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

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I. Introduction and general account of the area.

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

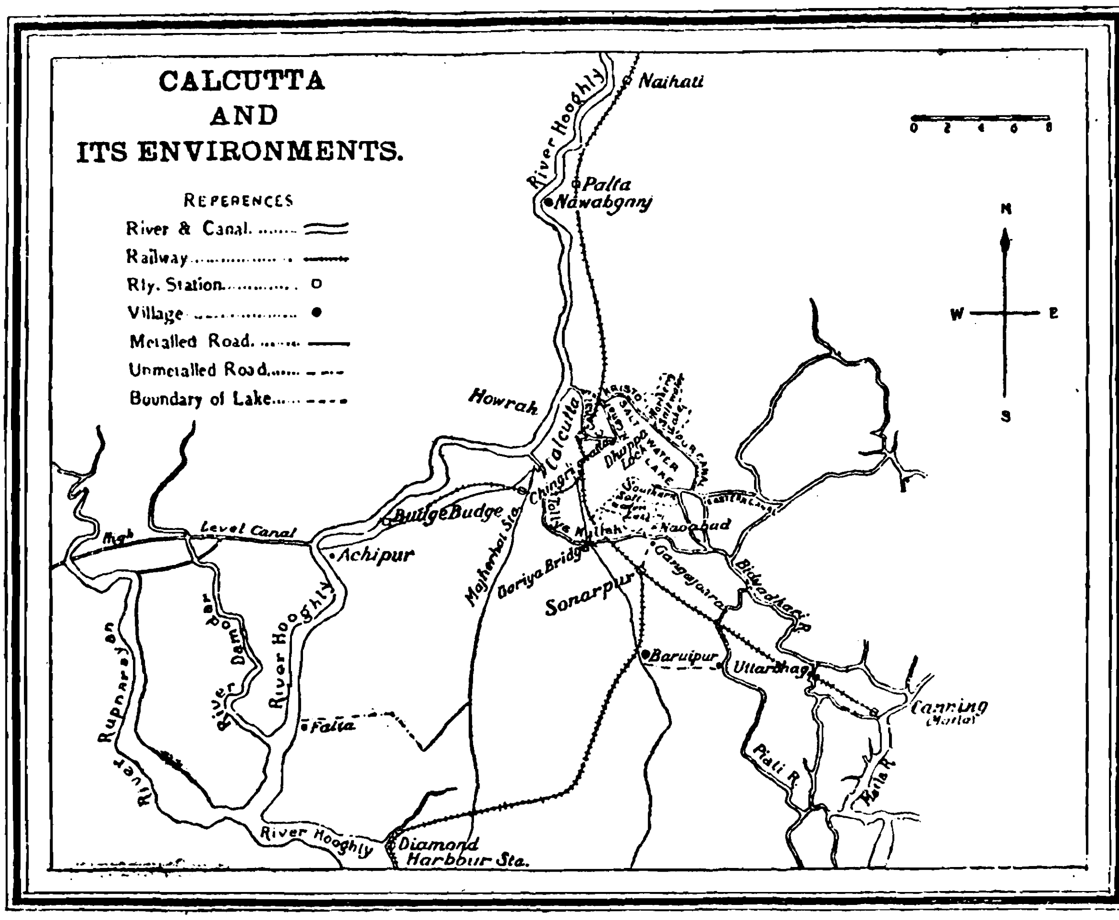
In 1926 the Zoological Survey of India established a camp, on the Kristopur Canal at the north end of the Salt Lakes, for a short period for the purpose of investigating the fauna of this area and the work was repeated in 1928.

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

The Geography of the Area.

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

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



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

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

For several years past there has been a steady change in the conditions existing in and the general character of some of the rivers in Lower Bengal, and these changes have had a profound effect on the Salt Lakes and the associated streams and thus indirectly on the general character of the fauna of certain areas. For our knowledge of the river changes we are indebted largely to Mr. A. N. Banerjee (1931), the River Surveyor to the Corporation of Calcutta, who has recently compiled an account of these changes. The chief changes, with which we are concerned in our study of the Salt Lakes and their fauna, are those that affect the rivers of the Matla Series, especially those of the Central Lake Channel and the Bidyadhari River, and to a less extent those that affect the Piali and Matla Rivers on the south and south-east and the Hooghly River on the west.

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

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

* In this year Dhappa Lock was constructed.

As the above figures clearly show, there was a steady increase in the amplitude of the tide up to 1901, but shortly after this date there was a decrease, that was due in the main to the rise in the height of low water. Banerjee (p. 8) goes on to point out that " the present-day condition of the tide is totally different. The tidal impulse is steadily receding off the upper reaches of the Bidyadhari and during neap tides the tidal impulse does not even reach up to Bamonghatta now-a-days." He further states that " the Bidyadhari generally carries fine sand and as such its section, according to some authorities should be narrow and deep and should approach more closely the section of those carrying clear water. The river lost this characteristic in about the year 1904" These changes are attributed to the silting up of the rivers and canals, and an attempt was made to counteract the gradual silting up of the river and especially of the upper reaches and the Central lake channel by dredging, but it was found that the process of silting was so rapid that the dredger was unable to keep pace with it and the attempt was given up. The final effect of the silting is very clearly seen in its effect on navigation. " The Bidyadhari formed a part of the inner and outer boat routes for a long time. Although the first reach of the Central Lake Channel and the Bidyadhari between Dhappa and Shamookpota was not navigable by boats of heavy drafts, yet boats of all drafts could ply the Bidyadhari at high water upto the year 1915. Now-a-days only boats of 6" to one foot drafts can come up to the Dhappa Lock and that only during high spring tides of monsoons" (*loc. cit.*, p. 11). Since this was written an earth 'bund' has been constructed across the channel just to the south of Dhappa Lock, so that this is now useless and is rapidly silting up.

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

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

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

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

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

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

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

General Considerations.

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

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

Murray (1908) has pointed out that " it is a well known fact that the clayey matter which is carried to the ocean by rivers is nearly all precipitated to the bottom on contact with the salt-water, but a small quantity of siliceous matter is apparently still retained in salt water of relatively low salinity. Diatoms and Radiolaria, the shells and skeletons of which are chiefly composed of silica, flourish in the surface waters of the ocean where there is reason to believe clayey matter is more abundant than elsewhere. . In the tropical Indian and Pacific Oceans, where the greatest rainfall occurs and where much detrital matter is carried into the ocean from the land; and off the mouths of great rivers both in the tropics and elsewhere, there is a great development of silica-secreting organisms in the surface waters" In consequence of these natural conditions there is a very rich and varied fauna in the estuarine regions of the tropics, and as Annandale (1922) has pointed out " we find not only a fairly large fauna of brackish-water which cannot be regarded either as strictly marine or as strictly fluviatile, but also considerable number of marine types that have established themselves permanently in fresh water far above the influence of the tides" In this paper Annandale has given an extremely interesting account of the euryhaline fauna of the brackish-water or deltaic region of the Ganges and he points out that the " Deltaic tract is tidal, even in places where the water is practically fresh, and is inhabited mainly by animals of marine origin"

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

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

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

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

In addition *Spongilla carteri* is at the present day common in those parts of the Salt Lakes that lie to the north and east of the Kristopur canal. Annandale (1922) has also recorded the presence of "the cosmopolitan parasite *Cliona vastifica,* which is not uncommon in oyster-shells in the lower part of the Delta".

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

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

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

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

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

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

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

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

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

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

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

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

Copepoda.

Mesocyclops (Mesocyclops) leuckarti.

Cladocera.

Ceriodaphnia rigaudi.

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

Balanus amphitrite.
Balanus patellaris.
Chthamalus stellatus.

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

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

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

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

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

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

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

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

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

To this list may be added a species of *Gelasimus*, probably *Gelasimus annulipes*, that has succeeded in establishing itself in a colony on the left bank of the Hooghly river at Diamond Harbour. Annandale (1922, p. 151) has pointed out that " the greater number of the euryhaline crabs belong to the family Grapsidae and to such genera as *Sesarma*, *Varuna*, *Grapsus* and *Ptychognathus*..... Next to the Grapsidae in point of numbers come the Ocypodidae, most of which belong to the subfamily Scopimerinae." In this subfamily *Tympanomerus stapletoni* is very common on the banks of the Hooghly river at Calcutta.[1] Among fresh water species *Palaemon lamarrei* is common in both fresh and slightly brackish water ; *Palaemon rudis* is not unknown in the vicinity of Calcutta and *P. mirabilis* also occurs in the rivers of the delta. *Leander styliferus*, *L. tenuipes* and *L. fluminicola* are all known from the area. Of these three species Annandale remarks that "*L. tenuipes* is distinguished from the others by the extreme length and tenuity of its walking legs, which are no longer capable of supporting it on the bottom, but have apparently assumed the function of tactile organs. This species and *L. styliferus* are anadromous, but do not migrate inland beyond the limits of brackish water. *L. fluminicola* on the other hand is equally at home in fresh and in brackish water and is common well above the upper extremity of the delta." *Caridina nilotica* and *Caradina propinqua* are common in the vicinity of Calcutta.

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

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

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

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

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

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

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

True marine forms, such as

Pyrazus palustris,
Potamides (Telescopium) telescopium,

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

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

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

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

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

It must not be supposed that the whole of this fauna is to be found at any one place in the Gangetic Delta or even that such species as are found in a given area at one time will be found there on a subsequent occasion. I have already sufficiently indicated the great changes that are continually going on in this region and these changes have a profound effect on the fauna, while seasonal changes may cause the appearance or disappearance of species in the course of a few weeks. This is particularly well exemplified in the behaviour of *Campanulina ceylonensis*, of which Annandale (1922, p. 152) writes " Every year the lock-gates of a certain canal on the outskirts of Calcutta are opened about April and water flows in from creeks of brackish water in the delta. Shortly afterwards the water having at the time a specific gravity of about 1008·5 at 15°C., becomes alive with the medusae of this Hydrozoon, while the minute Hydroid is to be found on every submerged brick or pile in the canal. Both generations remain abundant until the rainy season commences in June or July. Then the specific gravity of the water sinks rapidly. As it does so the medusae and hydroids become scarcer. They finally disappear when it falls to about 1006·0."

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

Some Observations on the Salt-water Lakes near Calcutta.

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

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

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

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

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

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

The Salinity of the Water.

No systematic examination of the specific gravity and salinity of the water in the Salt Lakes and the associated canals and pools has been carried out, though from time to time certain observations have been made on this subject.

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

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

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

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

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

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

Structural Modifications.

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

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

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

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

List of stations.

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

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

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

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

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

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

Cladocera :

Diapnanosoma excisum var. *longiremis* Ekman.

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

Copepoda :

Diaptomus blanci Guerne and Richard.
Diaptomus contortus Gurney.
Diaptomus strigilipes Gurney.
Diaptomus viduus Gurney.
Pseudodiaptomus lobipes Gurney.
Acartia chilkaensis Sewell.
Cyclopina minuta, sp. nov.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).

Cladocera :

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

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

Copepoda :

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

Station 2 ; near the shore.

Copepoda :

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

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

Copepoda :

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

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

Copepoda :

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

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

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

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

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

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

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

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

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

Cladocera :
Diaphanosoma excisum var. *longiremis* Ekman.

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

Among the Rotifera that were present were the following :—

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

11. Tolly's Nullah. Gangajoara. 2. ii. 33. Salinity 4·07 per mille.
   Copepoda :
      Pseudodiaptomus binghami Sewell.
      Acartia chilkaensis Sewell.
      Acartia (Acartiella) tortaniformis Sewell.
      Mesocyclops (Mesocyclops) leuckarti (Claus).

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

Salt Lake Canal System.

