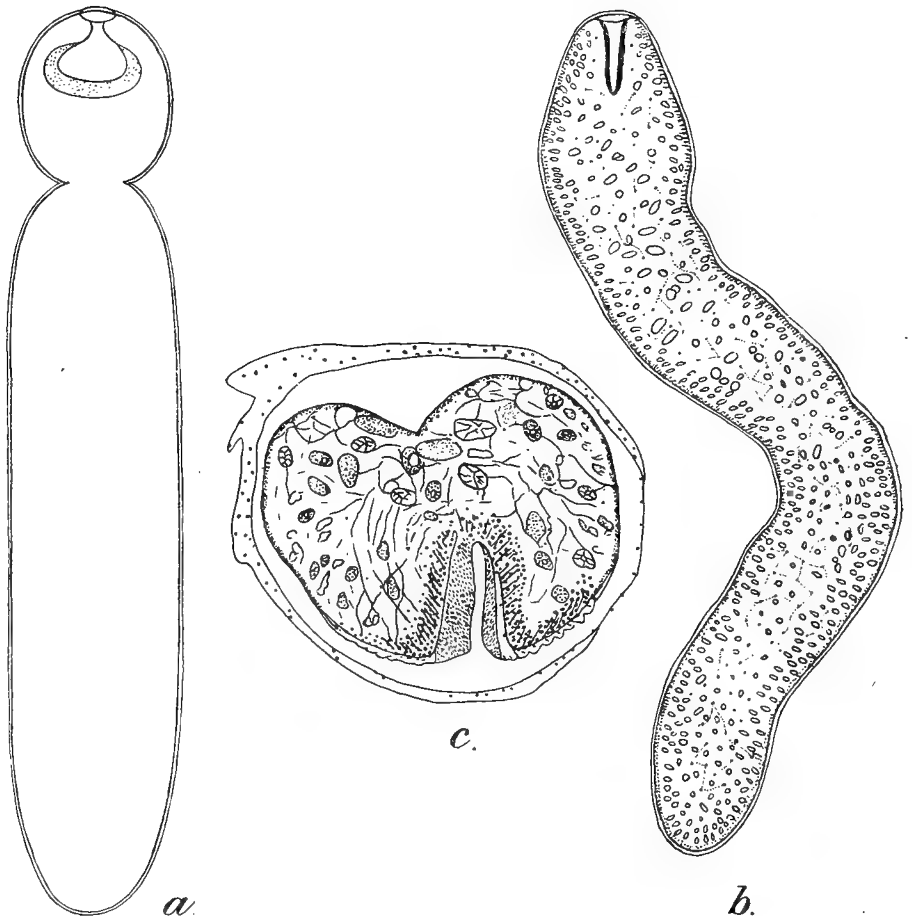
Both fresh and preserved specimens have a milky-white colour and can be seen easily with the naked eye, especially in the fresh condition. The larva is solid and is covered with a definite cuticle. There is a very definite sub-cuticular tissue made up of a series of small spindle-shaped cells, closely packed together, the nuclei of which stain deeply (fig. *c*). Internally the larva consists of a stroma framework enclosing a few large cells which in cross section measure about 38μ by 25μ. Their antero-posterior length was not determined.

These cells are at first granular, but, later on, calcareous corpuscles develop within them and gradually fill the cell. Eventually the calcareous corpuscles (which are very large and numerous) become free, and the cells which secreted them are no longer visible, being replaced by others apparently from the sub-cuticular layer.

The anterior extremity is marked by a deep pit, lined with extremely small spinules. The base of this pit is thickened, the thickened area consisting of very numerous small elongated cells with well defined nuclei. As in other Cestoda the head develops from the base of this pit. In our specimens development had not proceeded beyond the formation of this pit and no trace of the head was to be seen.

The differences noted in the specimens were confined to the size and shape of the pit. In one or two specimens a constriction appeared immediately behind the *anlage* of the head, separating the worm into two parts (fig. *a*).

Remarks.—There can be no doubt that the parasites are Plerocercoid larvae. It is impossible to identify or classify them at this stage of their development.



TEXT-FIGURE. 1.—Plerocercoid larva from *Acromitus rabanchatu.*
a. Outline of a larva showing construction behind the head × 69.
b. Entire worm in optical section × 69.
c. Oblique section through anterior region of larva × 143.

As far as I am aware, no Cestode larvae have been recorded previously from animals so low in the zoological scale as Medusae.

It would appear probable that the chances of these larvae becoming adult worms are practically nil, for I know of no animal which feeds on jelly-fish. We may thus regard their occurrence in Medusae as representing a cul-de-sac in their life-history.

FAUNA OF THE CHILKA LAKE.

POLYCHAETA OF THE CHILKA LAKE AND ALSO OF FRESH AND BRACKISH WATERS IN OTHER PARTS OF INDIA.

By ROWLAND SOUTHERN, *B.Sc., M.R.I.A.*

(With Plates XIX–XXXI and 18 text-figures.)

CONTENTS.

POLYCHAETA.

By ROWLAND SOUTHERN.

INTRODUCTION.

It was considered advisable, whilst describing the Polychaeta from the Chilka Lake, to examine also those species of the group in the Indian Museum which, at various localities in India, had been found in water which was either fresh or periodically mixed with fresh water, or in other words was not distinctively marine. The collection contains very few species which spend their whole lives in fresh water. The majority live either in brackish water of low salinity, or belong to the "Euryhaline" group. The latter term was first used by Moebius to designate those species which can live in water the salinity of which varies between wide limits. In Europe very few species of Polychaeta can tolerate marked changes in the salinity of the sea-water and fewer still can reproduce under such conditions, but in India, judging from the list of species dealt with in the present paper which is obviously far from exhaustive, they are relatively far more numerous. This adaptation may be correlated with the sharp division of the climate into wet and dry seasons, whereby the littoral region is periodically flooded with water of low salinity, especially in bays and estuaries.

From the whole of India only two species of Polychaeta have been recorded from fresh or brackish water. These are *Matla bengalensis* Stephenson (1908, p. 39 and 1910, p. 82) and *Spio bengalensis* Willey (1908, p. 389) both from brackish pools at Port Canning, Lower Bengal. *Matla bengalensis* is based on juvenile specimens of a Capitellid, and neither it nor *Spio bengalensis* were represented in the present collection. Records of littoral marine Polychaeta from Indian shores are practically absent. A number of species have been recorded from Ceylon by Schmarda, Grube, Michaelsen, and Willey. It is therefore not surprising that almost all the species in the present paper are new to science, especially when one remembers the peculiar nature of the habitat in which they have been found. Many of the species of Polychaeta known from the Indian Ocean and South Pacific have been very imperfectly described and inadequately figured, judged by modern standards. Any specimens now referred to such species would be involved in a cloud of uncertainty, and it seems preferable, where there is any doubt, to ignore them until they have been redescribed from trustworthy material.

LIST OF SPECIES.

Ancistrosyllis constricta, sp. nov. Chilka Lake.
Lycastis indica, sp. nov. Gangetic Delta; Cochin Backwater.

Tylonereis fauveli, sp. nov. Chilka Lake.
Nereis (*Nereis*) *chilkaënsis*, sp. nov. Chilka Lake.
Nereis (*N.*) *glandicincta*, sp. nov. Gangetic Delta.
Nereis (*N.*) *reducta*, sp. nov. Chilka Lake.
Perinereis marjorii, sp. nov. Chilka Lake.
Dendronereis aestuarina, sp. nov. Gangetic Delta.
Dendronereides heteropoda, gen. et sp. nov. Gangetic Delta.
Nephthys polybranchia, sp. nov. Chilka Lake.
Nephthys oligobranchia, sp. nov. Cochin Backwater; Chilka Lake.
Diopatra variabilis, sp. nov. Chilka Lake.
Marphysa gravelyi, sp. nov. Chilka Lake.
Lumbriconereis polydesma, sp. nov. Chilka Lake.
Lumbriconereis simplex, sp. nov. Chilka Lake.
Glycera alba, Rathke, var. *cochinensis*, var. nov. Cochin Backwater.
Glycinde oligodon, sp. nov. Chilka Lake.
Scoloplos marsupialis, sp. nov. Chilka Lake.
Polydora hornelli, Willey. Chilka Lake.
Polydora (*Carazzia*) *kempi*, sp. nov. Gangetic Delta.
Myriochele picta, sp. nov. Chilka Lake.
Heteromastus similis, sp. nov. Chilka Lake.
Barantolla sculpta, gen. et sp. nov. Gangetic Delta.
Mastobranchus indicus, sp. nov. Gangetic Delta.
Euclymene annandalei, sp. nov. Chilka Lake.
Sternaspis costata, Marenzeller. Chilka Lake.
Potamilla leptochaeta, sp. nov. Gangetic Delta.
Laonome indica, sp. nov. Chilka Lake.
Fabricia (*Manayunkia*) *spongicola*, sp. nov. Chilka Lake.
Ficopomatus macrodon, gen. et sp. nov. Cochin Backwater.

The species represented in the collection fall naturally into three geographical groups, viz. (1) those living in the Gangetic Delta and in the neighbourhood of Calcutta, (2) those collected in the Cochin Backwater, near Ernakulam, on the south-west coast of the Madras Presidency, and (3) those collected in the Chilka Lake.

1. THE GANGETIC DELTA.

Specimens were collected at the following localities:—

Barantolla. In brackish pools and salt lakes.
Chingrighatta. In a canal of slightly brackish water.
Durgapur. In a canal of slightly brackish water.
Beliaghatta Canal. Water slightly brackish.
Garia. Pools of slightly brackish water.
Dhappa. Salt lake and adjacent ditches of brackish water.

All these places are within 10 miles of Calcutta. The salinity of the water is very variable, but never high, probably never exceeding sp. gr. 1·015 at 15°C.

The Sunderbans. In a pool of brackish water inside the protection embankment of a clearing high up the Munda River. Vide p. 602.

Port Canning. The variation in the salinity of the ponds at Port Canning is very great, ranging from 9·82 to 22·88 parts per thousand of saline residue.

The following species were collected in the Gangetic Delta :—

Lycastis indica, sp. nov. Beliaghatta Canal ; Garia.
Nereis glandicincta, sp nov. Barantolla ; Garia ; Dhappa.
Dendronereis aestuarina, sp. nov. Sunderbans.
Dendronereides heteropoda, gen. et sp. nov. Barantolla.
Polydora (Carazzia) kempi, sp. nov. Chingrighatta Canal.
Barantolla sculpta, gen. et sp. nov. Barantolla.
Mastobranchus indicus, sp. nov. Barantolla.
Potamilla leptochaeta, sp. nov. Port Canning.

In addition, *Matla bengalensis* Stephenson, and *Spio bengalensis* Willey, have been recorded from Port Canning.

2. The Cochin Backwater.

Collections were made in the Cochin Backwater near Ernakulam, on the south-west coast of the Madras Presidency. These backwaters are part of a system connected both with the sea and with large freshwater lakes. The salinity is probably very variable, according to the season of the year, but precise information is not available.

The following species occur here :—

Lycastis indica, sp. nov.
Nephthys oligobranchia, sp. nov.
Glycera alba, Rathke, var. *cochinensis*, var. nov.
Ficopomatus macrodon, gen. et sp. nov.

3. The Chilka Lake.

The following species were obtained here :—

Ancistrosyllis constricta, sp. nov.
Tylonereis fauveli, sp. nov.
Nereis chilkaensis, sp. nov.
Nereis reducta, sp. nov.
Perinereis marjorii, sp. nov.
Nephthys polybranchia, sp. nov.
Nephthys oligobranchia, sp. nov.
Diopatra variabilis, sp. nov.
Marphysa gravelyi, sp. nov.
Lumbriconereis polydesma, sp. nov.
Lumbriconereis simplex, sp. nov.
Glycinde oligodon, sp. nov.
Scoloplos marsupialis, sp. nov.
Polydora hornelli, Willey.
Myriochele picta, sp. nov.
Heteromastus similis, sp. nov.
Euclymene annandalei, sp. nov.
Sternaspis costata, Marenzeller.
Laonome indica, sp. nov.
Fabricia spongicola, sp. nov.

No species is common to the three districts. *Lycastis indica* was found in the Gangetic Delta and the Cochin Backwater, whilst *Nephthys oligobranchia* was found in the Chilka Lake and the Cochin Backwater. So few species were found in the latter locality that it may be left out of further consideration. As regards the Chilka Lake and the Gangetic Delta, in the almost complete absence of any knowledge of the species comprising the Polychaete fauna of the Indian littoral, it is quite impossible to reach any reliable conclusions as to whether the species here described are peculiar to, or specially adapted to survive in the euryhaline conditions in which they occur. Nevertheless, certain opinions which I have formed may be stated for what they are worth. The collection of species from the Chilka Lake has a typically marine facies. It probably represents an impoverished remnant of the Polychaete fauna which inhabited the open bay before the present lake was almost completely cut off from the sea by the spit of sand which forms its eastern boundary (*vide* Annandale and Kemp, 1915, p. 5). How far the species living in the Chilka Lake have been differentiated from their relations still probably living in the adjacent open sea, in order to fit themselves for the altered environment, cannot at present be stated, but the changes have probably not been great. It seems likely that only those species survived which already had the capacity to withstand great variations of salinity. This point receives further consideration below (p. 571).

The group of species found in the Gangetic Delta conveys the impression, in a rather vague manner, of having undergone greater modification than the Chilka Lake group. The eight species found here are all new to science, and two of them belong to genera previously undescribed. All the species possess branchiae, or analogous organs for performing the function of respiration. Six of the species belong to genera which have seldom or never been found before. Speculations of this nature, however, will have greater claims to validity when the whole fauna of the two areas is taken into consideration. In other groups of animals, the species common to the Chilka Lake and the Gangetic Delta are more numerous (Annandale and Kemp, 1915, p. 15).

DISTRIBUTION OF POLYCHAETA IN THE CHILKA LAKE.

For a full account of the conditions, topographical and hydrographical, prevailing in the Chilka Lake, reference must be made to the account given by Annandale and Kemp (1915, p. 1). For our purposes, a very brief description will suffice. The Chilka Lake is on the east coast of India, and is connected by a very narrow opening with the Bay of Bengal. It lies mostly in Orissa, but the southern extremity extends into the Madras Presidency. It is about 40 miles long, the greatest breadth is $12\frac{1}{2}$ miles, and it occupies an area of about 350 square miles. It is divisible into two well-defined areas, where the biological and physical conditions are very different. There is the main area, a shallow lagoon 4-8 feet deep in the dry season, 10-15 feet in the wet season. The northern part of the lake is very shallow, and very few Polychaeta were collected there. The bottom of the lake is predominantly muddy, though on the shores of some of the islands, and at the south-western extremity there is an admixture of sand. Near the middle of the eastern shore there is a shallow bar leading into a narrow channel about 12 miles long and a mile wide, which connects the lagoon with the Bay of Bengal, the outer opening being only several hundred yards wide. The channel is separated from the sea by a narrow spit of sand. The inner part of the channel has a bottom of mud and sand, whilst the outer part is clean sand, and has an extensive oyster bed at Manikpatna. The dominating feature, at any rate in the channel, is the great seasonal change in the salinity of the water. All the main rivers enter the lake at the northern end. In the rainy season an enormous amount of fresh water enters this part of the lake, and gradually expels the salt water, so that from the middle of August to the middle of October, the northern half of the lake and the whole of the channel are occupied by water which is quite fresh. In the dry season the volume of water in the lake is reduced by evaporation, and salt-water from the Bay of Bengal enters the channel, and occupies it entirely as far as the inner entrance to the main area. Here the transition to water only slightly brackish occurs in a small space, and the main area is filled with water of low salinity. The southern half of the lake receives no large rivers, and throughout the year contains water only slightly brackish, varying between the limits sp. gr. 1·001-1·015. The variation at any particular spot in this part of the lake is not more than ·010, and is usually less, or one-third to one-fifth of that in the channel, where the sp. gr. ranges from 1·000-1·0270. The level of the water in the lake is 5 or 6 feet higher in the freshwater season (August to December) than in the salt-water season (December to August).

The following table shows the distribution of the various species in the lake, the date of capture (salt or freshwater season), the specific gravity of the water where they were found, and the extreme observed range of the specific gravity they would have to endure if they lived there throughout the year. The true range is probably greater, as the limits represent observations made only in February and March (salt-water season) and in September (freshwater season) in 1914 (Annandale and Kemp, 1915, p. 6). The majority of captures at the south-west end of the lake were made during the salt-water season, but this is largely due to the lower level of the water at that period rendering it easier to reach the habitat of the various mud- and sand-dwelling species. In the outer channel the bulk of the records were made in the fresh-water period, because it was only at that time that the launch used for dredging and trawling, could cross the shallow bar which separates the main area from the outer channel, at Mugger-Mukh. These circumstances limit to some extent the conclusions which might be drawn from the distribution of species as known at present.

TABLE I.

Species.	Specific gravity of water.[1]		Distribution.	Date of capture.
	At time of capture.	Annual range at place of capture.		
Ancistrosyllis constricta ..	1·000—1·010	1·000—1·027	South and south-west shores; outer channel.	S. F.[2]
Tylonereis fauveli ..	1·000—1·0265	1·000—1·027	Outer channel.	S. F.
Nereis chilkaënsis ..	1·002—1·011	1·001—1·015	South of lake.	S. F.
Nereis reducta ..	1·000	1·000—1·027	Outer channel.	F.
Perinereis marjorii ..	1·000	1·000—1·027	Outer channel.	F.
Nephthys polbranchia ..	1·001—1·0115	1·001—1·015	South of lake.	S. F.
Nephthys oligobranchia ..	1·0015—1·0115	1·001—1·015	South of lake.	S. F.
Diopatra variabilis ..	1·000—1·010	1·000—1·015	South and north-west of lake.	S. F.
Marphysa gravelyi ..	1·008—1·0115	1·001—1·015	South of lake.	S.
Lumbriconereis polydesma ..	1·011	1·006—1·015	South of lake.	S.
Lumbriconereis simplex ..	1·011	1·006—1·015	South of lake.	S.
Glycinde oligodon ..	1·000—1·011	1·000—1·026	South of lake: once at inner end of outer channel.	S. F.
Scoloplos marsupialis ..	1·0264	1·000—1·027	Outer channel.	S.
Polydora hornelli ..	1·000	1·000—1·027	Outer channel.	F.
Myriochele picta ..	1·005—1·010	1·001—1·015	South of lake.	S. F.
Heteromastus similis ..	1·000—1·0261	1·000—1·0265	Inner end of channel, near bar.	S. F.
Euclymene annandalei ..	1·002—1·011	1·001—1·015	South of lake.	S. F.
Sternaspis costata ..	1·000	1·000—1·027	Outer channel.	F.
Fabricia spongicola ..	1·006—1·011	1·001—1·015	South of lake.	S. F.
Laonome indica ..	1·009	1·004—1·009	South of lake.	S.

[1] At 15°C. [2] S = Salt-water season (February—July); F = Freshwater season (September—November).

When the distribution of the species in Table I is studied, two main groups are easily distinguished. In the first are those species confined to the south end of the lake, which have to withstand variations in the salinity ranging from 1·001-1·015, if spread over the whole area. If very localised in range, the variation may be much less The species in this group are :—

GROUP I.

Nereis chilkaënsis.
Nephthys polybranchia.
Nephthys oligobranchia.
Marphysa gravelyi.
Lumbriconereis polydesma.
Lumbriconereis simplex.
Myriochele picta.
Euclymene annandalei.
Fabricia spongicola.
Laonome indica.

In the second group are those species which have only been found in the Outer Channel. These are :—

GROUP II.

Tylonereis fauveli.
Nereis reducta.
Perinereis marjorii.
Scoloplos marsupialis.
Polydora hornelli.
Sternaspis costata.

There remain four species not included in the above groups. *Glycinde oligodon* was found at eleven stations in the southern end of the lake, and at one station in the inner part of the Channel, south of Mahosa, so that it may be considered as essentially belonging to Group I. *Heteromastus similis* was taken at three stations between Nalbano and Barhampur, that is to say, near the inner entrance to the lake. It is thus intermediate in distribution between the two groups, and probably likes the bottom of muddy sand which occurs there. *Diopatra variabilis* was found at eight station in the south end of the lake, twice near the middle, and once at the north-west corner, off Kalapara Ghat, so that it probably belongs to Group I. *Ancistrosyllis constricta* was taken four times at the south end of the lake, and twice in the Outer Channel during the freshwater season, though it probably lives there the whole year round. Of all the Polychaetes in the lake, this is the species which can endure the greatest range of conditions. A more complete knowledge of the distribution of the species in the lake might cause some changes in this grouping, though probably not to a great extent. The species in Group II have to endure much greater variations in the salinity of the water than those in Group I. It would, however, be rash to claim that the salinity is the determining factor. The species found in the Outer Channel are sand-loving forms, whilst those in the lake are chiefly mud-loving, though some of them live in sponges, etc. The faunistic boundaries are probably two in number, one lying close to the inner entrance of the lake near Barhampur, and limiting the inward range of the sand-loving euryhaline species of the Outer Channel; the other lying in the area roughly bounded by Patsahanipur—Nalbano—Parikudh —Kalidai Id.—Barkul Point, and cutting off, in the south end of the lake, the mud-loving species living in water of low, but not greatly varying salinity. There is not yet sufficient evidence to decide whether the determining factor is the salinity of the water or the nature of the bottom.

Annandale (1915, p. 7) has stated, with reference to the Chilka Lake fauna, that "the great majority of what we may call the permanent residents are, for the reasons that I have already given you, very ordinary in appearance. There is an absence both of brilliant colours and of colouration specially in a high degree adapted for concealment. There is a lack of bizarre form, and the majority of the animals are not modified structurally to a visible extent." Our complete ignorance of the littoral Polychaeta of the Bay of Bengal prevents any analogous statements being made here. To anyone accustomed to examining the Polychaeta of the European coasts, a collection which, out of 17 genera, contains representatives of *Ancistrosyllis*, *Tylonereis*, *Glycinde*, *Myriochele*, *Heteromastus*, *Sternaspis*, *Laonome*, and *Manayunkia*, cannot be considered as ordinary in appearance. This impression is also greatly strengthened if the species from the Gangetic Delta are added, though it might be dissipated by a knowledge of the species in the adjacent sea.

It may be stated generally that the species in Group I are adapted for life in waters of low, but not very variable salinity, and the majority of them prefer a muddy bottom. The species in Group II can live in water ranging in salinity from quite fresh to normal sea-water of the Bay of Bengal, and they seem to prefer a sandy bottom.

SEXUAL MATURITY.

In an environment like that of the Chilka Lake it may well be that some species are able to live throughout the later larval and adult periods of their life, without being able to reproduce there (Annandale and Kemp, 1916, p. 337). Free-swimming adults and larvae, or eggs, may be periodically carried into the lake by favourable winds, currents and tides, to places which are suitable for their further growth. This is much more probable in the case of those species which live in the Outer Channel than in those which occupy the main area of the lake. Such a sterile migration is much more probable in the case of mobile animals like the fishes and Crustacea than in such a relatively sedentary group as the Polychaeta. Of the 20 species found in the lake, 8 contained genital products more or less mature, the species *Nereis chilkaënsis* being represented by the Heteronereis in all stages of maturity. A number of quite small and immature individuals of several species were also collected. Probably the majority of the Polychaeta, if not all, are permanent residents. The subject is worthy of further investigation.

HABITAT OF THE CHILKA LAKE POLYCHAETA.

Five types of habitat may be provisionally distinguished. Information on this subject is very defective, and the scheme may be greatly modified by further observations.

Species found mainly or wholly on a muddy bottom.

Ancistrosyllis constricta.
Nephthys polybranchia.
Nephthys oligobranchia.
Diopatra variabilis.
Marphysa gravelyi.
Lumbriconereis simplex.
Glycinde oligodon.
Myriochele picta.
Euclymene annandalei.
Laonome indica.

Species found mainly or wholly on a sandy bottom.

Tylonereis fauveli.
Nereis chilkaënsis (?).
Nereis reducta.
Lumbriconereis polydesma (?).
Scoloplos marsupialis.
Sternaspis costata.

In the case of the two species queried, the distribution in the lake would lead one to expect a muddy habitat, though the labels attached indicate sand.

Species found on the oyster bed at Manikpatna in the Outer Channel.

Ancistrosyllis constricta (on one occasion).
Perinereis marjorii.
Polydora hornelli.

The last named only is a true shell-borer; the two former species probably only take shelter amongst the oysters.

Species living in sponges (*Spongilla* and *Laxosuberites*).

Nereis chilkaënsis.
Fabricia spongicola.

Species living amongst weeds.

Nereis chilkaënsis.
Fabricia spongicola.

DIAGRAMMATIC REPRESENTATION OF THE PARAPODIA.

An effort has been made, by means of diagrammatic text-figures, to give a more precise idea of the structure of the parapodium, and the distribution of the various types of setae, than is possible in the usual method of illustration. In the latter, the foot—the horizontal axis of which is at right angle to the main axis of the trunk—is shown either from the anterior or posterior point of view. The text-figures now endeavour to represent the foot diagrammatically as seen from the side, that is to say, when looking at the distal end of the various lobes. The observer is supposed to be looking at the parapodium on the right side of the specimen, so that the anterior face of the parapodium is on the right, facing the head, and the posterior face on the left, facing the tail. Further details are given on p. 576 and text-fig. 1.

MATERIAL NOT FIT FOR IDENTIFICATION.

For various reasons a small number of specimens in the collection were not identified. They were either too immature, or too imperfect, or (in one case) the preserving fluid had evaporated and the specimens had shrivelled up. They furnished sufficient evidence, however, to prove the presence in fresh or brackish water, of a number of additional species not described in the present report. Of special interest was a tube of dried specimens from a canal of slightly brackish water at Durgapur, near Calcutta, containing species of the genera *Perinereis*, *Lepidonotus* and *Phyllodoce*, the two latter belonging to families not otherwise represented, whilst the *Perinereis* sp. was distinct from *P. marjorii* of the Chilka Lake.

Family HESIONIDAE.

Ancistrosyllis constricta, sp. nov.

(Plate XIX, figs. 1A–1G.)

This species, of which many individuals were taken, was found only in the Chilka Lake.

The general appearance of the body is very characteristic. The greatest width is at the anterior end, the peristomial segment being the widest. The body narrows rapidly as far as the 4th setigerous segment, this anterior region enclosing the large thick-walled pharynx, which causes it to be circular in section. The body then becomes flat, and on account of the greater size and length of the parapodia, it seems to increase considerably in width, but in reality the trunk, after a slight increase, remains the same width for some distance, and then gradually tapers towards the tail. The body has thus a distinct neck, or waist, and hence the specific name. Towards the posterior end the ventral surface becomes rather more convex, and the feet appear to be on the dorso-lateral surface.

The peristomium and three anterior setigerous segments (fig. 1A) are longer than the succeeding ones, and are only separated from each other externally by very indistinct grooves.

In the largest individuals the posterior region is absent. A fragment, 23 mm.

long, had 120 setigerous segments. Another fragment, full of sperm, was 16 mm. long, with 65 setigerous segments, and was rather stouter than the other immature specimens. A complete individual 19 mm. long had 105 setigerous segments.

The head (fig. 1A) bears in front two flattened palps, fused in the median line where they are very thin and transparent. The front margin is concave. Each palp has a small terminal joint. The postero-lateral angles, where the head is widest, are rounded and indented. The posterior border is concealed beneath the very thin projecting margin of the peristomium. There are three tentacles, the median, which is nearly twice as long as the laterals, being slightly in front of them. The lateral tentacles project a little beyond the palps.

As in *A. robusta*, Ehlers, the entrance to the pharynx is guarded by large pear-shaped papillae, 14 in number. In *A. robusta* there are 16 of them. When the proboscis is fully extruded, the mouth is a vertical slit, but when retracted the mouth is large and gaping, bounded behind by the much folded lower lip, in front and at the sides by the folded and flattened palps. No jaws are present. In the dorsal median line the projecting collar of the peristomium is fused with the head, and only separated from it by a faint groove. At the sides of the head, and in front of the tentacular cirri, the peristomium has two forwardly projecting rounded lobes. There are two pairs of tentacular cirri placed near the front of the peristomium. The dorsal pair are about one quarter longer than the ventral pair, and all have filiform tips and swollen bases. Neither setigerous lobes, setae, nor spines are present.

The succeeding segment bears the first pair of parapodia. They are distinguished from the remaining feet by the very long and tapering dorsal cirri (fig. 1B), which doubtless function as tentacular cirri, and are as long as the median tentacle. The ventral cirrus is clavate, less than one-third as long as the dorsal cirrus. The setigerous lobe is pointed at the tip, where the spine terminates. Two rows of simple capillary setae lie obliquely above and below the spine. The anterior setae in each row are short, strongly curved, and coarsely serrated (fig. 1F). The posterior setae are three times as long, gently curved and very slender, the upper edge being smooth and very thin. There is a gradual transition from one extreme to the other, and the two groups, above and below the spine, are similar. The dorsal division of the foot is represented by a single short and very slender spine, which pierces the base of the dorsal cirrus.

The second foot (fig. 1C) is very minute. The clavate dorsal cirrus projects beyond the conical setigerous lobe, and there is no ventral cirrus, a rather remarkable feature. The dorsal spine is very small. In each group of setae there are six or seven with coarse teeth, two with short teeth, and three or four smooth setae. The next few feet increase till the normal size is attained. The setae increase in numbers, and there are very few intermediate between the coarsely serrate and the smooth forms, except as regards length. One of these intermediate forms is shown in fig. 1G. Some of the long posterior setae show minute serrations, and this is probably the original condition, the smooth ones having lost their teeth by abrasion, as the edge of the seta on which they occur is very thin. In the 4th foot the dorsal spine is small and straight, just reaching the base of the dorsal cirrus. In the 5th foot it is much longer, passing into the cirrus, but not piercing the epidermis. In the 10th foot all the setae show at least traces of serrations, and the anterior setae have longer teeth than those in the example figured from the 1st foot. In the 20th foot the dorsal spine is curved at the tip, but still completely embedded in the foot. There are two minute papillae on the base of the dorsal cirrus. The setae in the upper group are longer than those in the lower group, and the number of coarsely serrate setae is relatively less.

Between the 30th and 40th feet a stout sickle-shaped seta appears in the dorsal division (fig. 1D). It is in addition to the dorsal spine, which still persists, thin and curved, and does not pierce the epidermis. Ehlers (1908, p. 60) says that in *A. robusta*, the stout sickle-shaped seta replaces the slender spine. The sickle-shaped seta tapers gradually towards the tip, which pierces the skin, and there is no nodulus such as MacIntosh shows in *A. groenlandica* (1877, pl. 65, fig. 3). Behind it are a few small conical papillae on the base of the dorsal cirrus.

The succeeding feet do not show much change. In the posterior 27 feet of the specimen examined the spine and hook of the dorsal division are joined by a slender capillary seta (fig. 1E) which pierces the skin. The spine tapers very rapidly near the curved tip. The papillae on the base of the dorsal cirrus are larger and more numerous than in the anterior and middle feet, and the setigerous lobe is shorter and more rounded. The anus is terminal, and the anal segment bears two slender ventro-lateral cirri, equal in length to the last six segments.

A specimen with the body-cavity full of ripe sperm was found in September, in the Outer Channel, during the freshwater season.

This species greatly resembles in many respects the *A. robusta,* Ehlers (1908, p.59), found at Great Fish Bay, S.W. Africa, but differs in the following characters:—(1) the shape of the body; (2) the palps are fused almost throughout their length, and are flat, not cylindrical; (3) the 1st foot has a well-developed setigerous lobe, and the dorsal cirrus is $3\frac{1}{2}$ times as long as the ventral cirrus. In *A. robusta* the setigerous lobe is small, and the dorsal cirrus twice as long as the ventral; (4) the papillae on the base of the dorsal cirrus, and the dorsal capillary seta of the posterior feet were not observed by Ehlers in *A. robusta*; (5) the proboscis has 14 papillae, that of *A. robusta* 16; (6) the absence of the ventral cirrus of the second pair of feet is not mentioned by Ehlers nor MacIntosh.

The *A. groenlandica* of MacIntosh (1877, p.502), dredged in 410 fathoms in Davis Strait, is very different from *A. constricta* or *A. robusta,* but in several characters of the feet it shows the greater affinities with the former species. The setigerous lobe and dorsal and ventral cirri bear many small cylindrical papillae. More important, however, is the presence in the dorsal division, together with the stout sickle-shaped seta, of a slender bristle, generally enclosed in the tissues. According to Ehlers the sickle-shaped seta is a modified aciculum, which, in *A. robusta,* has replaced the simple curved spine of the anterior segments, and he does not regard the presence of both forms in the same foot in *A. groenlandica* as affecting this theory. It is clear, however, in *A. constricta*, that the slender curved aciculum is present in all the feet, and that the sickle-shaped seta is an addition in the middle and posterior segments, in the latter of which it is accompanied by a slender capillary seta. It is extremely probable, therefore, that the sickle-shaped seta is a modified dorsal seta, and not an aciculum.

The *A. albini* of Langerhans (1881, p.107) is quite distinct from any of these species, if, indeed, it is a true *Ancistrosyllis* at all.

Habitat.—This species was found on six occasions in the Chilka Lake. Twice it was taken in the outer channel, three times near the southern extremity of the lake and once off Balugaon.

On one occasion it was found in crevices of oyster shells at Manikpatna, but usually it occurred on a muddy bottom in a few feet of water, and once it was taken on a sandy bottom south of Mahosa.

The salinity of the water varied from 1·000-1·015, but the occurrence in the outer channel at Manikpatna in oyster shells suggests that it can survive the salt-water season when the gravity is as high as 1·026.

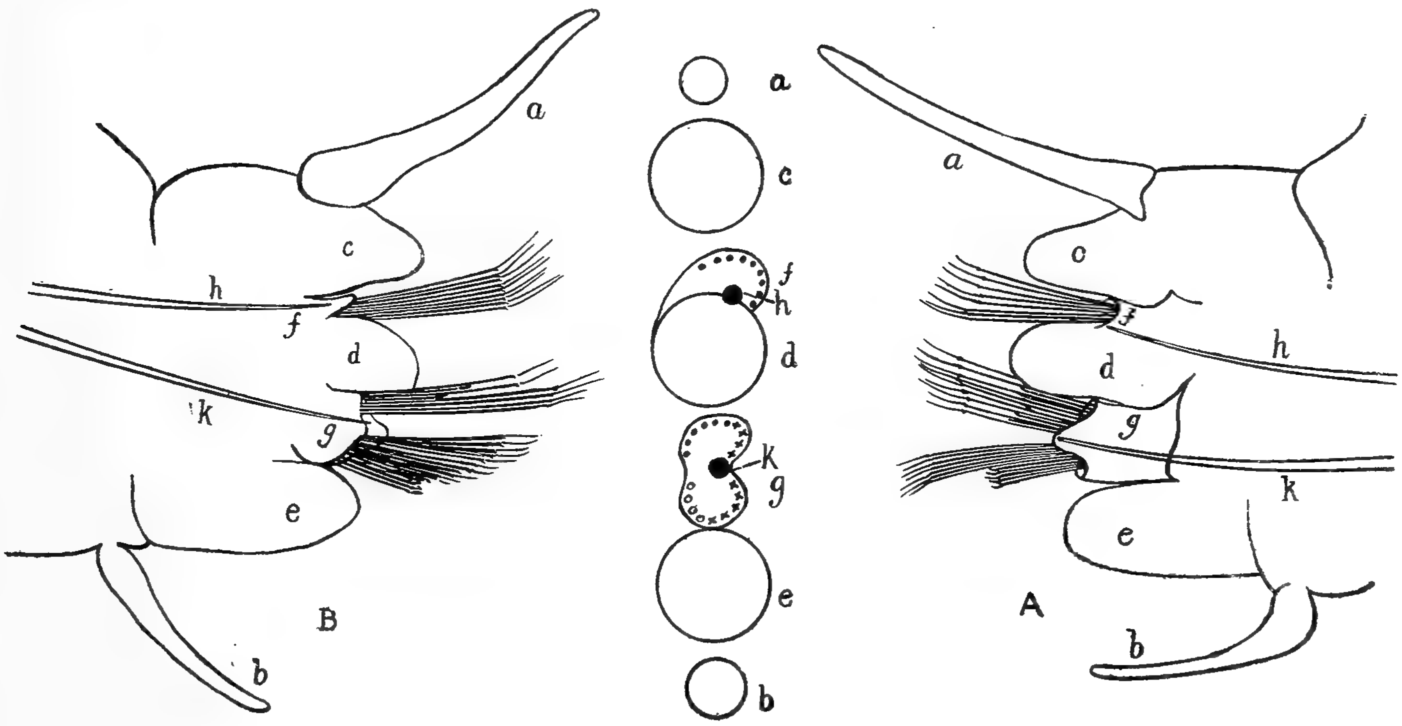
Family NEREIDAE.

The wide variation usually to be observed in the structure of the parapodia from various parts of the same specimen of *Nereis* necessitates a very close examination. The difficulty of adequately representing the structure of the foot by the usual method of illustrating the anterior and posterior aspects led to an attempt to depict it diagrammatically from the terminal aspect. In text-fig. 1, a typical foot from the right side of a specimen of *Nereis pelagica*, L. is shown from the anterior (A) and the posterior (B) points of view and C is a diagram representing the same foot as it would appear if examined from the terminal aspect. The arrangement of the various lobes and different types of setae is obscure in A and B, but is clearly shown in C. The position of the setae and their differing structure are indicated by the use of various symbols.

The posterior side of the foot is on the left of the vertical axis and the anterior on the right. Thus the diagram represents the foot as it would appear if looked at *in situ* on the right side of the worm, with the head to the right and the tail to the left.

Complete uniformity has not yet been attained in the nomenclature of the various lobes which constitute the foot of a Nereid and the following explanation of the terms here used may conduce to this end. There is considerable variation in detail in the parapodia of the different species of the Nereidae, but the fundamental plan remains fairly constant. The simplest and most typical form is seen in the sub-genus Nereis, as represented by *Nereis pelagica*, L. (text-figs. 1 A–C). Here the foot consists of dorsal cirrus *a*, a ventral cirrus *b*, and three lobes designated in this paper the dorsal ligule *c*, the median ligule *d*, and the ventral ligule *e*. Between the dorsal and median ligules emerge the setae here known as "the setae of the dorsal division." Where they emerge from the foot, these setae are surrounded by a membrane, the " dorsal fillet " *f*. Beneath the setae, and embedded in the upper part of the median ligule, is the dorsal spine *h*. The dorsal fillet is attached by its edges to the median ligule. Between the median and ventral ligules lie the " setae of the ventral division," enclosed within the ventral fillet *g*. The latter projects outwards in two lobes, a larger anterior and a smaller posterior. The " ventral spine " *k* terminates in the anterior lobe of the fillet.

Three types of setae are most commonly found in the Nereidae, and their position in the foot is fairly constant, the arrangement in *N. pelagica* being typical. Homogomph setae with elongate finely-serrated terminal pieces (plate XXI, fig. 6K) occur in



TEXT-FIG. 1.—Foot of *Nereis pelagica*, L.

A. 10th right foot, front view. B. 10th right foot, posterior view.
C. 10th right foot, diagram.

The lettering is identical in the three figures.

a = dorsal cirrus ; *b* = ventral cirrus ; *c* = dorsal ligule ; *d* = median ligule ; *e* = ventral ligule ; *f* = dorsal fillet ; *g*. = ventral fillet ; *h* = dorsal spine ; *k* = ventral spine.

• = Homogomph setae with elongate tips ; o = Heterogomph setae with elongate tips ; x = Heterogomph setae with falcate tips.

the dorsal division, and in the upper posterior part of the ventral division. Heterogomph setae with elongate terminal pieces (plate XIX, fig. 2H) occur in the lower posterior part of the ventral division. Heterogomph setae with short falcate terminal pieces (plate XXI, fig. 7K) occur in two groups on the anterior side of the ventral division, one group above, and the other below, the spine.

Variations from this typical structure take the form either of reduction of the number of lobes on the one hand, or on the other of increased complexity due to branching. The condition of the various genera may be passed in review.

In *Lycastis* the foot is very simple, consisting only of dorsal and ventral cirri and the setigerous divisions. This simplicity is probably not primitive, but derived, as the dorsal setigerous division is to be found in various stages of reduction. In *Micronereis* the foot has not yet been adequately described, but appears to consist of dorsal and ventral cirri, ligules, and setigerous divisions, the median ligule being absent.

In *Dendronereis* the foot appears to be normal, except that in some anterior segments the dorsal and ventral fillets project in a large and variable number of lobes. In *Dendronereides* the ventral ligule is absent. In some anterior segments the dorsal ligule is richly branched. In the posterior parapodia only dorsal and ventral cirri and median ligule are present. In *Tylonereis* the median ligule is apparently absent, but it may be represented in the anterior segments by the retractile lobe, and in the posterior segments by the lower lobe of the dorsal setigerous division. *Ceratocephala*, Malmgren, with which I am not acquainted, seems to be very abnormal. Judging from Malmgren's figures, it has a dorsal cirrus, a bifid ventral cirrus, a ventral ligule, dorsal and ventral setigerous divisions, and a lobe near the dorsal setae, which may be either the dorsal or median ligule. *Tylorrhynchus*, Grube, has dorsal and median ligules but no ventral ligule. The remaining genera of the family, comprising *Leptonereis, Leonnates, Nereis, Perinereis, Platynereis*, and *Cheilonereis*, have parapodia of typical structure.

Lycastis indica, sp. nov.

(Plate XIX, figs. 2A–J, and text-figs. 2 *a–d*.)

This species was taken in three different localities. It was not found in the Chilka Lake.

The five specimens from the Beliaghatta Canal are small, and the largest is incomplete. It is 26 mm. long, and consists of the head and 120 setigerous segments. Probably the perfect individual had at least 200 segments. The smallest specimen, 8 mm. long, has 40 setigerous segments. The specimen from the Cochin Backwater differs slightly from the others, and is described below. The specimen selected for the examination of the feet, from the Beliaghatta Canal, was complete, 16 mm. long, having 115 setigerous segments.

The dorsum is pale reddish brown in the anterior region, and the pigment increases in density and redness towards the tail. The ventral surface is colourless and deeply grooved.

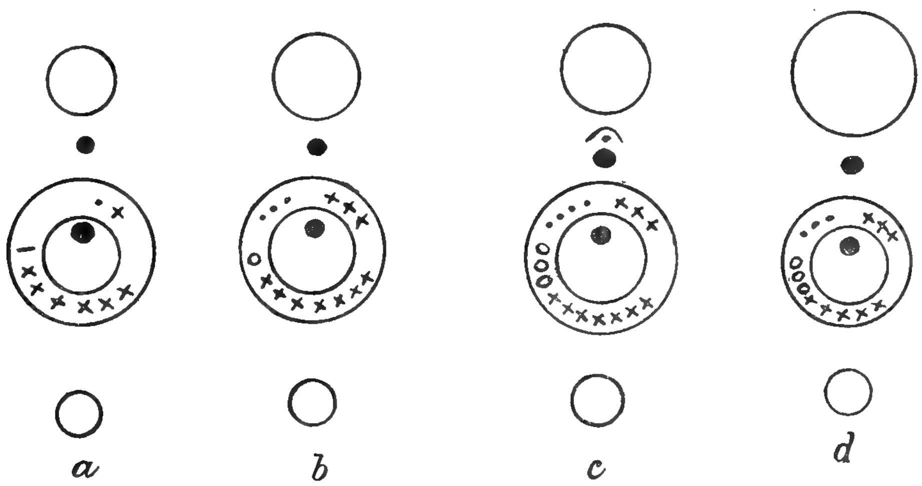
The head is thickly speckled with dark reddish brown pigment, except in the median groove and the posterior median part, where it is colourless. The bases of the tentacular cirri are pigmented, the remainder being colourless. The head (fig. 2A) is much broader than long, with two short tentacles in front. In the anterior median region there is a deep groove which widens to form a pit on the middle of the head. The eyes are on the posterior margin, almost in a straight line, and are provided with lenses. The palps are short, thick and stumpy, and the tentacular cirri are also rather short. The jaws are short, with 9 teeth. The everted proboscis has neither papillae nor paragnaths.

The buccal segment is rather narrower than the succeeding ones.

The feet increase in size up to the 7th pair. The two anterior feet differ from those of most species of the Nereidae in having a dorsal spine present.

The 1st foot (fig. 2B and text-fig. 2*a*) has a short stumpy dorsal cirrus, jointed at the base, and is shorter than the finger-shaped ventral cirrus. The setigerous lobe is broad and truncated, with a papilliform retractile tip. The dorsal division is only represented by a black spine. The ventral setae are in two groups, one above and one below the spine. The upper group, emerging from the front of the foot, consists of two setae, one a short falcate heterogomph (fig. 2F), the other a hemigomph with a long finely serrated terminal piece (fig. 2G). The lower group consists of heterogomphs, the upper posterior one having a long finely serrated terminal piece, the others short falcate tips.

In the 2nd foot the dorsal cirrus is larger than the ventral. The upper group of



TEXT-FIG. 2.—Parapodial diagrams of *Lycastis indica*, sp. nov.

a. 1st foot of specimen from the Beliaghatta Canal.
b. 10th ,, ,, ,, ,, ,, ,,
c. 10th ,, ,, ,, ,, Cochin Backwater.
d. 70th ,, ,, ,, ,, Beliaghatta Canal.

· = Hemigomph setae with long finely serrated tips; × = Heterogomph setae with falcate tips; — = Heterogomph setae with finely serrated tips; o = Heterogomph setae with coarsely serrated tips.

setae consists of two hemigomphs with long finely serrated tips, and two falcate heterogomphs. The 3rd foot is similar, the dorsal cirrus being a little larger.

In the 10th foot (fig. 2C and text-fig. 2*b*) the upper group consists of three anterior falcate heterogomphs and three posterior hemigomphs with finely serrated tips. In the lower group the upper posterior seta is a heterogomph with a long tip which has very coarse serrations on its lower edge (fig. 2H). This has replaced the finely serrated heterogomph of the anterior segments. Beneath it are 4-7 falcate heterogomphs. The dorsal cirrus is jointed, with a cylindrical base, and the apparent increase in size of the dorsal cirrus in this and the succeeding segments is due to the enlargement of the base, which carries the dorsal cirrus at its tip.

In the succeeding feet there is little alteration, except as regards the gradual enlargement of the base of the dorsal cirrus (figs. 2D, 2E and text-fig. 2*d*). This enlargement is greatly accentuated about the 60th foot. In the posterior segments it attains a relatively enormous size, and its length exceeds the width of the body. It is traversed by three main blood-vessels, which give off numerous capillaries lying beneath the cuticle. The dorsal spine emerges in a small papilla. In the posterior feet the spines are only black near the tip. The falcate heterogomphs in the upper group have rather longer and more spinous tips than those in the lower group. There may be as many as three heterogomphs with coarsely serrated tips in the posterior part of the lower group. The setae are fewer in the posterior segments.

The anal segment is button-shaped, with very bright and conspicuous streaks of reddish brown pigment. The anal cirri are as long as the posterior dorsal tentacular cirri.

The single specimen from the Cochin Backwater is 30 mm. long, consisting of 150 setigerous segments. The head, bases of the tentacular cirri, and anterior dorsum are bright rusty red in colour. The middle region is reddish brown, and the posterior region is bright red, especially in the lateral intersegmental areas. The anal segment is bright reddish brown. The tentacular cirri, feet, and ventral surface are colourless, except near the tail, where the ventral surface is pale reddish brown. The colour is due to granular pigment in the skin.

The most striking difference in the feet of this specimen is the presence, with the dorsal spine of the 10th to about the 60th foot, of a single slender hemigomph with a long finely serrated tip (fig. 2J). The arrangement of the setae in the 10th foot is shown in text-fig. *2c*. The dorsal seta is guarded by a small fillet.

The specimen from Garia, Lower Bengal, is in bad condition, but resembles this form in having a single hemigomph in the dorsal division of the foot.

The head is similar in all the specimens, except that the tentacles and tentacular cirri are shorter in the Cochin specimen. All were immature.

This species is closely related to the *Lycastis hawaiiensis*, first described by Johnson (1903, p. 210) whose specimens were found in a spring near Honolulu, Hawaii. It was afterwards described by Horst (1909, p. 1), from specimens found in a freshwater pond in the Botanical Garden at Buitenzorg, Java. The *Lycastis indica* differs from that species, as described by Johnson and Horst, in the following characters :—(1) the groove in the head ends in a pit, and does not run to the posterior border; (2) the eyes are almost in a line and are provided with lenses. According to Johnson, in the type the external pair are slightly in front of the internal pair, and have no lenses; (3) in the presence of much reddish brown pigment. Johnson says that the only pigment present in his specimens was in the yellow tips of the posterior dorsal tentacular cirri. Horst says: "The body of the preserved worms is quite colourless, except the underside of the head and of two or three anterior segments, having a yellowish hue.......During life the worms appear to be flesh-coloured, due to the blood of the peripheral vascular system shining through the skin." (4) The arrangement and structure of the setae differ considerably. Neither Johnson nor Horst mentions the occurrence of the heterogomph setae with the long coarsely serrated tips. According to Johnson, the setae are in two groups, the group above the spine consisting of two or three moderately heterogomph setae (similar to the hemigomphs shown in fig. 2G), the lower group consisting of a number of falcate heterogomphs, the lower ones having shorter tips than the upper ones. Horst's description is substantially similar. Thus the present species differs from *L. hawaiiensis* in having falcate heterogomphs above the spine, and heterogomphs with long coarsely serrated tips below the spine. Horst found in the dorsal lobe of the 41st foot of one specimen " a faintly developed setose bristle."

In the present state of our knowledge of the genus *Lycastis*, this form has as much claim to specific rank as any of the previously described species. Sufficient attention has not been given to the precise arrangement and structure of the setae. On the other hand, too much significance has been attached to slight differences in the arrangement of the eyes.

The following six species of *Lycastis*, characterised by the great enlargement of the posterior dorsal cirri, have been described :—

L. brevicornis, Audouin and Milne-Edwards. Noirmoutiers (France). Marine.

L. abiuma, Grube. Desterro, Brazil. Marine.

L. senegalensis, de Saint-Joseph. Marsassoun (100 kilometres from the sea) Senegal, West Africa. Brackish water.

L. ouanaryensis, Gravier. French Guiana. Marine and freshwater.

L. Geayi, Gravier. French Guiana. Freshwater.

L. hawaiiensis, Johnson. Hawaii and Java. Freshwater.

L. Geayi is sufficiently characterised by the complete absence of falcate setae. In *L. brevicornis*, *L. abiuma*, *L. senegalensis*, and *L. hawaiiensis*, the heterogomph setae with coarsely serrated tips have not been described. There remains *L. ouanaryensis*, which was found both in the sea and in freshwater in French Guiana, on the north-east coast of South America. The similarities between this species and *L. indica* are very striking. The setae are very similar in arrangement, and the ventral division of the middle and posterior feet contains heterogomph setae with slender coarsely serrated tips, exactly as in *L. indica*. The anterior part of the body is rose coloured, the posterior green. The very slight distinctions between the two forms are as follows :—In Gravier's species (1) the longitudinal median groove on the head runs back to the buccal segment ; (2) the eyes are devoid of lenses ; (3) the tentacular cirri are shorter than in *L. indica* ; (4) the jaws have six teeth, as against nine in *L. indica* ; (5) the dorsal cirri of the posterior segments are longer than in *L. indica* ; (6) the dorsal division of the foot contains 2 or 3 setae, and the falcate setae have tips of rather different shape.

L. indica is intermediate between *L. hawaiiensis* and *L. ouanaryensis* as regards the setae. It agrees with the former in the great reduction of the dorsal division of the foot, and with the latter in the presence of the coarsely serrated heterogomph setae.

Habitat. This species was obtained from the three following localities :—

In rotting cocoa-nut shell floating in the Beliaghatta Canal, near Calcutta, 26. viii. '09. Water slightly brackish. In the same tube was a specimen of the freshwater Oligochaete, *Branchiura sowerbyi*, Beddard.

Garia, near Calcutta, burrowing in mud.

The Cochin Backwater, near Ernakulam, in the Madras Presidency, September 1914.

In the two former localities the salinity of the water is very variable, but never high, probably never exceeding 1·015 at 15°C. The Cochin Backwater has also water of very variable salinity, but precise information regarding it is not available. It is part of a system connected both with the sea and with large freshwater lakes.

Tylonereis fauveli, sp. nov.

(Plate XIX, figs. 3A–J, and text-figs. 3*a*–*c*.)

Two complete specimens and fragments of four individuals of this species are available for examination.

The preserved specimens have retained very little pigment. The dorsum is pale yellowish brown, and the head is faintly marked as shown in fig. 3A. The anal segment (fig. 3B) is, however, of a conspicuously bright red colour.

The body is slender, and rather more delicate and transparent than is usual in the Nereidae. Of the two complete specimens, both of which are immature, one is 95 mm. long, composed of 200 segments, the other is 55 mm. long, with 150 fully formed segments and a number of developing segments at the posterior end. Several of the fragments apparently belong to larger specimens than either of these.

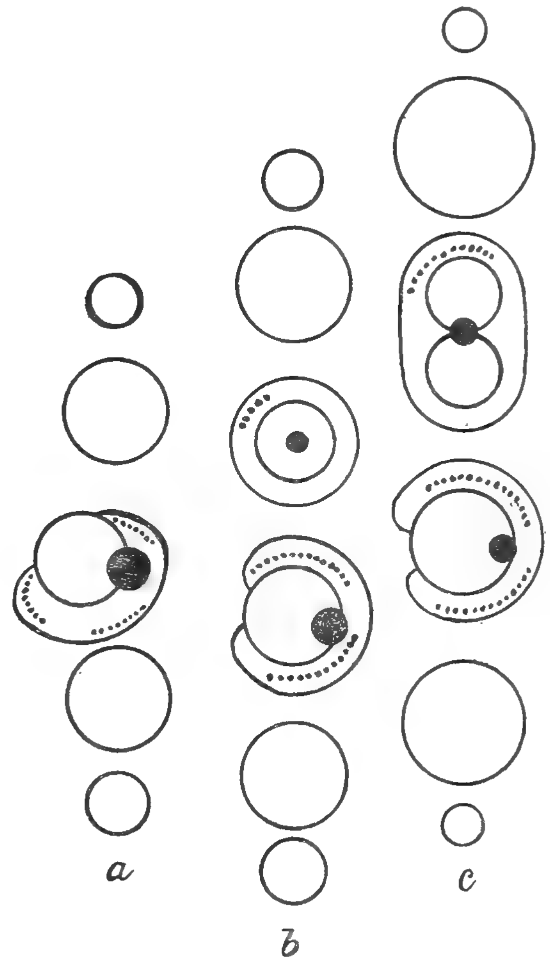
The head (fig. 3A) is rounded at the angles, divided into two lobes in front by a shallow indentation. The width of the posterior part slightly exceeds the length. The eyes are black, and the posterior pair are larger and closer together than the anterior pair. All are provided with lenses. The tentacles and palps are normal. The tentacular cirri are rather short, the anterior dorsal being two-thirds of the length of the posterior dorsal cirri, and a little longer than the posterior ventral cirri. The peristomial segment is only a little longer than the succeeding segments, and like them is grooved in the lateral regions.

The proboscis was not everted in any of the specimens, and its condition could only be observed by dissection. No horny paragnaths are present, but two large papillae were seen on the dorsal surface of the basal ring, that is to say, one in each Group VI. An interrupted row of smaller papillae was seen on the ventral side of the maxillary ring, in Group IV. None could be seen in Groups V, VII or VIII, but they may be present, as it is difficult to observe the soft papillae in dissected specimens. The jaws are small and slender, pale except at the tip, with 12 teeth.

The feet increase in size up to the 6th pair. In the 1st and 2nd feet the dorsal setigerous division is absent.

The 1st foot (fig. 3C and text-fig. 3*a*) is relatively small. The dorsal cirrus is a little longer than the dorsal ligule. The ventral setigerous lobe is somewhat fusiform, and its base is enveloped on its anterior and ventral sides by a prominent fillet, which in side view resembles an additional lobe, and gives a bifid appearance to the setigerous lobe. In *T. bogoyawlensky* Fauvel represents the setigerous lobe as terminating in three lobes (1911, Pl. XIX, fig. 2). The setae are in three groups, two anterior, above and below the spine, and a posterior ventral group. They are all homogomphs, with slender finely serrated terminal pieces, those in the lower anterior group having shorter tips than the rest. The 2nd foot resembles the 1st, except that it is a little larger, the lobes are larger, and the setae more numerous.

In the 7th foot (fig. 3D, and text-fig. 3*b*) the dorsal cirrus is relatively smaller. The dorsal ligule is larger and flatter, pointed at the tip, and filled with glands. The dorsal setigerous lobe is long and cylindrical, rounded at the tip, and its base is surrounded by a sheath or fillet, within which it can be retracted by powerful muscles. It is penetrated almost to the end by the dorsal spine, the tip of which is surrounded by a sheath of columnar cells. There are three to five setae in the dorsal division. The ventral setigerous division remains as in the 1st foot, except that the setae are more numerous, and apparently only in two groups, and the ventral ligule is relatively thinner.



TEXT-FIG. 3.—Parapodial diagrams of *Tylonereis fauveli*, sp. nov.
a. 1st foot. *b*. 7th foot. *c*. 30th foot.
· = Homogomph setae with spinose tips.

The 15th foot differs from the 7th only in having the dorsal and ventral cirri somewhat smaller, the dorsal ligule rather larger and flatter, and the lobes of the ventral setigerous division thinner and more elongate. The dorsal division has four setae, the ventral division ten in the upper group, sixteen in the lower group.

At the 22nd foot a slight indentation appears in the tip of the elongate dorsal setigerous lobe, and this gradually deepens till in the 26th or 27th foot the bifid condition shown in fig. 3E is attained. In smaller specimens the change may be complete in the 24th foot. A similar change occurs in *T. bogoyawlenskyi*, but according to Fauvel only in the posterior segments, the exact position not being stated.

In the 30th foot (fig. 3E, and text-fig. 3*c*) the dorsal and ventral cirri and the ventral ligule are greatly reduced in size. The dorsal ligule is large and long, pointed at the tip, and full of glands. The dorsal setigerous lobe is deeply bilobed at the tip, the spine lying between the two lobes. Its tip, enclosed in the gland, is shown in fig. 3F. The dorsal setae, eight in number, lie above the two lobes, whereas Fauvel says that in *T. bogoyawlenskyi* they emerge between the two lobes. The dorsal setae now differ markedly from those in the ventral division. The terminal pieces are short, and they taper rapidly to a fine point (fig. 3J). The terminal pieces of the ventral setae are 2-4 times as long, and taper very gradually to the tip. The space between the ventral ligule and the ventral cirrus has greatly increased.

The 70th foot (fig. 3G) is smaller, and the setigerous lobes and fillets are reduced and flattened. The setae in the dorsal division have stouter shafts than those in the ventral division. In the posterior feet (fig. 3H) the two setigerous divisions are more widely separated. In the dorsal setigerous lobe the upper lobe is reduced to a small papilla, but the lower lobe has relatively increased. The ventral fillet is still very obvious, giving a bifid appearance to the ventral division. The dorsal setae have longer tips, which taper more gradually than those in the middle region of the body.

The anal segment (fig. 3B) is bright red in colour. It is button-shaped, and the anus is round and terminal. The ventral anal cirri are short and slender.

The dorsal setae are all pure homogomphs, but some of the ventral setae show a tendency towards the hemigomph condition, the enlarged cup-shaped tip of the shaft having a process on one side, of variable size.

This species is very closely related to the *T. bogoyawlenskyi* described by Fauvel (1911, p. 376) from a single specimen collected in the Persian Gulf, for which he created the genus *Tylonereis*. This genus is characterised by the presence of soft papillae only on the proboscis, by the structure of the dorsal setigerous division of the feet, and by having setae of one type only. *T. bogoyawlenskyi* differs from the present species chiefly by the trilobed condition of the ventral setigerous lobe in the anterior feet. Other minor characters distinguishing the present species are the shape of the head and tentacular cirri, the red anal segment, the shape of the setae, and the proportions of the various parts of the feet. The change in the condition of the dorsal setigerous lobe apparently occurs in a more anterior position in *T. fauveli*. According to Fauvel there is no difference between the dorsal and ventral setae. A noteworthy character of the two species of *Tylonereis* is the apparent absence of the median ligule of the foot. Possibly, however, it may be represented in the anterior segments by the retractile lobe, and in the posterior segments by the lower lobe of the dorsal setigerous division.

Habitat.—This species was taken on two occasions, in the Chilka Lake, both times in the outer channel. It was taken in September, when the water was quite fresh, and in March, when the specific gravity was 1·0265, showing that it can withstand the full rigours of the violent seasonal alternation of conditions in the outer channel.

Nereis (Nereis) chilkaënsis, sp. nov.

(Plate XXII, figs. 8A–R, and text-figs. 4*a*–*c*.)

This species was found in great abundance in the southern half of the Chilka Lake. It is evidently quite at home there, for both immature and heteronereid stages were found.

The largest specimen is 92 mm. long, and has 81 setigerous segments. Others are 65, 56 and 44 mm. in length, with 84, 66 and 81 segments.

The dorsum is deeply coloured with purplish brown pigment, dark in front, and growing paler behind. The ventral surface is colourless. The head (figs. 8A, 8B) is deeply coloured, with a median pale streak which broadens out between the eyes. The palps are more faintly coloured. The basal part of the proboscis is tinged with the purple pigment. The bases only of the tentacular cirri are deeply coloured. The first few segments have the dorsum pigmented all over, except for a few pale oblique lateral grooves. Further behind, the pigment forms a definite pattern on each segment (fig. 8D). The central part becomes paler, leaving a dark band on each side, separated from the central part by a narrow pale band. The intersegmental areas are pale. In the anterior segments the base of each foot is pigmented, but in the middle and posterior regions the feet are colourless. The pigment is not uniformly diffused, but is more or less granular, especially in the dark lateral bands.

The head (fig. 8A) is considerably narrower in front than it is behind, and the length is about equal to the greatest width. It projects a little in front between the tentacles, which are $\frac{1}{3}$rd to $\frac{1}{4}$th as long as the head. In small specimens the palps are separated from the head by grooves, but in large specimens these grooves become indistinct. The palps are large and stout. The eyes, in immature individuals, are small and dark, equal in size, the anterior pair being a little further apart than the posterior pair. The tentacular cirri have dark ringed ceratophores. The posterior dorsal pair are much longer than the others, reaching back usually to the middle of the 6th setigerous segment, in some cases to the 8th and even the 12th segment. The anterior dorsal tentacular cirri are one-half to two-thirds as long. The ventral cirri are approximately equal in length, being half the length of the 1st dorsal cirri. These sizes and proportions are subject to great variations.

The paragnaths have the normal form and arrangement for the subgenus. Those on the basal ring are longer than those on the maxillary ring. They are arranged as follows :—

Group I, 6–10, usually 7 or 8.
,, II, 18–20.
,, III, 26–34, usually 28.
,, IV, 35–41, varying greatly.

Group V, absent.
,, VI, 3–5 usually 4, larger than the others, in a curved row.
,, VII and VIII, forming a continuous band in two rows.

The paragnaths of the anterior row in Groups VII and VIII are large; those forming the posterior row are more numerous and of different sizes.

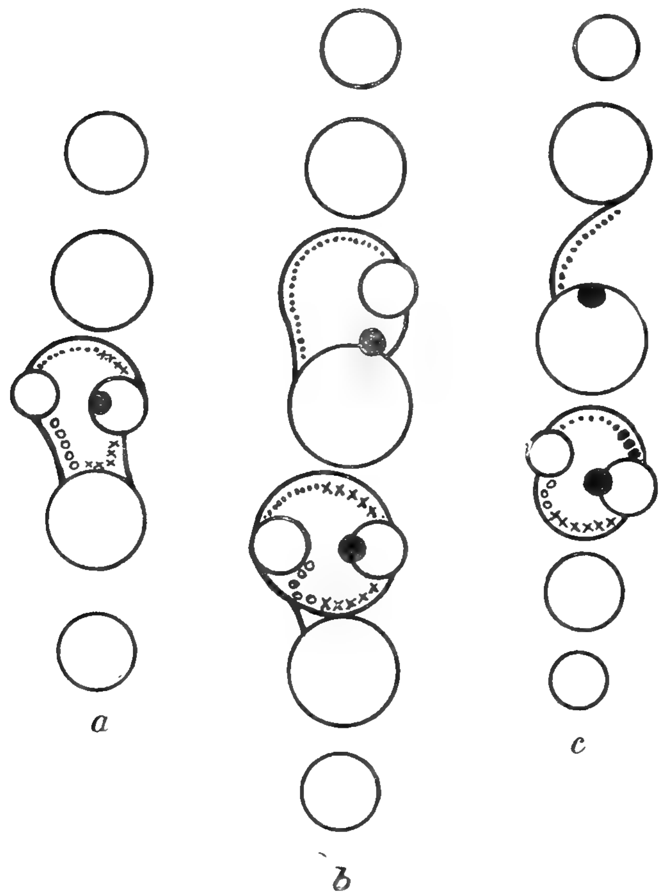
The jaws are of the usual shape, with eight teeth.

The peristomium (fig. 8B) is nearly twice as broad as the succeeding segments. In fig. 8A it is crushed by the extruded proboscis.

The feet were examined in a specimen 56 mm. long, having 66 setigerous segments.

The feet increase in size up to the 6th or 7th.

The 1st foot (fig. 8E, and text-fig. 4*a*) contains only the ventral setigerous division. The dorsal and ventral cirri are long and slender. The median (?) and ventral ligules are stout and conical. The ventral setigerous region consists of a fillet forming a dome over the setae. The fillet is produced outwards into two conical lobes, one in front of, and one behind the setae, and its lower edges are attached to the ventral ligule. The spine pierces the anterior lobe of the fillet. In some specimens there are two ventral spines. The setae are in three groups, a dorsal group consisting of a single row with falcate heterogomphs in front, long-tipped (spinose) homogomphs behind, and two ventral groups, an anterior group of falcate heterogomphs, and a posterior group of spinose heterogomphs. The 2nd foot is similar. The dorsal division appears in the 3rd foot.



TEXT-FIG. 4.—Parapodial diagrams of *Nereis chilkaënsis*, sp. nov.

a. 1st foot. *b*. 10th foot. *c*. 50th foot.

· = Homogomph setae with long spinous tips; o = Heterogomph setae with long spinous tips; x = Heterogomph setae with long falcate tips; • = Heterogomph setae with thick shafts and tips.

The 10th foot (fig. 8F, and text-fig. 4*b*) exhibits the normal condition. The dorsal cirrus is long, greatly surpassing the dorsal ligule, but the ventral cirrus is small. The dorsal, median, and ventral ligules are large, thick, and bluntly rounded, the dorsal being the largest. In the dorsal division the fillet has a prominent pointed anterior lobe, and a smaller rounded posterior one, and its lower edges are attached to the median lobe, before and behind the spine. The setae are all homogomphs (fig. 8N) with long slender terminal pieces. The ventral division is as in the first foot.

In the succeeding feet the lobes become gradually more elongate and pointed. The dorsal setigerous lobe decreases in size, and fuses more or less completely with the median ligule. The dorsal part of the foot, including the median ligule, increases in size relatively to the ventral part and projects beyond it.

In the 50th foot (fig. 8G and text-fig. 4*c*) the dorsal cirrus is long and slender, the ventral cirrus small and thin. The dorsal and median ligules are large and pointed. The dorsal setigerous lobe is represented by a small swelling, pierced by the spine, on the upper side of the median ligule, and by a small and indistinct fillet guarding the dorsal setae. The ventral ligule is much smaller. The ventral fillet, with its two lobes, is as before, and forms an arch above and below the setae.

In the 63rd foot the dorsal cirrus is $2\frac{1}{2}$ times as long as the dorsal ligule. The dorsal division is relatively still larger and more prominent than the ventral division. The upper group of the ventral division consists only of a single thick falcate heterogomph, the spinose homogomphs having disappeared.

There are four types of setae present in this species, in addition to the modified setae of the Heteronereid phase. In the dorsal division only homogomphs with long tapering spinose tips occur (fig. 8N). In the ventral division, the anterior setae, above and below the spine, are falcate heterogomphs (fig. 8P). They have moderately long terminal pieces, smooth at the tip, spinose below. The posterior setae consist of an upper group of spinose homogomphs, similar to those in the dorsal division, and a lower group of spinose heterogomphs. Between the 20th and 30th feet two or three setae appear in the upper anterior group of falcate heterogomphs of the ventral division, which have shafts rather thicker than those of the other setae. In the subsequent feet these setae increase in thickness, but diminish in number, and in the last few feet, as already stated, the upper ventral group is represented only by a single falcate seta with a shaft three times as thick as that of the normal type of seta. The terminal piece is relatively shorter, with only a few strong spines on the edge (fig. 8Q). The shafts of the falcate setae of the lower group also increase in thickness in the posterior feet, but not to the same extent.

There is considerable variation in this species. In some individuals the tentacular cirri and dorsal cirri are much longer than usual (fig. 8B).

The terminal pieces of the very thick ventral falcate setae have sometimes only three or four spines, and rounded tips, as in fig. 8Q, but in other specimens they may have ten or twelve spines, and pointed tips. This character doubtless depends on the amount of wear they have undergone. The eyes vary considerably in size, as do the paragnaths, and the intensity of the epidermal pigment. Some or all of these characters may be associated with approaching change to the Heteronereid condition.

Three specimens of this species were taken which had, in varying degrees, assumed the Heteronereid condition. The more advanced of the two female specimens was selected for examination. It is 40 mm. long, with 63 setigerous segments. The colour of the dorsum is much deeper than that of the immature individuals, and the eyes are much larger, but not connate. The paragnaths on the basal segment of the proboscis are larger than usual. The anterior 18 pairs of feet show no change. In the 19th foot the ventral cirrus shows indications of a small ventral lobe near the base. The 20th foot has a few of the characteristic swimming setae in both divisions of the foot, and the basal lobe of the ventral cirrus is well developed. The setigerous lobes and their fillets are enlarged.

In the 25th foot (fig. 8J) the dorsal cirrus remains unchanged. The ventral cirrus has a large ventral and a small dorsal wing near the base. The three ligules are elongate and pointed. The two lobes of the ventral setigerous division are enlarged and flattened, and the posterior one has two flat wings. The setae are mostly of the natatory type, but a few of the old setae remain. In the 30th foot the flattening of the various lobes is more obvious. In the 40th foot (fig. 8K) the dorsal cirrus has a small flat wing above its base, and the wings of the ventral cirrus are larger. The posterior lobe of the dorsal fillet is greatly enlarged, displacing by its growth the median ligule. The ventral setigerous lobes are also greatly enlarged and flattened, and the ventral ligule is directed downwards. The 58th foot is much the same, but it is smaller, and has a larger proportion of the normal setae.

The eggs escape from the body cavity through the tips of papillae on the ventral surface near the base of the feet. The swimming setae (fig. 8R) are modified homogomphs. They are very transparent. The end of the shaft is cup-shaped, with an anterior spinous projection. The blade, which is minutely serrate, increases in width to near the tip, and then narrows suddenly to a sharp point.

The two female Heteronereids were found under stones on the shore. Another Heteronereid was taken on the surface of the lake, where it was gyrating in a spiral course. It is a fully developed Heteronereid, but the sexual products have been completely extruded. It is probably a male, as it differs in several important points from the specimen just described. It is small in size, being only 16 mm. long, but it consists of 72 setigerous segments. The eyes are very large, and the head is deeply pigmented, the white patch, which occurs in all other specimens, being absent. The anterior end of the body is dorsally very deeply coloured with metallic brown pigment, and is without the characteristic pattern. The tentacular cirri are unusually long.

The anterior 19 pairs of feet are unmodified, except that the 19th has a single swimming seta in the dorsal division, and that the dorsal setigerous division is in all the feet fused with the median ligule (fig. 8L). In the 20th foot the lobes are not altered, but the dorsal division contains only swimming setae, and a few of these are also in the ventral division. The only unchanged setae are the two thick falcate heterogomphs of the upper ventral group. In the 25th foot only one thick falcate seta remains. The setigerous lobes are enlarged and flattened, and the ventral cirrus has basal wings. In the 30th foot (fig. 8M) the median ligule, to which the dorsal setigerous lobe is fused, is enlarged and flattened. The ventral setigerous lobes are also flattened, the anterior one being large and foliate. The 18 posterior feet are not modified, and have only normal setae. The dorsal cirrus is very long, and the ventral cirrus has increased and projects beyond the ventral ligule. The spines are very thick and dark.

A specimen taken on the shore seems to represent a stage in the development of the last described form. It is a slender worm, 22 mm. long, with 62 setigerous segments. The body cavity is full of sperm morulae in an early stage of development. The head of this specimen is shown in fig. 8B. It has very large eyes, and the tentacular cirri are unusually long. In both these points it resembles the male *Heteronereis*. The colour, however, is normal. The most exceptional character of this specimen is that in a few of the posterior feet the dorsal ligule decreases very much in size (fig. 8H), a character noted in no other individual of this species. The jaws of this specimen have 10 teeth.

It is remarkable that all the partially or completely metamorphosed Heteronereids are smaller than the average immature individual in the collection, though they have the normal number of segments. The two female Heteronereids were taken in January and February, the small immature male in February, and the spent male in November, so that the period of sexual maturity is evidently prolonged. The specific gravity of the water at these four stations varied only from 1·006–1·009.

Habitat.—This species was found at 15 stations, all south of a line drawn from Nalbano to Patsahanipur. Twice it was found in November, and on thirteen occasions in January to March. In this part of the lake, however, the season makes little difference in the specific gravity of the water, which ranged at the various stations from 1·002–1·011. The habitat of this species varies widely. It was often found in sponges, both *Spongilla* and *Laxosuberites*. It also lives under stones on the shore, amongst algae on the rocks, and in sand above and below high-water mark.

Nereis (Nereis) glandicincta, sp. nov.

(Plate XXIII, figs. 9A–L, and text-figs. 5*a–e*.)

This species was taken at four localities near Calcutta, in brackish lakes or pools. Twenty-six specimens are available, most of them approaching a state of maturity.

The preserved specimens are pale buff brown. Running transversely across the dorsal and ventral surface of each segment is a very conspicuous row of dark glands. The glands are continued into the feet, and are especially prominent in the dorsal ligule. They occur to a lesser degree in the median and ventral ligules and the base of the ventral cirrus, but are not found in the dorsal and ventral cirri nor in the setigerous lobes. There is usually a band of glands on the median dorsal area of the peristomium. There is considerable variation in the number of glands in each row. Sometimes they are absent from the median dorsal and ventral areas, and in other specimens they form complete and very thick bands round each segment. The specific name is derived from this character. The dorsal vessel shows very distinctly. The ventral surface is slightly grooved, and the nerve-cord shows as a pale line.

The type-specimen is 88 mm. long, and comprises 123 setigerous segments. It is a female, full of eggs, but shows no sign of assuming the Heteronereis condition.

In all the specimens which have the pharynx extruded, the peristomium is large, oval, and greatly inflated. Even when the pharynx is retracted, the peristomium is large, bulging out at the sides and in front of the head.

The head (fig. 9A) is narrow in front, wide behind, where the width exceeds the length. In front are the two short tentacles. The posterior angles are rounded. The eyes vary considerably in size in the different specimens, probably owing to the approaching condition of sexual maturity. They are provided with lenses. The pigmentation of the head also varies. In some specimens there is a conspicuous band on each side of the anterior part, reaching from the base of the tentacles to the front eyes. In others there are only two oval patches of pigment between the posterior pair of eyes. Others have two short lateral and a narrow median band as in fig. 9A. The palps are very large and flat. The posterior dorsal tentacular cirri are twice as long as the anterior dorsal pair, and reach back to the 3rd setigerous segment.

The armature of the pharynx (figs. 9A, 9B) is of considerable interest. The maxillary ring has its full complement of teeth, but the basal ring is greatly reduced. The arrangement is as follows:—

Group	I,	10 scattered unequal teeth.	Group	V,	absent.
,,	II,	10–13 large curved teeth.	,,	VI,	one small tooth.
,,	III,	transversely elongated band of 50 teeth, in 4 rows.	,,	VII, VIII,	a single row of 7 minute teeth.
,,	IV,	10–12 large teeth.			

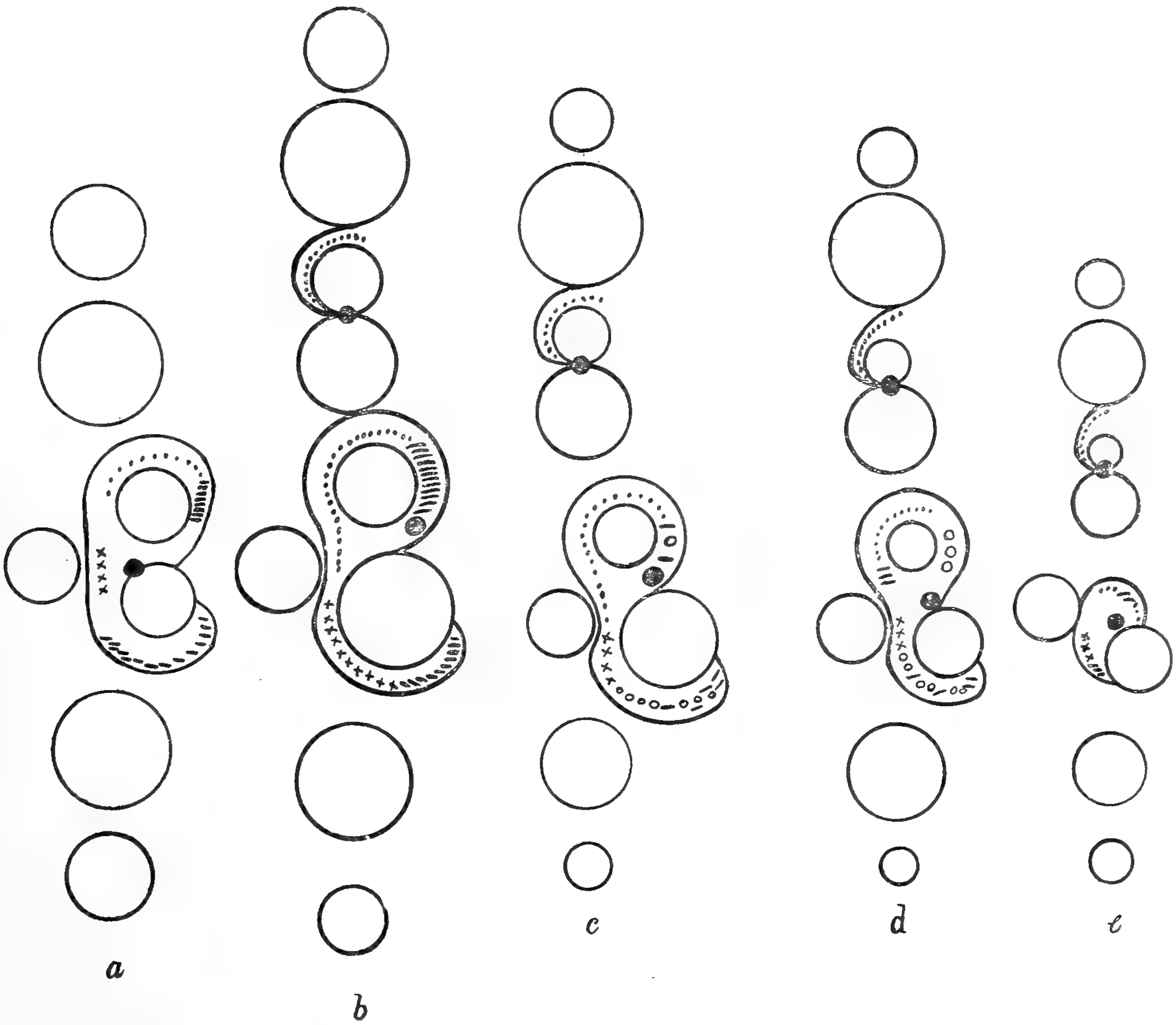
In group III the two middle rows of teeth are larger than those in the outer rows. All the teeth on the maxillary ring are of the normal size and conical shape. On the basal ring, however, they are rudimentary. Dorsally there are two small pale paragnaths seated on rounded papillae (figs. 9A, 9C). Ventrally there is a single row of 7 similar minute paragnaths. In two other specimens there were only 3 and 4 paragnaths respectively in the ventral row. These rudimentary paragnaths easily fall off, and consequently some or all of them are frequently missing. The condition of things characteristic of the sub-genus *Ceratonereis* is thus attained. The two dorsal papillae can always be distinguished, even when the paragnaths have fallen off.

The jaws (fig. 9D) are slender, and have 15–16 teeth, an unusually large number. In a specimen from the Salt Lake at Dhappa, however, there are only 10 teeth on each jaw.

The feet gradually increase in size up to the 8th. The 1st foot (fig. 9E, and text-fig. 5*a*) has pointed dorsal and ventral cirri, equal in size and shorter than the adjacent ligules. The latter are stout pointed lobes. The ventral division consists of three slender lobes, two in front more or less completely surrounded by the fillet and setae, the third behind the setae. The edges of the fillet are attached to the lower anterior lobe. The setae are of three types. Above the spine there is a group consisting in front of hemigomphs with rather short coarsely serrate tips, behind of homogomphs with long slender finely serrate tips (fig. 9J). Below the spine the anterior and ventral group consists of hemigomphs as in the anterior dorsal group. Behind the spine is a group of hemigomphs with long finely serrate tips. The anterior hemigomphs with coarsely serrate tips resemble those shown in fig. 9K, except that the tips are shorter.

The 2nd foot resembles the 1st, except that it is larger and more glandular. In the 3rd foot the dorsal division appears. It is deeply bifid, with a few slender homogomphs. The 10th foot (fig. 9F, and text-fig. 5*b*) has small clavate dorsal and ventral cirri, much smaller than the adjacent ligules. The dorsal ligule is pointed and triangular in shape, richly supplied with glands. The dorsal setigerous division consists of a slender lobe lying in front of the dorsal setae The latter are homogomphs (fig. 9J) with long finely serrate tips. They are guarded behind by a fillet which is attached to the dorsal and median ligules.

The tip of the spine, which is curved and enclosed in a sheath of gland cells, lies between the median ligule and the dorsal setigerous lobe. The ventral division resembles that of the 1st foot, except that the setae are much more numerous, forming a continuous row. At the 18th foot a number of falcate hemigomphs appear in the



TEXT-FIG. 5.—Parapodial diagrams of *Nereis glandicincta*, sp. nov.
a. 1st foot. *b.* 10th foot. *c.* 30th foot. *d.* 50th foot. *e.* 100th foot.
· = Homogomph setae with long finely serrated tips ; — = Hemigomph setae with short coarsely serrated tips ; × = Hemigomph setae with long slender finely serrated tips ; o = Hemigomph setae with falcate tips.

ventral division. The 20th foot is very like the 10th in shape. The median ligule is relatively larger.

In the 30th foot (text-fig. 5*c*) the dorsal and ventral cirri, and the dorsal and ventral setigerous lobes have decreased relatively in size, whilst the dorsal, median and ventral ligules have increased. In the ventral setigerous lobe, as compared with the 10th foot, the setae are fewer and some of the hemigomphs with short coarsely serrate tips have been replaced by falcate hemigomphs (fig. 9L) especially in the lowest group. These setae have very elongate spinous tips, and the point is boldly curved.

In the 50th foot (fig. 9G, and text-fig. 5*d*) there is no marked change in the dorsal division. In the ventral division the upper anterior group of setae are all falcate hemigomphs. A few hemigomphs with short coarsely serrate pointed tips appear in the posterior row behind the spine.

In the 60th foot the two anterior lobes of the ventral division are smaller, and the setae are fewer in number. The falcate hemigomphs have disappeared and are not present in the succeeding feet. In the 80th foot the upper anterior lobe of the ventral division is reduced to a small papilla, scarcely visible. In the 90th foot it has quite disappeared.

In the 100th foot (fig. 9H, and text-fig. 5*e*) all the foot lobes are slender and sharply pointed.

In the last few segments the dorsal cirrus increases in length till it surpasses the dorsal lobe. The dorsal setigerous lobe becomes small and rudimentary. There appear to be no true heterogomph setae in this species, their place being taken by setae having the shafts ending in the intermediate condition which has been termed "hemigomph." There is no sharp distinction to be drawn between these various types, the falcate seta shown in fig. 9L being nearer the true heterogomph condition than the coarsely spinose seta shown in fig. 9K.

The anal segment is conical, the anus forming a terminal slit. The anal cirri are short and slender, a little shorter than the anterior ventral tentacular cirri. There is a ring of reddish brown pigment (or glands) round the middle of the anal segment.

In a number of the specimens, the body cavity was full of eggs, but no indication of change to the Heteronereis condition was observed. This species is characterised by the armature of the proboscis, the structure of the feet, and the shape and arrangement of the setae, especially by the absence of falcate setae from the anterior and posterior segments. The girdle of glands on each segment is also very characteristic. *Nereis kerguelensis*, McIntosh, has some points of resemblance to this species but is otherwise not closely related to it. Of greater interest is a comparison with *Nereis reducta* (p. 593). In both species the paragnaths of the basal ring are greatly reduced in size and number, so as to be almost rudimentary. The dorsal setigerous division in *N. glandicincta*, though small, is much more developed than that of *N. reducta*. In both species the dorsal and ventral cirri are short, but *N. glandicincta* has a prominent dorsal ligule, whilst that of *N. reducta* is small in the anterior and posterior segments. In *N. reducta* the spinous heterogomph setae are absent in the anterior segments, and only in small numbers elsewhere, whilst in *N. glandicincta* it is the falcate setae which are absent from the anterior and posterior segments. These resemblances indicate no close affinity, but are probably due to convergence. They are mostly of a negative character, and may be due to modification fitting for life in brackish or freshwater. It is significant that *Lycastis*, the genus found most frequently in fresh and brackish water, shows great simplicity in the structure of the foot, little variety in the shape of the setae, and has no paragnaths on the proboscis.

Habitat.—Twenty-six specimens were found in the four following localities :—

Salt lake, Barantolla near Calcutta. Netted in 5–6 feet.

Brackish pools near the Salt lake, Barantolla, November 1913.

From mud in a ditch containing brackish water, at the edge of a salt lake at Dhappa, near Calcutta, January 1911.

Burrowing in mud at Garia, Lower Bengal.

