PRELIMINARY REPORT ON THE FAUNA OF THE TALÉ SAP OR INLAND SEA OF SINGGORA.

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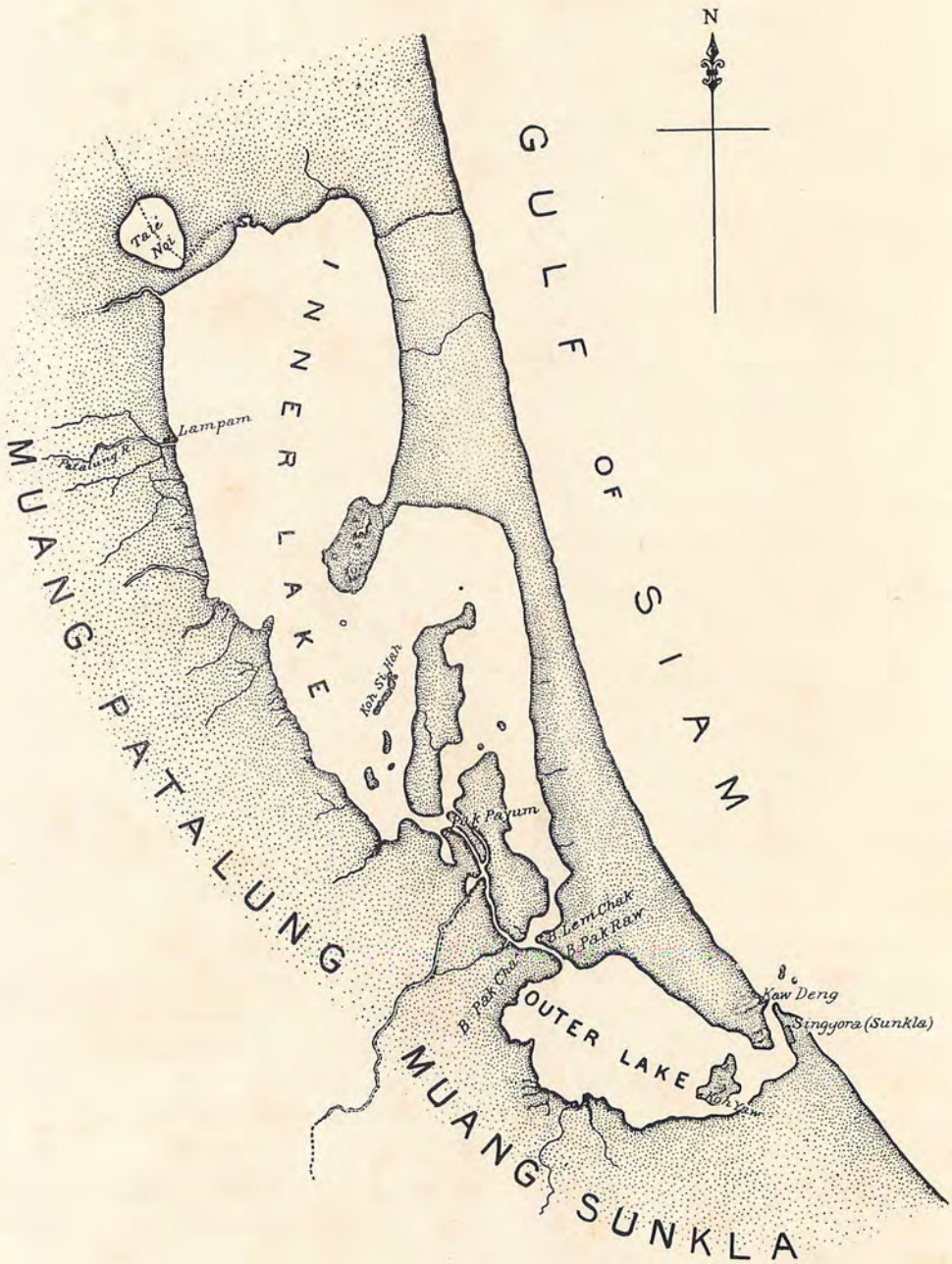
With a Map.