12. Chingrighatta, in Canal. Surface tow-netting 19. x. 14.
   Copepoda :
      Pseudodiaptomus annadalei Sewell.
      Pseudodiaptomus binghami Sewell.
      Pseudodiaptomus tollingeri Sewell.
      Diaptomus contortus Gurney.
      Acartia chilkaensis Sewell.
      Acartia plumosa T. Scott.
      Acartia spinicauda Giesbrecht.
      Acartia (Acartiella) tortaniformis Sewell.
      Oithona brevicornis Giesbrecht.
      Cyclopina longifurca Sewell.
      Halicyclops aequoreus (Fischer).
      Halicyclops tenuispina Sewell.
      Mesocyclops (Mesocyclops) leuckarti (Claus).
      Mesocyclops (Thermocyclops) rylovi Smirnov.
      Stenhelia longifurca, sp. nov.
      Laophonte bengalensis, sp. nov.
      Mesochra meridionalis Sars.
   Cladocera :
      Daphnia lumholtzi Sars.
      Diaphanosoma excisum var. *longiremis* Ekman.
      Diaphanosoma modiglianii Richard.
      Moina dubia Richard.
      Ceriodaphnia cornuta Sars.
      Ceriodaphnia rigaudi Richard.
      ? *Alona quadrangularis* Müller.
      Chydorus sphaericus Müller.

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

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

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

13. Salt Lake Canal System. Dhappa Lock ; Inside Lock Gates, 20. x. 30.
   Copepoda :
      Diaptomus contortus Gurney.
      Pseudodiaptomus annandalei Sewell.

Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Cladocera :
Diaphanosoma excisum var. *longiremis* Ekman.
Diaphanosoma modiglianii Richard.
Moina dubia Richard, in enormous numbers.

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

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

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

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

Copepoda :
Diaptomus cinctus Gurney.
Pseudodiaptomus annandalei Sewell.
Acartia chilkaensis Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.
Cladocera :
Moina dubia Richard, in large numbers.

In addition the following Rotifera were present :—

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

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

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

Copepoda :
Diaptomus cinctus Gurney.
Pseudodiaptomus annandalei Sewell.
Acartia chilkaensis Sewell.
Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.
Cladocera :
Moina dubia Richard.

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

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

Copepoda :
Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus tollingeri Sewell.
Acartia chilkaensis Sewell.

Acartia (*Acartiella*) *tortaniformis* Sewell.
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.
Cladocera :
Moina dubia Richard.

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

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

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

Pseudodiaptomus annandalei Sewell.

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

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

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

Copepoda :
Mesocyclops (*Mesocyclops*) *leuckarti* (Claus).
Mesocyclops (*Thermocyclops*) *rylovi* Smirnov.
Cladocera :
Moina dubia Richard.
Diaphanosoma excisum var. *longiremis* Ekman.

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

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

Copepoda :
Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus binghami Sewell.
Acartia chilkaensis Sewell.

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

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

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

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

Copepoda:

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

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

Copepoda:

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

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

Copepoda:

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

III. SYSTEMATIC ACCOUNT.

ROTIFERA.

Family ASPLANCHNIDAE.

Genus **Asplanchna** Gosse.

Asplanchna brightwelli Hudson and Gosse.

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

A large number of examples of this species were taken in a tow-netting at Z. S. I. Station 3 (Sample 21) in the northern part of the Salt Lakes in March 1933. The species appears to be widely distributed throughout fresh water in and around Calcutta.

Family BRACHIONIDAE.

Genus **Brachionus** Ehrenberg.

Brachionus bakeri Ehrb.

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

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

Brachionus bakeri var. **brevispinus** Ehrb.

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

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

Brachionur bakeri var. **latissimus** Schm.

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

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

Brachionus pala Ehrb.

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

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

Brachionus rubens Ehrb.

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

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

Brachionus urceolaris Ehrb.

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

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

PHYLLOPODA: Cladocera.

Family DAPHNIDAE.

Genus **Daphnia** O. F. Müller.

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

Daphnia lumholtzi Sars.

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

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

Family SIDIDAE.

Genus **Diaphanosoma** Fischer.

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

Diaphanosoma excisum var. **longiremis** Ekman.

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

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

Diaphanosoma modiglianii Richard.

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

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

Genus **Ceriodaphnia** Dana.

Ceriodaphnia rigaudi Richard.

Ceriodaphnia rigaudi, Gurney, 1907, p. 21.

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

Ceriodaphnia cornuta Sars.

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

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

Genus **Moina** Baird.

Moina dubia Richard.

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

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

Family CHYDORIDAE.

Genus **Alona** Baird.

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

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

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

Genus **Chydorus** Leach.

Chydorus sphaericus (O. F. Müller).

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

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

COPEPODA : Calanoida.

Family PARACALANIDAE.

Genus **Paracalanus** Boeck.

Paracalanus dubia Sewell.

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

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

Genus **Acrocalanus** Giesbrecht.

Acrocalanus inermis Sewell.

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

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

Family DIAPTOMIDAE.

Genus **Diaptomus** Westwood.

Diaptomus blanci Guerne and Richard.

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

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

Diaptomus cinctus Gurney.

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

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

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

Diaptomus contortus Gurney.

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

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

Diaptomus orientalis Brady.

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

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

Diaptomus strigilipes Gurney.

(Text-fig. 2 *a*.)

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

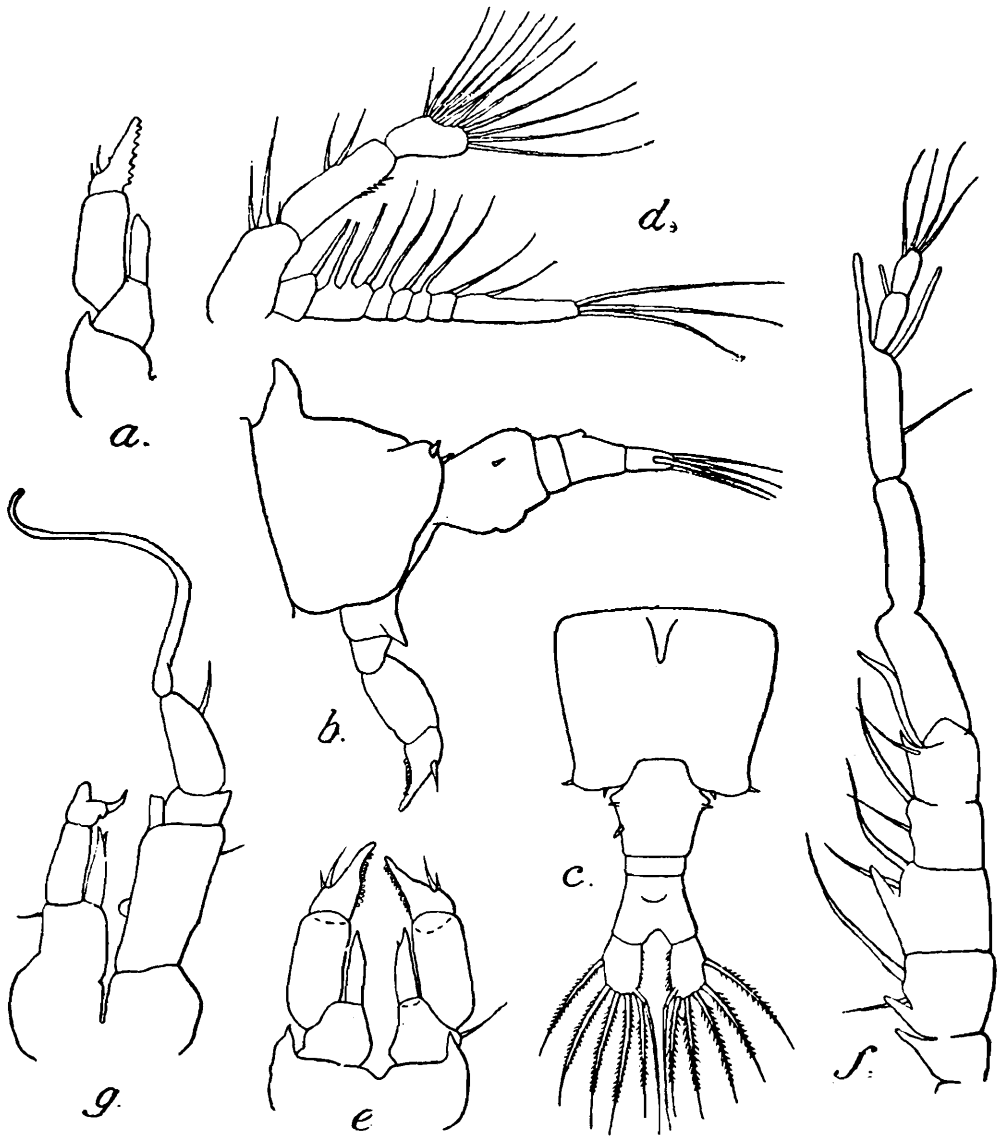
This species is now known to occur in Chakradharpur, in Chota Nagpur, and in Bankipur and Chittagong in Bengal.

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

Diaptomus indicus, sp. nov.

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

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



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

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

♀: Total length 1·083 mm.

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

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

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

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

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

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

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

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

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

♂: Total length 1·271 mm.

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

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

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

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

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

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

Diaptomus viduus Gurney.

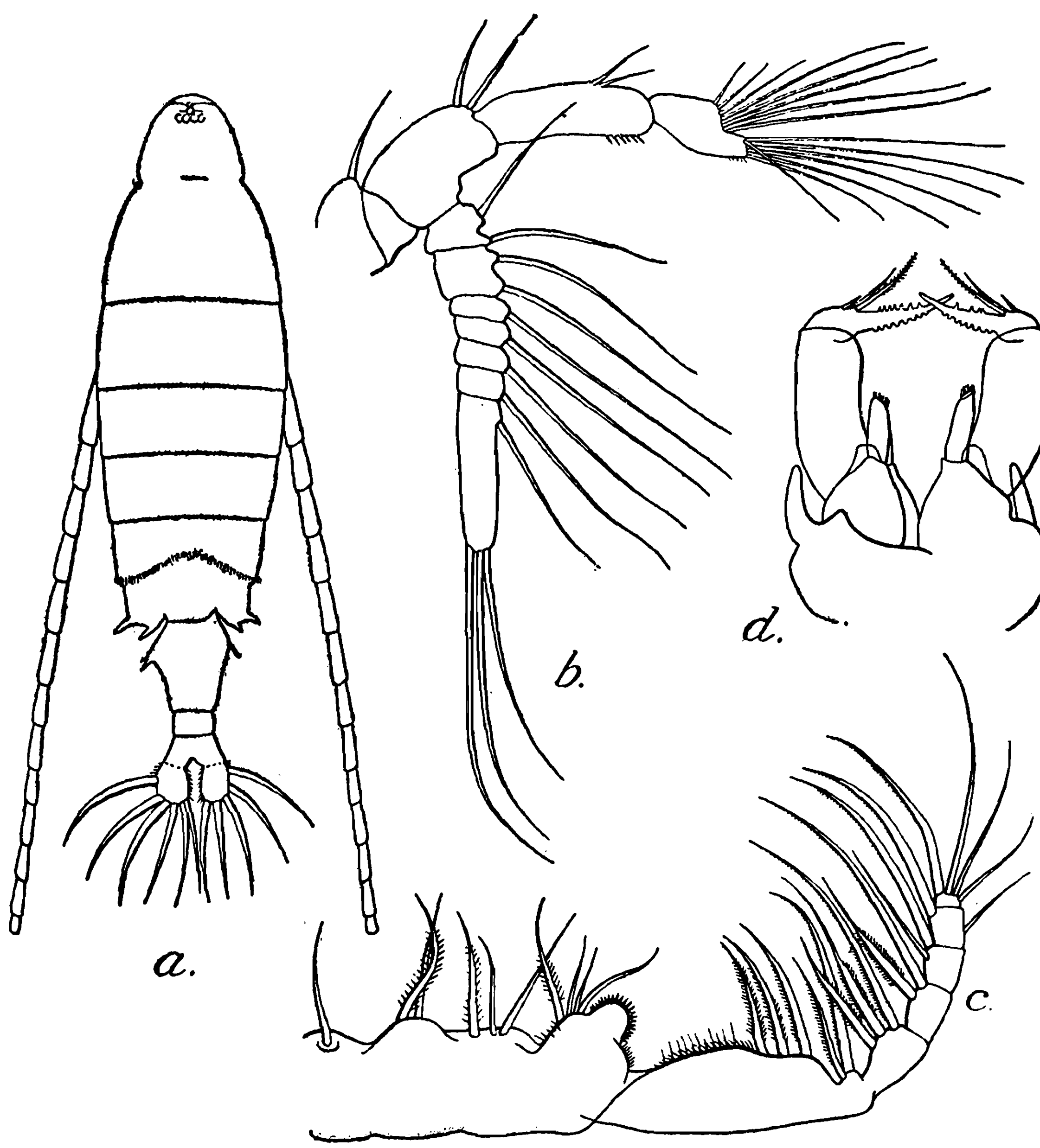
(Text-fig. 3, *a-d*).