These localities are all within 10 miles of Calcutta. The specific gravity of the water in which the specimens were found is very variable but never high, probably never exceeding 1·015.

Nereis (Nereis) reducta, sp. nov.

(Plate XXI, figs. 7A–7K, and text-figs. 6*a–d*.)

Only a single specimen of this species was obtained, about one mile inside the mouth of the Chilka Lake. The body is 50 mm. long, and is composed of 96 setigerous segments. It is relatively narrow, and the ventral surface is grooved. The segments are three times as wide as long in the anterior region, but the length increases and the width decreases till they are less than twice as wide as long. The body does not taper very much towards the posterior end. The head and dorsal surface of the anterior segments are pale brown in colour ; the rest of the body is colourless.

The head (fig. 7A) is narrow in front, broad behind, and the length slightly exceeds the width. The eyes are small and distinct, with lenses. The palps are large and pointed. The tentacular cirri are rather short, the posterior dorsal pair being a little longer than the anterior dorsal.

The proboscis of the unique specimen is fortunately fully extruded (figs. 7A, 7B).

The paragnaths are distributed as follows :—

Group	I, A single large paragnath.	Group	V,	2 minute paragnaths.
,,	II, 6 paragnaths of varying size.	,,	VI,	
,,	III, 11 ,, ,, ,, ,,	,,	VII,	Numerous paragnaths in longitudinal rows.
,,	IV, 8–10 ,, ,, ,, ,,	,,	VIII,	

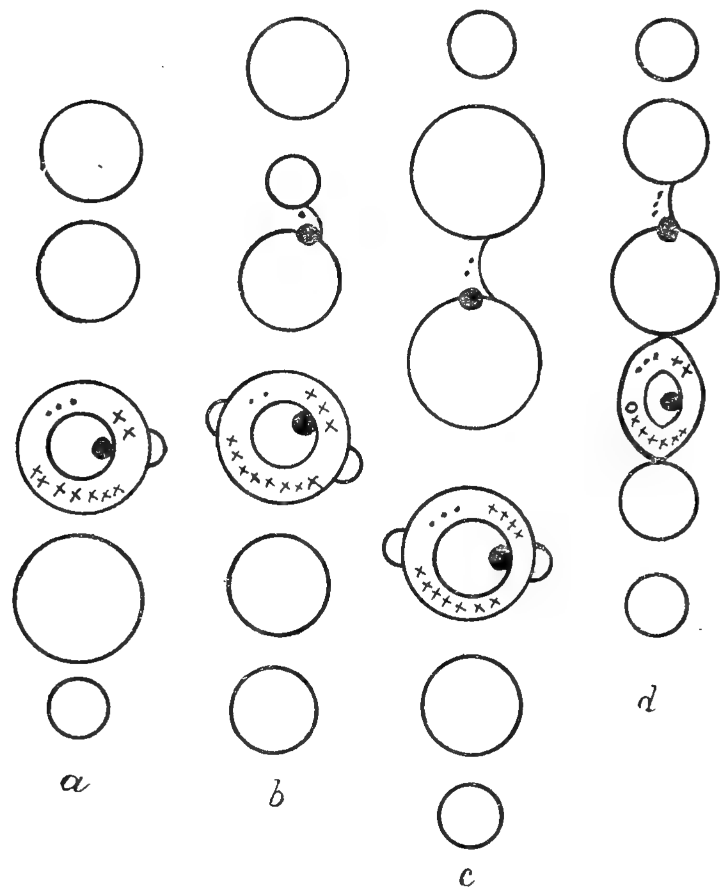
The paragnaths of the distal or maxillary segment are of the normal dark conical type (fig. 7C). Those of the basal segment are small, flattened, and circular, of a pale amber colour (fig. 7D). The dorsal group consists of two paragnaths close together in the median line, and may both be in Group V, or one each in Group VI. They are very minute, and easily overlooked. The ventral Groups VII and VIII occupy a large area, and are composed of numerous longitudinal rows, each containing 4–7 minute paragnaths.

The jaws are provided with 7 or 8 teeth.

The feet gradually increase in size up to the 6th.

The 1st foot (fig. 7E, and text-fig. 6*a*) as usual, is represented by the ventral division, the dorsal cirrus and a lobe between them. This latter lobe, as a consideration of figs. 7E, 7F, and 7G clearly shows, represents the median ligule. The dorsal and ventral cirri are rather short and finger-shaped, the median and lower ligules are still a little shorter and thicker. The ventral setigerous division consists of a stout central papilla, pierced at the tip by a spine, and surrounded by a stout fillet, which has an entire margin behind, but projects in front, forming a small lobe. The upper group of setae consist of 3 spinous homogomphs behind, and 2 falcate heterogomphs in front, the lower group of 7 falcate heterogomphs.

The 2nd foot closely resembles the 1st, except that the central papilla of the setigerous lobe is rather larger. In the 3rd foot (fig. 7F, and text-fig. 6*b*) the dorsal division appears. It consists of a small lobe, the rudiment of the dorsal ligule, and a small fillet in front of the spine, and a single spinous homogomph seta. In the ventral division the chief change is that the posterior margin of the fillet is produced into a papilla similar to but smaller than the one on the anterior margin. The setae are unchanged.



TEXT-FIG. 6.—Parapodial diagrams of *Nereis reducta*, sp. nov.

a. 1st foot. *b*. 3rd foot. *c*. 10th foot. *d*. 60th foot.

· = Homogomph setae with long tips ; x = Heterogomph setae with falcate tip ; o = Heterogomph setae with long tips.

In the 10th foot (fig. 7G, and text-fig. 6*c*) the normal condition is shown. The dorsal and ventral cirri are relatively much smaller, whilst the upper and median ligules are considerably enlarged, especially the former. The dorsal setigerous division contains two spinous homogomphs, the ventral division showing little change in the setae. The dorsal ligule gradually increases in size from the 3rd to about the 23rd foot, and attains a size equal to that of the median ligule.

The 30th foot is much the same. The papillae on the fillet of the ventral division are not so prominent, and the margin is more vertical. The dorsal ligule has now begun to decrease again slightly. In the upper posterior part of the lower ventral group of setae there is a single spinous heterogomph. In the 40th foot the dorsal ligule is still smaller, and in the 50th foot is just shorter but thicker than the dorsal cirrus.

In the 60th foot (fig. 7H, and text-fig. 6*d*) the dorsal cirrus, dorsal and ventral ligules are about equal in size, the ventral cirrus being smaller. The largest lobe is the median ligule. The dorsal division contains three spinous homogomphs. The ventral setigerous division is flattened from side to side, and the margins of the fillet are rounded, the papillae noted in the anterior segments having disappeared. The setae have the same arrangement, only a single spinous heterogomph being present. The remaining feet show no change, except that they decrease in size and the setae become fewer in number. The anal segment is button-shaped, with two very short anal cirri, only as long as the segment is wide. The anal segment and cirri are possibly regenerated, as the posterior feet are quite large.

The dorsal homogomphs are slenderer than any of the ventral setae (figs. 7J and 7K). The falcate setae have tips of medium size with spinous edges.

The most interesting characters of this species are those which exhibit a tendency towards degradation from the normal type. These are (1) the insignificance of the paragnaths on the basal segment of the proboscis. In this respect the species is approaching the condition found in the sub-genus *Ceratonereis*, Kinberg, in which the basal segment is devoid of paragnaths; (2) the insignificance of the dorsal setigerous division, indicated by the small number of dorsal setae, and the reduction in size of the dorsal ligule in the anterior and posterior segments; (3) the rarity of the spinous heterogomph setae, which only occur singly in the middle and posterior segments, and are absent from the anterior segments.

According to the classification of de Saint-Joseph (1898, p. 285), based on the structure and arrangement of the paragnaths, this species belongs to the sub-genus *Nereis* of the genus *Nereis*.

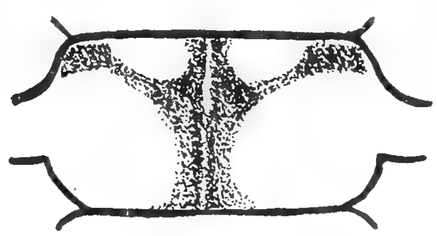
A point of considerable interest, clearly established in this species at any rate, is that the lobe beneath the dorsal cirrus in the 1st and 2nd feet represents the median ligule. A consideration of figs. 7E, 7F, and 7G leaves no room for doubt. The dorsal ligule appears in the 3rd foot as a small lobe.

Habitat.—Only a single specimen of this species was obtained, on the shore about one mile from the mouth of the Chilka Lake. It was taken in September, during the freshwater season, and the water was quite fresh.

Perinereis marjorii, sp. nov.

(Plate XXIII, figs. 10A–G, and text-figs. 7 and 8*a–c*.)

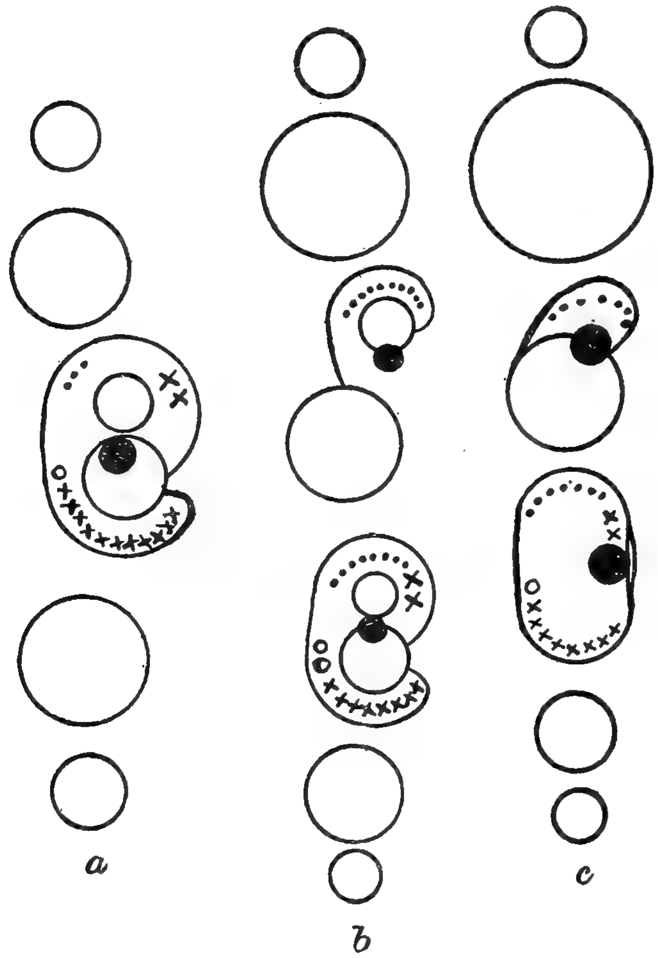
The largest of the 10 specimens of this species, from the Chilka Lake, is 61 mm. long, and has 80 setigerous segments. Another is 53 mm. long, with 76 setigerous segments. The body is long and slender, 2·5–2·75 mm. wide, including the parapodia at the widest part. The segments are very distinct, 2–3 times as wide as long, and the feet are comparatively short. The colour is pale purplish brown, and is strongest on the head and anterior dorsal region (fig. 10A). On the head there are three longitudinal bands of pigment, two of them marginal, and a shorter median one. Behind the latter, between the eyes, there is a V-shaped band. In the anterior region of the body there are three short transverse bars on the dorsum of each segment, the median being a little behind the other two, leaving a colourless patch in



TEXT-FIG. 7.—*Perinereis marjorii*, sp. nov. Dorsal view of a posterior segment, showing the colour-pattern.

front. From each of these bars a band passes to the posterior margin of the segment. In the middle and posterior regions the two lateral longitudinal bands disappear, but the median band remains very distinct (text-fig. 7). The ventral surface is colourless. The anal segment is short, cylindrical, and colourless, and the anus is terminal. There are two short tapering anal cirri equal in length to the last three segments.

The head (fig. 10A) is narrow in front, with an abruptly widening posterior part which bears the two pairs of dark eyes, each provided with a lens. The width of the posterior part exceeds the length of the head. The tentacles and palps are normal. The tentacular cirri are rather short, and of the usual relative proportions. All the paragnaths are large, well-formed, and dark in colour (figs. 10A, 10B). Group I consists of 5–12 teeth; Group II of curved bands each containing 18–22 teeth; Group III of 19 teeth; Group IV of 16–22 teeth; Group V of 3 large teeth curved backwards and arranged in a triangle; Group VI on each side of a single large semi-circular smooth tooth with the thin edge in front; Groups VII and VIII of a double row of fairly large teeth with oval bases, and approximately equal in size.



TEXT-FIG. 8—Parapodial diagrams of *Perinereis marjorii*, sp. nov.

a. 1st foot. *b.* 10th foot. *c.* 50th foot.

· = Homogomph setae with spinous tips; o = Heterogomph setae with spinous tips; x = Heterogomph setae with falcate tips.

The jaws are of the usual shape, and have 10–12 small teeth.

The feet increase in size up to the 5th.

The 1st foot (fig. 10C, and text-fig. 8*a*) has slender dorsal and ventral cirri. The upper lobe (median ligule ?) is clavate, shorter than the dorsal cirrus. Only the ventral setigerous division is present. It consists of two slender lobes, and the black spine lies in the upper part of the lower and longer one. Almost surrounding these lobes and the setae is a large and prominent fillet, its edges attached in front to the lower of the two lobes. The setae above the spine consist of 2 anterior falcate heterogomphs and 3 posterior long-tipped homogomphs. Below the spine is a single posterior long-tipped heterogomph and 10 inferior falcate heterogomphs.

The 2nd foot resembles the 1st, but in the 3rd foot the dorsal division appears.

In the 10th foot (fig. 10D, and text-fig. 8*b*) the dorsal cirrus is equal in length to the dorsal ligule, the latter being stout and conical. The dorsal setigerous lobe consists of a small papilla lying above the dorsal spine. From the front face of this papilla the fillet runs above and behind it, and is attached below to the median ligule. The setae are all long-tipped homogomphs. The median ligule is stout and rounded. The ventral division is very much as in the 1st foot. The ventral ligule is finger-shaped, and the ventral cirrus is small and slender. The long-tipped homogomphs and heterogomphs are of the usual type. The falcate heterogomphs (fig. 10G) have short terminal pieces, with smooth tips, and the spinous portion is short.

The 20th foot is very similar, except that the two lobes of the ventral division are much smaller. In the 30th foot the base of the dorsal ligule has begun to elongate, carrying out the dorsal cirrus with it. The median ligule is also a little longer. In the ventral division the lower of the two lobes is broad and thin, and forms an almost indistinguishable part of the setigerous fillet. The upper lobe is very much reduced. The two upper anterior setae in the ventral group of falcate heterogomphs are much stouter than the other setae.

In the succeeding feet these tendencies are accentuated. The dorsal division of the foot is greatly enlarged (figs. 10E, 10F). The papilla in the dorsal setigerous division disappears, but the fillet remains (text-fig. 8*c*), both edges being fused to the median ligule. In the ventral division the small upper lobe disappears, and the lower one completely fuses with the fillet.

In the 70th foot (fig. 10F) the dorsal division is very large and conical, with many glands. The dorsal and ventral setigerous lobes are represented only by the fillets. In the anterior part of the ventral division two of the falcate heterogomphs just above the spine, and one below it are much thicker than the rest. All the feet are very vascular.

This species has some points of resemblance to *N. variegata*, Grube (*Paranereis elegans*, Kinberg, 1910, p. 53), Ehlers (1901, p. 112), especially in the colour pattern, but differs in the arrangement of the paragnaths, the length of the dorsal cirri and other foot lobes, etc. In the shape of the feet, especially in the position of the dorsal cirri, it is more closely related to *Pseudonereis novae-hollandiae*, Kinberg (1910, p. 52), from Port Jackson, Australia, but differs from the latter in having much shorter dorsal cirri and in the paragnaths of Groups I and V. From *N. camiguina*, Grube (1878, p. 87), it differs in the shape of the head, length of the tentacular cirri, colour pattern, etc.

Habitat.—Ten specimens of this species were found, living in burrows or crevices in oyster shells, at Manikpatna in the outer channel of the Chilka Lake. They were taken in September, during the freshwater season, when the water in the outer channel was quite fresh. From the nature of the habitat, it is probable that the species lives there throughout the year.

Dendronereis aestuarina, sp. nov.

(Plate XX, figs. 4A–N, and text-figs. 9*a–h*.)

Nineteen specimens of this species were obtained in brackish water in the Gangetic delta, in very good condition.

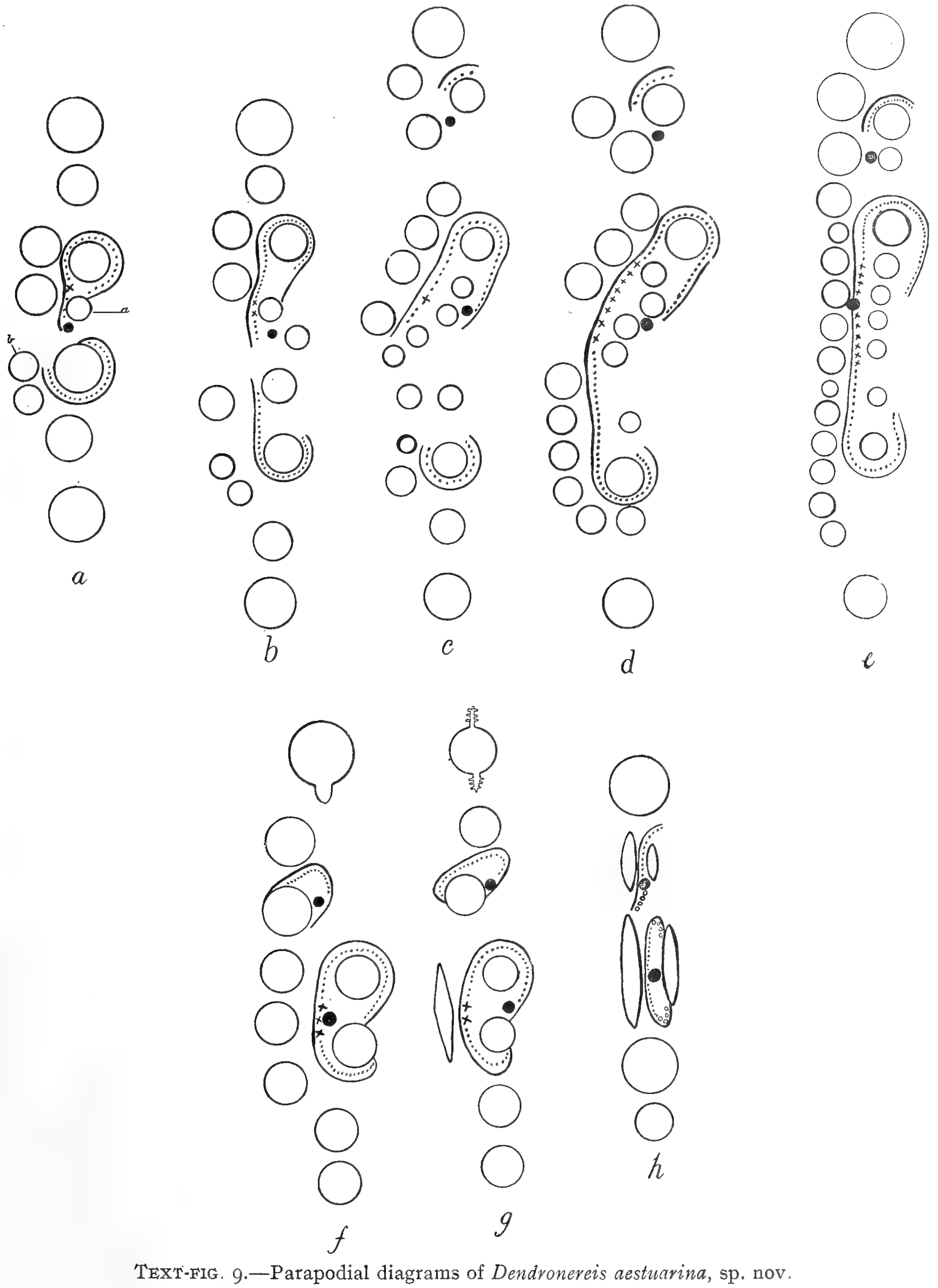
The type specimen is 160 mm. long, and consists of 160 setigerous segments. It is a female, full of immature ova. In life the body is reddish brown, the colour being probably due to the blood, and the gills and dorsal vessel are bright red. The body in front of the gills is much darker, and appears to be coloured with brown pigment.[1] The preserved specimens are colourless. On the ventral surface of segments 3—13, in the median line, there is in all specimens a definite pattern of grooves (fig. 4C).

The head (fig. 4A) is deeply indented in front, where it bears two small tentacles. The posterior part is short and wide, with rounded corners. It bears two pairs of large eyes, the pair on each side being close together. In front the head is prolonged into the two large conical palps. The peristomium bears four pairs of tentacular cirri, with large jointed ceratophores. The posterior dorsal pair are much the longest, and when laid backwards they reach to the end of the 9th setigerous segment. They are nearly three times as long as the posterior ventral pair, and $2\frac{1}{2}$ times as long as the anterior dorsal pair, whilst the latter are nearly twice as long as the anterior ventral pair.

The proboscis (figs. 4A, 4B) is not armed with horny paragnaths, but on the anterior border of the basal segment it carries a number of papillae. Of these the two largest are near the median dorsal line. On the ventro-lateral region there are two on each side, and there are three smaller ones in the median ventral area. The papillae are pear-shaped or fusiform. The whole of the basal segment is covered with low rounded papillae, but these are probably produced by the contraction of the proboscis in the preservative, and have no relation to the papillae on the anterior margin. The maxillary segment is devoid of papillae. The jaws have 14–17 teeth, 2 or 3 at each end of the row being indistinct.

The branchiae commence on the 15th foot (fig. 4F). Each branchia consists essentially of the greatly enlarged, flattened, and branched base of the dorsal cirrus. The dorsal cirrus itself is, as usual, a simple lobe, attached to the tip of the enlarged base. Two large blood-vessels traverse the main stem, giving off or receiving numerous branches which divide several times, and penetrate the filaments. Apart from the vessels in the filaments, there are numerous capillaries in the walls of the main stem of the branchia. In the 1st branchia (fig. 4F) there are 8 clavate lobes on the outer edge of the main stem. They are slightly contracted at the base, and diminish in size towards the tip of the stem. The 2nd pair of branchiae resemble the 1st pair. The 3rd pair, on the 17th feet (fig. 4G), have each 10 filaments, and indications of another row on the outer side of the stem. The 4th pair, on the 18th feet, show the complete development of the branchiae (fig. 4H). The main stem is almost

[1] This description is from a coloured figure, drawn from a living specimen, by A. Chowdhary.



TEXT-FIG. 9.—Parapodial diagrams of *Dendronereis aestuarina*, sp. nov.

a. 1st foot (lobes *a* and *b* sometimes absent); *b.* 2nd foot; *c.* 3rd foot; *d.* 4th foot; *e.* 10th foot; *f.* 15th foot; *g.* 22nd foot; *h.* 70th foot.

· = Homogomph setae with long smooth tips; × = Homogomph setae with coarsely serrated tips; o = Homogomph setae with thick shafts and short tips.

completely occupied by the two blood-vessels. There are 13 pairs of branches, each bearing a double row of slender filaments which are nearly as long as the branches. The slender dorsal cirrus is carried at the tip of the stem. The 5th, 6th and 7th pairs are similar, with 14 pairs of branches. The 8th and last pair, on the 22nd feet, are much smaller, with 9 or 10 pairs of branches. The base of the dorsal cirrus of the 23rd foot is short, simple, and slender.

In the anterior region of the body the feet differ so much that it is necessary to examine them all carefully. The first foot (fig. 4D, and text-fig. 9*a*) consists only of the dorsal cirrus with a lobe beneath it, which is either the dorsal or the median ligule, and the ventral setigerous division. The dorsal cirrus, seated on a jointed base, is long and tapering. The ventral division is composed of 6 or 8 lobes and the ventral cirrus. The setae are in two groups, each guarded by a fillet, the single spine lying between the groups. They are all homogomph setae (fig. 4L), with long minutely serrate or smooth terminal pieces. A single seta in the posterior row of the upper group differs from the rest in having a shorter terminal piece with long stout teeth (fig. 4M). The arrangement of the lobes and setae is shown in text-fig. 9*a*. Sometimes the lobe *b* is absent, sometimes *a* and *b*. The foot is very vascular, blood-vessels passing into each lobe. The 2nd foot (text-fig. 9*b*) resembles the 1st, but it has 11 lobes in addition to the ventral cirrus in the ventral division, and two setae with coarsely serrate terminal pieces. The lowest ventral setae, as in all other segments, have shorter terminal pieces than those in the upper part of the foot.

In the 3rd foot (text-fig. 9*c*) the dorsal setigerous division appears. It consists in addition to the dorsal cirrus and dorsal ligule, of two other lobes, the posterior one being the median ligule, between which lies the spine. Above and behind the anterior lobe is a group of a few slender homogomphs like those in the ventral division, guarded externally by a fillet. The ventral division consists of 15 lobes, in addition to the ventral cirrus.

The 4th foot is very similar (text-fig. 9*d*), especially the dorsal division. In the ventral division the setae now form a continuous series, guarded externally by a fillet. There are 16 lobes in the ventral division, of which 9 are behind, and 7 in front of the setae. The coarsely serrate setae are more numerous. The base of the dorsal cirrus shows signs of flattening.

The 5th foot is similar to the 4th, with more numerous setae. The 10th foot (fig. 4E, and text-fig. 9*e*) shows still greater complexity. The base of the dorsal cirrus is large and flattened. In the dorsal division the setae are more numerous, and an additional small lobe lies in front of the spine. The ventral division has 18 or 19 lobes, of which 12 form a fringe behind the setae, whilst the anterior 6 or 7 lobes are almost surrounded by the setigerous fillet. The upper posterior lobe of the ventral division is flattened at the base and pointed distally. The 11th–14th feet are similar.

At the 15th foot (fig. 4F, and text-fig. 9*f*), which carries the first branchia, there is a marked change. The dorsal division is reduced to the two posterior lobes, the upper one corresponding to the dorsal ligule of the anterior feet, the lower one to the median ligule. The setae lie above and in front of the median ligule, to which the edges of the setigerous fillet are attached. The ventral division consists of two anterior lobes, almost surrounded by the fillet, three posterior lobes, the ventral ligule beneath the setae, and the ventral cirrus. The coarsely serrate setae are few in number.

In the 16th foot one of the posterior ventral lobes has disappeared. The 17th and 18th feet (fig. 4H) are similar. The two posterior lobes of the ventral division are flattened at the base, and the spine terminates in a small papilla. In the 19th and 20th feet (fig. 4J) the upper anterior lobe of the ventral division has a small papilla beneath it, which disappears in the 21st foot. The posterior lobes are still more foliate. In the 21st foot the lower posterior lobe is almost entirely fused with the upper one.

In the 22nd foot (text-fig. 9*g*) the two lobes of the dorsal division show signs of flattening. In the ventral division, the two posterior lobes have fused to form a single foliate lobe.

In the 23rd–40th feet (fig. 4K) the two dorsal lobes gradually grow thin and foliate, and the lower one assumes an anterior position. In the ventral division the upper anterior lobe is gradually reduced to a small papilla, and finally disappears, the ventral division then consisting of two foliate lobes, one on each side of the setae, a conical lobe between them, the ventral ligule and the ventral cirrus.

Between the 50th and 60th feet a new type of homogomph seta appears (fig. 4N). It is stouter than the others, and the terminal piece is short and smooth, tapering rapidly to a very slender tip. It occurs in the lower part of the dorsal division, and in the upper anterior part of the ventral division. There is no sharp distinction between these setae and the normal homogomphs, intermediate forms occurring both in shape and position. In the 70th foot (text-fig. 9*h*) these thick setae occur also on the lower anterior end of the ventral division. None of the coarsely serrated homogomphs were observed after the 35th foot. In the posterior feet the setae become fewer in number, the lobes of the feet greatly reduced, and the whole foot decreases in size. The tips of the shafts of the setae are more swollen than those of the anterior segments.

The anal segment bears two slender anal cirri, equal in length to the last six segments.

Members of this genus have rarely been found, and only two species have been described. The first of these *Dendronereis arborifera*, Peters, from the coast of Mozambique differs conspicuously in the structure of the branchiae, the main stem of which carries only simple branches. The second species, *D. pinnaticirris*, Grube (1878, p. 92), from the Philippines, agrees with the present species in the structure of the branchiae. It differs, however, according to Grube, in having no papillae on the proboscis, and in having only 6 teeth on the jaws, as compared with 14–17 in the present species. In *D. pinnaticirris*, the branchiae begin on the 12th or 13th segments, and there are 10–12 pairs of branchiae. In *D. aestuarina* they begin on the 15th foot, and there are only 8 pairs. In *D. pinnaticirris* all the branchiae appear to have two rows of compound branches, whilst in *D. aestuarina* the three anterior pairs have only a single row of simple branches. The fully formed branchia of *D. aestuarina* has more branches than that of *D. pinnaticirris.* The anterior feet of the present species have many more lobes than those of *D. pinnaticirris,* but the brief description and figures given by Grube do not permit a close comparison as regards the structure of the feet. A re-examination of *D. pinnaticirris* would doubtless show other important differences.

Only a single specimen of *D. arborifera* has ever been examined, and according to Ehlers (1864–68, p. 581) the proboscis is retracted, and has no paragnaths. It is possible, however, that papillae may have been overlooked on the retracted proboscis, as they are often difficult to observe in this condition. In *D. pinnaticirris,* according to Grube, there are neither paragnaths nor papillae on the proboscis. Their presence then, in *D. aestuarina,* was rather a surprise, and I still think it possible that they have been overlooked in the other two species of the genus.

Habitat.—19 specimens of this species were collected on the 27th of November, 1911, by Mr. S. G. Platts in the Sunderbans, a district in the Gangetic Delta, and sent by him to the Indian Museum. In a letter accompanying the specimens he gave the following information :—"The Polychaetous worms I sent you this morning were found by me in a small pool of brackish water inside the protective embankment of a clearance fairly high up the Munda river. There were hundreds swimming round and round three or four vortices, and it looked as if they were coming up from the ground at these points. A few minnows were hovering about. These used to occasionally pull down a worm, but the fish were either not strong enough to swallow the worms, or the worms were not relished, since they were invariably let go."

The water in which the worms were despatched was analysed by Mr. David Hooper, who reported as follows :—

"The sample of brackish water you left with me yesterday contains 833 parts of solid matter and 376·3 parts of chlorine per 100,000 parts. This approximately represents a mixture of three parts of fresh water with one of sea water."

The two species of *Dendronereis* previously described were found in sea-water, so that the occurrence of the present species in water almost fresh is of considerable interest. The three known species live on or near the shores of the Pacific and Indian Oceans, and the genus is not known elsewhere.

Genus **Dendronereides**, gen. nov.

The following will serve as a preliminary diagnosis of the genus, until additional species are known :—*Proboscis armed only with soft paragnaths. Dorsal setigerous lobe absent in first and second feet. In some of the anterior feet, branchiae are present, in the form of numerous filaments situated below the dorsal cirrus. They are not provided with blood-vessels. Setae of two kinds, falcate homogomphs, and spinose homogomphs. In all feet except a few anterior ones there is a peculiar gland opening to the exterior beneath the dorsal cirrus. The ventral ligule is absent. In the post-branchial region the foot is greatly simplified.*

The presence of parapodial branchiae in this genus at once suggests relationship to *Dendronereis*. The obvious distinction that the branchiae of *Dendronereis* are formed by modification of the dorsal cirrus, whilst those of *Dendronereides* lie beneath and do not involve the dorsal cirrus, is not so decisive as it appears at first. I have shown above that the branchiae of *Dendronereis* are attached to the *base* of the dorsal cirrus, the latter structure remaining unchanged, at the tip of the swollen base. If figs. 6E, 6H, are examined, it will be seen that the branchiae of *Dendronereides* also are attached to the base of the dorsal cirrus, though in this case the base is not elongate, and the area of attachment is condensed. A more important distinction between the two genera lies in the fact that the branchiae of *Dendronereis* are supplied with an elaborate system of blood-vessels, whilst those of *Dendronereides* are apparently not. In both genera the gills are concentrated on the anterior part of the body. These resemblances, however, may be due to convergence. It is remarkable, however, that in both genera there is great simplification of the foot behind the branchial region, and an unusually large number of foot-lobes in the anterior segments. In both genera the proboscis is provided with soft papillae, and devoid of horny paragnaths. In both genera also, heterogomph setae are absent, and a number of the spinose setae have very long slender teeth.

This genus also shows rather more distant affinities with *Tylonereis*, *Ceratocephala*, and *Tylorrhynchus*.

Dendronereides heteropoda, sp. nov.

(Plate XXI, figs. 6A—N, and text-figs. 10*a*–*f*.)

Nine specimens of this species are available. They are all immature, with new segments in process of formation in the posterior region. The type specimen is 66 mm. long, and consists of 140 segments. The body is long and slender, and attains its greatest width at the 8th setigerous segment. Dorsally the anterior margin of each segment is distinctly concave. The anterior segments are two or three times as wide as long. Further back, the length of the segments increases till it exceeds the width, but in the posterior region the segments become short again.

The anal segment is large and button-shaped, and the anus is terminal. The two short anal cirri are ventro-lateral in position, and taper to filiform tips.

The head, palps, tentacular cirri, and anterior dorsal region of the body are rusty red in colour, the pigment being most marked on the head. In some of the specimens the colour is quite gone, except for the three dark patches on the head.

The head (fig. 6A) is relatively very small, and the width greatly exceeds the length. In front it is deeply bilobed, with the small tentacles at the tips of the lobes. The eyes are rather small in the specimen figured, and are larger in other individuals. They are placed near the postero-lateral angles of the head, and the anterior pair are more widely separated than the posterior pair. The palps are short, stout, and contracted. At the back of the head, in the median dorsal line, is a narrow transverse band of deep reddish brown pigment. At the base of each tentacle there is a more diffuse patch of the same colour. The bases of the palps, and the ventral surface of the head and body are colourless. The posterior dorsa tentacular cirri are stout at the base, and are twice as long as the anterior dorsal pair, three or four times as long as the posterior ventral pair.

The proboscis is only partially protruded in one specimen, showing the basal or oral ring (fig. 6B). In the dorsal region there is a group of 7 papillae; 3 median of which the largest is in front, the smallest behind; and lateral groups of 2 papillae on each side. These papillae may represent groups V and VI, or group V only. The three anterior papillae are seated on large hemispherical bases. Ventrally and laterally, in groups VII and VIII, there is a ring of papillae in two rows, 9 in each row, those in the anterior row being the largest and the lateral ones larger than the ventral. The distal, or maxillary ring had to be dissected, and as the proboscis is small, and the papillae soft, inconspicuous and crushed, their numbers and arrangement can only be stated approximately. Group I consists of about 12 papillae of different sizes, II of a small number of larger and more conical papillae. Ventrally are indistinct groups of very large conical papillae, which may represent two groups on IV, or possibly three groups on III and IV.

The jaws are of a pale amber colour, with numerous small teeth, 18–20 in number in one specimen, only 10 in another.

In the 1st and 2nd pairs of feet, the dorsal setigerous division is represented only by the dorsal cirrus.

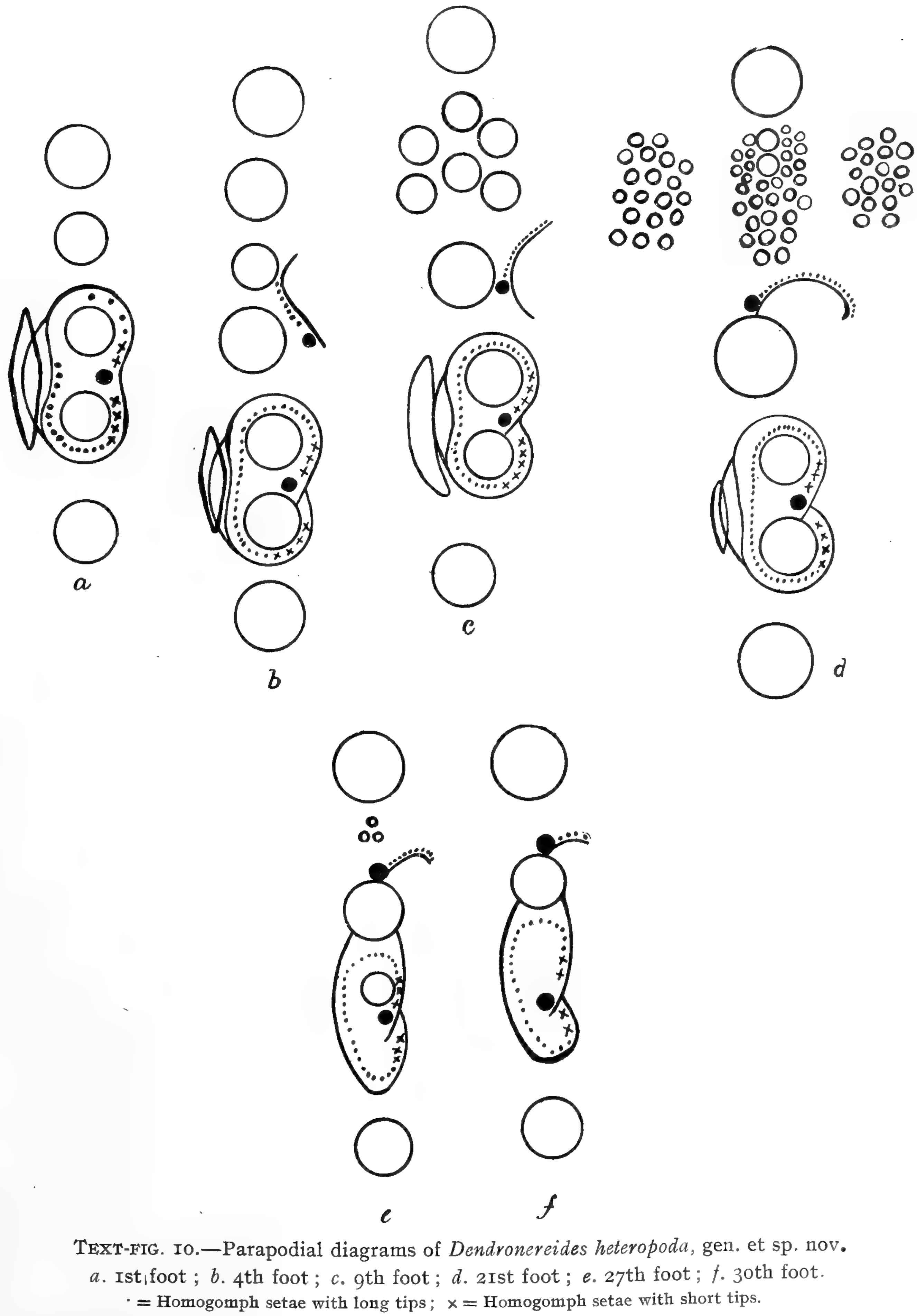
Above the ventral setigerous region (fig. 6C, and text-fig. 10*a*) is a clavate lobe representing either the dorsal or the median ligule. The dorsal and ventral cirri are short, stout, and conical. In the ventral setigerous division there are three lobes, two slender ones in front, and a posterior foliate lobe. The setigerous fillet curves right round the two anterior lobes, projecting outwards to form the posterior lobe behind, and a small papilla in front, pierced by the black spine. Two kinds of setae are present, both having homogomph shafts. At the front of the foot are two small groups of setae, above and below the spine, with short smooth terminal pieces (fig. 6M), rounded at the tip. The remaining setae have relatively long tapering terminal pieces with very long slender teeth on the lower half (fig. 6L). In the 2nd foot the upper ligule is nearly as large as the dorsal cirrus, and the line of setae is continuous behind the anterior lobes.

In the 3rd foot the dorsal setigerous lobe appears. Between the dorsal cirrus and the ventral setigerous lobe are the dorsal and median ligules, and a setigerous fillet lying in front of and just above the median ligule. There are three homogomph setae, having slender terminal pieces with long serrations, as in the ventral division. The spine lies beneath the setae.

In the 4th foot (fig. 6D, and text-fig. 10*b*) the dorsal division has now two lobes between the dorsal cirrus and the median ligule, and the setae are more numerous.

In the 5th and 6th feet there are three of these dorsal lobes, four in the 7th foot, five in the 8th foot.

In the 9th foot (fig. 6E, and text-fig. 10*c*) there are six dorsal lobes. The median ligule is now larger than the dorsal cirrus. The ventral division remains practi-



TEXT-FIG. 10.—Parapodial diagrams of *Dendronereides heteropoda*, gen. et sp. nov.
a. 1st foot ; *b*. 4th foot ; *c*. 9th foot ; *d*. 21st foot ; *e*. 27th foot ; *f*. 30th foot.
· = Homogomph setae with long tips ; × = Homogomph setae with short tips.

cally unchanged. The setae of the dorsal division have longer and more slender terminal pieces than those of the ventral division, and the serrations are not so long (figs. 6K, 6L). The falcate homogomphs are confined to the ventral division. In some of the long-tipped setae the shaft is quite homogomph, but in others it is produced into a point at one side (fig. 6N), the so-called 'hemigomph' condition.

The 11th foot has 8 lobes, the 12th has 9 lobes, in the dorsal division. In the ventral division the upper anterior lobe has increased, and the posterior lobe decreased in size relatively.

In the 13th foot the dorsal division has 11 lobes, in the 14th foot 21 lobes, in the 15th foot 28 lobes, and in the 16th foot 32 lobes. The number of these lobes or filaments reaches its maximum in the 21st foot, where there are about 65–70 (fig. 6F, and text-fig. 10*d*). They appear to be arranged in three groups, each group having a common stout stem, lying side by side. The median ligule is large, and the setigerous fillet of the dorsal division rises from its upper side, curves forwards and upwards, and is attached beneath the filaments. In the ventral division the posterior lobe is greatly reduced.

In the 23rd foot the lower anterior lobe of the ventral division has disappeared, and the upper one is small. The posterior lobe still has a pointed tip. The setae are much fewer in number, and there are about 55 filaments in the dorsal division.

In the 25th foot the dorsal filaments are much fewer in number, and appear to spring from four main stems. The ventral division is now without pointed lobes, and the setigerous fillet forms a broad rounded flap behind the setae, and a smaller one in front, the setae curving round the minute remnant of the upper anterior lobe, which is first visible in side view. The spines are only black near the tip, having grown gradually paler from the front backwards. In the 26th foot (fig. 6H) the filaments rise from four stems, the lower one being unbranched. In the 27th foot (text-fig. 10*e*) there are only three filaments rising from a single stem. The ventral division consists of two fillets attached to the median ligule. The remnant of the anterior upper lobe, round which the setae form a circle, is very small, and is not visible in side view.

In the 28th and 29th feet there is only a simple short filament beneath the dorsal cirrus, and in the 30th foot this also has disappeared (fig. 6J, and text-fig. 10*f*). The lobe inside the ventral setae has also vanished. In the middle and posterior parts of the body the foot does not change much in shape, but gradually grows smaller, the setae become fewer in number, and the median lobe and setigerous fillets smaller and more indistinct.

The falcate homogomph setae, with smooth terminal pieces (fig. 6M), are regularly present in the ventral divisions of the anterior 25 feet or so. They then become fewer in number, and are frequently absent in many adjacent feet. They were noted, however, in the 70th and 80th feet. The ventral and spinose setae have, as a rule, shorter terminal pieces with longer serrations, than those of the dorsal division (figs. 6K, 6L), but both kinds frequently occur in the ventral division.

It can hardly be doubted that the dorsal filaments of the anterior feet have a respiratory function. They are not, however, supplied with blood-vessels as in *Dendronereis.* The filaments have an ill-defined central lumen (fig. 6G). Morphologically they appear to represent the proliferation of the dorsal ligule.

A remarkable glandular organ occurs in most of the feet. They first appear in the 14th setigerous segment, and continue to the end of the body. This distribution shows that they have no functional connection with the branchial filaments. At first they are small, but they rapidly increase in size. They lie in the upper part of the foot, and open to the exterior just beneath the dorsal cirri. Their usual shape and position is shown in figs. 6F, 6H, and 6J. Each consists of a number of elongate cells with granular contents, the whole being surrounded by a thick muscular coat. There is no common duct to the gland, and all the elongate cells apparently open to the exterior through the thickened lip of the gland. In the middle and posterior segments the gland decreases considerably in size, and consists only of a few elongate cells with a very thin muscular coat. In the segments where the glands occur, the nephridia are very large, with many black granules in the duct cells. The nephridia occupy most of the cavity of each foot, and are closely surrounded by branched blood-vessels.

In many respects this species is one of the most aberrant of the Nereids. The parapodia are very heterodox in structure, and it is difficult to homologise the various lobes. One of the most remarkable features is the presence of only a single lobe beneath the ventral setae. This may be either the ventral ligule or the ventral cirrus. As the latter is a much more constant structure than the former, it is highly probable that this lobe is the ventral cirrus, and that the ventral ligule is absent. As already mentioned, the dorsal lobe in the 1st and 2nd feet may be either the dorsal or median ligule. In all the other feet the median ligule is present. The dorsal ligule is absent at least after the 29th foot.

Habitat.—In brackish pools, salt lakes, Barantolla, near Calcutta. The salinity is very variable, but never high, probably never exceeding sp. gr. 1.015 at 25°C. The specimens were collected in November.

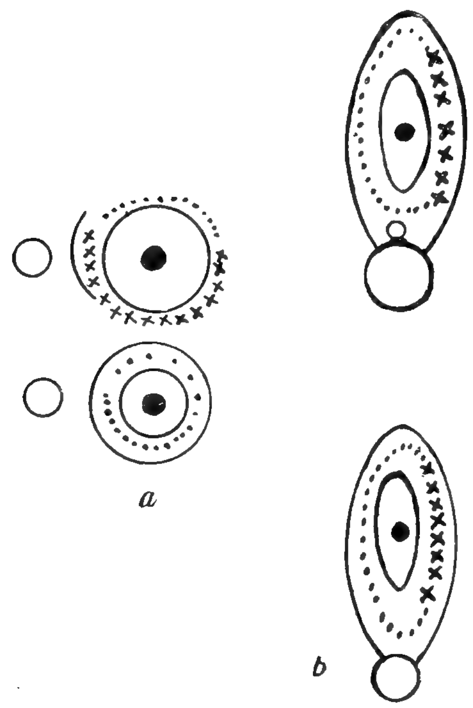
Family NEPHTHYDIDAE.

Nephthys polybranchia, sp. nov.

(Plate XXIV, figs. 11A–G, and text-figs. 11*a*–*b*.)

Twelve specimens of this species were taken in Chilka Lake. They were all approaching maturity, full either of ova or sperm. One specimen was 22 mm. long, and had 52 setigerous segments. Another was 19 mm. long, with 50 setigerous segments. No trace of colour remains in the specimens. The body is widest near the anterior end and tapers gradually towards the tail.

The head (fig. 11A) is rather elongate, with parallel sides. The dorsal tentacles are at the anterior angles, and the ventral pair are a little further behind on the lower surface of the head. At the posterior dorsal angles of the head are two small rounded papillae. The brain is clearly visible behind the head. It is bilobed, and on its upper surface lie two small but distinct black eyes. No individual had the proboscis extruded, and so far as could be ascertained by dissection there are 20–22 rows of papillae, 4 in each row. There is no specially large one in the mid-dorsal line, but in the two median rows the anterior papilla is a little in front of the other rows, although only of the same size. This point needs to be verified with better material than was available.



TEXT-FIG. 11.—Parapodial diagrams of *Nephthys polybranchia*, sp. nov.
a. 1st foot ; *b*. 10th foot.
· = slender capillary setae ; × = camerated setae.

The 1st foot (figs. 11A, 11B, and text-fig. 11*a*) projects obliquely or directly to the front, and does not attain the anterior border of the head. It has well-marked dorsal and ventral divisions, with spines, but the lamellae are minute and the branchiae are absent. On the posterior face of each division there is a small cirrus. The dorsal division is conical. Above the spine there is a group of long slender capillary setae, with smooth or minutely serrated flattened blades. Below the spine is a group of camerated setae. There is a minute posterior lamella. The ventral division is truncated at the tip. The spine pierces a conical papilla, which is completely surrounded by the setigerous fillet or lamella. Emerging between the papilla and the fillet is a ring of long smooth capillary setae. No camerated setae are present in the ventral division.

The peculiar nature of the 1st foot may perhaps be explained by regarding it as composed of two imperfect feet. If the text-fig. 11*a* is turned round till the cirri are ventral in position, the resemblance of each division to a single division of a typical foot (text-fig. 11*b*) will be at once apparent. The ventral division, which does in fact lie somewhat in front of the dorsal division, would represent the 1st foot, armed only with capillary setae, whilst the dorsal division would be the 2nd foot, with an anterior row of camerated setae and a posterior row of capillary setae. The two cirri would correspond to the ventral cirri. The papillae at the posterior dorsal angles of the head may be the reduced dorsal divisions of the 2nd pair of feet. On this hypothesis the two anterior feet would be represented only by the ventral division of the typical foot, as in *Nereis*.

In the 2nd foot (fig. 11C) the dorsal and ventral divisions are widely separated from each other, and the various lamellae of the normal foot are present, though still very small. There is a small ventral cirrus, and camerated setae are present in both divisions. At the ventral side of the dorsal division there is a small lobe (fig. 11C, a), which appears to be the rudiment of the branchia.

In the 3rd foot the lamellae are more prominent, the branchia is rather larger, and there is a slight indication of the dorsal cirrus. The anterior row of setae in the ventral division are mostly barred, but a few smooth setae occur at the upper and lower ends of the row. The setae are now in two rows, before and behind the spines, not above and below them as in the 1st and 2nd pairs of feet. The 4th foot is very similar, but a distinct change occurs in the 5th foot, which is almost normal. The branchia is large and thick, with a small cirrus on its upper basal portion. The normal condition of the anterior feet is shown in fig. 11D (also text-fig. 11*b*) of the 10th foot. The spines, which are ringed at the tip, terminate in each division at the tip of a conical papilla, which is surrounded by a ring of setae. The setae in front are of the usual camerated type, rather short and stout. The posterior setae are very long and slender capillary setae, with slightly flattened blades very finely serrated along one edge (fig. 11F). They are more numerous than the camerated kind, and tend to invade the front row at the upper and lower ends of the bundles. Surrounding the setae is a fillet which, in both divisions, projects a little beyond the spine on the posterior side of the foot, but not on the anterior side. In the dorsal division the lower ends of the fillet are attached to the branchia, in the ventral division to the ventral cirrus. The dorsal cirrus is small but distinct. The vascular system of the foot consists of a vessel which traverses the branchia as a single loop (fig. 11D). On emerging, it divides, and the smaller branch runs down to the ventral division. It then curves back and terminates in a flask-shaped ampulla.

In fully grown specimens the barred setae are found only in the anterior 16 feet, whilst smaller specimens may have them in 12–15 feet. They are then replaced by smooth capillary setae (fig. 11G), which are smaller than those in the posterior row. The blade widens rather suddenly, and then tapers to a fine tip. The 20th and 30th feet (fig. 11E) are very similar, except that the anterior dorsal lobe of the fillet is rather larger, the posterior lobes are smaller, and the branchia is relatively very large. In the posterior feet the fillets are small, and are considerably surpassed by the spinal lobes. At the 45th foot the branchia suddenly becomes small, and is absent on the succeeding 7 posterior segments.

The anus is terminal, and there is a single short tapering anal cirrus.

This species is characterised by the structure of the proboscis, the shape of the head, and by the condition of the feet. As regards the latter, the most important characters are the size and shape of the lamellae ; the restriction of the camerated setae to the anterior feet, and their replacement in the middle and posterior feet by peculiar capillary setae ; the distribution of the branchiae, and the presence in them of only a single vascular loop.

Habitat.—The 12 specimens, all mature or approaching maturity, were taken at 4 stations, all in the south-west end of the lake between Rambha and Nalbano, the shore being mud or sandy mud. Two of the stations were worked in February, the salt-water season, and two in September and November, the freshwater season, but in this part of the lake the specific gravity only ranges from 1·001–1·0115.

Nephthys oligobranchia, sp. nov.

(Plate XXIV, figs. 12A–12C.)

This species is unique in the collection, insomuch as it is represented by specimens from the Chilka Lake and also from another locality, viz. the Cochin Backwater, near Ernakulam, in the south-west of the Madras Presidency.

The superficial resemblance of this species to *Nephthys polybranchia* is so strong that at first it was regarded as a mere variety of that species, but a closer examination revealed such striking differences as to indicate that the two forms are not closely related. The description will be confined to these points of difference. A mature male specimen was 17 mm. long, consisting of 51 setigerous segments. Another had 47 setigerous segments.

The head (fig. 12A) is rectangular, and the length slightly exceeds the width. At the posterior dorsal angles are two small rounded papillae. The brain is rounded behind, with a deep posterior indentation, and carries two small black eyes. The front margin is almost straight. The head in fig. 12A is distorted and widened, owing to the protrusion of the pharynx. The latter organ has in the distal region, 14 rows of papillae, 3–5 in a row. In the anterior dorsal line there is a conspicuously long median papilla, but no corresponding ventral papilla. The mouth is surrounded by 16 bifid papillae.

In small specimens the 1st pair of feet are directed forwards, alongside the head, which they slightly surpass, but in adults they point obliquely outwards, and do not reach the front of the head.

This species differs only slightly from *N. polybranchia* as regards the shape and arrangement of the setae. Camerated setae are as a rule confined to the anterior 13–15 pairs of feet, but in one specimen they persisted as far as the 18th feet. The setae which replace them subsequently in the anterior rows, differ slightly from those of *N. polybranchia,* the blade being narrower and more uniform in width.

There is a marked difference between the two forms in the structure of the feet. The first fully formed branchia is on the 6th foot, that on the 5th foot being very small. They cease abruptly on the 20th–23rd foot, and are quite absent from the feet of the middle and posterior regions of the body. Thus in a specimen having 47 setigerous segments, branchiae are present on 17 pairs of feet only, the 6th to the 22nd, and one specimen with 51 setigerous segments has 30 posterior abranchiate pairs of feet.

A typical branchiate foot, the 10th, is shown in front view in fig. 12B. The posterior lamellae are very small and are surpassed by the spinal lobes, so that in front view they are not visible. The anterior lamellae resemble those of *N. polybranchia,* and the ventral cirrus is equally small. The dorsal cirrus is very insignificant, being represented only by a small lobe on the upper side of the base of the branchia.

The vascular system of the foot differs from that of the preceding species. The vessel which penetrates the branchia, after emerging, sometimes for a considerable distance, returns and traverses the branchia again, so that there appear to be four vessels in the branchia. The branch to the ventral division of the foot terminates as in the preceding species in a rounded ampulla. In a few of the anterior feet, branchiae containing only a single loop were occasionally noted, but a double loop is the normal condition. The presence of two loops in the branchiae of this species may be correlated with the relatively small number of branchiae.

One of the abranchiate feet is shown in fig. 12C. In the posterior region of the body the feet are large and deeply bilobed, the lobes being large, conical, and widely divergent, giving a characteristic appearance to these specimens.

The anus is terminal, and there is a single anal cirrus. Mature specimens, containing ova and sperm, were taken in January, February, March and September, in both the fresh and salt-water seasons.

This species differs from *N. polybranchia* (1) in having 14 rows of papillae on the proboscis, as compared with 22 ; (2) in having a long anterior unpaired papilla on the median dorsal line of the proboscis ; (3) in the distribution of the branchiae, which occur fully developed on the 6th foot, and disappear on the 20th to the 23rd foot, whereas in *N. polybranchia*, the branchiae are large on the 5th foot, and persist almost to the end of the body ; (4) in that the branchiae contain a double vascular loop, whereas there is only a single loop in *N. polybranchia* ; (5) in that the posterior lamellae of the feet are considerably surpassed by the spinal lobes.

Habitat.—18 specimens were collected in the Cochin Backwater, near Ernakulam, in the south-west of the Madras Presidency. The salinity of the water is probably very variable in this locality, but precise information is not available.

In the Chilka Lake this species was taken at ten stations, all in the south-west end of the lake, between Rambha and Nalbano.

The species was apparently taken usually on a muddy bottom, both on the shore, and dredged down to 15 feet. Eight stations were worked during the salt-water season, and two during the freshwater season, but the gravity of the water in this part of the lake only varies between the limits of 1·0015 and 1·0115.

Family EUNICIDAE.

Diopatra variabilis, sp. nov.

(Plate XXV, figs. 14A–14R, and text-figs. 12*a–e*.)

Of this species there are fragments, more or less complete, of seven large specimens, all from the same station in Rambha Bay, and twenty-two small specimens from various parts of the lake. The nature of the habitat, and the relation between the large and small specimens, will be discussed below, when the large individuals have been described.

The largest (type) specimen, in three fragments, is 312 mm. long, composed of 451 segments. There is a short gap, probably consisting of about 20–30 segments, between the first and second fragments, as is shown by the condition of the branchiae, and a few posterior segments are missing, so that the animal originally had probably about

480 segments. The greatest width of the body, not including the feet, is 4–5 mm.

The whole body is suffused with iridescent purplish green, especially marked in the anterior region. The basal parts of the various appendages of the head are deeply coloured. In several specimens the anterior part of the body (10–14 segments) is paler in colour than it is further behind, especially the branchiae. This may be due to regeneration of the anterior end. The body is round in front, somewhat flattened behind.

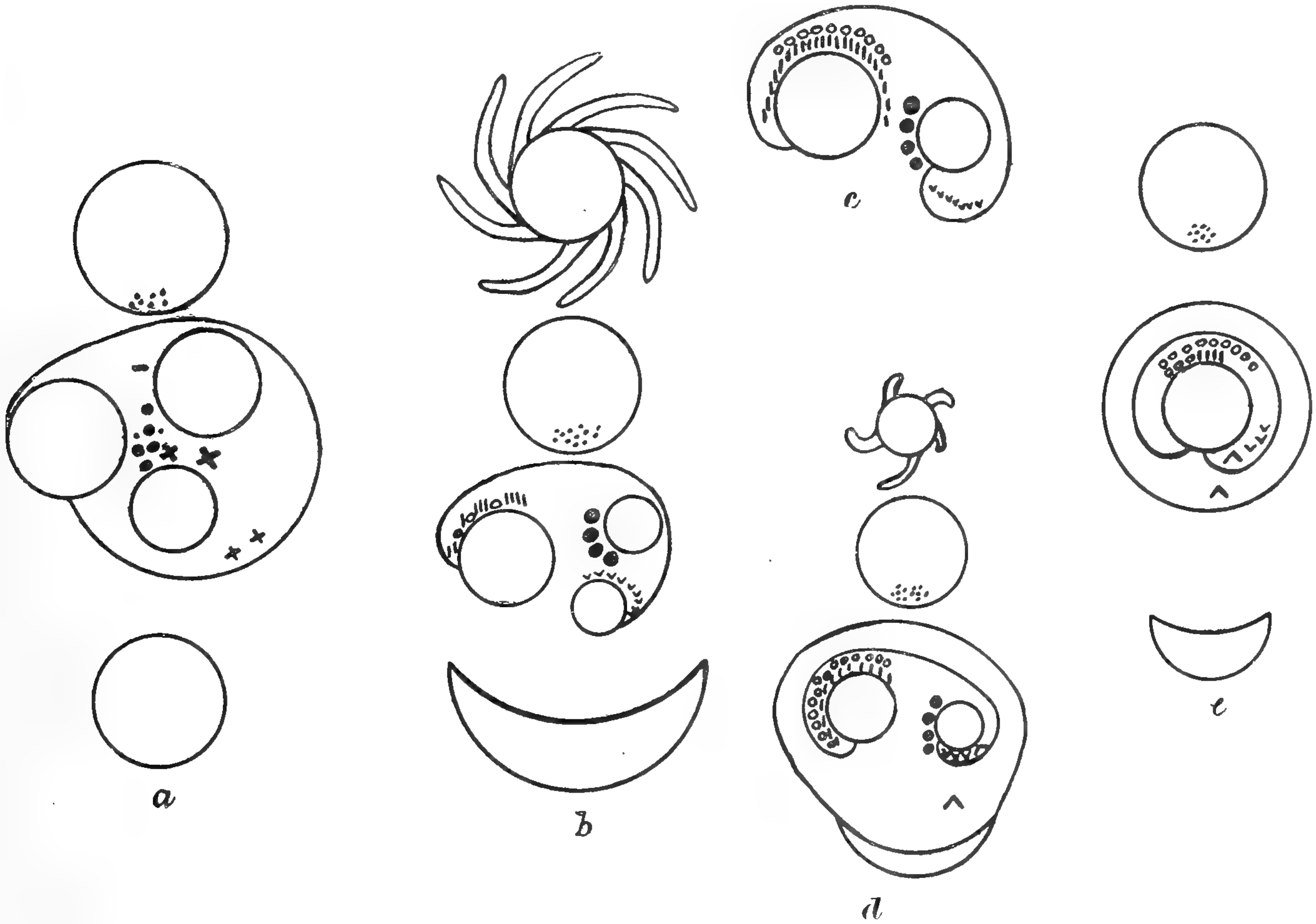
The head (figs. 14A, 14B), as usual in this genus, is partly concealed dorsally by the projecting peristomium, ventrally by the palps. The median antenna is 11 mm. long, very slightly exceeding the inner paired antennae, and nearly twice as long as the outer pair. The median antenna if bent back reaches to the middle of the 10th setigerous segment. The swollen bases of the antennae are composed of 12–13 rings. The cephalic lobe is small, and the posterior part is hidden by the peristomium. It bears two dark pigment spots which may represent eyes. The outer antennae are attached beneath the median pair. The frontal palps are fusiform, shorter than the ringed bases of the antennae. The palps are large, and are grooved on the dorsal surface. The lower surface shows two portions differing in appearance, the inner (anterior) half being the more tumid, and marked off by a deep groove from the outer half. The peristomium is very little longer than the succeeding segments, and slightly narrowed. The tentacular cirri are about as long as the ringed bases of the antennae. At first sight they appear to be attached to the anterior margin of the peristomium, but a closer examination shows that they really spring from the dorsal surface, a short distance behind the front margin. Ventrally the peristomium forms a wide loose lower lip.

In six out of the seven large individuals the first branchia is on the 4th foot. In the other one, which is the smallest of the seven, the first branchia is on the 5th foot. The branchiae (figs. 14A, 14F) increase in size as far as the 4th–6th pair. The largest have about seven whorls of moderately long filaments, attached to a stout stem, the base of which is more or less distinctly ringed. The anterior 77 pairs of branchiae are branched and are approximately as long as the dorsal cirri, the two organs gradually decreasing together. The 78th pair consists of simple filaments. There are 20–40 segments with these simple filiform branchiae, the last few being like minute papillae.

The mandibles (fig. 14D) are fused at the anterior end. The front margin has a rounded notch at each side and a more acute notch on each lateral margin. The posterior limbs are black and slightly expanded distally. The maxillae are very broad (fig. 14C), the supports being rather short and rounded, the forcipate processes stout and boldly curved. The great dental plates have 6–8 teeth on the right side, 7–9 on the left. The azygos plate has 6–9 teeth. The crescentic plates have 7–10 teeth. On the outer side of the latter are two rectangular plates, without teeth.

The feet are all provided with long slender dorsal cirri, each of which has a bundle of slender spines running into its base, but not piercing the skin. In the four anterior pairs of feet the setigerous lobe is relatively much larger than in the others.

The 1st foot (fig. 14E, and text-fig. 12*a*) has a large fusiform lobe behind the setae. In front of it lie two low rounded papillae, the dorsal one being the larger. A single capillary seta emerges behind the dorsal papilla. Ventrally there are 4 bifid hooks, 2 thin ones in front of the ventral papilla, and two thicker ones between the two papillae. In addition there are many stout and slender setae in the setigerous lobe and in the base of the dorsal cirrus which do not pierce the skin. In the bifid



TEXT-FIG. 12.—Parapodial diagrams of *Diopatra variabilis*, sp. nov.
a. 1st foot; *b.* 10th foot; *c.* 20th foot, setigerous lobe only shown; *d.* 70th foot; *e.* 150th foot.
— = dorsal capillary setae, without wings, in segments 1–4; × = bifid setae in segments 1–4; ·: =spines or setae of varying thickness, which are embedded in the tissues and seldom pierce the skin; o = brush setae; I = capillary setae, winged and smooth in anterior segments, serrate in posterior segments; v= ventral capillary setae, with flat smooth wingless blades; ∧ = stout ventral hooks of middle and posterior segments.

setae (fig. 14M) the tip is enclosed between two wings, and the shaft is obliquely striated. A short distance behind the tip there is in some cases a pseudo-articulation. The dorsal capillary seta is strong, broad, curved, and finely pointed, with smooth edges. The blade is flattened, but not winged.

The 2nd and 3rd feet are similar in shape, with two dorsal capillary setae, three stout bifid setae between the anterior papillae, and two thin ones in front of the lower papilla. The posterior lobe is rather more elongate than in the 1st foot. On the 4th foot is the first branchia, rather shorter than the dorsal cirrus. The rest of the foot does not differ from those in front. In the 5th foot there is a marked change. The ventral cirrus is much shorter and stouter, and the bifid setae are replaced by capillaries. The upper capillary setae lie above and behind the posterior lobe, and now show a narrow wing (fig. 14H). They are accompanied by a single brush seta (fig. 14Q), which has an expanded oblique tip, with about 13 coarse teeth and two external slender teeth, the latter differing very little in length from the others. The ventral capillary setae (fig. 14J) are shorter than the dorsal, and have no wings. They taper suddenly to a very slender tip, and are obliquely striated with smooth edges.

In the 6th foot the ventral cirrus is reduced to a short stout stump and ventral pad. There are two brush setae in the dorsal division. Three spines lie between the two anterior papillae. They taper rapidly at the distal end to filiform tips, which pierce the skin. In the 7th foot the ventral cirrus is still more rounded, and in the following segments it consists of a flat glandular pad, large in the anterior segments, but gradually becoming smaller towards the tail.

In the 10th foot (fig. 14F, and text-fig. 12*b*) the setigerous lobe forms a relatively small part of the foot. The setigerous fillet runs from beneath the anterior ventral papilla round the front of the foot and is connected to the back of the posterior lobe. There are four stout spines in the ventral division, and a bundle of fine spines enters the base of the dorsal cirrus. There are three brush setae. The dorsal capillary setae are long, stout, tapering gradually, with narrow wings, only one of which can usually be seen. The ventral setae are shorter with much flatter blades, without wings, and taper much more rapidly to very slender tips. In the 15th foot there are 8 brush setae, in the 20th foot 10.

In the 15th foot the lower anterior papilla has disappeared (text-fig. 12*c*), and the fillet is attached to the ventral side of the upper anterior papilla. In the 28th foot a stout hook appears in the ventral part of the foot, below the setae. The tip (fig. 14N) is bifid, and the lower tooth, which is slightly bent, is stouter and longer than the upper one. The tip is guarded by two delicate flexible wings. In the 40th foot there are 18 brush setae and 4 or 5 capillary setae in the dorsal division. There are two ventral hooks, the lower one emerging far down on the ventral side of the setigerous lobe.

In the 70th foot (text-fig. 12*d*) the branchia and ventral pad are greatly reduced in size. The posterior lobe is still conspicuous, but the anterior papilla is not visible in side-view. Of the ventral setae, only two or three project beyond the skin. They have short broad blades, with slender tips. Some of them seem to have been converted into stout spines with filiform tips. Outside the setigerous fillet there is another fold of skin, which completely surrounds the setigerous lobe. One of the stout ventral hooks emerges with the ventral setae within the fillet, the other is more ventral in position and emerges outside the fillet. There are more brush setae than capillary setae in the dorsal group.

In the 100th foot the posterior lobe is greatly reduced, and the anterior papilla has disappeared. The setae form a single series, arched round the posterior lobe.

The 150th foot (fig. 14G, and text-fig. 12*e*) is mammillate, with a tapering dorsal cirrus. The posterior lobe is small, and is almost completely surrounded by the inner fillet. There are 12 brush setae and 4 capillaries in the dorsal group. In the ventral group there are 3 stout capillaries with acutely tapering tips, and 2 very thick bifid hooks. In the latter (fig. 14P) the lower tooth is now much longer than the upper one. Towards the posterior end of the body the foot becomes smaller and more elongate, the setae fewer in number, and only one ventral hook occurs. The spines which pierce the dorsal cirrus are fewer in number and much finer and shorter. In none of the large specimens is the anal end complete.

The dorsal capillary setae show certain interesting changes as one passes from the anterior end backwards. In the 4 anterior feet they are devoid of wings. A certain number of feet follow in which the setae have narrow wings and smooth edges (fig. 14H). In the middle and posterior feet they are as shown in figs. 14K, 14L. The wings are not quite opposite each other, so that in side view only one is seen. The proximal part of the wing expands suddenly, and the margin is finely but distinctly toothed. In setae from the posterior feet this serrate part is more elongate than in those from the mid-body. The ventral capillary setae also show changes. The blade becomes wider and shorter and the abruptly filiform tip more obvious in the posterior feet. The tapering part of the seta is minutely spinous. The acicula are not wider than the ventral capillaries, and approach them in shape, the filiform tip being very notable. The brush setae are not flat, but have the edges curved towards each other.

The smaller specimens differ in several respects from the above description. The most obvious difference is in the branchiae. Fig. 14R shows the 10th foot of one of these specimens. The branchia is many times longer than the dorsal cirrus, which is only about twice as long as the posterior lobe. The filaments are longer, and not so crowded on the stem. In a few specimens the 1st branchia is on the 4th foot, but in the majority it is on the 5th. The anterior branchiae are relatively much longer than in the large specimens. The last branchia occurs on the 37th–39th foot, and there are very few with only a single filament. In some specimens the filaments are long, and loosely arranged, but in others they are bushy, as in the large specimens. In the smallest of the large specimens the 1st branchia is on the 5th foot, and the filaments are long and loosely arranged, but the stem is only as long as the dorsal cirrus. In the small specimens the serrate part of the dorsal capillary setae is more elongate and not so wide as in the large specimens. The peristomium does not project over the posterior margin of the head.

Only one of the small specimens is complete. It measures 64 mm. in length, and has 150 segments. The rest are incomplete, some larger than this, and some smaller. The anal segment is button-shaped, and bears 4 ventral cirri, the upper pair being 4 times as long as the lower pair, and equal in length to the last 6 segments. In one of these small specimens, one of the ventral hooks of the 3rd foot has 2 teeth beneath the main fang, but this is exceptional. In the structure of the head, jaws and tubes, the two forms agree closely. If these specimens had come from different localities they would probably have been regarded as distinct species. It seems very probable, however, that the distinctions observed are due to differences in size and age. The most important difference is in the relative lengths of the branchia and dorsal cirrus, and it is difficult to see how this can be a function of age and size. The large specimens were found only at one locality, in March, though empty tubes, apparently belonging to this form, were obtained in September. The small specimens were found both in March and September. The question of whether one or two species are involved can only be decided by a more ample supply of material, collected at different seasons of the year.

If all the specimens are regarded as belonging to the same species, then the following variations were observed :—

1. In the anterior segments the dorsal cirrus may be longer than, equal to, or only one quarter as long as, the stem of the branchia.
2. The branchiae may commence on the 4th or 5th foot.
3. The branchial filaments may be long and open, or short and bushy.
4. The stem of the branchia may be thick or thin, and the base may be clearly or obscurely ringed.
5. There may be few or many branchiae pairs of (33–120), according to the size of the individual.
6. There may be few or many feet with simple branchiae.
7. The peristomium may or may not project over the posterior part of the head.
8. There may be considerable variation in the number of teeth in the dental plates.

These variations show that many of the criteria which have hitherto been used to discriminate the various species of this genus, are of little or no value. Crossland (1903, p. 132) has already commented on this point. In these circumstances it is probably useless to compare the present species with the majority of the species previously described, which will need careful examination, and will probably be considerably reduced in number. The most characteristic features of this species are the long dorsal cirri (in the large specimens), and the shape of the dorsal serrate capillary setae in the middle and posterior segments. In the possession of long dorsal cirri, the species agrees with *D. amoena,* described by Kinberg (1910, p. 38), from the Atlantic, near the mouth of the Rio de la Plata. The text is too brief to be of any value, but judging from the figures recently published, *D. amoena* differs from the present species in having smaller, and probably fewer branchiae, with fewer filaments, more elongate feet and larger palps. The upper jaws also differ in shape, especially the supports and forcipate processes.

The smaller specimens, however, closely resemble certain species already described, such as *D. chiliensis,* Quat. (Ehlers 1901, p. 123), and *D. leuckarti,* Kinberg (1910, p. 38). The structure of the dorsal capillary setae, which apparently differentiates the present species, may have been overlooked by previous workers.

Habitat.—Dr. Annandale writes of the large specimens of this species—" I think it is the largest worm in the collection. Specimens were taken in February or March with their tubes, near Ganta Sila, Rambha Bay. This worm lives at the edge of the lake in muddy sand or sandy mud, at a depth of about two feet below the surface of the bottom. When the water is high, its burrows are covered by 5 or 6 feet of water, but the fore part of the tube is exposed as the level sinks in the dry weather. The upper part of the tube is shaped like the ventilation funnel on a steamer, and in places where suitable molluscs occur, the worm fixes a single white shell on the top of the funnel, rendering the structure very conspicuous. The specimens of the animal are very difficult to obtain, and so far as I remember, we only succeeded in digging them out on one occasion, on which the tops of the tubes were exposed."

The tubes are large and thick-walled, formed of mud and sand on a membranous basis. These specimens were taken in water of specific gravity about 1·011. Empty tubes of similar form, though smaller, were taken in 10–12 feet of water, off Nalbano.

The small specimens were taken at nine stations, usually in the dredge, in as much as 15 feet of water. Seven of these stations were south of a line joining Patsahanipur with Nalbano, one station was a little north of this line, and the remaining station was in the north-west corner of the lake, off Kalupara Ghat. The water was always of low salinity, the specific gravity ranging from 1·000–1·010. Four stations were worked during the salt-water season, and five during the fresh-water season.

Marphysa gravelyi, sp. nov.

(Plates XXIV, figs. 13A–G, and XXV, 13H–L, and text-figs. 13*a–d*.)

Twenty-seven specimens of this species, all from the Chilka Lake, are available for study. They are of various sizes, but fall roughly into two groups, with probably an age difference of a year between them. A specimen from each of these two groups was examined, and there is no doubt but that they belong to the same species, the distinctions noted being all explicable by the difference in size and age.

The larger (type) specimen is 172 mm. long, composed of 360 segments. The body is cylindrical so far back as the 5th segment. It then becomes flattened dorso-ventrally. The skin is iridescent, and the dorsum shows faint white spots in front, which are probably much more distinct in living specimens.

The head (fig. 13A) is rounded at the sides, deeply indented in front. The indentation is continued as a groove, running dorsally to the base of the median tentacle, ventrally to the mouth. The median tentacle is slightly longer than, and the external tentacle slightly shorter than, the other two. Two small black eyes lie between the bases of the lateral tentacles, hidden by the projecting collar of the peristomium (fig. 13A is from a small specimen). The head is followed by two achaetous segments, of which the first—the peristomium—is about three times as long as the next and succeeding segments.

The anal segment (fig. 13B) is button-shaped, with a crenate margin. On the ventral border are two long cylindrical anal cirri, and beneath these another pair of very small stumpy cirri.

The branchiae are distributed in the type specimen as follows :—

No. of filaments.	*No. of segments.*	*Position of segments.*	*No. of filaments.*	*No. of segments.*	*Position of segments.*
0	32	1–32	7	38	268–305
1	6	33–38	6	17	306–322
2	4	39–42	5	2	323–324
3	22	43–64	4	12	325–336
4	19	65–83	3	10	337–346
5	44	84–127	2	5	347–351
6	12	128–139	1	5	352–356
7	27	140–166	0	4	357–360
8	101	167–267 [1]			

There is, of course, considerable variation in the distribution of the branchiae, and the numbers of filaments frequently differ on the two feet of the same segment. In three other specimens the first branchia appears on the 36th, 42nd, and 52nd feet respectively. The maximum number of filaments is 8 or rarely 9. They are much longer than the dorsal cirrus, and are crowded together on a short stem (fig. 13G).

The mandibles (fig. 13D) are blackish at the posterior ends, paler in front. The ringed anterior ends are small, and the two halves are not very firmly attached to each other. The maxillae (fig. 13C) are stout and boldly curved, the posterior processes being spatulate. The maxillary plates have 6 teeth on the right, 5 teeth on the left side. The azygos plate on the left has 7 or 8 teeth, whilst the anterior crescentic plates have 9 teeth on the right, 6 on the left. Dark horny patches of indefinite shape occur in front of and at the side of the anterior toothed plates. The right anterior crescentic plate bears less resemblance to its corresponding left plate than it does to the azygos plate.

The feet increase gradually in size up to the 10th. The 1st foot (fig. 13E and text-fig. 13*a*) has stumpy rounded dorsal and ventral cirri, and a short rounded median lobe behind the setae. In front there is a thin fillet guarding the setae. The foot is very vascular. There are three black spines, lying horizontally. The setae are in two groups, above and below the spines. The dorsal group consists of about 9 capillary setae of various lengths, with flattened, very finely serrate blades (fig. 13H). Ventrally there are 7 or 8 compound setae (fig. 13J). The tip of the shaft is bevelled, and has a row of spines along the upper edge. The blade is very finely serrated, and tapers to a long filiform tip. The 2nd foot resembles the 1st, but the setae are more numerous.

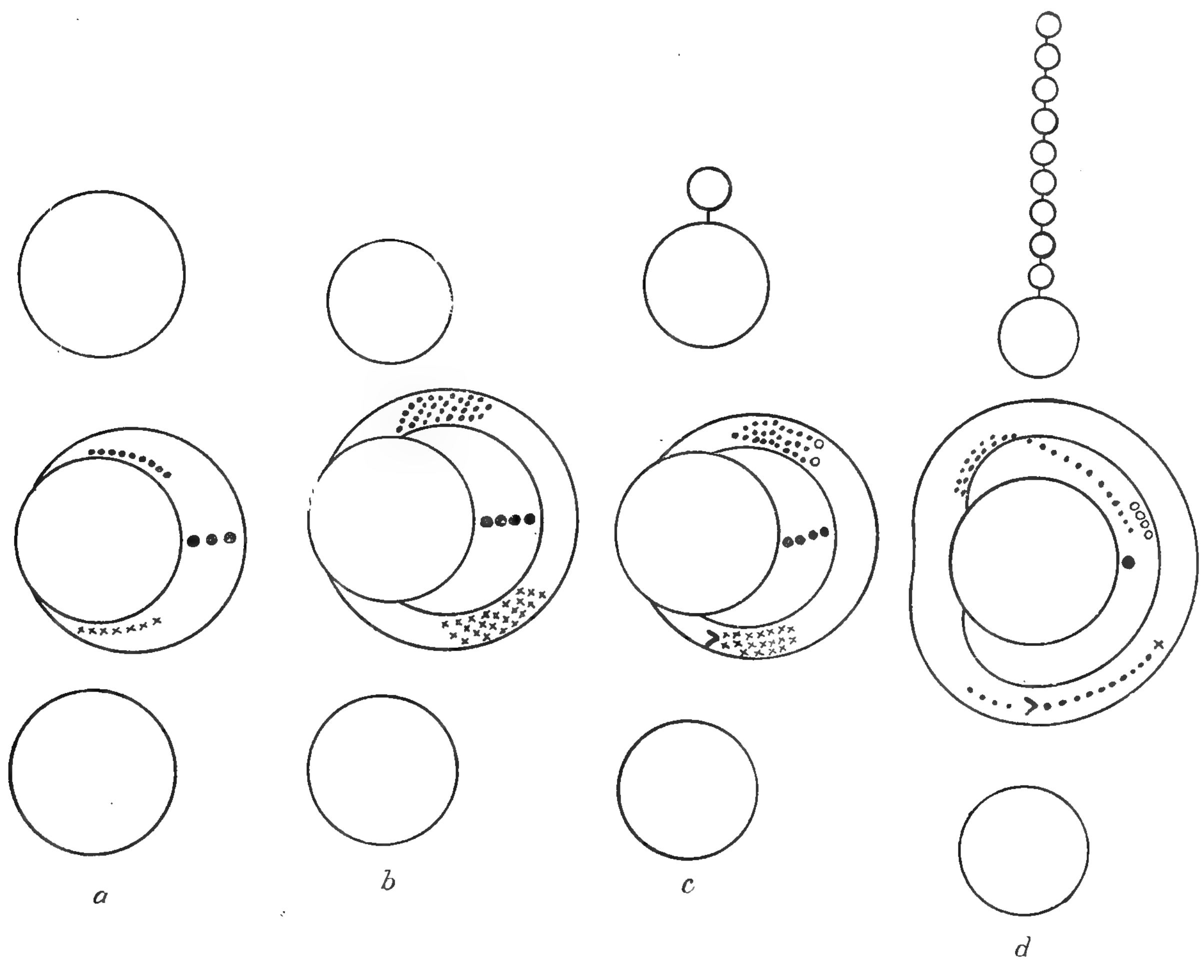
The 5th foot (text-fig. 13*b*) has 4 black spines. The setigerous lobe is relatively larger and the setae much more numerous. The setae are enclosed within two fillets, which are attached by their edges to the middle lobe, and lie outside the spines.

The 10th foot has 5 spines, and the ventral setae are still more numerous. In the 25th foot there are 4 spines, and 2 brush setae (fig. 13K) appear, lying in front

[1] A few of these have 9 filaments.

of the dorsal setae. They have expanded oblique tips, with numerous fine teeth, of which the two outermost are much longer and stronger than the others. At the 35th foot a powerful hook (fig. 13L) appears on the lower edge of the ventral setae. It is bifid at the tip, but in the anterior segments the points are either rounded or worn away. The tip is guarded by two delicate flexible wings, and the shaft is finely dotted.

The 40th foot (fig. 13F, and text-fig. 13*c*) has 3 or 4 spines, the upper one being colourless. The dorsal and ventral cirri are relatively smaller than in the 1st foot. In segments 50–120 there are two ventral hooks.



TEXT-FIG. 13.—Parapodial diagrams of *Marphysa gravelyi*, sp. nov.

a. 2nd foot; *b*. 5th foot; *c*. 30th foot of small sp., 40th foot of large sp.; *d*. 160th foot of small sp., 240th foot of large sp.

· = capillary setae; ● = spines; x = compound setae; > = simple bifid hook.

After the 100th foot, capillary setae appear in the ventral bunch, replacing the compound setae. A single compound seta remains in many feet, at the upper anterior border of the ventral bunch (text-fig. 13*d*), but the posterior 100 feet have no compound setae. At the 240th foot (fig. 13G, and text-fig. 13*d*) the branchia has its maximum of 9 filaments. The dorsal cirrus is short and conical, the ventral cirrus stumpy and round. The middle papilla is very small, and the internal fillet runs out to the tip of the black spine or spines. The external fillet now runs completely round the setigerous lobe. The dorsal division has 4 brush setae in front, arranged in a gradual sequence, the uppermost being the shortest and smallest. The greatest number of brush setae noted in any foot was 4. The dorsal capillary setae lie close to the inner fillet, emerging inside it in the anterior region (text-fig. 13*d*). In the ventral division there is a single compound setae in the front of the foot, and a bifid winged hook on the lower margin. All the other setae are simple capillaries. The ventral setae are shorter than the dorsal, and the blades are more distinctly flattened.

In the posterior segments the setigerous lobe is smaller in proportion to the dorsal and ventral cirri. The setae are few and simple. There is one spine, one ventral hook, and 1–3 brush setae with somewhat coarser teeth than those in the anterior segments.

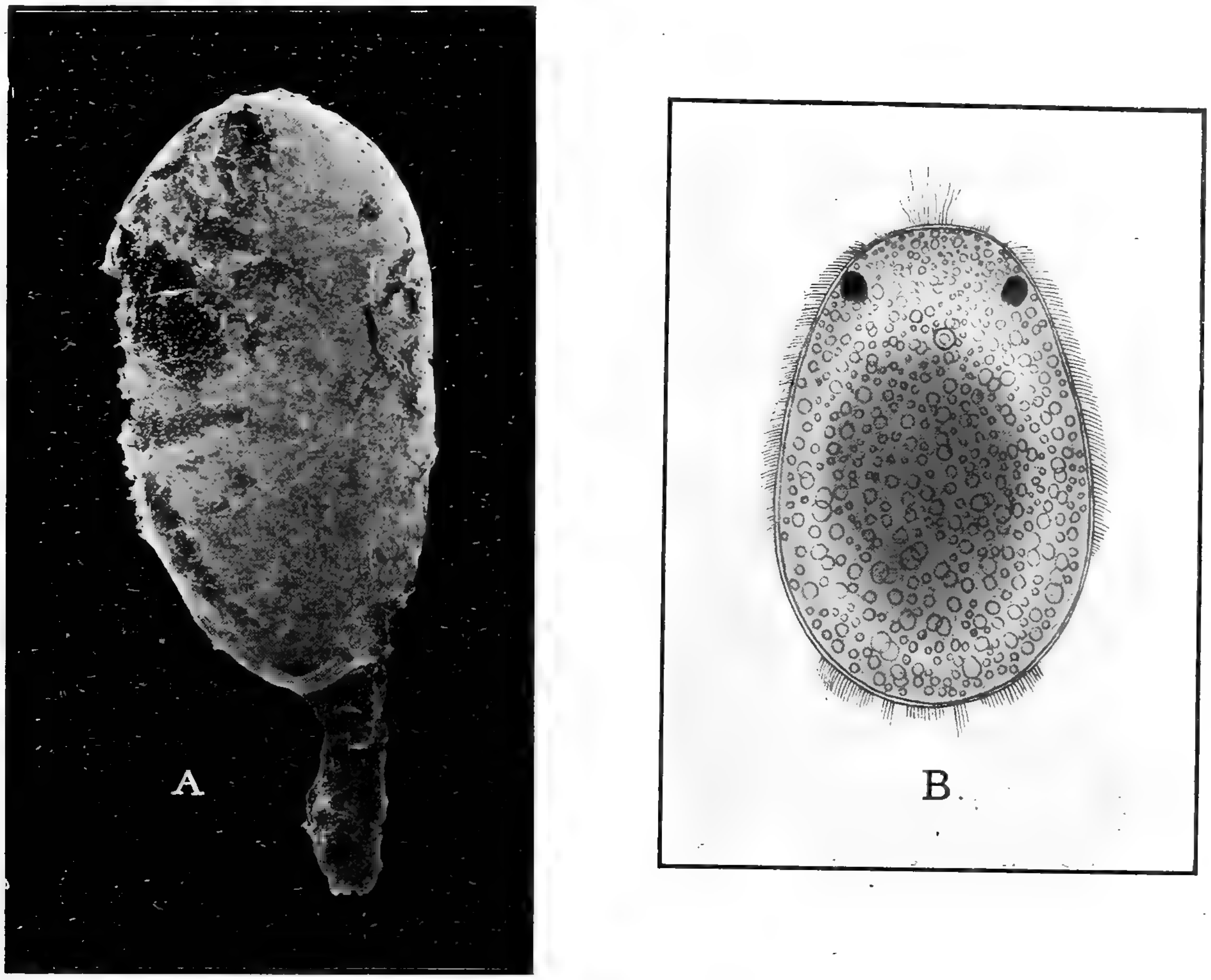
The smaller specimens differ from the above description in many respects, but these differences are due to age and size. The specimen examined was 66 mm. long, composed of 220 segments, with traces of others forming in front of the anal segment. The eyes are larger and more distinct, and are not hidden by the collar of the peristomium (fig. 13A). The first branchia appears on the 22nd foot, and the maximum number of filaments is 5, on segments 145–165. The branchiae are absent from the posterior 20 segments. The maximum number of spines present in any foot is 4. The first brush seta appears in the 20th foot, and the first ventral hook on the 26th foot. The capillary setae appear in the ventral division of the 80th foot, and there are no compound setae behind the 160th foot. Genital products were not observed in any of the specimens.