My first visit to the Talé Sap was made in 1899 as a member of the Skeat Expedition to Peninsular Siam. I was there again in 1902, but merely as a traveller, for my object was to reach Penang from Singgora as quickly as possible. The following notes are based mainly on a third visit in January and February, 1916. The object of this last visit was to obtain materials for comparison with a somewhat similar lake or lagoon on the east coast of India, the Chilka Lake in Orissa and the Madras Presidency, on which Mr. S. W. Kemp and I have been engaged for some years in preparing a faunistic report.[1] Both lakes are directly connected with large, open, tropical bays, the Chilka Lake with the Bay of Bengal, the Talé Sap with the Gulf of Siam; both are shallow and muddy, and both contain water that is, at least in part, brackish, and that varies in salinity in accordance with seasonal and climatic conditions. Both, moreover, are separated, geographically and faunistically, into an outer and an inner region in which conditions of life are different, but not always different in precisely the same way, thoughout the year.

My knowledge of the varying conditions due to hydrographic and other changes in the Chilka Lake is naturally much fuller than that I possess of the Talé Sap. At the former not only had I the invaluable collaboration of Mr. Kemp in the field, but we were able to make observations at different seasons and at frequent intervals; whereas in the Talé Sap, I worked alone so far as scientific help was concerned, and only at one period, and that period was at the extreme end of the wet and the beginning of the dry season, in some respects perhaps the most unfavourable from the point of view of the collector.

1 "Fauna of the Chilka Lake." *Mem. Ind. Mus.*, vol. V. 1915— (still in progress).



SKETCH MAP OF THE TALÉ SAP.

In spite of this, interesting results were obtained that may already be discussed in a general way. Before discussing them it will be necessary to give a few additional facts about the "Great Lake" (Talé Sap) or Inland Sea. Like the Chilka Lake it is a great lagoon, nowhere much more than 16 feet deep, and separated from the sea merely by a narrow stretch of sandy country. It is between 50 and 60 miles long, and opens at its southern end into the Gulf of Siam by a short channel, on the southern bank of which the town of Singgora, or Songkla, is situated. A peninsula and a group of large islands separate the lagoon into an outer (southern) and an inner (northern) lake, connected together merely by narrow waterways of considerable length. In the inner lake conditions are almost lacustrine, and the water, except for a slight infusion at times from the connecting channels, is practically fresh; but in the outer lake the water, varying in salinity from season to season, and, probably at times from hour to hour, is always brackish. At the time of my visit its specific gravity (reduced to a standard temperature of 15° C.) was found to range at different spots, from 1·0035 to 1·0085, whereas that of the inner lake was only 1·002 at the point at which the main connecting channel opened into it. Hardly any trace of salinity was indicated by specific gravity further north.

The faunas of the two regions differ, as might be expected, considerably and may be discussed separately.

I. Fauna of the Inner Lake.

Vertebrates. Only two species of snake were observed in the inner lake. They were *Herpeton tentaculatum*, which has not hitherto been recorded from Peninsular Siam, and *Hypsirhina plumbea*, a widely distributed Indo-Malayan form. In the lower reaches of the Patalung River at least two tortoises are common, namely *Damonia subtrijuga* and *Bellia crassicollis*, and both of these probably enter the lake occasionally.

At the margin I found three species of frog, one of *Oxyglossus* and two of *Rana*. The two latter have hitherto been included in the composite group to which the name *R. tigrina* has been applied, but should in my opinion be known as *R. rugulosa* Wiegmann, and *R. cancrivora* Gravenhagen.

Very few fish are found in this part of the lake, but I made a large collection at Lampam from the lowest reaches of the Patalung River and from the creeks in its small delta. Most of the genera represented are well known and widely distributed fresh-water genera such as *Anabas*, *Osphromenus*, *Mastacembelus*, *Panchax*, *Barbus*, *Rasbora*, *Monopterus*, etc., and a large proportion of the species have already been recorded from the Malay Peninsula; but a few estuarine forms such as *Scatophagus argus* occur, and a certain proportion are new to science. Of these the most interesting is a new species of *Etroplus*, the only Oriental genus of the family Cichlidae. This family has not hitherto been found east of the Bay of Bengal, but has a wide range in tropical America and tropical Africa and has made its way northwards, through channels now completely blocked up, into the Jordan system. Several species of *Etroplus* are found in Peninsular India and Ceylon, but none have as yet been recorded from Burma or Siam or any part of the Malay region. A species of Sting Ray, probably *Hypholophus sephen*, occurs on the bottom of the inner lake. *H. sephen* makes its way far up the Ganges and other rivers[1].