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

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

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

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



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

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

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

The genital segment is slightly asymmetrical; each bears a short spine, that on the right side being situated somewhat more anteriorly than that on the left. The segment is itself slightly produced at the point of origin of the latter spine and the spine is bifid, a small accessory spine arising near the base. The furcal rami are short and broad, the relative dimensions being in the proportion of 9 in length to 8 in breadth. The inner margins and the proximal part of the outer margin are fringed with delicate hairs. The furcal setae are short and stout, The 1st antenna overreaches the tip of the furcal ramus by the last three or four segments. The proportional lengths of the segments are as follows :—

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

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

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

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

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

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

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

The 5th pair of legs (Text-fig. 3*d*) are as figured. The 1st basal segment bears a stout spine-like process at its distal external angle. The 2nd basal segment bears the endopod at its inner distal angle and close to the articulation is a rounded or somewhat truncated projection. The 1st free segment of the exopod is stout, and the 2nd segment is slightly swollen at the base and tapers to a point-in length it is but little shorter than the proximal free segment and on each side there is a row of stout teeth, the actual number of which appear to vary even in the same individual, as in the one figured in which there were eight teeth on the outer margin of one and only four on the other.

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

Genus **Pseudodiaptomus** Herrick.

Pseudodiaptomus annandalei Sewell.

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

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

Pseudodiaptomus binghami Sewell.

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

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

Pseudodiaptomus lobipes Gurney.

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

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

Pseudodiaptomus tollingeri Sewell.

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

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

Pseudodiaptomus hickmani Sewell.

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

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

Pseudodiaptomus aurivillii Cleve.

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

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

Family PONTELLIDAE.

Genus **Labidocera** Lubbock.

Labidocera gangetica, sp. nov.

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

This form was first described by me from the Rangoon River estuary ; it has also been taken in the Ramree River and at Chittagong. I have hitherto been inclined to regard it as a large dimorphic form of *Labidocera euchaeta* Giesbrecht with which in previous collections it was associated, though in my last paper (1932, p. 362) I pointed out that a comparison of the segmental lengths in this form and in *Labidocera euchaeta* Giesbrecht showed distinct differences from what one would expect if they were two forms of the same species, and I then remarked that "such a difference from the normal leads one to suspect that one is not dealing with two stages in the same life history" In the present collections a number of examples of this form were taken at Diamond Harbour and associated with adults of both sexes were numerous immature forms. It thus seems certain that this is a different species from *L. euchaeta* and I, therefore, give it the name *L. gangetica.* It was taken in the Hooghly River at Diamond Harbour and Achipur and in the Piali River at Uttarbhag (Samples 6, 8 and 26), and appears to be an estuarine form.

Genus **Pontella** Dana.

Pontella andersoni Sewell.

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

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

Family ACARTIIDAE.

Genus **Acartia** Dana.

Sub-genus **Acanthacartia** Steuer.

Acartia (Acanthacartia) chilkaensis Sewell.

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

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

Acartia (Acanthacartia) plumosa T. Scott.

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

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

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

Sub-genus **Odontacartia** Steuer.

Acartia (Odontacartia) spinicauda Giesbrecht.

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

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

Sub-genus **Acartiella** Sewell.

Acartia (Acartiella) tortaniformis Sewell.

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

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

Acartia (Acartiella) major Sewell.

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

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

CYCLOPOIDA.

Family OITHONIDAE.

Sub-family OITHONINAE.

Genus **Oithona** Baird.

Oithona brevicornis Giesbrecht.

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

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

Oithona horai, sp. nov.

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

♀: Total length 0·521 to 0·604.

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

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

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

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

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

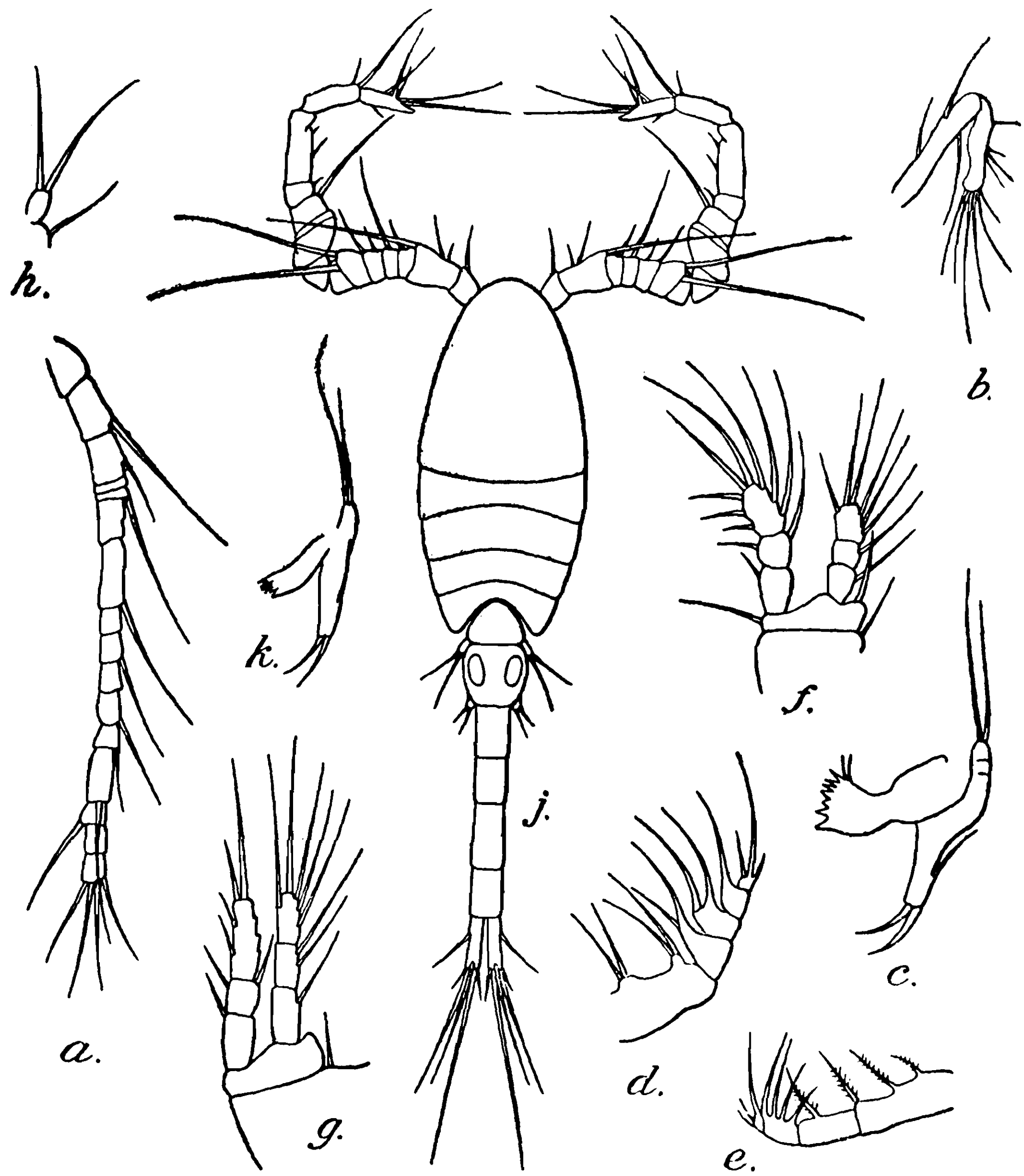
Seta 1	5
Seta 2	46
Seta 3	27
Seta 4	5
Seta 5 .	10
Dorsal Seta . .	29

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

Segment	1	2	3	4	5	6	7	8	9
	114	86	100	14	14	86	114	43	50

10	11	12	13	14	15	16	
43	43	57	100	36	57	43	=1000

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



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

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

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

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

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

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

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

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

♂: Total length 0·542 mm.

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

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

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

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

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

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

CYCLOPOIDA.

Family CYCLOPINIDAE.

Sub-family CYCLOPININAE.

Genus **Cyclopina** Claus.

Cyclopina longifurca Sewell.

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

Originally described from specimens taken in the Chilka Lake in water that had a density of 997·0 at 31·5 C. Further examples have been obtained from weed-washings in the sea at Tuticorin, South India, and also in the Canal system of the Salt Lakes, Calcutta, at Chingrighatta on 19th October 1914.

Cyclopina minuta, sp. nov.

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

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

♀: Total length: 0·433 to 0·500 mm.