This species belongs to the *M. sanguinea* group. The most remarkable character is the appearance of the capillary setae in the ventral division of the feet in the middle and posterior parts of the body. It is improbable, considering the size of the larger specimens, that this is a larval character, especially as these setae appear at relatively the same position in both large and small specimens, viz. near the beginning of the middle third of the body. The same proportion is also seen in the position of the last compound seta, viz. segment 150 in the small specimen, and segment 240 in the large one. In this character there is a tendency towards *M. mossambica*, Grube, which has no compound setae.

This species has also some resemblance to *M. californica*, Moore (1909, p. 251), but differs in the shape of the head, relative length of the tentacles, number and distribution of the branchiae, etc. *M. californica* has two kinds of brush setae in the middle segments, one kind with many, the other with few teeth. Moore's specimens were incomplete behind, so that no comparison can be made as to the arrangement of the setae, a feature so characteristic for *M. gravelyi*.

Dr. Annandale writes *in litt.* of this species :—" Another interesting Eunicid was obtained only in very small numbers, though actually abundant everywhere round the lake where the shores are muddy. This species produced large balloon-like masses of gelatinous spawn anchored to the mud by a tubulous structure and known to the Ooriyas as *nowdar*." It is possible that this may be the same species as was found by Borradaile (1901, p. 714). In a lagoon at Jaffna, on the north coast of Ceylon, he found a species of *Marphysa* which liberated its eggs in a pear-shaped mass of jelly, attached to the bottom by a short stalk. He has described the early development of the worm most carefully, but unfortunately all the adult specimens were lost, and the species was never definitely identified, but was said by Willey, who saw a damaged specimen, to be identical with, or closely allied to, *M. teretiuscula*, Schmarda, a species differing distinctly from the present form.

Dr. Annandale further writes that similar spawn is a conspicuous object in shallow creeks and lagoons of brackish water both on the east coast of India and on



TEXT-FIG. 13[1].—*Marphysa gravelyi*, sp. nov.

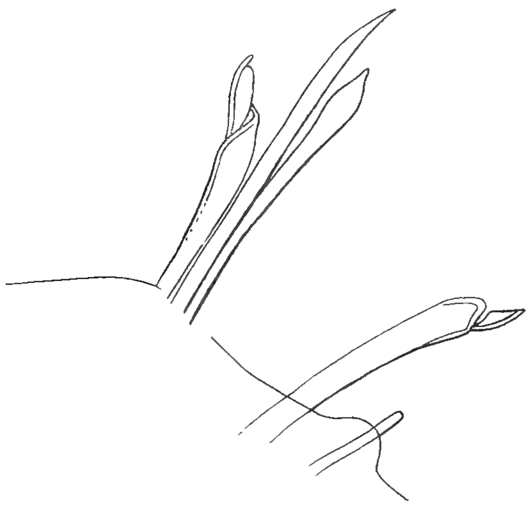
A. Egg-mass, × ½. The outer layer has been removed at one spot, showing the clear jelly containing the eggs. B. Larva, highly magnified.

that of the Malay Peninsula. It was common at the outer edge of and in small ditches connected with the outer section of the Tale Sap on the Gulf of Siam[1] in January 1916, where the mass seemed as a whole more cylindrical than those in the Chilka Lake. In the Chilka Lake the masses are pear- or egg-shaped, often as much as six inches long, and are anchored to the mud, in which the worm burrows to a considerable depth, by a tube at one end. The mass consists of jelly, which is quite hyaline and colourless, and contains the eggs or larvae to the number of several hundreds. The eggs are minute and scattered. The outer part of the gelatinous mass is stiffer than the central part, to which the eggs are confined, and the whole is

[1] Concerning this lake see *Mem. Asiatic Soc. Bengal*, VI, pp. 3–6, text-fig. 3 (map).

covered by a thin, soft, sticky layer, transparent in itself but soon powdered with fine silt, which adheres to it firmly. This soft external layer and also the outer, stiffer layer of the central mass are continued at the base to form a narrow tube, which is usually filled with the excreta of the worm. The tube goes straight down into the mud for a foot or more and is inhabited by the parent worm. In the photograph of an egg-mass of *M. gravelyi* here reproduced the basal tube is well shown; also the thin external layer, which is torn at one place, revealing the egg-mass with the minute contained eggs or larvae.

Dr. Gravely adds that the unhatched larvae (text-fig. 13^1b) can move freely in the jelly in which they are embedded. They closely resemble Borradaile's larvae, but minute examination revealed somewhat greater differentiation among the cilia than is indicated in his figures. Two groups of setae crushed out of a larva with two setigerous segments are shown in text-fig. 13^2. It will be observed that of the simple setae in the anterior group one is pointed at the end and the other somewhat blunter, as described by Borradaile. There is, moreover, a single jointed seta associated with them. Neither this jointed seta nor the one in the second group is, however, quite like either of the jointed setae figured from Borradaile's older larva. The figures of the Chilka larva have been prepared under Dr. Gravely's supervision.



TEXT-FIG. 13^2.—Parapodium of larva of *Marphysa gravelyi*, sp. nov., highly magnified.

A minute nematode worm *Monhystera uria*, Stewart (*Rec. Ind. Mus.* X, p. 247) is found in the jelly with the larvae.

Habitat.—27 specimens of this species were taken at 7 stations in Chilka Lake. All the stations were in the southern end of the lake, from Nalbano to Rambha, and the bottom was muddy. The species was apparently only taken during the salt-water season, from January to March. In this part of the lake, however, the specific gravity is only from 1·008 to 1·0115 in the salt-water season. It is certain that the species lives in this area throughout the year, when the gravity is as low as 1·001, and is only obtained in January to March because, at that time, the level of the water has sunk so low that the mud flats and banks, in which the worm lives, can be examined.

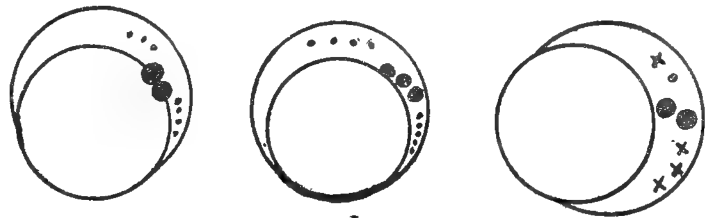
Lumbriconereis polydesma, sp. nov.

(Plate XXVI, figs. 15A–L, and text-figs. 14*a*–*c*.)

Only one specimen, fortunately quite complete, and a fragment of a second of this species were taken in the south-western end of Chilka Lake. It is 185 mm. in length, and is composed of 386 segments. It is not fully grown, as genital products are absent, and new segments are in process of formation in front of the anal segment.

The body is very slender, the greatest width being 1·0–1·2 mm., not including the feet. It tapers very gradually towards the tail, more rapidly, but to a lesser degree towards the head. The skin of the preserved specimen is opaque white in colour, with a faint green iridescence.

The head (figs. 15A, 15B) is rounded in front and at the sides. Dorsally the posterior border is covered by the projecting front border of the peristomium. No eyes were observed, though there is a small patch of pigment near the posterior border of the head, a little on the right of the median line. The mouth is bounded in front and at the sides by two large lips formed by the infolding of the lateral posterior margins of the head. Between the head and 1st setigerous segment are two achaetous rings, the first being twice as broad as the second. Ventrally the 1st ring is incomplete, being interrupted by a projecting lobe of the 2nd ring. Both rings are furrowed on the ventral side.



a *b* *c*

TEXT-FIG. 14.—Parapodial diagrams of *Lumbriconereis polydesma*, sp. nov.

a. 1st foot; *b*. 10th foot; *c*. 80th foot.

· = Simple capillary setae; × = crochets.

The feet increase gradually, and only very slightly, as far as the 10th. The 1st foot (text-fig. 14*a*) has a prominent rounded ventral lobe. The setae lie above and in front of this lobe, and are guarded externally by a conspicuous curved fillet. There are two colourless spines. The setae are stout winged capillaries, with bilimbate obliquely striated blades. There are 3 of them above the spines and 4 below.

In the 10th foot (fig. 15F and text-fig. 14*b*) the fillet forms a hood over the ventral lobe. It is attached to the middle of it in front, then curves over it, and is attached to it again on the lower posterior border. There are 3 spines in a horizontal row. They are colourless, except the tips of the two anterior ones, which are dark brown. There are 4 capillary setae above the spines and 5 below. The upper setae are rather longer than the lower, and they all curve towards the spines.

At the 29th foot the first crochet appears in the ventral division. The 30th foot has 2 colourless spines, 3 capillary setae above the spines, 2 capillary setae and 1 crochet below the spines. The fillet lies more in front of the ventral lobe than in the 10th foot, and its anterior line of attachment is near the ventral border of the lobe.

The 40th foot is similar in shape. It has 2 spines, 2 capillary setae and 1 crochet above the spines, 1 capillary seta and 2 crochets below.

In the 80th foot (fig. 15G, and text-fig. 14*c*) the ventral lobe is smaller and slenderer, and curves upwards. The fillet lies almost altogether on the anterior side of the lobe, and is hardly visible from the posterior aspect. There are 2 spines, 1 capillary seta and 1 crochet above the spines, 3 crochets below.

The shape of the feet is very uniform in the middle and posterior parts of the body. At the 300th foot (fig. 15H) the ventral lobe is rather longer and thinner.

The fillet is attached near the base of the lobe, and projects outwards, in front of it. There is a single colourless spine, one capillary seta and one crochet above the spine, and one crochet below. This capillary seta persists in all the feet.

The anus is terminal. On its ventral margin are the remains of 4 short stumpy cirri, the upper pair being the longer. The capillary setae (figs. 15J, 15L) have broad wings which tend to curve inwards, so that frequently only one is visible. They are obliquely striated, and taper to a slender tip. In the posterior feet the wings are broader than those in the anterior feet. The crochets (fig. 15K) have each two broad wings over the tip, with delicate oblique striations. The boldly curved terminal tooth has a crown of 6–10 slender spines.

The mandibles (fig. 15E) are fused throughout their whole length. The biting plate is composed of 5 or 6 half-rings. The shafts are striated longitudinally and also obliquely. The whole structure is very delicate and the edges are so thin that it is impossible to indicate the precise shape. The forcipate processes of the maxillae are normal in size and shape, and are equal in length to the posterior processes or "supports", which have a distinct waist. Lying alongside the forcipate processes are two narrow dotted strips of chitin. The main dental plates are each composed of a dark-coloured ventral part, rather narrow and bearing teeth, and a larger and paler reflexed plate lying above it. There are 5 teeth on the right side, 4 on the left. The 3rd pair of jaws have bifid tips, and the 4th pair strong simple tips. Fig. 15D shows them after they have been flattened. Lying alongside the 3rd and 4th pairs are two rectangular dotted plates.

This species is characterised by the very slender elongate body, the structure of the jaws, the shape of the head and setae, and the presence of capillary setae in all the feet.

In the shape of the jaws it resembles the *L. tetraura* (Schmarda) as described by Ehlers (1901, p. 137), but the two species differ widely in the distribution of the capillary setae and crochets. In the form of the setae, and in having two teeth on the 3rd pair of jaws, it resembles *L. indica*, Kinberg (1910, p. 48), from the Bangka Straits, but differs in having only a single tooth on the 4th pair of jaws, and in the presence of capillary setae in the posterior segments, etc. This species rather closely resembles the *L. heteropoda* of Marenzeller (1879, p. 30), from Japan. The latter differs in having a longer and more pointed head, shorter and broader body, with fewer segments, feet of somewhat different shape, and in the relative length of the two lobes. In the middle of the body the foot of *L. heteropoda* carries a rudimentary dorsal lobe with a few simple setae embedded in the tissues. The capillary setae are distributed as in the present species, and occur in the posterior feet. The jaws are similar as a whole, but differ in details, especially in the shape of the maxillae and mandibles. The tips of the crochets also differ.

Habitat.—A single entire individual and a fragment of a second were obtained by digging in sand just above high-water mark on the shore of Chiriya Island, in the south-western extremity of the Chilka Lake. They were collected during the salt-water season, in February, and the salinity of the adjacent water was 1·011.

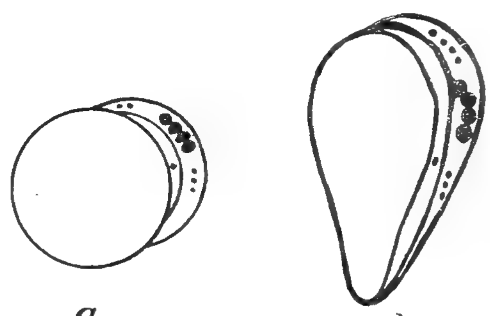
Lumbriconereis simplex, sp. nov.

(Plate XXVI, figs. 16A–16M, and text-figs. 15*a*–*b*.)

Six specimens of this species, from the Chilka Lake, all from the south-western end, are available for description, all of them in a fragmentary condition, and the posterior end is missing in all cases. The largest fragment is 32 mm. long, and consists of 125 segments. It is probably half the total length, or rather more.

The preserved animals are colourless, except for a delicate greenish iridescence. There is a dark amber-coloured spot near the base of each foot, on the ventral side, composed of granular pigment, like dried blood. Similar granules are scattered over each foot, especially near the tip of the setigerous lobe, and just above the foot. The body expands gradually up to the 15th setigerous segment, and then tapers still more gradually towards the posterior end. The feet are rather prominent. The width of the body at the 15th foot is 1·7 mm. or including the feet and cirri 2·7 mm. The 1st achaetous ring is $2\frac{1}{2}$ times as long as the 2nd ring.

The head (figs. 16A, 16B) is triangular, with rounded angles, the length slightly exceeding the width. No trace of eyes could be found, though there is some subcutaneous pigment on the head. The mouth is bounded in front by two tumid lips belonging to the head, laterally by the first ring, and in the mid-ventral region by the second ring, which interrupts the first ring and projects forwards to the mouth.



a *b*

TEXT-FIG. 15.—Parapodial diagrams of *Lumbriconereis simplex*, sp. nov.
a. 1st foot; *b*. 10th foot.
· = Simple capillary setae; • = spines.

The 1st foot (fig. 16G, and text-fig. 15*a*) consists of a setigerous lobe composed of two lamellae or fillets, and a rounded lobe lying behind and beneath the fillets. Between the fillets lie four colourless spines. The setae are in two groups, a dorsal bundle of two long bilimbate setae above the spines, and four similar but shorter setae beneath the spines. The upper ventral seta emerges inside the inner fillet, all the others between the two fillets. The succeeding feet increase in size and in the number of setae. In the 10th foot (fig. 16H, and text-fig. 15*b*) the posterior lobe is longer, bluntly pointed, and flattened, and the two fillets lie in front of it. There are four bilimbate setae in each bundle. The succeeding feet up to the 30th show little change. The base of the posterior lobe then becomes gradually fused to the fillets, and the terminal portion projects backwards as a finger-shaped lobe (fig. 16K). The number of spines in the 30th–50th feet is 3, in the 100th foot there are 2. From the 30th foot there are only 3 setae in each foot, one dorsal and 2 ventral.

In the anterior segments the setae (fig. 16L) are long and tapering, with smooth flattened obliquely striated blades. They are bilimbate, but the two wings are not directly opposite each other, so that usually only one is seen. The dorsal setae are longer than the ventral. In the middle and posterior feet the setae (fig. 16M) have wider and flatter blades, and the wings are very narrow or quite absent. In a fragment, evidently from near the posterior end of a specimen, the feet are more translucent and more elongate. They have 1 or 2 spines, and 1 dorsal and 2 ventral setae. The blades of the setae are short, broad, and flat, with very narrow wings, and they taper rapidly to a long fine tip. The setigerous lobe is more conical at the tip, and the posterior lobe more elongate.

The feet of this species are remarkable for the richness of their blood supply, and they evidently function as branchiae. In many of the feet there is in the dorsal region of the base a large heart-shaped structure full of blood (fig. 16J), into which a number of vessels open. It is not present in all the feet, and is apparently formed by the swollen junction of the blood-vessels. When present, it forms a conspicuous spot on the dorsal side of the foot. From this 'heart' a large vessel runs into the foot, giving off numerous branches which lie under the cuticle on the front side of the foot. A large branch runs round the margin of the setigerous lobe, and another passes into the posterior lobe. All these vessels branch repeatedly, and the capillaries finally unite to form large vessels lying on the posterior side of the foot. In the fragment from the posterior end of the body, mentioned above, the blood-vessels are greatly reduced in size and number.

The mandibles (fig. 16F) are translucent, broad, and fused throughout almost the whole length. The anterior or biting end is composed of numerous semi-rings. There is very little pigment, which is confined to the lines of growth.

The maxillae (fig. 16C) are stout and boldly curved. Their posterior portions (the 'supports,' or 'carriers') are laterally deeply indented. This part varies greatly in length, as is seen by comparing figs. 16C and 16D, but is always shorter than the forcipate processes The posterior oblique margin is thin and frayed. Lying on the outer margin of the forcipate processes is a long thin horny plate. The great dental plates have each 4 large teeth. At the anterior end each has a flat cap (fig. 16E). The dental plate itself is rather narrow, but it has a broad dorsal flange lying behind the forcipate process. The 3rd pair of jaws are bidentate. The 4th pair have each a stout tooth, which may be slightly bifid at the tip, possible through abrasion. Lying ventrally to the 3rd and 4th pairs of jaws is a thin rectangular coarsely dotted plate on each side.

So far as one can judge from the brief description and inadequate figures, this species resembles *L. atlantica*, Kinberg (1910, p. 47), from the mouth of the Rio de la Plata, especially in having only slender capillary setae. It appears to differ in the shape of the head, and in having two teeth on the 3rd pair of jaws.

Habitat.—Fragments of six specimens were taken at two stations, both of them on the shore of the south-western extremity of the lake, at Rambha, in mud. Of one station, no further information is available. The other station was in March, and the specific gravity of the water was 1·011.

Family GLYCERIDAE.

Glycera alba, Rathke, var. **cochinensis**, var. nov.

(Plate XXVII, figs. 17A–J, and text-figs. 16*a–e*.)

Two specimens of this species were collected in the Cochin Backwater, near Ernakulam. One of them is in good condition for description, the other is softened and lacks the posterior region.

This species closely resembles the European *Glycera alba* in appearance. The preserved animals are buff coloured. The type specimen is 39 mm. long, and consists of 120 setigerous segments. The body attains its greatest width between the 30th and 40th segments. From this region it tapers abruptly towards the head, and only very gradually towards the posterior end. On approaching the tail, however, it decreases rapidly in size. The segments are biannulate, the two rings being almost equal in length, or the ring bearing the feet is very slightly the longer of the two.

The mouth (fig. 17A) is bounded laterally by two large tumid lips, formed of two rings. In front of it are 10 rings which gradually taper towards the tip. The terminal ring bears four small tentacles. The large segment which forms the posterior margin of the mouth is much folded ventrally, and bears a fairly large pair of parapodia. In front of this segment are two others which are very narrow and incomplete ventrally. Each of them bears a pair of rudimentary parapodia, the anterior pair especially, being very small.

The proboscis in both specimens is completely retracted, and the jaws lie opposite the 21st pair of parapodia. The posterior part of the retracted proboscis is shown in fig. 17B. The expanded part—the gizzard—containing the jaws, is almost square in section, the rounded angles being formed by four large glands, whilst there is a smaller gland on each face. Attached to the front margin of the gizzard are four flat, almost rectangular lamellae, two directed forwards and two folded backwards. They are composed of large rounded cells with large nuclei.

The jaws (fig. 17E) are stout and curved. The fixing process is slender, and is attached near the middle of the jaw. It bears a thin triangular wing on the basal part. In the specimen figured, the posterior end of the jaw is bifid, but this is probably due to fracture, as it is entire in other jaws which were examined.

The internal surface of the retracted proboscis is covered with small papillae of various shapes. The most numerous variety has a cylindrical stem (fig. 17C), with an oblique mammillate tip, bounded by flat wings. The diameter of the stem is equal to the width of the wings, and the papilla is $2\frac{1}{2}$ times as high as the diameter. Another variety is pear-shaped (fig. 17D), whilst others are similar in shape, but slenderer. All are traversed by ducts opening at the tip.

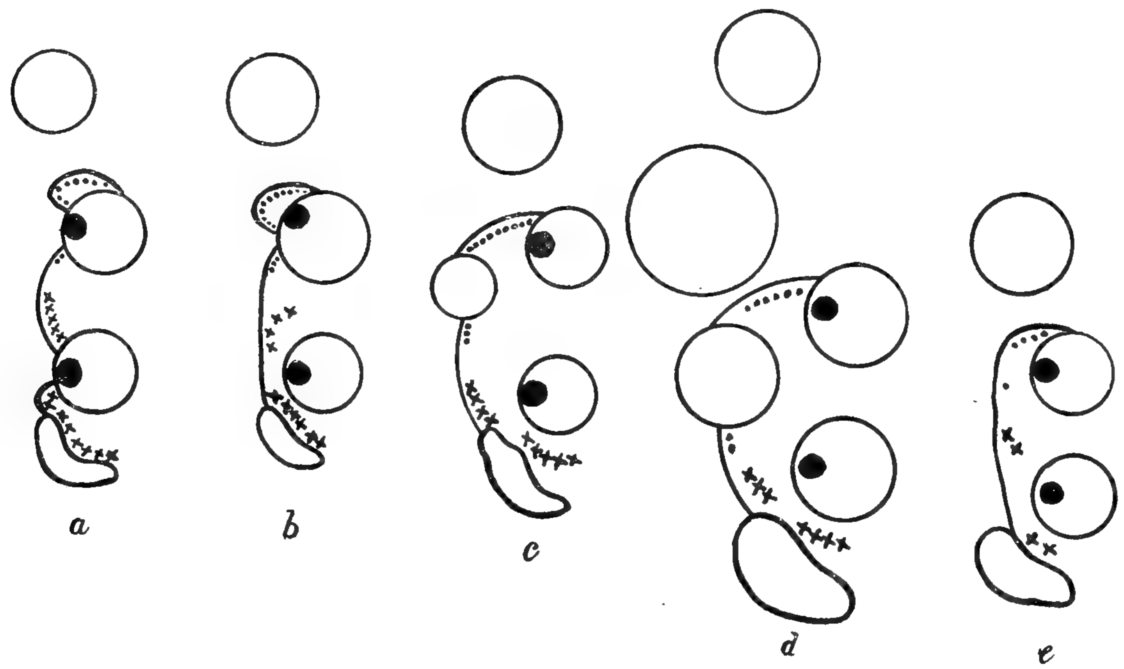
The 1st foot is very minute, and consists only of a setigerous lobe with a group of compound setae, and a flat heart-shaped posterior lobe.

The 2nd foot is a little larger. The setigerous lobe has two bundles of compound setae, an anterior finger-shaped lobe, and a posterior cordate lobe.

In the 3rd foot, which is almost normal in size, there is a rounded dorsal cirrus, and a group of dorsal capillary setae. There are two long slender anterior lobes. The posterior cordate lobe has now moved towards the ventral border, and there is no posterior lobe. There are two spines.

In the 4th foot (fig. 17F, and text-fig. 16*a*), the posterior cordate lobe of the 1st and 2nd feet has now definitely assumed its position as the ventral cirrus. The fillet, which lies behind the setae, is attached to the two anterior lobes in the region of the spines, and is thus broken into three sections. The dorsal capillary setae are in two bundles, above and below the dorsal spine, whilst the compound setae have a similar relation to the ventral spine.

The 6th and 8th feet (text-fig. 16*b*) are similar, except that the fillet runs further out along the upper anterior lobe. It then passes direct to the ventral cirrus, and is not fused to the lower anterior lobe.



TEXT-FIG. 16.—Parapodial diagrams of *Glycera alba* var. *cochinensis*, var. nov. *a.* 4th foot; *b.* 6th or 8th foot; *c.* 10th foot; *d.* 40th foot; *e.* 110th foot.
· = capillary setae; x = compound setae.

In the 10th foot (text-fig. 16*c*) the dorsal projection of the fillet now forms a posterior lobe, and is quite free from the upper anterior lobe.

In the 12th foot the posterior lobe is half as long as the upper anterior lobe. The fillet projects slightly outwards behind the lower anterior lobe.

The first branchia appears on the 17th foot, as a short stumpy lobe above the posterior dorsal lobe. It increases in size up to the 30th foot.

The 40th foot (fig. 17H, and text-fig. 16*d*) represents the normal condition. The branchia is very large, 3 or 4 times as long as any of the foot lobes. The upper posterior lobe is always much shorter than the anterior lobes, whilst the lower posterior lobe is only just indicated by the outward curve of the fillet.

Towards the posterior end the various lobes (excepting the dorsal cirrus, which remains short and rounded) become thinner and more pointed. The 110th foot (text-fig. 16*e*) consists only of the dorsal cirrus, the two anterior lobes, and the ventral cirrus. The branchia and posterior lobes have disappeared, and the fillet is perpendicular. The posterior 12 feet are without branchiae. The anal segment bears a pair of long tapering cirri, stout at the base.

The setae are of the usual type. The dorsal capillary setae have slightly flattened blades, with slight traces of a wing. The compound setae have the ends of the shafts unequally bifid (fig. 17J), and slender terminal pieces. The edges of the latter are minutely crenulate, rather than serrate.

I have compared these two individuals carefully with specimens of *Glycera alba*, Rathke, from Ireland, and have been unable to find any differences worthy of specific rank. In the Cochin specimens the branchiae are a little longer, and the lobes of the feet rather more acute, the posterior lobes being shorter relatively. It is also possible that examination of more material would show differences in the structure of the anterior feet, especially in the origin of the posterior lobes. The structure of the proboscis is very similar in both forms.

Glycera africana, Arwidsson (1898, p. 21) and Fauvel (1902, p. 75), seems to be a similar variety of *G. alba*, hardly distinguishable from the present form. It has been recorded from Senegal, Cape of Good Hope, and the Red Sea. The branchiae of the European forms of *G. alba* vary considerably in size, *G. convoluta*, Keferstein, having apparently been described from specimens with very large branchiae. *G. alba*, var. *macrobranchia*, Moore (1911, p. 301), from San Diego Bay, California, is very closely related to the present form. A number of other species will probably eventually be referred to *G. alba*, which appears to have an almost world-wide distribution. It has not, however, previously been found in fresh or brackish water, though its wide distribution indicates great capacity for adaptation.

Habitat.—Two specimens were collected in September, 1914, by F. H. Gravely, in the Cochin Backwater, near Ernakulam, south-west coast of the Madras Presidency. The water is of variable salinity, but precise information on this point is lacking.

Glycinde oligodon, sp. nov.

(Plate XXVII, figs. 18A–Q, and text-figs. 17*a–c*.)

This species is widely distributed in the Chilka Lake. The type specimen is an immature female, 20 mm. long, having 97 setigerous segments. The colour of the body is a dark greenish yellow. In the intersegmental areas of the lateral region the pigment is much darker, except between the parapodia. In the median ventral line there is a row of dark spots—the neural eye-spots—not very distinct in the anterior segments. Each spot is formed, sometimes by a small bar on each side of the intersegmental groove, but more often by two short parallel longitudinal bars crossing the groove. The body is narrow in front, and gradually expands till the beginning of the posterior third. It then tapers a little, more rapidly in the last few segments, but still the tail terminates rather bluntly, especially in small specimens (fig. 18B). The anal segment bears two long cirri, swollen at the base, with long filiform tips. The anus is terminal, and the cirri are ventral, equal in length to the last 9 or 10 segments.

The segments increase in length up to the 22nd, where the length of each is two-thirds of the width, then slightly decrease up to the 28th. Then they suddenly decrease greatly till the length is only $\frac{1}{6}$th–$\frac{1}{8}$th of the width, the latter having at the same time increased. The anterior part of the body is rounded, the middle and posterior regions are flat. In the anterior segments the nerve cords are widely separated (fig. 18A), and are indicated externally by faint lines of pigment, which are thickened to form a dot in the middle of each segment.

The basal ring of the head (fig. 18A) is broad, and has a small deeply seated black eye at each side. No other eyes were observed on the head. The distal ring of the head has four small tentacles, each having a small terminal joint furnished with palpocils. The ventral tentacles are a little in front of the dorsal. The head is composed of the basal ocular segment and eight tapering rings. The dorsal region of the head is defined by lateral grooves.

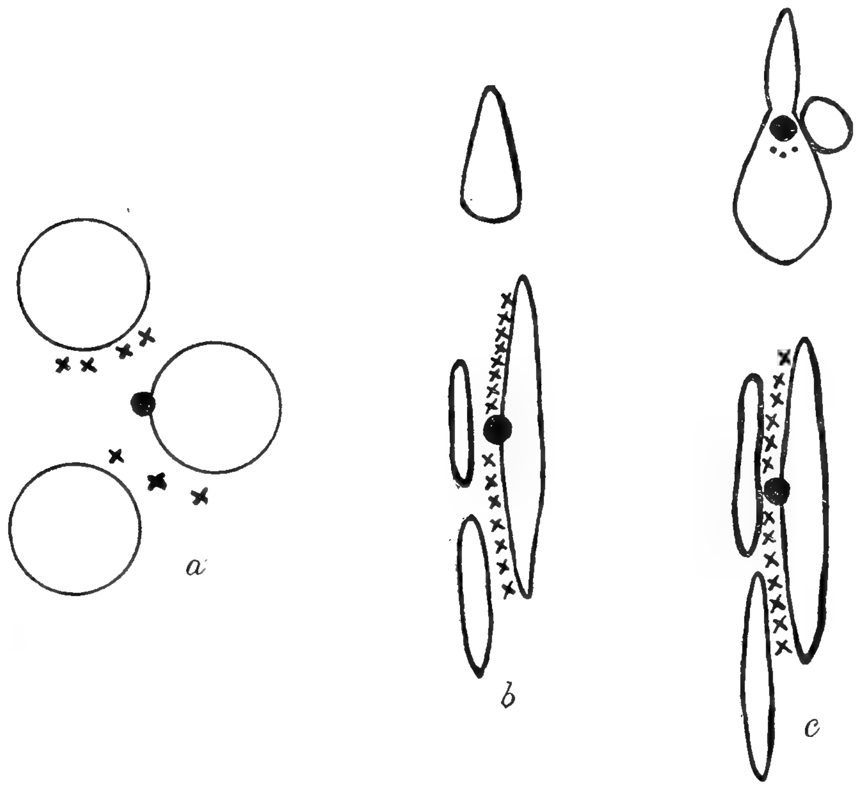
The everted proboscis is armed with two dorsal and two ventral bands of tooth-like papillae or paragnaths (fig. 18C). Each ventral band consists of two rows of papillae. The inner or median row is composed of soft mammillate papillae (fig. 18E), each with a pore at the tip. The outer row is composed of harder thick-walled paragnaths (fig. 18F), each with one large and one small tooth. These outer paragnaths are largest at the proximal end of the everted proboscis, and become smaller and more shapeless towards the distal end. Each dorsal band consists of four irregular rows of paragnaths. Between the bands, in the median dorsal line (fig. 18C), is a row of small rounded horny papillae with transverse apical pores. The paragnaths composing the inner row of each dorsal band are distinguished clearly from the others by their larger size and peculiar shape (figs. 18C and 18D). Each is attached near the middle, and the outer end is expanded to form a knob. The inner end is pointed, and a short distance from the tip on the upper side is a round pore. Lying externally to this row, are three very irregular rows of paragnaths, those in the outer row being usually the smallest. They have simple bases, and the tips may be simple or bifid, with terminal pores. The paragnaths, in addition to being in longitudinal bands and rows, are also arranged in transverse rows, each row being completed in the lateral region of the proboscis by a ridge. On this ridge, on each side, are two flat papillae with pointed angles (figs. 18C, 18G). These ridges and papillae are absent on the basal part of the proboscis, largest in the middle and distal regions.

The jaws (fig. 18H) are disposed in a single row, and are very few in number. There are two large ventral jaws (*a*) each with two or three large blunt roots and six teeth. There are no small jaws between the large pair. There is a dorsal row of four small denticles, each consisting of several rounded lobes (*b*), sometimes with two sharp teeth (*c*), or with four teeth and a larger bifid tooth (*d*) occasionally there is an additional denticle, still smaller and simpler.

The 1st foot is very small, the 2nd a little larger, and the 3rd almost normal in size.

The 1st foot (fig. 18J, and text-fig. 17*a*) consists of three lobes, one in front of the setae and two behind. The small spine, with bent tip, lies behind the front lobe. The setae are all compound, and lie in two groups, 4 beneath the upper lobe, and 3–4 between the anterior and lower lobes. The 2nd foot is similar, and there is an additional seta in each group. The 3rd foot has 9 dorsal and 4 ventral setae. In the 6th foot the anterior lobe is much flatter and wider, and a small lobe appears behind it. The two posterior lobes have moved further apart, and now obviously represent the dorsal and ventral cirri.

At the 10th foot (fig. 18K, and text-fig. 17*b*) all the lobes are flatter. The dorsal cirrus has taken up a more elevated position. It has a rounded ventral projection near the base, and is also indented near the tip, the latter characteristic being very



TEXT-FIG. 17.—Parapodial diagrams of *Glycinde oligodon*, sp. nov.
a. 1st foot; *b*. 10th foot; *c*. 30th foot.
· = simple dorsal setae; × = compound ventral setae.

constant in all the subsequent feet. The anterior lobe is very much enlarged, flat and tapering to a slender tip. There are 8 setae above and 7 below the spine. The 15th foot is very similar, the dorsal spine and setae being still absent. In the 20th foot the dorsal cirrus is still more obviously enlarged near the base, which projects outwards as two small papillae, between which terminate the dorsal spine and one or two slender spines.

At the 30th foot (fig. 18L, and text-fig. 17*c*) the dorsal division consists of the short stout swollen base of the dorsal cirrus, the latter organ, with its indented tip, being carried on the upper surface. Beneath the dorsal cirrus lies the dark reddish brown spine, accompanied by two or three dark brown setae (fig. 18N), which do not pierce the skin. In front of the spine is a small rounded papilla. The ventral division shows little change, except that the posterior lobe is rather larger and wider. In some specimens, however, this lobe is narrower and longer than that shown in fig. 18L. The succeeding feet undergo little change, except that the various lobes gradually become shorter, and the dorsal division relatively increases in size, till at the 90th foot (fig. 18M) it slightly exceeds the ventral division.

The ventral compound setae are of the usual type (fig. 18P, 18Q). The end of the shaft is swollen, and the terminal piece is long and slender, with very minute serrations. The dorsal setae (fig. 18N) are of the shape characteristic for the genus *Glycinde*, having a curved tip with a long slender curved spine on the crest. In none of the feet do they pierce the skin.

This species is characterised (1) by the small number of rings composing the head; (2) by the structure of the proboscis, and especially by the small number of dorsal jaws; (3) by the structure of the feet.

G. oligodon seems to be most closely related to the *G. armigera* described by Moore (1911, p. 307), from California, in rather deep water. It differs in the shape of the paragnaths, the smaller number of dorsal jaws, the smaller number of rings composing the head, and in the shape of the foot-lobes.

Habitat.—Numerous individuals of this species were taken at 12 stations in the Chilka Lake. With one exception these stations were in the south-western half of the lake. The remaining station was in the outer channel, and was worked during September, when the water was quite fresh. At the other stations, 9 of which were worked in the salt-water season, and 2 in the freshwater season, the specific gravity of the water varied from 1·001–1·011. The species was usually taken on a muddy bottom, at some distance from the shore.

Family ARICIIDAE.

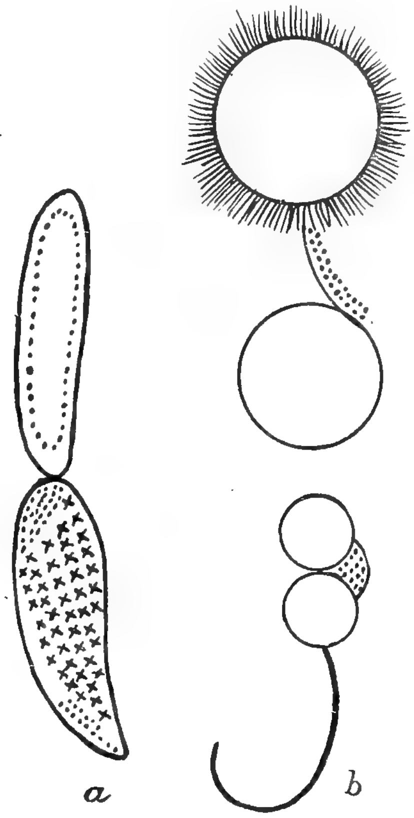
Scoloplos marsupialis, sp. nov.

(Plate XXVII, figs. 19A–G, and text-figs. 18*a*, *b*.)

Only a single specimen of this species was obtained, in the Chilka Lake, but fortunately it is complete. It is a male, and the body cavity is full of nearly ripe spermatozoa. The body is wide and flattened in front, attaining its greatest width at the 13th setigerous segment. It is 50 mm. long, and is composed of 210 segments. The ventral surface is flattened in front for a short distance, but soon becomes markedly convex, and is traversed by a median groove which commences in the 15th segment, and runs to the posterior end. The dorsal surface is convex up to the 5th setigerous segment, and then becomes flat, but the crowding of the parapodia on the dorso-lateral borders makes it appear concave. In the anterior region there is a transverse ridge running round the middle of each segment, dorsally and ventrally. In the middle and posterior regions, each segment is biannulate. The prostomium (fig. 19A) is composed of two rings. The anterior ring is a slender cone, separated by a groove from the posterior ring, which is much wider. The mouth is at the anterior end of the buccal segment, and has two lateral semicircular lips, with a longitudinal slit—the mouth—between them. These lips may possibly represent the proboscis as it begins to be extruded. No eyes were observed. The intestine is full of sand grains.

The 1st foot (text-fig. 18*a*) has dorsally a numerous group of capillary setae, with serrated blades, diminishing in size from above downwards. They are guarded in front by a low insignificant fillet, behind by a rather more conspicuous one. The ventral bundle consists of three or four rows of stout hooks (fig. 19F). Above and below the hooks, and posterior to them are two groups of capillary setae like those in the dorsal bundle. The whole ventral bundle is surrounded by a low and inconspicuous fillet. The 2nd foot is similar. In the 3rd foot the dorsal bundle is relatively a little smaller, and has a small flat cirrus behind it. No cirrus was noted in the ventral division.

In the 4th foot (fig. 19B) there is a conical cirrus behind the middle of the ventral division, as well as the flat finger-shaped dorsal cirrus.



TEXT-FIG. 18.—Parapodial diagrams of *Scoloplos marsupialis*, sp. nov.
a. 1st foot; *b*. 30th foot.
· = capillary setae; x = short hooks.

The short ventral hooks are only present in numbers in the anterior 8 setigerous segments. In the 9th segment only 2 were observed, and in the 10th, none. This type of seta has a number of coarse serrations beneath the rounded tip, which is guarded by two very delicate wings. The shaft shows a double curvature. In the anterior segments the ventral capillary setae are shorter and stouter than the dorsal setae, and the blade is more abruptly widened.

No further change occurs in the feet till the 13th setigerous segment, where the branchiae appear as minute papillae, and the dorsal cirrus commences to elongate. At the 17th foot (fig. 19C) the dorsal cirrus and branchia are very similar in size and shape, but the ventral cirrus is still small. In the 18th and 19th feet (fig. 19D) marked changes commence. The dorsal cirrus and dorsal setae are much longer. The ventral cirrus is longer also, and behind and beneath it is a large thin membrane shaped like a pocket. The latter commences on the 18th segment, and increases a little in size in the succeeding segments. All the setae are now longer, slenderer, and with finer serrations than those in the anterior region, the dorsal setae being longer than the ventral. Each bundle is supported by a number of pale spines. The ventral cirrus, however, still remains entire, and the area from which the ventral setae emerge is still elongate, as in the preceding feet.

In the 20th foot the metamorphosis is complete. The ventral cirrus is bifid at the tip, and the setae emerge in a small area in front of and between the two lobes. The dorsal cirrus is constricted near the base. The ventral setae have also changed again slightly, the blade, instead of tapering very gradually, narrowing abruptly near the tip (fig. 19G). The branchiae have gradually increased, and the 30th foot may be taken as typical of the median and posterior regions of the body (fig. 19E, and text-fig. 18*b*).

The branchiae are large and tapering and covered with cilia. They lie close together near the median dorsal line. The dorsal cirrus is fusiform, and a thin fillet at its base lies behind the dorsal setae. The ventral setigerous lobe is also constricted at the base and bilobate at the tip. The ventral setae emerge in a bunch just in front of the bifid tip, and are guarded by a low anterior fillet. Beneath the ventral division is the delicate pocket-shaped membrane, from which the specific name is derived. It is attached by its anterior edge in a line with the setigerous lobes, and its shorter posterior margin is thus behind the foot. The setae are almost equally long in both divisions. Very little change takes place in the succeeding feet. In the 70th foot the dorsal cirrus is half as long again as the branchia, which is very short and stout, but in the 150th foot the two are equal in length. As only a single specimen was available it is impossible to say whether these variations have any significance. The posterior 10 pairs of feet decrease rapidly in size. The anal segment is large and cylindrical and the anus is terminal. There are two very slender dorso-lateral anal cirri.

This species differs from *S. armiger* (Müller) in many respects. In the latter species the pockets below the feet are absent. The position of the first branchia differs, as does the shape and arrangement of the anterior feet, the shape of the setae, etc.

S. kerguelensis, McIntosh, is easily distinguished from the present species by the shape of the setae, the position of the first branchiae, etc.

Habitat.—A single specimen was found in the outer channel at Manikpatna Island, during the salt-water season, when the specific gravity of the water was about 1·0264. It probably lives there throughout the year, though this remains doubtful, in the absence of material collected during the freshwater season.

Family SPIONIDAE.

Polydora hornelli, Willey.

(Plate XXVIII, figs. 21A–D.)

1905. *Polydora hornelli*, Willey, p. 286.

A single specimen, the posterior part of which is missing, was found in an oyster shell at Manikpatna, Chilka Lake. It exhibits no obvious characters by which it can be distinguished from the *P. hornelli* described by Willey (*tom. cit.*), who obtained his specimens from pearl oysters in the Gulf of Manaar, Ceylon. Unfortunately Willey's description is rather brief, and is illustrated only by a single figure showing one of the modified setae of the 5th segment. He gives no account of the structure of the posterior region, so important in diagnosing the species of this genus, and the absence of the tail in the Chilka specimen prevents me from completing his account.

The single incomplete individual is 31 mm. long, consisting of 92 segments. After preservation in alcohol, it is quite colourless.

The head (fig. 21A) corresponds fairly well with the description given by Willey. The prostomium is slightly indented in front. Between the bases of the tentacles there is an oval area of the prostomium, separated by grooves, which seems to correspond to the 'ocular area' of Willey. The prostomial ridge, or caruncle, runs back to the end of the 3rd setigerous segment. No eyes were observed. The tentacles are stout, long and firmly attached.

The 1st foot has a bundle of ventral capillary setae, with a cirrus (the ventral lamella) behind them. There are no dorsal setae, but just outside the base of the tentacles on each side is a small conical lobe, representing the dorsal lamella.

The dorsal bundles of the succeeding feet have two rows of setae, the anterior row consisting of short setae, the posterior row of long setae.

The 5th setigerous segment (fig. 21B) bears the modified setae. In the middle of the lateral region is a curved row of 8 or 9 stout hooks, alternating with as many pointed setae. At the anterior end of the row is a bunch of capillary setae, the dorsal superior setae. According to Willey (*tom. cit.*) these setae are absent in his specimens. There is no trace of dorsal or ventral lamellae. Beneath the middle of the modified setae is a tuft of capillary setae, representing the ventral bundle.

The tips of the hooks differ according to their position in the row. The oldest hooks, at the anterior end of the row, are worn at the tip (fig. 21C, *a*, *a*[1]), which is spoon-shaped, with a distinct excavation, and a neck below. The unworn posterior hooks (fig. 21C, *b*) have a closely applied tooth, which occupies the concavity of the tip. The latter type is figured by Willey (1905, Pl. V, fig. 117). The capillary setae which alternate with the hooks, and which represent the anterior row of dorsal inferior setae, have rather short flattened blades and slender tips, and the dorsal superior setae resemble them.

The branchiae and ventral crochets appear on the 7th setigerous segment. The branchiae continue to the end of the imperfect worm (the 92nd setigerous segment at least). The crochets (fig. 21D) have a distinct constriction beneath the neck. The main tooth is long and pointed, making an angle somewhat less than 90° with the shaft. There is a simple tooth on the crest, making an angle of 45° with the main tooth.

This specimen is very close to the *P. hornelli* of Willey. The chief differences are (1) the caruncle extends over the 3 anterior setigerous segments, whereas Willey gives 2 segments for his specimens; (2) the dorsal superior group of setae of the 5th setigerous segment is present in the Chilka specimen, absent in the Ceylon specimens. It is possible that a closer examination of the Ceylon specimens would show other differences, which would necessitate the creation of a new species for the Chilka form, but meanwhile it may be regarded as a variety of Willey's species. There is no doubt but that this species is distinct from *P. ciliata* (Johnston).

Habitat.—In crevices of oyster shells, Manikpatna, Chilka Lake. The specimen was collected in September, when the water was quite fresh. From the nature of its habitat it is highly probable that it survives through the salt-water season.

Polydora (Carazzia) kempi, sp. nov.

(Plate XXVIII, figs. 20A–J.)

Five specimens of this species were collected from a canal near Calcutta. Unfortunately the specimens are all incomplete, and nothing is known of the posterior end. The longest fragment is 6·5 mm. long, composed of 27 setigerous segments. The body is of the usual shape, the anterior region being flattened dorsally, somewhat rounded ventrally. Near the 17th segment the body becomes round in section. The anterior segments are short, but gradually elongate, till at the 20th they are nearly as long as broad.

The anterior segments have each a single transverse line of black spots on the dorsum, but the line is sometimes reduced to two median spots.

The head (fig. 20A) is rather small and broad. It bears in front two short but distinct anterior lobes. There are four black eyes, the two posterior being small and round, whilst the anterior pair, which are more widely separated than the others, are crescentic. The posterior margin of the head is rounded, and there is no caruncular prolongation, but instead there is a large erect occipital tentacle, lying between the bases of the tentacular cirri. The latter organs are relatively large.

The 1st foot (fig. 20C) consists of a stumpy round dorsal papilla, without dorsal setae. The ventral setigerous lobe is vertically elongate, with a row of slender capillary setae, which have only slightly flattened blades.

The 2nd foot has a fairly large rounded dorsal lamella lying behind the dorsal setae. The dorsal setigerous lobe is conical, and the setae are long and slender, with only slight indications of a wing. The ventral setae are shorter and wider than the dorsal, with narrow wings.

In the 3rd foot the lower dorsal setae are wider than those in the 2nd foot, and have wings. The ventral setae have increased in size, and are very distinctly flattened, with slender tips. These changes are much more marked in the 4th foot (fig. 20D), especially in the dorsal division. The upper dorsal setae remain long and slender, with very narrowly winged tips, but there is a gradual transition to the lower ones (fig. 20G), which are short and boldly curved, with widely winged blades. The ventral setae, in two rows, are all lance-shaped (fig. 20H), those at the lower border being very slender. The lower edge of the dorsal bundle curves backwards a little, as in *P. antennata*, Clap. (Mesnil, 1896, p. 228), and this tendency is much more obvious in the next segment.

The 5th foot (fig. 20E) seems to be less modified than that of any other species of *Polydora*, and is very similar in structure to the 4th foot, as may be seen from a comparison of figs. 20D and 20E. Mesnil (1896, p. 235) on the contrary, expresses the view that in *P. polybranchia*, Haswell, and *P.* (*Carazzia*) *antennata*, Clp., the 5th segment has undergone greater modification than in any other species of *Polydora*. This opinion is apparently based on the presence, in these two species, of two kinds of modified setae in the 5th segment. If the 4th and 5th feet of *P. kempi* (a species very closely related to *P. antennata*) are compared, it will be apparent that the only difference of note is in the shape of the dorsal inferior setae. In both feet the dorsal and ventral lamellae are similar, the dorsal and ventral bundles are vertically elongate, the dorsal superior setae are very long, with narrow wings, and the ventral setae are lance-shaped. In the 5th foot the dorsal inferior setae are sharply differentiated from the other setae. They consist of two rows, 11–15 in a row, of modified setae (figs. 20E and 20F). The anterior setae are bilimbate capillaries, short, with very broad wings and rapidly tapering filiform tips. The posterior row consists of rather stout hooks with curved tips. There is not much difference between the setae of the anterior row and the dorsal inferior setae of the 4th foot. Moreover, though the row of dorsal setae is distinctly curved at the lower end (fig. 20B), a similar tendency is observed in the 4th foot. If the 5th foot of *P. kempi* is compared with that of a typical *Polydora* (as in fig. 21B), it is difficult to see how Mesnil's assertion can be maintained. In the typical 5th foot, the dorsal and ventral lamellae are absent, and the general disposition of the dorsal and ventral bundles is more modified. The anterior row of dorsal inferior setae are usually modified as much as, or more than, those of *P. kempi*. The curvature of the dorsal row of setae of the 5th foot in *P. kempi* is much less than in the case of *P. antennata*, as figured by Mesnil (1896, Pl. XIV, fig. 22), or Carazzi (1893, Taf. 2, fig. 12).

The 6th foot is very like the 4th, but the dorsal lamella is not quite so large. The setae are as in the 4th foot, except that the posterior row of the ventral division is composed of very slender thread-like setae.

There are two pairs of glandular pouches in the 6th and 7th segments, as in *P. antennata*.

In the 7th setigerous segment the branchiae appear. They are quite free from the dorsal lamellae, and at first are large. They are only 10–12 pairs of them, and the last few pairs are very small.

In the 8th foot the ventral crochets appear (fig. 20J). They are 18–20 in each foot, and they are not accompanied by any capillary setae. On the crest there is a slender tooth so closely applied to the main fang that there is no angle between them. The shaft swells gradually above, and abruptly below, the narrow waist. The longest crochets are in the middle of the row. These crochets greatly resemble those of *P. antennata*. The dorsal setae are longitudinally striated, slender, and very narrowly winged, the lower ones being short but narrow. The wide form of the 4th foot has disappeared.

In the 18th foot the dorsal setae, 8 or 9 in number, are very long and slender, wingless, or with indistinct wings. They emerge in a bunch, and no longer form a transverse row. The branchia is reduced to a small papilla, and the lamellae and fillets are small. In this region of the body the feet are insignificant, and project only slightly. In the absence of the posterior region it is impossible to be certain, but the insignificance of the feet in the middle of the body would seem to differentiate this species from *P. antennata*, where, according to Mesnil, the feet of the posterior region are very prominent, and the dorsal lamellae and fillets are well developed.

Moreover, in the latter species the branchiae extend from the 7th foot to the 40th or 50th.

There is no pharynx in this species.

None of the specimens was sexually mature, and probably they are not fully grown, so that changes may occur as growth proceeds.

There is no doubt that this species has its closest affinities with *P. antennata.* It resembles it, and differs from other species of Polydora, in the structure of the 5th setigerous segment, which is only slightly modified, and in the appearance of the crochets in the 8th setigerous segment and in their shape. In other ways the two species are alike. I agree with Mesnil that these differences justify the separation of *P. antennata* and the creation for it of the genus *Carazzia*, in which the present species must also be placed.

Habitat.—Five specimens were collected in October 1914, in a canal at Chingrighatta, near Calcutta. The specific gravity of the water was 1·004.

Family AMMOCHARIDAE.

Myriochele picta, sp. nov.

(Plate XXXI, figs. 30A–F.)

Very numerous specimens of this species were included in the collection, all from the Chilka Lake. Unfortunately, the tubes are so narrow and tough, and the animals so fragile and firmly attached to the tubes, that it is almost impossible to extract an entire specimen. Frequently, also, the posterior extremity seems to be missing, or to have been regenerated to a certain extent.

The tubes are very uniform in size, 7–11 mm. long, and only 2 mm. in width. They are composed of a tough inner membrane, covered on the outside with small quartz grains (fig. 30B). The posterior end of the tube is somewhat narrowed, and is covered with rather smaller quartz grains than the anterior end.

The worms themselves are 3–4 mm. long. No specimens containing sperm or ova were observed, so that possibly the worms attain greater dimensions, but their uniform size, whether found in February or September, tends to show that they are fully grown.

On the back of the head, opposite the anterior end of the mouth, is a conspicuous patch of reticulate purplish brown pigment (fig. 30C). This patch is fairly constant in occurrence, though of variable size and density. At the posterior end of the buccal segment is a transverse dorsal band of similar pigment. A fainter band may occur near the anterior dorsal margin of the first thoracic segment, and smaller patches are sometimes found on other parts of the head, though these are frequently absent, at least in the preserved animals.

A specimen, apparently complete (fig. 30A), was extracted from its tube. It is 3·5 mm. long, and consists of the head and 16 setigerous segments, of which 3 are thoracic and 13 abdominal. The head and buccal segments (fig. 30C) are quite fused, and frequently marked off from the thorax by a constriction. The head is sometimes swollen and bent, as in fig. 30A. The mouth forms a conspicuous opening on the ventral surface (figs. 30C, 30D). It is surrounded by a thick folded lip, which is richly ciliated.

The thoracic segments, 3 in number, are provided on each side with a group of capillary setae, 2–4 in number, and lateral in position. No hooks are present on the thorax.

The first abdominal segment is as long as, or a little longer than, the three thoracic segments. The second abdominal segment is still longer, and is the longest segment of the body. The succeeding eight segments diminish only very slightly in length, but the three posterior segments are much shorter, especially the two last. The anal segment is conical. All the abdominal segments are provided with dorsal capillary setae and ventral hooks. The capillary setae are 1–5 in number. The proximal part of the seta is smooth, the distal part spinous, but the spines are so small that even under a magnification of 1300 diameters they are indistinct. The thoracic setae are slightly thicker than those of the abdomen.

In the ventral tori the hooks are arranged in irregular transverse rows. The anterior segments contain 25–35 in each torus, the middle segments sometimes 55–65, the posterior segments as few as 5–10. The hook (fig. 30E) has a straight tapering shaft, a distinctly constricted neck, and above this a boldly curved bifid tip. The teeth at the tip vary considerably in thickness, the two represented in fig. 27E being the extremes. One hook is placed above the other, so that when seen from above (fig. 30F) only a single tooth is visible. In the anterior abdominal segments the setae are near the front part of the segment, but in the posterior segments they are at the back.

The head and buccal segment are almost entirely occupied by the buccal mass (figs. 30C, 30D). Passing backwards from the mouth, and lying beneath the buccal mass, is a clavate diverticulum, probably homologous with the "Lippen-organ" described by von Drasche in *Owenia fusiformis*, D. Chiaje, and later by Watson, but not previously noted in *Myriochele*. The narrow oesophagus lies in the two anterior thoracic segments. In the third thoracic segment it passes into a somewhat swollen 'pharynx.' This is succeeded by the swollen intestine, which, in the first abdominal segment, is composed of a mosaic of flattened granular cells, and differs markedly in appearance from the succeeding and narrower part, though the transition in the second abdominal segment is gradual. The intestine is full of organic debris, and contains numerous diatoms, but no sand is present. A septum divides the buccal from the first thoracic segment, and another lies between the second and third thoracic segments. No septa could be distinguished in the anterior abdominal segments, but they are present in the posterior segments, just behind the bundle of setae. In *Owenia fusiformis* all the segments, except the three thoracic, are separated by septa.

Five pairs of 'thread glands' are present (fig. 30D), a pair in each of the three thoracic segments and in the two anterior abdominal segments. The thoracic glands are small, those in the third segment being the largest, whilst those in the abdominal segments are very long. The thoracic glands open to the exterior by minutes pores near the setae, the abdominal glands between the dorsal and ventral setae. In *Owenia* there are 6 or 7 pairs of glands in the anterior segments, those of the third thoracic segment being sometimes small or absent. In *Myriochele heeri*, according to Hansen (1882, pp. 41, 42), there is a pair of glands in each of the long segments, and he shows 14 such segments (*tom. cit.* T. vi, fig. 6). Fauvel (1914, p. 264) says that in *M. heeri* there is a pair of glands in each segment. McIntosh (1885, p. 410) refers a form dredged in 2975 fathoms, east of the Antilles, to the same species. The great depth at which it was taken, the large size of the specimens, and the fact that both extremities were missing when McIntosh examined the material, make the identification more than doubtful. McIntosh quotes the statement of Dr. v. Willimoes-Suhm, who examined the specimens when they were captured, that "there is a pair of glands in each of the segments, from the second to the seventh." This agrees more closely with the present form, in which they occur in segments 2–6.

The *Psammocollus australis* of Grube (1867, p. 30) from St. Paul, appears to differ from the present species, so far as one can tell from the rather imperfect description and figures, in a few points, such as the size, position of the thoracic setae, shape of the hooks, which have only a single hook at the tip, and the larger number of capillary setae per bundle. Glands were observed to accompany the first and three following girdles of hooks, that is to say, in the four anterior abdominal segments.

Habitat.—This species was found on 6 occasions, in the southern part of the lake, between Kalidai I. and Rambha. Five occasions were during the salt-water season and one during the freshwater period, but the specific gravity of the water only varied between 1·005–1·01. The specimens were taken on a muddy bottom, in a fine-meshed net attached to the trawl.

Family CAPITELLIDAE.

Heteromastus similis, sp. nov.

(Plate XXIX, figs. 23A–23H.)

In addition to two very small specimens, one complete individual and a number of fragments are available for study. The description is drawn up from the complete individual (the type specimen). It is 55 mm. long, composed of 212 segments. Some of the other fragments apparently belong to rather larger individuals, and as no trace of sexual products was found, the mature individual is doubtless larger still. The body is long and slender, swollen at the anterior end, and tapering very gradually to the tail. In the preserved specimens the thoracic segments are pale buff colour, the abdominal segments greyish brown with a tinge of purple.

The head (fig. 23A) is small and pear-shaped, consisting of a wide basal part and a much narrower tip. It usually projects freely, but may be partly contracted beneath the anterior border of the peristomium. No eyes were observed. The basal part of the proboscis is thin-walled, and is covered regularly with mammillate papillae. The walls are full of clear oval refringent bodies. The anterior five segments are usually swollen, and the inter-segmental grooves are faint. Behind the 5th (the 4th setigerous) and the succeeding segments the grooves are deeper, and there are faint transverse grooves in line with the setae. Beginning on the 1st setigerous segment there is on each side of the body a shallow groove, and these, combined with the broad and shallow ventral groove, produce two ventro-lateral ridges, carrying the ventral setae, somewhat in the manner of *Ammotrypane*. The ridges fade away in the middle of the body.

The thorax consists of 12 segments, the 1st being achaetous. The 5 anterior setigerous segments have rather short capillary setae in both dorsal and ventral bundles. The dorsal setae (fig. 23F) have broad tapering wings. The ventral setae are very similar, except that the wings are rather narrower, more elongate, and proximally do not taper so gradually. There are 7–15 setae in the dorsal bundles, 4–14 in the ventral bundles. In the 1st and 2nd feet the dorsal setae are in two rows, in the other bundles only in a single row. In the 7th–12th segments all the bundles are composed of long crochets (fig. 23G). The distal quarter is widened, and enclosed in a sheath. The shaft narrows beneath the tip, which has a large tooth, with two small and indistinct spines on the crest. The shaft is long, doubly curved, and has no nodular swelling.

In the 1st setigerous segment the dorsal bundles of setae are separated by a space rather greater than that which separates the dorsal and ventral setae on each side. In the subsequent thoracic segments this interval is only slightly reduced, but in the 12th setigerous segment—the 1st abdominal—the dorsal bundles lie close together near the median line. The setae in the abdominal segments are surrounded by tumid lips, which are absent in the thoracic segments.

In the thoracic segments the setae lie in the middle of the segment, but in the abdominal region the setae are near the posterior border. Furthermore, in the anterior region the segments are as long as broad, but they gradually shorten, till in the mid-region they are three or four times as wide as long. The length again increases in the posterior region till it equals half the width. In the middle of the body the constrictions between the segments are very deep, especially in the dorsal region. The abdominal setae are all very short crochets (fig. 23H), and have a nodular swelling in the middle of the shaft. There are 10–15 of them in each bundle.

The structures which, in this genus, are supposed to have a branchial function, consist of a number of lobes projecting from the posterior part of each segment. There are two of them on the dorsal surface (fig. 23C), carrying the dorsal setae, two in the latero-ventral region (figs. 23D, 23E) carrying the ventral setae, and one in the mid-ventral region, overlying the nerve-cord. The dorsal lobes, which make their appearance near the 100th segment, are by far the most conspicuous. The ventral lobes appear near the 140th segment, and are smaller and more rounded than the dorsal pair. In the last few feet the branchial lobes are small and inconspicuous. In other specimens the branchiae are on fewer segments, but this may be due to regeneration of the posterior region.

The anal segment bears ventrally a slender clavate tail, ·33 mm. long (fig. 23B).

The type of this genus is *Heteromastus filiformis* (Clap.). It is known from the Mediterranean, the west coast of France, and Belgium (Ostend), and from several localities on the east coast of North America (Eisig, 1887, p. 839). The two forms are apparently so closely related that it is difficult to distinguish them. The Chilka Lake species is the smaller (55 mm. as against 100 mm.), but has more segments (212 against 140). The head, arrangement and structure of the setae, the branchiae and tail are almost identical. Eisig's figures of the branchiae (1887, Taf. 27, fig. 18) shows a lobe on each side, between the dorsal and ventral lobes, which is absent in the Chilka Lake specimens (fig. 23E). In *H. filiformis* the anterior abdominal segments are much longer than the thoracic segments, whereas in *H. similis* the lengths do not differ. Moreover, though considerable work has been done in the intervening area of the Red Sea and Persian Gulf, *Heteromastus* has not been found there. I have not been able to examine specimens of *H. filiformis*, but it is probable that a comparison of the two species would reveal other differences, whilst possibly reducing the importance of those mentioned above.

Habitat.—This species was taken at three localities in the Chilka Lake, between Nalbano and Berhampur, that is, near the inner end of the outer channel. Two of these stations were worked in March and one in September. The specific gravity of the water ranged from 1·000–1·0261. The species was taken once on the shore, twice in a few feet of water.

Genus **Barantolla**, gen. nov.

Capitellidae having 12 thoracic segments, of which the 1st is achaetous. Segments 2–7 have only capillary setae, segments 8–12 only elongate crochets. The abdominal segments have short crochets only. The anterior thoracic segments have reticulate markings on the skin, and the sculpture of the thoracic segments is rather elaborate. Branchiae in the form of short finger-shaped lobes behind the dorsal setae of the middle and posterior segments. These segments are provided each with a membranous collar, produced into four shallow parapodial lobes.

This genus shows marked affinities with *Heteromastus* and *Mastobranchus*, and it is evident that the three genera are closely related. They all possess 12 thoracic segments, of which the 1st is achaetous. *Barantolla* agrees with *Heteromastus* in having capillary setae on the anterior, long hooks on the posterior thoracic segments, and only short hooks on the abdominal segments, but differs in having capillary setae on the segments 2–7, whereas *Heteromastus* has them only on segments 2–6. *Mastobranchus* is peculiar in having capillary setae only, on the thoracic segments, and in the dorsal bundles of a number of the anterior abdominal segments. On the other hand, *Barantolla* agrees with *Mastobranchus* in having finger-shaped branchiae, situated behind the dorsal setae of the middle and posterior segments. The parapodial lobes (branchiae) of *Heteromastus* are very like those of *Barantolla*. *Heteromastus* and *Mastobranchus* are peculiar in having finger-shaped appendages on the anal segment, and it is unfortunate that no information is available on this point for *Barantolla*. The general appearance of the abdominal segments is very similar in all three genera. The affinity between *Barantolla* and *Mastobranchus* is also indicated by the crenulated skin of the anterior thoracic segments, and by the discovery in the species of *Mastobranchus* described below of two elongate crochets in the ventral bundle of the 12th segment (*vide* p. 646).

A comparison of these three genera, based on a much more ample supply of material, would probably lead to considerable modifications.

The form described by Stephenson (1908, p. 39) from brackish ponds at Port Canning, Lower Bengal, as *Matla bengalensis* may be related to one of the above genera. The specimens examined were very young, 1·5–4·5 mm. in length, and there is little in the description to indicate what the adult would be like.

Barantolla sculpta, sp. nov.

(Plate XXIX, figs. 24A–K.)

This species is represented by a number of fragments, including the anterior ends of four individuals. Unfortunately the posterior end is not present in any specimen.

The largest fragment is 117 mm. long, composed of 135 segments. Judging from the appearance of the last few segments, the missing portion of the tail is quite short. The body is widest near the 4th or 5th setigerous segment (1·7 mm. wide), and gradually tapers till near the 30th segment. It then remains fairly uniform in diameter for a long distance, expanding again a little near the posterior end. The length of the segments varies considerably, according to their position. In the type-specimen the approximate ratio of the width to the length is in segments 1–5, 3 to 1; segments 6–14, 4 to 1; segments 15–20, 3 to 1; segments 21–35, 2 to 1; segments 36–43, $1\frac{1}{2}$ to 1; segments 44–55, 1 to 1; segments 56–70, a little less than 1 to 1; segments 71–80, 1 to 1. The segments then gradually become shorter towards the tail, and the last segments are 6–8 times as wide as long.

The head in all the specimens is contracted, and withdrawn under the peristomium, and hence it is difficult to describe accurately. It is conical, composed of two rings, a wide basal, and a narrower terminal. The latter, in its contracted condition, is rounded. No eyes could be seen, but behind the basal ring of the head is an irregular transverse row of deeply embedded black pigment spots, which, however, may have no optical function.

The proboscis is partially extruded (fig. 24A), and this part is covered with very minute papillae.

The thorax consists of 12 segments, of which the first is achaetous. In the first four segments, and to a lesser degree, in the anterior part of the 5th, the skin is distinctly tessellated (figs. 24A–C), but on the succeeding segments it is smooth, except for ridges caused by unequal contraction of the skin.

Segments 2–7 have capillary setae only, segments 8–12 long crochets only, and the abdominal segments short crochets only. In the thoracic segments the setae are near the middle of the segment, but in the abdominal segments they are near the posterior end. Each of the abdominal segments is in two parts, an anterior narrow smooth part, and an expanded posterior part, the latter bearing the swollen tori. The dorsal tori (fig. 24C) are widely separated in segments 2–4, and then gradually approach each other, till from the 12th segment backwards the tumid lips of the tori form a dorsal ridge.

The sculpturing of the integument of this species is very characteristic. On the ventral surface (fig. 24A) there is, in the median line of segments 2–5, a row of hexagonal areas, 2 or 3 in each segment. These are replaced in segments 6–12 by raised areas not clearly marked off except by a median transverse groove. In segments 5–12, on each side of the raised median areas, are narrow hexagonal areas, the outer ends of which reach to the ventral setae. In side view (fig. 24B) the lateral organs are clearly shown in segments 5–12, less clearly in segments 2–4, and are very indistinct on the abdominal segments. Dorsally (fig. 24C) there are median hexagonal areas on segments 6–11. A shallow lateral groove runs backwards on each side from the 13th segment, but occasionally it begins near the anterior end. It is probably due to the contraction of the specimens, and the presence of very powerful longitudinal latero-ventral bands of muscle.

The branchiae commence between the 55th and 60th segments. They lie under the dorsal parapodial lobes (figs. 24D–E). The anterior branchiae consist of 3 or 4 short rounded lobes, hidden by the parapodial lobes. Towards the tail the branchiae increase in number and length. The largest, near the posterior end, have 9–11 finger-shaped lobes, attached to the underside of the dorsal parapodial lobes (fig. 24E). The latter structures are part of a thin membrane which surrounds the segment like a collar, the anterior margin being fixed, the posterior one free and produced into four rounded lobes, the two larger carrying the dorsal setae, the two lateral, which are not so pronounced, carrying the ventral setae. The collar is attached to the body-wall near the middle or the beginning of the posterior third of the segment. The appearance of this part of the body is very like that of *Heteromastus*.

In segments 2–7 the dorsal and ventral tori contain only capillary setae. They have narrow wings (fig. 24F), and taper to a slender tip. The bundles of the 2nd segment (1st setigerous) have about 16 setae in each, the 3rd–7th segments have 20–40 setae in each bundle. In segments 8–12 the bundles contain only long crochets (fig. 24G), which closely resemble the similar setae of *Heteromastus*. The tip (fig. 24H), which is enclosed in a long narrow sheath, is not expanded as in *Heteromastus*. It terminates in a strong tooth, with 5 or 6 slender spines on the crest. There is a very slight nodulus where the seta pierces the skin. The nodulus lies just within the proximal half of the seta. Each bundle contains 20–40 of these setae.

The transition between the thoracic crochets and the typical abdominal crochets is not so abrupt as in other species of the family. The typical abdominal crochets are much smaller than those of the thorax (fig. 24K), they have a more distinct swelling below the neck, the sheath over the tip is relatively shorter, and the nodulus is more distinct, and is in the distal half of the seta. On the anterior abdominal segments, the setae (fig. 24J) are intermediate in size, rather more like the thoracic than the abdominal crochets in shape, with only a slight expansion below the neck, but they have short wings over the tips, and the nodulus is in the distal half, though only slightly developed. The length of these crochets is as follows :—

On the	8th	segment,	·33 mm.
,, ,,	13th	,, ,	·25—·26 mm.
,, ,,	14th	,, ,	·15—·17 mm.
,, ,,	60th	,, ,	·05—·06 mm.

Passing towards the tail the abdominal setae become fewer and smaller. In the 13th foot there are 25 in a bundle, on the 60th foot 10, and on some of the posterior feet 2 or 3, or none at all. The spines on the crest of the crochets form a transverse curved row, the concavity facing the terminal tooth.

Habitat.—This species was collected in some brackish pools near the salt lake at Barantolla, near Calcutta, in November. The salinity of the water is very variable, but never high, probably never exceeding 1·015.

Mastobranchus indicus, sp. nov.

(Plate XXX, figs. 25A–F.)

This description is founded on a single specimen from brackish pools, near Barantolla. Unfortunately only the anterior end is available, in a very contracted condition. It is 46 mm. long, and consists of 90 segments. The widest part is near the anterior end, where it is 3 mm. wide. The fragment evidently belongs to an individual considerably larger than the specimens of *Barantolla sculpta*.

The head (fig. 25A) consists of a small rounded lobe, withdrawn under the buccal segment. No trace of eyes or nuchal organs could be found. The skin of segments 1–6 and the anterior part of 7 is tessellated, the grooves being deeper in the anterior segments. The thorax consists of 12 segments, of which the 1st is achaetous. The sculpturing of the thorax recalls that of *Barantolla sculpta* (compare fig. 25A and fig. 24A), but is not so distinct or general. On the ventral surface hexagonal areas occupy the median line in segments 5–8 and the anterior part of 9. The ventro-lateral narrow hexagonal areas are clearly differentiated on segments 6–9, less clearly on segments 3–5. In segments 10–13 these areas gradually coalesce with the tumid tips of the ventral tori. The lateral organs are not very distinct, but narrow hexagonal areas, clearly marked off by grooves, lie between the dorsal and ventral setae in segments 5–8. They probably exist in other adjacent segments, but are not distinctly differentiated in this specimen. On the dorsum narrow transverse hexagonal areas occur between the dorsal bundles of setae in segments 5–11. As is the case with all the other areas, lateral and ventral, it is the posterior groove which disappears first, the anterior grooves remaining on many posterior segments, forming a complete groove round each segment. Four pairs of genital pores were observed, behind segments 8–11. In the lateral region there is a deep groove on each side, commencing in the 6th segment, and these, combined with a shallow ventral groove, help to form two ventro-lateral ridges, containing the stout longitudinal neural muscle bands.

The tori in segments 2–4 are very short, containing about 20–30 setae. Segment 5 has rather longer tori, and on the 6th and subsequent segments the tori are 3–4 times as long, and contain 50–60 setae. There is no very obvious external difference between the posterior thoracic and the anterior abdominal segments. The latter are divided into two rings, a smooth anterior and a slightly enlarged posterior ring, the latter bearing the tori with their tumid lips.

The setae of segments 2–4 are rather short, with pointed tips, bilimbate, with narrow wings. The ventral setae closely resemble the dorsal setae (fig. 25B), and they are very similar to the capillary setae of *Barantolla sculpta.* The thoracic setae are all capillaries with the exception of two in the right ventral bundle of the 12th segment (11th foot). This bundle contains 45 setae, of which 43 are normal capillaries. The other two are elongate hooks, very similar to those in the posterior thoracic segments of *Barantolla sculpta.* The nodulus is only slightly indicated. It is well in the distal half of the shaft, thus differing somewhat from the similar setae of *Barantolla sculpta.* The shaft is widest near the lower end of the wing, and narrows gradually towards the neck, beneath the hooked tip. In the absence of any marked widening of the shaft below the neck, these setae resemble those of *Barantolla sculpta* and differ from those of *Heteromastus similis* (compare figs. 23G, 24G and 25C). The tooth at the tip is rather slender, and makes an obtuse angle with the shaft. Behind the tooth the crest bears 5 or 6 slender spines. These setae are ·52 mm. long, a little shorter than the capillaries of the same bundle, which are ·6 mm. long. Except for the hooked tip, they greatly resemble the capillary setae in general appearance. No other crochets were found in the thoracic tori. The setae of the corresponding ventral bundle on the left side of the body were all broken, except a few, which had capillary tips. In the 11th segment all the setae were capillaries. Owing to the lack of material it is impossible to elucidate the significance of the presence of these two elongate crochets. The resemblance they exhibit to the similar setae in the posterior thoracic segments of *Heteromastus* and *Barantolla* indicates the close affinity existing between these three genera, and their presence in this specimen may represent a reversion to an ancestral type which possessed them normally in the posterior thoracic segments. On the other hand it is possible that these setae occur normally in the young and immature stages of *Mastobranchus indicus,* and are replaced by capillaries as the individuals approach maturity.

The dorsal bundles of the 13th and 14th segments each contain about 40 capillary setae, similar to those in the thoracic feet, and there are no crochets accompanying them. The ventral bundles contain only crochets, about 40 in each bundle. These differ considerably from those in the last thoracic ventral bundle (figs. 25D, 25E). The nodulus is distinct, in the distal part of the shaft. The shaft shows a distinct swelling below the neck. These setae are only ·28 mm. long. The wing, enclosing the tip, is relatively short. The terminal tooth makes rather a wide angle with the shaft, and on the crest behind it are two transverse rows of spines. In the dorsal bundle of the 15th segment there are only crochets, ·33 mm. long, in shape like those of the ventral bundles. In the 20th segment the dorsal crochets are ·174 mm. long, the ventral crochets ·108 mm. long. The nodulus is very distinct, but the swelling below the neck is not so evident. In the 50th segment the dorsal crochets are ·12 mm. long. In the ventral bundle there are 63 crochets, ·1 mm. long (fig. 25F). The nodulus is very distinct, in the middle of the shaft.

From Garia, near Calcutta, in December 1910, were obtained two fragments of a Capitellid, which may belong to the present species or to *Barantolla sculpta*. They are both from the middle of the body, but one is evidently from a more posterior region than the other. Both fragments have very powerfully developed ventro-lateral muscles, which are more prominent than those of *Barantolla sculpta*. One fragment has branchiae on each segment, behind the dorsal setae. They are very similar to those of *Barantolla*, but rather longer, consisting of 5–7 finger-shaped lobes. The dorsal tori are more elongate and the setae more numerous than those of *Barantolla*. In the absence of any knowledge of the structure of the middle and posterior regions of *Mastobranchus indicus*, it is not possible to assign these fragments to any species at present.

The present species is assigned to the genus *Mastobranchus* by virtue of the structure of the thorax and anterior segments of the abdomen. A knowledge of the structure of the anal appendages, and branchiae (if any are present) is necessary to modify or confirm this conclusion.

In view of the great resemblance between this species and *Barantolla sculpta*, and the presence of both forms in the brackish ponds near Barantolla, the question arises whether the latter does not represent a stage in the growth of the former. All the specimens of *Barantolla* available are immature. In the sculpture of the skin, shape of the anterior end, and the form of the setae there is close resemblance. On the other hand, all the specimens of *Barantolla sculpta* agree in having capillary setae on segments 2–7, long crochets on segments 8–12, and only short crochets on the anterior abdominal segments. *Mastobranchus indicus* has capillary setae only, on the thoracic segments 2–12, with the exception of the two long crochets noted above, and capillary setae in the dorsal bundles of the two anterior abdominal segments. If *B. sculpta* is only a stage in the development of *M. indicus*, then the completion of the metamorphosis has been postponed to an unusually late period, as the specimens are at least 120 mm. long. On the whole I am inclined to regard the two forms as distinct, but the question can only be definitely settled by the examination of more material, at different stages of growth.

Habitat.—A single imperfect specimen from brackish pools, salt lakes, Barantolla, near Calcutta. The specific gravity of the water is very variable, but never high, probably never exceeding 1·015.

Family MALDANIDAE.

Euclymene annandalei, sp. nov.

(Plates XXVIII, figs. 22A–G, and XXIX, figs. 22H–K.)

This species is represented by numerous specimens, collected at 11 stations, all in the south-western end of the Chilka Lake. Apparently they live in tubes, but these are so brittle that only a few fragments remain, composed of sand grains. The body varies from 40–80 mm. in length, and each complete individual is, without exception, composed of the head, buccal segment (achaetous), 21 setigerous segments, 2 posterior achaetous segments, a funnel-shaped ring, and the caudal ring.

The preserved specimens are almost colourless, except for the ocelli. Epidermal glands were diffusely scattered on the head and anterior segment (fig. 22A). On the 1st, 2nd and 3rd setigerous segments there is a narrow ring of glands in the anterior part, in front of the setae, the 3rd also having scattered glands over the whole skin. The 4th setigerous segment has bands of glands in front of and behind the setae. In the 5th–8th setigerous segments the epidermis in front of the setae is thickly covered with glands, as well as the parapodial pads. In the subsequent segments there is a strong longitudinal mid-dorsal band of glands and the parapodial pads are thinly covered. There are also narrow diffuse longitudinal bands running in the line of the dorsal setae. Beginning in the 7th setigerous segment there is a conspicuous double band of glands on the mid-ventral surface, lying over the ventral nerve-cord, and running back to the caudal ring.

The head (figs. 22A–C) has a large and concave dorsal cephalic plate. The frontal process is fairly large and rounded. The sides are thin and broad, divided by indentations into two lateral smooth areas with entire borders, and a posterior (dorsal) crenate portion of eight rounded lobes. The nuchal grooves are rather long, almost parallel, and are separated by a narrow high keel. On the tip of the ventral side of the prostomium (fig. 22D), in front of the mouth, are 4 elongate patches of very numerous reddish-brown ocelli. The two median patches lie partly under the frontal process, and in some cases are fused in the median line. The two other patches are more lateral in position. The proboscis is partly extruded in several specimens. Its proximal portion is covered with low conical papillae, which are largest near the mouth, and the distal region is smooth.

The buccal segment and prostomium combined are rather longer than the 1st setigerous segment. Setigerous segments 1–6 are approximately equal in length, the proportions varying greatly in different individuals, according to the degree of contraction. The 7th setigerous segment is rather longer, and the 8th is the shortest of all. The following segments are considerably longer, diminishing a little towards the tail, the last setigerous segment—the 21st—being rather short. Then follow two achaetous segments, the second of which is very short. The latter is prolonged into a bell-shaped ring, which has no parapodial pads. The caudal segment is funnel-shaped (figs. 22E–F), with a deep posterior depression, at the bottom of which lies the anal cone. The height of the latter varies according to the degree of contraction of the intestine. It is folded, especially round the anus. The caudal ring is fringed with short bluntly rounded cirri. The median ventral cirrus is stouter than the rest, and 2–4 times as long. In 15 specimens examined, the number of cirri, including the large ventral one, is as follows:—24, 20 (2), 19 (2), 18, 17 (3), 16 (3), 15, 14 (2). Sometimes several of the cirri are fused together, forming a flat plate.

In setigerous segments 1–3 the parapodia are in the anterior half of the segments, in 4–8 in the middle, and in the subsequent segments near the posterior end.

The three anterior setigerous segments have dorsally a double row of capillary setae. They are longitudinally striated, with two narrow wings and slender tips. Ventrally there is a single uncinus (fig. 22H) with a simple boldly curved tip. In the two anterior bundles the setae are rather more numerous than in the 3rd. In the 4th setigerous segment the dorsal setae are similar, but fewer in number. Ventrally there is a row of uncini, each with 5 teeth above the main fang (fig. 22K). In the 8th foot several of the dorsal capillaries have plumose tips (fig. 22J), the spinelets being rather long. These setae are much shorter than the smooth capillaries. There is a ventral row of 14 uncini. In the 10th segment there are 17 uncini, in the 17th segment 14 uncini. In the anterior segments the row of dorsal capillary setae gradually shortens as the setae become fewer in number, and at the same time the papilla from which they emerge increases in length. It is low and insignificant on the 1st setigerous segment, but on the 5th or 6th it forms a distinct swelling. In segments 1–9 the capillary setae form a transverse row. At the 10th segment the row tends to be oblique, and this tendency increases till at the 15th segment the setae form an arch above the uncini (fig. 22G). The latter are embedded in a long narrow slit surrounded by prominent tumid lips. The uncini (fig. 22K) have 5 or 6 diminishing teeth above the main fang. Beneath the latter there is on each side a bundle of bristles, but their point of attachment is not indicated by a prominent boss, as in many other species. The uncini of segments 4–21 are all similar, and there is no obvious difference between the uncini of the same foot.

Habitat.—This species was taken in large numbers at 11 stations, all in the south-west end of the lake, south of a line drawn from Patsahanipur to Nalbano. Usually they were obtained by digging in mud or sand at the water's edge, but on three occasions they were taken some distance off the shore, on a muddy bottom. As might be expected from the habitat of this species, it was usually taken in the salt-water season, when the water level was low, but on one occasion it was taken in the dredge in the freshwater season. The specific gravity of the water ranged from 1·002–1·011.

Family STERNASPIDAE.

Sternaspis costata, Marenzeller.

(Plate XX, figs. 5A, 5B.)

1879. *Sternaspis costata,* Marenzeller, p. 34, taf. vi, fig. 4.
1890. *Sternaspis costata,* Sluiter, p. 108.

It is with some hesitation that the numerous specimens of *Sternaspis* from the Chilka Lake are referred to the species from Japan, described by Marenzeller, and rediscovered at Batavia by Sluiter. According to Marenzeller, it agrees closely with the widely distributed *S. scutata* (Ranzani) of European seas, the most marked difference being in the shape of the posterior ventral shield. In the latter respect the Chilka Lake specimens show a fairly close agreement with the description and figures given by Marenzeller.

Not one of the 316 specimens which I examined showed any trace of an elongate proboscis such as Sluiter found in *S. spinosa*, and it is obvious that the latter species should be removed to a new genus. The prostomial lobe is small and rounded, exactly as in *S. scutata*. The largest specimens were 8 mm. long, and the greatest width was 3–3·5 mm. The largest specimen examined by Marenzeller was 12 mm. long and 5 mm. wide. Sluiter examined three specimens, 18 mm., 22 mm., and 35 mm. long respectively. In the smallest of these, the ventral shield closely resembled that of *S. costata* in shape and colour, but the largest individual varied considerably in the direction of *S. scutata*, the other specimen being intermediate in size and structure. European specimens of *S. scutata* which I have been able to examine were larger than those from the Chilka Lake, and differed in the shape of the ventral shield. Some of the specimens, taken in the outer channel in September, had the body cavity full of ripe eggs, so that apparently the Chilka Lake species does not attain a much greater size than 8 mm.

The body as a whole is brownish yellow in colour. The yellow pigment is specially marked on the gills, the intersegmental areas, and in the area surrounding the mouth and prostomial lobe. The wide posterior part of the body is more deeply coloured than the narrow anterior part, and the body-wall of the former is also thicker and less transparent. The prostomial lobe is quite transparent. The ventral shield (fig. 5A) is brightly coloured, the colour ranging from rusty red to scarlet. There is a narrow colourless margin on the lateral and posterior borders. It easily separates into two halves, and each half is slightly longer than broad. It has a series of ridges radiating from the centre, each ridge forming a groove over one of the bundles of setae, which emerge from the body-wall beneath the shield. A series of concentric markings is also obvious. The anterior and posterior borders are apparently deeply indented, the indentations, which are not so rounded as in Marenzeller's figure, being occupied by paired triangular plates. The anterior pair, which Marenzeller calls accessory plates, and which are absent in *S. scutata*, really form part of the large plates, being only differentiated by their delicate transparency and smoothness, and by the conspicuous ridge which separates them from the large plates. They only occupy part of the anterior concavity. The posterior triangular plates make the posterior border almost straight. They show the same ridges and concentric markings as the large plates, and five pairs of bundles of setae emerge from beneath them. From beneath the large plates 9–11 pairs of bundles of setae emerge. There are thus 14–16 pairs altogether, those at the outer posterior angles being the largest and longest. All these setae are longitudinally striated, and some are smooth, whilst others have the terminal part of the shaft covered with fine short hairs.