Molluscs. With a few noteworthy exceptions, the molluscs found in the inner lake are lacustrine forms. Those that live among weeds near the edge belong to the genera *Vivipara*, *Melania* and *Ampullaria*, while inside the mouth of the Patalung River, *Limnaea*, *Ancylus* and *Planorbis* are also represented. These genera are abundant in all eastern lakes or rivers, and the species found near Lampam are divided pretty equally between Malayan and Indo-Chinese forms; but another form dredged both at Lampam in the river-mouth and out in the lake seems to be unique among its family in living in fresh water. It is a species of *Marginella* and, curiously enough, an allied but distinct species replaces it in the outer lake.

The bivalves taken on the bottom, both in the lake and in the river-mouth, belong to the genera *Corbicula* of the Family Cyrenidae, and *Dimotus* of the family Uniondae. At least three species of the former occur; all can be identified with forms already known from the Malay Peninsula or Indo-Chinese countries. The single Unionid

1. See Chaudhuri, *Journ. Asiat. Soc. Bengal* (n. s.), Vol. VI. p. 427 (1910).

(*D. contradens*) is interesting in that it is also found in Perak and Sumatra, but is represented in Cambodia and other countries to the east of the Gulf of Siam by distinct local races.

The two most interesting genera of bivalves of this region, however, were found only in the open lake. They are *Modiola* of the family Mytillidae or true mussels and *Scaphula* of the family Arcidae. The former genus is essentially a marine one, and has been dredged at considerable depths in the Bay of Bengal. In the rivers and lagoons of India and Burma certain species make their way well into brackish water and can even exist for periods in pure fresh water, while further east, in Siam, Cambodia and Java, allied forms have become wholly fluviatile. Finally, *M. lacustris* was discovered in a lake in the centre of China. The species found in the Ta'é Sap was described some years ago by E. A. Smith[1], from specimens collected by Dr. R. Evans and myself at the Koh Sih-Ha, as *M. evansi*. It is very abundant on rocks, dead tree-trunks and weeds in the neighbourhood of these islands, but I found no specimens in the outer lake that I could assign to it with certainty.

Scaphula is a genus hitherto only known from Indian and Burmese river-systems that open into the Bay of Bengal. It is a dwarfed and slightly modified derivative of the marine genus *Arca*, some species of which (notably *A. granosa*) habitually make their way into brackish water. The Talé Sap species is distinct from any of the Indian or Burmese forms. It is common on weeds all over the inner lake and occurs, much more sparingly, on stones in the outer lake round Koh Yaw near Singgora.

Insects. I had no time to collect insects seriously in any part of the Talé Sap, but two species of surface-bug (Hydrometridae) were observed at different places in the inner lake. Close to the edge near Lampam the widely distributed *Gerris spinolae* was abundant, while off Pak Payun, at the mouth of the main channel connecting the two parts of the lake-system, *Halobates sexualis* was by no means uncommon. The latter was described by Distant[2], from an estuary opening into

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1. Smith, *Journ. Conch.* vol. X, p. 368, fig. (1903).
2. Distant, "Rhynchota Heteroptera" in Annandale and Robinson's *Fasciculi Malayenses*, Zoology, vol. I, p 258, pl xv, figs. 10, 10a, 10b, (1903).

Patani Bay on the same coast. The head of a water snake (*Herpeton*) taken near the mouth of the Patalung River was covered with the eggs of a bug of the same family.