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

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

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

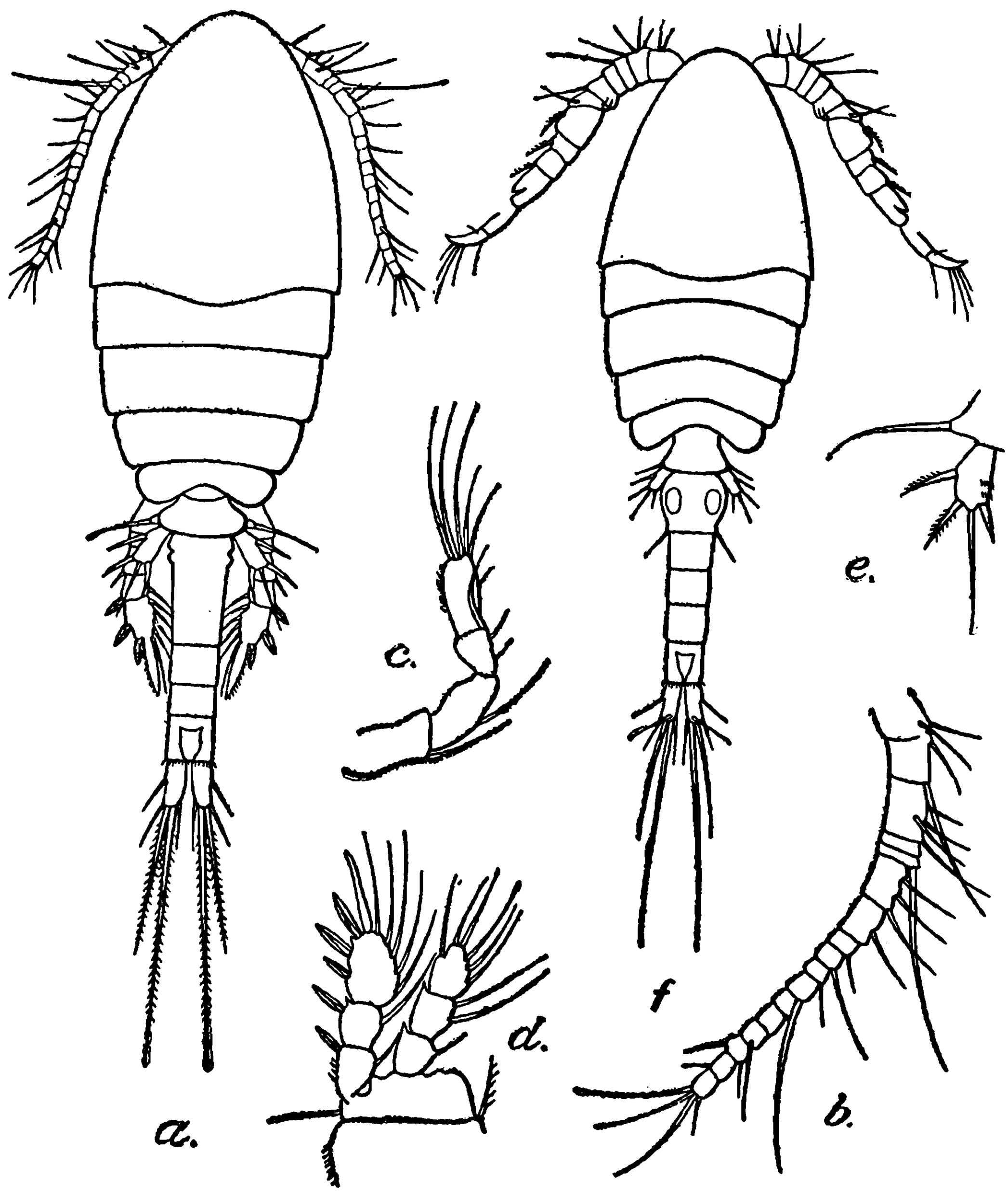
The anterior part of the genital segment is somewhat swollen and is grooved on the lateral margins. The anal segment is armed with a row of needle-like spines along the articulation of the furcal rami. The furcal rami are about twice as long as broad. Of the furcal setae four arise from the distal end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

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

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

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

The 5th leg (Text-fig. 5*e*) consists of a basal segment that is fused with the thoracic segment and bears a long seta on its outer border; the free segment is comparatively short and stout and bears two spines with a single seta between them on its distal margin and a third spine about the middle of the length of the outer margin; two short rows of fine needle-like spines run transversely across the inner aspect.



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

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

♂: Total length 0·467 mm.

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

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

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

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

Family CYCLOPIDAE.

Sub-family HALYCYCLOPINAE.

Genus **Halicyclops** Norman.

Halicyclops aequoreus Fischer.

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

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

Halicyclops propinquus Sars.

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

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

Halicyclops tenuispina Sewell.

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

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

Sub-family CYCLOPINAE.

Genus **Cyclops** Müller.

Sub-genus **Metacyclops** Kiefer.

Cyclops (Metacyclops) dengizicus Lepeschkin.

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

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

Genus **Mesocyclops** Sars.

Sub-genus **Mesocyclops** Kiefer.

Mesocyclops (Mesocyclops) leuckarti Claus.

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

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

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

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

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

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

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

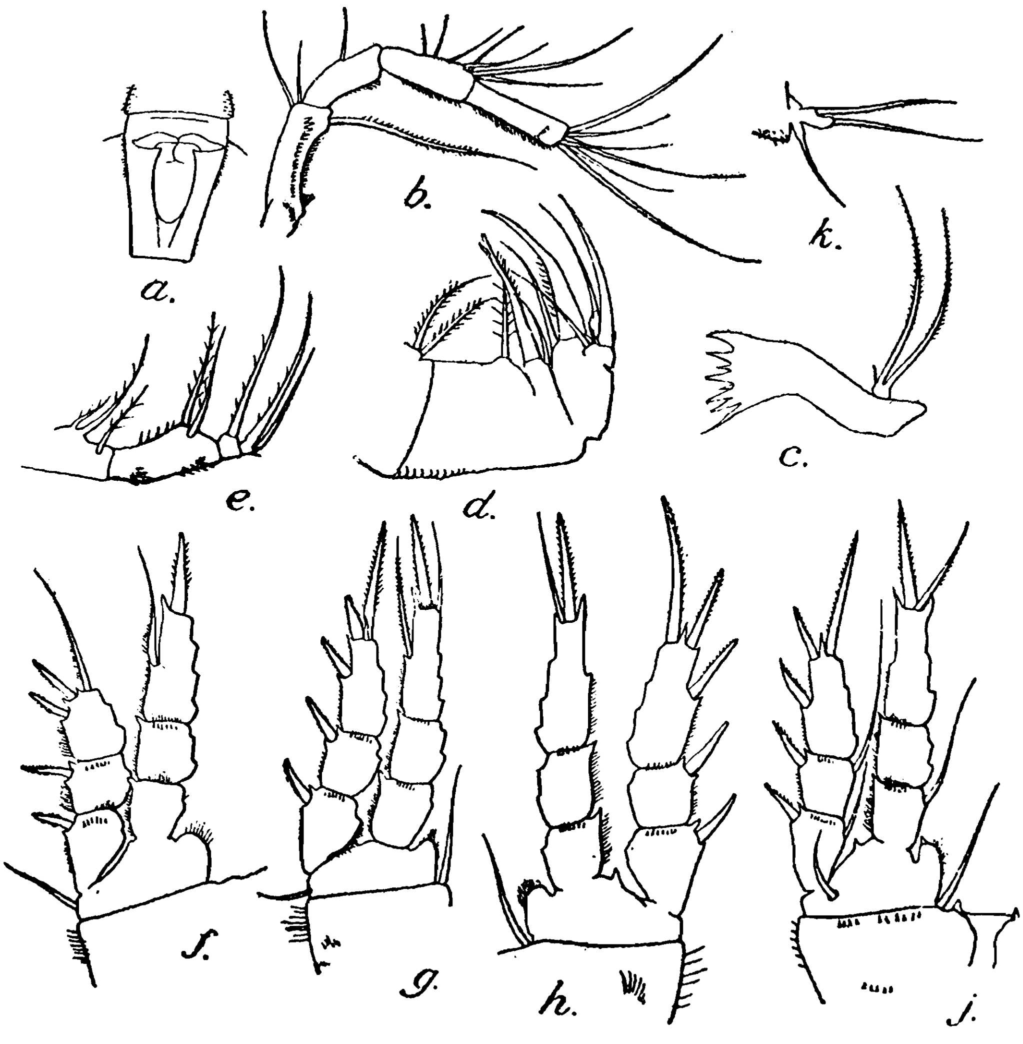
Abdominal segment .	1-2	3	4	5	Furca.	
	37	17	14	11	21	=100

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

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

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

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



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

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

The 2nd antenna (Text-fig. 6*b*) is long and slender. The 1st segment is armed with several rows of spines, of which three are composed of fine needle-like spines and the fourth that runs along the lateral aspect is composed of triangular spines that increase in size distally. The 2nd and 3rd segments are both armed with a row of needle-like spines along their posterior margins. In the 4th segment there are two such rows; the proximal is by far the longer and passes along the proximal three-fourths of the posterior margin and then turns across the face of the segment in a transverse direction. The smaller distal row commences in the posterior fourth of the segment and after a short course turns across the face of the segment near the distal margin.

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

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

The 1st maxilla is as figured.

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

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

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

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

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

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

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

Sub-genus **Thermocyclops** Kiefer.

Mesocyclops (Thermocyclops) rylovi Smirnov.

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

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

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

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

The present form possesses the following characters :

♀ : Total length about 1·0 mm.

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

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

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

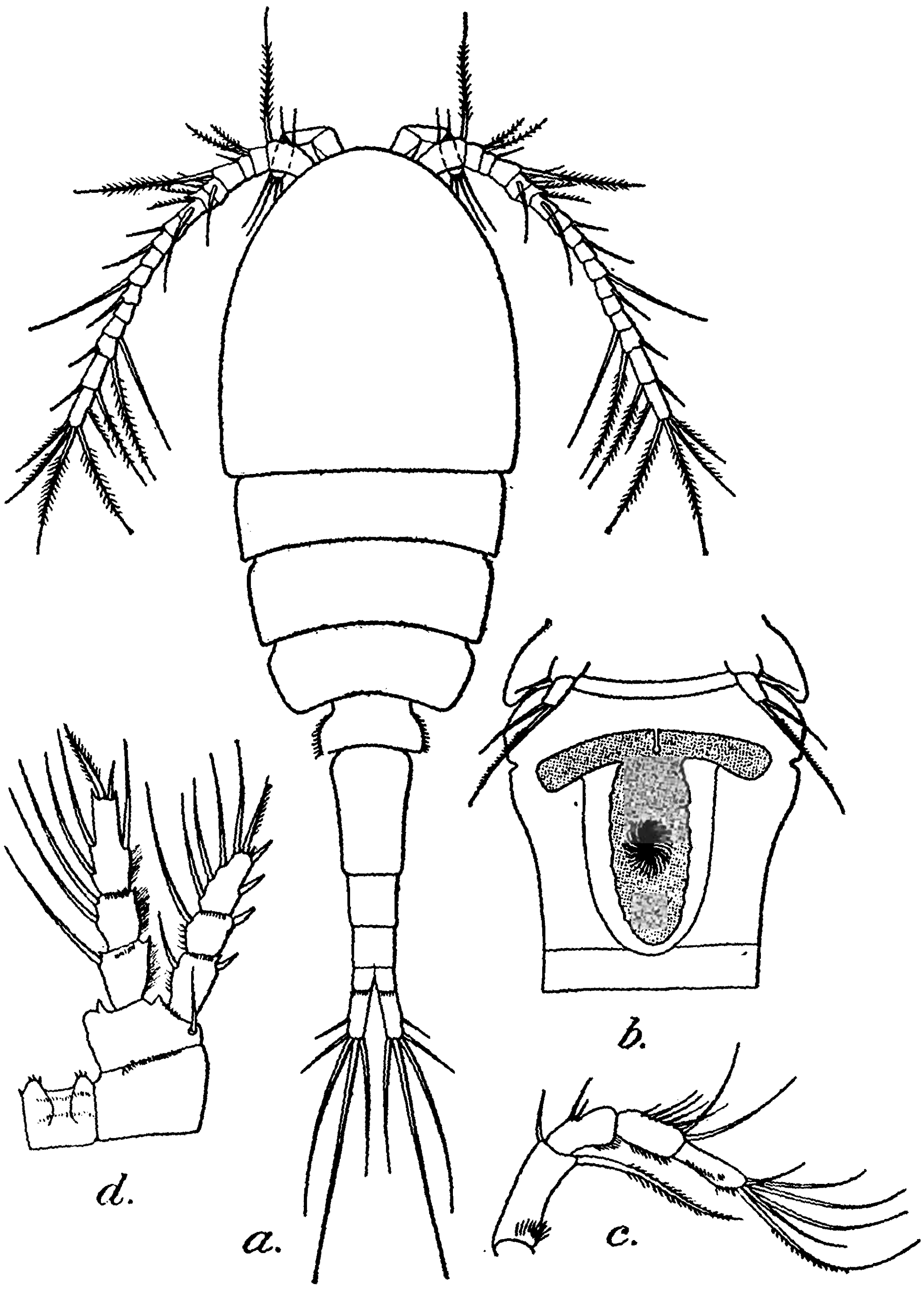
The furcal rami are slightly divergent and are $3\frac{1}{2}$ times as long as wide. The outer furcal seta arises at the junction of the middle and distal thirds of the ramus. The proportional lengths of the furcal setae are as follows :—

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

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

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

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



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

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

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

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

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

HARPACTICOIDA.

