THE FAUNA OF THE INLE LAKE.

SUMMARY OF RESULTS.

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With Plate XXVI.

The object of this paper is to summarize what has been said in previous papers in this volume on the biology, the geographical relations and the origin of the fauna of the Inlé Lake.

In the time at our disposal in the Shan States Dr. Gravely and I were able to study only the macroscopic fauna and I must ignore one important element, namely the plancton, which I have purposely omitted from consideration. At the time of our visit to the lake, in early spring, floating organisms were extremely scarce and it is always necessary if the plancton of fresh water is to be examined in a satisfactory manner that collections should be made at all seasons. We know that many of the organisms are plastic and vary greatly with temperature and the like, and I am not at all sure that descriptions of stray samples of plancton are not liable to obscure rather than to elucidate the biology of a given body of water. In another direction we were able to do little—in the collection of aquatic reptiles, Batrachia and the more delicate insects, mainly because we were on the lake too soon after winter.

ZONES OF LIFE IN THE INLE LAKE.

Three zones of life can be distinguished in the Inlé Lake :—a Marginal Zone, an Intermediate Zone and a Central Region.

Marginal Zone.—This is a zone of varying width that encircles the lake. It owes its most peculiar features to the fact that it is covered with floating islands of dead and living plants in which the dead matter is undergoing a transformation into fen-peat. The process produces chemical changes in the water and also in both the chemical and the physical condition of the mud at the bottom, which is black, fairly coherent and often malodorous. Contamination of another kind is due to the villages built at the edge of the lake and on piles in the water. The floating islands provide abundant cover, with the floating plants on the channels between them, while the villages provide food for foul-feeding animals ; but the conditions prevalent in this zone are unfavourable to the more delicate forms of life and the environment is of the paludine rather than the lacustrine type. At the two ends of the lake, and to a less extent at certain places on the western shore, the ring of floating islands merges gradually into a great marsh, covered with a network of natural and artificial waterways and containing numerous small stagnant pools. This marsh is buried in gigantic reeds, which are burnt

down by the villagers in spring and explode with reports like pistol-shots, producing dense clouds of smoke. The floating islands are often reversed and cultivated or made to support pig-styes or even human habitations.

Intermediate Zone.—On the inner edge (*i.e.*, the edge nearer the centre of the lake) of the Marginal Zone the water, though doubtless less pure than that of the central parts, is clear, and the mud, though black, is less coherent and less malodorous. Submerged thickets of such plants as *Ceratophyllum*, *Hydrilla* and *Utricularia* flourish, those of *Ceratophyllum* being particularly luxuriant. This part of the lake may be conveniently considered as an Intermediate Zone, but its boundaries, whether inwards or outwards, are ill-defined.

Central Region.—In the open central parts of the lake the water is of the most perfect transparency, oxygenation of dead vegetable matter takes place rapidly and completely, and the bottom is composed of minute calcareous particles and fragments of dead plants mingled together to produce a peculiar greyish semi-liquid mud much less solid than good porridge. It has no foul odour. Mr. R. V. Briggs has provided the following analyses of dried mud and of water from this region :—

Water from Surface in Central Region.

	Per litre.
Total solids	0·1710
Organic matter	0·0160
Calcium	0·0222
Magnesium	0·0279
Chlorine	0·0017
Sulphate (SO_4)	0·0017
Silica	0·0010
Carbonic Acid (CO_3)	0·1030
Iron	Less than one part in 5 million.

Mud from Bottom of Central Region.

	Per cent.
Insoluble Silicious matter	0·98
Alumina	1·30
Oxide of Iron	2·25
Lime	45·31
Magnesia	1·25
Potash	0·12
Soda	0·46
Moisture	3·10
Carbonic Acid	33·15
Phosphoric Acid	0·17
Sulphuric Acid	0·41
*Organic matter and combined water by difference	11·50
	100·00
*Containing Nitrogen	·0619

A considerable part of the Central Region, from which, despite its shallowness, plants growing up out of the water or floating on the surface are practically absent, is filled almost to the surface with thickets of *Ceratophyllum*, but the bottom in many places is almost bare, with scattered plants of *Potamogeton* and *Hydrilla* or with clumps of Characeae, the growth of which seems to choke that of other plants. The Intha fishermen have the custom of protecting the houses occasionally built on poles in the Central Region in connection with fisheries or for other purposes, by floating breakwaters formed of strips cut off from the islands of the Marginal Zone, towed out and anchored by bamboo poles thrust through them into the bottom. These artificial floating islands flourish and produce in their immediate vicinity conditions similar in some respects to those prevalent in the Intermediate Zone, but they are not numerous and their influence is on the whole of small importance.

ANIMAL LIFE IN THE MARGINAL ZONE.

The most striking feature of the fauna of this zone is its wealth of insect life. Characteristic species occur among the fish and molluscs, but most of them are also found in marshes and pools and the fauna as a whole is paludine.

SPONGES.—*Ephydatia fluviatilis* var. *intha* is occasionally found and *Spongilla fragilis* var. *calcuttana* and *S. lacustris* var. *proliferens* occur.

ANNELIDS.—In mud at the edge of the lake we found two species of Oligochaeta, the Tubificid *Branchiura sowerbyi*, one of the few species with external gills, and the Megascolecid *Perionyx fulvus*, a form that possesses no obvious modification for an aquatic life. The specimens of *Branchiura* are of normal size with the gills long and as a rule numerous. A small almost colourless leech of the genus *Glossosiphonia* is common on the gastropod molluscs *Taia shanensis* and *Ampullaria winkleyi*, and we found specimens of a larger species of the same family on the tortoise *Cyclemys dhor shanensis*.