Crustacea. There are comparatively few Crustacea in the lake. The only crab observed was a species of Petamonidae—an almost exclusively fluviatile and lacustrine family. It appears to belong to a form (*Potamon germaini*) common in Siam and the northern part of the Malay Peninsula, and is found in considerable numbers both at the edge of the lake and in streams, rice-fields, etc., in the vicinity. Small shrimps belonging to several species of the family Atyidae—also a freshwater family—abound among weeds in several places. One of them has already been described by Lanchester[1] as *Caridina gracillima*; the type specimens were taken by Dr. Evans and myself at the mouth of the Patalung River in 1899. Inside this river several species of *Palaemon* are caught as food, ranging in size from the gigantic *P. carcinus*, the largest of all the freshwater prawns, which occurs all over tropical and subtropical Asia east of Arabia, to the little *P. lanchesteri* de Man (= *P. paucidens* Lanchester), which is only known from Singgora and Patalung. *Palaemon* is again a freshwater genus, though, as we shall see, certain species migrate into brackish water or can even live in the sea.

In the central part of the inner lake no true crabs or shrimps were found, but a "Schizopod" of the family Mysidae was taken in small numbers. Though this family is mainly marine, certain species have established themselves, both in Europe and in Asia, in brackish and even in fresh water. The Talé Sap form occurs very sparingly if at all in the outer lake and would, therefore, seem to have become strictly lacustrine in habits. Neither Amphipods nor Isopods are abundant in this region, either near the edge or in the central parts. A single specimen of the curious genus *Quadrivisio*, found in brackish water in India and East Africa and common in the outer lake, was obtained at the mouth of the Patalung River, while a narrow-bodied Isopod was found fairly common in the bed of the lake.

The Plankton of this region is probably scanty at all sea-

1. Lanchester, *Proc. Zool. Soc. London*, 1901, p. 560, pl. xxxiv, fig. 1.

sons. In January only a few Copepods and Daphniids were taken in my townets.

Polyzoa. The Polyzoa observed in the inner lake were all true freshwater forms, belonging to the cosmopolitan genera *Paludicella* (of which an interesting new species was taken at Lampam), *Fredericella* and *Plumatella.* Several species of the last are represented in my collection, including *P. tanganyikae* Rousselet, which, as its name indicates, was described from Central Africa and is not uncommon in Peninsular India.

Sponges. The only sponges (three species) found in the Talé Sap belong to the cosmopolitan freshwater genus *Spongilla,* and one of them cannot be separated specifically from the common European *S. lacustris.* Dry specimens of this species were found in a field near Pak Payun, where they had been left by a retreating flood. Specimens of two species were found at Lampam. One of these *(S. nana)* I recently described from the Chilka Lake in Orissa, while the other is a particularly interesting new species of the subgenus *Eunapius.* So far as I am aware, these are the only freshwater sponges (with the exception of *Ephydatia blembingia* Evans,[1] from the Province of Patani) as yet found either in the Malay Peninsula or in Siam; so far as it is yet known, the aquatic fauna of these countries offers a striking contrast to that of India and Burma in the poverty of its Spongillidae.

Even this summary description of the fauna of the inner lake of the Talé Sap system is sufficient to show that it is in the main a true lake-fauna, exhibiting its connection with the sea merely in the presence of a few estuarine fishes and possibly one or two molluscs of marine origin. The most noteworthy of these is the *Marginella,* but the fact that this species is replaced in the outer lake by another, may indicate that it has become a permanent inhabitant of fresh water, and possibly occurs in other lakes or rivers of Siam or the Malay Peninsula.

The inner lake of the Talé Sap is comparable, therefore, from a biological point of view, not with marine lakes such as the Chilka

1. Evans, *Quart. Journ. Micros. Sci.* (n. s.) vol, XLIV, pp. 71-109, pls. iiv (1901).

Lake on the east coast of India, but rather with shallow inland freshwater Lakes such as the Tai Hu in the Kiangsu Province of China and possibly the Tonlé Sap in Cambodia. Comparison with the former is particularly apposite, because there is evidence both geographical and faunistic, that it was connected with the sea at no very distant date and has been isolated by the rapid growth of the Yangtse delta.