The three anterior segments of the body have two bundles of setae each. There are 14–26 setae in each bundle, the youngest being on the ventral margin of the bundle. The setae have a double curvature, and are longitudinally striated the striations being in the superficial layer. The core of the seta is abruptly truncated some distance from the tip (fig. 5B). This appearance is not caused by injury, as it was observed in cases where the seta tapered to a fine point.

Distribution.—Miya Bay, Japan; Bai von Batavia, in mud, 10–12 fms.

Habitat.—316 specimens were taken at four stations in the outer channel near Mahosa, in September, when the water was quite fresh. The bottom here is sand and sandy mud. Mr. Kemp says *in litt.*: "As regards the *Sternaspis*, we only found it in the outer channel at the season when the water was quite fresh. But our observations in March were a little incomplete, for the water was too shallow to permit the passage of the launch across the bar separating the main area from the outer channel, and we had only a dinghy to work from. The species is doubtless present all the year round in salinities varying from 1·000 to 1·027."

Family SABELLIDAE.

Potamilla leptochaeta, sp. nov.

(Plate XXXI, figs. 28A–N.)

A number of small specimens of this species were found in masses composed of Entoproct Polyzoa (*Loxosomatoides colonialis*, Annandale), accompanied by *Bowerbankia caudata*, Hicks, and by a number of Nematode worms (*Oncholaimus indicus*, von Linstow, *Rec. Indian Museum*, Vol. I, 1907, p. 45).

The *Potamilla* lives in rather brittle membranous tubes, coated with fine mud, very like those of *P. torelli*, but not quite so hard and hyaline. The stolons of the Polyzoan are attached to the worm tubes, the whole forming a tangled mass.

Most of the specimens are incomplete, the posterior extremity usually being absent. A moderate sized individual, not the largest, measured 4·5 mm. in length, of which the branchiae were 1·3 mm., the thorax 1·2 mm., and the abdomen 2 mm.

The branchiae are marked by two broad bands of reddish brown pigment. The total number of setigerous segments is about 33 or 34, of which 6 compose the thorax, and 27 or 28 the abdomen. The thorax is of uniform width, but the abdomen tapers gradually towards the anal segment. The latter is rather flattened, and heart-shaped, with rounded posterior border. No eyes were observed, either on the anterior or anal segments or on the branchiae.

In all specimens examined, there were 9 branchiae, 4 on the right side, 5 on the left. Each branchia has 40–50 filaments. The latter are nearly all of the same length, decreasing slowly in size towards the tip. In most of the specimens the tip is short, bare, and blunt (fig. 28C), but one specimen was found in which all the branchiae had rather long bare tips (fig. 28D). A more careful examination then showed that branchiae with long tips were by no means uncommon, even in specimens where the majority had short tips. Moreover the left ventral branchia, which was always much shorter than the others, always had an elongate tip. It seems probable, therefore, that the long tip is the normal condition, and that the short tips are due to accidents.

Dorsally the front margin of the collar slopes backwards, and the two ends are attached near the median line (fig. 28A). Ventrally the collar inclines forward (fig. 28B), and in the ventral region it is deeply cleft and bilobed.

The thorax is composed of 6 setigerous segments. The faecal groove is narrow shallow, and very indistinct, and can hardly be seen on the abdomen. Ventral gland shields are very inconspicuous. On the mid-dorsal area there is a slightly elevated ridge (fig. 28A), especially distinct at the anterior end, where it narrows, and lies between the ends of the collar. The first thoracic segment bears only dorsal bundles of setae. Each bundle contains 7 setae, the 3 upper being long and bilimbate, as in the succeeding thoracic segments (fig. 28F). The 4 lower setae are shorter (fig. 28E), with wider and shorter bilimbate blades and filiform tips. They are intermediate in shape between the elongate capillaries and the spatulate setae. In the remaining thoracic segments, the dorsal bundles contain two types of setae, capillary and spatulate. The capillary setae (fig. 28F) have elongate narrow wings and very long filiform tips. There are 3–6 in each bundle. Beneath and behind them are the spatulate setae, 5–10 in number. They have pear-shaped blades (fig. 28G) with finely pointed tips. The ventral bundles also contain two types of setae. The anterior row (figs. 28H, 28J) consists of 7–10 cuspidate setae (soies en pioche). The posterior row contains 7–9 avicular uncini (fig. 28K). The anterior part of the base is large and swollen, and the posterior process is rather short.

In the anterior abdominal segments the ventral bundles contain 5–7 capillary setae, with short blades and very long filiform tips. They vary in length (figs. 28L, 28M), but are all bilimbate, and the blades are shorter and wider than those of the thoracic setae. The dorsal bundles contain 9 or 10 avicular uncini (fig. 28N), differing very slightly from those of the thorax. The posterior process is shorter, and the spinose crown is higher and narrower. The uncini vary much in size in each bundle, the largest being ventral, the smallest dorsal. In the posterior part of the abdomen the setae are similar, but fewer and smaller. The ventral bundles contain 1–3 capillary setae, the dorsal bundles 1–3 uncini.

The most remarkable feature about the setae of this species is the great length and extreme slenderness of the tips of the capillary setae, from which character the specific name is derived.

Habitat.—From a brackish pool, Port Canning, Lower Bengal, December 1908. The water here is of very variable salinity (Annandale, 1907, pp. 35 and 197).

Laonome indica, sp. nov.

(Plate XXX, figs. 26A–H.)

Only a single individual of this species is available. It is 28 mm. long, the trunk being 26 mm., and the unusually short gills only 2 mm. The body is slender, composed of the 110 segments, and the anal segment is large and conical. The posterior 15 segments are much shorter than the preceding ones, and may have been regenerated.

There are seven pairs of branched gills, unconnected by a membrane (fig. 26A). Each gill is penetrated by a single blood-vessel (fig. 26C), which sends off a single branch to each barbule. The barbules are rather short, and the distal quarter of each gill is devoid of them. In addition there are two smooth unbranched ventral tentacles, or palps.

The upright collar is equal in length to the 1st setigerous segment. On the dorsal side (fig. 26A) the two halves of the collar are simply folded inwards, and attached to the body wall. On the ventral side (fig. 26B) the collar projects forwards in two peculiar lobes, each pointed at the tip. Between these two lobes and the palps is a median lobe rounded at the tip. No eyes or otocysts were observed.

The thorax is composed of six setigerous segments. Along the median dorsal line there is a narrow groove, which passes to the ventral side in the 6th setigerous segment, and runs to the posterior end. Ventral thoracic gland plates are inconspicuous or absent. The 1st thoracic segment bears only dorsal bundles of setae, which lie nearer the median line than those of the succeeding segments (fig. 26A.) The setae are all capillaries, mostly long and slender, with narrow bilimbate blades. A few are shorter, with relatively broader blades. In the 2nd segment the dorsal setae are of two kinds. The upper setae are long slender capillaries (fig. 26D), 6 or 8 in number, with narrow wings and long tapering tips. Below these are 9–11 setae with spatulate tips (fig. 26E) terminating in a long fine point. The ventral setae consist of a row of 20 uncini (fig. 26G). Each of the latter has a stout rounded base. In front view (fig. 26G, *a*) there are 4 or 5 rows of teeth on the crest above the main fang. The side view (fig. 26G, *b*) shows that the main fang is very acute, with 4 teeth above it. The remaining thoracic segments, 3–6, have similar setae.

Of the abdominal setae those on the 8th setigerous segment may be taken as typical. The dorsal division consists of 17 uncini (fig. 26H) differing only very slightly from those of the thorax. The rounded base is rather more oblique, and the gap between it and the main fang is larger. The ventral group contains 4 or 5 capillary setae (fig. 26F). The expansion formed by the wings is shorter and broader than in the thoracic setae, and the tip is long and slender.

In the posterior segments the setae are similar in shape, but the capillaries are rather longer. Nothing is known about the tube of this species.

Habitat.—A single specimen was taken in the south-western extremity of Chilka Lake, 1–8 miles N.W. by N. of Sanad Point. The specific gravity of the water was 1·009 during the salt-water season.

Fabricia (Manayunkia) spongicola, sp. nov.

(Plate XXXI, figs. 29A–E.)

A number of specimens of this species are available, in a rather contracted condition. They inhabit tubes, consisting of a delicate membrane covered with flocculent mud. The length of the animal varies from 1·5–3 mm. In a specimen 1·65 mm. long, the branchiae constituted ·44 mm., the thorax 1 mm., and the abdomen ·25 mm. In a second specimen 2·3 mm. long, the branchiae were only ·33 mm. in length.

The branchiae (fig. 29A) consist of about 18–20 slender unbranched filaments on each side (i.e. about 36–40 in all). Occasionally they present the appearance of being arranged in groups attached to a short common stem, but this is probably due to the contraction of the basal membrane. In appearance and structure they closely resemble those of *Manayunkia speciosa,* as described and figured by Leidy (1883, p. 206, pl. ix, fig. 1). Within the circle of branchiae are two short clavate processes, the "palps" or "prostomial tentacles." The body (fig. 29A) is cylindrical, and consists of 13 segments, the first and last being without setae. The head is conical in front, and bears two black eyes. There is a prominent collar, with an entire convex border ventrally. Dorsally the ends of the collar are rounded and folded inwards. The thorax consists of 8 setigerous segments, the anterior three being short, but gradually increasing up to the 8th, which is the largest in the body. No otocysts are present. There are 3 setigerous abdominal segments, and an achaetous anal segment, the latter being usually spatulate, sometimes pear-shaped, and bearing two black eyes.

The 1st thoracic segment has a bundle of 4 slender capillary setae on each side, but no crochets. On the succeeding 7 segments there are on each side 2–4 dorsal capillary setae, and 2–5 ventral crochets in a single row. The capillary setae (fig. 29B) have short flattened blades and long slender tips. The crochets (fig. 29C) are rather stout, with three teeth above the main hook. In the abdominal segments the ventral bundles contain one or two very slender capillary setae (fig. 29D), which show only very slight flattening of the blade and no wings. The dorsal bundles contain 9–11 crochets of peculiar form (fig. 29E). They are rather small, with elongate shafts, and with numerous very fine long teeth, in several rows, at one end. Beneath the teeth there is a slight swelling of the shaft or base of the crochet. These setae closely resemble those of *Haplobranchus aestuarinus,* described and figured by Bourne (1883, p. 171, pl. ix, fig. 14), and in a lesser degree, those of *Manayunkia* and *Fabricia.* They are obviously intermediate in shape between the elongate crochets of the thorax and the avicular uncini such as are found in *Potamilla* and other genera (fig. 28K).

The species agrees closely with the three genera *Fabricia, Manayunkia,* and *Haplobranchus.* The characters held in common are: (1) the possession of 11 setigerous segments, 8 thoracic and 3 abdominal; (2) the shape of the dorsal and ventral setae in the thoracic segments; (3) the peculiar elongate crochets in the abdominal segments; (4) the presence of eyes on the first segment; (5) and the absence of otocysts. The present species agrees with *Manayunkia* in having a well-developed collar and unbranched branchiae, and differs in the presence of caudal eyes. It resembles *Fabricia* in having caudal eyes, and differs in having unbranched branchiae and a well-developed collar. It agrees with *Haplobranchus* in having unbranched branchiae, though in much larger number, in the presence of a well-developed collar, and in the shape of the abdominal crochets, and differs in the presence of caudal eyes and in the shape of the abdominal capillary setae. Leidy (*tom. cit.*) figures but does not describe the collar of *Manayunkia speciosa*, and his figures are not decisive as to the presence or absence of the dorsal indentation. Bush, however (1905, p. 188), in a generic diagnosis of *Manayunkia*, says that the collar is entire, without incisions or clefts. If this is the case it resembles *Haplobranchus* and differs from *F. spongicola*. The latter reduces the gap between *Manayunkia* and *Haplobranchus* on the one hand, and *Fabricia* on the other, and it has as much or as little right as these forms to generic rank. All the characters cited above, which differentiate the various forms, are probably only of specific rank, with the possible exception of the simple or branched branchiae. In the latter respect the Chilka species agrees with *Manayunkia*. The latter title has priority over *Haplobranchus* (1883), having been described by Leidy in 1858, and it may itself be regarded as a sub-division of the genus *Fabricia*.

Habitat.—Taken on two occasions, in the extreme south-west end of the Chilka Lake. On one occasion it occupied tubes embedded in the sponge *Laxosuberites lacustris*, Annandale; on the other, it was living amongst algae on the lower surfaces of rocks on the shore. It was taken both in the fresh and salt-water seasons, but the specific gravity of the water only varied from 1·006–1·011.

Family SERPULIDAE.

Genus **Ficopomatus,** gen. nov.

This genus may, for the present, be defined by the following combination of characters :—

Modified setae present on the first thoracic segment, having blades provided with very stout teeth. Beneath the blades is a transverse row of more than two teeth. Uncini with relatively few teeth, the lowest of which is in the form of an elongate bifid spine. Ventral abdominal setae geniculate. Operculum fig-shaped, without any outgrowths.

The modified setae of the first thoracic segment are very peculiar. They differ from those of *Serpula*, *Hydroides* and *Crucigera*, in having teeth on the blade, and in having more than two stout teeth below the blade. In these genera the stout teeth are paired, whilst in *Ficopomatus* the largest tooth is median and unpaired. These setae also differ markedly from those of *Spirorbis*, *Chitinopoma*, etc., which have a crenulated wing below a finely serrated blade. The uncini resemble those of *Pomatoceros*, *Spirobranchus* and *Pomatostegus* in having few teeth, of which the lowest is bifid, but *Ficopomatus* differs markedly from these genera in the shape of the operculum and the modified setae of the first thoracic segment.

Ficopomatus macrodon, sp. nov.

(Plate XXX, figs. 27A–M.)

Two small pieces of wood from the Cochin Backwater were covered with the interlacing tubes of this species. The tubes form masses as in *Hydroides norvegica*, Gunn., or *Pomatoceros triqueter*, L. When free or erect the tube is circular in section, with a single dorsal ridge, which is usually worn away in the older part of the tube (fig. 27M, *a* and *b*). The ridge terminates over the orifice in a small sharp tooth. Where the tube is attached, it tends to flatten on the ventral surface, and spreads out two latero-ventral ridges (fig. 27M, *c*). This flattening of the attached tube is due to the thickening of the walls in the latero-ventral region, the bore remaining almost circular in section.

A rather elongate specimen is 11 mm. in length, of which the abdomen is 8 mm., the thorax 2 mm., and the branchiae ·5–1 mm. The width of the body is ·5–·75 mm. The thorax is composed of 7 setigerous segments, the abdomen of 43–57 segments and in addition there are 6 or 7 narrow rings forming the tapering posterior end.

The specimens are all stained a deep reddish brown by pigment extracted by the preservative spirit from the wood to which they are attached, and the original colour pattern is obscured. Traces of deep blue pigment bands remain on the branchiae and thorax, and other pigment is present, so that probably the living animals were coloured rather after the manner of *Pomatoceros triqueter*, L.

The branchiae are 13–17 in number, 7–9 on the right side, 6–8 on the left. In addition, the left dorsal branchia forms the operculum. Each branchia has 3–5 diffuse bands of dark pigment, which spread on to the adjacent filaments. There are 18–20 pairs of rather long filaments on each branchia. The naked tip varies greatly in length, and may be longer or shorter than the filaments. The longest filaments are attached just above the middle of the stem, and those at each end are shortest. The stem of the branchia bears no other appendages.

The operculum usually exceeds the branchiae in length. The stem is rather flattened (figs. 27A, 27C), and passes more or less abruptly into the swollen head. The latter varies in shape according to the manner in which it is compressed within the tube, the two extreme forms being shown in figs. 27A and 27C. It is rather fig-shaped, and tends to spread out over the branchiae, so as to protect them when withdrawn into the tube. The distal end is almost flat in some specimens, as in fig. 27C, in others it is markedly convex. There are no outgrowths either on the stem or the head of the operculum. Usually there are patches of pigment, a narrow band just beneath the swollen head being rather constant.

The thorax (fig. 27A) is composed of 7 setigerous segments. The free margin of the thoracic membrane is entire, except for adventitious lobes.

The 1st setigerous segment bears dorsal bundles only. They are much nearer the mid-dorsal line than those of the succeeding segments, and are lodged in small depressions, the setae being directed forwards. There are two kinds of setae in these bundles. The stouter kind, usually 3 in a bundle (figs. 27D, 27E), have very slender tips, with a series of very coarse teeth, diminishing in size towards the smooth tip. For some distance beneath these teeth the shaft is smooth. Then comes a transverse row of teeth, varying in number, but there is always present a large median tooth, with a smaller one on each side. In addition there are usually 2–4 smaller teeth on each side, but sometimes these are indistinct. These setae are obviously homologous to the peculiar setae found in the 1st thoracic segment of many other genera of Serpulidae. They are accompanied by a number, usually four, of slender setae (fig. 27F), with finely tapering tips and minutely hispid edges.

The dorsal setae of the 2nd–7th bundles are all capillary, in two rows, the anterior row composed of 8 slender setae resembling those in the 1st bundle (fig. 27F), the posterior row of 7 shorter capillaries, not winged, but with slightly flattened blades (fig. 27G). Sometimes these setae appear quite smooth, but in other cases the blades are minutely hispid, the edge easily fraying, so as to appear serrated.

The ventral bundles are composed of uncini (fig. 27H, *a* and *b*), having 7, rarely 8 teeth. The lowest tooth is widely bifid.

The abdomen is traversed by a ventral groove, shallow in front, but large and deep behind. The posterior end, in most specimens, narrows abruptly to a conical tail, terminating in two rounded lobes, between which the anus lies (fig. 27B). The abdominal parapodia project prominently as flat lobes (fig. 27J) bearing a row of uncini on the upper external margin, whilst the ventral capillaries project beneath the lower edge. The ventral capillaries are usually two or three in a bundle, one or two in the posterior segments. They project from the parapodium so far that the exposed part of each seta is usually twice as long as the part embedded in the tissues. The shaft expands suddenly towards the tip (fig. 27K), and then bends abruptly, the bent portion being serrated.

In the anterior abdominal segments there are about 26 uncini in each parapodium. They resemble those in the thoracic segments, but have 11–12 rather slenderer teeth (fig. 27L). They are also thinner and larger than the thoracic uncini, and when viewed on edge the forks of the bifid spine are smaller. In the mid-abdominal region there are 45 uncini in each foot, each with 12–14 teeth. In the posterior segments there are 6–10 uncini in each foot, and they are smaller, with fewer and finer teeth.

Habitat.—Two pieces of wood, covered with the interlacing tubes of this species were found in the Cochin Backwater, near Ernakulam, on the south-west shore of the Madras Presidency, in September 1914. The masses of tubes resemble in general appearance those of *Pomatoceros triqueter*, L., or *Hydroides norvegica*, Gunn. They were accompanied by several specimens of *Balanus amphitrite*. The salinity of the water is probably very variable, but no precise information is available.

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EXPLANATION OF PLATE XIX.

Ancistrosyllis constricta, sp. nov.

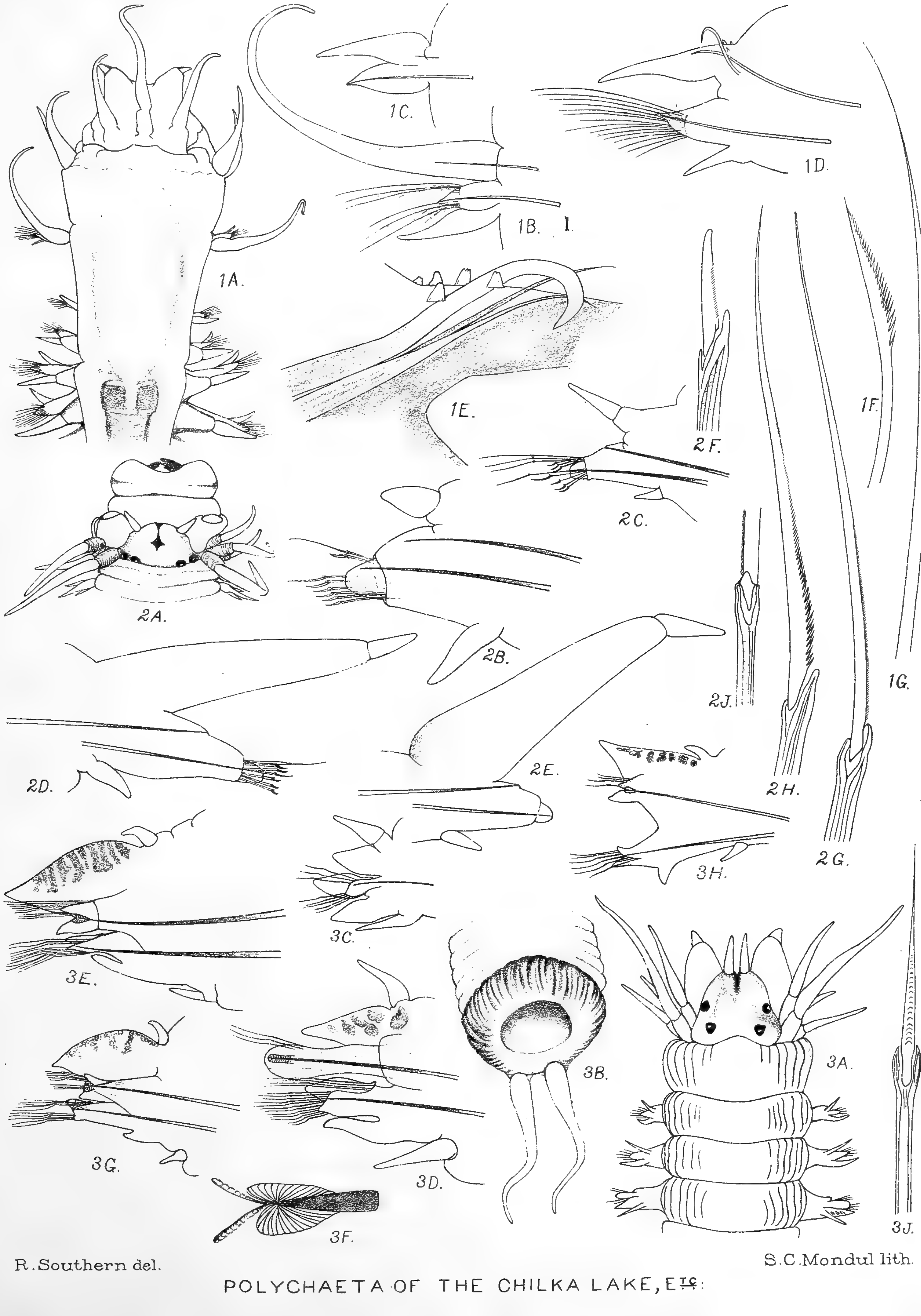
FIG. 1A.—Anterior end, dorsal view. × 40.
,, 1B.—1st right foot. × 100.
,, 1C.—2nd right foot. Setae not shown. × 100.
,, 1D.—40th right foot. × 100.
,, 1E.—Part of dorsal lobe of 80th right foot, posterior view. × 330.
,, 1F.—Anterior short seta from 1st foot. × 560.
,, 1G.—Intermediate type of seta from 4th foot. × 560.

Lycastis indica, sp. nov.

FIG. 2A.—Anterior end, dorsal view. × 40.
,, 2B.—1st right foot, anterior view. × 140.
,, 2C.—10th right foot, anterior view. × 56.
,, 2D.—70th foot. × 100.
,, 2E.—100th right foot, posterior view. Setae not shown. × 100.
,, 2F.—Falcate heterogomph seta from upper part of 50th foot. × 560.
,, 2G.—Hemigomph seta with long finely serrated tip, from upper part of 10th foot. × 560.
,, 2H.—Heterogomph seta with long coarsely serrated tip, from middle of 10th foot. × 560.
,, 2J.—Tip of shaft of hemigomph seta from dorsal division of 10th foot. Specimen from Cochin Backwater. × 560.

Tylonereis fauveli, sp. nov.

FIG. 3A.—Anterior end, dorsal view. × 30.
,, 3B.—Posterior end, dorsal view. × 27.
,, 3C.—1st right foot, anterior view. × 56.
,, 3D.—7th right foot, anterior view. × 56.
,, 3E.—30th right foot, anterior view. × 56.
,, 3F.—Tip of dorsal aciculum and gland, in 30th foot. × 330.
,, 3G.—70th right foot, anterior view. × 56.
,, 3H.—150th foot. × 56.
,, 3J.—Seta from dorsal division of 30th foot, front view. × 560.



R. Southern del. S. C. Mondul lith.

POLYCHAETA OF THE CHILKA LAKE, ETC.

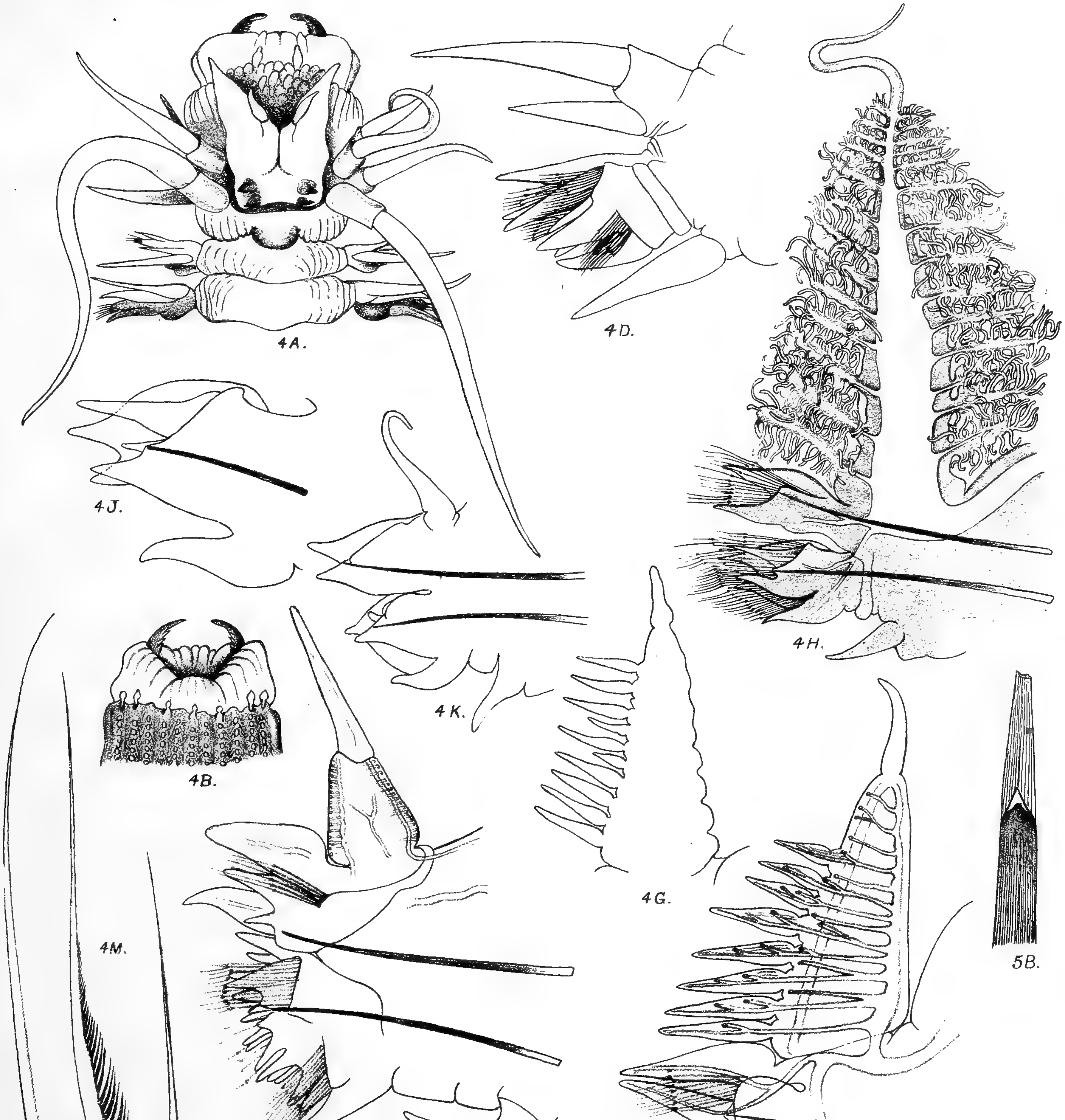
EXPLANATION OF PLATE XX.

Dendronereis aestuarina, sp. nov.

FIG. 4A.—Anterior end, dorsal view. × 17.
,, 4B.—Everted proboscis, ventral view. × 17.
,, 4C.—10th segment, ventral surface. × 20.
,, 4D.—1st right foot, front view. × 40.
,, 4E.—10th right foot, front view. × 40.
,, 4F.—15th right foot, front view. × 40.
,, 4G.—Dorsal cirrus of 17th foot. × 30.
,, 4H.—18th right foot, front view. × 25.
,, 4J.—Ventral division of the 20th right foot, front view. Setae not shown. × 40.
,, 4K.—30th right foot, front view. Setae not shown. × 25.
,, 4L.—Homogomph seta with long finely serrated terminal piece, as found in all the feet. × 330.
,, 4M.—Homogomph seta with long coarsely serrated terminal piece, from the 3rd foot. × 560.
,, 4N.—Homogomph seta with moderately short smooth tip, from upper division of the 60th foot. × 330.

Sternaspis costata, Marenzeller.

FIG. 5A.—Ventral shield. Only the basal portion of the lateral bundles of setae shown. × 40.
,, 5B.—Tip of dorsal seta from 1st bundle. × 330.



R. Southern del. D. Bagchi lith.

POLYCHAETA OF THE CHILKA LAKE, E$^{\text{TC}}$.

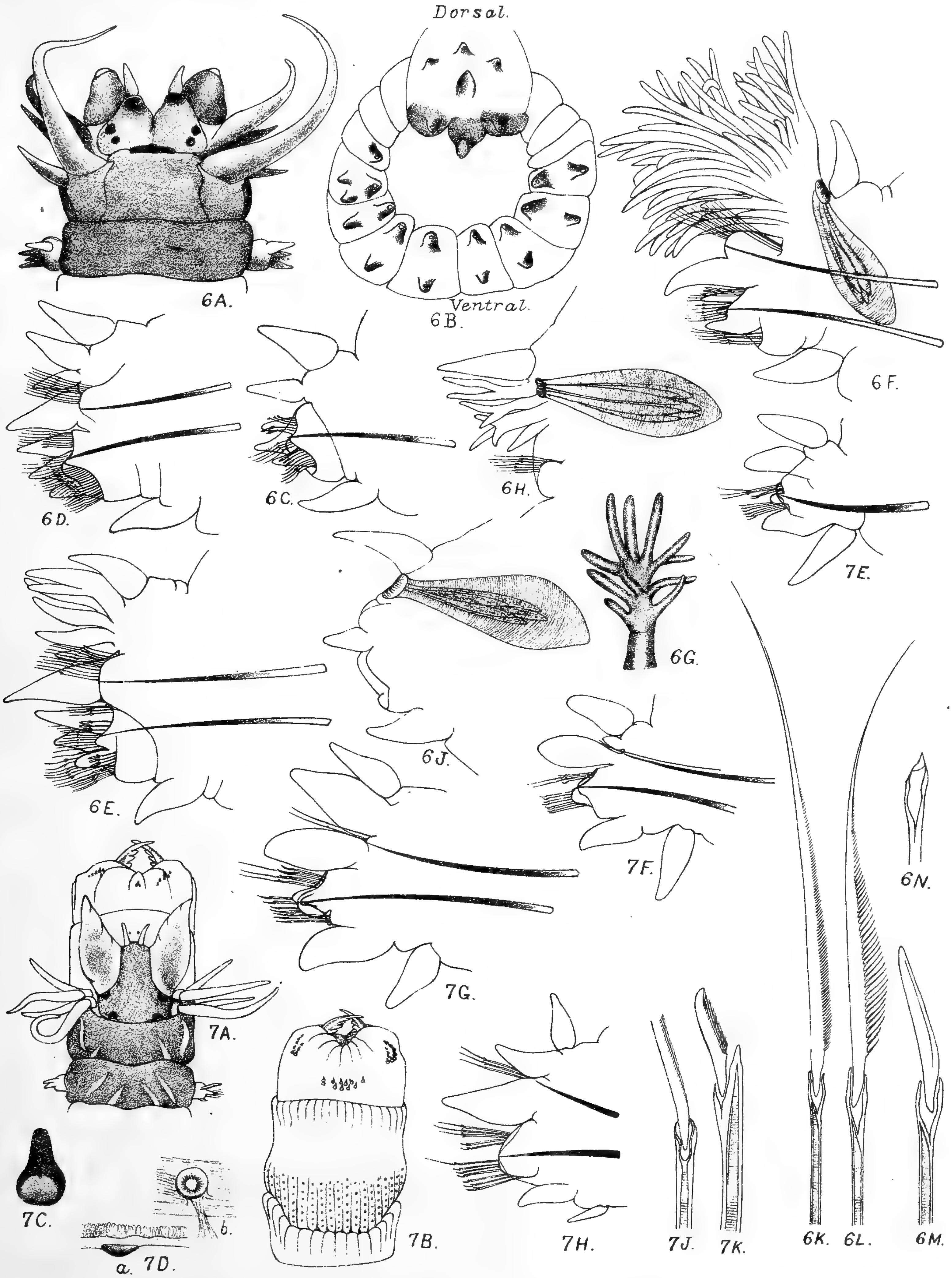
EXPLANATION OF PLATE XXI.

Dendronereides heteropoda, gen. et sp. nov.

FIG. 6A.—Anterior end, dorsal view. × 40.
,, 6B.—Front view of partially extruded proboscis, showing the basal ring of papillae.
,, 6C.—1st right foot, front view. × 100.
,, 6D.—4th right foot, front view. × 100.
,, 6E.—9th right foot, front view. × 100.
,, 6F.—21st right foot, front view. × 100.
,, 6G.—Single bunch of gill branches from the 25th foot. × 100.
,, 6H.—Dorsal division of 26th right foot, front view. × 100.
,, 6J.—30th right foot, front view. Setae not shown. × 100.
,, 6K.—Dorsal seta from the 14th foot. × 560.
,, 6L.—Ventral seta with long teeth, from 14th foot. × 560.
,, 6M.—Homogomph falcate seta from the ventral division of the 14th foot. × 560.
,, 6N.—Tip of shaft of seta from the ventral division of the 22nd foot, showing the 'hemigomph' condition. × 560.

Nereis reducta, sp. nov.

FIG. 7A.—Anterior end, dorsal view. × 26.
,, 7B.—Anterior end, ventral view. × 26.
,, 7C.—Paragnath from Group I. × 330.
,, 7D.—Paragnath from Group VIII. *a*=side view; *b*=surface view. × 330.
,, 7E.—1st right foot, front view. × 100.
,, 7F.—3rd right foot, front view. × 100.
,, 7G.—10th right foot, front view. × 100.
,, 7H.—60th right foot, front view. × 100.
,, 7J.—Homogomph seta with long tapering tip, from dorsal division of 40th foot. × 560.
,, 7K.—Heterogomph falcate seta from lower part of ventral division of 40th foot. × 560.



R. Southern del.

S.C.Mondul lith.

POLYCHAETA OF THE CHILKA LAKE ETC.

EXPLANATION OF PLATE XXII.

Nereis chilkaënsis, sp. nov.

FIG. 8A.—Anterior end, dorsal view. × 12.

,, 8B.—Anterior end, dorsal view, of a small male specimen, apparently commencing its metamorphosis, with partially extruded proboscis. The eyes are larger and the tentacular cirri relatively longer than in fig. 8A. × 26.

,, 8C.—Anterior end, ventral view, of a small specimen. × 12.

,, 8D.—Dorsal view of 26th and 27th segments. × 12.

,, 8E.—1st left foot, front view. × 56.

,, 8F.—10th right foot, posterior view. × 56.

,, 8G.—50th left foot, front view. × 56.

,, 8H.—60th right foot, posterior view, of small male specimen shown in fig. 8B. × 150.

,, 8J.—25th left foot, posterior view, of ♀ Heteronereis. × 40.

,, 8K.—40th left foot, posterior view, of same specimen. × 40.

,, 8L.—19th right foot, posterior view, of ♂ Heteronereis. × 56.

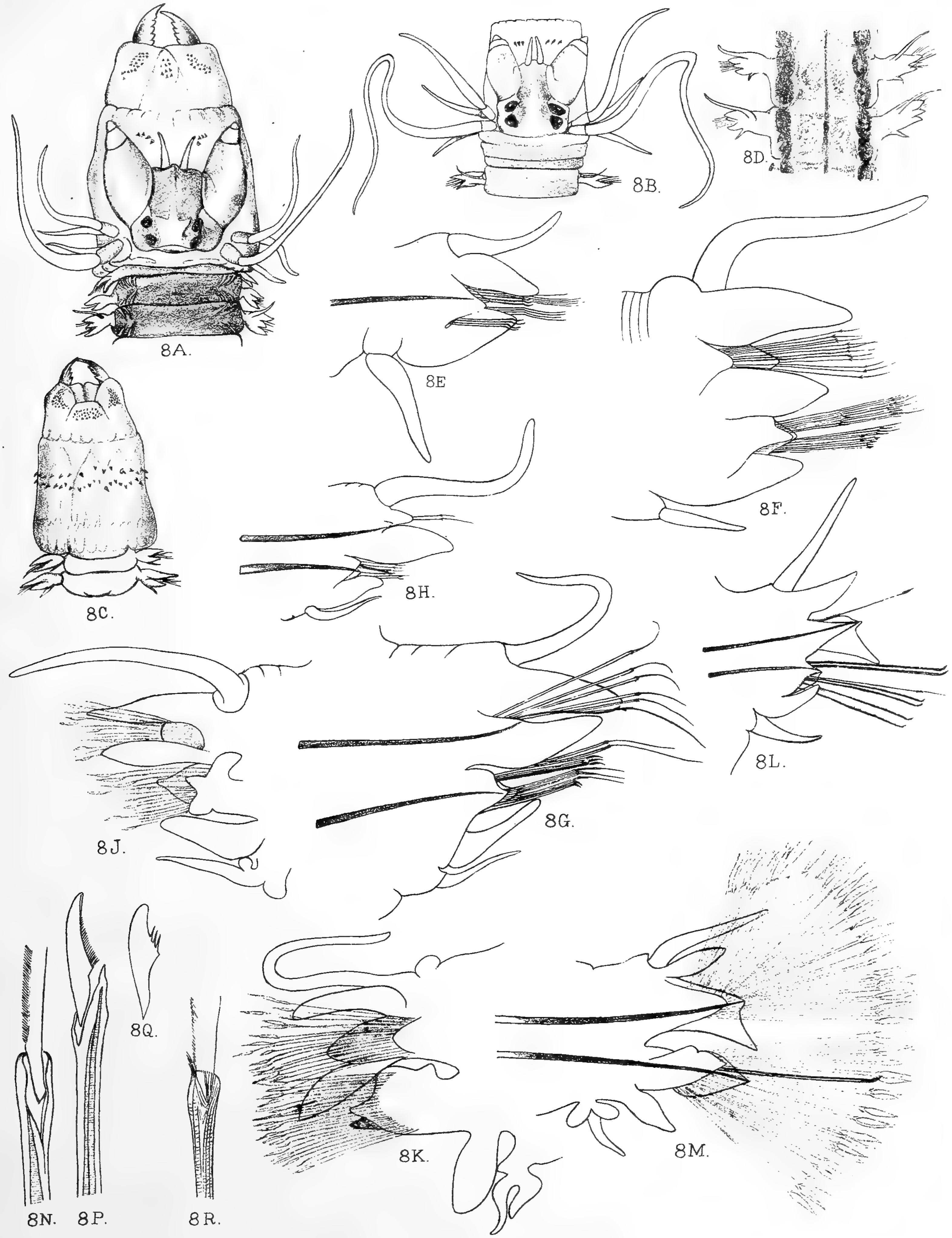
,, 8M.—30th right foot, posterior view, of same specimen. × 56.

,, 8N.—Homogomph seta with slender terminal piece, from the dorsal division of the 20th foot. × 560.

,, 8P.—Heterogomph seta with falcate terminal piece, from the ventral division of the 20th foot. × 560.

,, 8Q.—Terminal piece of one of the short thick heterogomphs from the upper part of the ventral division of the 65th foot. × 560.

,, 8R.—Tip of the shaft of one of the swimming setae of the Heteronereis, from the 30th foot. × 560.



R. Southern del.

A. Chowdhary lith.

POLYCHAETA OF THE CHILKA LAKE E^TC^.

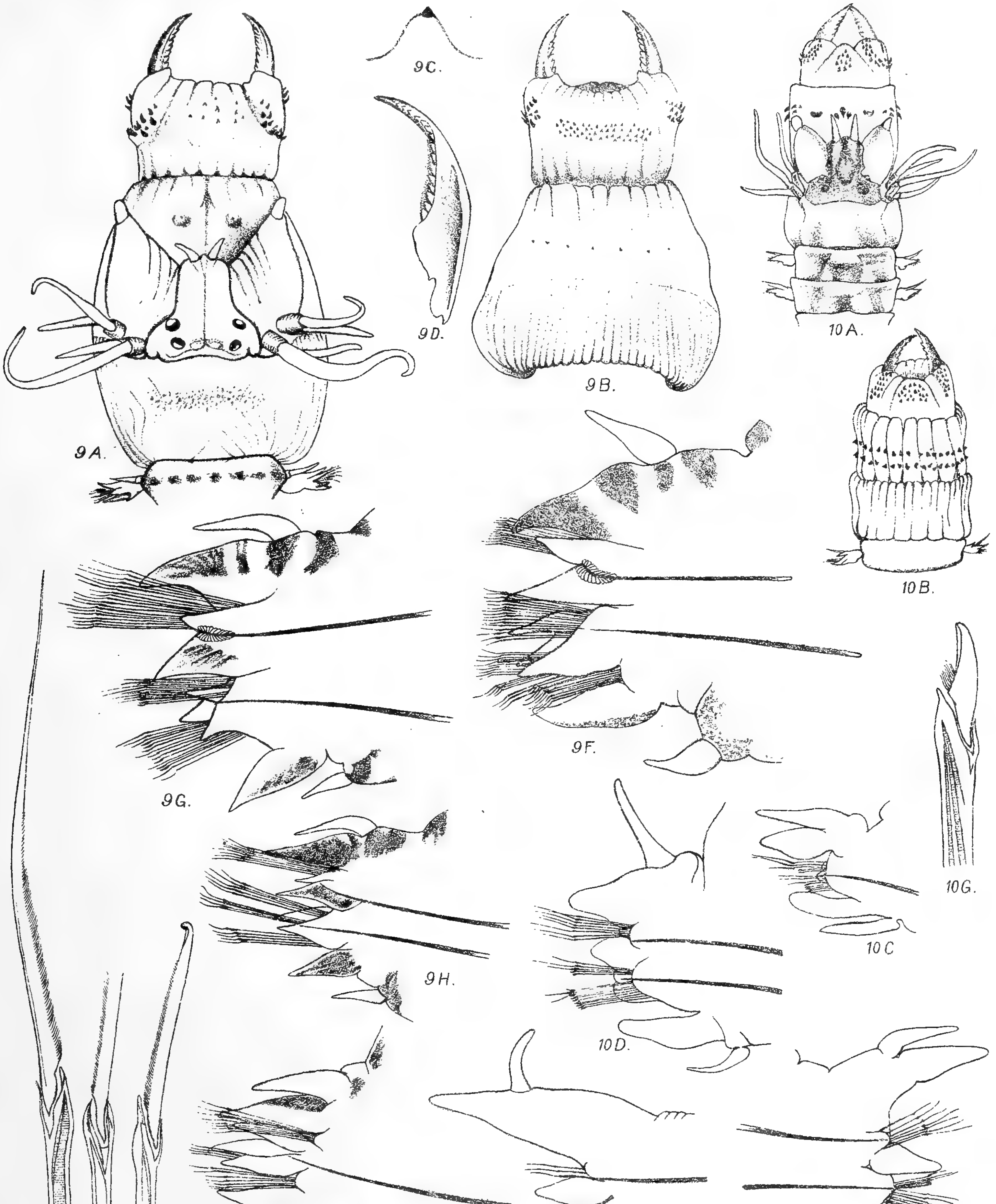
EXPLANATION OF PLATE XXIII.

Nereis glandicincta, sp. nov.

FIG. 9A.—Anterior end, dorsal view. × 17.
,, 9B.—Everted proboscis, ventral view. × 17.
,, 9C.—Papilla, with paragnath, from Group VI. × 100.
,, 9D.—Jaw. × 26.
,, 9E.—1st right foot, front view. × 56.
,, 9F.—10th right foot, front view. × 56.
,, 9G.—50th right foot, front view. × 56.
,, 9H.—100th right foot, front view. × 56.
,, 9J.—Homogomph seta with long finely serrated terminal piece, from the dorsal division of the 10th foot. × 560.
,, 9K.—Hemigomph seta with shorter, more coarsely serrated terminal piece from the ventral division of the 10th foot. × 560.
,, 9L.—Hemigomph seta with falcate terminal piece, from the lower part of the ventral division of the 20th foot. × 560.

Nereis (Perinereis) marjorii, sp. nov.

FIG. 10A.—Anterior end, dorsal view. × 12.
,, 10B.—Anterior end, ventral view. × 12.
,, 10C.—1st left foot, posterior view. × 56.
,, 10D.—10th left foot, posterior view. × 56.
,, 10E.—50th left foot, front view. × 56.
,, 10F.—70th right foot, front view. × 56.
,, 10G.—Heterogomph seta with falcate terminal piece, from the 10th foot × 560.



R. Southern del.

A. Chowdhary lith.

POLYCHAETA OF THE CHILKA LAKE, E^{TC}.

EXPLANATION OF PLATE XXIV.

Nephthys polybranchia, sp. nov.

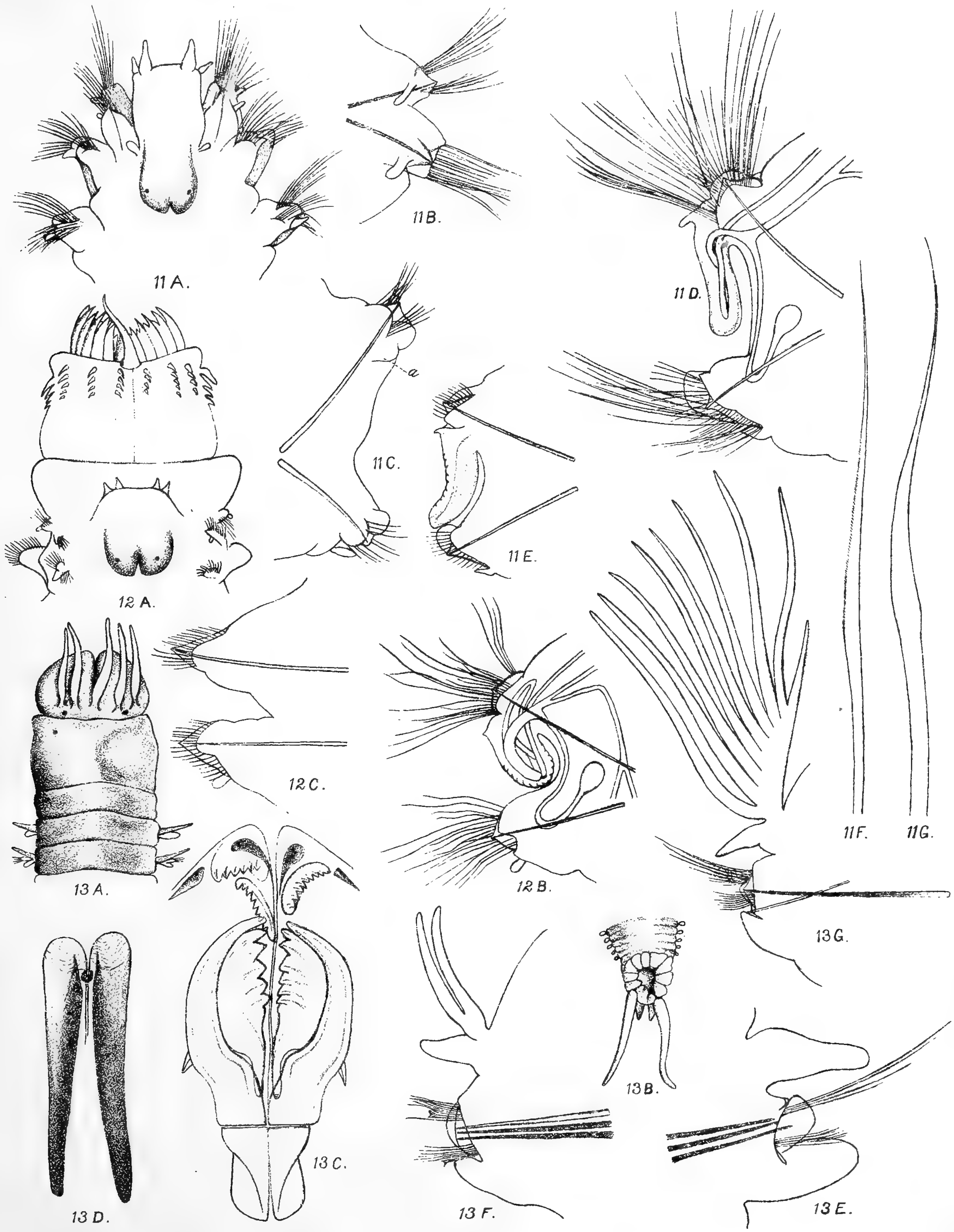
FIG. 11A.—Anterior end, dorsal view. × 56.
,, 11B.—1st right foot, posterior view. × 100.
,, 11C.—2nd right foot, posterior view, setae not fully shown. *a*=rudiment of branchia. × 100.
,, 11D.—10th right foot, front view. × 70.
,, 11E.—30th right foot, front view. Setae not fully shown. × 56.
,, 11F.—Seta from posterior row of 20th foot. × 330.
,, 11G.—Seta from anterior row of 20th foot. × 560.

Nephthys oligobranchia, sp. nov.

FIG. 12A.—Anterior end, dorsal view. The head is distorted by the extruded proboscis. × 38.
,, 12B.—10th right foot, front view. × 70.
,, 12C.—21st right foot, front view. Setae not fully shown. × 70.

Marphysa gravelyi, sp. nov.

FIG. 13A.—Anterior end, dorsal view, of a small individual. × 18.
,, 13B.—Posterior end, dorsal view, of a small individual. × 25.
,, 13C.—Maxillae. × 25.
,, 13D.—Mandibles. × 25.
,, 13E.—1st left foot, front view. × 100.
,, 13F.—30th right foot, front view, of a small individual, equivalent to the 40th foot of a large individual. × 56.
,, 13G.—240th right foot, front view, of a large individual. × 38.



R. Southern del. A. Chowdhary lith.

POLYCHAETA OF THE CHILKA LAKE, E^{TC}.

EXPLANATION OF PLATE XXV.

Marphysa gravelyi, sp. nov.

FIG. 13H.—Dorsal capillary seta from the 20th foot. × 560.
,, 13J.—Ventral compound seta from the 20th foot. × 560.
,, 13K.—Brush seta from the 160th foot. × 560.
,, 13L.—Ventral hook from 50th foot. *a*=side view; *b*=front view. × 560.

Diopatra variabilis, sp. nov.

FIG. 14A.—Anterior end, dorsal view. × 8.
,, 14B.—Anterior end, ventral view. × 6.
,, 14C.—Maxillae. × 18.
,, 14D.—Mandibles. × 18.
,, 14E.—1st right foot, front view. × 25.
,, 14F.—10th right foot, front view. × 18.
,, 14G.—150th left foot, front view. × 40.
,, 14H.—Dorsal winged capillary seta from 6th foot. × 166.
,, 14J.—Ventral seta, without wing, from 5th foot. × 166.
,, 14K.—Capillary seta from the dorsal group of the 56th foot, side view. × 166.
,, 14L.—Front view of the same seta. × 166.
,, 14M.—Ventral seta from 1st foot. × 560.
,, 14N.—Ventral hook from 28th foot. × 166.
,, 14P.—Ventral hook from 100th foot. × 166.
,, 14Q.—Brush seta from the 5th foot. × 560.
,, 14R.—10th right foot, front view, of a small individual. × 18.

R. Southern del.

A. Chowdhary lith.

POLYCHAETA OF THE CHILKA LAKE, E^{TC}.

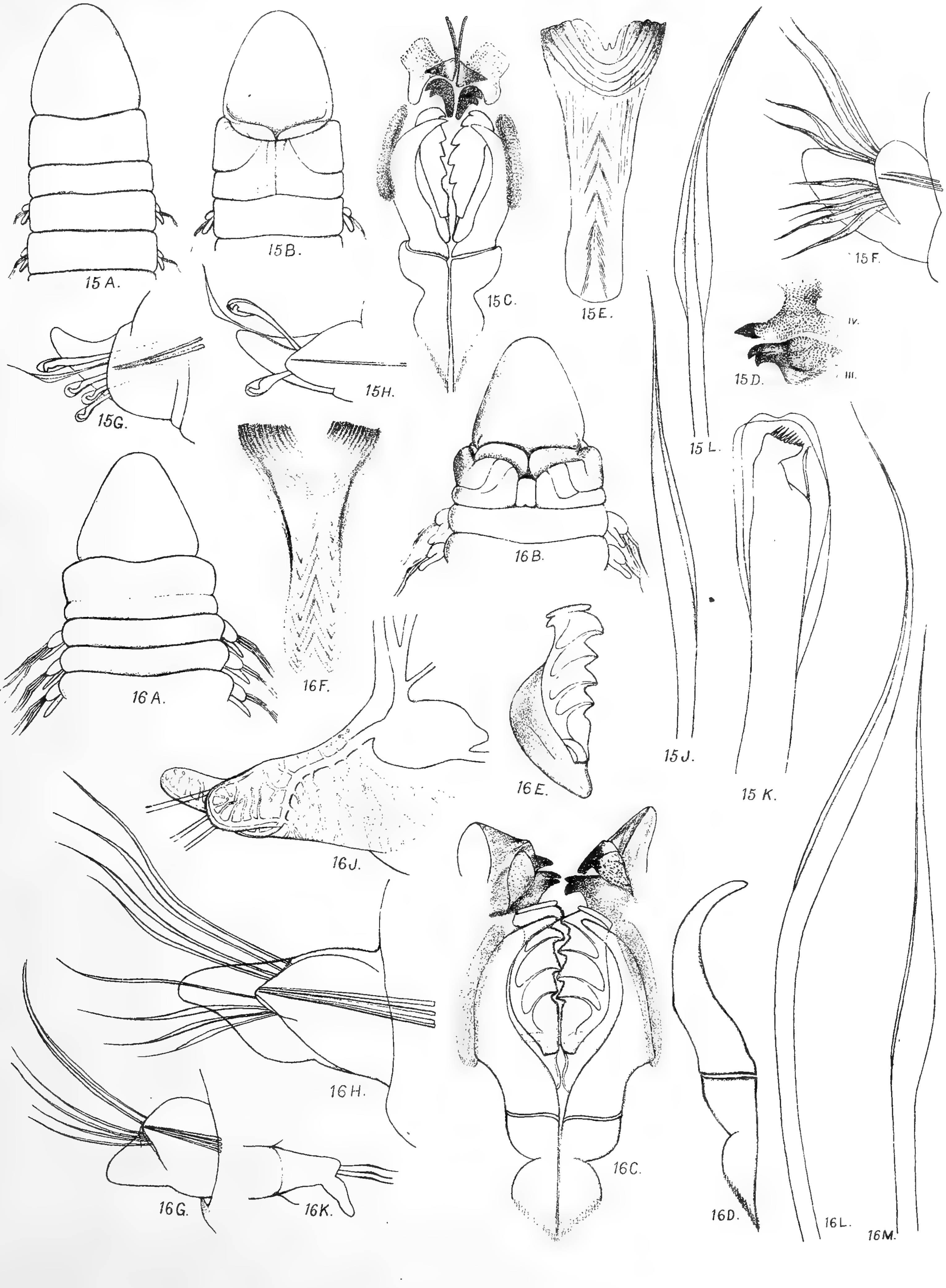
EXPLANATION OF PLATE XXVI.

Lumbriconereis polydesma, sp. nov.

FIG. 15A.—Anterior end, dorsal view. × 26.
,, 15B.—Anterior end, ventral view. × 26.
,, 15C.—Maxillae. × 56.
,, 15D.—3rd and 4th pairs of jaws, flattened. × 56.
,, 15E.—Mandibles. × 56.
,, 15F.—10th right foot, front view. × 100.
,, 15G.—80th right foot, front view. × 100.
,, 15H.—300th right foot, front view. × 100.
,, 15J.—One of the shorter capillary setae from the 10th foot. × 330.
,, 15K.—Tip of crochet from ventral part of the 60th foot. × 560.
,, 15L.—Capillary seta from the upper part of the 350th foot. × 330.

Lumbriconereis simplex, sp. nov.

FIG. 16A.—Anterior end, dorsal view. × 26.
,, 16B.—Anterior end, ventral view. × 26.
,, 16C.—Maxillae. × 56.
,, 16D.—Left half of 1st pair of maxillae, with more elongate base than that shown in fig. 16C. × 56.
,, 16E.—Left half of 2nd pair of maxillae. × 56.
,, 16F.—Mandibles. × 40.
,, 16G.—1st right foot, front view. × 86.
,, 16H.—10th right foot, front view. × 86.
,, 16J.—100th right foot, front view, showing blood-vessels. Setae only partly indicated. × 86.
,, 16K.—Foot from mid-body, seen from above.
,, 16L.—Short capillary seta from lower part of the 10th foot. × 330.
,, 16M.—Seta from a posterior foot. × 330.



R. Southern del. A. Chowdhary lith.

POLYCHAETA OF THE CHILKA LAKE, E^{TC}.

EXPLANATION OF PLATE XXVII.

Glycera alba, Rathke, var. **cochinensis,** var. nov.

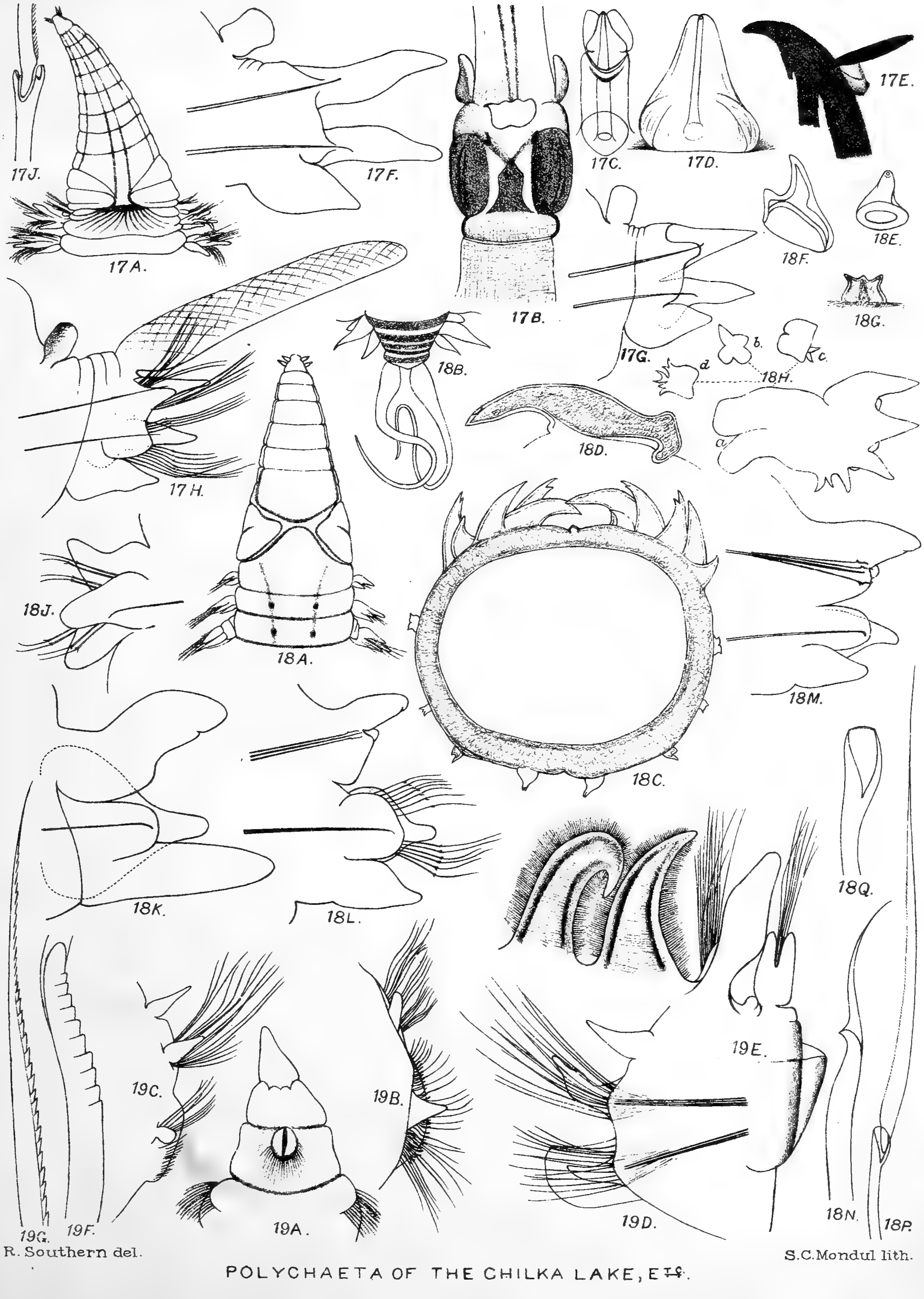
FIG. 17A.—Anterior end, ventral view. × 40.
,, 17B.—External aspect of inverted pharynx. × 18.
,, 17C.—Winged papilla of the proboscis. × 560.
,, 17D.—Conical papilla of the proboscis. × 560.
,, 17E.—Jaw. × 70.
,, 17F.—4th right foot, posterior view. × 150.
,, 17G.—10th right foot, posterior view. × 100.
,, 17H.—40th right foot, posterior view. × 100.
,, 17J.—Tip of shaft of compound seta from 40th foot. × 560.

Glycinde oligodon, sp. nov.

Fig. 18A.—Anterior end, ventral view. × 100.
,, 18B.—Posterior end, dorsal view. × 70.
,, 18C.—Transverse section of proboscis, mid-region. × 150.
,, 18D.—Paragnath from inner dorsal row of proboscis. × 230.
,, 18E.—Paragnath from inner ventral row, near base of proboscis. × 560.
,, 18F.—Paragnath from outer ventral row, near base of proboscis. × 560.
,, 18G.—Paragnath from transverse lateral ridge of proboscis. × 560.
,, 18H.—Jaws. × 330.
,, 18J.—1st right foot, anterior view. × 330.
,, 18K.—10th right foot, posterior view; setae omitted. × 330.
,, 18L.—30th right foot, posterior view. × 150.
,, 18M.—90th right foot, posterior view; setae omitted in part. × 150.
,, 18N.—Dorsal seta from 90th foot. × 1120.
,, 18P.—Ventral seta from 20th foot. × 560.
,, 18Q.—Tip of shaft of same seta. × 1120.

Scoloplos marsupialis, sp. nov.

FIG. 19A.—Anterior end, ventral view. × 56.
,, 19B.—4th right foot, posterior view. × 100.
,, 19C.—17th right foot, posterior view. × 56.
,, 19D.—19th right foot, front view. × 56.
,, 19E.—30th right foot, posterior view. × 70.
,, 19F.—Short thick seta from 6th foot. × 1120.
,, 19G.—Tip of ventral seta from 150th foot. × 1330.



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POLYCHAETA OF THE CHILKA LAKE, E^{TC}.

EXPLANATION OF PLATE XXVIII.

Polydora (Carazzia) kempi, sp. nov.

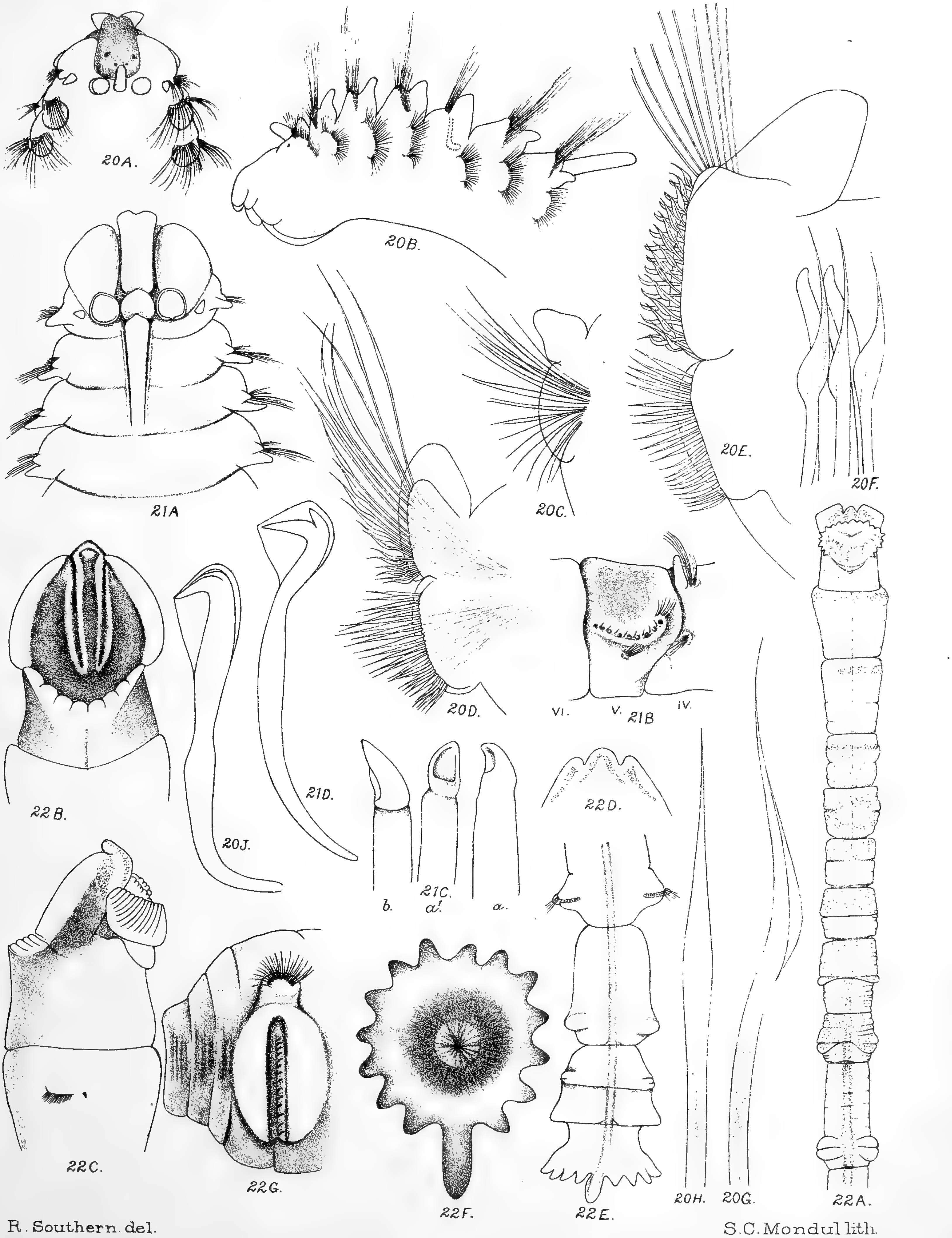
FIG. 20A.—Anterior end, dorsal view. × 56.
,, 20B.—Anterior end, lateral view. × 56.
,, 20C.—1st right foot, front view. × 230.
,, 20D.—4th right foot, front view. × 150.
,, 20E.—5th right foot, front view. × 230.
,, 20F.—Lower dorsal setae from 5th foot. × 560.
,, 20G.—Seta from the lower part of the dorsal bundle of the 4th foot. × 800.
,, 20H.—Seta from the middle of the ventral bundle of the 4th foot. × 800.
,, 20J.—Ventral crochet from the 8th foot. × 800.

Polydora hornelli, Willey.

FIG. 21A.—Anterior end, dorsal view. × 56.
,, 21B.—5th segment, lateral view, showing arrangement of setae.
,, 21C.—Modified setae from the 5th segment. × 360.
,, 21D.—Ventral crochet from the 38th foot. × 560.

Euclymene annandalei, sp. nov.

FIG. 22A.—Anterior end, ventral view. × 8.
,, 22B.—Anterior end, dorsal view. × 18.
,, 22C.—Anterior end, lateral view. × 18.
,, 22D.—Anterior border of the head, ventral view, showing the arrangement of the eyes. × 18.
,, 22E.—Posterior end, ventral view. × 12.
,, 22F.—Anal funnel, posterior view. × 25.
,, 22G.—Posterior part of the 16th setigerous segment, right side, showing arrangement of setae. × 40.



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POLYCHAETA OF THE CHILKA LAKE, ETC.

EXPLANATION OF PLATE XXIX.

Euclymene annandalei, sp. nov.

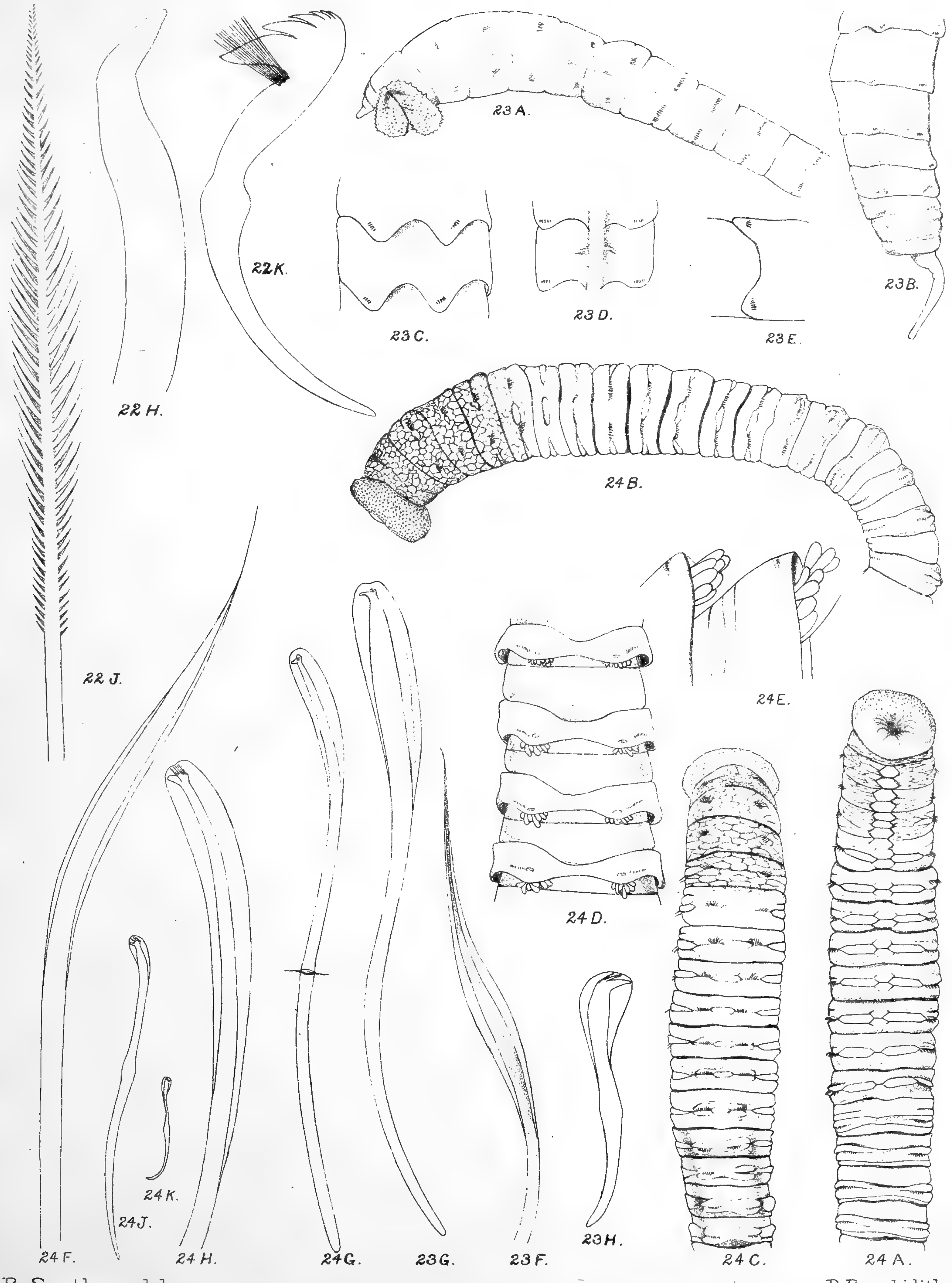
FIG. 22H.—Ventral hook from the 1st setigerous segment. × 230.
,, 22J.—Tip of a plume seta from the 10th setigerous segment. × 560.
,, 22K.—Ventral crochet from the 8th setigerous segment. × 560.

Heteromastus similis, sp. nov.

FIG. 23A.—Anterior end, side view. × 18.
,, 23B.—Posterior end, side view. × 56.
,, 23C.—180th segment, dorsal view. × 56.
,, 23D.—190th segment, ventral view. × 56.
,, 23E.—190th segment, side view. × 56.
,, 23F.—Dorsal seta from 4th setigerous segment. × 560.
,, 23G.—Dorsal crochet from 7th setigerous segment. × 660.
,, 23H.—Ventral crochet from 86th segment. × 660.

Barantolla sculpta, gen. et sp. nov.

FIG. 24A.—Anterior end, ventral view. × 12.
,, 24B.—Anterior end, lateral view. × 12.
,, 24C.—Anterior end, dorsal view. × 12.
,, 24D.—Dorsal view of segments 115—118. × 40.
,, 24E.—Lateral view of branchiae and dorsal lobes in the posterior segments. × 100.
,, 24F.—Dorsal capillary seta from the 3rd foot. × 560.
,, 24G.—Dorsal crochet from the 7th foot. × 360.
,, 24H.—Tip of the same seta. × 870.
,, 24J.—Dorsal crochet from 14th foot. × 360.
,, 24K.—Dorsal crochet from 60th foot. × 360.



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POLYCHAETA OF THE CHILKA LAKE, ETC.

EXPLANATION OF PLATE XXX.

Mastobranchus indicus, sp. nov.

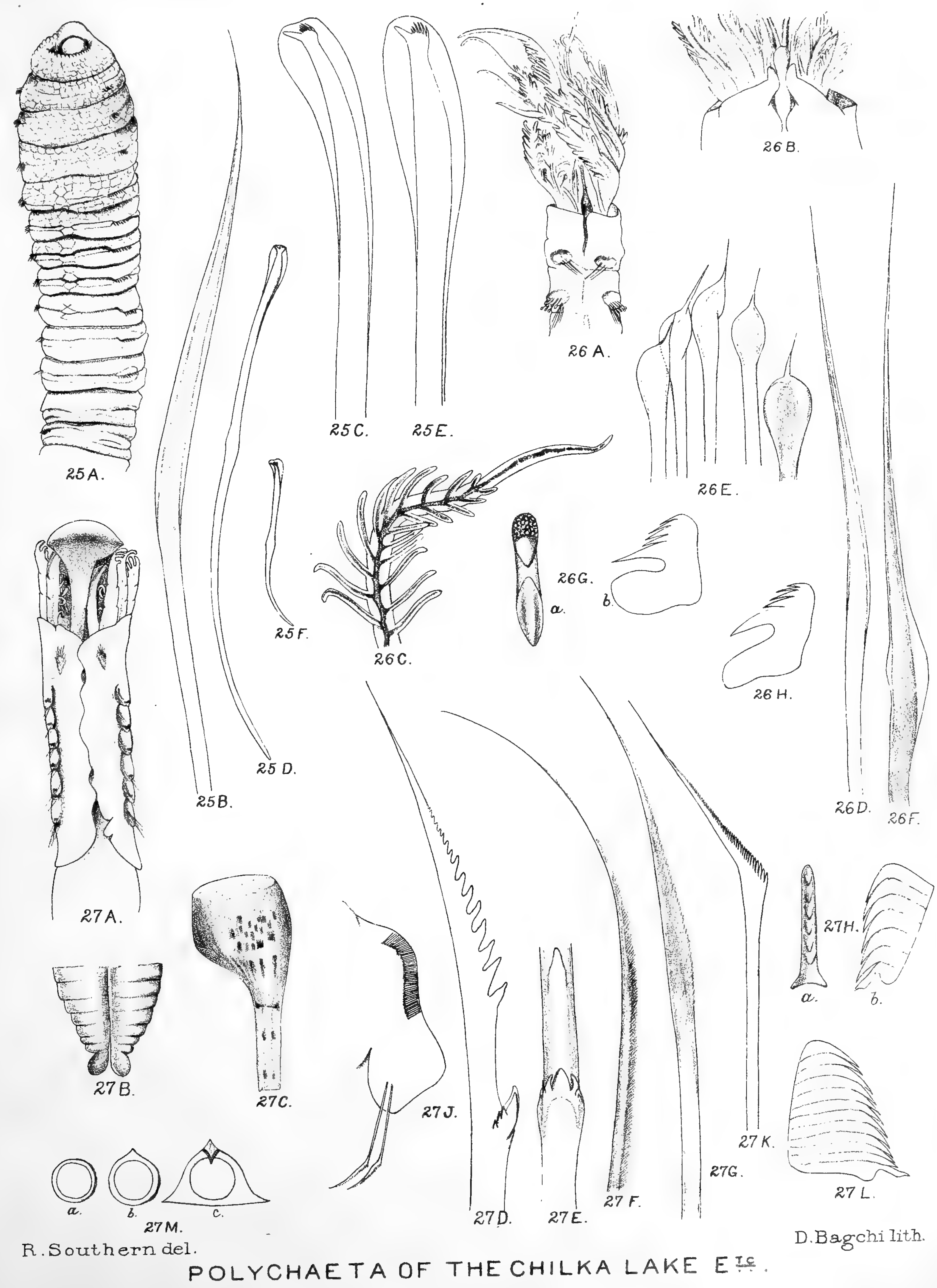
FIG. 25A.—Anterior end, ventral view. × 8.
,, 25B.—Dorsal capillary seta from the 12th segment (11th foot). × 485.
,, 25C.—Tip of long crochet from the ventral division of the 12th segment (11th foot). × 1120.
,, 25D.—Ventral crochet from the 13th segment (12th foot). × 360.
,, 25E.—Tip of the dorsal crochet from the 15th segment (14th foot). × 1120.
,, 25F.—Ventral crochet from the 50th segment. × 360.

Laonome indica, sp. nov.

FIG. 26A.—Anterior end, dorsal view. × 25.
,, 26B.—Collar segment, ventral view. × 56.
,, 26C.—Tip of a branchia. × 56.
,, 26D.—Dorsal capillary seta from the 2nd setigerous segment. × 660.
,, 26E.—Spatulate dorsal setae from the 2nd setigerous segment. × 560.
,, 26F.—Capillary seta from the 8th setigerous segment. × 660.
,, 26G.—Uncinus from the 2nd setigerous segment. *a*=front view; *b*=side view. × 800.
,, 26H.—Uncinus from the 8th setigerous segment. × 800.

Ficopomatus macrodon, gen. et sp. nov.

FIG. 27A.—Anterior end, dorsal view. × 26.
,, 27B.—Posterior end, ventral view. × 56.
,, 27C.—Operculum from the left side. × 40.
,, 27D.—Modified seta from the 1st setigerous segment, side view. × 560.
,, 27E.—The same seta, front view. × 560.
,, 27F.—Simple capillary seta from the 1st setigerous segment. × 560.
,, 27G.—Capillary seta as found in the dorsal bundles of segments 2—6. × 560.
,, 27H.—Uncinus from a thoracic segment. *a*=face view; *b*=side view. × 840.
,, 27J.—Anterior abdominal parapodial lobe.
,, 27K.—Ventral seta from an anterior abdominal segment. × 560.
,, 27L.—Uncinus from an anterior abdominal segment. × 840.
,, 27M.—Diagrammatic sections of the tube. *a*=old portion of a free tube; *b*=recent portion of a free tube; *c*=front view of the aperture of an attached tube.



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POLYCHAETA OF THE CHILKA LAKE Etc.

EXPLANATION OF PLATE XXXI.

Potamilla leptochaeta, sp. nov.

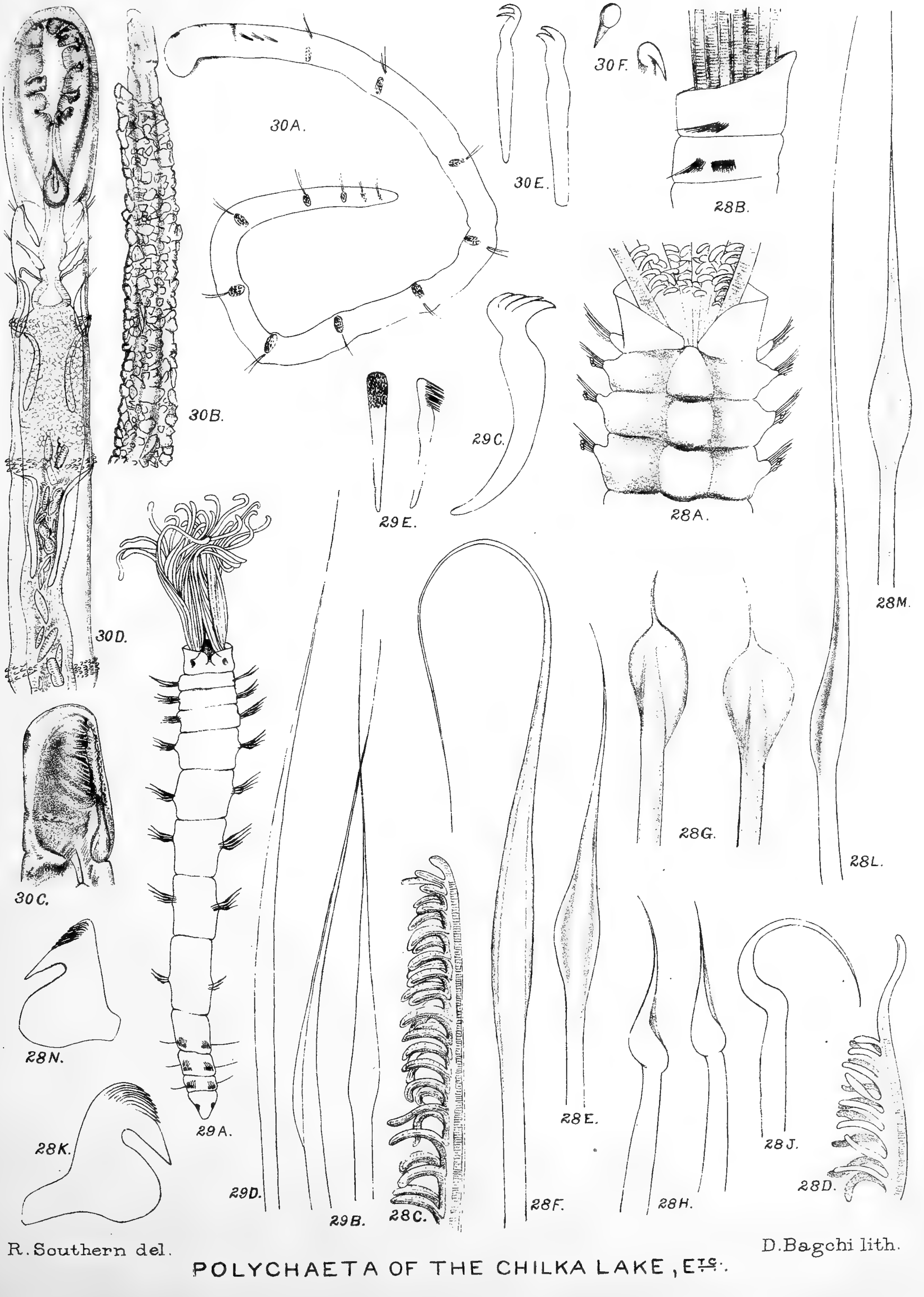
FIG. 28A.—Anterior end, dorsal view. × 70.
,, 28B.—Anterior end, lateral view. × 50.
,, 28C.—Branchia, almost entire. × 50.
,, 28D.—Tip of another branchia. × 50.
,, 28E.—One of the shorter setae of the 1st thoracic segment. × 840.
,, 28F.—A dorsal capillary seta from the 6th thoracic segment. × 840.
,, 28G.—Spatulate setae from the 6th thoracic segment. × 840.
,, 23H.—Cuspidate setae from the upper part of the anterior row of ventral setae of the 4th thoracic segment. × 840.
,, 28J.—Cuspidate seta from the lower part of the anterior row of ventral setae of the 6th thoracic segment. × 840.
,, 28K.—Avicular uncinus from the 6th thoracic segment. × 840.
,, 28L.—Side view of one of the longer capillary setae from one of the anterior abdominal segments. × 840.
,, 28M.—Face view of one of the shorter capillary setae from one of the anterior abdominal segments. × 840.
,, 28N.—Avicular uncinus from one of the anterior abdominal segments. × 840.

Fabricia (Manayunkia) spongicola, sp. nov.

FIG. 29A.—Entire animal, dorsal view. × 70.
,, 29B.—Capillary setae from a thoracic segment. × 1050.
,, 29C.—Ventral crochet from a thoracic segment. × 1700.
,, 29D.—Capillary seta from an abdominal segment. × 1050.
,, 29E.—Crochets from an abdominal segment. × 870.

Myriochele picta, sp. nov.

FIG. 30A.—Complete specimen (?). × 50.
,, 30B.—Anterior end, in tube. × 50.
,, 30C.—Lateral view of the anterior end. × 70.
,, 30D.—Ventral view of the anterior end, showing internal structure. × 90.
,, 30E.—Crochets. × 1730.
,, 30F.—Crochets viewed from above. × 2000.



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POLYCHAETA OF THE CHILKA LAKE, ETC.

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FAUNA OF THE CHILKA LAKE

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FAUNA OF THE CHILKA LAKE

ON SOME LEECHES FROM THE CHILKA LAKE.

By TOKIO KABURAKI, *Research Student, Imperial University, Tokio.*

(*From the Zoological Laboratory, the Museums, Cambridge.*)

(With five text-figures.)