Family ECTINOSOMIDAE.

Genus **Ectinosoma** Boeck.

Ectinosoma melaniceps Boeck.

Ectinosoma melaniceps, Sewell, 1924, p. 809.

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

Family TEGASTIDAE.

Genus **Parategastes** Sars.

Parategastes sphaericus var. **similis** Sewell.

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

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

Family DIOSACCIDAE.

Genus **Stenhelia** Boeck.

Stenhelia longifurca, sp. nov.

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

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

♀: Total length 0·708 mm.

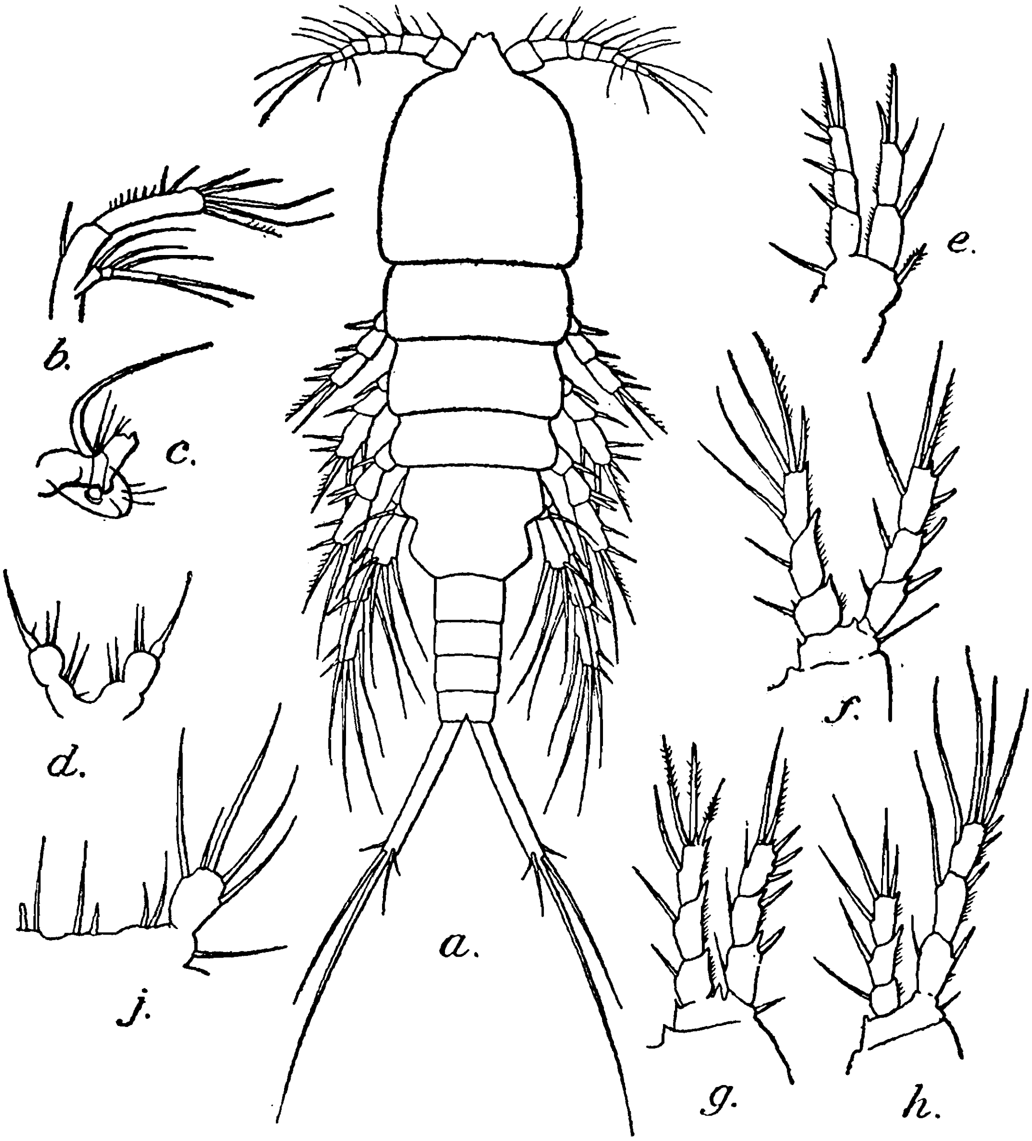
The proportional lengths of the anterior and posterior regions of the body are as 1·045 to 1. The anterior region of the body (Text-fig. 8 *a*) is comparatively robust. The cephalic segment bears anteriorly a broad rost um that terminates anteriorly in a pair of rounded protuberances. The urosome is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

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

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

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

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



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

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

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

The rest of the swimming legs (Text-figs. 8*f*, *g* and *h*) all have a three-jointed exopod and endopod. In the 2nd leg the 1st basal segment is produced at its inner distal angle in a rounded prominence. The 2nd basal segment bears a spine-like process on its inner margin and a second spine-like process is situated between the articulation of the two rami; a slender seta arises from the outer margin. In the exopod the 1st and 2nd segments each bear a single marginal spine and a slender seta arises from the inner border; this seta is especially delicate in the 1st segment. The 3rd segment carries two marginal spines and an end-spine, two setae arise from the segment, one from the inner margin and one distally. In the endopod the segments bear 1, 1, and 5 setae respectively.

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

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

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

Family CANTHOCAMPTIDAE.

Genus **Mesochra** Boeck.

Mesochra meridionalis Sars.

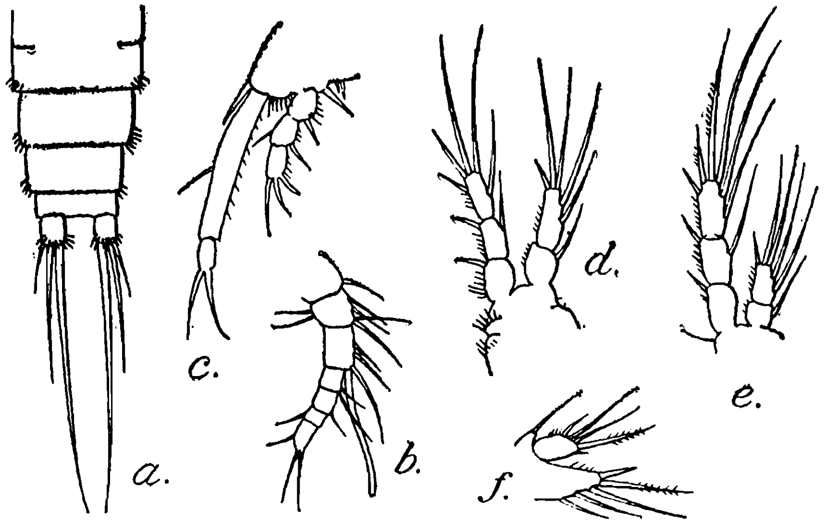
(Text-fig. 9, *a-f*.)

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

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

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

In the general shape and proportions of the body the present examples agree closely with Sars' description. The genital segment of the abdomen (Text-fig. 9*a*) is considerably longer than the following segments and is indistinctly subdivided near the lateral margin. The anal segment is much the shortest. The furcal rami are about as broad as long and are fringed along their distal margin with a row of delicate spines. Of the furcal setae the outer is quite small and of the two distal setae the inner is twice the length of the outer and is as long as the abdomen, The 1st antenna (Text-fig. 9*b*) is short and is composed of seven segments, of which the proximal three are considerably stouter than the



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

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

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

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

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

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

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

The 5th leg (Text-fig. 9*f*) closely resembles the description given by Sars (*loc. cit.*, p. 390 and fig. 100). The basal segment bears a fine seta on its outer margin. The free segment is somewhat more pyriform than as figured by Sars, but the number and arrangement of the spines and setae that arise from the distal end are exactly similar. Two fine setae arise between two stout spines, of which the outer is much the shorter. The prolongation of the basal plate extends as far as or slightly further than the end of the free segment and bears five spines, of which two arise from the distal margin and three from the inner border. The innermost spine is considerably shorter than the next and is even shorter than is figured by Sars.

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

CHIROGNATHA.

Family LAOPHONTIDAE.

Genus **Laophonte** Philippi.

Laophonte bengalensis, sp. nov.

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

♀ Total length 0·563.

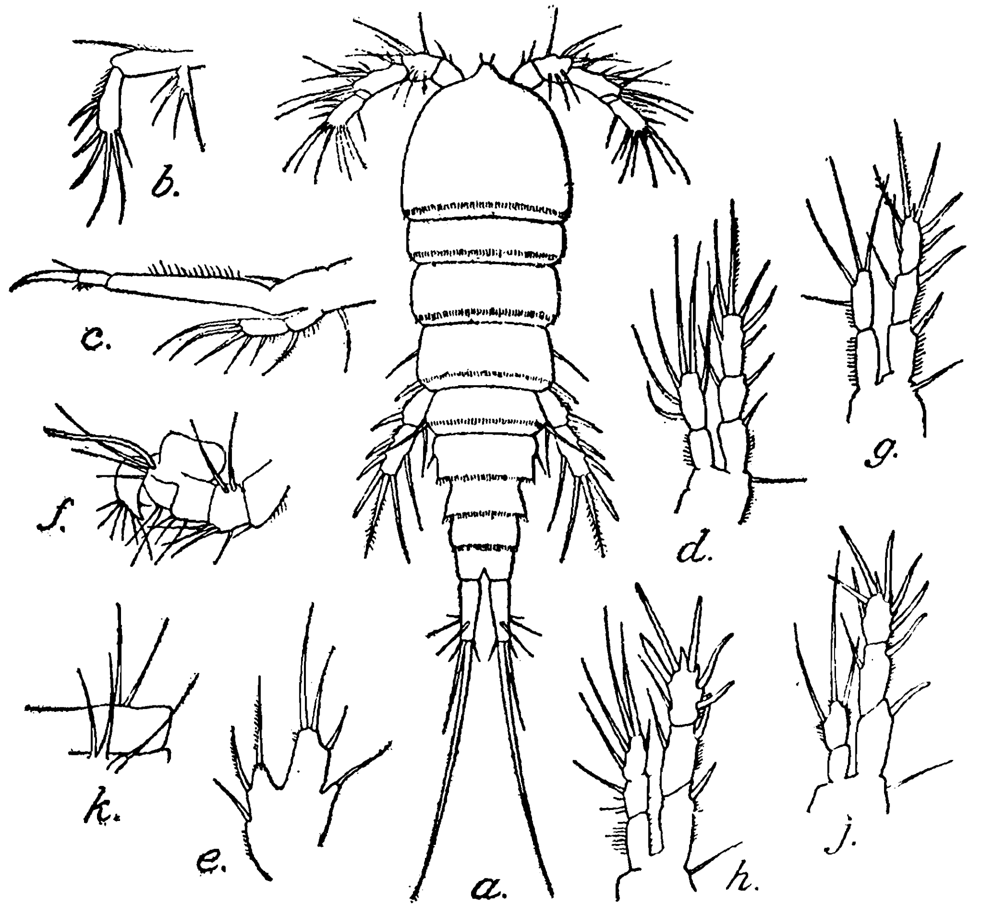
In all the specimens that I have examined the segmentation of the body is complete ; there are four free thoracic segments present but the abdomen consists of four segments only.

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

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

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

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



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

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

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

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

All four pairs of swimming legs (Text-fig. 10*d*) consist of a three-jointed exopod and a two-jointed endopod. The arrangement of the setae and spines on the various segments of the limbs is as follows :—

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

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

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

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

♂ Total length, 0·479 mm.