II. The Fauna of the Outer Lake and of the Connecting Channels.

The change of fauna as one proceeds southwards from Pak Payun is remarkable and immediate. We have to deal no longer with freshwater animals, but with marine and estuarine types, some of which are extremely characteristic of marine lakes.

Mammals. The only aquatic mammal that I have seen in the Talé Sap is a small Cetacean that inhabits, or inhabited, the main connecting channel at certain seasons of the year. I saw a small school of this porpoise near the upper end of the channel in March and April, 1899, and again in December, 1901; but though it then appeared to be well known to the villagers (who refused to assist in the capture of specimens for any reward that we were able to offer), I was unable to obtain any information about it in January and February, 1916. The species is probably an interesting one and is almost certainly unknown to science. It is remarkable for its small size, long narrow snout and bright brown colour

Other Vertebrates. Several species of sea snake enter the mouth of the Talé Sap freely and are caught in the fishermen's nets near Singgora. The commonest are *Enhydris hardwickii* and *Enhydrina valakadien*. *Chersydrus granulatus* is also caught in the nets, and *Cerberus rhynchops* is common among stones round the shores of Koh Yaw.

One of the two species of *Rana* found at the edge of the lake in the neighbourhood of Lampam (*R. cancrivora*) is also common in the same position near Singgora and does not hesitate to enter brackish and even salt water.

There is a wealth of fish at Singgora, where large numbers of a great variety of species are caught at different seasons, mainly in

stake-nets and dip-nets. The stake-net season terminated in 1916 about the beginning of February, but in the week before it did so I was able to make a large collection. Most of the species are marine and probably swim in and out of the mouth of the lake, but the estuarine forms noted at Lampam also occur with others of like habits. Among the Rays, I collected examples of *Rhynchobatis* (including *R. thouini*, which is a scarce form in the Bay of Bengal), *Trygon*, *Hypolophus*, *Pteroplatea* and *Aetobatis*. Several of the best of the Indian food fishes, for example the Bekhti (*Lates calcarifer*), and the Hilsa, (*Clupea ilisha*), were abundant.

From a zoological point of view, however, the most interesting forms were certain minute Gobies dredged from the bottom of the lake and, in particular, a peculiar little transparent fish which seems to belong to the family Salangidae. This family, which is believed to consist of degenerate relatives of the Salmonidae, has not been found hitherto west of China. Its members, which are more or less anadromous, are remarkable for the transparency of their tissues, for their elongate form and peculiar flattened narrow triangular heads. All the specimens found in the Talé Sap were unfortunately immature, but I have little doubt that they represent post-larval stages in the life-history of a species of *Salanx* or some allied genus that occurs in the Gulf of Siam.

Molluscs. A remarkable feature in the fauna of the outer lake was the large number of dead bivalve shells obtained from the bottom in my nets. A great flood, in which enormous volumes of fresh water had been carried through the outer lake and out of its mouth into the sea by a strong and steady wind, had occurred shortly before my visit, and it is possible that this flood had killed some of the molluscs. We noted in the Chilka Lake[1] that in some species a large proportion of the individuals were killed by the monsoon floods. Some of the beds of dead shells in the Talé Sap are, however, probably of older and less incidental origin. This is indicated by the fact that they include large numbers of acorn-barnacle shells which must have been attached to solid bodies of some kind, and that these shells were lying perfectly

1. Annandale and Kemp, *Mem. Ind. Mus.*, vol. V, p. 337 (1916).

free on the bottom, the objects to which they had been attached having completely perished.

The number of molluscs found living in this part of the lake-system was extremely small. The genera represented in my collection are :—*Marginella* (by an apparently undescribed species), *Cassidula*, *Potamides*, *Faunus*, *Littorina*, *Conradia*, *Stenothyra* and *Neritina* among the Gastropods, and *Ostrea*, *Modiola*, *Arca*, *Scapliula*, *Sphenia*, *Xylotrya*, *Theora* and *Anatina* among the Lamellibranchs. Many of these genera (for example *Cassidula*, *Potamides*, *Neritina*, *Ostrea* and *Arca*) are represented by species of very wide Oriental distribution that are found in almost every estuary between that of the Indus and that of the Yangtse-Kiang. It is remarkable that the species of the other Lamellibranch genera are in most cases totally different from those recorded or described by Lynge[1] from shallow water on the other side of the Gulf of Siam. The only species that I can assign with certainty to one found also in the inner lake is the *Scaphula*. Some very small specimens of *Modiola* may belong to *M. evansi*, but most of them seem rather to be the young of *M. undulata*, a species common in Indian estuaries and lagoons but originally described from the Philippines.