CONTENTS.

ON SOME LEECHES FROM THE CHILKA LAKE.

By TOKIO KABURAKI.

In his paper dealing with the leeches from the Chilka Lake, W. A. Harding[1] puts on record three species, viz. *Piscicola olivacea*, *Glossosiphonia heteroclita* and *Placobdella emydae*. Recently I have had the opportunity of examining a large collection of Indian leeches, in which some specimens from the same locality are included. On examination some of these proved to be of great interest on account of the hitherto undescribed species representing it. The following is a list of the species dealt with in this paper:—

Piscicola olivacea, Harding.
Piscicola caeca, n. sp.
Pterobdella amara, n. g., n. sp.
Glossosiphonia ceylanica, Harding.
Limnatis (*Poecilobdella*) *granulosa* (Savigny).

Of these species *Glossosiphonia ceylanica* appears to be identical with the form referred by Harding to the well-known leech *G. heteroclita* (Linn.), but it may be distinguished from this by some different characters as will be mentioned later. No examples of Harding's *Placobdella emydae* have been brought under my own observation.

Before proceeding further, I should like to express my hearty thanks to Dr. Sir A. E. Shipley for his suggestions in respect to the present investigation and to Dr. N. Annandale for the privilege of examining interesting material. My thanks are also due to Mr. W. A. Harding for his kind help in many respects, and to Professor J. S Gardiner for allowing me the use of a table at the Zoological Laboratory.

Piscicola olivacea, Harding.

(Fig. 1.)

Numerous specimens of the species apparently identical with *Piscicola olivacea* are found included in the collection. This species generally occurs adhering to the body, or to the palate within the mouth, of fishes such as *Hypolophus sephen*, *Tetradon reticularis* and *Dorosoma indica* and appears to be fairly common in the Chilka Lake, it having been secured, besides the localities recorded by Harding, from several places, viz. in the neighbourhood of Mahosa, in the channel between the Satpur and Barhampur Islands, at the mouth of Barkul Bay, off Parikudh, and off the island in the bay beyond Grakala opposite to Kitrapal Village.

[1] Harding, W. A., 1920. Hirudinea. Fauna of the Chilka Lake. *Mem. Ind. Mus.*, Vol. V, p. 509.

As Harding states, there is little more to mention in respect of the external features of this species. The body, which commonly measures 8 mm. long, inclusive of the suckers, by 1 mm. across at the middle, is almost cylindrical, sometimes flattened and of nearly similar breadth for its greater length, though it considerably tapers forwards. On some occasions it shows a slight constriction a short distance in front of the genital opening, so that there can be distinguished a neck and a trunk. The anterior sucker is of a circular shape and rather less than half the posterior sucker, which is circular or oval in shape, the diameter being about 1 mm.

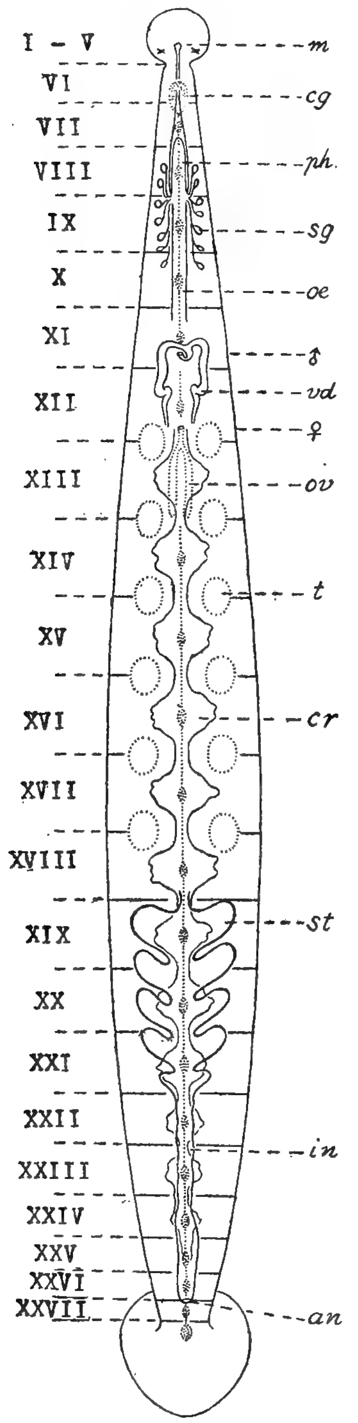

FIG. 1.—Diagrammatic representation of the organization of *Piscicola olivacea*, Harding, as seen from the dorsal side.

an = anus, *cg* = cephalic ganglionic mass, *cr* = crop, *in* = intestine, *m* = mouth, *oe* = oesophagus, *ov* = ovary, *ph* = pharynx, *sg* = salivary gland, *st* = stomach, *t* = testis, *vd* = vas deferens.

So far as I could count with certainty, the complete somite is, as described by Harding, made up of fourteen rings, and the eleven somites XIII-XXIII, according to Dr. Annandale's note, are each provided with a pair of pulsating vesicles, which in the preserved specimens have collapsed.

Dorsally situated on the anterior sucker are found two pairs of eyes which on each side lie so close together as to give the appearance of a single eye. The first pair are directed obliquely forwards, while the second pair are directed obliquely backwards.

The ground colour is subject to variation, generally being bright or pale olive green. Both dorsally and ventrally the body appears more or less dark brown on account of irregular pigments present all over in reticular distribution, leaving only a small space free on the mid-lateral sides of each somite. As has been mentioned by Harding, the anterior sucker shows three transverse pigment bands on the dorsal surface, one band following the junction with the body, one near the anterior tip and a third and broader one between the two, in the posterior part of the sucker, which contains the eyes. Medially these bands are traversed by a longitudinal band. The posterior sucker is marked with seven pairs of radiating pigment bands, corresponding to the seven somites of which it is composed.

The epidermis, as is well known in *Piscicola*, presents the most primitive arrangement of cells which are not closely packed. Below the epidermis, in the parenchyma, are found enormous quantities of pigments which are widely distributed as mentioned above.

The glandular cells in the parenchyma are very weakly developed, and in no case have I been able to demonstrate such large and round cells as are observable in the following new species closely resembling this leech.

The mouth lying nearly in the centre of the anterior sucker leads directly into the pharyngeal sheath, which reaches behind somite VIII. In it lies the pharynx which is of a short cylindrical shape and at the base receives the ducts of the salivary glands widely distributed in the anterior parts of the body. The pharynx gives rise posteriorly to a long passage, the oesophagus, which connects with the crop in somite XIII. The crop is a distensible part of the digestive organ, extending backwards nearly to the end of the trunk and ending blindly, and gives off a pair of slightly subdivided lateral pouches in each somite. At the end of somite XVIII the crop passes dorsally into the stomach which bears four pairs of wide lateral pouches, lying within somites XIX-XXI. The intestine is a narrow passage leading from the stomach backwards to the anus which is situated dorsally just between somites XXVI and XXVII.

The vascular and coelomic systems are well developed, and appear to be constructed on the same plan as in other species of *Piscicola*. The dorsal vessel is single and lies in the dorsal sinus, forming some dilations in its course. In no section have I been able to demonstrate the connection of the dorsal vessel with the ventral. The dorsal and ventral sinuses give off metamerically arranged transverse branches which communicate on each side with lateral sinuses and vesicles.

The cephalic ganglionic mass lies for the most part in somite VI, consisting, as is usual, of the fused ganglia of the first six somites. The acetabular mass is composed of seven ganglia of the last seven somites forming the posterior sucker. Between these masses there can be found twenty-one ganglia in the ventral chain, each lying in the middle of the corresponding somite.

The male genital aperture lies in somite XI, directly leading into the tubular vestibulum, and the female aperture in somite XII.

There exist six pairs of testes which are ovoid in shape and are situated intermetamerically on either side of the crop in somites $\frac{\text{XII}}{\text{XIII}}-\frac{\text{XVII}}{\text{XVIII}}$. Each testis gives rise to a short vas efferens communicating with the vas deferens, which pursues a forwardly directed tortuous course and at the same time dilates into a thick-walled glandular canal. In the region of the male genital aperture the canal nears the median line and finally unites with its fellow of the opposite side to form a wide passage, the "prostate," which opens into the vestibulum. The prostate is lined with an epithelium made up of high columnar cells closely packed, and is supplied with the ducts of glandular cells forming a large accumulation.

The ovaries are represented by a pair of simple sacs lying in somite XIII. Not far behind the female genital aperture they unite into a short common duct which makes its way to the exterior.

Ventrally occupying somite XIII is found a swelling of the body-wall in some specimens examined; this may be regarded as representing a part of the clitellum.

Piscicola caeca, n. sp.

(Fig. 2.)

In his paper Harding puts on record a note upon a leech closely resembling *P. olivacea* in form and size but wholly destitute of eyes. To my mind, that note appears, however, to be partly applicable to the following new genus and species. The species described below is based upon the material which has been placed by him in my hands. The three specimens of this new species were found attached outside close to the junction of the skin and teeth on both upper and lower jaws of *Hypolophus sephen* which was collected about eight miles S.S.-W. of Kalidai in March, 1914. In the general collection is included an example of this species, which was procured near the landing stage at Rambha.

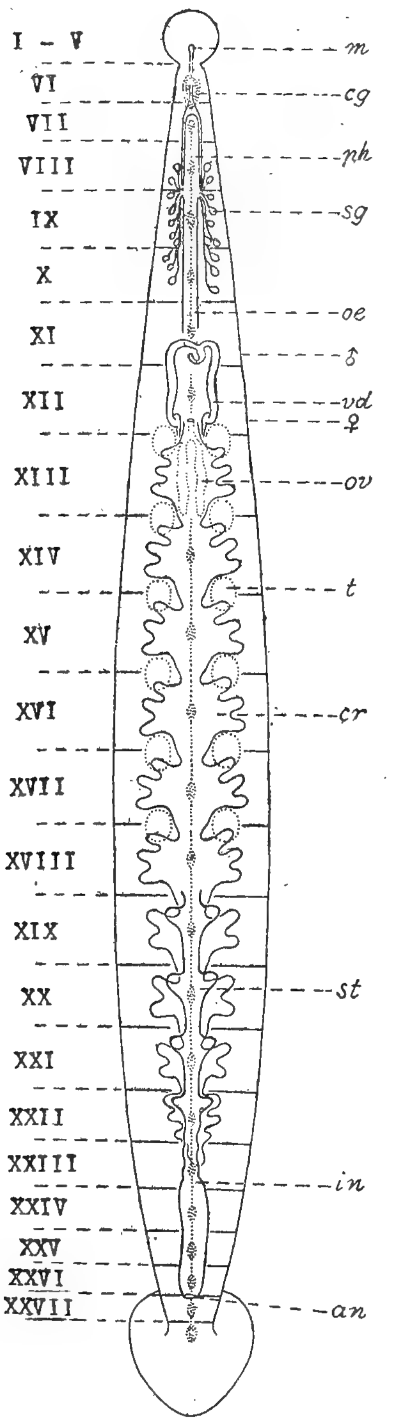

FIG. 2.—Diagram showing the organization of *Piscicola caeca*, n. sp., dorsal view. Index letters as in fig. 1.

The body is much flattened, slender and in the middle of a nearly uniform breadth, though it is attenuated more anteriorly than posteriorly. The anterior sucker is cup-shaped, almost circular and about half as broad as the posterior sucker, which is also circular or heart-shaped, measuring about 1 mm. in diameter. In the specimens examined I have been unable to demonstrate any trace of lateral pulsating vesicles. The worm measures 13 mm. in length, inclusive of the suckers, and about 1 mm. in breadth.

In the preserved specimens the rings are merged into irregular groups, and to obtain the correct number of them is extremely difficult. But a closer examination proves it to be grouped into twenty-one somites, each made up of fourteen rings.

This species is wholly devoid of eyes. No trace of eye-like organs could be demonstrated even in sections.

The ground colour is greyish white in spirit, wihout being marked with any trace of pattern. The crop is visible with more or less distinctness, owing to the ingestion of blood.

On the body-wall I have nothing peculiar to mention, excepting enormous quantities of unicellular glands which occur all over the body, just below the dermal musculature. These cells are round and far larger than those found in *P. olivacea*.

The organization agrees in the main with that of the preceding species. The mouth is situated at about the middle of the anterior sucker, leading dorsally into the pharyngeal sheath which continues backwards through the cephalic ganglionic mass, extending into somite VIII. Within the sheath lies the pharynx which is of a short cylindrical shape and is supplied at the base with numerous ducts of the salivary glands. These glands are always unicellular and represent large and round cells, which are extensively distributed in the anterior parts of the body. Posteriorly the pharynx is continuous with the crop filled with blood. The crop represents a distensible part of the digestive tract, extending over ten somites XIII–XXII, without being divided into two branches, and giving off ten pairs of sub-divided lateral pouches which come off metamerically in these somites. Near the end of somite XVIII the crop gives rise dorsally to the stomach which bears four pairs of lateral pouches, a pair in each of somites XIX–XXII. The intestine extends through five somites, being distinguished by a slightly winding proximal part and a simple wide distal part, opening dorsally at the anus just between somites XXVI and XXVII.

The coelome, though resembling that of the preceding species, is considerably reduced, and no trace of lateral pulsating vesicles could be detected even in sections.

Of the nephridia I have been unable to obtain any more insight than a few ducts in sections available.

The nervous system is very closely similar in its arrangement to that observed in *P. olivacea*, there being twenty-one ganglia in the ventral chain, not counting the cephalic and acetabular ganglionic masses. Each ganglion occupies a position in the middle of the corresponding somite. The cephalic ganglionic mass is, as usual, composed of six ganglia, chiefly situated in somite VI; the acetabular mass is made up of seven ganglia.

The male genital aperture lies in somite XI, as it seems to me, between rings 79 and 80, leading into the tubular vestibulum. The female aperture is situated fourteen rings behind the male, in somite XII, being much smaller than the latter.

The six pairs of testes exist anterior to and partly below the first six pairs of the crop-pouches, appearing to lie intermetamerically in somites $\frac{\text{XII}}{\text{XIII}}-\frac{\text{XVII}}{\text{XVIII}}$. The testes on each side are connected by short vasa efferentia with the vas deferens which runs forwards and, after pursuing a somewhat tortuous course and dilating into a thick-walled glandular canal in somites XI and XII, opens in common with its fellow into the vestibulum as in the preceding species. Around the prostate is a large accumulation of glandular cells which make their way into its lumen.

The ovaries represent a pair of simple sacs lying in somite XIII, usually lateral to the ventral nerve chain. Before opening to the exterior they unite into a short common duct.

In the specimens examined there can be also observed, as in *P. olivacea*, a swelling of the body-wall, which occupies ventrally about one somite (XIII).

In spite of the entire absence of eyes and the reduction of the coelomic cavity this leech may be placed in the genus *Piscicola* Malm., on account of its great resemblance in external and internal features, as is evident from above. It is also nearly allied to the genus *Platybdella* Malm., but it is distinguishable from this by the difference in the number of rings forming the complete somite as well as in some structural respects. It is, I think, better to regard this leech as a member of *Piscicola* occupying a position on the border between this genus and *Platybdella*.

Pterobdella amara, n. g., n. sp.[1]

(Figs. 3, 4.)

Some remarkably interesting examples appearing to represent a new genus and species were obtained near Kalidai and four miles E. ½ N. of Patsahanipur, from the mouth of *Hypolophus sephen* as well as near Manikpatna, from the mouth of *Trygon uarnak*. Usually they are to be found firmly adhering to the gums of their hosts..

This leech is of some resemblance in its features to Blanchard's *Piscicola elegans*[2] described by that author from Kiu-Kiang and Yang-tse-Kiang in China. The body is depressed anteriorly and almost cylindrical posteriorly. As is seen from Fig. 3, it presents a peculiar shape, being sharply divided into three distinct regions, each of which is on some occasions about one-third the entire length of the body, though the anterior region is usually shorter than the other. The two anterior regions are each provided with a pair of conspicuous lateral fin-like bodies, extending almost throughout the length of each region, while the posterior region is bare, without being marked with any trace of appendages. The anterior sucker is somewhat excentrically attached, nearly campanulate and much smaller than the posterior sucker, which is centrally attached and represents a thick circular disc, as is the case with *Pontobdella, Ichthyobdella* and *Ancyrobdella*, with the diameter about as broad as the posterior part of the trunk. The specimens from *Hypolophus* are large, measuring about 12 mm. long, inclusive of the suckers, by about 3 mm. across at the middle, while the examples from *Trygon* are much smaller, being about 10 mm. in length and 2. mm. in breadth.

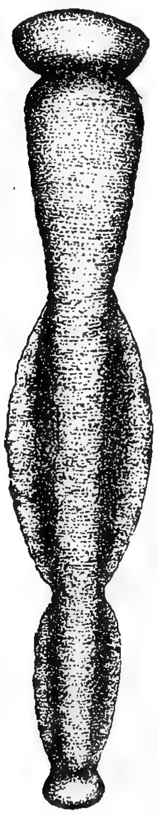

FIG. 3.—*Pterobdella amara*, n. g., n. sp. Dorsal aspect.

A correct count of rings forming the trunk is almost an impossibility. So far as I have examined the posterior region of the body where the rings are more or less distinct, the complete somite appears to be formed of some fourteen rings, which are merged into irregular groups.

The ground colour is white, occasionally marked, according to Dr. Annandale's

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[1] Here I beg to express my indebtedness to Dr. H. A. Baylis of the British Museum for his suggestion of the generic name "Pterobdella."

[2] Blanchard, R., 1896. Description de quelques Hirudinées asiatiques. *Mém. Soc. Zool. France*, T. IX.

note applicable to this leech, with numerous minute spots of faint pink on the dorsal surface.

The eyes are entirely absent. No trace of visual organs could be detected even in sections.

The epidermis consists of a layer of cells covered with a cuticle. Among the epidermic cells are, as is usual, glandular cells for the secretion of mucus. Immediately beneath the epidermis lies the dermal musculature which is strongly developed, consisting of two sets of fibres, outer circular and inner longitudinal. The circular muscles form a continuous sheet of great thickness, while the longitudinal muscles occur in distinct and thick bundles. Widely scattered in the parenchyma are numerous glands, which represent a large and round cell as is seen in *P. caeca*.

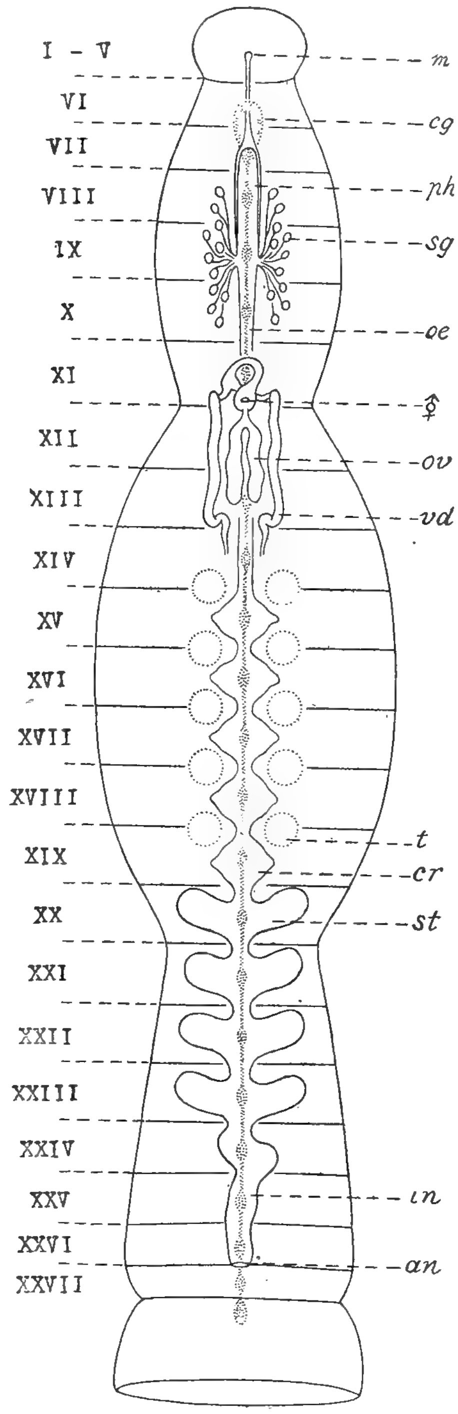

FIG. 4.—Diagrammatic representation of the organization of *Pterobdella amara*, as seen from the dorsal side. Index letters as in fig. 1.

The mouth is placed in the centre of the anterior sucker, leading into the usual pharyngeal sheath, which extends backwards into about somite IX. Within the sheath lies the pharynx, which commences as a short slender and cylindrical tube just behind the brain. Opening into the posterior end are a pair of groups of the salivary glands, each group consisting of a bunch of numerous large gland-cells. The long oesophagus leads into the crop, which is produced laterally into five pairs of irregularly outbulged pouches in somites XV–XIX, the last of which connects with the stomach, without being prolonged posteriorly into a blind sac. The stomach is provided with four pairs of simple pouches, coming off somewhat metamerically in somites XX–XXIII. The intestine follows, and passes to the dorsally situated anus between somites XXVI and XXVII.

The vascular system agrees in the main with that of *Pontobdella* and some others, the dorsal vessel being situated outside the dorsal sinus, but coming inside it occasionally. It becomes dilated in the anterior and middle regions of the body into a spacious sac to surround the pharynx and oesophagus with its coeca. In the region of the pharynx the dorsal coeca send out on each side lateral branches, communicating with the ventral vessel, where the latter forms a complete loop. In some sections of the middle parts of the body there can be found the connection of the dorsal vessel with the lateral vessels which in some parts give off branches running into the lateral fin-like bodies. The ventral vessel is simple for the greater part of its length usually inside the ventral sinus. Its posterior communication with the dorsal vessel could not be traced out, owing to my careless manipulation while sacrificing the body to the microtome. So far as my observation goes, the vascular system appears to be in communication, as in other Ichthyobdellids, with the coelomic cavity.

The coelome represents a system of very complicated sinuses, especially in the anterior two-thirds of the body. In the anterior region there is a large sinus which surrounds the pharynx and its sheath, the brain and nerve cords, and communicates on each side with lateral sinuses. This large sinus is divided in the middle region into two sinuses, dorsal and ventral, which connect with the lateral sinuses, after uniting into a common canal. The lateral sinuses in these two regions are widely spread in the lateral fin-like bodies, forming a system of anastomoses. They communicate with each other by metamerically arranged transverse canals just beneath the epidermis and thus form a complete circle. In the posterior region the arrangement of sinuses closely resembles that of *Pontobdella* and does not present any special features. No trace of pulsating vesicles could be detected even in sections. Judging from its arrangement and extension, the lateral sinus seems to play an important part in the respiratory function.

The nephridia, though seeming to be similar in their arrangement to those of *Pontobdella*, were not clearly made out in sections available.

The nervous system differs from that of the preceding two species in so far as the anterior ganglionic mass contains a ganglion more than ordinal. The cephalic ganglionic mass lies in somite VII, consisting, as in the case of *Ancyrobdella*, of seven ganglia, this is apparently due to the addition of the seventh ganglion. The acetabular mass is, as usual, composed of seven ganglia. Between these masses there are twenty ganglia which are metamerically arranged and joined by paired connectives. The ordinal position of the ganglion is in the middle of each somite. In the posterior end of the body, however, there can be noticed a slight centripetal displacement of the ganglia.

The common genital aperture lies in somite XI, directly leading into the wide, upwardly directed vestibulum of an irregular contour, which receives the male duct from the front as well as the oviduct from behind.

There are five pairs of testes, lying immediately in front of the five pouches of the crop; they are placed intermetamerically, as in the preceding two species, in somites $\frac{\text{XIV}}{\text{XV}}-\frac{\text{XVIII}}{\text{XIX}}$. The testes on each side communicate by short vasa efferentia with the vas deferens pursuing a tortuous course. In its course this duct becomes gradually dilated into a thick-walled glandular canal, which in front of the genital opening enters a large muscular, thick-walled and gland-covered "prostate," which soon unites with its fellow into a common duct, passing upwards and then backwards dorsally to open into the vestibulum.

The female organs consist of the usual pair of small ovarian sacs which communicate by a short narrow duct with the vestibulum.

This remarkable leech is nearly allied, as is evident from the above, to *Piscicola elegans* from China, but a closer examination has revealed the fact that it cannot be ranged under the genus *Piscicola*, as dealt by Blanchard with *elegans*. To my mind, a minute investigation of the latter species would necessarily result in its generic distinction from *Piscicola*. This leech is also closely allied to the genus *Trachelobdella* Diesing, but stands distinctly at variance from this in the general shape of the body, not to speak of other points of differences.

The following are the chief characters which distinguish this new genus *Pterobdella* founded on a single species.

Brackish water leeches, ectoparasitic on fish. Body smooth, formed of three distinct regions, of which the anterior two are flattened and each provided with a pair of lateral fin-like bodies; but the posterior region is cylindrical, without pulsating vesicles. Anterior sucker nearly campanulate, excentrically attached; posterior sucker circular, disc-like, centrally attached. Without eyes. Complete somite, though still uncertain, may be said to consist of some fourteen rings which are merged into irregular groups. Crop produced into five pairs of pouches, without posterior blind sac. Male and female genital organs opening in common. Testes five paired.

Glossosiphonia ceylanica, Harding.

(Fig. 5.)

The material was collected by Dr. Annandale and also by Dr. F. H. Gravely from the pond in the island of Barkuda. This leech was found occasionally attached to the body of *Rana cyanophlyctis*. At a glance some examples appeared to be identical with *G. heteroclita*, but a closer examination has revealed the fact that this is not so. After some hesitation I have referred it to Harding's *G. ceylanica*,[1] which has not been adequately described. This species appears to be fairly common in India, some examples being found in the general collection.

The body is nearly ovate-elliptical in contraction, and in some preserved specimens the head is seen separated from the trunk by a slight neck-like narrowing. No trace of papillae have I been able to demonstrate in the specimens examined. The anterior sucker lies on the ventral side of the head, within the limits of rings 1-6. The mouth occupies a position slightly anterior to the centre of the sucker. The posterior sucker is somewhat ventral in position and oval or circular in shape, the diameter measuring about 1 mm. The specimens measure about 8 mm. long by 3 mm. across at the middle of the body.

On the dorsal side seventy-one rings are counted in front of the posterior sucker. They are grouped into twenty-seven somites, of which somites I, XXVI and XXVII

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[1] Harding, W. A., 1909. Note on two new Leeches from Ceylon. *Proc. Camb. Phil. Soc.*, Vol. XV, Pt. III.

are uniannulate; somites II, III, XXIV and XXV biannulate; the twenty somites IV–XXIII are complete with three rings.

The six eyes are disposed in two close sub-parallel rows, as is the case with *G. complanata*. The first and smallest pair lie in ring 3. The second and larger pair occur in ring 4 but may be shifted somewhat further back and appear to extend into ring 5. The third pair are usually one ring behind the second, that is in ring 7.

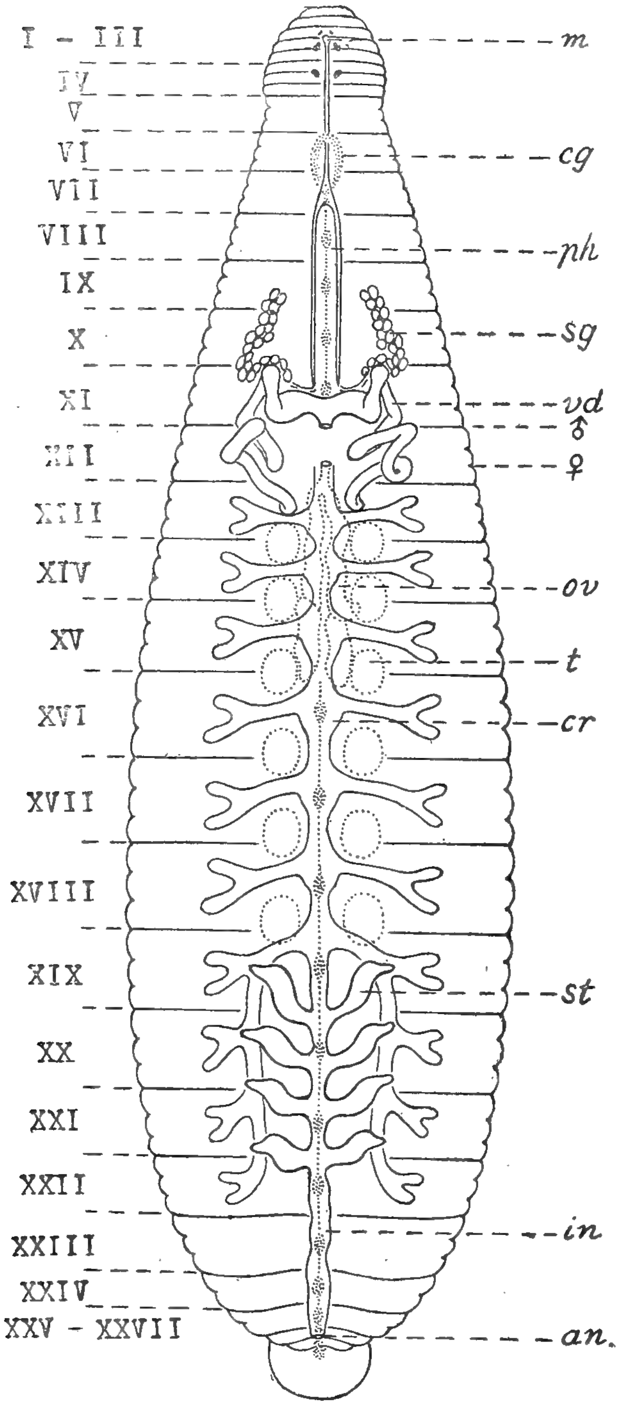

FIG. 5.—Diagram showing the organization of *Glossosiphonia ceylanica*, Harding, as seen from the dorsal side. Index letters as in fig. 1.

The colour in spirit is pale buff or pale grey, being marked with some three longitudinal rows of dark brown pigment patches, one in each half of the body and one median in position. The patches are arranged metamerically, marking the middle ring of each somite. Harding speaks of there being traces of four longitudinal brown stripes on the dorsal surface, but no trace of such stripes was shown in the specimens examined.

In structural respects the body-wall presents no noteworthy feature, being constructed in a similar manner to that found in other Glossosiphonids.

The mouth lying at the level nearly between the anterior two pairs of eyes leads into the pharyngeal sheath with the pharynx, which extends over about four somites VIII–XI. The salivary glands are closely aggregated into a compact group in each half of the body, the group lying symmetrically, within somites X and XI. The oesophagus represents a short passage connecting the base of the pharynx with the crop. The crop, differing from the general form of this genus, possesses seven pairs of lateral diverticulae, a pair arising in the middle of each of somites XIII–XIX. All of the first six pairs are usually bilobed distally, and each of the seventh pair is reflected posteriorly and extends into somite XXII, giving off four secondary lateral diverticulae, which come off metamerically in somites XIX–XXII. The stomach is provided with its four pairs of lateral diverticulae, lying within three somites XX–XXII. Posteriorly the stomach is continuous with the intestine which passes to the anus between somites XXVI and XXVII.

The vascular and coelomic systems, though not being traced out clearly, appear to be constructed on the same plan as in other Glossosiphonids.

The nephridia form several coils in their central portion and open out ventrally on the middle ring of the somite. The total number could not be definitely made out.

The cephalic ganglionic mass occupies two somites VI and VII, and consists, as usual, of the fused ganglia of the first six somites. Behind this there exist twenty-two distinct ganglia in the ventral chain, the last one representing the acetabular ganglionic mass. Each ganglion usually lies in the middle of the somite, though it is slightly displaced towards either end of the body.

The male genital aperture is placed between somites XI and XII. The female aperture is two rings behind the male, between the first and second rings of somite XII.

The six pairs of testes lie between the lateral diverticulae of the crop, intermetamerically in somites $\frac{\text{XII}}{\text{XIV}}-\frac{\text{XVIII}}{\text{XIX}}$. The vasa deferentia on each side proceed forwards, and, after, forming several coils in somites XI–XIII, unit in the median plane into a thick-walled common canal, the "prostate," opening to the exterior.

The ovaries are a pair of simple sacs extending over four somites XIII–XVI, and open in common as usual.

This leech may be placed in the genus *Glossosiphonia*, Johnson, with which it agrees in almost all of the diagnostic characters, excepting only the difference in the number of lateral diverticulae of the crop. In my opinion the difference may be regarded as being of not more than specific value.

Limnatis (Poecilobdella) granulosa (Savigny).[1]

This species, as is well known, is used for blood-letting in India and is very wide in its distribution, a considerable number of examples having been recorded by several authorities from Celebes, Sumatra, Borneo, Java, Cochin, Siam, China, India, Ceylon and elsewhere. In addition to a single individual from this lake, I have examined numerous examples from various parts of India, Ceylon and Burma, which are included in the general collection.

The body in the preserved condition is flattened and has a rough or granular appearance on both sides, owing to the presence of small closely-set papillae disposed transversely on the ring. In some cases the papillae are so small that a comparatively smooth surface is seen. This leech is of extremely varying size, the largest

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[1] Blanchard, R., 1893. Revision des Hirudinées du Musée de Turin. *Boll. Mus. Zool. Univ. d Torino*, Vol. VIII, No. 146. 1897a, Hirudinées du Musée de Leyde. *Notes from the Leyden Museum*, Vol. XIX. 1897b, Hirudinées des Indes Néerlandaises. *Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indian herausgegebenen von Dr. Max Weber.*

examples measuring about 160 mm. in length in front of the posterior sucker and 20 mm. in breadth at the middle of the body.

The anterior sucker presents a cup-shaped deepening on the ventral side of the head and is very rough, due to the presence of numerous minute papillae. The upper lip is divided on its inferior surface into two lobes by a longitudinal groove, at the base of which are found three small jaws arranged in the usual manner. The jaw is provided with numerous papillae and armed with a single row of numerous minute teeth.

The posterior sucker is of a circular shape, not wider than the greatest breadth of the body and also marked with some seven rows of transversely arranged papillae.

The rings are very conspicuous, on the dorsal side counting 102 in front of the posterior sucker, of which rings 6 and 7 are fused ventrally to form the posterior boundary of the anterior sucker. The same is true of rings 8 and 9. The last ring is pierced by the anus, thus showing signs of subdivision.

According to Oka's procedure[1] in determining the boundaries of somites, all the rings are grouped, as is usual, into twenty-seven somites, of which somites I, II, III and XXVII are uniannulate; somites IV, V, and XXVI biannulate; somites VI, VII and XXV triannulate; somites VIII and XXIV quadriannulate; the fifteen somites IX–XXIII are complete, consisting of five rings.

There are five pairs of eyes, lying, as in all species of *Hirudo*, respectively in rings 2, 3, 4, 6 and 9.

The segmental papillae are arranged, as has been stated by Blanchard, in eight dorsal and six ventral rows.

The male genital aperture is situated between rings 31 and 32, that is between the fourth and fifth rings of somite XI. The female aperture is five rings behind the male, that is between the fourth and fifth rings of somite XII.

The nephridial pores in some specimens could be somewhat easily demonstrated from the exterior. There are in all seventeen pairs, the pore lying in the furrow separating the second and third rings of somites VIII–XXIV.

The clitellum embraces the four somites X–XIII.

This species, as has been described by Blanchard (*loc. cit.*, 1897b) in detail, exhibits great variation in colour and markings, so that their differences are purely individual, and not such as to authorise even the distinction of "varieties." In the majority of cases the ground colour of the dorsal surface in spirit is a brownish olive with a slight touch of bluish grey. There are seven longitudinal rows of black patches, one median and three lateral on each side. The median stripe is sometimes of a dark brown colour and is in some cases continuous, the side of the median stripe extending almost throughout the whole length of the body. On each is seen a row of patches which mark in most instances the first and last rings of each complete

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[1] Oka, A., 1917. Hirudinea. Zoological Result of a Tour in the Far East. *Mem. Asiat. Soc. Bengal*, Vol. VI.

somite. The black patches forming the outer lateral stripes usually fall on the second and fourth rings, while those composing the inner lateral stripes are sometimes entirely absent. The ventral surface is generally a dull brown or a bluish grey, sometimes marked with marginal bands of a deep colour.

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FAUNA OF THE CHILKA LAKE

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FAUNA OF THE CHILKA LAKE.

THE HYDROGRAPHY AND INVERTEBRATE FAUNA OF RAMBHA BAY IN AN ABNORMAL YEAR.

By R. B. Seymour Sewell, *B.A., F.A.S.B., Major, I.M.S., Surgeon Naturalist to the Marine Survey of India*

AND

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(Plates XXXII–XLIII.)

CONTENTS.

OBSERVATIONS IN RAMBHA BAY.

The main object of this paper is twofold; firstly to describe the differences in density found in the water of the inner part of the Chilka Lake at different levels and secondly to put on record changes in the composition of the invertebrate fauna noted in the same locality, in a year in which the density of the water as a whole was considerably below normal.

It was noted in August, 1919, that the water of Rambha Bay, which forms the south-western extremity of the Chilka Lake, was apparently much less salt than it had been at the same season or a little later in 1914, when Annandale and Kemp concluded their investigation of the fauna of the lake. For various reasons it was impossible to carry out another survey of the lake as a whole, but arrangements were made for observations on the bay at different seasons with Barkuda Island as our headquarters.

We were unable to visit the mouth of the lake, but trusted to obtaining information from official sources as to its condition at the time. In this we have been to some extent disappointed. We have to thank the Director of Fisheries, Bengal, Bihar and Orissa, and also the Executive Engineer, Cuttack, for supplying us with such facts as were known to the departments concerned. They have spent much time and labour in doing so, but unfortunately no inspection seems to have been made at the critical period at which we believe that channel became closed, *i.e.* towards the end of the dry season. The mouth is known to have been open in April, 1919 and in the same month of 1920, and changes in its position are known to have occurred in the former year. We have little doubt that it was closed for a considerable period in the summer or autumn of 1919, in which low density was associated with exceptionally high water in a season of by no means excessive rainfall. We were informed by the serang of the Rajah of Kallikota's steam launch, who is well acquainted with all parts of the lake, that the channel was entirely blocked in November, 1919, but this is contradicted by other statements. In the rainy season of 1920 conditions apparently became normal again.

PART I. HYDROGRAPHY.

By R. B. SEYMOUR SEWELL.

The present investigations were undertaken by me in order to supplement the work done by Dr. N. Annandale and Dr. S. W. Kemp[1] during their survey of the Chilka Lake in 1914. The conclusions at which these investigators arrived were

[1] Annandale and Kemp: "Fauna of the Chilka Lake, Introduction, Hydrography of the Lake," *Mem. Ind. Mus.* pp. 5-12, Vol. V (Calcutta, 1915).

based entirely upon observations made on the surface waters, and it was felt that this was not altogether satisfactory. I therefore undertook to carry out a series of observations on the water at different levels, but as in the time at my disposal it would have been quite impossible to conduct such a hydrographic survey of the whole lake, I decided to confine my investigations to a small area, and Rambha Bay at the extreme south end was selected as being the most convenient locality.

The water-samples were taken by means of an 'Ekman' reversing water-bottle and temperatures were simultaneously recorded by a reversing thermometer and were subsequently reduced in accordance with the formula given by W. Walfrid Ekman.[1] The density of the water-samples was estimated—usually on the day following their collection—by a 'Buchanan' hydrometer and the findings were subsequently reduced to 0°C, Standard Temperature, and temperature *in situ* by means of Knudsen's Tables. I have throughout adopted 25·0°C as Standard Temperature, so that my results are not directly comparable with those given by Annandale and Kemp who reduced their results to 15°C.[2]

The various stations—numbered consecutively—were made as nearly as possible in lines, running roughly at right angles to the main length of the bay and more or less parallel with each other, so that the results obtained could be plotted out in sections. The positions of the stations were in every case taken by means of a prismatic compass, and, in order to fix them as accurately as possible, three observations were taken at each station of the bearings of prominent land-marks; their positions are shown in Chart 1.

The results obtained by Dr. N. Annandale and Dr. S. W. Kemp in 1914 showed very clearly that there was during the course of that year a very considerable range of variation in the degree of salinity of the surface water, correlated with and in the main due to two causes, namely, the influx of fresh water from the Mahanaddi River system during the S.W. monsoon season and the influx of sea-water during the winter months. To quote their own words (*loc. cit.*, pp. 11–12), the conclusions at which they arrived were that "the annual sequence of events, as it concerns the lake as a whole, may be stated briefly as follows:—

"The floods that enter the lake at the close of the monsoon from the Mahanaddi delta expel all salt water from the northern portion, driving it through the outer channel to the sea, and are of sufficient volume to raise the level of the lake some 5 or 6 feet above the mean of the dry season. There being no outlet at the southern end, the comparatively saline water which had accumulated there is banked up by the flood, becoming, however, diluted to a considerable extent both by admixture with water from the north and by surface drainage from the land in the vicinity. Towards the end of the year the floods subside. The first effect of the alteration in

[1] W. Walfrid Ekman: "On the use of insulated water-bottles and reversing thermometers," *Pub. de Circonstance*, No. 23. (*Conseil permanent Internat. pour l'explor. de la mer.* Copenhagen, April, 1905.)

[2] Table IV (p. 710) shows the corresponding values of the different densities at 25°C and 15°C respectively.

level is that the water of low salinity, hitherto confined at the southern end, spreads further north. In course of time the level sinks to a minimum and subsequently, under suitable conditions of wind and tide, volumes of salt water enter from the sea and entirely fill the outer channel. This in 1914, had already taken place before the month of February. Under normal conditions the waters of the main area probably rise in salinity owing to successive inflows from the Bay of Bengal, until a maximum is reached in July. By August the monsoon floods have commenced, the water level rises rapidly and a repetition of the annual cycle begins."

In order, therefore, to obtain so far as was possible an insight into the annual changes that take place in the salinity of the water in Rambha Bay, two series of observations were carried out, in August, 1919, and in April, 1920, respectively. These months were selected as being the most likely periods in which to get the desired information, since in August the influx of fresh water would be causing a rise in level and a fall in salinity, while in April, there should be a large influx of salt water entering the lake from the sea.

In the following pages I propose first to consider these two periods separately and afterwards to compare and correlate the results obtained.

I. Observations in August, 1919.

During the early part of my visit to the Chilka Lake, from August 11th to 16th, 1919, the local conditions were more or less constant and, on the whole, the weather was fine with light winds from the south and south-west; there were occasional light showers of rain and a somewhat heavier shower, accompanied by a north-easterly wind, occurred on August 16th, and lasted for about an hour. On August 17th, however, there was a heavy storm with strong wind from the north-east which caused a considerable rise in the height of the lake. The reverse effect, of a strong wind from the south-west lowering the level of the water in Rambha Bay, has been recorded by Annandale and Kemp (*loc. cit.*, p. 11). Unfortunately I had no means available of measuring the actual amount of the rise of level that occurred, but it must have been several inches, and simultaneously the waves raised by the wind must have caused a considerable disturbance and admixture of the water in the upper levels. Obviously then observations taken after this date (August 17th) are not comparable with those recorded earlier, and I have therefore considered them separately.

Wherever it was found possible, three observations—on the surface, at 5 feet and 10 feet depth—were made at each station, but where the shallowness of water did not permit of observations at this latter depth, I took two observations, at the surface and at 6 feet depth respectively, and the results obtained are given *in extenso* in the Appendix, Table 1. As my investigations were of necessity made on different days and therefore under slightly different conditions of temperature, etc., it might be argued that the results obtained are, in view of the shallowness of the water in the Bay and the varying effects of radiation and conduction of heat through the different layers of water, not strictly comparable with each other. I have, therefore in addition to giving the densities at the temperature *in situ* in the various sections also given corresponding sections after all densities had been reduced to standard temperature, 25·0°C. In an investigation of the physical conditions of so small an area of water it was expected that it would prove necessary somewhat to reduce the usual intervals between contour lines, and this proved to be correct especially as regards temperatures and I have in places drawn them as close as 0·25°C; but as regards the densities obtained, these were found to differ so widely and in such short distances that as a rule I have given them in 0·5 intervals.

Annandale and Kemp (*loc. cit.*, p. 5) give the depth of water in Rambha Bay as having a maximum of 8 feet during the dry season, with a rise of 5 to 6 feet during the floods. In September, 1914, the density of water in this area was found to be 6·5 [they give it as 1·0065, distilled water being 1·000 (*loc. cit.* p. 8)] and again in November of the same year they found the density to be 6·0, though on this occasion they state that "water of appreciable salinity was, however, not so closely restricted to the southern area (of the lake) for a sample obtained off Kalidai[1] gave a reading of 1·0035 and others off Barkul[1] of 1·003. The flood waters had somewhat abated, with the result that the level had decreased and the saline water confined during September at the extreme south had spread further north."

At the time of my visit to the lake the depth of water in the middle of the Bay was 11 feet and during September it rose still higher. On August 11th, 1919, a sample of water taken at the surface at Barkuda Island showed a density of 9·29 in situ at a temperature of 29·9°C or of 10·78 at standard temperature.

Throughout the whole period between August 11th and December 16th, 1919, there seems to have been a steady fall in the density of the surface layers (*vide* Appendix, Table II), and a sample taken near Breakfast Island on this latter date and sent to me for examination gave a density at standard temperature of only 2·19. Allowing for such annual variations as are bound to occur owing to variations in the annual rainfall, my results up to this point seem to agree fairly well with those obtained by Annandale and Kemp in 1914. It was, however, found that the surface conditions of the water in the bay in August were by no means constant. In plate XXXVIII I have given the densities of the various water-samples taken *at the surface* at the temperatures that existed *in situ*, and it shows very clearly the way in which the density *decreases* as we pass from the mouth of the bay between Barkuda and Chiriya Islands in a south-westerly direction towards the village of Rambha, situated a the head of the bay to which it gives its name. This distribution of the water in the bay in 1919, is the exact opposite of that found by Annandale and Kemp in November, 1914, who record (*loc. cit.* p. 10) that "throughout the southern part of the lake the water in the middle was of lower specific gravity than that nearer the shores." During the period of my observations between August 11th and 18th, 1919, surface-

[1] As neither Kalidai or Barkul are shown on my charts I may mention that the former is an island some 8 miles away to the north-east of the entrance to Rambha Bay, while the latter lies on the mainland about 2 miles to the north of Kalidai.

water having a density of 9·0 or over was found only at the mouth of the bay and in a small area in the southern prolongation of the head of the bay to the south-east of Rambha village; throughout the whole length of the bay the density was found to decrease steadily as we approach Rambha village, and the contour lines of equal density drawn on the plate show very clearly that this fall is due to an influx of fresh water. The map shows that at the head of the bay in the vicinity of the village two streams enter the lake and at this period of the year, and even on into December a quantity of warm fresh water was being brought down, which flowed out into the lake over the top of the more dense water below. As this current of water passes out into the lake its own density is raised by gradual admixture with the denser water of the lake, while at the same time the salinity and consequent density of the lake-water is diminished, and the effects can be traced even as far as the mouth of the bay. The effect of this surface current of fresh and comparatively warm water is seen extremely well in sections 1 and 2, plate XXXII, at stations 14 and 20 respectively. The current runs from near Rambha village across the mouth of the southern continuation of the bay towards Ganta Sila, and in August its course was plainly marked by floating leaves and scum. At this point the current alters its course and sweeping round the northern promontory of Ganta Sila appears to divide. A study of section 4, plate XXXII, shows that we have two areas of lower density situated at the two sides of the entrance to the bay, at stations 8 and 11 respectively, and, furthermore, in both these areas the temperatures recorded are higher than that of the surrounding water. That the lowered density is not merely the result of this raised temperature is, however, clearly shown in section 4, plate XXXIII, in which I have plotted out the densities after reduction to standard temperature. One area of lowered density occur on the surface at station 11, and it has a temperature of 0·2°C higher than the surrounding water, while at a depth of 6 feet the temperature is as much as 0·61° higher than the water at the corresponding level at station 10. This area is a direct continuation of the surface current noted above and on a calm day the course of the current could be easily traced from Ganta Sila to the south-west corner of Barkuda Island by the presence of the leaves and scum referred to above; it is obvious that any breeze from the S.W. or S.S.W. will very materially assist, even if it is not the actual determining factor, in the causation of this current. A strong breeze will cause a flow of surface water of low density out of the bay and this must naturally be compensated for by an influx of water from outside the bay at the deeper levels. At station 8, the second area of lowered density is found, not on the surface, but at a depth of from 5 to 6 feet, and in order to account for its presence at this depth we must first study the conditions existing in the deeper waters of the lake.

One of the earliest points that attracted my attention during my survey was the extremely rapid rise in the density of the water of the bay as we pass from the surface towards the bottom. This alteration of density is most marked, as one would expect, at stations 13, 14 and 15 at the head of the bay where owing to the influx of fresh-water the surface density is markedly lowered, and in this region a reference to section I, plate XXXII, shows that the density *in situ* increases from 4·46 on the surface at station 14 to over 7·0 at 5 feet and to nearly 10·0 at 9 feet depth; but even at the mouth of the bay we still find a very considerable rise in density as we pass from the surface to the 10-feet depth-level. If now we examine the density contour lines at the three levels—surface, 5 feet and 10 feet depth—shown in plates XXXVIII, XXXIX and XL respectively, we see that there is at all levels, but especially at the 10-feet depth-level, a distinct curvature indicating a slow but steady flow of water into the bay. This is particularly noticeable at the 5–10 feet depth-levels, where the inflowing current can be traced throughout the whole length of the bay except in its southerly prolongation near Rambha village.

This inflowing deep current, after passing through the comparatively narrow channel to the south-east of Samal Island, enters Rambha Bay and flows along the bottom till it strikes the shore in the neighbourhood of Chiriya Island and Ganta Sila, and is then deflected towards the surface. This deflection is well seen in section 4, plate XXXII. On reaching the surface the denser water spreads out and flows over the top of the southern branch of the surface current of low-density water that we saw was coming from the head of the bay, where the streams enter the lake, and in this way we get the formation of the area of low density at a depth of 5 feet, that we found to be present at stations.

The only feature in the conditions existing during the first part of my observations prior to August 17th, 1919, that remains to be considered is the area of higher density that was found in the southern extremity of the bay near Rambha village at stations 16, 17 and 18. This patch of water appears to lie outside the influence of the circulation of water that was going on in the rest of the bay, and station 18 showed particularly clearly an area of raised density on the surface. I attribute the comparatively high densities found in this area to the effects of evaporation; as Annandale and Kemp have pointed out (*loc. cit.*, p. 11) "in a lagoon of the size and shallowness of the Chilka Lake evaporation must, especially in a tropical climate, be more than considerable and doubtless plays a great part in the phenomena we have been discussing."

I now pass on to the conditions observed after the occurrence of the storm on August 17th.

During the time when my observations were made on August 18th, a wind was blowing from the south and south-west and this gradually increased in strength so that I was eventually compelled to discontinue my work. The results obtained are shown in section 3, plate XXXIII, and the first fact that strikes one is that in the centre of the bay extending from station 23 to station 25 and having a depth in the centre of about 6 feet is an area of water having a lowered density—7·0 and under—and raised temperature—29·5°C and over. It seems to me that owing to the wind the surface current coming from the southern end of the lake, which we have already studied, is modified, so that instead of dividing into two areas, the whole of the low-density water is now carried in a north-easterly direction across the bay. We have here a condition of affairs very similar to that recorded by Annandale and Kemp in 1914 (*loc. cit.*, p. 11) except that in this case the effect on the density of the water is the reverse of that seen by them, because, as I have already pointed out, the water at the head of the bay in 1919 had a lower density than that in the centre.

At the same time I found that the density of the lower layers of water near the bottom showed a considerable diminution below what had been found in corresponding situations previously, the bottom water at a depth of 10 feet being now only a little over 9·0 in density *in situ* or a little over 10·0 at standard temperature of 25°C, whereas previously in sections 2 and 4 I had found that at this depth it was 10·0 or over *in situ*, or 11·0 and over at standard temperature. Furthermore, the temperature of the water at this depth showed an increase of more than 1·0°C above that

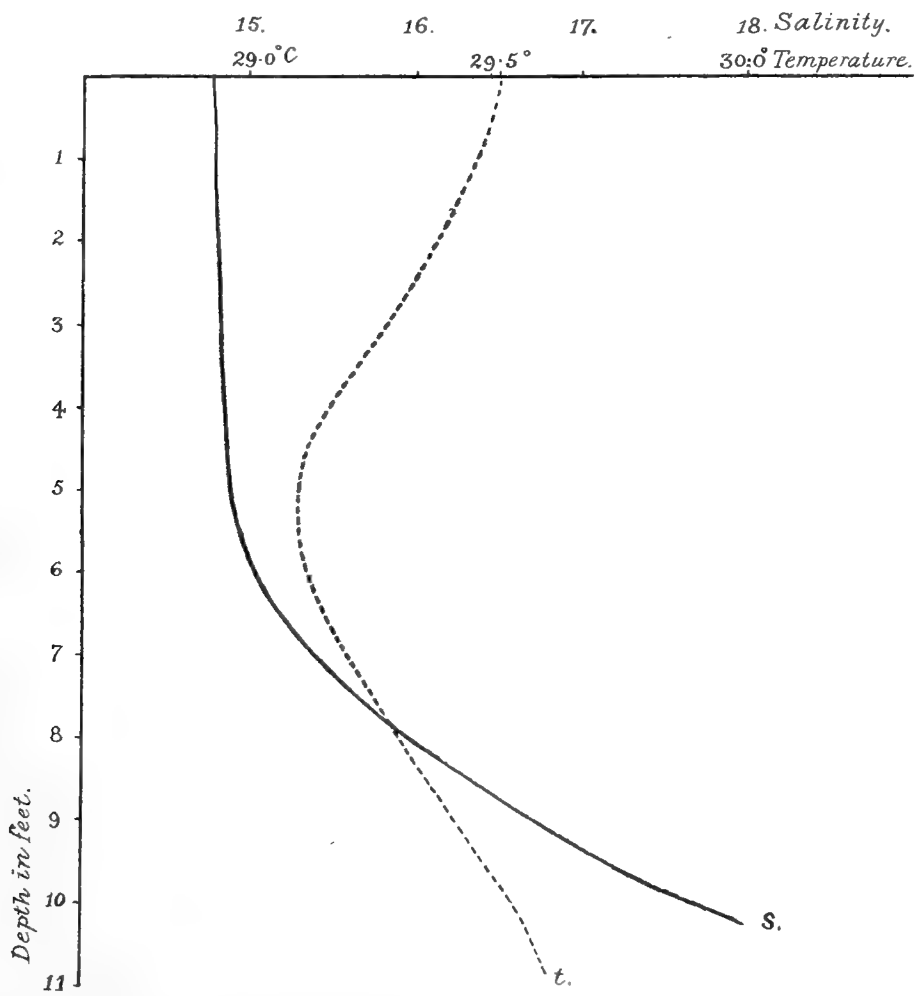

FIG. 1.—The vertical distribution of temperature (*t*) and salinity (*s*) at station 23, August 18, 1919.

previously noted. The cause of these changes is by no means obvious, and it is probable that more than one factor has contributed towards their production; the purely mechanical effect of the waves raised by the storm must have caused a considerable amount of admixture between the various layers and would thus tend to cause a fall in density and rise in temperature, but if this had been the sole cause the temperature at 5 feet depth would have been higher than that at 10 feet depth which is not the case. It seems, therefore, that it must be due to an influx along the bottom of water having a higher temperature than that of the mid-water. It is possible that this flow may be merely an increase in the inflowing deep current that we have already seen to be normally taking place at the 10 foot level, brought about in order to compensate for the increased outflowing surface-current caused by the wind, since there seemed to be no appreciable fall in the surface level of the water of the bay; but I am inclined to think that we have here an additional inflow from a source not indicated in my previous observations, namely from the extensive and somewhat enclosed area lying between the mainland and Cherriakuda, Barkuda, and Samal Islands. The surface current due to the wind must have blown a quantity of water into this area through the passages between the mainland and Cherriakuda Island and between this latter and Barkuda Island, and this must produce a corresponding outflow.[1]

A study of the temperatures and salinities found at stations 2 and 3 in section 2, August, 1919, and again at station 23, section 3, August 1919, further seems to indicate that we have present in the lake at this season of the year a condition of affairs that is very similar to that which is known to exist in the Oyster 'Polls' in Norway. The depth of the water in the lake is considerably less than that present in a typical 'Poll', such as the Kverne-Poll, but a comparison of the vertical distribution of temperature and salinity at the above stations in the Chilka Lake with the distribution present in the Kverne-Poll in June as given by Murray and Hjort (1912, p. 226)[2] reveals many features in common: and this is particularly well shown in the chart of station 23 which I give above. In both cases the water on the surface is of appreciably higher temperature and slightly higher salinity than that present at a depth of about 4–5 feet and below this level both temperature and salinity steadily increase. The differences present in the Chilka Lake are not so marked as those in the Kverne-Poll but the conditions present are essentially similar.

2. OBSERVATIONS IN APRIL, 1920.

My second visit to the Chilka Lake was from the 27th–29th April, 1920. Throughout this period the weather was fine. Each morning there was little or no wind, but, as the day wore on, light airs sprang up from the S.S.W. and by midday a strong breeze was blowing from this direction. As the weather conditions on all three days were exactly similar, the results obtained are all comparable with each other.

A very considerable change had occurred in the level of the lake since my visit in August, 1919, and the depth of water in the bay instead of being about 11 feet was now only 5 feet—that is to say *was 3 feet lower than the maximum depth given by Annandale and Kemp for the dry season* (*vide loc. cit.*, p. 5). In consequence it was

[1] From observations made in August, September, October, and December 1919, and in April June and July, 1920, Dr. Annandale tells me that he is convinced that the normal direction of the wind at Barkuda island is approximately S.W. throughout the year. This wind blows the water of the bay past the island during the day so that the water-level of the lake sinks appreciably. The breeze tends to fall in the evening, however, and is usually less strong at night. The water then returns to the bay, with the result that the level is usually higher in the morning than it is in the evening.

[2] Murray and Hjort, "The Depths of the Ocean" (London, 1912).

only possible to obtain two samples of water at the great majority of the stations namely at the surface and at a depth of four feet.

As before, observations were taken in a series of traverses across the bay, and the positions of the various stations—numbered 26 to 40—are shown in plate XLI. On this occasion, the prismatic compass used for taking bearings was not so satisfactory as the one employed in August, 1919, and in several cases the bearings do not meet very satisfactorily, so that the positions of the stations shown on the plate are to be regarded as approximate only. The results obtained are given *in extenso* in the Appendix, Table III.

The first point to be considered is the general density of the water in the bay, and here at the outset we find a most surprising difference from the results obtained in April, 1914. In that year Annandale and Kemp (*loc. cit.*, p. 8) found that the density in Rambha bay was 10·0 except at the southern prolongation near Rambha village, where it was as high as 11·0. A reference to plate XLII shows that in 1920, the surface water of the bay was everywhere less than 5·0, except just at the mouth and in the southern extension at the head of the bay where it was only little over 5·0.

As was found to be the case in August, 1919, the surface density shows an appreciable range of variation in different areas. In plate XLII, I have plotted out the various densities, at the temperature *in situ*, of the surface samples taken at each of the stations. To the north-east of Chiriya Island is an area of higher density that appears to be slowly making its way into the bay. The source of this area is by no means obvious for two observations taken to the north and east of Samal Island (*vide* samples 94 and 95, Appendix 8, Table III), show that in that region the density of water is on the whole less than that in Rambha Bay. Another area of higher density occurs in the southern extension of the head of the bay, between Rambha village and Ganta Sila, and this I attribute, as before, to evaporation. In the centre of the bay at stations 32 and 33 we find a peculiar circumscribed area of lowered density, 4·5 and under, and a similar lowering of density of the surface water was found at station 35 in the channel between Cherriakuda Island and Barkuda Island, though separated from the area in the centre of the bay by a band of water having a density of 4·58. A reference to the corresponding stations in section 2, plate XXXVI, in which I have shown the densities at standard temperature, shows that at station 32 the lowering of the density on the surface is due entirely to a rise in temperature, for the density at standard temperature in this area is uniform with those on each side. As to the cause of this very local rise in temperature I am unable to offer any explanation.

Turning now to the results obtained from samples taken at a depth of 4 feet, I have plotted the results, as before, in plate XLIII and here again we find the same areas of increased density both at the entrance and at the extreme head of the bay, while we still get evidence of the area of low salinity in the centre of the bay at station 32. But, unlike the surface area, the lowered density at this depth is not the result of a raised temperature. It is still clearly seen in section 2, plate XXXVI, after the density has been reduced to standard temperature. No sign of any similar lowering of density is seen in either sections 1 or 3 so the condition is obviously local, and it seems to me that the most probable explanation is that there is in the neighbourhood of this station an under-water spring. If this be so, the spring appears to be an intermittent one, for no trace of it is visible in the results obtained in August, 1919. We now find that in the channel between Cherriakuda and Barkuda Islands there is an area of higher salinity and raised temperature. The sample was taken at 12-20 p.m. on the 17th April, 1920, when a strong breeze was blowing across the bay from the S.S.W. and it seems to me that we have here corroborative evidence of the view put forward by me above that a strong breeze from this direction in addition to causing a surface outflow from the bay also sets up a counter-current flowing along the bottom *into* the bay from the shallow area enclosed by Cherriakuda, Barkuda, and Samal Islands.

A sample of water sent to me by Dr. Annandale in June, 1920, showed that yet another great change had taken place in the density of the water. This example was taken at 10-30 a.m. at the end of the jetty on Barkuda Island and at the time a strong breeze was blowing from the S.S.W. Unfortunately, no record of the temperature was taken simultaneously, but the density of the sample at standard temperature was 9·66 so that it is obvious that there had been a great increase in the salinity of the water in the lake since April.

A comparison of my observations in 1919 and 1920 with those made by Annandale and Kemp in 1914, shows clearly that the conditions existing in Rambha Bay during these two periods were vastly different. At the commencement of my work in August, 1919, my results agree very fairly well with those obtained five years previously; but between August, 1919, and June, 1920, changes occurred in the Lake that were quite unlike anything observed in 1914. I have already given Annandale and Kemp's account of what, judging from their experience, is the normal sequence of events in the lake during successive seasons of the year, and a comparison with my results show that the abnormal features present during the end of 1919 and early part of 1920 are: (1) the steady and progressive diminution in the density of the lake-water long after the close of the monsoon season, so that in December the density was only a little over 2·0; (2) the steady fall in the level of the lake up to and possibly even beyond April, 1920; and (3) the subsequent rapid rise in salinity in May-June, 1920. These changes in the density and salinity of the water in the lake produced a very noticeable effect on the fauna, which Dr. Annandale has dealt with in the second part of this paper, and we are here merely concerned with the changes themselves.

As I have already mentioned the height of the lake was steadily rising throughout the whole period of my survey in August, 1919, and for some weeks afterwards. As Annandale and Kemp have pointed out, by far the most potent factor in producing changes of level and reduction of density is the monsoon flood-water brought down by the Mahanaddi river-system and poured into the north end of the lake, and as a result of this influx the water in the greater part of the north-east end of the lake becomes fresh or almost fresh. According to their view (*loc. cit.*, p. 8) "the great volume of silt-laden water brought down into the northern end by the branches of the Mahanaddi System had expelled all that of higher salinity—a phenomenon already noted with reference to the outer channel. It is evident that, in these parts of the lake, the changes are not due to admixture so much as to the expulsion of one volume by another." They appear to have overlooked the possibility that the fresh-water coming into the lake might flow over the top of the denser water, and thus produce the diminution in the density that they found during the monsoon months, and since all their observations were confined entirely to samples taken from the surface, it is impossible to say whether the same rapid rise in density as we pass from the surface to the bottom, such as we have seen to be present in Rambha Bay in August, 1919, and to a less extent though still recognisable in April, 1920, existed at all in 1914, though I see no reason to suppose that it was not present at any rate to some degree, or that it is a phenomenon confined to the area at the south-west end of the lake.

On the occasion of both my visits we obtained evidence that this bottom layer of denser water is steadily flowing into Rambha Bay from the main area of the lake. This inflow was vastly greater in August, when the lake was rising, than it was in April, and it seems probable that there are two factors concerned in its production. The first of these factors is in my opinion the steady and continuous breeze that blows throughout the greater part of the year across the lake from the south-west or south-south-west. We have already seen that the effect of this breeze is to produce a strong *surface* current out of the bay, and it is to this that I attribute the deep influx of water of higher density into the bay along the bottom that was occurring in April, 1920. In August, 1919, however, the effect was too great to be accounted for by this agency, and was, moreover, accompanied by a rise in the surface level, and it seems to me that we have here evidence of the 'banking up' of the more saline water, as far as the deeper layers are concerned, such as Annandale and Kemp (*loc. cit.*, p. 11) postulated in 1914.

The steady influx of fresh water from the Mahanaddi and local streams causes a correspondingly steady fall in the density of the lake water so that the minimum appears in a normal year to be reached about February when the influx of salt water from the sea takes place, and a corresponding rise in density follows, reaching its maximum about July, during which month Annandale and Kemp found the density in Rambha Bay to be as high as 14·5 to 15·0. During the period of my observations in 1919–1920, we have two outstanding features of great interest. As I have already mentioned between the months of August–December, 1919, the density of the water in the bay had fallen very considerably, till at the end of the year the density at standard temperature of a sample taken off Breakfast Island was only 2·19. In April, 1920, the density of the water off Barkuda Island at standard temperature had risen to more than twice this and varies from 5·5 to 6·1. There had, therefore, been no appreciable influx of *fresh water* into the bay and presumably into the whole lake, and the explanation of the raised density combined with a marked lowering of the surface level that existed in April seems to be found in the absence of the normal inflow from the sea, which usually occurs in February and March, combined with extensive evaporation from the surface. As Annandale and Kemp point out (*loc. cit.*, p. 11). "In a lagoon of the size and shallowness of the Chilka Lake evaporation must, especially in a tropical climate, be more than considerable and doubtless plays a great part in the phenomena we have been discussing. We have no means of estimating the exact influence of this factor, but it is not unreasonable to suppose that beyond compensating for the comparatively small amount of fresh water that comes from the Mahanaddi system in the dry season, it also plays an important part in inducing an inflow from the sea." Any inflow from the sea must, however, depend on the existence of a free channel between the two areas, and although I have been unable to obtain any direct evidence that such was actually the case, the serang of the launch informed me that this channel was closed in November, 1919.

PART II. FAUNA.

By N. Annandale.

The chief object of these notes is to put on record changes in the invertebrate fauna of the south-western extremity of the Chilka Lake that took place between the years 1914 and 1919–20. I have also added one or two particulars that supplement statements made in former parts of this volume. My observations were made in August, September, October and December, 1919, and in April and June, 1920. A few notes were also obtained in July and August of the latter year.

PORIFERA.

Three species of sponge were found in Rambha Bay in 1914, namely *Cliona vastifica* Hancock, *Suberites sericeus* Theile, and *Laxosuberites lacustris* (Annandale). All of these belong to marine genera. In the rainy season and in December, 1919, *Laxosuberites lacustris* was still common on the lower surface of stones in the landing stage at Barkuda, but no specimens of the other two sponges were found, and by April, 1920, the *Laxosuberites* had also disappeared. One of the most noteworthy changes in the fauna of the bay was the appearance in it of the freshwater sponge *Spongilla alba* Carter in great abundance. In 1915 I wrote of this sponge, "In the Chilka Lake its distribution is somewhat remarkable. It occurs on all the rocks of the northern region, often growing luxuriantly and covering considerable areas, and is found among loose algae in the outer channel. In sheltered inlets among the rocks its gemmules often form a scum on the surface. South of Kalidai I. it is not present in the lake, although many rocks apparently suitable for its growth are situated round Rambha Bay. . . . We found it growing actively and producing larvae in water of sp. gr. of 1·0065, but it cannot exist in water that never becomes fresh or practically fresh."

At the end of July, 1919, and on several occasions in the next month I found dead sticks on both the north and the south shore of Barkuda covered with dead sponge of this species containing numerous gemmules. In September and October small sponges were common on the lower surface of stones on both sides of the bay, and my nets were on several occasions completely blocked up by masses of weed coated with *Spongilla alba*. In the dry season of 1919–20 it died down, as it also did in a small pool of nearly fresh water on Barkuda, but dead sponges containing gemmules were common on the under side of stones at the edge of the lake. At the end of June, 1920, when the water had again become much salter, gemmules, which showed no tendency to germinate, were common in the same position and also on the surface of the bay. A single young sponge was, however, found on *Potamogeton* on June 26th.

COELENTERATA.

The following species of coelenterates were found in Rambha Bay in 1913 and 1914: *Gyrostoma glaucum*, *Phytocoetes*[1] *chilkaeus*, *Pelocoetes exul*, *Halianthus limnicola*, *Edwardsia tinctrix*, *Virgularia* sp., *Acromitus rabanchatu*, *Dicyclocoryne filamentata* and *Bimeria fluminalis*. Of these species, all of which but the *Virgularia* were originally described by myself, the first five are, in a wide sense, Actiniaria, the sixth is an Alcyonarian, the seventh a Rhizostomatous medusa, while the eighth and ninth are gymnoblastic Hydrozoa. Most of the species belong to marine genera and all to marine families, but *Phytocoetes*, *Pelocoetes* and *Dicyclocoryne* have been taken only in brackish water.

In 1919–20, the only species included in this list that were observed were *Halianthus limnicola*, *Acromitus rabanchatu*, *Dicyclocoryne filamentata* and *Bimeria fluminalis*. These I will discuss in order, but first I must put on record additions to the coelenterate fauna of the bay. On August 14th, 1919, Major Sewell took, in a sample of water from the surface, a single medusa of *Campanulina ceylonensis* (Browne) of the typical form. This medusa was obtained in the outer channel of the lake in 1914, but not in the main area. In the neighbourhood of Calcutta the hydroid is abundant in canals of brackish water at the beginning of and just before the rainy season and produces medusae in great abundance in water having a low specific gravity. Both hydroid and medusae disappear when the specific gravity sinks below 1·006 C. (corrected to standard temperature of 15°C) owing to increase in the rainfall. In the Gangetic delta this usually takes place about the end of July. On June 26th, 1920, numerous specimens of the medusa *Phialidium cruciferum*, a form hitherto known only from the outer channel of the Chilka Lake, were taken in a tow-net round Barkuda. In one of them one of the radial canals branched a short distance from the proximal extremity. The branch, which reached the edge of the umbrella, bore an imperfectly formed subsidiary manubrium. On the inner surface of the umbrella the Protozoon *Trichodina* was abundant. The medusae were feeding on pelagic fish-eggs, which were observed in the stomach of several.

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[1] Mr. T. A. Stephenson has just published an important paper on the classification of the Actiniaria (*Quart. Journ. Mic. Sci. LXIV, No.* 256) in which he discusses the brackish-water species assigned by me to the Sagartiidae, subfamily Metridiinae. He considers these species as constituting a new family (Diadumenidae) with *Sagartia schilleriana* Stoliczka, as type, under the name *Diadumene* (gen. nov.) *schilleriana*. He further separates my *Phytocoetes chilkaeus* from *P. gangeticus* generically under the name *Mena* (gen. nov.) *chilkaea*. As to the generic distinction of Stoliczka's species he is undoubtedly right, but I am not at present prepared to follow him in the other changes suggested.

Halianthus limnicola.—No sea-anemones were dredged in the rainy season of 1919, but several specimens of this species were obtained in April, 1920. They were much less active and not so contractile as those observed in the cold weather of 1914.

Acromitus rabanchatu.—This medusa was common in the bay in December, 1919, but none were observed in April or the early part of June, 1920. In the latter half of June young and half-grown individuals were common, including specimens in the Semostoman stage.

Dicyclocoryne filamentata.—A young medusa was taken on the surface of the bay in August, 1919, by Major Sewell and Dr. Baini Prashad. It is about twice the size of those previously described, which were killed when just set free in an aquarium, and agrees with them in all but two important characters. These two characters are (1) that an eye-spot is well developed in the sensory mass at the base of each tentacle, and (2) that each tentacle bears, about half-way along its length, a pair of lateral branches precisely like itself. It is, therefore, probable that the adult medusa of this species has branched ambulatory tentacles and resembles *Cladonema.* Less important differences from the original specimens observed are that the manubrium is narrowly bell-shaped and situated on a short peduncle, the mouth being now open in the form of a small pore, and that the umbrella expands a little towards the base. The subquadrate cross-section and minutely tuberculate surface are preserved. There is still no trace of the gonads. The medusa of this species had not been hitherto observed in the Chilka Lake, or indeed, anywhere in natural conditions, the youngest stage having been described from captive specimens.

Bimeria fluminalis.—The dwarfed form of this species was common on the lower side of stones near the edge of the lake with the sponge *Laxosuberites lacustris* as late as December, 1919, but I was not able to find any specimens in the early part of June, 1920. By the end of that month, however, very small colonies were abundant on the lower side of stones on the landing-stage on Barkuda. The species is able to live for short periods in fresh water, but apparently not permanently.

CTENOPHORA.

The only member of this group that occurs in the bay is *Pleurobrachia globosa bengalensis,* which, however, in 1914 was found only when the water was fairly salt. It was not found in December or April, 1919, but was common at the end of June with *Phialidium cruciferum* and the young of *Acromitus rabanchatu.*

POLYZOA.

The only Polyzoon I saw in the lake in 1919–20 was *Membranipora hippopus* Levinsen. *Loxosomatoides laevis,* which was common on stones at Barkuda in 1914, was not found. Small colonies of the *Membranipora* were common on *Potamogeton pectinatus* as late as December, 1919, but I could find none in April, 1920. At the end of June in the latter year it was fairly common on *Potamogeton.*

ANNELIDA.

Hirudinea.—Two species of Hirudinea were found in Rambha Bay in 1914, viz. *Glossosiphonia ceylonensis* (Harding), and a new species of *Piscicola*. They have been described by Mr. W. A. Harding, whose report on the leeches, as well as further remarks by Dr. T. Kaburaki, have been already published in this volume. None were collected in 1919-20, but no special search was made for them. I saw the *Piscicola* in June, 1920, among algae at the end of the landing-stage at Barkuda and obtained specimens in August from a pool on the island. The *Glossosiphonia* was collected in 1914 in flooded country at the head of the bay and is a true freshwater species closely allied to *G. heteroclita* (Linn.) of Europe and N. America.

Oligochaeta.—The following species of oligochaete worms were taken on the shores of Rambha Bay below water-level in 1914:—*Enchytraeus barkudensis* Stephenson and *Pontodrilus bermudensis* Beddard, f. *ephippiger* (Rosa). To these was added in July, 1916, *Monophylephorus parvus* Ditlevsen, which was found in masses of rotting weeds just afloat. This species has not been found since 1916, but conditions for its propagation, apart from changes in salinity, were perhaps unsuitable in 1919–20, owing to storms which washed away the dead weeds. The other species are apparently still common, as was to be expected.

Polychaeta.--Mr. R. Southern has recently published in this volume a full description of the species collected in 1914. The littoral Nereidae mentioned in his paper as occurring in the main area do not seem to have been affected by the physical changes that have taken place in the lake since that date, and no change has been observed in the common species dredged off shore.

CRUSTACEA.

Amphipoda.—The species collected in 1914 have been worked out by Prof. Charles Chilton, whose account has been published recently in this volume. Two amphibious species are common as "sandhoppers" on the shores of Rambha Bay, namely *Orchestia platensis* Kröyer, and *Talorchestia martensii* (Weber), the former being much the more abundant of the two. Nine true aquatic species occur. Of these at least three are easily recognized and are well known to me. They are, the new species of *Niphargus*, *Quadrivisio bengalensis* Stebbing, and *Grandidierella megnae* (Giles). In saying that I am acquainted personally with the last I should state that I have not attempted to distinguish between it and a closely allied new species described in Prof. Chilton's paper. The two forms, however, occur commonly together. *Niphargus*, *Quadrivisio* and *Grandidierella* are all very abundant among algae and stones on the shore of Barkuda Island and I noticed no diminution either in their numbers or in those of the sandhoppers in 1919 or 1920.

Isopoda.—The aquatic isopods collected in 1914 have not yet been identified, but I may note some further facts about the terrestrial but strictly littoral species, *Ligia exotica* Roux, which Prof. Chilton has already described in great detail in our report on the fauna of the lake. In the rainy season of 1914 we observed this species on the shore of Barkuda I. in great droves. They were also present in

August and for the greater part of September, 1919. About the end of that month they began to disappear and by the end of October not a single specimen could be found. In December also the species appeared to be entirely absent, but in April a few young individuals were seen on rocks and stones at the edge of the lake[1]. At the beginning of June the species was again becoming fairly common and fairly large, but no full-grown individuals occurred, while at the end of that month full-grown individuals were abundant. In August the individuals were as large and the droves as populous as in the same month in 1919. These phenomena are evidently seasonal and it is improbable that they are affected by changes in the salinity of the water, for *L. exotica,* though it takes to water readily and is a good swimmer, habitually lives on dry land. Our former notes on its habits were made in the rainy season of 1914.

Cumacea.—Only two species of Cumacea (*Iphinoe sanguinea* and *Paradiastylis culicoides* Kemp) were taken in the lake in 1914, and of these only the latter was found in Rambha Bay. In April, 1920, Major Sewell and I dredged specimens, probably belonging to the *Iphinoe,* just outside the bay.

Stomatopoda.—Dr. Kemp found only one species of Stomatopod in Rambha Bay, namely *Squilla scorpio* Latreille. The very great majority of the specimens belonged to this var. *immaculata.* In 1914, many adult individuals of this variety were observed under stones on the shore of Barkuda I. and in similar situations, but none were found in 1919 or 1920. In the rainy season of the former year, however, and as late as December, young specimens, an inch or more in length, were commonly dredged from the bottom of the bay. None were obtained in April, 1920, but a few larvae were observed on the surface with *Lucifer hanseni.*

Mysidacea.—Dr. Tattersall has recorded three species of this group as occurring in Rambha Bay. They are *Rhopalopthalmus egregius* Hansen, *Macropsis orientalis* and *Potamomysis assimilis* Tattersall. These species, which are easily recognized, were abundant in 1914, and equally so in 1919 and 1920. The first has been taken in the open sea and belongs to a marine genus, but the two latter are brackish-water forms occasionally found in fresh water at a considerable distance from the sea, but not as a rule in isolated bodies of water.

Decapoda.—No less than 23 sepcies of Crustacea Decapoda were taken in Rambha Bay in 1914, and, thanks to Dr. Kemp's enthusiastic study, we know more about the distribution in the lake of this group than about that of any of the other larger groups of animals represented in its fauna. Of the 23 species 10 belong to the Reptantia, 6 are crabs in the ordinary sense of the word, 3 hermit crabs and one a burrowing shrimp-like form belonging to the tribe Thalassinidea.

Of the six crabs, two (*Ebalia malefactrix* and *Philyra alcocki* Kemp) are small and rather scarce species dredged occasionally in 1914 from the bottom of the lake. My investigations in 1919 and 1920 were not sufficiently comprehensive to demonstrate their absence in these years beyond doubt, but I am convinced that they were at any rate scarcer than before. A single specimen of the *Philyra* was dredged off Nalbano, which lies some little distance to the north-east of Rambha Bay near the opening into the outer channel of the lake, in December, 1920. Two other species

[1] I have observed this also in February, April, May and June 1922.

(*Varuna litterata* (Fabr.) and *Pachygrapsus propinquus* de Man) are littoral, in damp weather practically amphibious, species. In 1914, they were common on the shore of Barkuda I., which I made my headquarters in 1919 and 1920 on several occasions for several weeks at a time. I found neither at any season in these years. The two remaining crabs, *Scylla serrata* (Forsk.) and *Neptunus pelagicus* (Linn.), are both free-swimming species, but *Scylla serrata* at any rate is often found in holes at the bottom. In the Chilka Lake both are caught for food. A fisherman I employed at Barkuda occasionally brought me the *Scylla* both in the rainy season of 1919 and in the hot weather of 1920. I saw fresh claws of *N. pelagicus* dropped by a fishing-eagle on Barkuda in December, 1919.

The three hermit-crabs (*Clibanarius padavensis* de Man, *C. longitarsis* (de Haan) and *C. olivaceus* Henderson) are all conspicuous species, partly amphibious in habits, and were found in 1914 on the landing-stage at Barkuda and among the rocks at the base of Ganta Sila across the bay. In the main area of the Chilka Lake the only Gastropod shell large enough for the body of adults is that of a species of *Cuma* closely allied to *C. carinifera* (Lamarck). Subfossil shells of this mollusc, found living in Rambha Bay in 1914, are still abundant all round Barkuda, but the hermit-crabs entirely disappeared as the lake became fresh.

Upogebia heterocheir Kemp, the only other representative of the Reptantia found in Rambha Bay, burrows in the soft mud in the open parts of the lake. It was if anything more abundant in April, 1920, than it was at any season in 1914.

The thirteen species of Decapoda Natantia collected in Rambha Bay in 1914 belong to five families, which it will be convenient to deal with separately to some extent. These families are the Palaemonidae, the Alphaeidae, the Atyidae, the Penaeidae and the Sergestidae. I shall discuss these not in taxonomic order but rather in reference to their habits.

The Palaemonidae and Atyidae may be considered together first, as they are in the main freshwater Crustacea whose presence in the lake provides perhaps the chief lacustrine or fluviatile element in its fauna. The Palaemonidae were represented in the bay in 1914 by three species of the freshwater genus *Palaemon* and by one of *Urocaris*; which is mainly marine. The names of the species are *Palaemon lamarrei* Milne-Edwards, *P. rudis* Heller, *P. scabriculus* Heller and *Urocaris indica*[1] Kemp. The three former were seasonal visitors to the lake, which they probably entered from bodies of fresh water for the purpose of breeding. *P. rudis* did so regularly and in large numbers, while the other two species were rarely met with. *P. rudis*, indeed, was one of the common prawns of the lake in a commercial sense in the rainy season. I have no reason to think that any change took place in this respect in the monsoon of 1919, in which the prawn-fishery was said to be particularly good. The specimens of prawns I saw in Rambha Bay at this season seemed to me to be *P. rudis*. The habits of *Urocaris indica*, which has also been taken in the sea, are different. It is a

[1] Dr. Kemp has recently revised the subfamily to which this species belongs and considers that it should be known as *Periclimenes* (*Periclimenes*) *indicus*. See *Rec. Ind. Mus.* XXIV, p. 144 (1922).

permanent inhabitant of the thickets of *Potamogeton pectinatus* that occur all over the Chilka Lake. What I take to be this prawn was common in these thickets in Rambha Bay in the rainy season of 1919, and I have no reason to think that it is less so now.

The two species of Atyidae found in Rambha Bay in 1914 were *Caridina nilotica* (Roux) and *C. propinqua* de Man. Their genus is fluviatile and lacustrine, but both species have been found at more than one locality in brackish as well as fresh water. *C. nilotica* is represented in India by a race that was called *bengalensis* by de Man[1] in 1908, but Dr. Kemp[2] has recently shown that this race cannot be separated from the same author's var. *gracilipes* from Celebes and China. Both *C. nilotica gracilipes* and *C. propinqua* are still abundant in the *Potamogeton* thickets of Rambha Bay.

The family Alpheidae was represented in Rambha Bay in 1914 by two species of *Alpheus*, namely *A. crassimanus* Heller and *A. paludicola* Kemp, the former a marine species, the latter only known from brackish water. In 1919 and in April, 1920, *A. paludicola* was dredged in considerable numbers in the bay with *Upogebia heterocheir*, which it resembles in habits. *A. crassimanus* was not obtained, but in 1914 this species was less abundant and less liable to be caught in our nets than the other.

As regards the Penaeidae my observations are very incomplete. This is the more unfortunate as we obtained evidence in 1914 that these prawns did not breed in the lake. Four species were obtained in the bay in 1914, viz. *Penaeus carinatus* Dana (de Man), *P. indicus* Milne-Edwards, *Peneopsis monoceros* (Fabr.) and *P. dobsoni* Miers. I am not sufficiently well acquainted with these species to distinguish them in the field and can only say that Penaeidae were found in the bay in the cold weather of 1919–20.

The last Decapod Crustacean to be mentioned is the little Sergestid *Lucifer hanseni* Nobili, the only completely pelagic species of its class found in the Chilka Lake. It was enormously abundant on the surface of Rambha Bay in 1914 on certain occasions but could not always be obtained. Its appearance and disappearance were not correlated with changes in season or salinity. This was observed also in the rainy season of 1919, in December of the same year and in April and June, 1920. There was, however, certainly no diminution in the abundance of the species on the whole. The genus *Lucifer* is marine, but *L. hanseni* is known to be very tolerant of changes in salinity.

It will be evident from what has been said that there was a considerable reduction in the Crustacean fauna of Rambha Bay in the dry season of 1919–20 as compared with that of 1914-15, doubtless in correlation with the reduction of the salinity of water demonstrated by Major Sewell. Some species, moreover, proved more tolerant than others and while, as might be expected, those of freshwater origin suffered less than those belonging to marine families and genera, it is somewhat remark-

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[1] de Man, *Rec. Ind. Mus.* II, p. 265, pl. xx, figs. 6, 6*a*, 6*b* (1908).

[2] Kemp, *Mem. As. Soc. Bengal* VI, p. 275 (1918).

able that the amphibious and littoral forms seem to have been affected more than any others. It is also interesting to note that none of the pelagic species (except those only found previously when the water was at its saltest) have apparently diminished in numbers, though one of the most abundant (*Lucifer hanseni*) belongs to a marine genus. I have been able to obtain no evidence of any fresh invasion of lacustrine or fluviatile species to take the place of those that have died out.

INSECTA.

Ephemeroptera.—A swarm of large may-flies was observed on the surface of the lake off Barkuda on Sept. 23, 1920. They were, however, fully mature and may have emerged from some body of fresh water in the neighbourhood and have been blown out on to the lake. They were evidently in a moribund condition. No members of this order were observed in the bay in 1914.

Odonata.—The dragon-fly *Pseudagrion microcephalum* (Ramb.) was as common in 1919–20 in Rambha Bay as it was in all parts of the lake in 1914. It was observed to breed in the lake in preference to the pond on Barkuda. The imago is common at all seasons, but particularly so at the beginning of the rains. The nymph emerges in the evening, as a rule on masses of dead weed on the shore, and there undergoes its final metamorphosis. Numbers of teneral adults, only able to flutter, can often be seen in the early morning at the edge of the water. *Anax guttatus* (Burm.) also breeds in the lake and probably *Brachythemis contaminata* Brauer, which skims along the shore in the evening, catching the sandhoppers (*Orchestia platensis*) as they leap into the air.