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

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

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

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

Family CLETODIDAE.

Genus **Limnocletodes** Borutzky.

This genus was created by Borutzky (1926) to accommodate a new species that he obtained from the Volga River and its delta. Unfortunately Borutzky's paper is in the Russian language ; he, however, gives a summary in German and a perusal of this and a comparison of the present form with his figures leaves no doubt that in the collection from the Salt Lake system we have a second and very closely allied species to *Limnocletodes behningi* Borutzky.

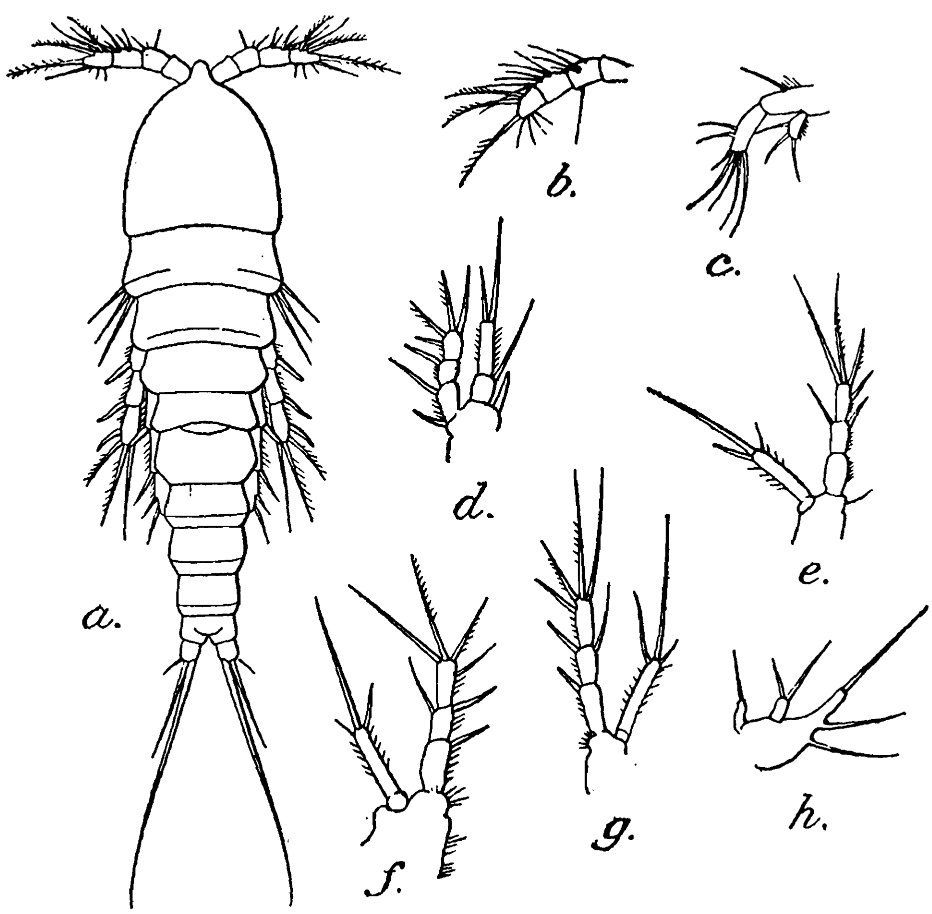
Limnocletodes secundus, sp. nov.

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

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

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

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



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

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

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

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

The mouth-parts appear to be feebly developed.

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

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

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

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

Genus **Cletocamptus** Schmankewitsch.

Cletocamptus confluens (Schmeil).

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

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

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

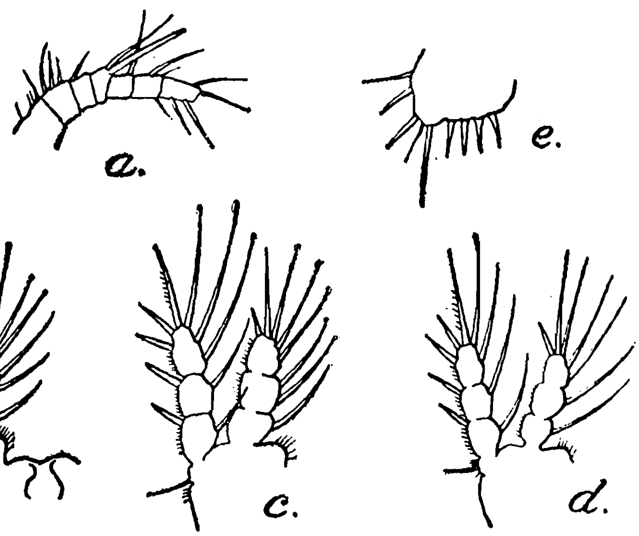
Family TACHIDIDAE.

Genus **Tachidius** Lilljeborg.

Tachidius sp.

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

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



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

Origin of and Changes in the Copepod Fauna.

In attempting to reach any conclusions regarding the origin of the fauna of such an area as this, one must bear in mind that the presence of any given species at the present day may have been the result of passive persistence in contradistinction to active migration. In times past there can be but little doubt that this region was actually a part of the Bay of Bengal and that with the gradual extension of the Delta seawards the water of the rivers and lakes gradually became less and less salt, though the actual process must have been extremely slow. A certain number of marine species that had established themselves within the area during the early stages of the formation of the Delta would doubtless be able to acclimatise themselves to the gradually changing conditions and thus equally be able to persist in their original habitat and form a relict fauna. Annandale (1922, p. 152) has pointed out that " the number of species of marine origin that have established themselves permanently in fresh water above the limits of tidal influence in the Ganges since the old immigration of the cosmopolitan freshwater fauna is small. Most of these species belong, however, to genera no longer found in the sea and probably of relatively ancient origin. The marine fauna of the Delta, on the other hand, is rich and includes not only many peculiar genera, but others, and even species, which also live in the sea. I cannot, however, find any definite dividing line between these two faunas. The relict fauna consists merely of organisms that have proved more capable of establishing themselves in abnormal circumstances, and, therefore, more successful in the peculiar line of life adopted by them." On the other hand a large percentage of the species that constitute the plankton may have been brought into the area by the action of the tidal currents ; in many of the rivers of the Delta the flood stream is extremely powerful and in the Matla and Hooghly rivers, especially at times of spring tides, forms a " bore " that sweeps up the river carrying with it a large planktonic population. Month after month, therefore, examples of the common inhabitants of the marine littoral zone and of the lower estuarine regions will be passively swept high up the river and should they possess the necessary degree of adaptability to changes in the salinity or specific gravity of the water there seems to be but little difficulty in the way of the establishment of a permanent domicile in the higher reaches of the delta or in the associated pools and lakes.

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

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

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

Chilka Lake.

Calanoida.

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

Cyclopoida.

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

Hooghly River and Calcutta Salt Lakes.

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

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

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

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

A study of the distribution of the planktonic fauna of the Salt Lake system reveals several interesting features. In the Hooghly River above the level of Howrah Bridge we got a number of species that we may definitely consider to be true fresh-water forms, since all observations on the salinity of the water in this area have shown that it is completely fresh and, although within the limit of influence of the tides, since there is a regular tidal rise and fall accompanied by a complete reversal of the flow, is yet so far removed from the sea that salt-water cannot penetrate sufficiently far up the river to affect the salinity of the water.

In this area we get the following species :—

Copepoda :—

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

Cladocera :—

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

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

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

and possibly in the same category should be placed

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

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

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

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

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

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

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

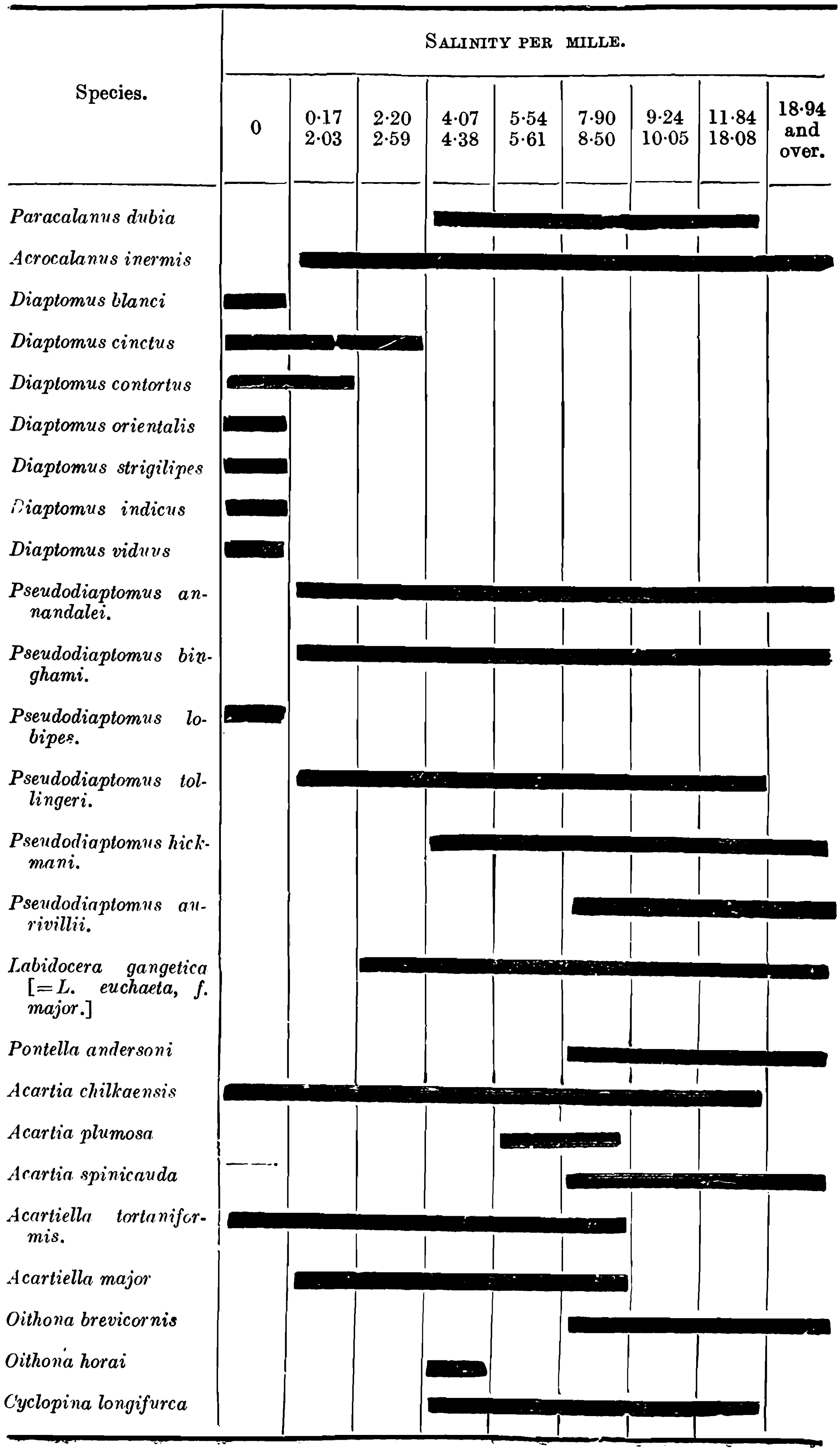
I have already pointed out that changes have been taking place in past years in the character of certain of the canals owing to silting up, and associated with this there has been a very interesting change or series of changes in the character of the fauna. In 1908 Annandale called attention to the presence in brackish-water pools at Port Canning of the Medusa, *Campanulina ceylonensis* (Browne), and in 1912 (*Rec. Ind. Mus.*, Vol. XII) the same species was discovered in large numbers in the Canals of the Salt Lake system. In 1926 the Zoological Survey party found the medusa still present in the Kristopur Canal but during the past few months no sign of its presence has been detected in any tow-netting from the canals either in this part or in any other : this may be due to the fact that it is not the proper season for it, but it appears not improbable that with the lowering of the salinity of the water it has died out owing to the changed conditions since, as Annandale noted (*vide supra* p. 57), it is killed off when the salinity falls below 1006. Another change that has taken place between 1926 and the present day in the plankton of the western portion of the Kristopur Canal is indicated by the comparison of two tow-nettings from the same locality. In the earlier one taken in 1926—the whole catch consisted of a pure culture of *Pseudodiaptomus annandalei,* which as I have indicated, is a brackish-water form ; but in 1932 a tow-netting in the same area contained, in addition to *Pesudodiaptomus annandalei,* examples of *Acartia chilkaensis* and *Mesocyclops* (*Thermocyclops*) *rylovi,* which I regard as brackish-water forms, and specimens of *Diaptomus cinctus,* which is definitely a fresh-water form. This gradual change in the plankton is still more clearly brought out by a comparison of three tow-nettings which I am fortunate enough to have before me, and which were taken in 1914, 1930 and 1932 respectively; the composition of these tow-nettings is given below:—