Crustacea. Most of the crabs of the outer lake belong to the family Grapsidae (which supplies a very large proportion of the species that haunt the estuaries of Oriental rivers) and are either shore-crabs or amphibious in habits. Some of these (such as *Varuna littorata*) have a very wide range on Indo-Pacific coasts, but a few seem to be, so far as we know at present, peculiar to the Gulf of Siam. The number of species, however, that are identical with those recorded by Miss Rathbun[2] from shallow water on the other side of the Gulf is not, excepting forms of wide range, so large as might be expected. The running-crabs (Oxypodidae), so characteristic of sea beaches in the tropics, are represented inside the mouth of the lake by but a few species and other families also are poorly represented. Among the

1. Lynge, "The Danish Expedition to Siam 1899-1900. IV. Marine Lamellibranchiata." *Det Kgl. Vidensk. Selsk. Skr. Kobenhavn*, 7 Raekke, nat. og mat., Afd. v, 3 (1909).

2. Rathbun, "The Danish Expedition to Siam, 1899-1900. V. Brachyura". *Det Kgl. Vidensk. Selsk. Skr. Kobenhavn*, 7 Raekke, nat. og math., Afd. V, 4 (1910).

swimming-crabs (Portunidae) the Indian Edible Crab *(Scylla serrata)*, which is also the common edible crab of the Malay Peninsula, and the Blue Swimming Crab *(Neptunus pelagicus)* are common. No Potamonid apparently enters this part of the lake, though *P. germaini* occurs in ditches and ponds at Singgora.

Hermit-crabs (Paguridea) are prevented from making their way for any distance into the lake by the absence of large Gastropod shells in which they might protect their soft bodies. At the mouth, the common Indo-Pacific estuarine form *Clibanarius padavensis* is very abundant, living when adult in marine shells such as those of *Purpura* and *Murex* which it brings in from the sea.

The principal edible prawns at Singgora belong partly to the marine and estuarine family Penaeidae and partly to the freshwater genus *Palaemon*. *Palaemon carcinus*, which has already been noticed as occurring in the Patalung River, commonly enters brackish water in this region to breed, while other members of the genus live in it habitually. The small Atyid shrimps that live among weeds in the inner lake appear near the edge of the outer lake at places where the surface-drainage is sufficient to lessen the salinity of the water. Some interesting burrowing forms occur in the mud of the connecting channel, in particular *Upogebia heterocheir* Kemp,[1] which was only known hitherto from backwaters and marine lakes on the coasts of India.

Several species of Mantis Shrimp (Stomatopoda) occur in the outer channel near Singgora. They all belong to widely distributed types.

A considerable number of Amphipods and Isopods were collected. The former include the four-eyed *Quadrivisio*, the latter are remarkable for the abundance of certain species parasitic, or quasi-parasitic, on fishes. Two of these have been described from the Talé Sap by Lanchester,[2] who has also described a peculiar little barnacle (*Platylepas ophiophilus*)

1. Kemp, *Mem. Ind. Mus.*, vol V, p. 257, pl. xiii, figs. 6, 7 (1915). Strictly speaking this species, which belongs to the group Thalassinidea, is not a prawn or shrimp as it belongs to the Reptantia and not to the Caridea, but it has a prawn-like appearance.

2. Lanchester, *Proc. Zool. Soc. London*, 1902, pp. 377, 378, pl. xxxv. figs. 5, 8, 9.

from the skin of a snake. The common tropical acorn-barnacle *Balanus amphitrite* often covers the surface of fishing-stakes off Koh Yaw with its shells, but is liable to be killed by floods of fresh water.