Rhynchota.—*Eurates formidabilis* Distant, was just as common on the surface of the bay in 1920 as it was in 1914. A single winged specimen of *Gerris spinolae* was observed from the landing-stage at Barkuda on the first day of the rains, June 11th. It was first noticed on a stone at the margin and may have just alighted from flight.

Diptera.—*Anopheles rossii* Giles, as in 1914, was the only mosquito found breeding in the lake in 1919–20. Imagines were enormously abundant on Barkuda, apparently coming from the lake, in the latter part of the rains of 1919 and the hot weather of 1920. Fortunately they are very easily affected by movements of the air and do not become really active till fairly late in the evening. In the day-time they hide in hollow trees, in crannies among the rocks and in corners of badly-ventilated rooms.

MOLLUSCA.

Twenty species of living Mollusca were taken in Rambha Bay in 1914, 12 species belonging to the Gastropoda and 8 to the Pelecypoda. Among the gastropods no less than 8 families are represented, and among the bivalves 6 families. Of the 20 families only one (the Hydrobiidae) is not essentially marine, and *Stenothyra,* the genus present, is essentially estuarine. The Mollusca, therefore, afford particularly good material for estimating the results of changes in salinity of the water of the Chilka Lake on the fauna, the more so as many of the species were extremely abundant in 1914 and are easily recognized.

Unfortunately several changes in nomenclature, affecting both genera and species, have been rendered necessary by further investigations undertaken since the publication by Dr. Kemp and myself of our report on the Mollusca in this volume (1916). These changes I will explain in footnotes.

Gastropoda.—Two of the species found in Rambha Bay in 1914, *Cuthona henrici* Eliot (fam. Aeolidae) and *Litiopa kempi* Preston (fam. Litiopidae) were of such rare and sporadic occurrence that they need not be considered further. Neither was found in 1919–20. At the end of this paper Dr. Baini Prashad and I describe a Nudibranch mollusc of the family Hermaeidae discovered in the bay in June, 1920.

The Opisthobranchia, apart from the *Cuthona*, were represented in 1914–15 by a single species (*Tornatina estriata* Preston, fam. Tornatinidae). This in 1914 was one of the commonest molluscs all over the lake. In August, 1919, I dredged numerous dead shells of this species, especially between Cherriakuda and the mainland. Among them I found two exceptionally small living individuals. In September and December of the same year I still found dead shells, but no living specimens, and in April, 1920, even empty shells seemed to have disappeared.

The Nassidae are represented in the bay by two very abundant species, *Nassa denegabilis* and *N. orissaensis* Preston. These were among the most abundant molluscs in 1914, and in 1920 showed no marked diminution in numbers.

By far the largest living gastropod in the main area of the lake in 1914 was a species (*Cuma disjuncta*) closely allied to *C. carinifera* (Lamarck)[1] of the family Muricidae. It was not uncommon on the landing-stage at Barkuda and among the rocks at the base of Ganta Sila, where the egg-capsules were found in February. Subfossil shells are still abundant on the shore at Barkuda but living individuals have completely disappeared.

The Cerithiidae, though many species live in brackish water, were represented in 1914 in the main area of the Chilka Lake by a single species, *Potamides cingulata* (Gmelin)[2]. This species was found living at only one spot in Rambha Bay, viz. in a ditch at Rambha. I have not been able to find it at this spot recently, but considerable changes have been made artificially in the ditch.

A small elongate shell from Rambha Bay, the true systematic position of which s still somewhat doubtful, was placed in the genus *Vanesia* and the family Turritellidae by Preston. Living specimens were found, occasionally in some abundance, in 1914. In 1919–20 only dead shells were obtained.

Preston recorded four species of the genus *Stenothyra* (family Hydrobiidae) as occurring in Rambha Bay. A re-examination of his material has convinced Dr. Baini Prashad and myself[3] that great confusion prevails in his identifications. We believe that the following species actually occurred in the Bay in 1914. *Steno-*

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[1] Identified by Preston as *Thais carinifera*, but really distinct. I have described it in the *Memoirs of the Asiatic Society of Bengal* VII, pp. 266–8, fig. 2 (1922).

[2] Named *Potamides* (*Typanotonos*) *fluviatilis* Pott. and Mich. by Preston. The name given above seems to be the correct one, as Dr. Baini Prashad has demonstrated to me.

[3] Annandale and Prashad, *Rec. Ind. Mus.* XXII, pp. 121–136, pl. xvi (1921).

thyra blanfordiana Nevill, *S. minima* (Sowerby) and *S.* (*Astenothyra*) *miliacea* (Nevill). No change in the numbers of these abundant forms, comparative or actual, was observed in April, 1920.

Pelecypoda.—All the bivalve molluscs taken in Rambha Bay in 1914 were abundant forms.

The Mytilidae were represented by two closely allied species of *Modiola*, *M. undulata* (Dunker), which was found attached to algae and other floating objects, and *M. striatula* Benson, which was taken on stones and other solid fixed objects. Both were extremely abundant, as they still are. Practically every stone at the edge of the bay, if not buried in mud, has several or many individuals of *M. striatula* fixed to it tightly, while in stormy weather innumerable shells of *M. undulata* are washed ashore. In suitable situations masses of living individuals are found attached to weeds. There has certainly been no diminution in the numbers of these species. *M. striatula*, an extremely plastic species, is known to be very tolerant of changes in salinity and allied forms are found in freshwater lakes in the centre of China.

The Veneridae include certain species of the genus *Meretrix* that are eminently characteristic of estuarine and similar waters and *M. casta* Chemnitz is abundant in a subfossil condition with *Arca granosa* (Linn.) at several places on the shores of Rambha Bay. The only species of the family found living in the bay in 1914 was, however, one of the genus *Clementia*, which is also characteristic of brackish water but differs from *Meretrix* in having an extremely delicate shell. This species (*C. annandalei* Preston) was one of the commonest molluscs all over the main area of the Chilka Lake. In September, 1919, I found many dead shells and a few living individuals, the latter all of small size. In December of the same year only dead shells were found, while in the following April very few even of these were left.

The Solenidae, a marine family with one freshwater genus, *Novaculina* Benson, were also represented by a single species, which was identified by Mr. Preston as possibly a form of *Solen jonesi* Dunker. We, therefore, referred to it as ? *Solen jonesi*, being doubtful as to the identification. Dr. Ekendranath Ghosh[1] has recently shown that it belongs to a new genus and species, which he has called *Neosolen aquaedulcioris*. This was another very common mollusc in the bay in 1914, and nearly every haul of our nets brought up, if not complete specimens, at any rate fragments of the very characteristic double siphon, which is segmented and very readily cast off. In the rainy season of 1919 no specimens were obtained; in December a couple of broken siphons were observed, while in April, 1920, no specimens of any kind were seen.

Theora opalina (Hinds), belonging to the family Scrobiculariidae, was the most abundant of all the bottom-haunting molluscs of the bay in 1914. It survived in greatly diminished numbers at any rate till April, 1920, when a few small individuals were taken with many dead shells.

The Cuspidariidae also were represented in 1914 by one abundant species, *Cuspi-*

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[1] Ghosh, *Rec. Ind. Mus.* XIX, p. 57 (1920).

daria annandalei Preston. It was usually taken with *Modiola undulata* on weeds or algae. Until December, 1919, it was still common, but in April only a few individuals were found alive.

The two remaining species, or nominal species, of the Pelecypoda taken in 1914 belong to the family Anatinidae and are doubtfully distinct. Mr. Preston has named them *Anatina barkudensis* and *A. barkulensis*. These molluscs can as a rule be secured alive only by digging in sand when the lake is low, *i.e.* in the cold season and the hot weather. None were obtained in 1919–20, but no special search was made for them. Fairly fresh shells were observed on Cherriakuda in April, 1920.

Considering the molluscs as a whole, we observed in 1914 that, in them as in other groups of animals, changes in the physiography and hydrography of the lake had a selective influence. This was also so in 1919–1920. Some species have disappeared, while others have survived without decrease of reproductive vigour. The species moreover, that have survived are not always those that might have been expected to do so *à priori*. Those of *Modiola* are, we know, tolerant, but *Nassa* is mainly a marine genus.

The changes observed in the invertebrate fauna of Rambha Bay in 1919–20 were doubtless correlated with the occurrence of abnormally low salinity of the water, and were almost certainly of a temporary nature. It is improbable that all individuals of the species that were not observed in these years had perished, and, indeed, observations made in June, July and August, 1920, proved that several of the more conspicuous forms were already recovering their old status.[1]

It will be convenient to add here the description of a new species of Nudibranch-mollusc discovered in Rambha Bay by Dr. Baini Prashad and myself.

Stiliger pica Annandale & Prashad, sp. nov.

The mollusc we call *Stiliger pica* is a very small aeolidiform Hermaeid with simple ungrooved rhinophores and without other tentacular processes on the head or foot.

The total length of the living animal in an expanded condition was 8·7 mm. and the breath of the foot 1·5 mm. The foot was long and narrow with parallel sides and sharply pointed but not produced into a filamentous process behind. In front it was somewhat expanded and its antero-lateral angles formed small, broad, blunt lobes separated by a deep emargination in front. The snout was truncate as a whole and depressed over the front of the foot; its anterior margin was separated into two lobes like those of the foot but smaller. The dorsal surface of the anterior part of the head was deeply concave. The rhinophores were long, slender, pointed and filiform; the eyes small but distinct and situated immediately behind the bases of the rhinophores. The cerata were relatively long and slender, almost filiform and sharply pointed at the tip. The longest were of about the same length as the rhinophores. They were arranged in two bands, one running down each side of the notum from a little behind

[1] In October, 1920, *Pachygrapsus propinquus* and a species of hermit-crab reappeared at Barkuda.

the eye to the posterior extremity. Each band of cerata consisted approximately of three or four rows, but the arrangement was irregular. As a rule the longest cerata were those of the innermost row. Some very small cerata, broader in proportion than others, were situated in the anterior third of each band. The central region of

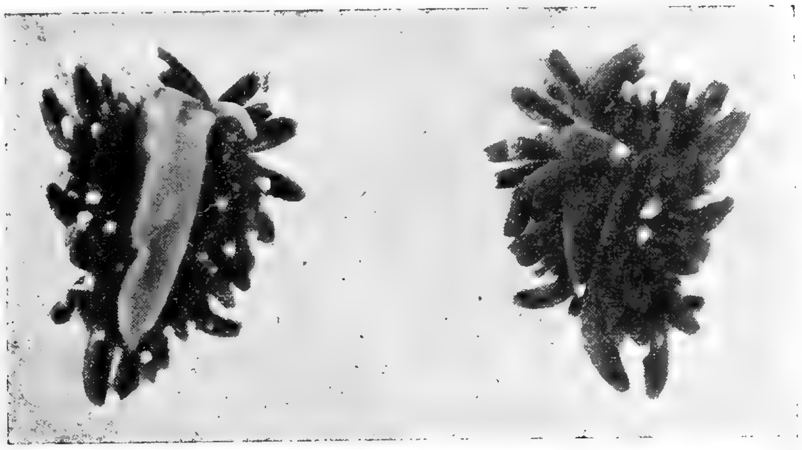

FIG. 1.—Photographs of the ventral and dorsal views of the type-specimen of *Stiliger pica* Annandale & Prashad (magnified).

the notum was bare and the anus opened on this region in the anterior third of the body. The sides were vertical and a little concave. The male pore lay below and a short distance behind the right tentacle, the female pore immediately behind it.

The penis was observed extruded in the living specimen. It was a slender organ about as long as one of the rhinophores and terminating in a slightly asymmetrical cup-shaped structure. The stylet was not observed in the living animal.

In life the back and sides were dull olive-green tinged with black between the rhinophores and obscurely vermiculated on the antero-lateral regions. There was a small pale spot round the anus. The sole of the foot was white, clouded with olive-green. The tip of the snout, rhinophores and a broad stripe extending backwards from their bases on either side to a point a little behind the eye, which was included, were translucent white with minute specks. The cerata were sooty black, obscurely speckled with grey, and had conspicuous white tips.

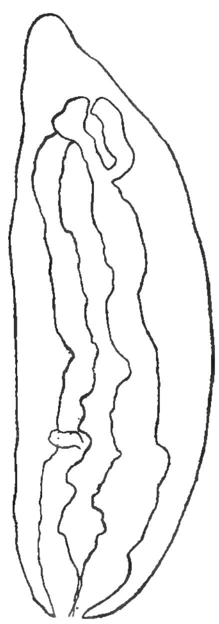

FIG. 2.—A ceras showing the arrangement of the hepatic diverticulum.

The animal was killed with boiling formalin (5 % sol.) and has retained the form and colouration described, except that the foot and head are slightly contracted and the latter somewhat depressed.

With a single minute specimen in our hands we have not been able to make out details of the internal anatomy. The genital system in general agrees with Bergh's description and figures of *Stiliger mariae* (M. & M.),[1] but the stylet of the penis is extremely short, slender and minute. The cup-like structure of the tip is withdrawn in a strongly muscular sheath. The alimentary system is also of the same type as in *S. mariae* and the radula is closely similar. The hepatic diverticula in the cerata (fig. 2) are not much coiled and bear only a few short branches.

S. pica differs from most species of *Stiliger* in its slender cerata, but otherwise seems to be a typical member of the genus. The only other species described from brackish water is *S. tentaculatus* Eliot. This peculiar form differs greatly from other species in having well-developed oral tentacles and also tentacle-like processes at the antero-dorsal angles of the foot.

The only specimen of *S. pica* we have seen was found in the latter part of June, 1920, in a small aquarium containing stones from the end of the landing-stage at Barkuda in the Chilka Lake. These stones were covered with both green and dark purple algae and it was not until they had been under observation for some days that the mollusc was observed, owing largely to the chance that it had strayed into a mass of green filamentous algae in which its dark colouration rendered it very conspicuous.

The number of Nudibranch molluscs known from brackish water in the Oriental Region is still small, but is increasing with our knowledge of the estuarine faunas and of those of maritime lakes. The following list may be of interest :—

Tribe Cladohepatica.

Family Aeolididae.

Cuthona annandalei Eliot ; Gangetic Delta. *Rec. Ind. Mus.* V, pp. 248, 249, pl. xix (1910).

Cuthona henrici Eliot ; Chilka Lake, east coast of India. *Mem. Ind. Mus.* V, p. 377, fig. 1 (1916).

Family Hermaeidae.

Stiliger tentaculata Eliot ; Talé Sap, Gulf of Siam. *Mem. As. Soc. Bengal* VI, pp. 179–182, figs. 1, 2 (1917).

Stiliger pica, sp. nov., Chilka Lake.

Family Elysiidae.

Elysia chilkensis Eliot ; Chilka Lake. *Mem. Ind, Mus.* V, p. 378 (1916).

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[1] Semper's *Reisen in Phillipinen, Wiss. Res.* Th. II, Cd. II, pp. 139–144, pl. xxvi, figs. 1–17 (1870-1875). See also Eliot, *Brit. Nud. Moll*, pt. VIII (suppl. pp. 136-137). According to Eliot, the species should be known as *S. bellulus* M. & M.

TABLE I.—*Hydrographic Observations taken at Stations* 1–25. *August*, 1919.

Number of Sample.	Date. Month.	Date. Day.	Hour.	Number of Station.	Bearings of Land.	Depth of water.	Depth from which sample was collected.	Temperature of water at time sample was taken.	Density of sample as found by Buchanan's Hydrometer.	Temperature of sample during experiment.	Density of sample. at 0°C.	Density of sample. at 25°C.	Density of sample. *in situ.*	REMARKS.
1	August	12	12-20 p.m.	1	1. West end of Barkuda Island 41° 20′. 2. Middle of Chiriya Isl. 112° 40′. 3. Ganta Sila 161° 40′ ..	10¾ ft.	Surface	31·5°	9·475	27·8°	14·13	10·30	8·26	
2	,,	,,					6 feet	28·49°	9·42	27·8°	14·07	10·24	9·21	
3	,,	,,	12-40 p.m.	2	1. End of Barkuda Island 120° 2′ (?). 2. Middle of Chiriya Island 121° 40′. 3. Ganta Sila 175° 40′ ..	11 feet	Surface	31·5°	9·17	27·95	13·85	10·04	8·02	
4	,,	,,					5 feet	28·39°	9·18	30·3°	14·67	10·81	9·79	
5	,,	,,					10 feet	28·59°	9·25	31·0°	15·00	11·10	10·01	
6	,,	,,	1-30 p.m.	3	1. East end of Barkuda Island 187°. 2. Middle of Chiriya Isl. 140° 40′. 3. Ganta Sila 187° ..	,,	Surface	31·5°	8·942	29·55°	14·15	10·42	8·30	
7	,,	,,					5 feet	28·39	8·978	31·0°	14·70	10·83	9·82	
8	,,	,,					10 feet	28·49°	9·25	31·1°	15·03	11·14	10·09	
9	,,	,,	2-10 p.m.	4	1. East end of Barkuda Island 69° 40′. 2. Chiriya Island 154° 40′ 3. Ganta Sila 191° 0′ ..	10½ ft.	Surface	31·5°	9·03	31·0°	14·76	10·88	8·86	
10	,,	,,					5 feet	28·59°	9·24	30·9°	14·950	11·06	9·67	
11	,,	,,					10 feet	28·50°	9·21	31·0°	14·954	11·07	10·02	
12	,,	,,	2-45 p.m.	5	1. E. end Barkuda Island 84° 20′. 2. Chiriya Island 163° 40′. 3. Ganta Sila 193° 20′ ..	9½ feet	Surface	32·0°	8·90	31·0°	14·62	10·76	8·57	
13	,,	,,					6 feet	28·59°	8·87	31·0°	14·59	10·73	9·65	
14	,,	14	11 a.m.	6	1. Breakfast Isl. 304° 40′ 2. Jetty, Bark. Isl. 23° 20′ 3. Chiriya Island 86° 0′ ..	10 feet	Surface	29·0°	9·20	29·9°	14·55	10·69	9·49	
15	,,	,,					6 feet	28·275°	9·20	30·75	14·86	10·98	10·00	
16	,,	,,	11-30 a.m.	7	1. Breakfast Isl. 282° 40′ 2. Jetty, Barkuda Island 22° 20′. 3. Chiriya Island 170° 40′	10½ ft.	Surface	29·0°	9·14	30·6	14·73	10·86	9·66	
17	,,	,,					5 feet	28·78°	9·18	31·0°	14·92	11·03	9·90	
18	,,	,,					10 feet	28·29°	9·21	30·6°	14·81	10·93	9·96	
19	,,	,,	12-0 Noon.	8	1. Breakfast Isl. 271° 40′ 2. Jetty, Bark. Isl. 21° 20′ 3. Chiriya Island 197° 0′	11 feet	Surface	29·0°	9·19	30·85°	14·87	10·99	9·80	
20	,,	,,					5 feet	28·78°	9·32	27·0°	13·705	9·905	8·78	
21	,,	,,					10 feet	28·185°	8·906	30·05°	14·28	10·44	9·50	

22	,,	,,	12-45 p.m.	9	1. Breakfast Isl. 250° 40′ 2. Cherriakuda Isl. (west point) 34° 0′. 3. Chiriya Island 210° 0′.	11 feet	Surface	29·0°	9·20	29·85°	14·26	10·42	9·225	
23	,,	,,					5 feet	28·93°	9·13	30.5°	14·72	10·85	9·67	
24	,,	,,					10 feet	28·185°	9·15	30·3°	14·64	10·77	9·93	
25	,,	,,	1-15 p.m.	10	1. Breakfast Isl. 241° 40′ 2. Cherriakuda Island (west end) 305° 0′. 3. Chiriya Island 208° 40′	11¼ ft.	Surface	29·0°	8·80	30·0°	14·15	10·315	9·115	
26	,,	,,					5 feet	28·27°	8·86	30·6°	14·43	10·58	9·61	
27	,,	,,					10 feet	28·29°	9·33	30·85°	15·03	11·135	10·15	
28	,,	,,	2-10 p.m.	11	1. Breakfast Isl. 231° 0′ 2. Cherriakuda Isl. (west end) 283° 0′. 3. Chiriya Island 206° 0′	11 feet	Surface	29·2°	8·74	30·0°	14·09	10·26	9·00	
29	,,	,,					5 feet	28·88°	8·375	30·15°	13·74	10·14	8·78	
30	,,	,,					10 feet	28·29°	9·26	30·3°	14·76	10·89	9·91	
31	,,	16	10-30 a.m	12	1. Mr. Minchin's House 212° 20′. 2. Ganta Sila 167° 0′ .. 3. Chiriya Island 139° 20′	6¾ feet	Surface	29·2°	7·74	29·3°	12·76	9·02	7·78	
32	,,	,,					6 feet	28·98°	8·88	30·25°	14·33	10·49	9·29	
33	,,	,,	10-50 a.m.	13	1. Mr. Minchin's House 211° 20′. 2. Ganta Sila 154° 20′ .. 3. Chiriya Island 128° 20′	9 feet	Surface	29·4°	6·80	29·15°	11·69	8·03	6·72	
34	,,	,,					6 feet	28·96°	8·76	29·35°	13·88	10·07	8·89	
35	,,	,,	11-25 a.m.	14	1. Mr. Minchin's House 214° 20′. 2. Ganta Sila 133° 0′ .. 3. Barkuda Island (east end) 62° 20′.	,,	Surface	30·2°	4·99	28·5°	9·51	6·01	4·46	Slight rain.
36	,,	,,					6 feet	29·06°	9·06	28·06°	13·76	9·96	8·745	
37	,,	,,	11-50 a.m.	15	1. Mr. Minchin's House 227° 0′. 2. Ganta Sila 112° 20′ .. 3. Barkuda Island (east end) 59° 41′.	10 feet	Surface	30·0°	7·97	28·25°	12·65	8·92	7·42	Raining heavily.
38	,,	,,					5 feet	29·09°	9·05	30·4°	14·56	10·70	9·47	
39	,,	,,					9½ feet	28·99°	9·42	31·4°	15·33	11·42	10·22	
40	,,	,,	12-20 p.m.	16	1. Mr. Minchin's House 283° 0′. 2. Ganta Sila 80° 40′ .. 3. Barkuda Island 52° 40′	7½ feet	Surface	30·0°	8·81	31·5°	14·69	10·82	9·30	Slight rain.
41	,,	,,					6 feet	28·98°	9·05	31·4°	14·97	11·08	9·88	
42	,,	,,	12-40 p.m.	17	1. Mr. Minchin's House 308° 40′. 2. Ganta Sila 71° 20′ .. 3. Rambha Railway Station 9° 40′.	5 feet	Surface	30·2°	9·01	31·7°	14·76	10·885	9·295	
43	,,	,,	1-0 p.m.	18	1. Mr. Minchin's House 314° 20′. 2. Ganta Sila 41° 20′ .. 3. Rambha Railway Station 343° 20′.	7¼ feet	Surface	30·0°	9·73	29·7°	15·05	11·16	9·635	
44	,,	,,					6 feet	29·78°	9·53	29·6°	14·81	10·83	9·48	

Number of Sample.	Date. Month.	Date. Day.	Hour.	Number of Station.	Bearings of Land.	Depth of water.	Depth from which sample was collected.	Temperature of water at time sample was collected.	Density of sample as found by Buchanan's Hydrometer	Temperature of sample during experiment.	Density of sample at 0°C.	Density of sample at 25°C.	Density of sample in situ.	REMARKS.
45	August	19	1-25 p.m.	19	1. Mr. Minchin's House 293° 40′. 2. Ganta Sila 48° 20′ .. 3. Rambha Railway. Stn. 336° 40′.	$9\frac{1}{2}$ ft.	Surface	30·6°	9·02	29·5°	14·22	10·38	9·67	
46	,,	,,					6 feet	29·46°	9·58	29·2°	14·72	10·85	8·50	
47	,,	,,	1-50 p.m.	20	1. Mr. Minchin's House 271° 40′. 2. Ganta Sila 76° 40′ .. 3. Cherriakuda Isl. (east end) 32° 20′.	$10\frac{1}{4}$ ft.	Surface	32·0°	7·915	29 55°	13·03	9·28	7·11	
48	,,	,,					5 feet	29·77°	9·34	28·4°	14·16	10·33	8·885	
49	,,	,,					10 feet	29·18°	9·16	32·0°	15·27	11·36	10·10	
52	,,	18	10-0 a.m.	21	1. Breakfast Isl. 311° 0′ 2. Cherriakuda Isl. (west end). 7° 20′. 3. Chiriya Island 109° 0′	$9\frac{1}{4}$ ft.	Surface	29·3°	7·09	30·25°	12·35	8·68	7·25	
53	,,	,,					6 feet	29·39°	8·04	30·3°	13·44	9·66	8·34	
54	,,	,,	10-15 a.m.	22	1. Breakfast Island 258° 40′. 2. Chiriya Island 131° 0′ 3. Cherriakuda Isl. (west end) 5° 0′.	$10\frac{1}{2}$ ft.	Surface	29·3°	7·265	29·45°	12·30	8·59	7·31	
55	,,	,,					5 feet	29·09°	7·28	30·1°	12·535	8·82	7·60	
56	,,	,,					10 feet	29·49°	8·905	30·35°	14·39	10·53	9·19	
57	,,	,,	10-45 a.m.	23	1. Breakfast Isl. 234° 0′ 2. Chiriya Island 160° 0′ 3. Cherriakuda Isl. (west end) 353° 0′.	$10\frac{3}{4}$ ft.	Surface	29·5°	6·60	30·3°	11·87	8·20	6·86	
58	,,	,,					5 feet	29·09°	6·80	29·9°	11·94	8·26	7·05	
59	,,	,,					10 feet	29·59°	8·90	30·3°	14·37	10·52	9·13	
60	,,	,,	11-30 a.m.	24	1. Breakfast Isl. 223° 40′ 2. Chiriya Island 175° 20′ 3. Cherriakuda Island (west end) 335°0′.	11 feet	Surface	29·9°	6·77	29·25°	11·69	8·03	6·57	
61	,,	,,					5 feet	29·175°	6·79	29·35°	11·74	8·08	6·84	
							10 feet	29·59°	8·78	29·9°	14·10	10·27	8·88	
62	,,	,,	12-15 p.m.	25	1. Ganta Sila 213° 0′. .. 2. Chiriya Island 185° 0′ 3. Barkuda Isl. (east end) 73° 0′.	$10\frac{1}{4}$ ft.	Surface	29·5°	7·00	29·95°	12·18	8·49	7·14	
63	,,	,,					5 feet	29·59°	7·65	29·3°	12·66	8·93	7·55	
64	,,	,,												

TABLE II.—*Showing the Density of Water taken from the Surface in Rambha Bay between August and December, 1919.*

Number of Sample.	Date. Month.	Date. Day.	Position.		Depth from which sample was taken.	Temperature at time sample was taken.	Density of sample as found by Buchanan's Hydrometer.	Temperature of sample during experiment.	Density of sample at 0°C.	Density of sample at 25°C.	Density of sample *in situ.*	REMARKS.
..	1919 August	11	Barkuda Island end of Jetty.		Surface	29·9°	9·13	30·4°	14·65	10·78	9·29	
50	,,	17	,, ,,	3-15 p.m.	,,	29·8°	6·70	29·5°	11·70	8·04	6·60	At the commencement of and after a storm wind and rain from the N.E.
51	,,	,,	,, ,,	5-15 p.m.	,,	29·1°	6·26	28·75°	10·97	7·36	6·15	
65	Sept.	5	,, ,,		,,	..	4·61	29·5°	9·09	5·615	..	Temperature of water at time sample was taken was not recorded
66	Oct.	19	,, ,,		,,	..	4·12	21·7°	6·575	3·35	..	
67	Dec.	16	Breakfast Island		,,	..	3·05	21·6°	5·40	2·19	..	
96	1920 June	7	Barkuda Island end of Jetty.		,,	..	8·11	30·1°	13·44	9·66	..	

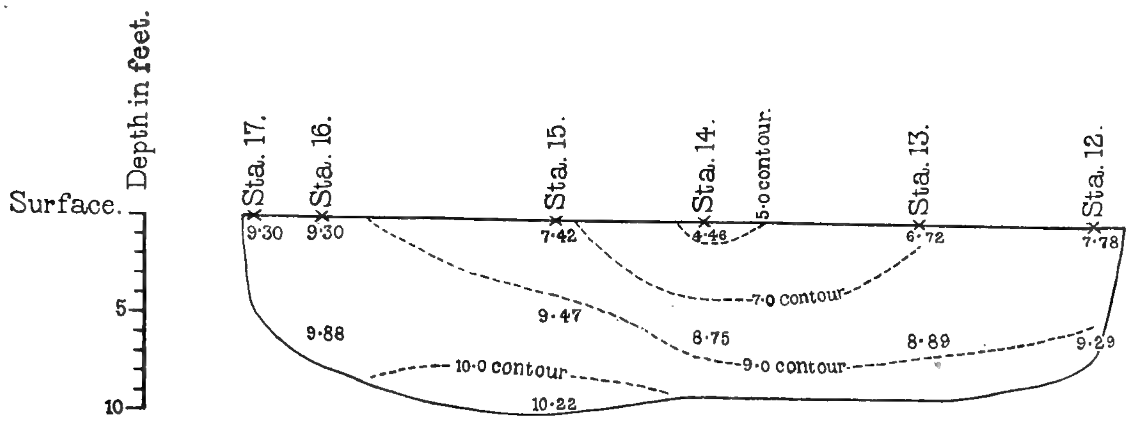
TABLE III.—*Hydrographic Observations taken at Stations 26–42, April, 1920.*

Number of Sample.	Date. Month.	Date. Day	Hour.	Number of Station.	Bearings of Land.	Depth of Water.	Depth from which sample was collected.	Temperature of water at time sample was taken.	Density of sample as found by Buchanan's Hydrometer	Temperature of sample during experiment.	Density of sample at 0°C.	Density of sample at 25°C.	Density of sample *in situ.*	REMARKS.
68 68A	April ,,	27 ,,	9-25 a.m.	26	1. Chiriya Island 207° .. 2. Ganta Sila 225 .. 3. Barkuda Isl. due E. ..	5 ft.	Surface 4 feet	28·25° 28·25°	3·70 3·74	31·0° 31·0°	8·97 9·01	5·50 5·54	4·58 4·62	
69 70	,, ,,	,, ,,	9·40 a m.	27	1. Chiriya Island 208° .. 2. Breakfast Isl 235° .. 3. Rambha 265° ..	5 ft. 3 in.	Surface 4 feet	28·2° 28·0°	3·66 3·64	31·2° 31·5°	8·99 9·08	5·52 5·55	4·60 4·69	
71 72	,, ,,	,, ,,	10-0 a.m.	28	1. Chiriya Island 215° .. 2. Breakfast Isl. 246° .. 3. Rambha Station 273°	5 ft. 9 in.	Surface 4 feet	28·2° 28·2°	3·19 3·24	53·9° 33·9°	9·49 9·53	5·98 6·03	5·06 5·10	Slight breeze from S.S.W.
73 74	,, ,,	,, ,,	10-40 a.m.	29	1. Chiria Island 222° .. 2. Rambha Station 286° 3. West end of Cherriakuda Island 312° ..	5 ft. 9 in.	Surface 4 feet	28·2° 28·2°	3·39 3·61	34·1° 31·5°	9·65 9·05	6·14 5·58	5·21 4·70	
75	,,	,,	10-45 a.m.	30	1. Chiriya Island 278° .. 2. West end of Cherriakuda Island 333°. 3. E. end of Barkuda Island 5°.	4 ft.	Surface	28·2°	3·67	31·7°	9·19	5·70	4·78	
76	,,	,,	11-0 a.m.	31	1. Chiriya Island 157° .. 2. Ganta Sila 245° .. 3. East end of Barkuda Island 37°.	4 ft. 9 in.	,,	28·6°	3·65	31·5°	9·09	5·62	4·58	
77 78	,, ,,	,, ,,	11-15 a.m.	32	1. Chiriya Island 180° .. 2. Ganta Sila 229° .. 3. Rambha Station 93° ..	5 ft.	,, 4 feet	29·6° 28·7°	3·66 3·72	31·5° 30·3°	9·10 8·71	5·63 5·30	4·28 4·23	
79 80	,, ,,	,, ,,	11-40 a.m.	33	1. W. end of Cherriakuda Island 328°. 2. Rambha Station 263° 3. Ganta Sila 218° ..	,,	Surface 4 feet	28·8° 28·8°	3·63 3·72	31·5° 31·5	9·06 9·16	5·59 5·68	4·49 4·58	
81 82	,, ,,	,, ,,	12 Noon.	34	1. East end of Barkuda Island 42°. 2. West end of Cherrikuda Island 308°. 3. Rambha Station 250°	,,	Surface 4 feet	28·9° 29·1°	3·65 3·39	31·8 34·1	9·20 9·77	5·72 6·24	4·58 5·04	Breeze steadily freshening.

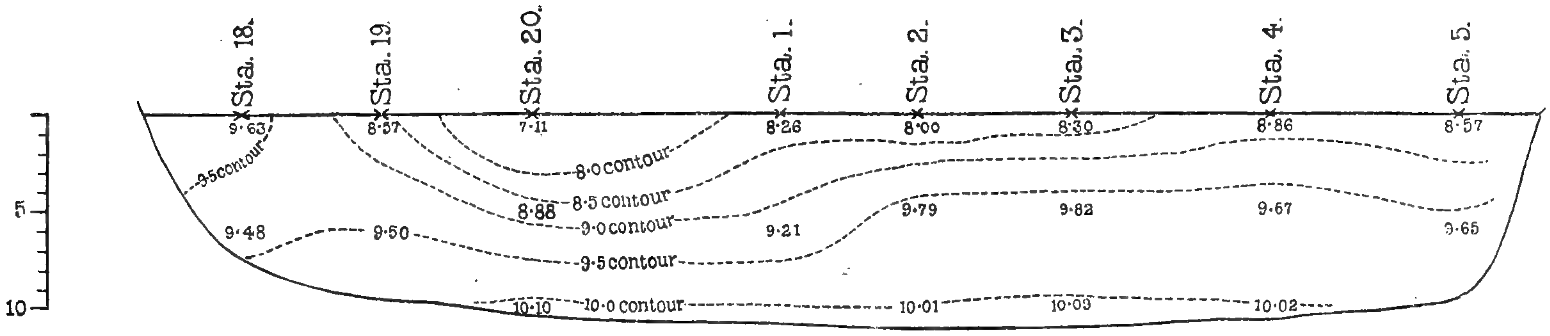
83	April	27	12-20 p.m.	35	1. Barkuda Jetty 81° .. 2. Chiriya Island 184° .. 3. Mr. Minchin's House 229°.	4 ft. 6 in.	Surface	29·1°	3·60	31·5°	9·03	5·56	4·37	Strong breeze from S.S.W.
84	,,	28	11-0 a.m.	36	1. Chiriya Island 117° .. 2. W. end of Barkuda Isl. 53°. 3. Mr. Minchin's House 255°.	5 ft.	,,	29·3°	3·65	33·9	9·97	6·43	5·17	Dead calm.
85	,,	,,					4 feet	28·2°	3·63	33·7	9·88	6·35	5·43	
86	,,	,,	11-15 a.m.	37	1. Chiriya Island 136° .. 2. Ganta Sila 177° .. 3. Mr. Minchin's House 237°.	,,	Surface	29·4°	3·58	32·8	9·49	5·98	4·69	
87	,,	,,					4 feet	28·6°		Sample	not kept			
88	,,	,,	11-40 a.m.	38	1. East end of Barkuda Island 56°. 2. Ganta Sila 190° .. 3. Rambha Station 271°	,,	Surface	29·2°	3·50	33·1°	9·52	6·01	4·78	Slight breeze from S.S.W.
89	,,	,,					4 feet	29·1°	3·62	32·9°	9·56	6·06	4·86	
90	,,	,,	12 Noon.	39	1. Chiriya Island 166° .. 2. Ganta Sila 204° .. 3. Mr. Minchin's House 242°.	,,	Surface	29·4°	3·68	32·0°	9·30	5·81	4·52	Breeze freshening.
91	,,	,,					4 feet	29·4°	3·61	33·0°	9·60	6·09	4·79	
92	,,	,,	12-25 p.m.	40	1. Chiriya Island 133° .. 2. Ganta Sila 167° .. 3. Mr. Minchin's House 233°.	,,	Surface	29·4°	3·64	32·0°	9·25	5·77	4·48	Strong breeze from S S.W.
93	,,	,,					4 feet	29·4°	3·63	31·9°	9·21	5·73	4·44	
94	,,	29	10-40 a.m.	41	1. East end of Samal Isl. 159° (?) 2. Kespool village 296° .. 3. Hill Section Grand Trunk Road 253°.	6 ft.	Surface	29·6°	4·35	30·2°	9·39	5·90	4·54	,,
95	,,	,,	11-45 a.m.	42	1. Chiriya Island 218° .. 2. S.E. corner Samal Isl. 181°. 3. E. corner Samal Island 320°.	5 ft. 6 in.	,,	30·0°	4·13	30·0°	9·08	5·61	4·13	,,

TABLE IV.—*Showing the corresponding densities of water at* 0°, 15° *and* 25°C. *respectively.*

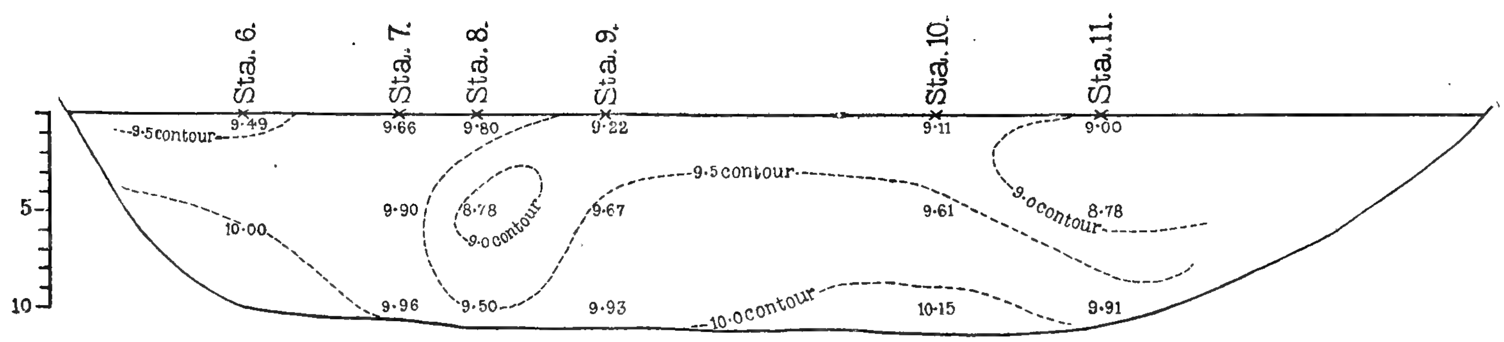
At 0°C.	At 15°C.	At 25°C.
1002·000	1001·164	999·044
1002·500	1001·619	999·506
1003·000	1002·093	999·969
1003·500	1002·567	1000·432
1004·000	1003·041	1000·895
1004·500	1003·514	1001·358
1005·000	1003·988	1001·822
1005·500	1004·463	1002·285
1006·000	1004·937	1002·749
1006·500	1005·411	1003·212
1007·000	1005·885	1003·676
1007·500	1006·360	1004·140
1008·000	1006·834	1004·604
1008·500	1007·308	1005·068
1009·000	1007·783	1005·532
1009·500	1008·257	1005·996
1010·000	1008·732	1006·461
1010·500	1009·207	1006·925
1011·000	1009·682	1007·390
1011·500	1010·157	1007·854
1012·000	1010·632	1008·319
1012·500	1011·107	1008·784
1013·000	1011·582	1009·249
1013·500	1012·067	1009·714
1014·000	1012·533	1010·179
1014·500	1013·008	1010·644
1015·000	1013·483	1011·110
1015·500	1013·958	1011·575
1016·000	1014·434	1012·041
1016·500	1014·910	1012·506
1017·000	1015·386	1012·972
1017·500	1015·862	1013·438
1018·000	1016·337	1013·904
1018·500	1016·823	1014·370
1019·000	1017·289	1014·836
1019·500	1017·766	1015·302
1020·000	1018·242	1015·769
1020·500	1018·718	1016·235
1021·000	1019·194	1016·702
1021·500	1019·670	1017·168
1022·000	1920·147	1017·635



Section 1 August, 1919.



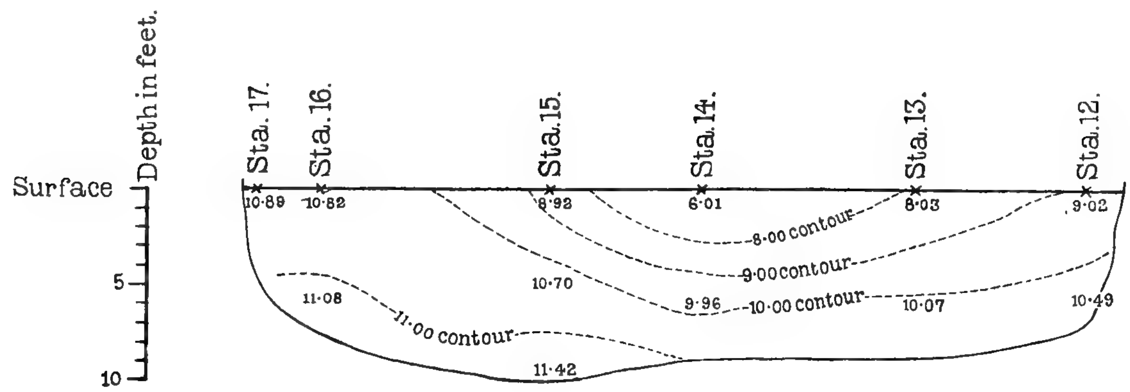
Section 2 August, 1919.



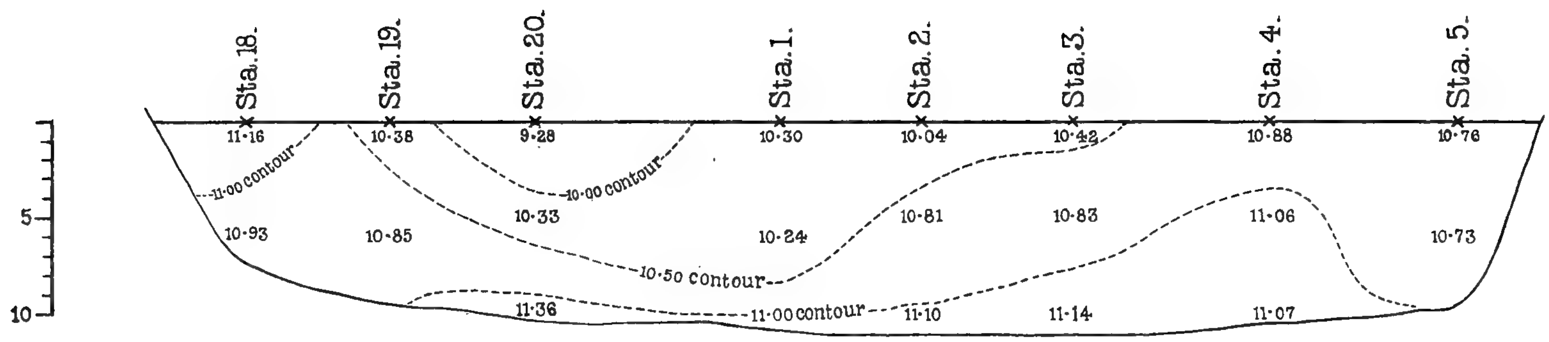
Section 4 August, 1919

R. B. S. S. del.

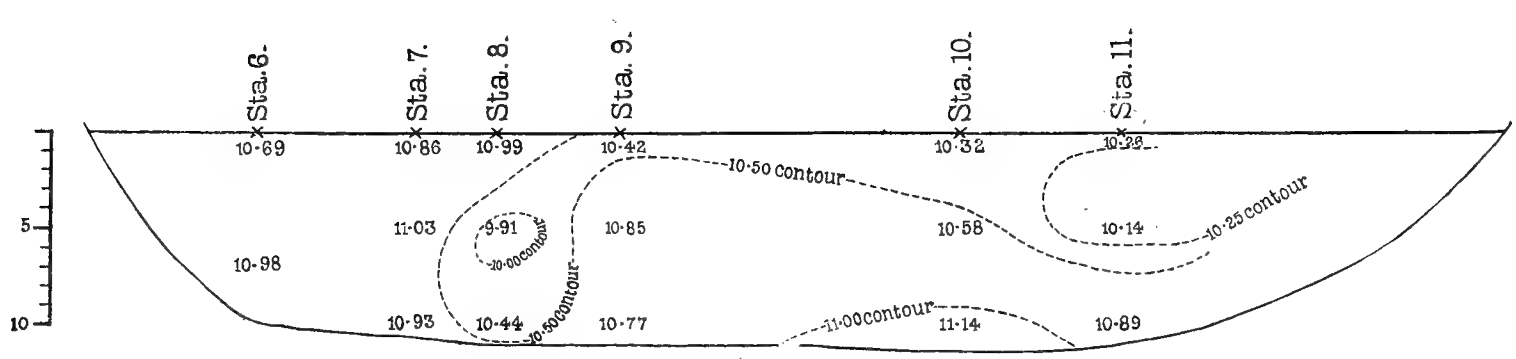
Sections of Rambha Bay, August 1919, showing densities *in situ*.



Section 1. August, 1919.



Section 2. August, 1919.

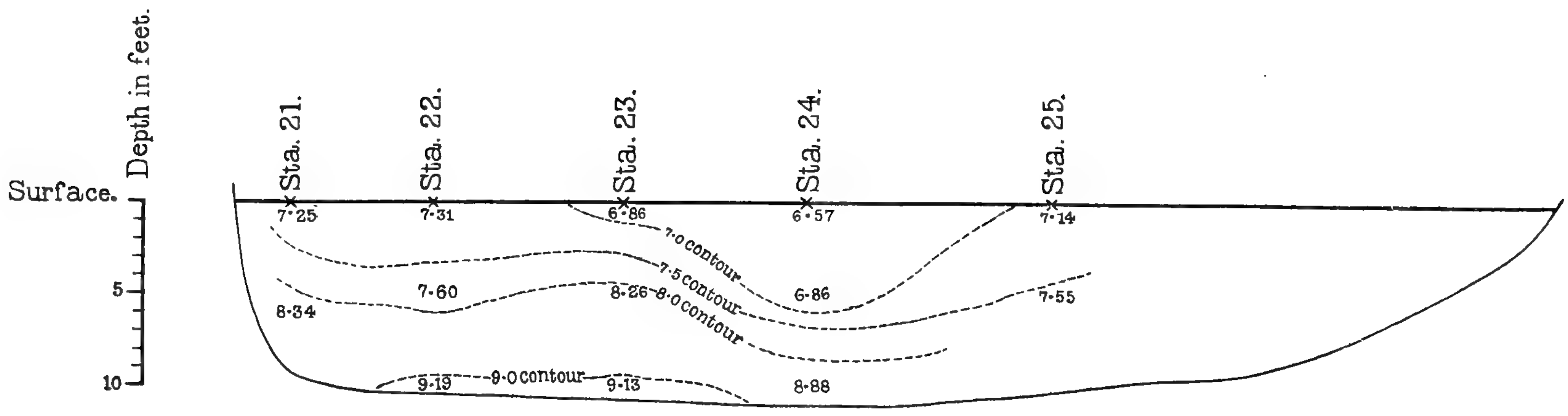


Section 4. August, 1919.

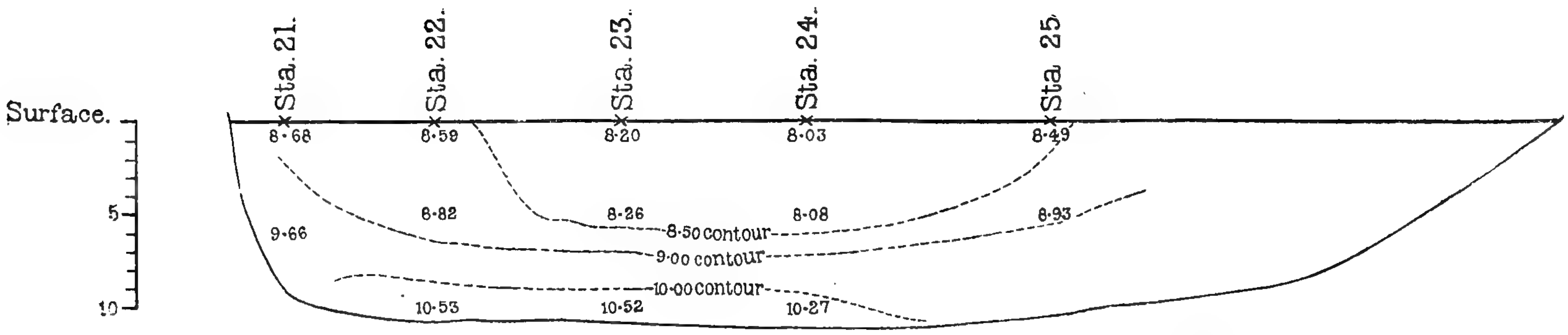
1 2 Scale in miles

R. B. S. S. del.

Sections of Rambha Bay, August 1919, showing densities reduced to standard temperature [25. 0°C.]



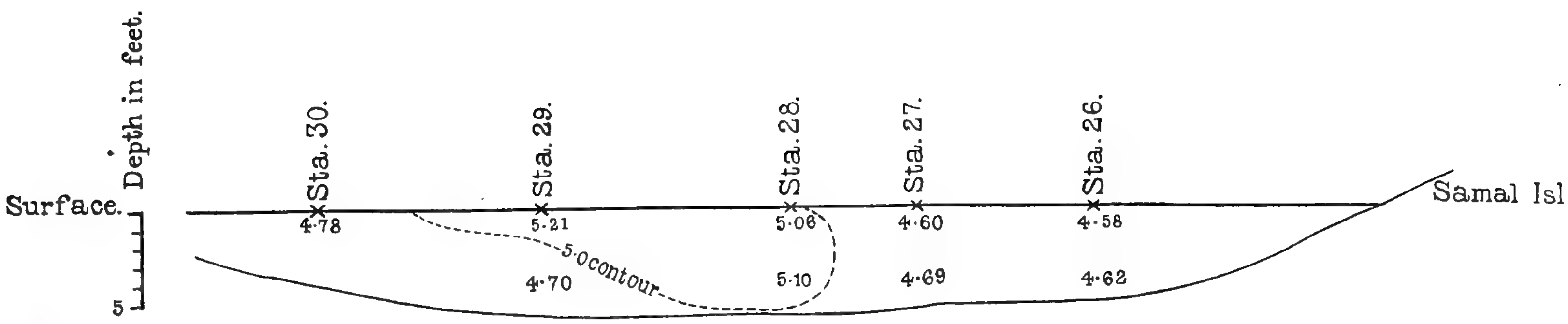
Section 3. August, 1919.



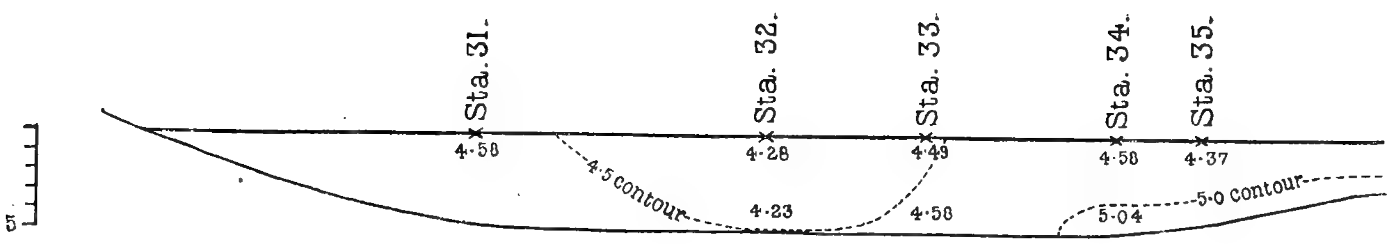
Section 3. August, 1919.

R. B. S. S. del.

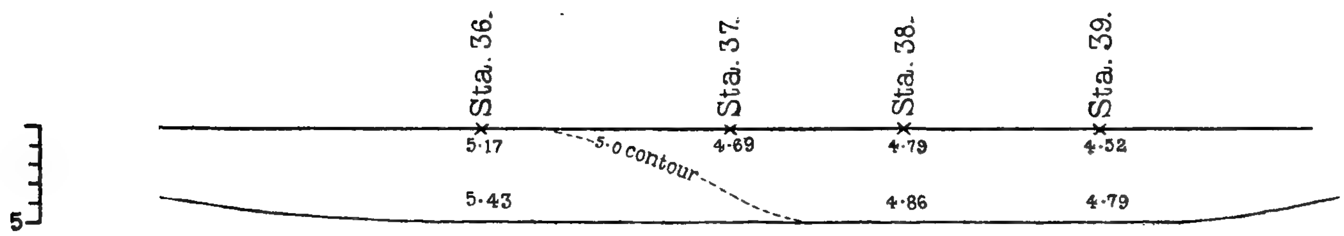
Sections of Rambha Bay, August, 1919, showing (above) density *in situ*, (below) density reduced to standard temperature [25. O°C.]



Section 1. April, 1920.



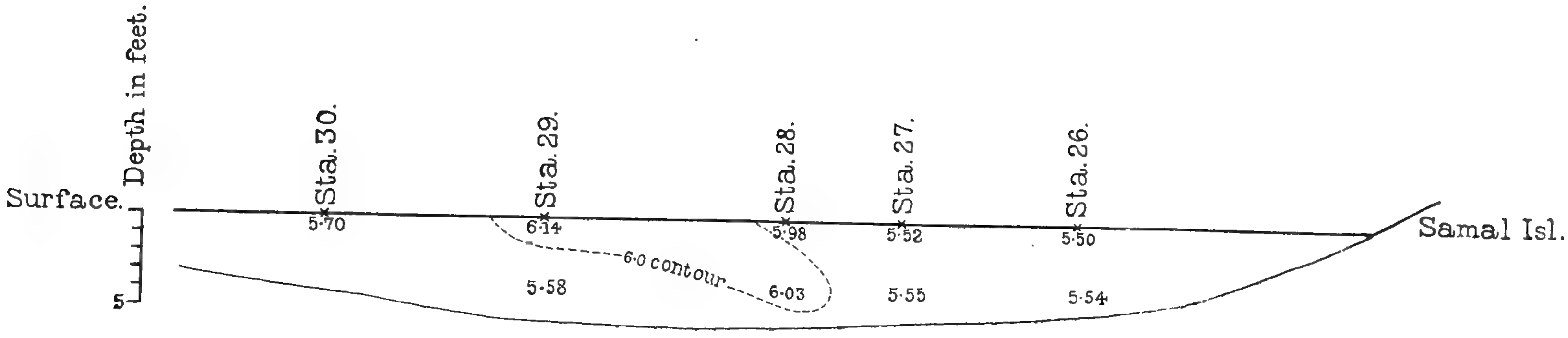
Section 2. April, 1920.



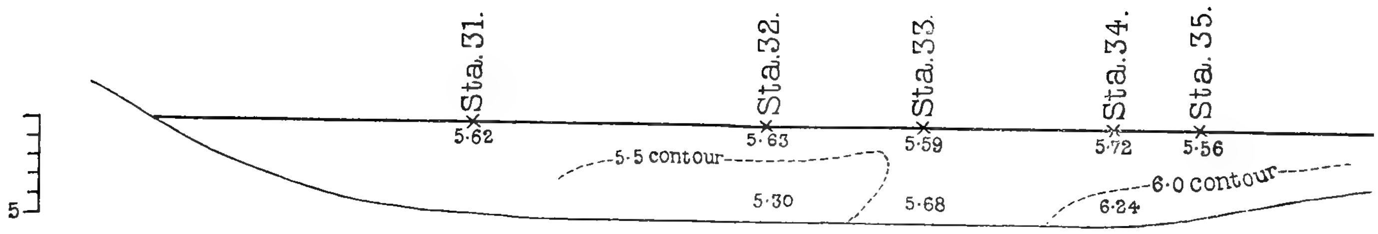
Section 3. April, 1920. 1 2 Scale in miles.

R. B. S. S. del.

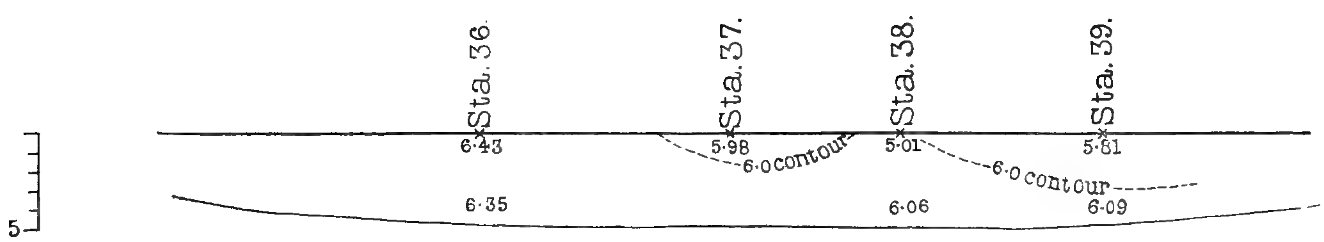
Section of Rambha Bay, April 1920, showing densities *in situ*.



Section 1. April, 1920.



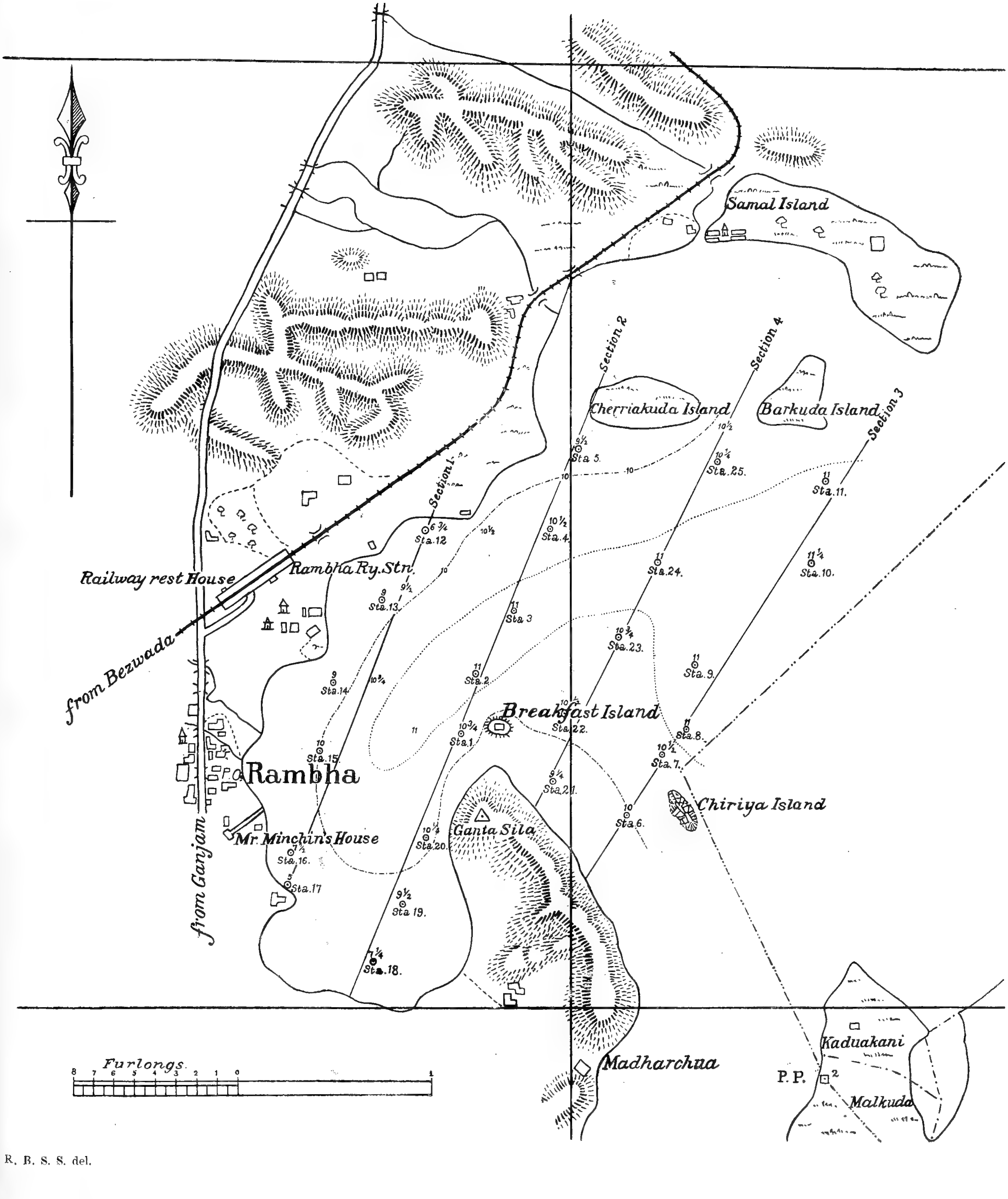
Section 2. April, 1920.



Section 3. April, 1920. 1 2 Scale in miles.

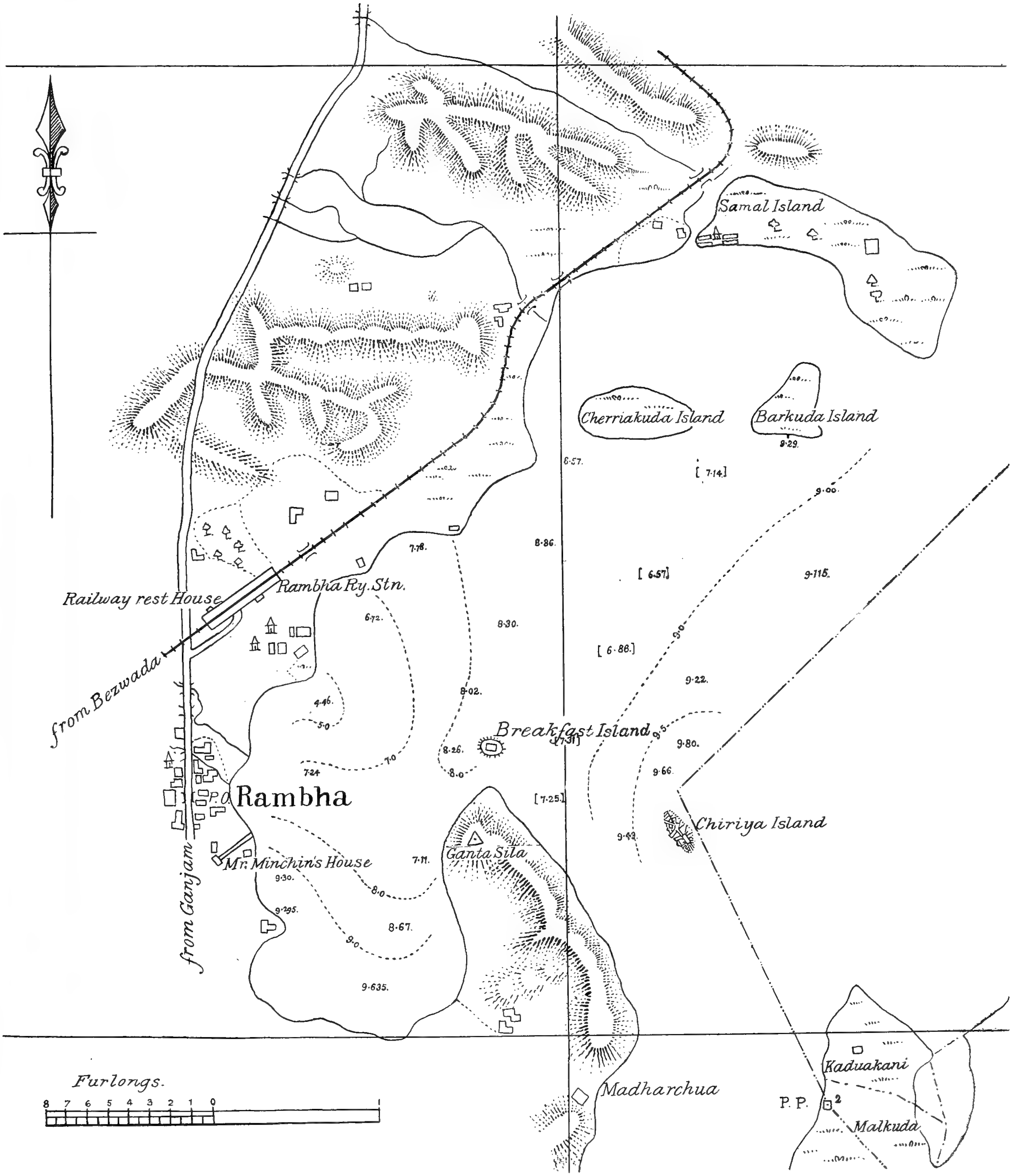
R. B. S. S. del.

Section of Rambha Bay, April 1920, showing densities reduced to standard temperature [25. O°C.]



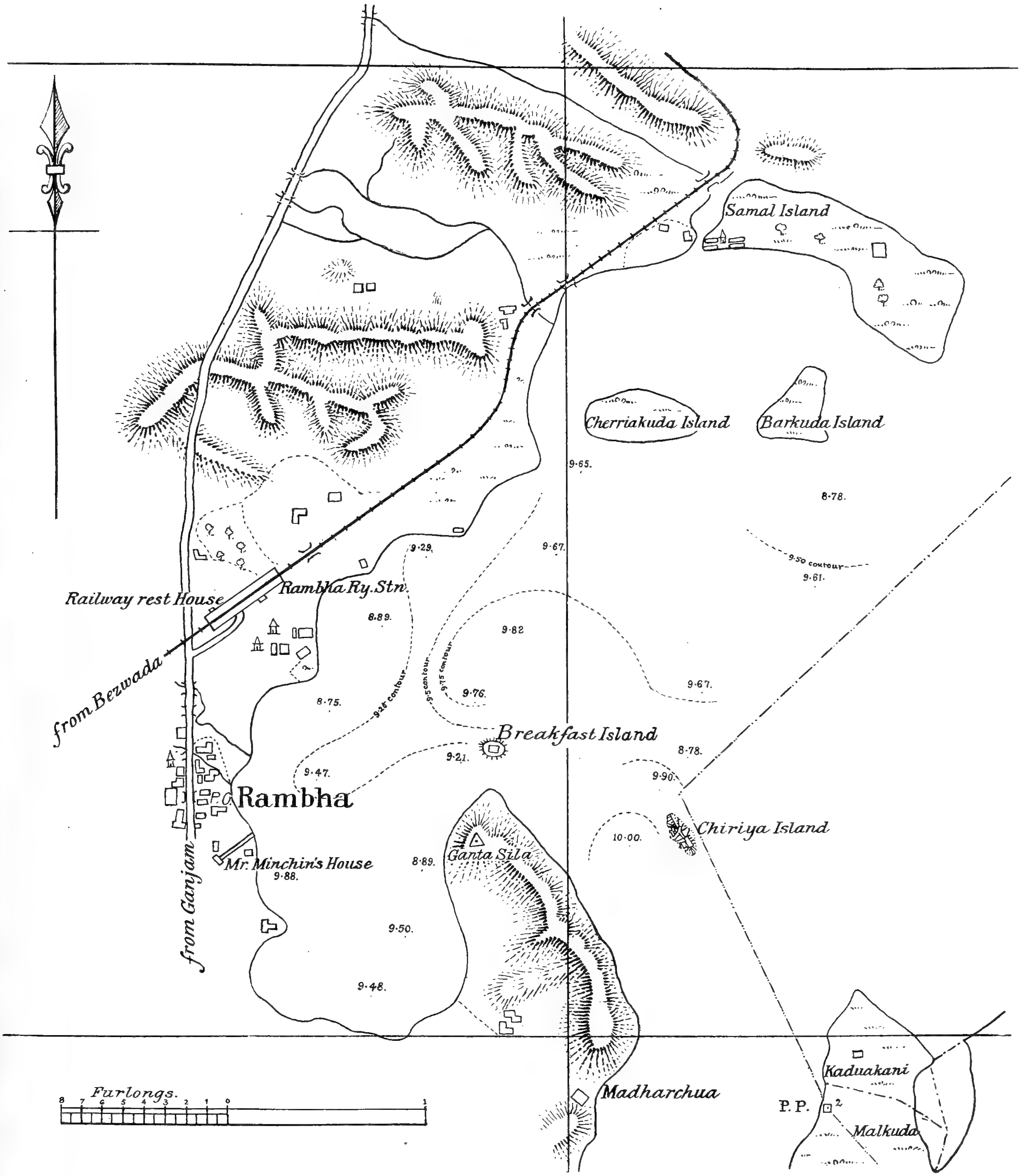
R. B. S. S. del.

Chart showing position of stations 1—25. August 1919.



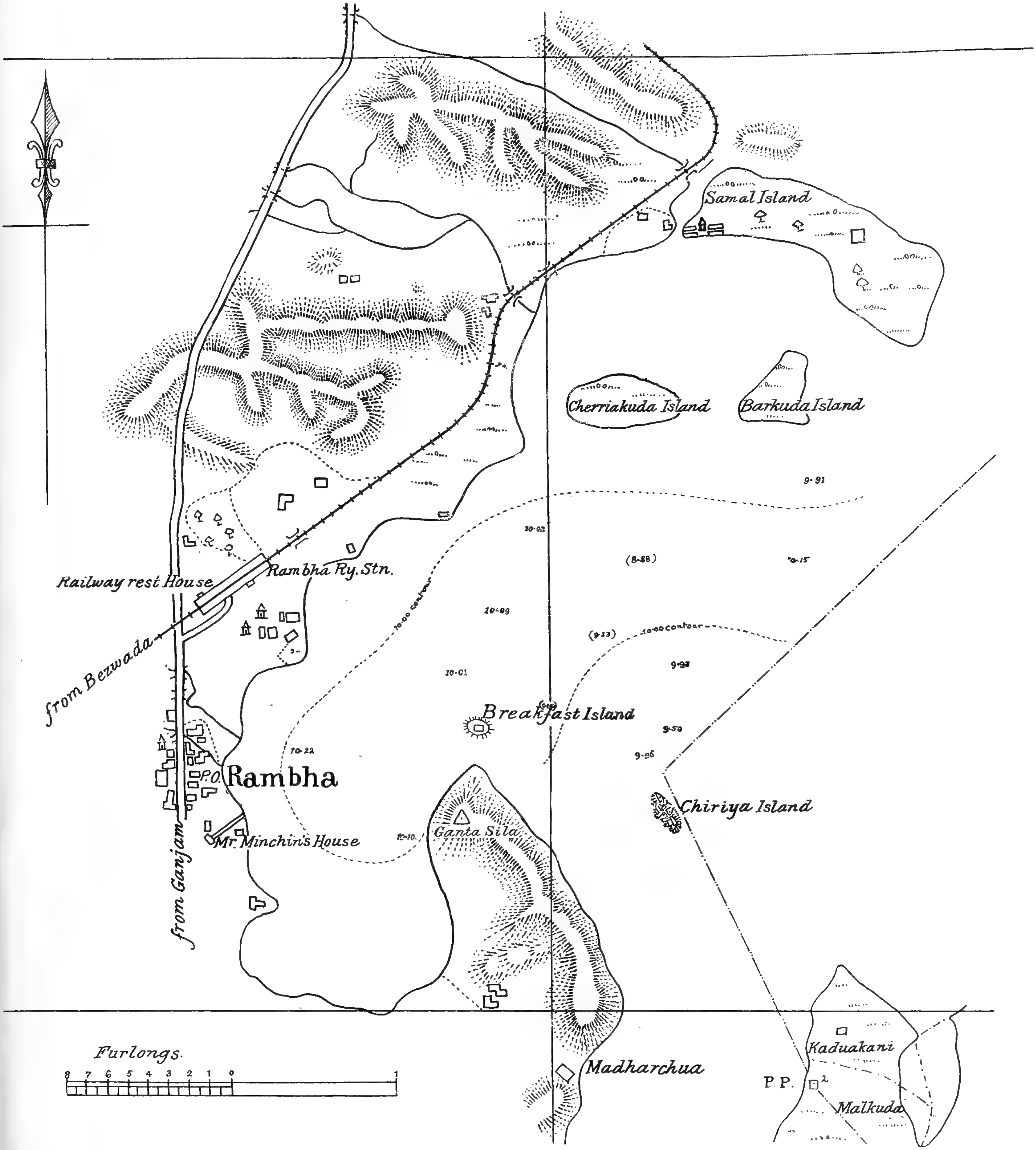
R. B. S. S. del.

Chart showing density at surface, August 1919.



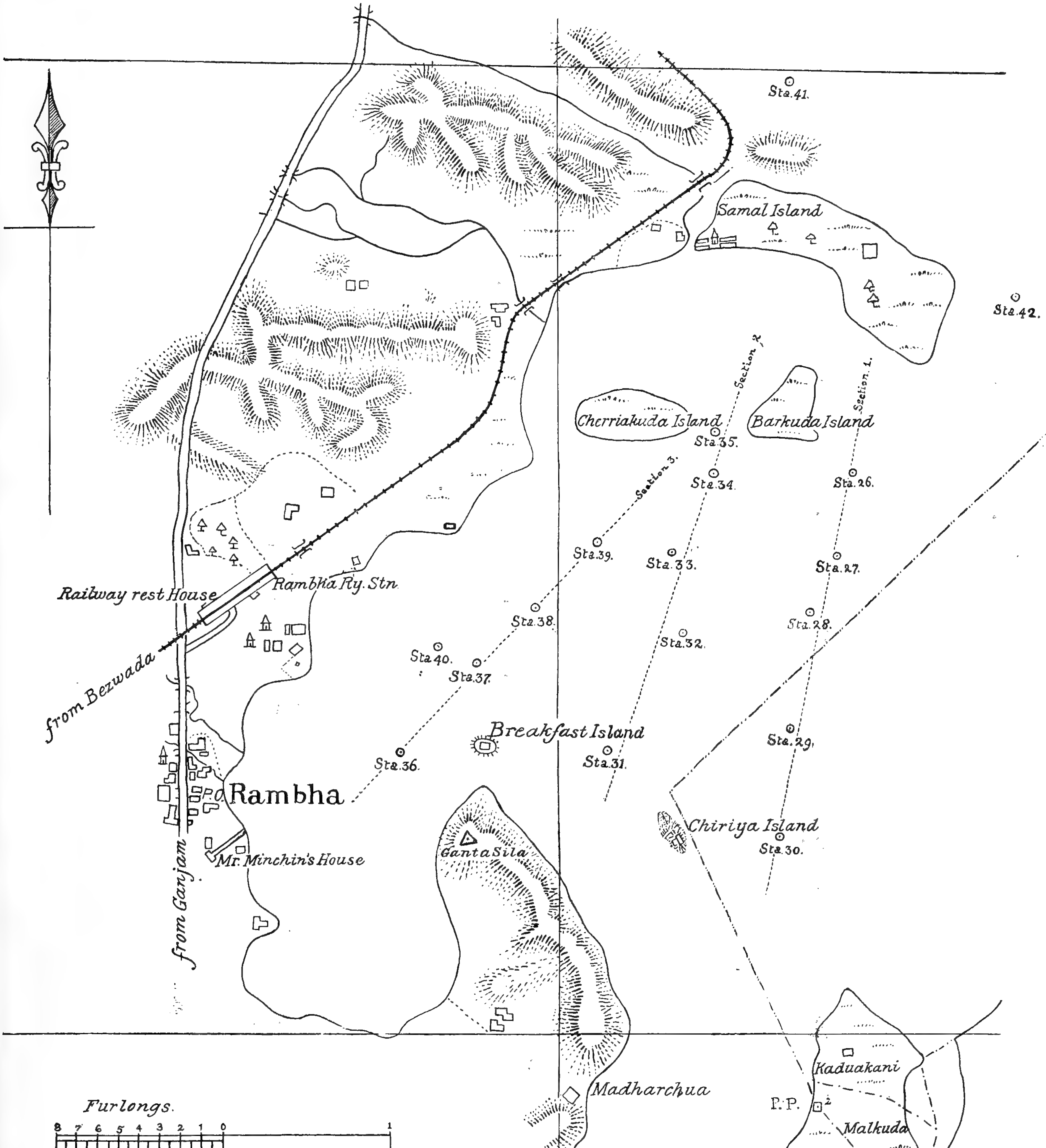
R. B. S. S. del.

Chart showing density at 5 feet depth, August 1919.



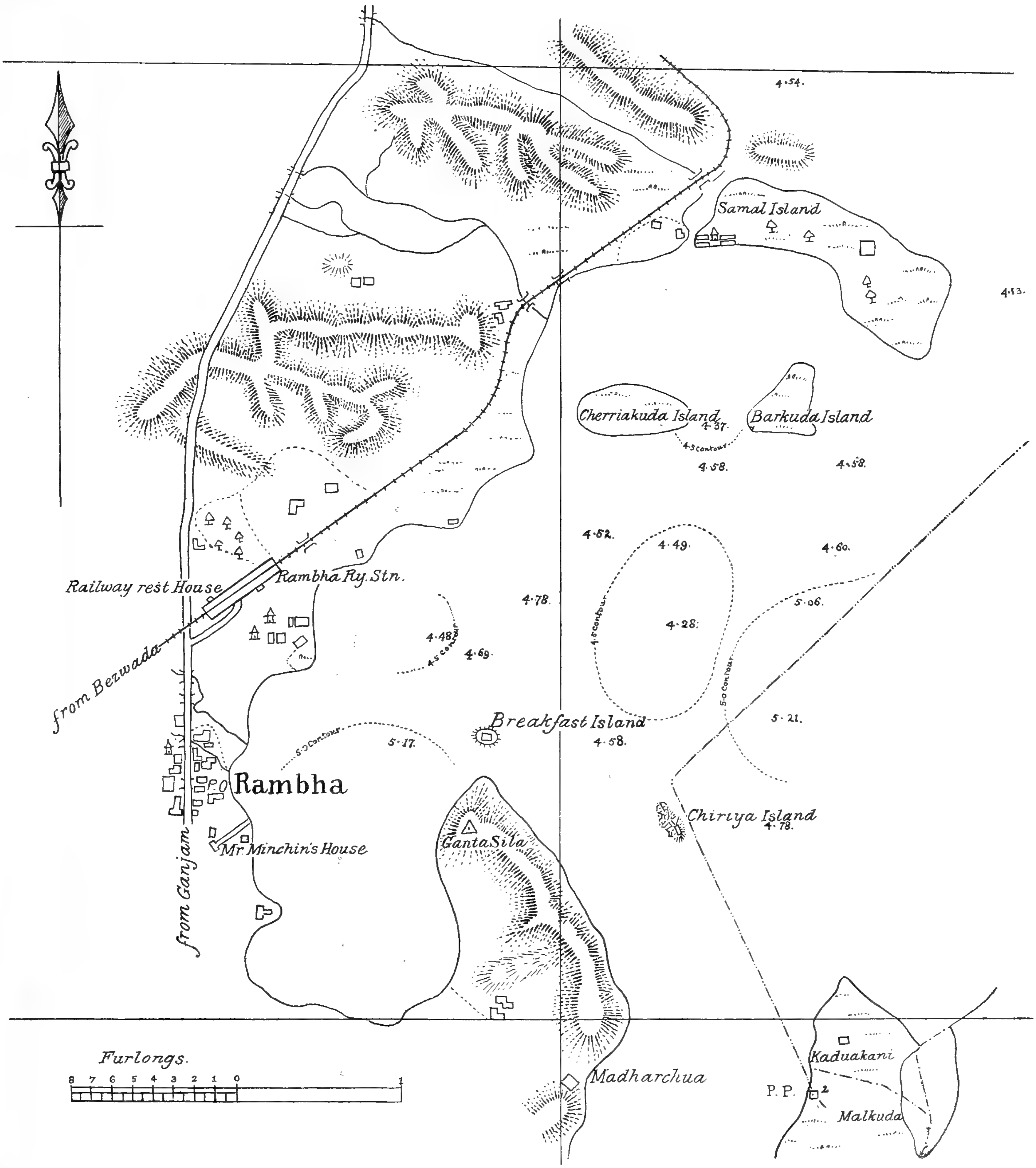
R. B. S. S. del.

Chart showing density at 10 feet depth, August 1919.



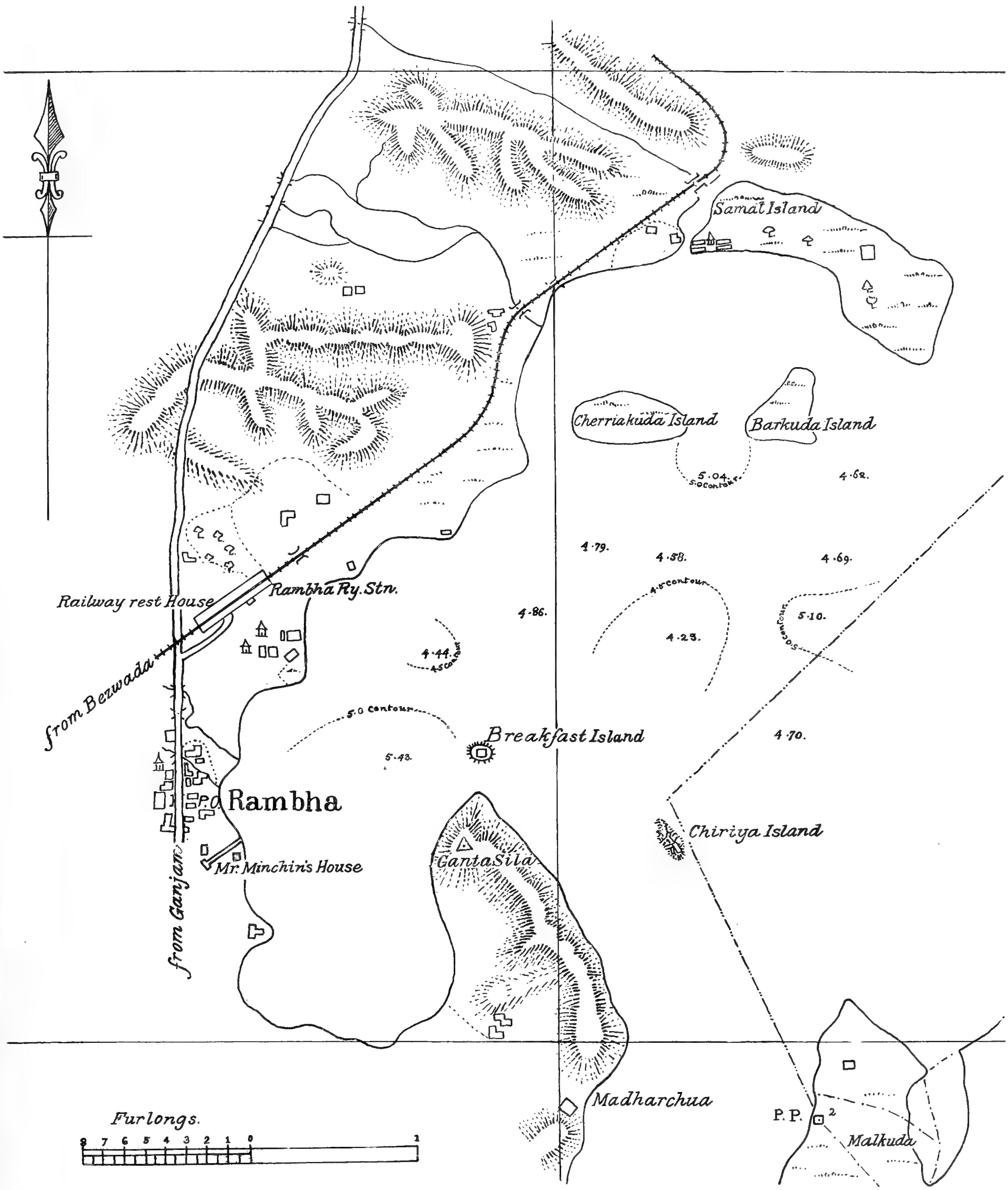
K. B. S. S. del.

Chart showing position of stations 26—40, April 1920.



R. B. S. S. del.

Chart showing density on the surface *in situ*.



R. B. S. S. del.

Chart showing density at 4 feet depth *in situ.*

MEMOIRS OF THE INDIAN MUSEUM, VOL. V.

FAUNA OF THE CHILKA LAKE

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FAUNA OF THE CHILKA LAKE.

FISH

PART IV.

By B. L. Chaudhuri, *D.Sc.* (*Edin.*), *F.R.S.E.*

CONTENTS.

FISH (*PART IV*).

By B. L. CHAUDHURI.

This paper contains a systematic treatment of the division Perciformes of the sub-order Acanthopterygii. The total number of specimens examined and recorded is 281. They belong to seventeen known species, to thirteen genera and seven families.

Sub-Order *ACANTHOPTERYGII.*

Division PERCIFORMES.

Family LOBOLIDAE.

Genus **COIUS** [1] Hamilton Buchanan.

Coius quadrifasciatus (Sevastianof).

1809. *Chaetodon quadrifasciatus,* Sevastianof, *Mém. Acad. Imp. Sci. St. Pétersbourg* I, p. 448, tab. xviii, fig. 2.
1822. *Coius polota,* Hamilton Buchanan, *Fish. Ganges,* pp. 95 and 370, pl. xxxviii, fig. 2.
1842. *Anoplus polota,* Temminck and Schlegel, *Faun. Japon.,* p. 17.
1844. *Anoplus polota,* Richardson, *Zool. Voy. 'Sulpher,'* p. 83.
1849. *Datina polota,* Cantor, *Journ. Asiat. Soc. Bengal,* p. 998.
1851. *Lobotes hexazona,* Bleeker, *Nat. Tijdschr. Ned. Ind.* I, p. 9.
1853. *Datnioides polota, id., ibid.,* V, p. 441.
1859. *Datnioides polota,* Günther, *Cat. Fish. Brit. Mus.* I, p. 339.
1876. *Datnioides quadrifasciatus,* Bleeker, *Arch. Néerl. Sc. Nat.* XI, i, p. 272.
1877. *Datnioides quadrifasciatus, id., Atl. Ichthyol. Ind. Orient. Néerl.* VIII, p. 32, pl. cccv. fig. 1.
1878. *Datnioides poluta,* Day, *Fish. Ind.* p. 96, pl. xxiv, fig. 6.
1889. *Datnioides quadrifasciatus,* Day, *Faun. Brit. Ind. Fish.* I, p. 535, fig. 162.
1890. *Datnioides polota,* Vinciguerra, *Ann. Civ. Stor. Nat. Genova* (2) IX, p. 162.
1905. *Coius quadrifasciatus,* Fowler, *Proc. Acad. Nat. Sci. Philadelphia* LVII, p. 504.
1907. *Datnioides polota,* Lloyd, *Rec. Ind. Mus.* I, p. 227.