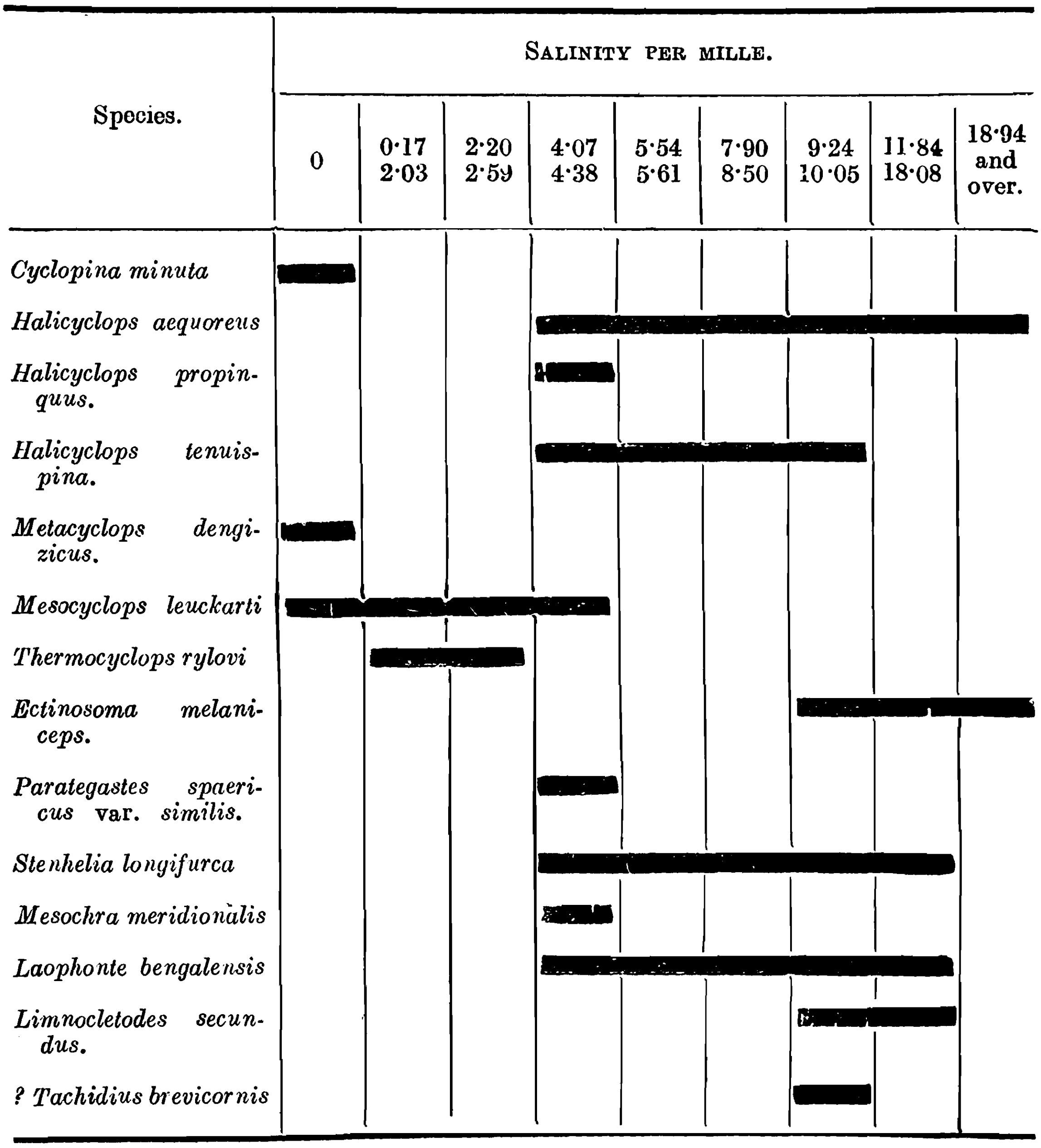
Station—Chingrighatta—Dhappa Canal.

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

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

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


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



In the family Paracalanidae examples of both *Paracalanus* and *Acrocalanus* occur in brackish water. In the former genus Dahl (1893) recorded the occurrence of *Paracalanus crassirostris* from the delta of the Amazon River in water that showed a salinity of 11·8-12·8 per mille. T. Scott (1894) recorded the presence of *Paracalanus pygmaeus* (Claus) from the Gaboon River and Banana Creek, Congo River, in West Africa. Subsequently it was pointed out by Giesbrecht and Schmeil that the species with which T. Scott was dealing was not *Paracalanus pygmaeus* (Claus), but was probably *Paracalanus crassirostris* Dahl. In 1912 I described a form of *Paracalanus*, under the name *P. dubia*, from the mouth of the Rangoon River in water the density of which was 1002. In 1924 I further pointed out that it was possible that all three forms might be representatives of the same species, and Früchtl (1924) in the same year reached the same conclusion and termed *Paracalanus crassirostris* Dahl from the Amazon River forma *typica*, the form described by T. Scott from the mouth of the Congo river as forma *scotti* and *Paracalanus dubia* mihi from the mouth of the Rangoon River as forma *sewelli*. Without accepting this terminology, it is certain that all three forms are closely related to each other and I am inclined to believe that the form described by T. Scott from the mouth of the Congo River may be the same as the form that I have called *Paracalanus dubia*; but I consider that *Paracalanus crassirostris* Dahl is in all probability a different species. Be that as it may, it is interesting to note that the form of *Paracalanus* found in the Hooghly River is the same as that found in the mouth of the Rangoon River but differs from that present in the Chilka Lake. The specific gravity of the water in which *Paracalanus crassirostris* Dahl (*sensu stricto*) has been taken ranges from 1028·5 to 1001·93, which corresponds to a range of salinity from 37·94 to 3·59. *Paracalanus dubia* Sewell has up to the present time only been taken within a range of salinity of 4·07 to 12·30.

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

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

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

(*a*) Forms known only from the sea:—

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

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

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

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

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

(*d*) Forms known from fresh water only:—

Pseudodiaptomus lobipes Gurney.

In a widely-distributed genus such as this the question naturally has arisen, whether migration has been from the sea into fresh water or *vice versa* or again whether the genus may not have arisen in brackish water and have migrated equally in both directions. Tollinger (1911) and Burckhardt (1913) have both studied this problem in the Diaptomidae and they have reached the conclusion that in the genus *Pseudodiaptomus* migration must have been from the sea through the brackish water areas into pure fresh water. Furthermore, this migration must have been carried out independently in both eastern and western hemispheres, and in the former from the Atlantic on the west coast of Africa, from the Indian Ocean, where it has given rise to *Pseudodiaptomus lobipes* Gurney, and from the Pacific Ocean, where it has caused the appearance of *Pseudodiaptomus forbesi* Poppe, *P. inopinus* Burckhardt, and *P. japonicus* Kikuchi. Burckhardt (1913, p. 392) has given a geneological tree of the relationships of various species of this genus and in this he shows the close relationship between *Pseudodiaptomus lobipes*, *P. poppei*, *P. forbesi* and *P. opinus*. Stillman Wright (1928, p. 596) points out that " by modifying the conformation of the tree somewhat, the species described since 1913 can be placed in their proper places. It is obvious that *P. tollingeri* should be placed near *P. poppei*. *P. smithi* may be placed on a branch coming off between the last two species, while a form similar to *P. smithi* may be considered ancestral to *P. forbesi* and *P. inopinus*. While *P. annandalei* cannot be properly considered a member of the group, it has certain characters which indicate that it may have a common ancestor with the group members." Gurney (1927, p. 140) on the other hand would appear to have reached the conclusion that the migration of the various species of the genus has been from fresh to salt water ; he remarks that " *Pseudodiaptomus salinus* belongs to a genus which is characteristic of fresh-water or of estuarine regions where salinity is low. Yet here we have a species living in Suez Bay (not in the sea to the South) and able to establish itself in the very high salinity of the Bitter Lakes." The view that this genus is characteristic of fresh water is contrary to all the evidence and I entirely agree with Burckhardt that the genus is of marine origin and that there has been and doubtless still is a tendency towards migration into brackish and on into fresh water, though but few species have actually been able to penetrate beyond the brackish-water regions.

Among the Pontellidae, in the genus *Labidocera* the majority of species are definitely marine in their habitat, but a few have become acclimatised to life in brackish waters. *Labidocera lubbocki* Giesbrecht was recorded by Lubbock under the name *L. darwinii*, from the mouth of the Guayaquil River and T. Scott under the same name, *L. darwinii*, described a form from the Gaboon River in West Africa ; this latter species was subsequently named *L. scotti* by Giesbrecht. *Labidocera fluviatilis* Dahl occurs in the estuary of the Amazon in water having a salinity ranging from 11·8 to 12·8 per mille. *Labidocera euchaeta* which was described by Giesbrecht from the Straits of Formosa, has frequently been taken in Indian waters and appears to be " essentially a brackish-water inhabitant and occurs in the estuarine regions of most, if not all, of the main rivers " (Sewell, 1932, p. 360) and in the case of the Rangoon River, where it was common, the salinity was only 3 per mille. In the present collection adult examples, as well as numerous young stages, of *Labidocera gangetica* were taken in a tow-netting in Diamond Harbour on the Hooghly River, in water that has a salinity of only 7·90 to 8·50 and young stages were obtained as high up as Achipur in water of a salinity of only 2·23. It thus seems clear that there is a distinct tendency for examples of this genus to extend their habitat upstream in most, if not in all, of the large rivers of the world.

The genus *Pontella* is almost entirely marine in its habitat. One species, *Pontella gaboonensis* T. Scott, was taken in the tow-net at the mouth of the Gaboon River, Africa, and in the present collections examples of *Pontella andersoni* Sewell were captured in Diamond Harbour, Hooghly River, in water having a salinity of 7·90 to 8·50. This latter species has previously been taken off Chittagong and in the vicinity of the Tavoy River and in the Mergui Archipelago, but never previously in water of so low a salinity.