Polyzoa. The Polyzoa of the outer lake are not unlike those found in similar situations in the Bay of Bengal. The most interesting species is perhaps an undescribed Entoproctous form, representing a new genus but allied to the Indian brackish water *Loxosomatoides*, and more remotely to the North American freshwater *Urnatella*. The Ectoproctous species belong to the genera *Membranipora*, *Triticella*, *Bowerbankia* and *Victorella*, and (with the exception of the *Triticella*) are identical with Indian forms. The *Triticella*, which was found on the tail of a sea-snake and on the shell of *Limulus*, is interesting in that it is a British species (*T. gedicillata*) not previously found in Eastern waters, in which the genus is very scarce.

"*Worms*". Lanchester [1] has described a small Echiuroid worm from the inner part of the connecting channels under the name *Thalassema sabinum*. I found a specimen exactly answering to his description in the outer channel opposite Singgora, but it differs greatly from the specimens preserved in the Cambridge Museum as the types of the species, and some confusion must have occurred.

Several Polychaete worms live in the mud of the outer channel, and one makes itself conspicuous by the relatively enormous size and the exposed situation of its egg-masses. These are encased in transparent pear-shaped bodies, which are anchored by a basal tube (which represents the stalk) and float like balloons in mid-water at the edge of the lake, and in ditches connected with it. This worm certainly belongs to the family Eunicidae and probably to the genus or subgenus *Marphysa*. The small white calcareous tubes of a Serpulid may be seen in large numbers on logs of wood and other bodies submerged in the outer lake. Similar worms are common in some of the Indian backwaters, but seem to be entirely absent from the Chilka Lake.

Sea Anemones, Medusae and Hydroids. At least three kinds of sea-anemone are found in the outer channel of the lake, but they are all small and inconspicuously coloured. One species, which is

1. *Id., ibid.*, 1905 (I), p. 40, pl. ii, fig. 5.

attached to the appendages of *Limulus*, is probably no more than an occasional and involuntary visitor to the lake-system; another lives on mollusc shells inhabited by hermit-crabs, while a third was dredged apparently unattached. None of these species are probably related to the characteristic forms of Indian backwaters and estuaries.

Large Medusae of various families are often carried into the mouth of the lake by tidal currents, but soon perish in brackish water, in which the only species that survive, so far as the Talé Sap is concerned, are small and colourless. One of these is the medusae of *Campanulina ceylonensis*, the life-history of which was recently worked out at Calcutta by Major R. E. Lloyd.[1] It is a marine form that can live in water of comparatively low salinity and is therefore able to make its way inland in the delta of the Ganges for considerable distances.

Only two Hydroids were observed in the Talé Sap, a species of *Perigonimus*, which forms shaggy and conspicuous fringes on fishing-stakes, and a small and transparent Campanulariid, not uncommon on the shells of molluscs and on dead palm leaves that had fallen into the water.

The fauna of the outer lake of the Talé Sap system is thus that of a true marine lake and is strictly comparable with that of the Chilka Lake. Very little is at present known about seasonal changes in physical conditions in the Talé Sap, but it is clear that considerable differences in respect to such changes exist between it and the Chilka Lake. Variation in salinity, for example, seems to be even more inconstant in the Talé Sap, and the fact that the rivers which enter it do so at intervals along the whole length of one side, rather than only in a comparatively small area at one end, must have considerable bearing on this point. Generally speaking, the fauna of the outer lake resembles that of the outer channel of the Chilka Lake, but there are important differences that cannot be fully estimated as yet, and only a comparatively small number of the species are identical. I hope to publish later, when at any rate the greater part of my collections have been worked out by specialists, a fuller account

1 Lloyd, *Rec. Ind. Mus.*, vol. XII, pp. 52-57, pls v-vii (1916).

of the main biological features of this interesting lake-system, but it is clear that no complete account can be prepared until observations have been made at different seasons and for considerable periods.

In preparing this preliminary report I have been much indebted for assistance to Mr. S. W. Kemp, Superintendent in the Zoological Survey of India, who has identified the majority of the Crustacea mentioned, and also to Dr. B. L. Chaudhuri, Assistant Superintendent in the same department, who has helped me greatly in naming the fishes.