The original specimen of Sevastianof (not Sebastian as given by Day in the Fauna volume) must have been a young one as his figure shows all the three radiating brown bands from the orbit which are conspicuous in the young specimens only. The figure of Sevastianof is apparently life size, measuring 55 mm. in length. In colouration and marking it resembles most of the young specimens in the collection.

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[1] *Coius* is one of Hamilton Buchanan's composite genera (*Fish. Ganges,* p. 85). As Bleeker's *Datnioides* is the last name proposed, it gives precedence to *Coius,* of which *Coius polota* of Hamilton Buchanan is the type.

Hamilton Buchanan's figure does not show the round marking on the post-opercle. Day's figures—both for *D. polota* in *Fish. Ind.* and for *D. quadrifasciatus* in the Fauna—show these markings, though no mention is made of them in the text. This round marking on the post-opercle is very conspicuous in all the young ones but is not traceable in the larger specimens in the collection. The ventral fin, the base of which is almost directly below the root of the pectoral fin, has one spine and five branching rays; the spine is outermost and of the rays the two next the spine have filiform endings, the inner one having a much more elongated ending than the one next to the spine. The fish is a permanent inhabitant in the main area of the lake, where it breeds at the end of the rainy season.

There are altogether eleven specimens in the collection of which eight are young.

The following list gives the different parts of the lake from which the specimens were collected, together with their number and size :—

							mm.
4 specimens	...	Mouth of Barkul Bay	...	18th September, 1914	...		21—37.
3 ,,	...	Off Mottapur	...	14th March, 1918	...		50—60.
1 specimen	...	Off Nalbano ...	...	18th September, 1914	...		22.
2 specimens	...	Rambha ...	...	21—31st July, 1913	...		125—175.
1 specimen	...	,, ...	...	1st January, 1915	...		142.

Distribution.—The estuaries of the Ganges and the rivers of Burma, Siam, the Malay Peninsula and the Malay Archipelago.

Family SERRANIDAE.

Sub-family *CENTROPOMINAE.*

Genus **LATES** Cuvier and Valenciennes.

Lates calcarifer (Bloch).

1790. *Holocentrus calcarifer*, Bloch, *Ausl. Fisch.* IV, p. 100, pl. ccxliv.
1801. *Perca calcar*, Bloch and Schneider, *Syst. Ichthyol.* I, p. 89.
1802. *Holocentrus heptadactylus*, Lacépède, *Hist. Nat. Poiss.* IV, p. 344.
1803. *Perca* sp. (*pandoomenoo*), Russell, *Fish. Vizagapatam* II, p. 23, pl. cxxxii.
1822. *Coius vacti*, Hamilton Buchanan, *Fish. Ganges*, pp. 86 and 369, pl. xvi, fig. 28.
1828. *Lates nobilis*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* II, p. 96, pl. xiii.
1828. *Lates calcarifer*, *id*, *ibid.*, II, p. 100.
1845. *Lates nobilis*, Bleeker, *Nat. Geneesk. Arch. Ned. Ind.* II, p. 524.
1846. *Lates nobilis*, Richards, *Rep. Brit. Assoc. Adv. Sc.* 1845, p. 222.
1846. *Lates calcarifer*, *id.*, *ibid.*
1849. *Lates nobilis*, Bleeker, *Verh. Batav. Gen.* XXII, p. 27.
1849. *Lates heptadactylus*, Bleeker, *Journ. Asiat. Soc. Bengal*, p. 983.
1853. *Lates nobilis*, Jerdon, *Madras Jour. Lit. Sci.* XVII, p. 128.
1859. *Lates calcarifer*, Günther, *Cat. Fish. Brit. Mus.* I, p. 68.
1865. *Lates calcarifer*, Day, *Fish. Malabar*, p. 2.
1870. *Lates calcarifer*, Günther, *Proc. Zool. Soc. London*, p. 824.

1876. *Lates calcarifer*, Day, *Fish. Ind.*, p. 7, pl. i, fig. 1.
1876. *Plectropoma calcarifer*, Bleeker, *Atl. Ichthyol. Ind. Orient. Néerl.* VII, p. 109, pl. cccxxii, fig. 3.
1877. *Pseudolates cavifrons*, Alleyne and Macleay, *Proc. Linn. Soc. N. S. W.* I, p. 262, pl. iii.
1878. *Lates darwiniensis*, Macleay, *ibid.*, II, p. 345.
1889. *Lates calcarifer*, Day, *Faun. Brit. Ind. Fish.* I, p. 440, fig. 139.
1890. *Lates calcarifer*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, (2) IX, p. 162.
1895. *Lates calcarifer*, Boulenger, *Cat. Perc. Fish. Brit. Mus.* I, p. 363.
1906. *Plectropomus calcarifer*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 255.
1907. *Lates calcarifer*, Lloyd, *Rec. Ind. Mus.* I, p. 225.
1907. *Plectropoma calcariferum*, Evermann and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 78.
1910. *Lates calcarifer*, Jenkins, *Rec. Ind. Mus.* V, p. 131.
1911. *Lates calcarifer*, Willey, *Spol. Zeylanica* VII, p. 100.
1912. *Lates calcarifer*, Jenkins, *Rec. Ind. Mus.* VII, p. 54.
1913. *Lates calcarifer*, Weber, *Siboga-Exped.* LVII, *Fische*, p. 215.
1916. *Lates calcarifer*, Sundara Raj, *Rec. Ind. Mus.* XII, p. 278.

There are two specimens in the collection, both from Satpara ; one measuring 262 mm. in length was secured in March 1914, and the other, measuring 137 mm. in length, was captured on the 10th October. The fish is thus reported only from the outer channel.[1]

Distribution.—Coasts and mouths of rivers of South Eastern Asia from India to Southern China, Malay Archipelago, the Philippine Islands, Australia and New Guinea.

Sub-family *CHANDINAE.*

Genus **CHANDA**[2] Hamilton Buchanan.

Chanda ambassis (Lacépède).

1775. ? *Sciaena safgha*, Forskål, *Descrip. Animal*, p. 53.
1801. ? *Perca safgha*, Bloch and Schneider, *Syst. Ichthyol.*

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[1] It is, however, common in Rambha Bay in the main area. *N. A.*

[2] The generic name *Chanda* of Hamilton Buchanan [*Fish. Ganges*, 1822, pp. 103 and 370] has priority over *Ambassis* of Cuvier and Valenciennes [*Hist. Nat. Poiss.*, II (1828), p. 175]. This was pointed out by M'Clelland and Cantor as well as by Waite, although Fowler (*loc. cit.*), the first reviser of *Chanda*, had regarded its type identical with the type of Bleeker's genus *Pseudoambassis*. *Chanda* of Hamilton Buchanan, which is the same as *Bogoda* of Bleeker, is characterized by the uninterrupted lateral line, small or minute scales and strong curved canines and is distinguished from the related genera by the serrated pre-orbital, small teeth, comparatively larger scales, complete lateral line and the presence of about ten rays in the dorsal fin. A procumbent dorsal spine is always present but in some cases it is small and concealed in the flesh [*The Fishes of Samoa* by Drs. Jordan and A. Seal, *Bull Bur. Fish.* (*U.S.*) xxv, p. 175]. Fowler, and long before him Cuvier and Valenciennes, observed that the two first species under *Chanda* as described by Hamilton Buchanan belonged to a different genus altogether and for this reason Cuvier and Valenciennes suppressed the name *Chanda*, but they often showed themselves zealous in cancelling valid names without any justification. It should be remembered that Hamilton Buchanan clearly expressed his doubts as to the propriety of placing these two species in his genus *Chanda*. The fact that he placed these two admittedly doubtful species under the generic name cannot therefore vitiate it. As to the first doubtful species, Hamilton Buchanan himself proposed to place it in another genus : " This species is ill defined, and might, perhaps, be placed as a *Coius*." (*Fish. Ganges*, p. 105). He further pointed out, " As in the genera already described there are, as it were, certain intermediate species, so in this the two first, which I have described, together with the *Zeus insidiator*, have but little of the transparency, which forms part of the generic character." He further stated that his excuse for including these two

1802. *Centropomus ambassis*, Lacépède, *Hist. Nat. Poiss.* IV, p. 273.
1828. *Ambassis commersonii*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* II, p. 176, pl. xxv.
1837. *Ambassis commersonii*, Rüppell, *Neu. wirbel. Fisch.*, p. 89.
1849. *Ambassis commersonii*, Bleeker, *Verh. Batav. Gen.* XXII, p. 30.
1849. *Ambassis macracanthus*, *id.*, *ibid.*, p. 30.
1859. *Ambasssis commersonii*, Günther, *Cat. Fish. Brit. Mus.* I, p. 223.
1859. *Ambassis macracanthus*, *id.*, *ibid.*, p. 227.
1865. *Ambassis commersonii*, Day, *Fish. Malabar*, p. 15.
1866. *Ambassis productus*, Guichenot, *Mém. Soc. Sci. Cherbourg* XII, p. 130.
1868. *Ambassis commersonii*, Peters, *Reis. Mossamb.* IV, p. 10.
1870. *Ambassis macracanthus*, Day, *Proc. Zool. Soc. London*, p. 681.
1875. *Ambassis commersonii*, *id.*, *Fish. Ind.*, p. 52, pl. xv, fig. 3.
1877. *Ambassis commersonii*, Bleeker, *Atl. Ichthyol. Ind. Orient. Néerl.* VIII, pp. 133 and 136.
1889. *Ambassis commersonii*, Day, *Faun. Brit. Ind. Fish.* I, 488.
1905. *Ambassis ambassis*, Fowler, *Proc. Acad. Nat. Sci. Philadelphia* LVII, p. 500.
1915. *Ambassis commersonii*, Boulenger, *Brit. Mus. Cat. Freshw. Fish. Africa* III, p. 112, fig. 85.
1916. *Ambassis ambassis*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 279.
1916. *Ambassis commersonii*, Boulenger, *Brit. Mus. Cat. Freshw. Fish. Africa*, IV, p. 326.

There are only two specimens in the collection, both secured from a fisherman at Kalupara Ghat on 7th April 1914; these are 54·6 and 64·5 mm. in length.

Distribution.—East coast of Africa, shores of India and the Malay Archipelago, North coast of Australia. The species ascends rivers and estuaries.

Genus **PRIOPIS**[1] Kuhl and van Hasselt.

Priopis gymnocephalus (Lacépède).

1802. *Lutjanus gymnocephalus*, Lacépède, *Hist. Nat. Poiss.* III, p. 479, pl. xxiii, fig. 3 and IV, p. 216.
1828. *Ambassis dussumieri*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* II, p. 181.
1831. *Lutjanus gymnocephalus*, Lacépède and Desmarest, *Hist. Nat. Poiss.* V, p. 108.
1834. *Ambassis dussumieri*, Quoy and Gaimard, *Voy. "Astrolabe" Poiss.* III, p. 645, pl. i, fig. 3.
1845. *Ambassis dussumieri*, Bleeker, *Nat. Geneesk. Arch. Ned. Ind.*, II, p. 520.
1849. *Chanda dussumieri*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 988.
1849. *Chanda gymnocephala*, *id.*, *ibid.*, p. 989.
1859. *Ambassis dussumieri*, Günther, *Cat. Fish. Brit. Mus.* I, p. 225.
1865. *Ambassis dussumieri*, Day, *Fish. Malabar*, p. 16.

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doubtful species (*viz.*, *C. setifer* and *C. ruconius.*) in his genus *Chanda* was that the name was a common local appellation for all the species he included. A very curious mistake may be noted here. In Agassiz's *Nomenclator Zoologicus* Pisces, p. 15) Hamilton Buchanan's generic name *Chanda* is stated to have been derived from "the Greek word καυδος =hians!" It is in reality a vernacular name. The word is not derived from the Hindi word *Chandi* (=silver), as wrongly supposed by Cantor and Day, but from the Bengali word *Chand*=moon, from the moon-like rounded shape and the moon-like semitranslucent lustre exhibited by these fishes in their sudden sallies to the surface of the water and quick retreat.

[1] The genus *Priopis*, Kuhl and van Hasselt (Cuvier and Valenciennes, *Hist. Nat. Poiss.* VI, *p.* 503) is defined as *Chanda* with the lateral line interrupted (Jordan and Seale, *Proc. U. S. Nat. Mus.* XXVIII, p. 780).

1865. *Ambassis dussumieri*, Kner, *Reis. 'Novara' Fisch.*, p. 41.
1869. *Ambassis vachelli*, Peters, *Monatsb. Königl. Preuss. Akad. Wiss., Berlin* (1868), p. 255.
1870. *Ambassis dussumieri*, Day, *Proc. Zool. Soc. London*, p. 681.
1874. *Ambassis gymnocephalus*, Bleeker, *Nat. Verh. Holl. Maatsch. Wetensch.* II, p. 15.
1877. *Ambassis gymnocephalus*, Bleeker, *Atl. Ichthyol. Ind. Orient. Néerl.* VIII, pp. 133 and 138, pl. ccclii, fig. 3.
1878. *Ambassis gymnocephalus*, Day, *Fish. Ind.* p. 54, pl. ccclii, fig. 3.
1879. *Ambassis gymnocephalus*, Bleeker, *Verh. Akad. Amsterdam*, XVIII, p. 13.
1889. *Ambassis gymnocephalus*, Day, *Faun. Brit. Ind. Fish.* I, p. 489.
1905. *Priopis gymnocephalus*, Jordan and Seale, *Proc. U. S. Nat. Mus* XXVIII, p. 780.
1905. *Ambassis gymnocephalus*, Fowler, *Proc. Acad. Nat. Sci. Philadelphia* LVII, p. 501.
1913. *Ambassis gymnocephalus*, Weber, *Fisch. 'Siboga'-Exped.*, p. 217.

Lacépède's figure is defective as it does not show that the lateral line is not continuous.

In many specimens there is no external appearance of the horizontal spine in front of the first dorsal fin.

In some specimens the tips of the pelvic fins reach the vent, covering the anal opening. The caudal fin is not tipped with black in some, and in some the skin between the first dorsal fin and the body is black.

There are altogether forty-seven specimens in the collection ; the following list gives the distribution of the species in the lake :—

						mm.
9 specimens	...	Off Barkul	18-21st September, 1914	...	39—48
16 ,,	...	Off mouth of Barkul Bay	18th September, 1914	...	35·5—48
1 specimen	...	Off Barkul	13th November, 1914	...	35
1 ,,	...	Chirriya Island (shore collecting) ...	13th February, 1914	...	16·5
3 specimens	...	Chirriya Island (Towards Samal Point) ...	17th February, 1914	...	42·5—47·5
1 specimen	...	Between Chirriya Island and Barkuda Island ...	17th November, 1914	...	47
3 specimens	...	Rambha Bay ...	February, 1914	...	46—51
1 specimen	...	,, ,, ...	March, 1914	...	44
1 specimen	...	Satpara (shore collecting)	13th March, 1914	...	17·5
2 specimens	...	West of Satpara (tow netting)	20th March, 1914	...	10—12
1 specimen	...	Satpara	March, 1914	...	43
5 specimens	...	,, ...	12-13th September, 1914	...	38—50
3 ,,	...	,, ...	October, 1914	...	40—43
1 specimen	...	,, ...	...	...	40·5

The species occurs in the main area of the lake as well as in the outer channel, where it breeds. It is a permanent inhabitant in the lake.

Distribution.—Coasts of Orissa and Malabar, entering rivers and estuaries in India, Seychelles, Penang, Javanese and Chinese seas, Celebes and Isle de France.

Sub-family *LUTJANINAE.*

Genus **LUTJANUS** Bloch.

Lutjanus johnii (Bloch).

1795. *Anthias johnii*, Bloch, *Ichthyol.* IX, p. 97, pl. cccxviii.
1801. *Anthias johnii*, Bloch and Schneider, *Syst. Ichthyol.*, p. 303.
1802. *Lutjanus johnii*, Lacépède, *Hist. Poiss.* IV, p. 235.
1803. *Sparus* sp. (*doondiawah*), Russell, *Fish. Vizagapatam*, I, p. 76, pl. xcvii.
1803. *Sparus* sp. (*mungimupudee*), *id.*, *ibid.*, II, p. 8, pl. cx.
1803. *Sparus tranquebaricus*, Shaw, *Gen. Zool.*, *Pisc.* IV, p. 471.
1822. *Coius catus*, Hamilton Buchanan, *Fish. Ganges*, pp. 90 & 369, pl. 38, fig. 30.
1824. *Mesoprion unimaculatus*, Quoy and Gaimard, *Zool. Freycin.*, pp. 304-441.
1828. *Mesoprion johnii*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* II, p. 443.
1831. *Mesoprion flavipinnis*, *id.*, *ibid.*, VII, p. 475.
1831. *Serranus pavoninus*, *id.*, *ibid.*, VII, p. 443.
1831. *Lutjanus johnii*, Desmarest, *Oeuvres Lacép.*, IX, p. 127.
1834. *Mesoprion unimaculatus*, Quoy and Gaimard, *Voy. de l'Astrolabe.*, *Poiss.* III, p. 665, pl. V, fig. 3.
1836. *Mesoprion unimaculatus*, Cuvier, *Règ. Anim.*, *Poiss.* p. 35.
1846. *Mesoprion unimaculatus*, Richardson, *Rep. Brit. Assoc. Adv. Sc.* (1845), p. 229.
1849. *Mesoprion johnii*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 995.
1849. *Mesoprion unimaculatus*, Bleeker, *Verh. Batav. Gen.* XXII, pp. 4, 20 and 42.
1853. *Mesoprion unimaculatus*, Jerdon, *Madras Journ. Lit. Sci.* XVII, p. 130.
1859. *Serranus pavoninus*, Günther, *Cat. Fish. Brit. Mus.* I, p. 126.
1859. *Mesoprion johnii*, *id.*, *ibid.*, p. 200.
1865. *Mesoprion johnii*, Day, *Fish. Malabar*, p. 11.
1865. *Mesoprion johnii*, Kner, *Reis. 'Novara' Fisch.*, p. 35.
1876. *Lutianis johnii*, Day, *Fish. Ind.*, p. 42, pl. xiii, fig. 1.
1877. *Lutjanus johni*, Bleeker, *Atl. Ichthyol. Ind. Orient. Neérl.* VIII, p. 49, pl. cccxxxviii, fig. 1.
1889. *Lutjanus johnii*, Day, *Faun. Brit. Ind. Fish.* I, p. 476.
1904. *Lutianus johnii*, Fowler, *Journ. Acad. Nat. Sci. Philadelphia* (2) XII, p. 325.
1906. *Lutianus johni*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 264.
1907. *Lutianus johnii*, Lloyd, *Rec. Ind. Mus.*, I, p. 226.
1907. *Lutianus johnii*, Evermann and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 79.
1908. *Lutianus johnii*, Gilchrist and Thomson, *Ann. South African Mus.* VI, p. 213.
1913. *Lutianus johnii*, Weber, *'Siboga'-Exped.* LVII, *Fisch*, p. 247.

There is only one specimen (young) measuring 50 mm. in length, captured on 17th November 1914, when proceeding across the mouth of Rambha Bay between Chirriya Island and Barkuda Island. There are three broad but faint transverse bands; the black ocellus commences at the thirty-fourth scale from the snout and on the twentieth scale of the lateral line; the ocellus measures 10 mm. × 8 mm.

The species is only an occasional visitor in the main area of the lake.

Distribution.—Coasts of Africa, Red Sea, seas of India, ascending some distance up tidal rivers, Malay Archipelago, coasts of China and Australia.

Genus **THERAPON**[1] Cuvier.

Therapon jarbua (Forskål).

1775. *Sciaena jarbua*, Forskål, *Descr. Anim.*, p. 50.
1788. *Sciaena jarbua*, Linnaeus, *Syst. Natur.*, *Gmelin*, Ed. XIII, p. 1303.
1790. *Holocentrus servus*, Bloch, *Ausl. Fisch.* IV, p. 80, pl. ccxxxviii, fig. 1.
1797. *Holocentrus servus*, *id.*, *Ichthyol.*, taf. ccxxxviii, fig. 1.
1801. *Grammistes servus*, Bloch and Schneider, *Syst. Ichthyol.*, I, p. 185.
1802. *Holocentrus jarbua*, Lacépède, *Hist. Nat. Poiss.* IV, pp. 348 and 355.
1817. *Terapon servus*, Cuvier, *Reg. Anim.*, Ed. I, II, p. 295.
1824. *Therapon timoriensis*, Quoy and Gaimard, *Voy. "Uranie" et " Physicienne, "* p. 341.
1829. *Therapon servus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* III, p. 125.
1831. *Therapon servus*, *id.*, *ibid.*, VII, p. 479.
1836. *Therapon servus*, Cuvier, *Règ. Anim.*, *Poiss.* p. 43.
1846. *Therapon servus*, Richardson, *Rept. Brit. Assoc. Adv. Sc.* (1845), p. 238.
1848. *Therapon servus* Bleeker, *Journ. Ind. Arch.* II, No. IX, p. 632.
1859. *Therapon servus*, Günther, *Cat. Fish. Brit. Mus.* I, p. 278.
1865. *Therapon servus*, Kner, *Reis. 'Novara,' Fisch.* p. 45.
1865. *Therapon servus*, Day, *Fish. Malabar*, p. 17.
1867. *Therapon servus*, Jouan, *Mém. Soc. Imp. Sci. Nat. Cherbourg* XIII, p. 251.
1868. *Therapon servus*, Peters, *Reis. Mossambique*, IV, p. 10.
1870. *Therapon jarbua*, Klunzinger, *Verh. Zool.-bot. Ges. Wien* XX, p. 729.
1873. *Therapon servus*, Günther, *Fisch. Sudsee* I, p. 26.
1873. *Therapon (Batnia) jarbua*, Bleeker, *Ned. Tijdschr. Dierk.* IV, p. 377.
1875. *Therapon servus*, Bleeker, *Atl. Ichthyol. Ind. Orient. Neérl.* VII, p. 112, pl. xxxiv, fig. 2.
1876. *Therapon jarbua*, Day, *Fish. Ind.* p. 69, pl. xviii, fig. 4.
1876. *Therapon (Datnia) jarbua*, Bleeker, *Arch. Néerl. Sc. Nat.* XI, I, p. 267.
1878. *Therapon (Datnia) jarbua*, Bleeker, *Arch. Néerl. Sc. Nat.* XIII, p. 42.
1884. *Therapon jarbua*, Klunzinger, *Fisch. Roth. Meer*, p. 729.
1889. *Therapon jarbua*, Day, *Faun. Brit. Ind. Fish.* I, p. 505, fig. 153.
1903. *Therapon jarbua*, Jordan and Evermann, *Proc. U. S. Nat. Mus.* XXV, p. 348.
1904. *Therapon jarbua*, Fowler, *Journ. Acad. Nat. Sci. Philadelphia* (2) XII, p. 527.
1905. *Terapon servus*, Jordan, *Guide Study Fish.* II, p. 342.
1906. *Terapon jarbua*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 266.
1907. *Terapon jarbua*, Smith and Pope, *Proc. U. S. Nat. Mus.* XXXI, p. 476.
1907. *Terapon jarbua*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 23.
1907. *Therapon jarbua*, Lloyd, *Rec. Ind. Mus.* I, p. 226.
1907. *Terapon jarbua*, Evermann and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 83.
1908. *Therapon jarbua*, Gilchrist and Thomson, *Ann. South Afric. Mus.* VI, p. 150.
1910. *Therapon servus*, Franz, *Abhandl. Akad. Wiss.* IV, p. 46.

[1] *Terapon*, Cuvier, *Reg. Anim.* Ed. I (1817), p. 295, was a misprint for *Therapon* and was subsequently corrected in a later edition. *Djabub*, Forskål, *Desc. Anim.* (1775), p. 44, though an earlier generic name, is held not eligible.

1911. *Terapon jarbua*, Jordan and Richardson, *Mem. Carnegie Mus.* IV, p. 187.
1912. *Therapon jarbua*, Bean and Weed, *Proc. U. S. Nat. Mus.* XIII, p. 605.
1913. *Therapon jarbua*, Weber, *'Siboga'-Exped.* LVII, *Fisch.*, p. 254.
1913. *Therapon jarbua*, Sewell, *Journ. Proc. Asiat. Soc. Bengal*, (n. s.) IX, pp. 334 and 344.
1913. *Therapon servus*, Jordan, Tanaka and Snyder, *Journ. Coll. Sci. Imp. Univ. Tokyo*, XXXIII, p. 168.
1915. *Therapon jarbua*, Boulenger, *Cat. Freshw. Fish. Afric. Brit. Mus.* III, p. 113, fig. 114.
1917. *Therapon jarbua*, Hornell, *Madras Fish. Bull.* XI, p. 91.

Hamilton Buchanan has left an excellent figure of this fish in the plate No. 67 of the volume of his manuscript drawings ;[1] the name "*Holocentrus (?) katkaya*" is on the back of the plate in his own handwriting. This drawing is evidently the original of the badly copied figure in Hardwicke's *Illustrations*.[2] The figure was named *Pterapon trivittatus* and was published without any acknowledgment of the source, the name also evidently was borrowed without acknowledgment from Hamilton's *Fishes of the Ganges* (p. 92) on a mistaken identity of the published species with the unpublished manuscript figures.

There are altogether five specimens in the collection, four of which are from Satpara, but no special locality is known for the fifth which measures 88 mm. and was collected at the end of July 1913. Of the Satpara specimens the biggest measures 115 mm. in length and was collected on 12th September 1914 and the remaining three on March, 1914, measuring 83 mm., 85 mm. and 95 mm. The biggest specimen has eleven spines in the first dorsal, the one measuring 95 mm. in length has ten prominent spines and a rudimentary one anteriorly. Of the rest one has a trace of a spine but the other two specimens have only ten prominent spines in the first dorsal fin. These facts satisfactorily explain the differences in the observations of Günther and Klunzinger on the number of spines.

Distribution.—Red Sea, east coast of Africa, seas and estuaries of India, the Malay Archipelago, north coast of Australia, Formosa, Japan, Samoa, Fiji, New Britain, New Guinea and the Solomon Islands.

Therapon puta, Cuvier.

1803. *Perca sp. (keelputa)*, Russell, *Fish. Vizag.* II, p. 19, pl. cxvi.
1817. *Terapon puta*, Cuvier, *Règ. Anim.* Ed. I, II, p. 295.
1822. *Coius trivittatus*, Hamilton Buchanan, *Fish. Ganges*, pp. 92 and 370.
1829. *Therapon puta*, Cuvier and Valenciennes, *Nat. Hist. Poiss.* III, p. 131.
1829. *Therapon ghebul*, *id.*, *ibid.* III, p. 133.
1836. *Therapon puta*, Cuvier, *Règ. Anim.*, *Poiss.*, p. 43, pl. xii, fig. 2.
1849. *Therapon trivittatus*, M'Clelland, *Journ. Asiat. Soc. Bengal*, p. 1001.
1853. *Therapon puta*, Jerdon, *Madras Journ. Lit. Sci.* XVII, p. 130.
1859. *Therapon trivittatus*, Günther, *Cat. Fish. Brit. Mus.* I, p. 281.
1859. *Therapon ghebul*, *id.*, *ibid.*, I, p. 281.
1865. *Therapon trivittatus*, Kner, *Reis. 'Novara,' Fisch.*, p. 45.
1865. *Therapon trivittatus*, Day, *Fish. Malabar*, p. 17.
1873. *Therapon (Datina) trivittatus*, Bleeker, *Ned. Tijdschr. Dierk.* IV, p. 375.

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[1] Chaudhuri, *Mem. Ind. Mus.* V, p. 444 and foot-note.
[2] Gray, *Illustrations of Indian Zoology from the collection of Major-General Hardwicke*, II, pl. lxxxviii, fig. 1.

1875. *Therapon puta, id., Fish. Ind.*, p. 68, pl. xviii, fig. 3.
1884. *Therapon trivittatus*, De Vis, *Proc. Linn. Soc. N. S. W.* VIII, p. 457.
1889. *Therapon puta*, Day, *Faun. Brit. Ind. Fish.* I, p. 505.
1906. *Terapon puta*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 266.
1907. *Terapon puta*, Jordan and Seale, *ibid.* XXVI, p. 24.
1907. *Terapon puta*, Evermann and Seale, *ibid.* XXVI, p. 83.
1912. *Therapon puta*, Bean and Weed, *Proc. U. S. Nat. Mus.* XLII, p. 605.
1913. *Therapon puta*, Weber, *'Siboga'-Exped.* LVII, *Fisch.*, p. 91.
1913. *Therapon puta*, Sewell, *Journ. Proc. Asiat. Soc. Bengal* (n. s.) IX, p. 352.
1917. *Therapon puta*, Hornell, *Madras Fish. Bull.* XI, p. 91.

There are altogether thirty-six specimens in the collection, more than twenty of which are young. The list given below will show the time and place of their occurrence in the lake.

							mm.
2 specimens	...	Off Barnikuda	...	6th September, 1914,	...	54—62
1 specimen	...	Cherriakuda towards Samal Point	...	17th February, 1914	...	58
8 specimens	...	Mahosa (Barhampur Island) ...	...	18th March, 1914	...	26—20
1 specimen	...	Rambha Bay	...	February, 1914	...	74
1 specimen	...	Between Samal Island and mainland	...	September, 1913	...	32
1 specimen	...	Satpara ...	...	...	...	77
7 specimens	...	,, ...	...	March, 1914	...	68—87
7 specimens	...	Satpara Bay	...	13th March, 1914	...	15—25
3 specimens	...	,, ...	...	17th March, 1914	...	17, 18 & 21
1 specimen	...	South side of Satpara Island ...	...	13th March, 1914	...	14
2 specimens	...	West of Satpara	...	20th March, 1914	...	15 & 17
1 specimen	...	Seruanaddi	...	8th September, 1914	...	60
1 specimen	...	From Seruanaddi going towards Barnikuda	...	4th September, 1914	...	67

The young ones were mostly obtained in shore-collecting in the neighbourhood of Satpara Island. Numerous round light spots are found in these specimens between the horizontal bands. The caudal fin is immaculate in most of the young specimens. In some of the young specimens there is a black spot at the root of the caudal fin.

This fish appears to be a permanent inhabitant in the main area as well as in the outer channel, breeding in the latter area in winter.

Distribution.—Red sea, seas of India, Malay Archipelago, the Philippine Islands, coast of Australia, sea of Timur and South Pacific Ocean (the island of Samoa).

Family SILLAGINIDÆ.

Genus **SILLAGO,** Cuvier.

Sillago sihama (Forskål).

1775. *Atherina sihama*, Forskål, *Descrip. Anim.*, pp. xiii and 70.
1801. *Platycephalus sihamus*, Bloch and Schneider, *Syst. Ichthyol.*, p. 60.

1801. *Sciaena malabarica*, *id.*, *ibid.*, p. 18, pl. xix.
1803. *Sparus sp.* (*soring*), Russell, *Fish. Vizag.* II, p. 9, pl. cxiii.
1817. *Sillago acuta*, Cuvier, *Règ. Anim.* (Ed. I) II, p. 258.
1827. *Sillago sihama*, Rüppell, *Atl. Reis. Nord. Afrik. Fisch. Meer.* p. 9, pl. ii, fig. 1.
1829. *Sillago acuta*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* III, p. 400.
1829. *Sillago erythroea*, *id.*, *ibid.*, p. 409.
1835. *Sillago sihama*, Rüppell, *Neu. Wirbel. Faun. Abyssin. Fisch.*, p. 100.
1836. *Sillago sihama*, Cuvier, *Règ. Anim.*, *Poiss.*, p. 45.
1845. *Sillago acuta*, Bleeker, *Nat. Geneesk. Arch. Ned. Ind.* II, pp. 524 and 527.
1849. *Sillago malabarica*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1003.
1853. *Sillago acuta*, Jerdon, *Madras Journ. Lit. Sci.* XVII, p. 131.
1860. *Sillago sihama*, Günther, *Cat. Fish. Brit. Mus.* II, p. 243.
1861. *Sillago sihama*, Gill, *Proc. Ac. Nat. Sci. Philadelphia*, p. 504.
1861. *Sillago malabarica*, *id.*, *ibid.*
1865. *Sillago sihama*, Day, *Fish. Malabar*, p. 47.
1866. *Sillago sihama*, Playfair, *Fish. Zanzibar*, p. 69.
1867. *Sillago sihama*, Jouan, *Mém. Soc. Imper. Sci. Nat. Cherbourg* XIII, p. 252.
1868. *Sillago sihama*, Kner, *Reis. Oster. Novar. Fisch.*, p. 128.
1870. *Sillago sihama*, Klunzinger, *Verhandl. Zool.-Bot. Ges. Wien.* XX, p. 818.
1874. *Sillago sihama*, Bleeker, *Verh. Akad. Amsterdam* XIV, p. 67.
1876. *Sillago sihama*, Day, *Fish. Ind.*, p. 265, pl. lvii, fig. 3.
1880. *Sillago sihama*, Günther, *Rep. Voy. H. M. S. "Challenger," Zool.* I, p. 56.
1885. *Sillago sihama*, Macleay, *Proc. Linn. Soc. N. S. W.* IX, p. 28.
1885. *Sillago sihama*, Steindachner and Doderlein, *Denk. Akad. Wiss. Wien.* XLIX, p. 19.
1889. *Sillago sihama*, Day, *Faun. Brit. Ind. Fish.* II, p. 224.
1902. *Sillago sihama*, Jordan and Snyder, *Proc. U. S. Nat. Mus.* XXIV, p. 486.
1904. *Sillago sihama*, Fowler, *Journ. Acad. Nat. Sci. Philadelphia* XII, p. 549.
1905. *Sillago sihama*, Jordan, *Stud. Fish.* II, p. 358.
1905. *Sillago sihama*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 277.
1907. *Sillago sihama*, *id.*, *ibid.*, XXVI, p. 25.
1907. *Sillago sihama*, Smith and Pope, *Proc. U. S. Nat. Mus.* XXII, p. 478.
1908. *Sillago sihama*, Gilchrist and Thomson, *Ann. S. Afric. Mus.* VI, p. 192.
1910. *Sillago sihama*, Jenkins, *Rec. Ind. Mus.* V, pp. 132 and 136.
1910. *Sillago sihama*, Franz, *Abhandl. Bayer. Akad. Wiss.* IV, *suppl.* I, p. 83.
1911. *Sillago sihama*, Jordan and Richardson, *Mem. Carnegie Mus.* IV, p. 192.
1912. *Sillago sihama*, Bean and Weed, *Proc. U. S. Nat. Mus.* XLII, p. 607.
1912. *Sillago sihama*, Jenkins, *Rec. Ind. Mus.* VII, p. 60.
1913. *Sillago sihama*, Tanaka, *Fig. Descrip. Fish. Japan* XIV, p. 241, pl. lxviii.
1913. *Sillago sihama*, Jordan, Tanaka and Snyder, *Journ. Coll. Sci. Imp. Univ. Tokyo* XXXIII, p. 187.
1913. *Sillago sihama*, Jordan and Metz, *Mem. Carnegie Mus.* VI, p. 41.
1913. *Sillago sihama*, Sewell, *Journ. Asiat. Soc. Bengal* (n. s.) IX, pp. 338 and 344.
1913. *Sillago sihama*, Weber, '*Siboga*'-*Exped.*. *Fisch.*, p. 267.
1914. *Sillago sihama*, Jordan and Thomson, *Mem. Carnegie Mus.* VI, p. 259.
1917. *Sillago sihama*, Hornell, *Madras Fish. Bull.* XI, p. 91.

Dr. Gill separates *S. malabarica* as a distinct species having the soft dorsal spotted.[1] Besides colouration specimens of this species show great variation in the depth of the body, attenuation of the head and snout and height of the spinous dorsal. That M. Leschenault saw "single individuals upwards of three feet in length" was first given currency by Cuvier.[2] Most subsequent writers, including Day, quoted this statement without any corroboration or acknowledgment. The species is, comparatively speaking, a small sized one.[3] As the species is of wide distribution and as no one else has observed it to reach anywhere near the size recorded by Leschenault, it is probable that his observation is erroneous. It is not unlikely that Leschenault mistook some species of *Sphyraena* for *Sillago sihama* as both the genera have two dorsal fins, a long pointed snout as well as a similar nature and arrangement of scales. Cuvier and Valenciennes partly confounded *S. panijus* (Hamilton Buchanan) with *S. sihama* (Forskål), for they remark that the vernacular name for the species in Calcutta is *Panji mas.*[4]

There are altogether seventeen specimens in the collection, seven of which are quite young and were obtained only a mile south-west of the mouth of the lake on the outer bar. The rest are all adult and were found distributed over the main area and collected throughout the year. The caudal fin is in most cases square-cut and in some emarginate but never deeply indented as represented in Russell's figure, which in all probability is defective. Most of the specimens have a broad longitudinal silvery band about the middle of the body not conspicuous in the young specimens. In some there are black blotches on the opercle. There is a horse-shoe shaped black marking on the occiput with white border in front.

The following statement shows the number and size of the specimens in the collection together with the localities in the lake from which they were obtained:—

			mm.
4 specimens	... Balugaon ...	... 21-31st July, 1913	... 112—144
2 specimens	... Parikud ...	... 28th November, 1914	... 115 & 160
1 specimen	... Rambha Bay	... February, 1914	... 135
3 specimens	... (purchased) ...	... 19th November, 1914	... 107—152
7 specimens	... Outer Bar, one mile south-west of the mouth of the lake. ...	... 19th March, 1914	... 25—44

The species is a permanent inhabitant of the main area of the lake going out to the sea or near the mouth of the lake to breed. In all probability the breeding time is about the month of February.

Distribution.[5]—Coasts of Abyssinia, Zanzibar, North and East Africa, Red Sea, seas of India, Bay of Bengal and estuaries of the Ganges, Malay Archipelago, seas of the

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1 *Proc. U. S. Nat. Mus.* XXIV, p. 487.

2 *Hist. Nat. Poiss.* III, p. 407.

3 "Erreicht fast 30 cm. lange" Weber, *'Siboga'-Exped. Fisch.*, p. 267.

4 *Hist. Nat. Poiss.* III, p. 401.

5 Günther in his catalogue enters "one skin (bad state)" of this fish as belonging to Nepal, presented by B. H. Hodgson; this is undoubtedly a mistake. The locality of the donor who was for a long time a resident in Nepal must have been mistaken for that of the fish. Günther has similarly referred a few more marine fish to Nepal which led T. C. Jerdon to contribute his paper "On the extension of certain marine fishes to the freshwater Rivers of India." *Ann. Mag. Nat. Hist.* (3) XVII, p. 153.

Philippines, China, Formosa, Japan and Korea, coast of Queensland and also that of Samoa.

Family SCIAENIDAE.

Genus **SCIAENA** Linnaeus.

The genus *Johnius* (including *Bola*) was restricted to *J. carutta* by Gill.[1] Bleeker proposed to separate those species which had enlarged teeth in the lower jaw from *Sciaena* and wanted to group them under a new genus *Pseudosciaena*,[2] for which he made *S. aquila* (Lacépède) the type. If Bleeker's arrangement be adopted the generic name of the group should for reasons of priority become *Argyrosomus*[3] of De La Pylaie, who founded the latter genus in 1832 on the same species. *Sciaena* is undoubtedly a large genus comprising a great variety of forms which, though differing widely among themselves, form an almost continuous series from one extremity to the other. The inter-relations of these forms have been fully discussed by Jordan and Eigenmann[4] and no useful purpose would be served by upholding the number of these artificial genera. The genus *Sciaena* is now therefore definitely restricted to *Cheilodipterus aquila* of Lacépède.[5] This species thus becomes the type of *Sciaena* which replaces the genera *Argyrosomus* of De La Pylaie and *Pseudosciaena* of Bleeker.[6]

Sciaena coibor (Hamilton Buchanan).

1822. *Bola coibor*, Hamilton Buchanan, *Fish. Ganges*, pp. 78 and 368.
1830. *Corvina albida*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* V, p. 93.
1830. *Corvina anei*, *id*, *ibid.*, p. 131.
1834. *Corvina albida*, Belanger, *Voy. Indes-orientales*, p. 355.
1860. *Johnius anei*, Blyth (not Bloch), *Proc. Asiat. Soc. Bengal*, p. 141.
1863. *Pseudosciaena albida*, Bleeker, *Ned. Tijdschr. Dierk.* I, p. 145.
1865. *Corvina albida*, Day, *Fish. Malabar*, *p.* 54.
1865. *Corvina neilli*, *id.*, *ibid.*, *p.* 55.
1876. *Sciaena albida*, *id.*, *Fish. Ind.*, p. 188, pl. xliv, figs. 4 and 6.
1889. *Sciaena albida*, *id.*, *Faun. Brit. Ind. Fish.* II, p. 117.
1910. *Sciaena albida*, Jenkins, *Rec. Ind. Mus.* V, p. 136.

There is only one specimen in the collection, 462 mm. in length without the caudal fin. It was caught off Barkul Point at the end of November, 1914. Another specimen was reported from Gopkuda in August, 1907. In the Barkul specimen the muciferous pore below the symphysis of the lower jaw (the centrally situated one behind the bluntish knob) is semilunar in shape with a short hanging fold in front, the two lateral pores are deep and elongated and the outer pores are almost slit-like. The barbel between the right corner of the semilunar pore and the right lateral elongated pore is very slender and thin and is only 5 mm. in length

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[1] *Proc. Acad. Nat. Sci. Philadelphia*, 1862 (published 1863), pp. 16-18.
[2] *Ned. Tijdschr. Dierk.* I (1863), p. 145., and *Arch. Néerl. Sc. Nat.* XI (1876), p. 329.
[3] *Compt. Rend. Congr. Sci. France* for 1834 (published 1835), p. 534.
[4] *Bull. U. S. Fish Comm.* for 1886 (published 1889), p. 395.
[5] Lacépède, *Hist. Nat. Poiss.*, Nou. Ed., IV, p. 373.
[6] Jordan, *The Genera of Fishes*, 1917, p. 94.

and is contained three times in the short vertical diameter of the eye. There is a minute (but thick) barbel-like growth near the left lateral pore. The eye is oval, the short vertical diameter is contained in the horizontal diameter one and one-third times. The longer diameter of the eye is contained twice in the interorbital distance.

The fish is an occasional visitor to the lake, appearing in the main area during the flood and also soon after the freshets are over. It grows to four feet and more in length.[1]

Distribution.—Seas of India, coast of Malabar, larger estuaries of the Ganges, and the estuary of the Sittang river; seas of China and the Philippine Islands.

Genus **UMBRINA** Cuvier.

Umbrina indica (Kuhl and Hasselt).

1803. *Labrus sp.* (*qualar katchelee*), Russell, *Fish. Vizag.* II, p. 13, pl. cxviii.
1824. *Sciaena indica,* Kuhl and Hasselt, *Bull. Sci. Nat.* (Ferussac), II, pp. 374 and 377.
1830. *Umbrina russelii,* Cuvier and Valenciennes, *Hist. Nat. Poiss.* V, p. 178.
1830. *Sciaena indica, id., ibid.,* p. 179.
1830. *Umbrina kuhlii, id., ibid.*
1836. *Umbrina russelii,* Cuvier, *Règ. Anim., Poiss.* p. 82.
1846. *Umbrina russelii,* Richardson, *Rep. Brit. Assoc. Adv. Sc.* (1845), p. 226.
1849. *Umbrina russelli,* Cantor, *Journ. Asiat. Soc. Bengal,* p. 1053.
1850. *Umbrina kuhlii,* Bleeker, *Verh. Batavia Gen.* XXIII (5), pp. 4, 5, 11 and 19.
1852. *Umbrina russelli,* Bleeker, *Nat. Tijdschr. Ned. Ind.* III, p. 56.
1853. *Umbrina russelli,* Jerdon, *Madras Journ. Lit. Sci.* XVII, p. 132.
1860. *Umbrina russellii,* Günther, *Cat. Fish. Brit. Mus.* II, p. 278.
1868. *Umbrina russellii,* Kner, *Reis. 'Novara,' Fisch.* p. 131.
1873. *Umbrina russellii,* Day, *Rep. Sea Fish and Fisher,* p. ccl.
1874. *Sciaena russelli,* Bleeker, *Verh. Akad. Amsterdam* XIV, p. 58.
1876. *Umbrina russelli,* Day, *Fish. Ind.,* p. 183, pl. xliii, fig. 4.
1889. *Umbrina russellii, id., Faun. Brit. Ind. Fish.* II, p. 110.
1907. *Umbrina russelli,* Jordan and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 25.
1907. *Umbrina russelli,* Evermann and Seale, *ibid.,* p. 87.
1910. *Umbrina russellii,* Jenkins, *Rec. Ind. Mus.* V, p. 136.

Russell described and figured this fish from Vizagapatam under its local name as a "Labrus with a pentagonal tail." Twenty-one years later Kuhl and van Hasselt redescribed it from a specimen obtained at Java and supplied a name under approved methods and called it *Sciaena indica.* Cuvier and Valenciennes, though acknowledging the name given by them, rechristened the species after the senior author and called it *U. kuhlii* and, thinking it a different species, invented the name *U. russellii* for Russell's species from Vizagapatam. Later writers, finding out the identity of *U. kuhlii* with Russell's species, dropped the name *U. kuhlii,* but did not restore the earlier name. Moreover they copied the inadmissible name with its incorrect spelling. The law of priority demands that the name given by Kuhl and van Hasselt should be restored.

[1] "This is a very beautiful fish, found in the larger estuaries of the Ganges. I saw only one specimen, which was four feet in length; but it is said to grow considerably larger." *Fish. Ganges,* p. 79.

There are altogether eight specimens in the collection. In all the specimens the second ray of the ventral fin ends in a prolonged filamentous extension, similar to that shown in Russell's figure though not mentioned by later authors. The upper ridges over the eyes are black in all the specimens; the upper two-thirds of the anterior dorsal fin is black or ashy brown in many and in some the membrane joining the spines is covered with minute dark brown spots, the other fins having yellow spots; a faint black blotch is noticed on the opercle of almost all the specimens.

The following list shows the different localities in the lake from which the specimens were obtained and their number and size :—

			mm.
1 specimen	Barkul	13th November, 1912	135
1 ,,	Barkul Bay	1st March, 1914	86
2 specimens	Chiriya Island	18th February, 1914	78
1 specimen	Between Maludaikuda and Kalidai	21st September, 1914	53
1 ,,	Samal Island	22nd September, 1913	63
2 specimens	Channel between Satpara and Barnikuda	4th September, 1914	55 & 58

The fish appears to be common in the main area and in the outer channel from September to March, the young ones being found in the outer channel after the floods are over. In all probability the fish is a permanent inhabitant of the lake, breeding in the outer channel. Some of the specimens grunted loudly on being removed from the water.

Distribution.—Seas of India, Bay of Bengal, coasts of Ceylon, Penang, Malay Archipelago, seas of China (Canton) and coasts of the Philippine Islands.

Family GERRIDAE.

Genus **GERRES**,[1] Quoy and Gaimard.

Gerres öyena (Forskål).

1775. *Labrus öyena*, Forskål, *Descr. Anim.*, p. 35.
1788. *Labrus öyena*, Linnaeus and Gmelin, *Syst. Natur.*, (Ed. 13th), I, p. 1287.
1802. *Labrus öyena*, Lacépède, *Hist. Nat. Poiss.* III, p. 463.
1802. *Labrus longirostris*, *id.*, *ibid.*, p. 468, pl. xix, fig. 1.
1802. *Sparus britannus*, *id.*, *ibid.*, IV, pp. 132 and 134.
1827. *Smaris öyena*, Rüppell, *Atl. Reis. Nord. Afrika*, p. 11, pl. iii, fig. 2.
1829. *Gerres öyena*, Cuvier, *Règ. Anim.*, *Poiss.* (2nd Edit.), p. 104.

[1] In 1824 the authors (*viz.*, Quoy and Gaimard) published the "*Voyage autour du Monde*" shortly before the second edition of the *Règne Animal.* In this publication (p. 293) they adopted the genus *Gerres* from Cuvier's manuscript. In 1829 in the second edition of *Règ. Anim.* Cuvier established the genus based on seven species, including *G. öyena.* In 1850, thinking *Gerres* pre-occupied by *Gerris* Fabricius—a genus of Hemiptera (1794), Cantor proposed *Catochaenum* in its place. *Gerres*, being spelled differently from *Gerris*, is not pre-occupied (See *Proc. California Acad. Sci.* (2) V, p. 470.) It should be noted here that the new name *Xystaema* created by Jordan for some species of *Gerres* has been withdrawn by the author (*The Genera of Fishes*, p. 118). Jordan further points out that *Gerres* and *Gerris* are words from different roots. *Podager* proposed as a substitute for *Gerres* [*Natur. Thier. Schul.*, p. ix] is pre-occupied in birds and thus could not replace *Gerres.* [*Proc. Acad. Nat. Sci. Philadelphia*, LXX p. 338 (1918)].

1830. *Gerres öyena*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* VI, p. 355.
1836. *Gerres öyena*, Cuvier, *Règ. Anim.*, *Poiss.* p. 104.
1845. *Gerres öyena*, Bleeker, *Nat. Geneesk. Arch. Ned. Ind.* II, p. 521.
1850. *Gerres öyena*, *id.*, *Verh. Batav. Gen.* XXIII, p. 12.
1859. *Gerres öyena*, Günther, *Cat. Brit. Mus. Fish.* IV, p. 261.
1863. *Diapterus öyena*, Bleeker, *Ned. Tijdschr. Dierk.* I, p. 232.
1866. *Gerres öyena*, Günther, *Fish. Zanzibar*, p. 111.
1875. *Gerres öyena*, Day, *Fish. India*, p. 99, pl. xxv, fig. 4.
1877. *Diapterus öyena*, Bleeker, *Atl. Ichthyol.* VIII, p. 129.
1884. *Gerres öyena*, Klunzinger, *Synops. Fisch. Roth.-Meer*, p. 49.
1889. *Gerres öyena*, Day, *Faun. Brit. Ind. Fish.* I, p. 538.
1890. *Gerres öyena*, Thurston, *Notes Pearl Fish. and Marine Faun. Manaar*, p. 91.
1907. *Xystaema öyena*, Smith and Pope, *Proc. U. S. Nat. Mus.* XXXI, p. 478.
1908. *Xystaema öyena*, Seale and Bean, *ibid.*, XXXIII, p. 244.
1913. *Gerres öeyena*, Weber, *'Siboga'-Exped. Fisch.*, p. 273.
1913. *Gerres öeyena*, Sewell, *Journ. Asiat. Soc. Bengal* (n. s.) IX, p. 344.

Most of the later authors from Cuvier down to Day and Smith have included under the synonymy of this fish, *Gerres equula* of Temminck and Schlegel,[1] which is a distinct Japanese species.[2] *G. equula* is, however, identical with *G. erythroarum* (Bloch).[3] It was first described from Japanese specimens. Both these names therefore have been excluded from the list of synonymy though they are found included in many of the previous lists.

There are altogether three specimens, more or less damaged, measuring in length 76 mm., 77 mm. and 85 mm. without the caudal fin. They were all obtained at Satpara on the 10th October, 1914.

In all probability the fish is not a permanent inhabitant of the lake, but is a casual visitor to the outer channel after floods.

Distribution.—East coast of Africa, Red Sea, seas of India, Malay Archipelago. the Philippines; the Fiji Islands and Japan.

Gerres setifer (Hamilton Buchanan).

1822. *Chanda (?) setifer*, Hamilton Buchanan, *Fish. Ganges*, pp. 105 and 370.
1830. *Gerres lucidus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* VI, p. 477.
1849. *Catochaenum lucidum*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1038.
1853. *Gerres lucidus*, Bleeker, *Verh. Batav. Genoot.*, XXV, p. 40.
1862. *Gerres altipinis* Günther, *Cat. Fish. Brit. Mus.* IV, p. 258.
1867. *Gerres lucidus*, Jouan, *Mém. Soc. Imp. Sci. Nat. Cherbourg* XIII, p. 263.
1875. *Gerres setifer*, Day, *Fish. Ind.* p. 97, pl. xxv, fig. 1.
1875. *Gerres lucidus*, *id.*, *ibid.*, p. 99, pl. xxv, fig. 5.
1889. *Gerres setifer*, *id.*, *Faun. Brit. Ind. Fish.* I, p. 536.
1889. *Gerres setifer*, *id.*, *ibid.*, p. 539.
1910. *Gerres lucidus*, Jenkins, *Rec. Ind. Mus.* V, pp. 131 and 135.
1913. *Gerres lucidus*, Sewell, *Journ. Asiat. Soc. Bengal* (n. s.) IX, p. 344.

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[1] Temminck and Schlegel, *Faun. Japon. Poiss.*, p. 76, pl. xl, fig. 1.

[2] Jordan, Tanaka and Snyder, *Journ. Coll. Sci. Imp. Univ. Tokyo* XXXIII, p. 177, fig. 129.

[3] Bloch, *Ichthyologie* VIII, p. 23, pl. cclxi.

Hamilton Buchanan found this fish in the estuaries of the Ganges and had a drawing made of it which is still preserved in the volume of manuscript drawings (Plate lxvi) in the library of the Asiatic Society of Bengal.[1] The name *Katchanda* is written on the page both in Bengali and Roman characters. This is the local name for the fish. In the absence of the type specimen this manuscript plate becomes the protograph. Hamilton Buchanan doubted the propriety of including it under the genus *Chanda* and suggested its removal to the genus *Coius*. In the drawing also, the number of spines in the dorsal fin is ten and that of rays only nine. *Gerres lucidus* of Cuvier and Valenciennes is described from specimens received from Pondicherry having nine spines and ten divided rays. Günther considers *G. lucidus* as a doubtful species and does not recognise *G. setifer* at all. He, however, described this fish as a new species under the name of *G. altipinnis*, from a specimen from the Ganges, which perhaps was Hamilton Buchanan's type as it was out of a collection presented by G. R. Waterhouse which is suspected to contain some of Hamilton Buchanan's types. Day has admitted both the names *G. setifer* and *G. lucidus* though he was strongly of opinion that they referred to the same species. Jordan[2] on the other hand proposed a new genus, which he styled *Gerreomorpha*, for specimens with ten instead of nine dorsal spines (*viz.*, *G. japonica* and *G. setifer*). Though in other respects quite similar, some of the specimens in the present collection have ten and others nine spines. This is, therefore, a variable character in the species.

There are altogether one hundred and twenty-two specimens in the collection, all obtained during the months of February and March. The species is found during this restricted period throughout the main area as well as in the outer channel of the lake. The following statement shows the different localities whence the specimens were obtained and their number and size :—

			mm.
1 specimen	... Off Barkuda Island ...	17th February, 1914 ...	56
2 specimens	... Off Barkul	1st March, 1914 ...	39 and 44
17 ,,	... Barkul Bay	1st March, 1914 ...	32—54
10 ,,	... Chilka lake ...	... ...	49—98
60 ,,	... Chirriya Island towards Samal Island ...	17-18th February, 1914 ...	28—56
7 ,,	... Off Kalidai	1st March, 1914 ...	31—43
1 specimen	... Between Kalidai and Samal Island ...	20th February, 1914 ...	36
6 specimens	... Off Patsahanipur ...	3-9th March, 1914 ...	18—55
8 ,,	... From Sankuda towards Samal Island ...	17th February, 1914 ...	26—43
7 ,,	... Rambha Bay ...	February, 1914 ...	45—74
1 specimen	... ,, ,, ...	March, 1914 ...	45
2 specimens	... Satpara	7th March, 1914 ...	33—60

The species appears to be a dry-weather visitor to the lake and does not breed in it. It is said to be the most common Indian species, visiting the coasts in enormous numbers and going up the estuaries.

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[1] Chaudhuri, *Mem. Ind. Mus.* V, p. 444.

[2] Jordan, The Gerrid fishes of Japan. *Proc. U. S. Nat. Mus.* XXXIII, p. 247 (1908).

Distribution.—Seas and coasts of India including estuaries, the Malay Archipelago and China.

Gerres punctatus, Cuvier and Valenciennes.

1803. *Zeus* sp. (*wodawahah*), Russell, *Fish. Vizag.* I, p. 52, pl. lxvii.
1803. *Zeus* sp. (*woodan*), *id.*, *ibid.*, p. 53, pl. lxviii.
1830. *Gerres punctatus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* VI, p. 480.
1830. *Gerres filamentosus*, *id.*, *ibid.*, p. 482.
1849. *Catochaenum filamentosum*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1038.
1850. *Gerres filamentosus*, Bleeker, *Verh. Batav. Gen.* XXIII, p. 10.
1853. *Gerres filamentosus*, *id.*, *ibid.*, XXV, p. 40.
1853. *Gerres punctatus*, *id.*, *ibid.*
1859. *Gerres filamentosus*, Günther, *Cat. Fish. Brit. Mus.* I, p. 345.
1859. *Gerres punctatus*, *id.*, *ibid.*, p. 346.
1862. *Gerres punctatus*, *id.*, *ibid.*, IV, p. 260.
1862. *Gerres filamentosus*, *id.*, *ibid.*, p. 261.
1863. *Diapterus filamentosus*, Bleeker, *Ned. Tijd. Dierk.* I, p. 231.
1867. *Gerres filamentosus*, Jouan, *Mém. Soc. Imp. Sci. Nat. Cherbourg* XIII (Ser. 20), p. 263.
1873. *Diapterus punctatus*, Bleeker, *Ned. Tijds., Dierk.* IV, p. 140.
1875. *Gerres filamentosus*, Day, *Fish. Ind.*, p. 98, pl. xxv, fig. 3.
1877. *Diapterus filamentosus*, Bleeker, *Atl. Ichthyol.* VIII, p. 124, pl. ccclxii, fig. 31.
1889. *Gerres filamentosus*, Day, *Faun. Brit. Ind.* I, p. 98, fig. 163.
1903. *Xystaema filamentosus*, Jordan and Evermann, *Proc. U. S. Nat. Mus.* XXV, p. 352.
1904. *Gerres filamentosus*, Fowler, *Journ. Acad. Nat. Sci., Philadelphia* (2) XII, p. 530.
1905. *Xystaema filamentosum*, Jordan, *Stud. Fish.* II, p. 348.
1905. *Xystaema punctatum*, Jordan and Seale, *Proc. U. S. Nat. Mus.* XXVIII, p. 782.
1906. *Xystaema punctatum*, *id.*, *Bull. U. S. Bur. Fish.* XXV, p. 272.
1907. *Xystaema punctatum*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 24.
1908. *Xystaema punctatum*, Seale and Bean, *Proc. U. S. Nat. Mus.* XXXIII, p. 244.
1911. *Xystaema punctatum*, Jordan and Richardson, *Mem. Carnegie Mus.* IV, p. 190.
1912. *Gerres filamentosus*, Snyder, *Proc. U. S. Nat. Mus.* XLII, p. 501.
1913. *Gerres filamentosus*, Weber, *'Siboga'-Exped. Fisch.*, p. 271.
1913. *Gerres filamentosus*, Gilchrist and Thompson, *Ann. S. Afric. Mus.* XI, p. 33.
1917. *Gerres filamentosus*, Hornell, *Madras Fish. Bull.* XI, p. 93.

G. punctatus is evidently the same as *G. filamentosus* (the depth, $3\frac{1}{2}$ in the total length with caudal, in *G. punctatus* is true of the very young stage only till $2\frac{1}{2}$ inches long—in the adult it is 3 or a little less). The name *punctatus* appears in the same work as *filamentosus*, but, being on an earlier page, has priority.[1]

There is only one specimen in the collection, 76 mm. in length, caught near Satpara in October, 1914. The dorsum is brown and the fins are dull yellow (in spirit) and the snout is not black. The specimen possesses an adipose eye-lid.

The species is only a casual visitor to the lake, and does not proceed further inwards than the outer channel.

[1] Jordan and Seale, *Bull. U. S. Bur. Fisher.* XXV, p. 272.

Distribution.—Red Sea, seas of India, Malay Archipelago, Indo-Australian Archipelago, China, Philippines and Formosa.

Genus **LEIOGNATHUS,** Lacépède.

Leiognathus equulus (Forskål).

1758. *Scomber flavescens latitudine ad longitudinem dimidea denticulis piliformibus,* Artedi, *Descrip. Exac. Princ. Curios. Natur. Cab. Seba,* III, p. 75, pl. xxvii, fig. 4.
1775. *Scomber equula,* Forskål, *Descrip. Anim. Pisc.* p. 58.
1785. *Scomber edentulus,* Bloch, *Allgem. Natur. Fisch.,* pl. ccccxxviii.
1788. *Centrogaster equula,* Linnaeus and Gmelin, *Syst. Natur.* (Ed. xiii), I, p. 1337.
1801. *Scomber edentulus,* Bloch and Schneider, *Syst. Ichthyol.* p. 36.
1802. *Caeses equulus,* Lacépède, *Hist. Natur. Poiss.* III, pp. 85, 90.
1803. *Leiognathus argenteus, id., ibid.,* IV, pp. 448 and 449.
1803. *Zeus* sp. (*tottah karah*), Russell, *Fish. Vizagapatam,* I, p. 49. pl. lxii.
1804. *Scomber equula,* Shaw, *Gener. Zool.* IV, p. 596.
1835. *Equula ensifera,* Cuvier and Valenciennes, *Hist. Nat. Poiss.* X, p. 66.
1835. *Equula caballa, id., ibid.,* p. 73.
1836. *Equula ensifera,* Cuvier, *Règ. Anim., Poiss.,* p. 139.
1836. *Equula totta, id., ibid.*
1838. *Equula caballa,* Rüppell, *Neu. Wirbel. Faun. Abyssinien Gehör. Fisch.* (*Roth.-Meer*), pp. 51 and 52.
1848. *Equula serrulifera,* Richardson, *Zool. Voy. 'Erebus' and 'Terror'* II, *Ichthyol.* p. 137, pl. lix, figs. 12 to 14.
1849. *Equula caballa,* Cantor, *Journ. Asiat. Soc. Bengal,* p. 1128.
1851. *Equula caballa,* Jerdon, *Madras Journ. Lit. Sci.,* p. 138.
1852. *Equula ensifera,* Bleeker, *Verh. Bat. Gen.* XXIV, p. 8.
1860. *Equula edentula,* Günther, *Cat. Fish. Brit. Mus.* II, p. 498.
1860. *Equula caballa, id., ibid.,* p. 499.
1863. *Leiognathus edentulus,* Bleeker, *Ned. Tijdsch. Dierk.* I, p. 235.
1865. *Leiognathus edentulus, id., ibid.,* II, p. 148.
1865. *Equula ensifera,* Kner, *Reis. 'Novara,' Fisch.,* p. 166.
1865. *Equula edentula,* Day, *Fish. Malabar,* p. 103.
1866. *Equula edentula,* Playfair, *Fish. Zanzibar,* p. 65.
1869. *Equula ruconius,* Day (not Hamilton Buchanan), *Proc. Zool. Soc. London,* p. 302.
1871. *Equula caballa,* Klunzinger, *Verh. Zool.-Bot. Ges. Wien,* p. 467.
1871. *Equula edentula, id., ibid.*
1873. *Leiognathus edentulus,* Bleeker, *Versl. Akad. Amsterdam* (2) VII, p. 37.
1875. *Leiognathus edentulus, id., Poiss. Madagascar et Réunion,* p. 98.
1876. *Equula edentula,* Day, *Fish. Ind.,* p. 238, pl. lii, fig. 1.
1879. *Leiognathus edentulus, Verh. Akad. Amsterdam* XVIII, p. 18.
1885. *Equula edentula,* Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) II, XXII, p. 88.
1889. *Equula edentula,* Day, *Faun. Brit. India, Fish.* II, p. 186, fig. 65.
1890. *Equula edentula,* Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2) IX, p. 171.
1903. *Leiognathus edentulum,* Jordan and Evermann, *Proc. U. S. Nat. Mus.* XXV, p. 338.
1905. *Leiognathus edentulus,* Fowler, *Proc. Acad. Nat. Sci. Philadelphia* LVII, p. 510.

1906. *Leiognathus edentulus,* Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 273.
1906. *Leiognathus equula,* Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 273.
1907. *Leiognathus edentula,* Evermann and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 69.
1907. *Equula edentula* Lloyd, *Rec. Ind. Mus.,* I, p. 228.
1908. *Leiognathus edentulus,* Seale and Bean, *Proc. U. S. Nat. Mus.* XXXIII, p. 242.
1908. *Equula edentula,* Gilchrist and Thompson, *Ann. S. Afric. Mus.* VI, p. 188.
1911. *Leiognathus edentulum,* Jordan and Richardson, *Mem. Carnegie Mus.* IV, p. 180.
1912. *Leiognathus argentium,* Snyder, *Proc. U. S. Nat. Mus.,* XLII, p. 412.
1912. *Leiognathus edentulus,* Bean and Weed, *Proc. U. S. Nat. Mus.* XLII, p. 604.

Artedi's specific name, although the earliest, being polynomial in form is inadmissible. Cuvier created the genus *Equula*[1], taking *Centrogaster equula* of Linnaeus and Gmelin[2] (which is *Scomber equula* of Forskål) as its type and named his newly created genus, as was his wont, after the specific name of the type, at the same time supplying a new name for the already named species by dropping the old and earliest specific name. Therefore the name of the species should have been *Equula equula,* even if there were any justification for the newly created Cuvierian generic name. Cuvier's objection to "*Leiognathus*" of Lacépède was its etymological meaning, *i. e.,* "toothless." Lacépède in separating the new genus *Leiognathus* from the old genus "*Scomber*" meant to take out all those species which did not possess any conspicuous teeth.[3] Cuvier and Valenciennes contended that as the group thus taken out actually possessed teeth, though minute, the name *Leiognathus* was not only inappropriate but also ineligible and therefore must go.[4] Thus Lacépède's generic name was discarded and Cuvier, after raising the specific name of the first author (*i.e.,* Forskål) to that of a genus, substituted the specific name *caballa* for *equula* of Forskål and *ensifera* for *edentulus* of Bloch, considering these two to be two distinct species and paying no regard to the law of priority. Günther, though he remarked that he had no hesitation [5] in considering the two species as identical, recorded them under different names as distinct species. He, however, restored Bloch's name *edentulus* in place of *ensifera,* but left the Cuvierian name *caballa* for *equula* of Forskål. The argument against the earlier name *Leiognathus* is no longer considered valid, hence the generic name *Equula* is ineligible. It is regrettable that the familiar name of a well-known species must be altered.[6]

There are altogether thirteen specimens in the collection. The fish is found all over the lake, including the outer channel, throughout the year. It is a permanent inhabitant, probably breeding in the lake during the flood-season.

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[1] Cuvier, *Règ. Anim.* (Ed. I), II, p. 323 (1817).

[2] Linnaeus and Gmelin, *Sys. Nat.* III, p. 1337 (1788).

[3] Lacépède, *Hist. Nat. Poiss.* IV, 449.

[4] Cuvier and Valenciennes, *Hist. Nat. Poiss.* X, pp. 60, 61, and 67.

[5] Günther, *Cat. Fish. Brit. Mus.* II, p. 499.

[6] Houttuyn in 1782 reported "*Centrogaster argentatus*" from Nagasaki. (*Verh. Hollandsche Maatsch. Weelen. Haarlem* XX, pp. 311—346). As Houttuyn's descriptions represent the earliest record of Japanese fishes his names must have precedence over all others when his descriptions can be identified. Jordan and Snyder in their "List of Japanese Fishes" point out that it is identical with *Equula nuchale* of Temminck and Schlegel (*Faun. Japonica, Poiss.,* p. 126, pl. lxvii, fig. i), which is one of the commonest of Japanese fishes; but the name should be *Leiognathus argentatum* (*Proc. U. S. Nat. Mus.* XXIII (1901), p. 747) and the name should be restricted to Japanese species. Forskål's name is applicable to the species from the Rea Sea and the Seas of India.

The following statement shows the different localities in the lake whence the specimens were obtained, and their number and size :—

				mm.
2 specimens	... Off Barkul ...	... 9-13th November, 1912	...	25 and 41
2 ,,	... Barkul Bay ...	1st March, 1914	...	37 and 38
1 specimen	... East of Barkul bunglow ...	... 3rd March, 1914	...	28
2 specimens	... Chirriya Island	... 18th February, 1914	...	30 and 32
2 ,,	... Rambha Bay	... February, 1914	...	50 and 54
2 ,,	... ,, ,,	... March, 1914	...	47 and 52
2 ,,	... Satpara ...	... 10th October, 1914	...	51 and 54

Distribution.—Red Sea, seas of India, Malay Archipelago, Australian coasts, New Guinea, Formosa and Japan.

Leiognathus blochii (Cuvier and Valenciennes).

1835. *Equula blochii,* Cuvier and Valenciennes, *Hist. Nat. Poiss.* X, p. 84.
1835. *Zeus notatus, id., ibid.,* (from ms. of Bloch).
1853. *Equula blochii* Bleeker, *Verh. Bat. Gen.* XXV, p. 46.
1865. *Equula blochii,* Day, *Fish. Malabar,* p. 105.
1876. *Equula blochii, id., Fish. India,* p. 241, pl. lii, fig. 3.
1889. *Equula blochii, id., Faun. Brit. India Fish.* II, p. 189.

Bloch named this fish *Zeus notatus* from specimens sent to him from Tranquebar. This name, however, remained in manuscript until it was noticed by Cuvier and Valenciennes [1] who identified Bloch's species with specimens from Malabar. But Cuvier and Valenciennes renamed it, as was usual with them, out of respect for the author who first named the species. Cuvier and Valenciennes were the first to publish Bloch's name along with the new name they substituted for it. Bloch only named the species but did not describe it ; moreover, Bloch's name in its first publication is printed after the name given by Cuvier and Valenciennes. Günther recorded it as a doubtful species,[2] but it is generally regarded to be a valid one and is believed to be restricted to Indian waters. The name given to it by Cuvier and Valenciennes must stand though it is regrettable that Bloch's original name was not adopted.

There are altogether seven specimens in the collection. This fish appears to be a permanent resident in the lake and is found throughout the main area as well as in the outer channel during the dry months.

The following statement shows the different localities where the specimens were obtained and their number and size :—

				mm.
3 specimens	... Barkul Bay ...	... 1st March, 1914	...	35, 40 & 41
1 specimen	... Between Kalidai and Samal Island	... 20th February, 1914	...	32
1 ,,	... South of Kalidai	... 21st February, 1914	...	26
1 ,,	... Kaluparaghat	... ...	...	49
1 ,,	... Satpara ...	... March, 1914	...	57

Distribution.—Seas of India.

[1] Cuvier and Valenciennes, *Hist. Nat. Poiss.* X, p. 84.
[2] Günther, *Cat. Fish. Brit. Mus.* II, p. 498.

Genus **GAZZA**, Rüppell.

Gazza minuta (Bloch).

1788. *Zeus argentarius*, Forster, *Descrip. Animal. Mar. Australis* (ms.)
1795. *Scomber minutus*, Bloch, *Natur. Ausl. Fische*, pl. ccccxxix, fig. 2.
1801. *Zeus argentarius*, Bloch and Schneider, *Syst. Ichthyol.* I, p. 95.
1803. *Zeus* sp. (*komah karah*), Russell, *Fish Vizagapatam* I, p. 60. pl. lxiii.
1835. *Equula coma*, Cuvier and Valenciennes, *Hist. Nat. Poiss.* X, p. 76.
1835. *Equula minuta*, *id.*, *ibid.*, p. 88.
1835. *Equula dentex*, *id.*, *ibid.*, p. 91.
1835. *Gazza equulaeformis*, Rüppell, *Neu.-Wirbelth. Fische*, p. 4, pl. i, fig. 3.
1844. *Zeus argentarius*, Forster and Lichtenstein, *Descr. Anim.*, p. 288.
1845. *Gazza equulaeformis*, Bleeker, *Nat. Geneesk. Arch. Ned. India* II, p. 518.
1849. *Gazza equulaeformis*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1135.
1851. *Gazza minuta*, Bleeker, *Nat. Tijdsch. Ned. India* II, p. 213.
1851. *Equula coma*, Jerdon, *Madras Journ. Lit. Sci.*, p. 138.
1851. *Equula minuta*, *id.*, *ibid.*
1853. *Gazza tapeinosoma*, Bleeker, *Nat. Tijdschr. Ned. India* IV, p. 260.
1860. *Gazza minuta*, Günther, *Cat. Fish. Brit. Mus.* II, p. 506.
1860. *Gazza equulaeformis*, *id.*, *ibid.*
1860. *Gazza argentaria*, *id.*, *ibid.*
1863. *Gazza argentarius*, Bleeker, *Ned. Tijdschr. Dierk.* I, p. 242.
1865. *Equula dentex*, Kner, *Reis. 'Novara,' Fisch.*, p. 170.
1866. *Gazza equulaeformis*, Playfair, *Fish. Zanzibar*, p. 65.
1871. *Gazza argentaria*, Klunzinger, *Verh. Zool.-Bot. Ges. Wien* XXI, p. 467.
1871. *Gazza equulaeformis*, *id.*, *ibid.*, p. 468.
1876. *Gazza minuta*, Day, *Fish. India*, p. 244, pl. liii, fig. 1.
1876. *Gazza aequulaeformis*, *id.*, *ibid.*
1881. *Gazza equulaeformis*, Günther, *Journ. Mus. Godeff.* IV, p. 144.
1881. *Gazza argentaria*, *id.*, *ibid.*, p. 144. pl. xci, fig. B.
1888. *Gazza argentaria*, Day, *Fish. Ind. Suppl.*, p. 790.
1889. *Gazza minuta*, *id.*, *Faun. Brit. India, Fish.*, p. 194, fig. 66.
1889. *Gazza equulaeformis*, *id.*, *ibid.*
1889. *Gazza argentaria*, *id.*, *ibid.*, p. 195.
1903. *Gazza equulaeformis*, Jordan and Evermann, *Proc. U. S. Nat. Mus.* XXV, p. 338.
1905. *Gazza minuta*, Jordan and Seale, *Proc. U. S. Nat. Mus.* XXVIII, p. 777.
1905. *Gazza minuta*, *id.*, *Bull. U. S. Bur. Fisher.* XXV, p. 273.
1905. *Gazza argentaria*, *id.*, *ibid.*
1905. *Gazza equulaeformis*, *id.*, *ibid.*
1905. *Gazza minuta*, Jordan, *Guid. Stud. Fish.* II, 287.
1907. *Gazza minuta*, Smith and Seale, *Proc. Biol. Soc. Washington*, XIX, p. 77.
1911. *Gazza equulaeformis*, Jordan and Richardson, *Mem. Carnegie Mus.* IV, p. 181.
1912. *Gazza minuta*, Bean and Weed, *Proc. U. S. Nat. Mus.* XLII, p. 604.
1913. *Gazza argentaria*, Weber, *'Siboga'-Exped. Fisch.*, p. 270.
1917. *Gazza minuta*, Jordan and Starks, *Ann. Carnegie Mus.* XI, p. 444.
1917. *Gazza equulaeformis*, Hornell, *Madras Fish. Bull.* XI, p. 92.

Weber sinks *G. minuta, G. equulaeformis* and *G. tapeinosoma,* in the synonymy of *G. argentaria,* J. R. Forster (1729–1798), described by him in his *Descriptiones Animalium.* But this work remained in manuscript till 1844 in which year it was published by Lichtenstein. In 1801, Schneider published Bloch's *Ichthyology,* in which Forster's name, *Zeus argentarius,* was first published with his description. Thus the name "*Scomber minuta*" was the earliest, being published in 1795, and has therefore priority.

There is only one specimen in the collection 69 mm. in length. It was secured near Nalbano on 25th November, 1914. Probably the fish is only a casual visitor to the lake.

Distribution.—Zanzibar, Red Sea, East Indian seas, Malay Archipelago, Indo-Australian Archipelago, Polynesia (Samoa), New Hebrides and the Philippines.

Family SCORPIDIDAE.

Genus **MONODACTYLUS** Lacépède.

Monodactylus argenteus (Linnaeus).

1754. *Chaetodon argenteus,* Linnaeus, *Chinens. Lagerstorm. Amoen. Acad.* IV, p. 249, No. 26.
1758. *Chaetodon argenteus, id., Syst. Natur. Ed.* X, p. 272.
1775. *Scomber rhombeus,* Forskål, *Descrip. Animal. Pisc.,* p. 58.
1788. *Chaetodon argenteus,* Linnaeus, *Syst. Natur.* (*Gmelin*), I, p. 1242.
1788. *Centrogaster rhombeus, id., ibid.,* p. 1338.
1800. *Monodactylus falciformis,* Lacépède, *Hist. Nat. Poiss.* II, pl. V, fig. 4.
1801. *Chaetodon argenteus,* Bloch and Schneider, *Syst. Ichthyol.,* p. 230.
1802. *Monodactylus falciformis,* Lacépède, *Hist. Natur. Poiss.* III, pp. 131 and 132.
1802. *Centropodus rhombeus, id., ibid.,* pp. 303 and 304.
1802. *Acanthopodus argenteus, id., ibid.,* pp. 558 and 559.
1803. *Zeus* sp. (*kanki sandwa*), Russell, *Fish. Vizagapatam* I, p. 47, pl. lix.
1803. *Scomber rhombeus,* Shaw, *Gen. Zool.* IV, p. 595.
1830. *Centropodus rhombeus,* Desmarest, *Oeuv. Lacép.* VIII, p. 132.
1831. *Psettus rhombeus,* Cuvier and Valenciennes, *Hist. Natur. Poiss.* VII, p. 245.
1831. *Psettus commersonii, id., ibid.,* p. 250.
1834. *Psettus rhombeus,* Cuvier, *Règ. Anim., Poiss.,* p. 111, pl. xlii, fig. 2.
1834. *Monodactylus rhombeus,* Griffith, *Cuv. Anim. K ngdom* X, pl. lv, fig. 2.
1839. *Monodactylus rhombeus,* Swainson, *Nat. Hist. Fish. Amphib. Rep.* II, p. 212.
1846. *Psettus argenteus,* Richardson, *Rep. Brit. Assoc. Adv. Sci.* (1845), p. 246.
1848. *Psettus argenteus, id., Zool. Voy. 'Erebus' and 'Terror,' Fish.,* p. 57, pl. xxxv, figs. 1-3.
1849. *Monodactylus rhombeus,* Cantor, *Journ. Asiat. Soc. Bengal,* p. 1154.
1853. *Psettus rhombeus,* Bleeker, *Verh. Batav. Genoot.* XXV, p. 40.
1855. *Psettus argenteus, id., Verh. Akad. Amsterdam* II, p. 10.
1855. *Psettus argenteus,* Peters, *Arch. Naturgesch.* p. 247.
1860. *Psettus argenteus,* Günther, *Cat. Fish. Brit. Mus.* II, p. 487.
1860. *Psettus falciformis, id., ibid.,* p. 488.
1863. *Monodactylus argenteus,* Bleeker, *Ned. Tijdschr. Dierk.* I, p. 242.
1865. *Psettus argenteus,* Kner, *Reis. 'Novara,' Fisch.,* p. 164.
1865. *Psettus argenteus,* Day, *Fish. Malabar,* p. 99.
1865. *Psettus falciformis, id., ibid.,* p. 100.

1866. *Psettus argenteus*, Playfair, *Fish. Zanzibar*, p. 64.
1871. *Psettus argenteus*, Klunzinger, *Verh. Zool.-Bot. Ges. Wien* XX, p. 794.
1875. *Monodactylus argenteus*, Bleeker, *Poiss. Madagascar*, p. 65.
1876. *Psettus falciformis*, Day, *Fish India*, p. 234, pl. li A, fig. 6.
1876. *Psettus argenteus*, *id.*, *ibid.*, p. 235, pl. li B, fig. 5.
1876. *Psettus argenteus*, Günther, *Journ. Mus. Godeffroy, Fisch.*, p. 140.
1879. *Psettus argenteus*, Bleeker, *Verh. Akad. Amsterdam*, p. 18.
1880. *Psettus argenteus*, Günther, *Introd. Study Fish.*, p. 448, fig. 199.
1889. *Psettus falciformis*, Day, *Faun. Brit. India, Fish.* II, p. 180.
1889. *Psettus argenteus*, *id.*, *ibid.*, fig. 62.
1905. *Monodactylus argenteus*, Jordan, *Guide Study Fish.* II, p. 398.
1906. *Monodactylus argenteus*, Stead, *Fish. Australia*, p. 133, fig. 49.
1906. *Monodactylus argenteus*, Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, pp. 178 and 237, fig. 30.
1907. *Psettus argenteus*, Lloyd, *Rec. Ind. Mus.* I, p. 227.
1907. *Monodactylus argenteus*, Evermann and Seale, *Bull. U. S. Bur. Fish.* XXVI, p. 32.
1907. *Monodactylus argenteus*, *id.*, *ibid.*, p. 71.
1909. *Psettus argenteus*, Goodrich, *Treat. Zool. Cyclost. Fish.*, p. 432, fig. 440.
1917. *Psettus argenteus*, Hornell, *Madras Fish. Bull.* XI, p. 91.

Jordan and Fowler proposed a new family Platicidae to include the genera *Monodactylus*, *Platax* and *Psettias* (a new genus created by Jordan). This is a small group of fishes of the Asiatic seas related to the Chaetodontidae, but showing differences in the skeleton.[1] In *Monodactylus* and *Psettias* the ventral fins are rudimentary and the body is still deeper in both than in *Platax*. In *Monodactylus* it is less deep than in *Psettias* and is not deeper than long, whereas in *Psettias* it is deeper than long.[2] Commerson proposed to unite three genera of Lacépède, *viz.*, *Monodactylus*,[3] *Centropodus*[4] and *Acanthopodas*,[5] erroneously thinking that these had "no teeth in the palate," under the name of *Psettus*. The mistake is repeated by Günther[6] and Day. Commerson's description of the genus was in manuscript until it was published by Cuvier and Valenciennes in 1831.[7] Moreover, *Monodactylus* has priority, having been created by Lacépède as early as 1802.

There are three specimens in the collection, all caught off the coast of Parikud. The dates of their capture are, however, not recorded. Three specimens measure respectively 85 mm., 89 mm. and 97 mm. in length and all are evidently young as the full grown adults of this bat fish are said to reach a length from 180 mm. to 250 mm. and over. All the three specimens show the orbicular and the opercular dark-brown or black bands characteristic of the young. The disappearance of these in more mature forms and the alteration of proportion of parts consequent on growth have led to the creation of a very large number of species and even a few genera out of this one single fish, as the long list of its synonymy

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[1] Jordan and Fowler, *Proc. U. S. Nat. Mus.* XXV. p. 525.
[2] Jordan and Seale, *Bull. U. S. Bur. Fish.* XXV, p. 236.
[3] Lacépède, *Hist. Nat. Poiss.* III, p. 131.
[4] *Id.*, *op. cit.*, III, p. 303.
[5] *Id.*, *op. cit.*, IV, 558.
[6] Günther, *Introd. Study Fish.*, p. 447 and *Cat. Fish. Brit. Mus.*, II, p. 486.
[7] Cuvier and Valenciennes, *Hist. Nat. Poiss.* VII, p. 240.

proves. The colour of the curved portions of the free anterior ends of the dorsal and the anal fins is dark brown in all the three specimens and that of the pectoral and the caudal fins is dull yellow. The fish is an occasional visitor to the main area of the lake and does not appear to breed in it.

Distribution.—The geographical range of this fish is very extensive; from the Red Sea through the east coast of Africa, Zanzibar and Aden to Indian seas, the Malay Peninsula, the Malay Archipelago, Polynesia (Samoa), seas of Australia and China and the Philippines. It is reported to be most common in Malabar and Coromandel during monsoon months and rather abundant in the harbour of Apia, Port Jackson and Singapore.

FAUNA OF THE CHILKA LAKE.

FISH

PART V.

By Sunder Lal Hora, *D.Sc.*

(With 14 text-figures.)

CONTENTS.

FISH (*PART V*).

By SUNDER LAL HORA.

This part contains a systematic treatment of the divisions Gobiiformes, Zeorhombi, Scombriformes, Jugulares and Scleroparei of the suborder Acanthopterygii and of the sub-order Opisthomi. I have also added a summary of the whole report on the fish of the Chilka Lake.

To the division Gobiiformes are referred 22 species, of which 16 belong to the sub-family Gobiinae, 4 to Eleotrinae, and one each to Periophthalminae and Gobioidinae. I have erected a new genus, closely allied to *Apocryptes*, to accommodate the minute transparent Gobies of the lake and in other genera have found as many as six species hitherto undescribed. I have refrained from naming a species of the genus *Eleotris*, represented by a single, probably immature, specimen. Most of the new species belong to the genus *Ctenogobius ;* others are distributed among the genera *Glossogobius*, *Micrapocryptes* (gen. nov.), and *Taenioides*. The only general feature of the Chilka fish of this family is their small size. Most of the new species hardly exceed a couple of inches in length, while forms like *Ctenogobius minima* and *Micrapocryptes fragilis* are among the smallest known vertebrates.

Belonging to the division Zeorhombi, there are three species representing three families —Bothidae, Cynoglossidae and Soleidae. Of the three species *Cynoglossus brevis* Günther is widely distributed in the lake area and is represented by a large number of specimens. Of the other two, *Pseudorhombus arsius* (Ham. Buch.) and *Synaptura orientalis* (Bl. and Schn.), a few specimens were found in the outer channel or in its immediate neighbourhood, and the species thus appear to be occasional visitors to the lake.

The Scombriformes are represented by two species, *Caranx carangus* (Bloch) and *Equula edentata* (Bloch). The former was found all over the lake, the latter in the main area only. Both are probably permanent residents in the lake.

A single species of Blenny (Jugulares) was found abundantly in different parts of the lake, in which it apparently is endemic. It has already been described by Dr. Chaudhuri [1] under the name *Petroscirtes bhattacharyae*, while Mr. D. R. Bhattacharya[2] has described post-larval stages in its development.

The Scleroparei are represented only by *Platycephalus insidiator*, a common species in Indian seas. A few specimens were taken in the outer channel, to which this species is evidently an occasional visitor.

Mastacembelus armatus was the only species of Opisthomi. It is an occasional immigrant from fresh water in the rainy season.