In the family Acartiidae, the genus *Acartia* is for the most part essentially marine in its habitat; but there is a distinct tendency, especially well marked in the sub-genus *Acartiella*, for certain species to migrate into brackish water, or even into water that is absolutely fresh. In the sub-genus *Acartiura*, *Acartia* (*Acartiura*) *clausi* var. *gaboonensis* T. Scott was found living in the Gaboon River on the west coast of Africa, but, as the specific gravity of the water in which the variety was taken was as high as 1023·01, it can hardly be considered to be a true brackish-water form. *Acartia* (*Acartiura*) *simplex* Sars, however, appears to have definitely established itself in brackish water in Chatham Island in the Pacific Ocean; this species is very closely related to *Acartia* (*Acartiura*) *ensifera* Brady that is known from New Zealand and it is possible that the one has been evolved from the other or that both may have had a common ancestor. In the sub-genus *Acanthacartia* we find a tendency for certain species to be present in brackish-water areas. *Acartia* (*Acanthacartia*) *chilkaensis* Sewell and *A.* (*A*). *plumosa* T. Scott have both been taken in such a habitat. The latter was recorded by T. Scott from Loanda Harbour in the Gulf of Guinea on the west coast of Africa and in Banana Creek, Congo River, in water that had a specific gravity of 1008·7 and in the present paper I have recorded its presence in the Salt Lakes, Calcutta, in water of a specific gravity of only 1004·6 (Salinity 5·81). *A.* (*A.*) *chilkaensis* Sewell was first recorded from the Chilka Lake from water the density of which ranged, according to Kemp, from 997·5 at 28·6° C to 1003·25; since then examples have been taken in the canals of the Salt Lakes, Calcutta, in which this species appears to be a permanent inhabitant, where the specific gravity ranges from 1014·52 (Salinity 18·08) to 1001·43 (Salinity 1·87), and in the Hooghly River, where the water was absolutely fresh. Again, in the sub-genus *Odontacartia* we have two species that are capable of maintaining their existence in water that is brackish. *Acartia* (*Odontacartia*) *centrura* Giesbrecht, which is normally an inhabitant of salt-water, has been taken in the Chilka Lake (Sewell, 1924) in water the density of which ranged from 1027·0 to 1014·5; and *A.* (*O.*) *spinicauda* Giesbrecht, which is also normally an inhabitant of salt water, has been taken in the Chilka Lake in water the density of which ranged from 1010·0 to 1015·0 at 15° C, and a single specimen occurred in the Salt Lake Canal system at Chingrighatta in 1914, when the general facies of the fauna was essentially of a brackish-water type; unfortunately I have no record of the actual specific gravity of the water here at that time and in more recent years there have been considerable changes, but it was then about 1006·0 to 1008·5. Numerous examples occur in the Hooghly River at Diamond Harbour, where the water has a specific gravity of 1006·3 to 1006·8 (Salinity 7·9-8·5).

In the sub-genus *Acartiella* the only species that has up to the present time been taken in the sea is *Acartia* (*Acartiella*) *kempi* Sewell, all the other species having been taken in brackish water and in the case of *Acartia* (*Acartiella*) *tortaniformis* Sewell in actually fresh water. There can be little doubt that the genus, and especially the sub-genus *Acartiella* is gradually making its way into the fresh waters of India and I have in a previous paper (Sewell, 1919, p. 17) called attention to the structural changes that are being undergone and that appear to be correlated with the change in habitat.

In the Cyclopoïda it is but natural to expect a very considerable degree of tolerance to brackish and even fresh-water conditions. Commencing with the Family Oithonidae, sub-family Oithoninae, there are several species of the genus *Oithona* that exhibit such a tolerance. I have in a previous paper (Sewell, 1924) recorded the presence of *Oithona brevicornis* Giesbrecht and *Oithona nana* Giesbrecht from the Chilka Lake ; the former was taken in water the density of which ranged from 1015·0 at 15° C. to 1003·25, while the latter appears to have been rather less tolerant and occurred in water with a density ranging from 1026·0 to only 1006. This latter species has not, so far, been recognised in the collections from the Salt Lakes and their associated waters but a species that appears to be new and to which I have given the name *horai* was found in the collections from Uttarbhag in water the specific gravity of which ranged from 1003·47 (Salinity 4·38) to 1003·29 (Salinity 4·16), while *Oithona brevicornis* has been taken in brackish water of a specific gravity of about 1006-1008·5 at Chingrighatta in 1914, and in both the Hooghly and Piali Rivers in water having a specific gravity of 1006·3-1006·8 (Salinity 7·90-8·50) and 1014·5 (Salinity 18·08) respectively. On the Atlantic coasts *Oithona minuta* T Scott has been taken in brackish water in Banana Creek, Congo River, in water having a specific gravity of 1008·7, while *Oithona amazonica* Burckhardt, as its name implies, was taken in freshwater in the Amazon River. Burckhardt (1913) has also described a new species belonging to a closely related genus *Limnoithona*, namely *L. sinensis*, from fresh water from the Tai-hu and Yangtze Kiang Rivers, China. This latter genus has since been transferred by Kiefer (1929) to a new sub-family Limnoithoninae. Burckhardt (1913, p. 444) claims that the occurrence of these species indicates that, although the native habitat of the genus is the sea, where the majority of species are found, certain species are at the present day attempting to migrate into fresh water and that whereas *Oithona minuta* has only proceeded a little way in this migration and is still for the most part to be found in salt water, *Oithona amazonica* has penetrated entirely or almost entirely into fresh water and *Limnoithona sinensis* completely so. Rosendorn (1927, p. 55) is, however, unwilling to accept this explanation and points out that certain species, namely *Oithona nana*, *O. simplex*, *O. minuta* and

O. brevicornis are all marine and brackish-water forms, and maintains that this is not due to any tendency to actual migration into fresh water but merely to a degree of adaptability that enables them to inhabit either type of locality. The occurrence of *Oithona horai* in the Salt Lakes seems to me, however, to be in favour of Burckhardt's view that there is in certain species or group of species in this genus a distinct trend towards migration into a fresh-water habitat, accompanied by definite structural changes.

In the family Cyclopinidae the great majority of species of the genus *Cyclopina* are inhabitants of salt water and most of the species have been reported from the northern Atlantic or its offshoots, as the following list clearly shows :—

Cyclopina longifurcata Scott	North Sea.
Cyclopina longicornis Boeck	North Sea.
Cyclopina littoralis Brady . .	British Coasts.
Cyclopina dilatata Sars . . .	Coast of Norway.
Cyclopina pygmaea Sars	South and South-west coasts of Norway.
Cyclopina brachystylis Sars	South and South-west coasts of Norway.
Cyclopina norvegica Boeck	North Sea and Baltic.
Cyclopina elegans T. Scott	Firth of Forth, Norwegian Coast and Gulf of Naples.
Cyclopina gracilis Claus	Arctic Seas, the North Sea, Mediterranean Sea and Suez Canal.
Cyclopina schneideri T. Scott	Around the Lofoten Islands.
Cyclopina steueri Früchtl	Mediterranean Sea and in the Aru Archipelago, Malay Straits.
Cyclopina belgica Giesbrecht	In the Antarctic seas between Lat. 70 and 71 S.

In a previous paper (Sewell, 1924) I recorded the presence of two species of this genus in the fresh or brackish waters of the Chilka Lake, namely *Cyclopina longifurca* and *C. intermedia*, and Sars (1905) has recorded *Cyclopina pusilla* from brackish water in Chatham Island in the Pacific Ocean. *Cyclopina intermedia* was taken in water that was absolutely fresh, but *C. longifurca* exhibits a wide range of tolerance, for it has now been taken in the water of the Chilka Lake that had a density of only 997·0 at 31·5° C, in the Salt Lake Canal system of Calcutta in water the specific gravity of which ranges from 1003·29 to 1007·40 (Salinity 4·16 to 9·24), and, at the other end of the scale, in weed washings from the sea at Tuticorin. The occurrence of yet another species, *Cyclopina minuta*, sp. nov., in water that was absolutely fresh, indicates that in this genus also there is a distinct tendency to spread inland into fresh-water areas.

In the genus *Halicyclops* only one species, namely *H. aequoreus* (Fischer) has up to the present time been found living in the sea and even in this species individuals have equally been taken in brackish and even in fresh water, or in inland salt-water lakes, etc. Burckhardt (1913, p. 456-7) has called attention to the close relationship between this genus and *Cyclops fimbriatus* and, if I understand him aright, he is of the opinion that *Halicyclops* has evolved from the genus *Cyclops* (*sensu lato*) and that it is now in the process of migrating from fresh to brackish or even to salt water.

The Harpacticidae have up to the present time received but little attention in India and in consequence we are still extremely ignorant both as regards the various species that inhabit Indian waters and their natural habitat. A number of species were taken in the Chilka Lake (*vide* Sewell, 1924) and many of these in water that was brackish, but with the exception of the two species, *Ectinosoma melaniceps* Boeck and *Parategastes sphaericus* var. *similis* Sewell, the Harpacticids taken in the Salt Lakes, Calcutta, and the associated water-ways belong to different species. Chappuis (1928) has given an account of several species of Harpacticids that were taken in fresh water, but again none of these species occur in the Salt Lake collections. It is, therefore, impossible to form any very definite opinion regarding the origin of the Harpacticid fauna of the Gangetic delta. In the Family Canthocamptidae several members of the genus *Canthocamptus* have been described from India (*vide* Chappuis, 1928) from fresh water. In this family numerous species, belonging to several genera, have succeeded in establishing themselves in a fresh-water habitat and in the genus *Mesochra* species are known to occur in either salt or brackish water, at least one species having been found occasionally in water that is actually fresh. According to Gurney (1920, p. 358) *Mesochra rapiens* (Schmeil) [=*M. hirticornis* (T. Scott)] is normally found in brackish water and always not far from the sea ; it has, however, been taken in absolutely fresh water in the Ekoln branch of Lake Malaren, that is considered to be the remains of a former extension of the Baltic, and its presence in this latter region suggests that it is to be regarded as a part of a relict fauna. In the present collections *Mesochra meridionalis* Sars has been found in the Salt Lake Canal system and its presence in two such widely separated localities as this and Chatham Island in the Pacific Ocean strongly suggests that in each case it is to be regarded as a relict, that has been left behind in the Salt Lakes as the deltaic area gradually extended further seawards.

Among the Laophontidae, two species belonging to the genus *Laophonte*, namely *L. chathamensis* and *L. quinquespinosa*, occur in the Chilka Lake. Of these the former had already been taken in brackish water in Chatham Island in the Pacific Ocean and in the Chilka Lake both occurred in water that had a specific gravity of 1002. In the Salt Lakes a new species, *Laophonte bengalensis*, has been taken in water having a specific gravity ranging from 1003·29 to 1014·52 (Salinity 4·16 to 18·08) ; but since at least one species, namely *L. mohammed*, is known to have established itself in fresh water, it is not possible to form an opinion as to whether these Indian species should be regarded as euryhaline species that have invaded this area from the sea or as marine relicts that have been able to survive the gradual diminution in the salinity of the water, or even casual visitors swept in by the flood tide.

The family Cletodidae includes a number of genera that between them exhibit a wide range of habitat but which are almost entirely marine. A certain number of species, belonging to the genera *Cletocamptus*, *Nannopus* and *Enhydrosoma* have established themselves in fresh water and in 1926 Borutzky created another genus, *Limnocletodes*, in this family to accommodate a species that he had taken in the Volga River.

The occurrence of a second species in this new genus in the delta of the Ganges is of considerable interest, but at the present time we do not know enough about its distribution to be able to determine the range of salinity in which it can exist or to form an opinion as to whether it normally inhabits brackish water. The occurrence of *Stenhelia longifurca*, sp. nov. and *Laophonte bengalensis*, sp. nov. in the Piali River and the adjoining pools at Uttarbhag, as well as in the Chingrighatta-Dhappa Canal before the Central Lake channel silted up and Dhappa Lock was closed, indicates that these species have in all probability been carried into these pools and canals from the river during periods of flood tides, and the same is probably true of *Limnocletodes secundus.*

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