In preparing my report on these fishes I am greatly indebted to Dr. B. L. Chaudhuri, who had made a preliminary investigation of the specimens before I examined them and had

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[1] Chaudhuri, *Rec. Ind. Mus.* XII, p. 107 (1916).

[2] Bhattacharya, *Mem. Ind. Mus.* V, p. 385 (1916).

separated them into their genera and in some cases into their species. I have to thank Dr. Annandale for suggesting new names and for revising my manuscript.

Family GOBIIDAE.

Sub-family *GOBIINAE*.

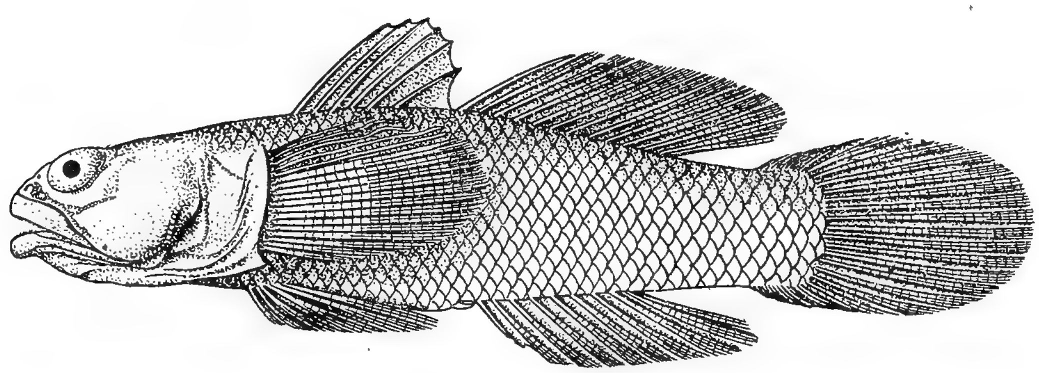
Genus **GOBIUS** Linnæus.

Gobius ostreicola Chaudhuri.

1916. *Gobius ostreicola,* Chaudhuri, *Rec. Ind. Mus.*, XII, p. 105.

1916. *Gobius ostreicola,* Bhattacharya, *Mem. Ind. Mus.*, V, p. 383 (larval stages).

There are altogether six specimens in the collection. They were collected in the months of September and December, 1914, near Manikpatna in the oyster-beds.



TEXT-FIG. 22.—*Gobius ostreicola* Chaudhuri: ×2.

Gobius albopunctatus Cuv. and Val.

1876. *Gobius albopunctatus,* Day, *Fish. India* I, p. 294, pl. lxiii, fig. 7.

Fifteen specimens of this species were collected on the oyster-beds near Manikpatna in December, 1914. The species differs from the others included in the genus in the possession of a distinct emargination at the anterior extremity of the tongue. The emargination is not so deep as it is in the species of *Glossogobius,* from which genus the species can be readily distinguished by the presence of free rays to the pectoral fin.

The emargination of the tongue has been considered to be a character of generic importance but I refrain at present from erecting a new genus for *G. albopunctatus,* because the Indian species that have hitherto been referred to the genus *Gobius* are in need of revision.

Distribution.—The seas of India to the Fiji Islands and Port Essington, Australia.

Genus **GLOSSOGOBIUS** Gill.

Gill[1] defined this genus as follows : " *Glossogobius* has a depressed head, protruding lower jaw, an anteriorly free and deeply emarginate tongue, and several rows of stout teeth in each jaw, the outer of which are hooked backwards." Quite recently the definition has been amplified by Jordon and Snyder,[2] and also by McCulloch and Ogilby.[3] The ampli-

[1] Gill, *Ann. Lyc. Nat. Hist. N. York,* p. 46 (1859).

[2] Jordan and Snyder, *Proc. U. S. Nat. Mus.* XXIV, p. 74 (1902).

[3] McCulloch and Ogilby, *Rec. Austr. Mus.* XII, p. 235 (1919).

fication has been made to include the peculiar structure of the mouth, which is very wide and of the gill-openings, which extend further forwards than in *Gobius*, rendering the isthmus narrow. All these characters are well-marked in the four old species, *G. platycephalus* (Richardson), *G. giuris* (Ham. Buch.), *G. biocellatus* (Cuv. and Val.) and *G. brunneus* (Schlegel), that have been included in this genus. Of the species that have been recently described, the tongue of *G. campbellianus* (Jordan and Snyder)[1] is stated to be "notched" and the "lower jaw slightly projecting." This species has been referred to *Glossogobius* because it possesses "the large mouth, notched tongue and narrow isthmus." It is open to question whether a species which does not possess "protruding lower jaw, an anteriorly free and deeply emarginate tongue" can be included in *Glossogobius*. The remaining species, *G. aglestes* (Jordan and Seale),[2] *G. abacopus* (Jordan and Richardson)[3] and *G. mas.* sp. nov. show typical *Glossogobius* characters.

Glossogobius giuris (Ham. Buch.).

1919. *Glossogobius giuris*, McCulloch & Ogilby, *Rec. Austr. Mus.*, XII, p. 236.

This is one of the most widely distributed species of the genus and is represented by a large number of individuals from different localities in the Chilka Lake. The outline of the tongue is liable to considerable variation. In some individuals a large parasitic Isopod was found inside the mouth cavity and in such examples the tongue was found to be abnormal in that it was swollen and the emargination was feebly indicated.

The following statement shows the different localities whence the specimens were collected and their number :—

5 specimens ...	... Satpara ...	... 10 November 1914.
3 " ...	... Chilka Lake, Orissa	... 31 July 1913.
2 " ...	... Barkul	... 10 September 1914.
4 " ...	... Satpara ...	... March 1914.
4 " ...	... Rambha Bay ...	... February 1914.
1 specimen ...	... Main channel W. of Satpara Island ...	... 16 March 1914.
2 specimens ...	... W. of Satpara ...	... 20 March 1914.
1 specimen ...	... Channel between Satpara and Barnikuda. ...	... 4 September 1914.
1 " ...	... About 1 mile off N.E. of Nalbano Island	... 25 November 1914.

Distribution.—The range of this species extends from the East Coast of Africa, through the seas and fresh waters of India to Malay Archipelago, Australia and beyond.

Glossogobius biocellatus (Cuv. and Val.).

1919. *Glossogobius biocellatus*, McCulloch & Ogilby, *Rec. Austr. Mus.*, XII, p. 237.

There are three specimens in the collection. All of these were collected in the neighbourhood of Barnikuda in early September, 1914. This species occurs near the coasts of India and the range extends to the Malay Archipelago and Australia.

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[1] Jordan and Snyder, *Proc. U. S. Nat. Mus.* XXXIII, p. 542, fig. 2 (1908).

[2] Jordan and Seale, *Proc. U. S. Nat. Mus.* XXVIII, p. 799, fig. 16 (1903).

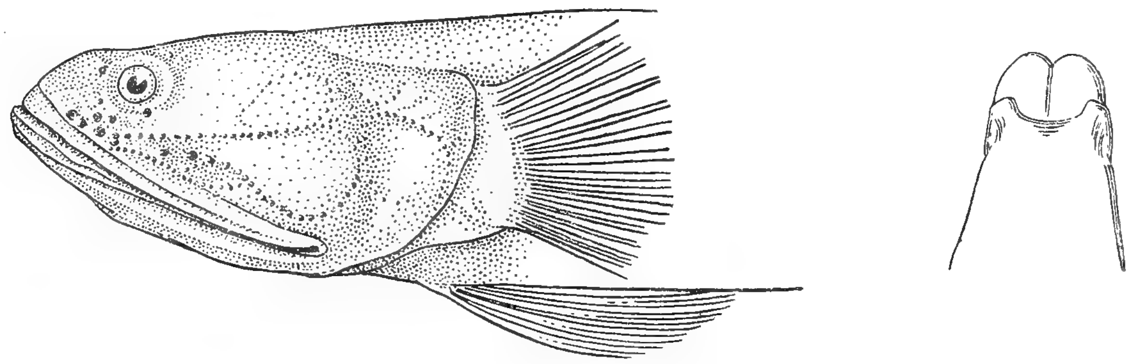
[3] Jordan and Richardson, *Mem. Carnegie Mus.* IV, p. 200, pl. lxxiv (1909).

Glossogobius mas, sp. nov.

D. VI|1/7. A. 7.

To this species I assign six specimens, 4 females and 2 males. There are some differences between the two sexes and I, therefore, propose to describe them separately. The species does not grow more than an inch and a half long.

Male.—The male is thin and slender, with a greatly flattened head. The profiles are slightly arched and the body tapers towards both ends. The head is flat and broad posteriorly, while anteriorly it is constricted and rounded. The snout is bluntly pointed and is slightly longer than the horizontal diameter of the eye. The head is contained 2·7 times



TEXT-FIG. 23.—*Glossogobius mas*, sp. nov.
a. Lateral view of head of a male specimen: ×6.
b. Tongue of same : ×8.

in the length of the fish without the caudal fin ; its depth at the occiput is contained 1·8 times and its breadth 1·6 times in its length. The eyes are small and are situated on the dorsal surface ; they are invisible from below ; their diameter is contained 5·2 times in the length of the head, 1·1 times in length of the snout and 0·9 times in the inter-orbital distance. The depth of the body near the anterior origin of the first dorsal fin is almost half the length of the head.

The mouth is oblique and very wide ; the maxilla reaches as far back as the lower margin of the operculum. The tongue is deeply notched.

The scales are deciduous and as a rule only their basal membranes are present in specimens. There are 24 to 26 scales in a longitudinal series between the angle of the operculum and the base of the caudal fin. The scale is rectangular in outline and is markedly ctenoid. There are a large number of radii proceeding from an eccentric nucleus to the apex. The circular striae are not well-developed and are greatly interrupted in their course.

The second dorsal and the anal fins are small and contain about seven rays each. The pectorals are almost as long as the ventrals and are shorter than the length of the head. The caudal fin is pointed in the middle.

Female.—All the 4 female specimens are full of eggs and consequently the body is deeper and stouter. The chief point of difference from the male is that the mouth is not so wide and the maxillae extend to just behind the posterior margin of the orbit. In all other respects the female agrees with the male.

The colour is rather characteristic. It is reddish brown all over ; the centre of the scales is whitish, while their edges are dotted with black. The under surface of head and body is whitish. The fins have no markings.

Gobius melanosticta Day, a small Goby from the backwaters of Madras, shows great similarity to the female of the new species. The two can, however, be readily distinguished by the number of their fin-rays, their proportions and colouration.

The dissection of a male specimen has not revealed the ripe testes. Possibly the two sexes will ultimately have to be regarded as separate species but I have refrained from describing them as such because the number of specimens at present available is very small.

The following statement gives the number of individuals, their localities and sex :—

4 specimens	... Off Samal Island	... 22 September 1913	3 ♀ & 1 ♂.
1 specimen	... Rambha Bay	... 4 September 1919	♂
1 ,,	... Off Barkul ...	... 2 November 1914	♀

Measurements in hundredths of total length without caudal.

	♂	♀
Total length without caudal	21 mm.	25 mm.
Length of head	37·1	33·2
Depth of head at occiput	20·0	20·4
Breadth of head	25·7	23·6
Length of snout	8·1	8·0
Diameter of eye	7·1	7·2
Interorbital width	6·1	6·4
Depth of body near origin of first dorsal	19·5	32·0
Length of caudal peduncle	28·5	31·2
Height of caudal peduncle	12·3	14·4
Length of caudal fin	26·6	14·0
Length of pectoral fin	29·5	24·0
Length of ventral fin	28·5	16·0
Longest ray of dorsal fin.	22·3	18·0
Longest ray of anal fin	27·6	20·0

Genus **CTENOGOBIUS** Gill.

The genus *Ctenogobius* is well represented in the fauna of the Chilka Lake, for there are as many as seven species in the collection. Four are described here for the first time. With the exception of two species, all are very small and may, therefore, have been overlooked elsewhere by collectors. Some of the species which I now assign to this genus have previously been referred to the genus *Gobius*, from which *Ctenogobius* can be distinguished by the absence of " silk-like free tips to the upper rays of the pectorals "[1] and by their smaller size and totally " different physiognomy."

Ctenogobius acutipinnis (Cuv. & Val.).

1876. *Gobius acutipinnis*, Day, *Fish. India* I, p. 291, pl. lxi, fig. 2.

There are four specimens in the collection, one from Rambha Bay, one from Barkul and the other two from Serua Naddi (September, 1914). The largest specimen is from Rambha Bay and is 41 mm. in length without the caudal.

Distribution.—The seas of India.

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[1] Jordan and Snyder, *Proc. U.S. Nat. Mus.*, XXIV, p. 54 (1902).

Ctenogobius chilkensis (JENKINS).

1910. *Gobius chilkensis,* Jenkins, *Rec. Ind. Mus.* V, p. 137, pl. vi, fig. 2.

There are eighty specimens of this species in the Chilka Survey Collection. Most of them were obtained from the neighbourhood of Nalbano Island. The largest is 35 mm. in length.

This species is only known from the Chilka Lake. Jenkins obtained his specimens from near Gopkuda Island.

Ctenogobius alcocki (Annandale).

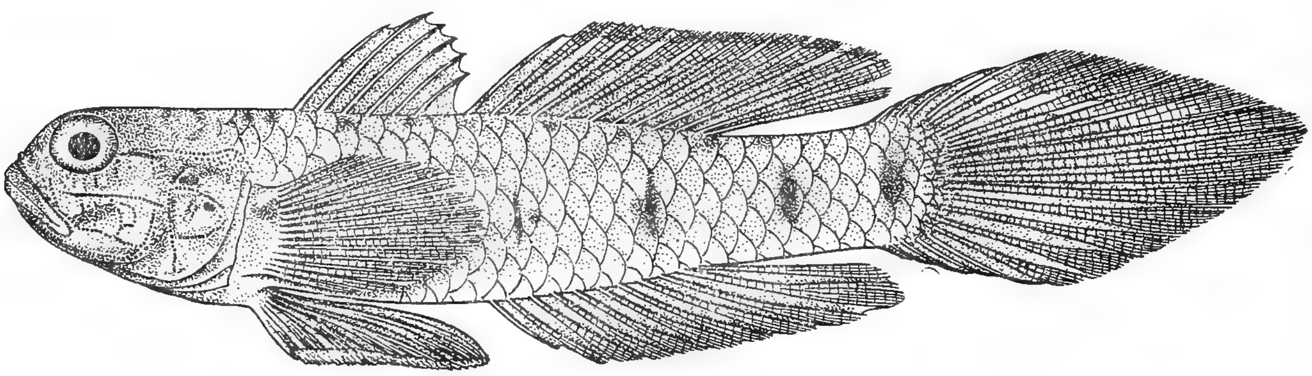
1906. *Gobius alcockii,* Annandale, *Journ. As. Soc. Bengal,* (n.s.) II, p. 201, fig. 1.

This small Gobiid fish was first described from Port Canning and Calcutta by Annandale. It is very common all over the Chilka Lake and is represented by a large number of specimens. There are six spines in the first dorsal fin instead of five, the number given in Annandale's description and figure. A large number of individuals was netted near Barku and specimens were also collected at various other localities in the Lake.

Ctenogobius globiceps, sp. nov.

D. VI|1/11. A. 1/10.

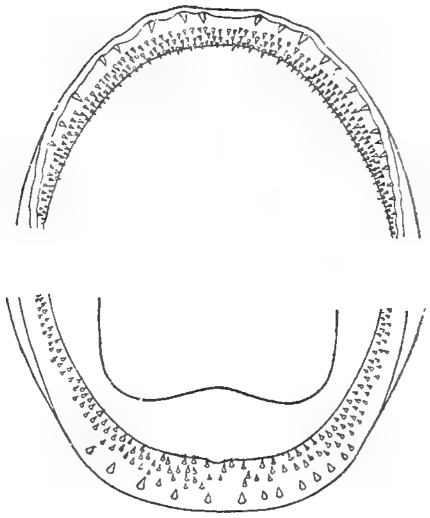
In this new species the body is somewhat compressed from side to side, and the head is almost globular. The dorsal profile is straight and horizontal ; the ventral rises towards both ends from below the middle of the base of the pectoral fin. The head is almost as high as the greatest depth of the body and its length is contained 4 times in the length without the caudal fin. The eyes are big and are situated near the dorsal surface ; they are hardly visible from below. The diameter of the eye is contained 3·3 times in the length of the head. The snout is short and rounded. The anterior pair of nostrils are tubular and are separated from the posterior pair by a short distance. The mouth is small and oblique ; the maxilla reaches to below the anterior $\frac{1}{4}$ of the orbit. The sides of the head are covered by a large number of mucous glands, which are arranged in definite rows.



TEXT-FIG. 24.—*Ctenogobius globiceps*, sp. nov. : ×4.

The anterior dorsal commences immediately above the origin of the pectoral fin and contains six spines ; its commencement is almost equidistant from the anterior origin of the second dorsal and the posterior margin of the orbit. The second dorsal is composed of one spine and eleven rays ; its anterior origin is midway between the base of the caudal and the tip of the snout. The ninth branched ray is the longest and its length is greater than the greatest depth of the body. The pectoral fin is as long as the ventral and is slightly shorter than the head. The anal fin is long and originates behind the commencement of the second dorsal. The penultimate ray is the longest and is longer than the longest ray of the second dorsal. The caudal fin is sharp and pointed in the middle; its length is contained 2·5 times in the length of the fish with the caudal.

The teeth are small and conical and there are several rows of them both in the upper and the lower jaw; those of the outer rows are slightly the longer. The tongue is slightly emarginated.



TEXT-FIG. 25.—Tooth-bands and tongue of *Ctenogobius globiceps*, sp. nov.: ×20.

There are 26 to 27 scales along the lateral line and 5½ series of longitudinal scales between the anterior origin of the second dorsal and the anal fins. The scales are feebly ctenoid.

In spirit the colour is yellowish with 4 or 5 short vertical black bands on the sides of the body. There are a few small black spots on the body above the lateral line. The pelvic fins are blackish, while the others are slightly dusky. There is a white band marking off the tip of the second dorsal fin and obliquely continued on the upper half of the caudal fin. The colour pattern is, on the whole, very characteristic of the species.

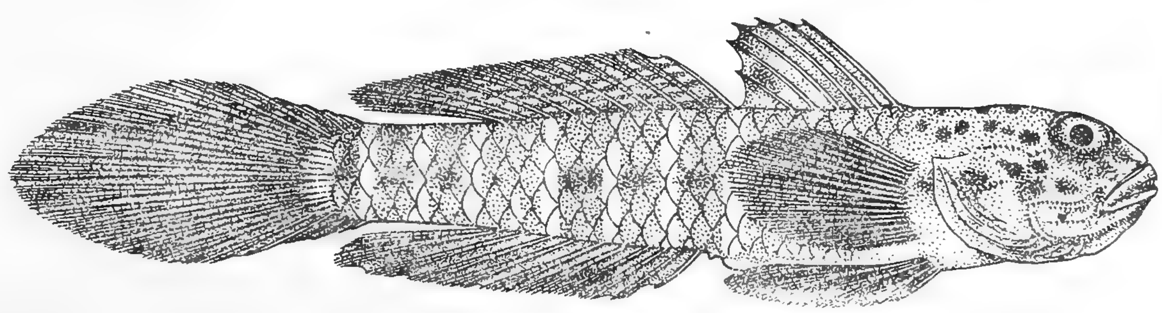
This species is widely distributed in the Chilka Lake and a large number of specimens were obtained from the following localities:—

Off Samal I.; Rambha Bay; Satpara; between Cherriakuda and the mainland; Serua Nadi; Mahosa, Barhampur Island; off Balugaon; off Nalbano; off Barkul bungalow; South of Kalidai.

Ctenogobius cylindriceps, sp. nov.

D. VI|1/9. A. 1/9.

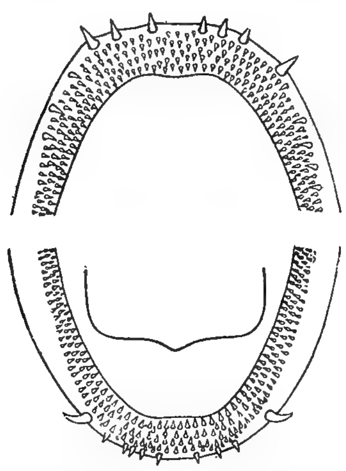
The new species is very common in the Chilka Lake and is represented by a large number of specimens in the collection. It does not grow to more than an inch and a half in length. The dorsal profile is almost straight or slopes gradually down to the base of the caudal fin from the anterior origin of the first dorsal. The head is sub-cylindrical and the body somewhat flattened from side to side. The length of the head is contained 3·7 times in the total



TEXT-FIG. 26.—*Ctenogobius cylindriceps*, sp. nov.: ×4.

length without the caudal and its height at the occiput is almost equal to the greatest height of the body. The eyes are situated near the dorsal surface and are not visible from below; their diameter is slightly greater than the length of the snout and is contained about 3·3 times in the length of the head.

The commencement of the first dorsal fin is almost equidistant from the posterior limit of the orbit and the anterior origin of the second dorsal. The length of the base of the second dorsal is almost equal to the length of the head and it commences immediately behind the membranous base of the first dorsal. The last divided ray is the longest and is as high as the greatest depth of the body. The anal fin originates slightly behind the anterior commencement of the second dorsal and its base is shorter than the length of the head. The last ray of the anal is the longest and is slightly greater than the greatest height of the body. The pectoral fin is short and rounded and is considerably shorter than the length of the head. The pelvic fins are as long as the pectoral and are separated from the anal by a short distance. The caudal fin is contained 2·4 times in the total length without the caudal; it is bluntly pointed behind.

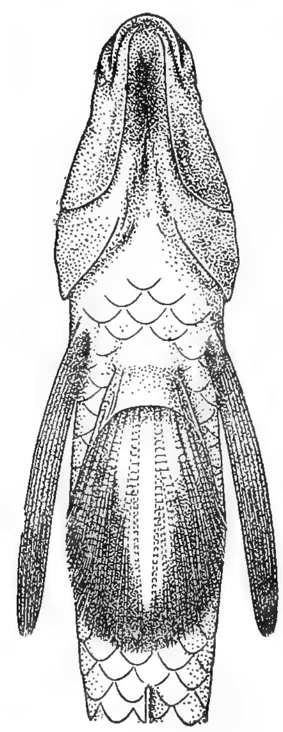


TEXT-FIG. 27.—Tooth-bands and tongue of *Ctenogobius cylindriceps*, sp. nov.: ×20.

The mouth is small, with a somewhat oblique opening; the maxilla just reaches to below the anterior margin of the orbit. There are several rows of minute teeth in both jaws; those of the outer row in the upper jaw and two teeth, one on each side, of the lower jaw are enlarged. The latter have the appearance of canines. The tongue is pointed in the middle.

The scales are comparatively large and firmly set on the body. There are about 25 between the angle of the operculum and the base of the caudal fin. Between the anterior origin of the second dorsal and the anal there are five rows of longitudinal scales. The scales are feebly pectinated. The cheeks and the opercula are naked.

The colouration is very characteristic. In alcohol the sides are dusky with 7 to 11 vertical, narrow, yellowish bands. The upper surface of the head is also dusky, but its lower surface and the under surface of the body are yellowish. The anterior dorsal is covered with minute black spots and there is also a deep black marking on the membrane between the 4th and the 5th spine. The second dorsal is variegated with black and white and the anal is dusky. The pectoral is almost colourless and the pelvic is dark. The upper rim of the caudal is variegated with black and white, while the remaining portion is light grey. There are usually a number of black spots along the lateral line and the last component of the series near the base of the caudal fin is somewhat deeper in colour. There are several rounded black spots on the top and sides of the head. The colour fades in some specimens and the fish assumes a uniform yellow tinge.



TEXT-FIG. 28.—Under surface of head and body of *Ctenogobius cylindriceps*, sp. nov.: $\times 5\frac{1}{3}$.

The new species can be readily distinguished by its characteristic colouration, especially deep black pelvic fins and by its small size. The dentition and the tongue are quite different from those of the preceding species.

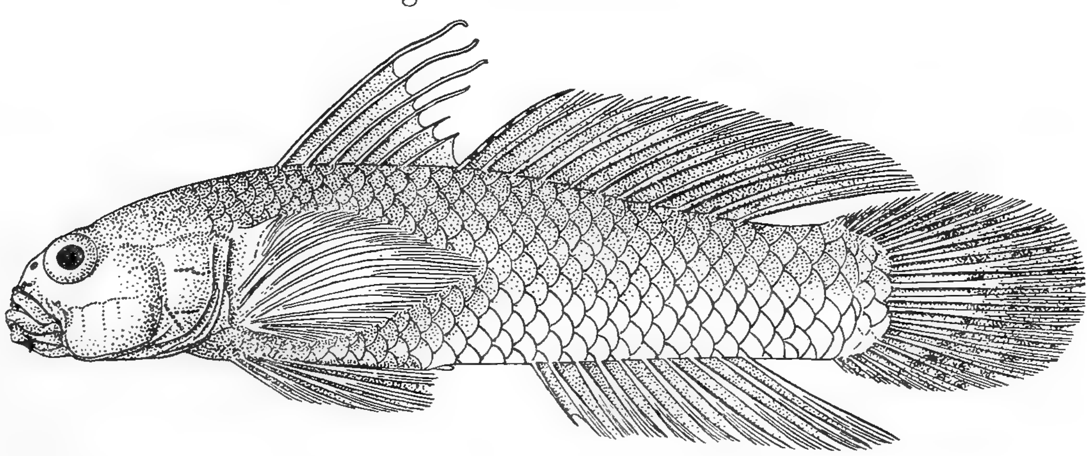
The following statement gives the localities whence the specimens were obtained, and their number :—

9 specimens ...	... Cherria Island	12 February 1914.
26 ,, ...	... Rambha Bay	14 February 1914.
3 ,, ...	... Off Rambha Bay	14 February 1914.
6 ,, ...	... East side of Rambha Bay ...	15 February 1914.
2 ,, ...	... Off Domkuda towards Samal I.	17 February 1914.
4 ,, ...	... Off North side of Samal I. ...	24 February 1914.
1 specimen ...	... East of Barkul	2 March 1914.
1 ,, ...	... Off Barkul Bungalow ...	4 March 1914.
20 specimens ...	... Main Channel, W. of Satpara Island	16 March 1914.
7 ,, ...	... Main Channel between Satpara and Barnikuda. ...	17 March 1914.
2 ,, ...	... Between Mahosa and Satpara	18 March 1914.
12 ,, ...	... Channel between Satpara and Barhampur Islands. ...	22 March 1914.
10 ,, ...	... Between Cherria and Mainland	20 July 1914.
15 ,, ...	... Serua Nadi	4 September 1914.
18 ,, ...	... Channel off Barhampur Island	9 September 1914.
3 ,, ...	... Kalidai W. part of Samalkuda	22 November 1914.
3 ,, ...	... Near Nalbano Island ...	25 November 1914.
1 specimen ...	... East of Barkul	29 November 1914.
21 specimens ...	... About half mile from Parikudh Island	29 November 1914.

Ctenogobius dentifer, sp. nov.

D. VI|1/10. A. 9—10.

There are eight specimens of this species in the collection. Of these six were obtained in Rambha Bay in February 1914, while the remaining two were collected near Satpara and Barnikuda. The fish does not grow to more than two and a half inches in length.



TEXT-FIG. 29.—*Ctenogobius dentifer*, sp. nov. : $\times 2\frac{1}{8}$.

The dorsal profile is slightly arched and the ventral is almost straight and horizontal throughout. The head is flat and somewhat depressed ; the body is compressed from side to side. The length of the head is contained 3·6 times in the total length without the caudal fin. The width of the head is contained 1·2 times and its height 1·5 times in its length. The greatest depth of the body is one-fifth of the total length without the caudal. The eyes are in the anterior half of the head and are situated near the dorsal surface ; they are not visible from below. The mouth is small and has a slightly oblique opening ; the maxilla just reaches to below the anterior third of the orbit. The snout is small and rounded and the margins of the eyes almost meet on the dorsal surface.

The commencement of the first dorsal is in the anterior third of the distance between the tip of the snout and the base of the caudal fin. All the spines are greatly produced ; the third is the longest and reaches to the base of the fifth ray of the second dorsal fin when adpressed. The base of the second dorsal is as long as the length of the head ; the rays increase in length as they proceed backwards. The anal fin commences slightly behind the anterior origin of the second dorsal and ends slightly in front of the end of the second dorsal fin. The rays in the middle of the pectoral fins are greatly elongated and are provided with silky terminations. The pelvic fins are shorter than the length of the head. The caudal fin is slightly longer than the pelvic fins and is rounded posteriorly.

The teeth are arranged in several rows both in the upper and the lower jaws ; those of the outer rows in each are longer and stronger than the others and are somewhat curved inwards near their extremities. In the lower jaw the outer teeth are well-marked and form a formidable series resembling canines.

The scales are large and well-developed. There are 28 to 31 between the angle of the operculum and the base of the caudal fin. Between the anterior origin of the second dorsal and the anal there are 9 series of the longitudinal rows. Scales are absent on the cheeks and the opercula, but on the dorsal surface of the head they are continued up to the margins of the orbits.

On the head there are a number of open pores ; they are arranged along the margins of the opercular bones and on the surface just behind the eyes.

In spirit the colour of the body is yellowish red. The pelvic and the anal fins are dark, while the remaining fins are white near their bases and dusky near their free margins. The snout, sides and under surface of the head are lighter in colour. The most characteristic feature of the colouration is the presence of a deep black spot on the bases of some of the upper pectoral rays.

The new species is readily recognised by its elongate dorsal spines and by the presence of well-developed canine-like teeth.

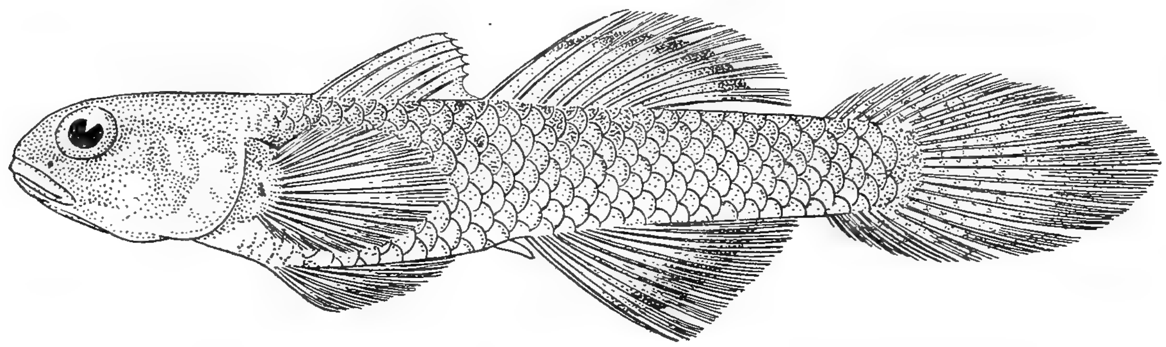
Measurements in hundredths of the total length.

Total length without caudal	40 mm.
Length of head	27·5
Width of head	22·5
Height of head near occiput	18·2
Greatest depth of body	20·0
Diameter of eye	7·5
Length of snout	5·7
Length of caudal peduncle	25·0
Height of caudal peduncle	14·5
Length of caudal fin	25·0
Length of pelvic fin	23·7
Longest ray of second dorsal fin	22·0
Longest ray of anal fin	21·2

Ctenogobius minima, sp. nov.

D. VI|1/7. A. 1/7-8.

This species, the smallest of the Chilka Gobies, is represented by a large number of specimens in the collection. It does not exceed 20 mm. in total length without the caudal fin.



TEXT-FIG. 30.—*Ctenogobius minima* sp. nov. : ×6.

The form is very characteristic ; the dorsal profile is straight and horizontal throughout and the ventral profile bulges most near the base of the pelvic fin. The body is deepest between the bases of the first dorsal and the pelvic ; the chest bulges outwards. The head is broad posteriorly and narrows anteriorly from side to side. The snout is shorter than the diameter of the eye and is rounded at the tip. The length of the head is contained 3·7 times in the length of the body without the caudal fin. The eyes are placed dorso-laterally and are hardly visible from below ; the horizontal diameter of the eye is contained 3·5 times in the length of the head. The mouth is small, with a slightly oblique opening ; the lower jaw is somewhat shorter than the upper. The teeth are minute and the tongue is grooved anteriorly and pointed in the middle. The gill-openings are restricted to the sides and do not extend beyond the base of the pectoral fin. There are four well-marked branchiostegal rays.

The commencement of the first dorsal fin is equidistant from the tip of the snout and the posterior limit of the base of the caudal fin. The anterior origin of the second dorsal is nearer the base of the caudal than the tip of the snout. It contains one spine and seven branched rays ; the fourth or fifth branched ray is the longest, and is almost as high as the greatest depth of the body. The anal fin begins posterior to the commencement of the second dorsal and contains one spine and seven to eight branched rays. The pectoral fin is rounded and is as long as the longest ray of the second dorsal. The pelvic is slightly longer than the pectoral. The caudal is rounded, with a sharp point in the middle.

The body is covered with ctenoid scales, which are firmly set. There are about 25 or 26 between the angle of the operculum and the base of the caudal fin, and six series of longitudinal rows between the bases of the second dorsal and the anal near their anterior origin. The scales are markedly ctenoid, with a large number of radii to the base.

The colour of the body in spirit is light olivaceous ; the margins of the scales in the upper half of the trunk are speckled with minute black dots. The head is also marked with clusters of black dots. In the female the caudal and the dorsal fins are marked with minute dots. The colouration of the male is somewhat different. The edges of the scales and of the head are comparatively darker but the most characteristic feature is the presence of a couple of black bands, one near the margin of the second dorsal and the other near the margin of the anal. The caudal fin is somewhat dusky.

The following statement gives the localities whence the specimens were obtained, their number and sex.

9 specimens ...	... Nalbano Island	6 January 1915.♂
2 ,, ...	... Rambha Bay	September, 1914.♂
1 specimen ...	... Off Balugaon	6 March 1914.♂
27 specimens ...	... Between Cherria I. and mainland.	20 July 1914.♂
1 specimen ...	... Off Kalidai	5 March 1914.♀
1 ,, ...	... N.E. of Nalbano	9 March 1914.♂
2 specimens ...	... Near Manikpatna	7 September 1914.♂
1 specimen ...	... Serua Nadi	8 September 1914.♂
10 specimens ...	... Domkuda and Samal Islands ...	18 June 1914.♀
5 ,, ...	... Near Nalbano	11 September 1914.♀
7 ,, ...	... Off Balugaon	6 March 1914.♀
1 specimen ...	... W. of Satpara	20 March 1914.♀
1 ,, ...	... Mahosa, Barhampur Island ...	20 March 1914.♀
3 specimens ...	... Serua Nadi	8 September 1914.♀
1 specimen ...	... Barkul point	2 March 1914.♀

Genus **OXYURICHTHYS** Bleeker.

Oxyurichthys tentacularis (Cuv. and Val.)

1876. *Gobius tentacularis*, Day, *Fish. India* I, p. 291, pl. lxiv, fig. 4.

This species is represented by a large number of specimens in the Chilka Survey collection. The following statement gives the different localities whence the specimens were collected, and their number.

8 specimens ...	... Channel off Barhampur I. ...	2 September 1914.
4 ,, ...	... Manikpatna Island ...	21 March 1914.
6 ,, ...	... Main channel between Satpara and Barnikuda ...	17 March 1914.
10 ,, ...	... Main Channel W. of Satpara Island	16 March 1914.
1 specimen ...	... Between Cherria I. and mainland	20 July 1914.
27 specimens ...	... Channel between Satpara and Barhampur Islands ...	2 September 1914.
3 ,, ...	... Channel S. of Satpara Island ...	5 September 1914.
6 ,, ...	... Serua Nadi	8 September 1914.

The largest specimen is 65 mm. in length without the caudal.

Distribution.—This species is found in the seas of India and its range extends to the Malay Archipelago.

Genus **APOCRYPTES** Cuv. and Val.

Apocryptes rictuosus (Cuv. & Val.).

1876. *Apocryptes rictuosus*, Day, *Fish. India*, I, p. 300.

There are four specimens in the collection, the largest of which is 69 mm. in length. The species is readily distinguished by the presence of a well-marked black ocellus on the last few dorsal rays. The caudal fin is marked with a number of faint brownish bands.

The following statement gives the different localities whence the specimens were collected and their number and size :—

1 specimen ...	Main channel west of Satpara Island ...	16 March 1914 ...	62 mm.
2 specimens ...	Channel between Satpara and Barhampur Islands.	...	69 & 56 mm.
1 specimen ...	Barkul	18 September 1914	45 mm.

Distribution.—The seas and estuaries of India.

Apocryptes lanceolatus (Bl. & Schn.).

1876. *Apocryptes lanceolatus*, Day, *Fish. India*, I, p. 301, pl. lxiv, fig. 5.

This species is represented by a single specimen in the collection. The specimen was obtained in the South Bay of the lake and is 168 mm. in length.

Distribution.—The seas of India, extending to the Malay Archipelago.

Genus **MICRAPOCRYPTES,** nov.

The new genus resembles *Apocryptes* Cuv. and Val. in the structure of the teeth, at any rate in the adult male, but exhibits sexual dimorphism in this respect. It is chiefly distinguished by the small size and hyaline tissues of the fish and by the moderately compressed and elongate form. The tongue is notched in the middle and the scales are feebly ctenoid.

The type-species is *Micrapocryptes fragilis,* sp. nov. from the Chilka Lake and the Gangetic delta.

To this genus I refer *Apocryptes brachypterus* Bleeker[1] from Java. It is said to occur in the lake Grati (Province of Pasuruan). Günther[2] was of opinion that this species had more affinity to his genus *Latrunculus* than to the typical species of *Apocryptes. Micrapocryptes* differs from *Latrunculus* in the possession of feebly ctenoid scales, which are firmly set on the body, in its small size and the small mouth-opening. The dentition is also different in the two genera.

Micrapocryptes fragilis, sp. nov.

The species consists of small transparent Gobies, in which the body is but moderately elongated and the form is compressed from side to side. The dorsal profile is slightly arched and the ventral rises to the base of the caudal fin from just below the beginning of the dorsal. The head is elongated and bluntly pointed. The caudal peduncle is somewhat constricted and in this region both the dorsal and the ventral profiles are almost straight and parallel.

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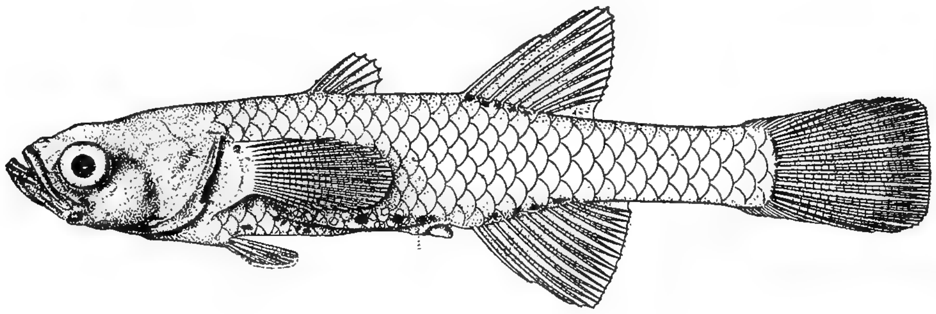
[1] Bleeker, *Nat. Tijdschr. Ned. Ind.* IX, p. 401 (1885).

[2] Günther, *Cat. Brit. Mus. Fish.* III, p. 80 (1861).

The measurements in hundredths of the length without the caudal fin are as follows: the length of head 25·3—27·6%, the depth of the body 19·6—22·2%, the length of the



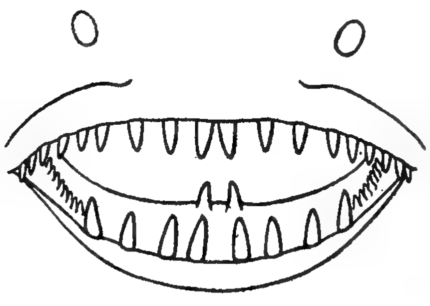
TEXT-FIG. 31.—*Micrapocryptes fragilis*, gen. et sp. nov.: ×4.

snout 4·4—5·5%, the horizontal diameter of the eye 5·5—6·8%, the length of the pectoral fin 19·5—21·6%, the length of the pelvic fin 9·5—11·1%, the length of the caudal fin 17·6—20·4%, the least height of the caudal peduncle 10·4—13·8%, the length of the caudal peduncle 24—27·6%, the width of head 17·6—18·1% and the depth of head at occiput 17·6—18·1%.

The distance between the anterior origin of the first dorsal fin and the tip of the snout is equal to the distance between the anterior origin of the second dorsal and the base of the caudal. The distance between the anterior origin of the first dorsal and the anterior origin of the second dorsal is almost equal to twice the depth of the caudal peduncle. The anterior origin of the anal, which is situated slightly behind the origin of the second dorsal, is almost midway between the tip of the snout and the posterior margin of the caudal. The distance between the origin of the pelvic and the tip of the snout is equal to the distance between the last ray of the second dorsal and the base of the caudal. The base of the anal is longer than the base of the second dorsal and is almost equal to twice the diameter of the eye. The least height of the caudal peduncle is equal to the length of the pelvic and is half the depth of the body below the anterior origin of the first dorsal fin.

The eyes are prominent and are situated on the sides; they bulge outwards and are visible from above as well as from below. The postorbital region of the head is almost equal in length to the remaining portion, and is twice the horizontal diameter of the eye. The snout is shorter than the diameter of the eye. The mouth is oblique and is turned upwards; the lower jaw is longer than the upper. The gape of the mouth reaches to below the anterior margin of the orbit.

The teeth show considerable variation with the sex and the age of the individuals. The structure of teeth is exactly alike in the young of both sexes. In both jaws there are a number of small conical teeth. They are minute and closely fitted together and their number is rather difficult to determine. They project very little beyond the jaws and, indeed, to the naked eye the jaws appear edentulous. The teeth are developed in very young specimens but it is only with great difficulty that the two canines on the mandibular symphysis can be made out. As the sexes mature, the teeth of the female do not undergo any appreciable change and continue to be just as in the young condition. In a ripe male, however, the dentition is absolutely different. Instead of

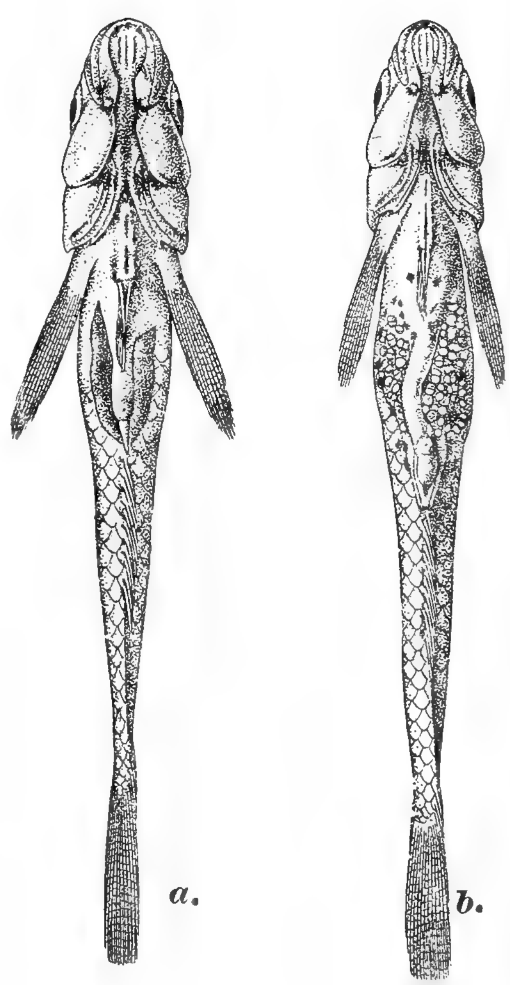


TEXT-FIG. 32.—Tooth-bands of *Micrapocryptes fragilis*, gen. et. sp. nov.: ×18.

the minute set of teeth, there are developed in both jaws a number of comparatively large conical teeth, which are distinctly visible to the naked eye. In the upper jaw there are about nine teeth on each side and they diminish in size as they recede from the middle of the jaw towards the angle of the mouth. In the lower jaw the big teeth are developed only in the middle and there are usually four of these of almost equal length on each side. The big teeth in both the jaws are separated from each other. Near the angles of the mouth on each side in the lower jaw are a number of minute, closely set teeth. These probably represent the dentition of the young individual. The canines become very conspicuous and are curved near their extremities.

In the development and structure of the teeth the Indian transparent Goby runs almost the same course as has been described by Collett[1] for the two European transparent Gobies (*Aphia pellucidus* and *Crystallogobius nilssoni*). I have not, however, been able to determine in this new form all those points which have been so ably discussed by Collett for the European genera.

The first dorsal fin consists of five weak spines none of which is longer than the diameter of the eye. The second dorsal consists of a spine and from seven to eight branched rays. The second branched ray is the longest and its height is greater than the depth of the body. The spine is as high as the length of the base of the second dorsal. The anal consists of one spine and from ten to eleven branched rays; the second branched ray is the longest and is equal in length to the depth of the body immediately below the first branched ray of the second dorsal. The pectoral is as long as the longest ray in the second dorsal; it usually contains thirteen to fourteen rays and its posterior extremity is rounded. The pelvic is situated on a raised area and begins immediately below the base of the pectoral. The fins are united for a considerable length and form a regular funnel-shaped tube. The caudal is truncate and consists of thirteen rays besides a number of smaller rays on the sides.



TEXT-FIG. 33.—Under surface of male and female of *Micrapocryptes fragilis*, gen. et sp. nov.
a. Male: $\times 5\frac{1}{3}$. *b.* Female: $\times 4$.

The scales are of moderate size; but they are extremely thin and are hardly distinguishable with the naked eye. There are 27 between the angle of the operculum and the base of the caudal fin. There are seven in an oblique line between the anterior origin of the anal fin and the base of the second dorsal. The scales are firmly set together. Under the microscope a series of small spines is seen along the posterior border of every scale, but I have not been able to make out any definite striae in the central portion. In a microscopic prepara-

[1] Collett, *Proc. Zool. Soc. London*, pp. 318—339 (1878).

tion the muscle fibres are seen running longitudinally underneath the scales. Except for these and certain other irregular interrupted markings I have not been able to make out any special structure.

The gill-openings extend for only a short distance on the under surface and the isthmus is of moderate width.

The anus is situated a short distance in front of the anal fin and this distance is almost equal to the diameter of the eye. In both sexes a prominent anal papilla is present and the gonads can be seen through the tissues of the body-wall. These facts are apt to give a wrong impression that the male carries eggs in its brood-pouch.

In the living condition the fish is transparent with a yellowish tinge. In the region of the heart and the main blood vessels the colour appears to be reddish owing to the transparent skin and body muscles. There are a series of black spots along the back and on the under surface from the origin of the anal to the base of the caudal. There are a few black spots irregularly scattered on the sides of the body as well. In alcohol the fish becomes opaque and takes on a light olivaceous tinge; the black spots are distributed as before. In the ripe females the skin in the region of the ovaries becomes deeply pigmented with a black colour. The tip of the lower jaw on the under surface is dark brown.

The new species closely resembles *Apocryptes brachypterus* Bleeker[1] from the Grati Lake in the province of Pasuruan, Java. I have not been able to consult the original description of this species and, therefore, I refer for relationships to Günther's[2] description of *A. brachypterus*. The Indian form differs from the Java species in the following characters :—

(*i*) The number of anal fin rays in the Indian form never exceeds 12, while in *M. brachypterus* it is stated to be 13.

(*ii*) In the new species the number of scales along the lateral line is 27, while in *M. brachypterus* it is 25.

(*iii*) The eyes in *M. fragilis* are more than one-fourth of the length of the head, whereas in the Javanese species the diameter of the eye is contained four times in the length of the head.

(*iv*) In *M. brachypterus* there are only sixteen teeth in the upper jaw whereas in the new species they are eighteen.

(*v*) The structure and arrangement of teeth on the lower jaw is totally different in the two species.

The following statement gives the different localities whence the specimens were collected and their number :—

Numerous specimens ...	... Baliaghata Canal, outskirts of Calcutta ...	... 17 July 1916.
1 specimen ...	... 1·9 miles N.E. of Kalidai	... 8 March 1914.
1 „ ...	... Off Balugaon ...	... 6 March 1914.
4 specimens ...	... East of Barkul ...	... 29 November 1914.

[1] Bleeker, *Nat. Tijdschr. Ned. Ind.* IX, p. 401 (1855).

[2] Günther, *Cat. Brit. Mus. Fish.* III, p. 84 (1861).

Measurements in hundredths of total length without caudal fin.

	♂	♀
Total length (without caudal fin)	18 mm.	22·1 mm.
Length of head	27·6	25·3
Depth of body	22·2	19·6
Length of snout	4·4	5·5
Depth of head at occiput	17·6	18·1
Width of head	17·6	18·1
From tip of snout to anterior limit of second dorsal fin ...	51·1	59·5
Length of pectoral fin	21·6	19·5
Length of pelvic fin	11·1	9·5
Length of caudal fin	17·6	20·4
Diameter of eye	5·5	6·8
Length of caudal peduncle	27·6	24·0
Height of caudal peduncle	13·8	10·4

Sub-family *ELEOTRINAE.*

Genus **ELEOTRIS** Gronovius.

Eleotris cavifrons Blyth.

1860. *Eleotris cavifrons*, Blyth, *Journ. As. Soc. Bengal* XXIX, p. 145.
1876. *Elotris cavifrons*, Day, *Fish. India* I, p. 313, pl. lxv, fig. 6.

This species is represented in the Chilka Survey Collection by a single specimen, which was collected near Satpara. The species has so far been known from the Andamans, where it is said to grow to 4 inches in length. The Chilka Lake specimen is 37 mm. in total length without the caudal.

Eleotris fusca (Bl. & Schn.).

1876. *Eleotris fusca*, Day, *Fish. India* I, p. 313, pl. lxv, fig. 7.

Of this species there are four specimens in the collection. The largest example is about 7 cm. in total length including the caudal. Two of these were obtained near Satpara, one near Barkul and the other one from near Mahosa.

Eleotris fusca is found all along the Indian Coast and its range extends to the Malay Archipelago. It is also met with along the African coast and is stated to ascend rivers for a considerable distance.

Eleotris sp.

There is a small specimen of the genus *Eleotris*, from Mahosa near Barhampur Island, which I have not been able to refer to any known species of the genus. I have refrained from naming it on account of the immaturity of the specimen. A short description of it is given below to facilitate reference in future.

The specimen is 23·5 mm. in total length without the caudal. The head is broad posteriorly but tapers towards the anterior end and the snout is almost sharp and pointed. The length of the head is contained about 3 times in the total length without the caudal. The horizontal diameter of the eye is shorter than the length of the snout and is contained 4·3 times in the length of the head. The eyes are situated in the anterior half of the head and are not visible from below. The mouth is small and the maxilla just reaches to below the anterior margin of the orbit. The lower jaw is slightly the longer and is turned upwards. The gill-openings extend on the under surface for a short distance. The preopercular spine is curved and is turned downwards and forwards. There are 9 weak rays in the second dorsal and 10 in the anal.

In spirit the colour is reddish yellow with a large number of minute black dots scattered all over the body. These dots are aggregated near the upper margin of the base of the pectoral fin and on the whole of the caudal fin, rendering them dusky. The under surface of the head and belly is somewhat whitish.

Measurements in hundredths of the total length without the caudal fin.

Total length excluding length of caudal	23·5 mm.
Length of head	33·1
Height of head near occiput	18·2
Width of head	22·1
Length of snout	8·5
Diameter of eye	7·6
Interorbital width	5·5
Length of caudal peduncle	30·6
Height of caudal peduncle	13·6
Longest ray of dorsal fin	14·8
Longest ray of anal fin	15·3
Length of pectoral fin	26·4
Length of pelvic fin	17·1
Length of caudal fin	22·1

Genus **BUTIS** Bleeker.

Butis butis (Ham. Buch.).

1876. *Eleotris butis*, Day, *Fish. India* I, p. 315, pl. lxvii, fig. 3.

This species is represented by a single specimen in the Chilka Survey Collection. It is 52 mm. in length without the caudal. It is known to occur in the seas and estuaries of India and its range extends to the Malay Archipelago.

Sub-family *PERIOPHTHALMINAE.*

Genus **PERIOPHTHALMUS** Bloch & Schneider.

Periophthalmus koelreuteri (Pallas).

There is only one specimen of this species, obtained near Manikpatna Island in March, 1914. It is 43 mm. in length without the caudal. The species is common on the coasts of India and in estuaries and is said to ascend tidal rivers.

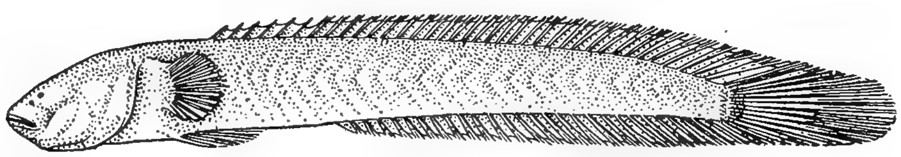
Sub-family *GOBIOIDINAE.*

Genus **TAENIOIDES** Lacépède.

Taenioides chilkensis, sp. nov.

This new species is represented by a large number of individuals from various localities in the Chilka Lake. It does not grow to a very large size, hardly exceeding $2\frac{1}{2}$ inches in length without the caudal fin.

The body is compressed from side to side and both the dorsal and the ventral profiles slope gradually down to the base of the caudal fin. In most cases the head is deeper than the body. The eyes are minute but distinguishable and are situated in the anterior third of the length of the head. The mouth is small and is turned upwards. The lower jaw is longer than the upper.



TEXT-FIG. 34.—*Taenioides chilkensis*, sp. nov.: $\times 1\frac{1}{2}$.

The length of the head is contained 5·4 times in the total length of the fish without the caudal and the height of body from 6·6 to 7·5 times. The head is 1·2 times as long as broad and 1·3 times as long as high. The snout is a little over one fourth of the length of the head.

The vertical fins are continuous; the dorsal fin commences immediately behind the pectoral and contains 6 spines and 31 or 32 rays. The anal fin is also very long and contains 27 to 29 rays. The pectoral fins are short and are provided with strong muscular bases. The pelvic fins are much longer than the pectorals. The caudal fin is longer than the head and contains about 15 rays; it is greatly produced in the middle.

There are several rows of sharp minute teeth both in the upper and the lower jaws. No scales are seen on the body even with the help of a lens.

The colour in spirit is dull olivaceous gray all over with the exception of the fins, which are whitish. There are no special markings on the body.

The following statement gives the localities whence the specimens were obtained and their number :—

5 specimens ...	... Satpara	September 1913.
1 specimen ...	... Channel off Barhampur Island	2 September 1914.
4 specimens ...	... Main channel between Satpara and Barnikuda ...	17 March 1914.
5 ,, ...	... Main Channel west of Satpara.	16 ,, 1914.
11 ,, ...	... Channel between Satpara and Barhampur Islands ...	22 ,, 1914.
14 ,, ...	... Serua Nadi	4 September 1914.

Measurements in millimetres.

Total length excluding length of caudal	52	49
Length of head	9·5	9
Height of head near occiput	7	7
Width of head	8	8·2
Length of snout	2·5	2·7
Length of caudal fin	10·5	9
Length of pectoral fin	3·8	3·8
Length of pelvic fin	5	5
Greatest height of body	7·8	6·5

The new species differs from all the other known Indian species of the genus in its small size, in the fewer number of rays in the vertical fins and in having different proportions.

Family BOTHIDAE.

Genus **PSEUDORHOMBUS** Bleeker.

Pseudorhombus arsius (Ham. Buch.).

1878. *Pseudorhombus arsius*, Day, *Fish. India* II, p. 423, pl. xci, fig. 5.

The four specimens of this species were collected from three localities, one from Parikudh, two in Serua Nadi and the remaining one in the channel between Barnikuda and Satpara. The largest specimen is 24 cm. in length including the length of the caudal fin.

There has always been a certain amount of confusion between this species and *Pseudorhombus russelli* (Gray), which was figured as *Platessa russellii* in the *Illustrations of Indian Zoology* on plate 94 without any description. Subsequently Günther[1] described it from the type and several other specimens from China, the East Indian Archipelago, Bengal and other places. Day,[2] who had previously regarded *P. russelli* as distinct from *P. arsius*, in his later work (*op. cit.*) considered the former to be synonymous with the latter. Several ichthyologists such as Castelnau,[3] Macleay,[4] Klunzinger,[5] Boulenger[6] and Sauvage,[7] who came after Day, recorded *P. russelli* from widely different localities without comment and without any reference to *P. arsius*. I have carefully compared Günther's description of *P. russelli* with an original manuscript drawing of Buchanan's *P. arsius*. I am of opinion that the two are identical, the latter representing an immature specimen, while the former is based on an adult. Day has already shown the variation which the members of this species exhibit as regards the number of fin-rays and scales along the lateral line.

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[1] Günther, *Cat. Brit. Mus. Fish.* IV, p. 424 (1862).

[2] Day, *Proc. Zool. Soc. London*, p. 287 (1865); *ibid.*, p. 523 (1869); *ibid.*, p. 698 (1870).

[3] Castelnau, *Proc. Linn. Soc. N. S. Wales* III, p. 391 (1878).

[4] Macleay, *ibid.* II, p. 362 (1878).

[5] Klunzinger, *Sitzungsb. K. Acad. Wiss. Wien* LXXX, p. 406 (1880).

[6] Boulenger, *Proc. Zool. Soc. London*, p. 665 (1887).

[7] Sauvage, in Grandidier's *Hist. Nat. Madagascar* XVI, p. 473 (1891).

The following are the measurements and the number of fin-rays in the manuscript drawing of Hamilton Buchanan's *P. arsius*, now preserved in the library of the Asiatic Society of Bengal :—

Total length, including length of caudal fin	68·5 mm.
Length of caudal fin	13·0 ,,
Length of head	17·0 ,,
Greatest depth of body	27·7 ,,
Length of pectoral fin of left side	8·6 ,,
Length of pectoral fin of right side	5·9 ,,
Length of ventral fin	5·8 ,,
Longest diameter of upper eye	3·3 ,,
Longest ray of dorsal	8·8 ,,
Longest ray of anal	6·5 ,,
No. of rays in dorsal	86
No. of rays in anal	55
No. of rays in caudal	15
No. of rays in ventral	5

Pseudorhombus arsius extends from the east coast of Africa, through the seas and estuaries of India, to Australia and China.

Family SOLEIDAE.

Genus **SYNAPTURA** Cantor.

Synaptura orientalis (Bl. & Schn.).

1878. *Synaptura orientalis*, Day, *Fish. India* II, p. 429, pl. xciii, fig. 4; pl. xciv, fig. 2.

In the collection from the lake there is only one specimen about 17·6 cm. in length including the caudal fin. It was collected near Parikudh.

There are 67 rays in the dorsal fin and 51 in the anal. The number of scales along the lateral line is 91. The depth of the body is contained about two and a half times and the length of the head five and a half times in the total length includingthe length of the caudal fin. The scales in the anterior part of the head on the blind side and also those along the gill-openings on both sides have their ctenoid processes greatly produced and the body surface in that region appears as if covered with soft cutaneous filaments. The scales of this type have already been figured by Gilchrist[1] for his species, *Synaptura ciliata*. In *S. orientalis* the processes are much longer than those figured for *S. ciliata*. In addition to these there are tufts of black hair-like filaments coming out from between the scales on the coloured side.

S. orientalis is found in the seas of India and China.

The following are the measurements of the Chilka Lake specimen in millimetres.

Total length, including length of caudal	176·0
Length of caudal	23·5
Length of head	31·2

[1] Gilchrist, *Mar. Invest. South Africa* III, p. 14, pl. xxxiv (1905).

Diameter of lower eye	4·5
Length of pectoral fin of right side	12·0
Length of pectoral fin of left side	9·0
Longest ray of dorsal	14·0
Longest ray of anal	13·5
Greatest depth of body	71·0
Length of pelvic fin	8·5

Family CYNOGLOSSIDAE.

Genus **CYNOGLOSSUS** Hamilton Buchanan.

Cynoglossus brevis Günther.

1862. *Cynoglossus brevis,* Günther, *Cat. Brit. Mus. Fish.* IV, p. 500.

1878. *Cynoglossus brevis,* Day, *Fish. India* II, p. 437, pl. xcvii, fig. 2.

There are sixty specimens of this species in the collection. It has so far been known from the river Hughli at Calcutta and is mainly a brackish water form. There is, however, one specimen in the old collection of the Indian Museum obtained by the Marine Survey from along the Orissa Coast (off Chilka Lake).

The colour varies greatly with age. In the young there are several short black bands on the body, which with the growth of the fish become thinner and more numerous and ultimately produce a reticulum in the adult. There is one very characteristic feature of the species, that several rays of the vertical fins at intervals are dark in colour.

The longest specimen is about 14·5 cm. in length including the caudal fin.

The list given below shows the place and time of occurrence of the species in the lake :—

1 specimen	Gopkuda Bay	14 February 1914.
1 ,, ...	Off Barkuda I.	17 February 1914.
1 ,, ...	South of Kalidai ...	21 February 1914.
1 ,, ...	Chirria I. Bay	23 February 1914.
1 ,, ...	¼ mile off Kalidai ...	1 March 1914.
3 specimens ...	1 mile South of Kalidai ...	1 March 1914.
3 ,, ...	Off Barkul Bay	1 March 1914.
4 ,, ...	Salari to Gantasila ...	3 March 1914.
4 young	West of Satpara I. ...	20 March 1914.
3 ,, ...	Shore of Mahosa	20 March 1914.
13 specimens ...	Channel between Satpara and Barhampur I.	2 September 1914.
5 ,, ...	Channel off Satpara ...	2 September 1914.
14 ,, ...	Channel off Barhampur I. ...	2 September 1914.
24 ,, ...	Channel between Satpara and Barnikuda	4 September 1914.
1 young	Island near Manikpatna ...	7 September 1914.
1 specimen	Serua Nadi	8 September 1914.
1 ,, ...	About 8 miles South-East of Kalupara	16 September 1914.
1 ,, ...	Mouth of Rambha Bay ...	17 November 1914.

Family CARANGIDAE.

Genus **CARANX** Lacépède.

Caranx carangus (Bloch).

1876. *Caranx carangus*, Day, *Fish. India* I, p. 215, pl. l, fig. 4.

The species is fairly common in the lake and is found both in the main area and the outer channel. It appears to be a permanent inhabitant of the lake.

The largest specimen is 12·6 cm. in length and was obtained in Rambha Bay in February, 1914.

Distribution.—The seas of India, the Malay Archipelago and the Atlantic coasts of tropical America.

Genus **EQUULA** Cuv. and Val.

Equula edentula (Bloch).

1876. *Equula edentula*, Day, *Fish. India* I, p. 238, pl. lii, fig. 1.

The species is represented by 14 specimens, of which 12 were collected in the main area, while the remaining two were obtained near Satpara. The species appears to be a permanent inhabitant of the lake.

Distribution.—The Red Sea, the seas of India, the Malay Archipelago and beyond.

Family BLENNIIDAE.

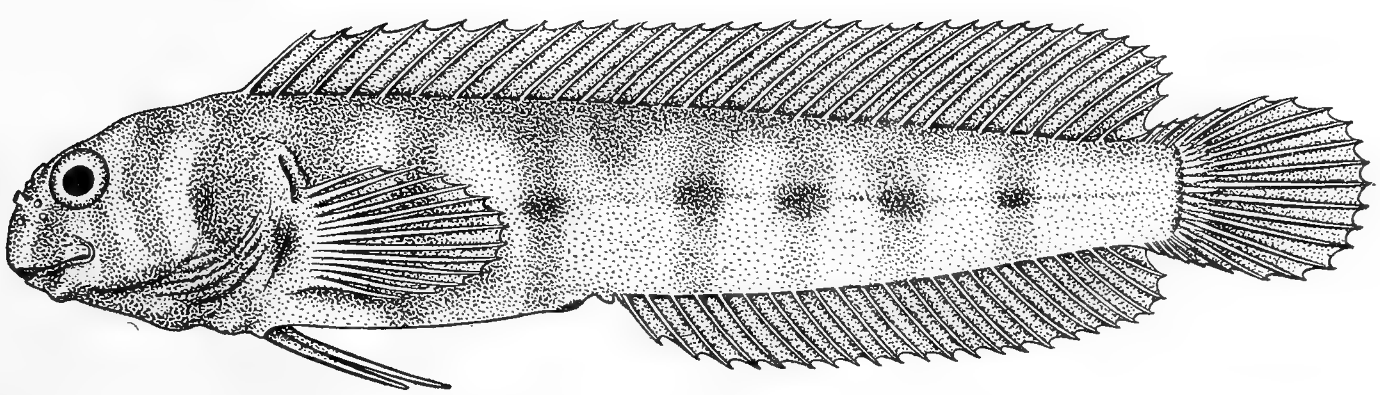
Genus **PETROSCIRTES** Rüppell.

Petroscirtes bhattacharyae Chaudhuri.

1916. *Petroscirtes bhattacharyae*, Chaudhuri, *Rec. Ind. Mus.* XII, p. 107.

1916. *Petroscirtes bhattacharyae*, Bhattacharya, *Mem. Ind. Mus.* V, p. 385, pl. xvii, figs. 8-11 (young stages).

The species occurs in the lake throughout the year and breeds in it. The specimens were collected both in the main area and the outer channel.



TEXT-FIG. 35.—*Petroscirtes bhattacharyae* Chaudhuri: × 3.

The fish has so far been found only in the Chilka Lake.

Family PLATYCEPHALIDAE.

Genus **PLATYCEPHALUS** Bl. & Schn.

Platycephalus insidiator (Forskål).

1876. *Platycephalus insidiator,* Day, *Fish. India,* I, p. 276.

A few specimens of this species were taken in the outer channel, to which it is evidently an occasional visitor.

Disribution.—The Red Sea, east coast of Africa, the seas of India, the Malay Archipelago and beyond.

Sub-order OPISTHOMI.

Family MASTACEMBELIDAE.

Genus **MASTACEMBELUS** Cuv. and Val.

Mastacembelus armatus (Lacépède).

1878. *Mastacembelus armatus,* Day, *Fish. India,* II, p. 340, pl. lxxiii, fig. 2.

The species is represented by two specimens captured near Patsahanipur. The largest is about a foot and half in length.

The fish is probably an occasional immigrant from fresh waters in the rainy season.

Distribution.—The fish occurs in the fresh and brackish waters of India, Ceylon and Burma. Its range extends as far as China.

SUMMARY OF THE REPORT ON THE FISH OF THE CHILKA LAKE.

The fish-fauna of the Chilka Lake comprises in all 118 species, of which 13 have been found to be new. Most of the new species, as many as seven, belong to the family Gobiidae, while the remaining six are distributed among the families Clupeidae, Siluridae, Ophichthyidae and Sphyraenidae. A new genus, *Micrapocryptes,* has been erected in the family Gobiidæ to accommodate the small transparent Gobies of the lake and the Gangetic Delta. In the genus *Eleotris* a specimen is recorded without any specific name. It probably represents a species hithereto undescribed but I have refrained from naming it on account of the immaturity of the single specimen.

Of the 118 species, 49 were taken in the main area only, 24 in the outer channel only and 39 from all over the lake. The distribution of the remaining six species in the lake is not known because they appear to have been purchased from local fishermen from time to time.

The most noteworthy feature in the physical environment of the fauna of the lake is the great periodic change in salinity. This has been fully discussed in the introduction to this volume by Annandale and Kemp (pp. 6—10) and also by Sewell in his paper on Rambha Bay (pp. 680-690). Most of the fishes inhabiting the lake are known from the estuarine waters of India and the Malay Archipelago, but certain forms such as *Pseudorhombus arsius, Gerres punctatus, G. öyena* and *Gobius albopunctatus,* which have hitherto been known from sea water, were only captured in the outer channel when the water was quite fresh. Other sea fishes such as *Eleotris fusca, Therapon puta, Priopis gymnocephalus, Tetrodon reticularis, Mugil cunnesius, Dorosoma nasus* and *Trygon uarnak*, have been found to live in salinities varying from fresh water to water as saline as that of the Bay of Bengal. Several species immigrate into the lake at a certain period. Purely freshwater fishes such as *Mastacembelus armatus* and *Ophiocephalus punctatus* visit the main area during the rains, while forms like *Periophthalmus koelreuteri* and *Rhabdura macrura* are found in the outer channel during a period of drought when the water is as salt as that of the sea outside.

I hope to have an opportunity shortly of comparing the fish-fauna of the Chilka Lake with that of the Talé Sap, a somewhat similar lagoon connected with the Gulf of Siam, and to publish a paper in vol. VI of the *Memoirs of the Asiatic Society of Bengal.*

In the following table the species are arranged in the order in which they have been treated in the report, with a statement as to the specific gravity of the water in which they were taken, their distribution in the lake and their geographical range.

Species.	Specific gravity of water in which specimens were taken.	Distribution in lake.		Further distribution.
		Main area.	Outer channel.	
PLAGIOSTOMI.				
SELACHII				
CARCHARINIDAE.				
Physodon mulleri Müller and Henle .	1·01075	X	...	Bengal and China.
Carcharinus gangeticus (Müller and Henle).	1·01075—1·02375	X	...	Seas and estuaries of India, Japan and Fiji.
,, *melanopterus* (Quoy and Gaimard).	1·00325	...	X	Seas of India and Malay Archipelago.
BATOIDEI				
PRISTIDAE.				
Pristis pectinatus Latham . .	1·0010	X	...	Tropical and temperate seas.
TRYGONIDAE.				
Trygon uarnak (Forskål) . .	1·000—1·0260	...	X	Red Sea, Indian Ocean, Gulf of Siam and East Indies.
,, *pareh* Bleeker	1·000—1·0020	X	...	River Hughli, Bay of Bengal and Malay Archipelago.
,, *imbricata* (Schneider) . .	1·00750—1·02375	X	X	East Indies.
Hypolophus sephen (Forskål) . .	1·00750—1·02375	X	X	Red Sea, Indian Ocean and East Indies.
MYLIOBATIDAE.				
Aetobatis flagellum (Schneider) . .	?	X	X	Tropical and semi-tropical waters of the world.
,, *guttata* (Bloch and Schneider)	?	X	...	Tropical parts of Indian Ocean.
Aetomylaeus nichofii (Schneider) .	1·0110	X	...	Seas of India, East Indies and Japan.
TELEOSTEI.				
MALACOPTERYGII.				
ELOPSIDAE.				
Elops indicus Swainson	1·00750—1·01050	X	...	Arabian Sea and Bay of Bengal, entering estuaries.
Megalops cyprinoides (Broussonet) .	1·00725	X	...	Indian and Pacific Oceans and their estuaries.

Species.	Specific gravity of water in which specimens were taken.	Distribution in lake. Main area.	Distribution in lake. Outer channel.	Further distribution.
TELEOSTEI—*contd.*				
MALACOPTERYGII—*contd.*				
CHANIDAE.				
Chanos chanos (Forskål) . . .	1·000—1·0075	X	...	Red Sea, East Coast of Africa, Indian and Pacific Oceans and their estuaries.
CLUPEIDAE.				
DOROSOMATINAE.				
Dorosoma nasus (Bloch) . . .	1·000—1·02650	X	X	South Arabia and Socotra, seas of India to Malay Archipelago, Philippines, Formosa and China.
,, *indicus* (Russel) . .	1·000—1·0030	?	?	Seas and estuaries of India, Siam, Malay Archipelago and Philippines.
ENGRAULINAE.				
Engraulis annandalei, sp. nov. .	1·000	X	...	
,, *kempi*, sp. nov. . .	1·00750—1·00775	X	...	
,, *rambhae*, sp. nov. . .	1·00750—1·00800	X	...	
,, *purava* (Hamilton Buchanan).	1·00750—1·02650	X	X	Seas and estuaries of India, Malay Peninsula and Archipelago.
,, *mystax* (Bloch and Schneider).	1·00750	X	...	Seas and estuaries of India, Malaysia and China.
Stolephorus indicus (v. Hasselt) .	1·000—1·00750	X	...	Seas of India and Malay Archipelago, Philippines, Formosa, Japan, Samoa and Tahiti.
,, *commersonii* Lacépède .	1·00750	X	...	Madagascar, seas of India, Malay Archipelago and Philippines.
,, *tri* Bleeker . . .	1·00750	?	?	Seas and estuaries of India, Malay Archipelago and Philippines.
CLUPEINAE.				
Clupeoides lile (Cuvier and Valenciennes).	1·00750	X	...	West coast of India, Ceylon, Burma, Siam and Malay Archipelago.
,, *ilisha* (Hamilton Buchanan.)	1·000—1·02650	X	X	Persian Gulf, coasts and estuaries of India and Siam.
OSTARIOPHYSI				
SILURIDAE.				
CLARIINAE.				
Platosus canius Hamilton Buchanan	1·000—1·02650	X	X	Seas, estuaries and rivers of India and the Malay Archipelago.
SILURINAE.				
Wallago attu (Bloch and Schneider) .	1·0020	X	...	Rivers and estuaries of India and the Malay Archipelago.
Callichrous bimaculatus (Bloch) .	1·0020	X	...	Ditto.
Pangasius pangasius (Cuvier and Valenciennes).	1·000	X	...	Ditto.
Osteogeneiosus militaris (Linnaeus) .	1·000—1·0020	X	...	Ditto.
BAGARINAE.				
Arius satparanus, sp. nov. . .	1·000	...	X	
,, *arius* (Hamilton Buchanan) .	1·000	...	X	Estuaries of Orissa, Bengal and Burma.

Species.	Specific gravity of water in which specimens were taken.	Distribution in lake.		Further distribution.
		Main area.	Outer channel.	
TELEOSTEI—*contd.*				
OSTARIOPHYSI—*contd.*				
Bagarinae—*contd.*				
Arius caelatus (Cuvier and Valenciennes).	1·0020—1·0070	X	...	Seas, brackish waters and rivers of India, Siam and the Malay Archipelago.
,, *falcarius* Richardson . .	1·0060	X	...	Seas of East Africa, India and China.
Macrones cavasius (Hamilton Buchanan).	1·0020	X	...	Fresh waters of India and Burma.
,, *gulio* (Hamilton Buchanan).	1·0020—1·0260	X	X	Seas and estuaries of India and the Malay Archipelago.
,, *vittatus* (Bloch) . .	1·000—1·0020	X	...	Fresh water of Tranquebar, India and Siam.
Cyprinidae.				
Cyprininae.				
Cirrhina latia (Hamilton Buchanan)	1·0080	X	...	Fresh waters of India.
Barbus sophore (Hamilton Buchanan)	1·000—1·0110	X	...	Fresh waters of India, also found within tidal influence.
,, *ticto* (Hamilton Buchanan) .	1·000—1·0110	X	...	Fresh waters of India and Ceylon, also occurring in brackish waters.
vittatus Day	1·0260	...	X	Cutch, Madras and Ceylon.
APODES				
Anguillidae.				
Muraenesox cinereus (Forskål) . .	?	?	?	Coasts of Africa and Arabia; seas and estuaries of India, Malay Archipelago, Australia, Japan and China.
Muraenidae.				
Rhabdura macrura (Bleeker) . .	1·0260	...	X	Natal, seas of India, Malay Archipelago, Australia and Formosa.
Ophichthyidae.				
Ophichthis chilkensis, sp. nov. . .	1·0060—1·0110	X	...	
,, *hijala* (Hamilton Buchanan).	1·000	X	...	Estuaries of Bengal and the sea of Penang.
,, *boro* (Hamilton Buchanan)	1·000—1·0020	X	...	Seas and estuaries of India and the Malay Archipelago.
HAPLOMI				
Cyprinodontidae.				
Aplocheilinae.				
Panchax panchax (Hamilton Buchanan).	1·0020—1·0110	X	...	Fresh waters and estuaries of India, Andamans, Siam, Malay Peninsula and Archipelago.
Aplocheilus melastigma McClelland .	1·000—1·0080	X	X	India, Formosa, Korea, Japan and Kiangsú in China.
CATOSTEOMI				
Syngnathidae.				
Ichthyocampus carce (Hamilton Buchanan).	1·0080	X	X	Seas, estuaries and fresh waters of India and the Malay Archipelago.
Hippocampus brachyrhynchus, Dunker	1·000—1·0110	X	X	Mekran Coast (Arabian Sea).

Species.	Specific gravity of water in which specimens were taken.	Distribution in Lake.		Further distribution.
		Main area.	Outer channel.	
TELEOSTEI—*contd.*				
PERCESOCES				
SCOMBRESOCIDAE.				
Belone strongylura v. Hasselt . .	1·0030—1·00750	X	...	Coasts and estuaries from Bengal to China.
Hemirhamphus limbatus Cuvier and Valenciennes.	1·000—1·0110	X	...	Indian Ocean and the Sea of Penang.
MUGILIDAE.				
Mugil cephalus Linnaeus . .	1·000—1·0060	X	...	Mediterranean Sea, West Coast of Africa, Red Sea, Indian Ocean, seas of China and Japan including estuaries, Pacific and Atlantic coasts of America.
,, *gymnocephalus* Swainson .	?	?	?	Seas of India and the Malay Archipelago.
,, *cunnesius* Cuvier and Valenciennes.	1·000—1·0260	X	X	Abyssinia, Red Sea, seas of India to the Malay Archipelago and beyond.
,, *subviridis* Cuvier and Valenciennes.	1·0020—1·0260	X	X	Seas of India entering fresh waters.
,, *caeruleo-maculatus* Lacépède .	1·000	...	X	Coasts of Mauritius, through seas of India to the Malay Archipelago.
,, *jerdoni* Day	1·0110	X	...	Seas of India.
,, *speigleri* Bleeker . . .	1·000—1·0080	X	X	Seas of India, Malay Archipelago and Shanghai.
Liza borneensis (Bleeker) . .	?	...	X	Seas of India, Malay Archipelago and East Indies.
,, *corsula* (Hamilton Buchanan) .	1·000	X	...	Fresh waters and estuaries of India.
,, *troschelii* (Bleeker) . .	?	...	X	Seas of India and Indo-Australian Archipelago.
POLYNEMIDAE.				
Eleutheronema tetradactylum (Shaw)	1·000—1·0060	X	...	Seas of India, Indo-Australian Archipelago, North Australia and China.
SPHYRAENIDAE.				
Sphyraena raghava, sp. nov. . .	?	...	X	
OPHIOCEPHALIDAE.				
Ophiocephalus punctatus Bloch .	1·000	X	...	Fresh waters of India, Ceylon and Yunnan.
PLECTOGNATHI				
SCLERODERMI.				
TRIACANTHIDAE.				
Triacanthus brevirostris Temm. and Schl.	1·000—1·0070	X	X	Seas of India, Malay Archipelago, Australia, China and Japan.
GYMNODONTES.				
TETRODONTIDAE.				
Tetrodon fluviatilis (Hamilton Buchanan).	1·000—1·0110	X	...	Seas and estuaries of India and Malay Archipelago.
,, *oblongus* (Bloch) . .	?	...	X	Seas of India, Malay Archipelago, China and Japan.
,, *patoca* Hamilton Buchanan	1·0260	...	X	Seas of India to China.
,, *reticularis* (Bloch and Schneider).	1·000—1·0260	...	X	Seas of India, Malay Archipelago and New Guinea.

Species.	Specific gravity of water in which specimens were taken.	Distribution in lake. Main area.	Distribution in lake. Outer channel.	Further distribution.
TELEOSTEI—*contd.*				
ACANTHOPTERYGII				
PERCIFORMES.				
LOBOTIDAE.				
Coius quadrifasciatus (Sevastianof) .	1·000—1·00750	X	...	Estuaries of the Ganges, rivers of Burma, Siam, the Malay Archipelago and Peninsula.
SERRANIDAE.				
CENTROPOMINAE.				
Lates calcarifer (Bloch) . . .	About 1·0000—1·0260	X	X	Coasts and mouths of rivers of South Eastern Asia from India to Southern China, the Philippines and Australia.
CHANDINAE.				
Chanda ambassis (Lacépède) . .	About 1·0150	X	...	East coast of Africa, shores of India, Malay Archipelago and North coast of Australia.
Priopis gymnocephalus (Lacépède) .	1·000—1·0260	X	X	Coasts of Orissa and Malabar, Seychelles and Sea of Penang.
LUTJANINAE.				
Lutjanus johnii (Bloch) . . .	1·0060	X	...	Coasts of Africa, Red Sea, seas of India, Malay Archipelago, coasts of China and Australia.
Therapon jarbua (Forskål) . .	1·000—1·0260	...	X	East coast of Africa, Red Sea, seas and estuaries of India, Malay Archipelago, North coast of Australia and Japan.
" *puta* Cuvier . . .	1·000—1·0260	X	X	Red Sea, seas of India, Malay Archipelago, coasts of Australia, the Philippines and South Pacific Ocean.
SILLAGINIDAE.				
Sillago sihama (Forskål) . .	1·000—1·260	X	X	North and East Africa, Red Sea, seas of India, Malay Archipelago, coasts of Queensland, the Philippines, Japan and China.
Sciaena coitor (Hamilton Buchanan)	1·0030	X	...	Seas of India, China and the Philippines.
Limbrina indica (Kuhl and Hasselt)	1·000—1·0110	X	X	Seas of India, Malay Archipelago, the Philippines, Sea of Penang and China.
GERRIDAE.				
Gerres öyena (Forskål) . . .	1·000	...	X	East coast of Africa, Red Sea, seas of India, Malay Archipelago, Fiji, Japan and the Philippines.
" *setifer* (Hamilton Buchanan) .	1·0070—1·0260	X	X	Seas and coasts of India, Malay Archipelago and China.
" *punctatus* Cuvier and Valenciennes.	1·000	...	X	Red Sea, seas of India, Malay Archipelago, China and the Philippines.
Leiognathus equulus (Forskål) . .	1·000—1·0110	X	X	Ditto
" *blochii* (Cuvier and Valenciennes).	1·00750—1·0260	X	X	Seas of India.

Species.	Specific gravity of water in which specimens were taken.	Distribution in lake. Main area.	Outer channel.	Further distribution.
TESEOSTEI—*contd.*				
ACANTHOPTERYGII—*contd.*				
GERRIDAE—*contd.*				
Gazza minuta (Bloch)	1·0020	X	...	Zanzibar, Red Sea, East Indian Seas, Malay Archipelago, New Hebrides and the Philippines.
SCORPIDIDAE.				
Monodactylus argenteus (Linneaus) .	?	X	...	East coast of Africa, Red Sea, seas of India, Malay Archipelago and of Australia, Philippines and China.
GOBIIFORMES				
GOBIIDAE.				
GOBIINAE.				
Gobius ostreicola Chaudhuri . .	1·000	...	X	
,, *albopunctatus* Cuvier and Valenciennes.	1·000	...	X	Seas of India, Australia and Fiji.
Glossogobius giuris (Hamilton Buchanan).	1·000—1·0260	X	X	East coast of Africa, seas and fresh waters of India, the Malay Archipelago, Australia and beyond.
,, *biocellatus* (Cuvier and Valenciennes).	?	...	X	Seas and coasts of India, the Malay Archipelago and China.
,, *mas*, sp. nov. . .	1·0010—1·0060	X	...	
Ctenogobius acutipinnis (Cuvier and Valenciennes).	1·000—1·0080	X	X	Seas of India.
,, *chilkensis* (Jenkins) .	1·000—1·0080	X	X	
,, *alcocki* (Annandale) .	1·0075—1·028250	X	X	Brackish water near Calcutta.
,, *globiceps*, sp. nov. . .	1·000—1·028250	X	X	
,, *cylindriceps*, sp. nov. .	1·000—1·028250	X	X	
,, *dentifer*, sp. nov. . .	1·000—1·0110	X	X	
,, *minima*, sp. nov. . .	1·000—1·0260	X	X	
Oxyurichthys tentacularis (Cuvier and Valenciennes).	1·000—1·0260	X	X	Seas of India and the Malay Archipelago.
Apocryptes rictuosus (Cuvier and Valenciennes).	1·0020—1·0260	X	X	Seas and estuaries of India.
,, *lanceolatus* (Bloch and Schneider).	?	X	...	Seas of India and the Malay Archipelago.
Micrapocryptes fragilis, gen. et sp. nov.	1·0020—1·0080	X	...	
ELEOTRINAE.				
Eleotris cavifrons Blyth	?	...	X	Andamans.
,, *fusca* (Bloch and Schneider) .	1·000—1·0260	X	X	East coast of Africa, coasts of India and the Malay Archipelago.
,, sp.	1·0280	...	X	
Butis butis (Hamilton Buchanan) .	?	?	?	Seas and estuaries of India and the Malay Archipelago.
PERIOPHTHALMINAE.				
Periophthalmus koelreuteri (Pallas) .	1·0280	...	X	Seas and estuaries of India.
GOBIOIDINAE.				
Taenioides chilkensis, sp. nov. .	1·000—1·0280	...	X	
ZEORHOMBI				
BOTHIDAE.				
Pseudorhombus arsius (Hamilton Buchanan).	1·000	X	X	East coast of Africa, seas of India to Australia and China.

Species.	Specific gravity of water in which specimens were taken.	Distribution in lake. Main area.	Distribution in lake. Outer channel.	Further distribution.
TELEOSTEI—*concld.*				
ACANTHOPTERYGII—*concld.*				
SOLEIDAE.				
Synaptura orientalis (Bloch and Schneider).	?	X	...	Seas of India and China.
CYNOGLOSSIDAE.				
Cynoglossus brevis Günther . .	1·000—1·0280	X	X	R. Hughli at Calcutta and along Orissa Coast.
SCOMBRIFORMES.				
CARANGIDAE.				
Caranx carangus (Bloch) . . .	1·000—1·0110	X	X	Seas of India and the Malay Archipelago to Atlantic Coast of Tropical America.
Equula edentula (Bloch) . . .	1·007750—1·0110	X	X	Red Sea, seas of India to the Malay Archipelago and beyond.
JUGULARES.				
BLENNIIDAE.				
Petroscirtes bhattacharyae Chaudhuri	1·000—1·0110	X	X	
SCLEROPAREI.				
PLATYCEPHALIDAE.				
Platycephalus insidiator (Forskål) .	1·02825	...	X	East Coast of Africa, Red Sea, seas of India to the Malay Archipelago and beyond.
OPISTHOMI				
MASTACEMBELIDAE.				
Mastacembelus armatus (Lacépède) .	1·000	X	...	Fresh and brackish waters of India, Ceylon and China.

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