POLYZOA.—The Ctenostome *Hislopia lacustris* sometimes grows on Gastropod shells, but not so commonly or so luxuriantly as in other parts of the lake.

DECAPOD CRUSTACEA.—The little Atyid prawns *Caridina annandalei* and *C. weberi* occur, but *C. weberi*, which apparently enters the lake occasionally from small streams, is much less abundant than its congener. The crab *Potamon acanthicum* is fairly common among the roots of floating islands and *P. curtobates* probably wanders in occasionally from the rice-fields and marshes it usually inhabits.

INSECTS.—Both larval and adult aquatic insects are very abundant, but the latter are mainly surface-forms, the family best represented both in species and individuals being the Hydrometridae, which are attracted both by the shelter afforded by the islands and the floating plants on the waterways, and also by the abundance of food. As all members of the family are rapacious or feed on dead insects that have fallen into the water it is important for them to live in places where other insects are abundant, while their movements on the surface are greatly impeded by even small waves. The commonest species of Hydrometridae on the Inlé Lake are *Gerris fossarum* and *G. nepalensis*. Another family of Rhynchota, not surface forms, is well represented in the Corixidae, but Nepidae are comparatively scarce. Water-beetles of all families are also rather scarce. Dragon-fly larvae (Agrionidae and Aeschnidae) are abundant. Among Dipterous larvae we observed those of Culicidae (both Culicinae and Anophelinae,[1] both very scarce), Chironomidae and Stratiomyidae. Caddis-worms were not very common.

Speaking generally, therefore, the insects of this zone are just such as would be found in any Oriental marsh, though the number of apparently endemic species is large. No special modifications were observed.

MOLLUSCS.—The characteristic molluscs of this zone are *Planorbis exustus*, *Ampullaria winkleyi*, *Hydrobioides nassa typica*, *Hyrobioides nana* and *Taia shanensis*. All of these but the last, which has not

[1] *Anopheles barbirostris*, v. d. Wulp. I have to thank Dr. Baini Prashad for naming specimens of larvae.

been recorded from any other definite locality, are also found in swamps, pools and canals in the neighbourhood and have a wide distribution at any rate in Burma. *Hydrobioides nassa lacustris* occurs with the typical form in this zone only. Probably the pond form of *Limnaea andersoniana*, of which a dead shell was found floating on the surface, visits it occasionally, but the smaller Limnaeidae of other parts of the lake are scarce if not altogether absent. *Succinea indica* is found at the margin. We took no specimens of *Melania* or of any Pelecypod.

Fish.—Most or all of the fish of the Central Region of the lake wander as far as the Marginal Zone occasionally, but its characteristic species, which rarely or never visit the Central Region, are the eels *Amphipnous cuchia* and *Monopterus albus*, the cat-fish *Clarias batrachus* and the minute but brilliantly coloured Cyprinid *Microrasbora erythromicron*. With the exception of the last, these are mud-haunting species of wide geographical range that flourish in marshes, rice-fields, ditches, canals and slow streams. *M. erythromicron* is, however, a surface or mid-water fish that conceals itself under floating vegetation. It is only known from the Inlé Lake and from other parts of the Inlé basin, in which it is, to judge from its frequent occurrence in the dried whitebait sold in the Intha bazaars, by no means uncommon. A single specimen of the peculiar little eel *Chaudhuria caudata* was taken in this zone.

Reptiles.—The tortoise *Cyclemys dhor shanensis*, only known from the Inlé system, is not uncommon at the edge of the lake.

Animal Life in the Intermediate Zone.

There are few species confined to this zone, which is naturally a meeting-place for those of the Central Region and those of the Marginal Zone. Perhaps the most characteristic feature is the rich growth of sponges, mainly *Ephydatia fluviatilis* var. *intha*.

Sponges.—The *Ephydatia* is very common on weeds and *Spongilla lacustris* var. *proliferens* occurs.

Hydrozoa.—Numerous specimens of *Hydra vulgaris* were found amidst a growth of *Hislopia* on a post in this region.

Annelida.—Minute free-living Oligochaetes of the family Naididae are common among weeds and Polyzoa, but the only specimens collected were from the canals of *Ephydatia*. They represent three species of the genus *Chaetogaster*, one of which has recently been described from freshwater sponges in Japan, while another was originally found in the same organisms in Calcutta, the third being Palaearctic and often quasi-parasitic on *Limnaea*.

Polyzoa.—The house-posts of fishing-huts erected in this zone are covered with a growth of *Hislopia lacustris*, which also occurs very commonly on the shells of living molluscs of the genera *Hydrobioides* and *Taia*. We found, on the stem of a plant, a single colony of *H. malayensis*, an allied species described from a small lake in the Siamese Malay States and also common in the River Hughli at Calcutta.

Decapod Crustacea.—Probably the only Decapod Crustacea that live in this zone are the same as those found in the Central Region, namely *Potamon acanthicum* and *Caridina annandalei*.

INSECTS.—Insects are much scarcer than in the Marginal Zone. Most if not all of the marginal species, however, make their way into it occasionally. Several Chironomid and free-living Trichopterous larvae were found in the canals of *Ephydatia*, together with one of the Neuropterous genus *Sisyra* (Hemerobiidae), a genus whose larva is always found in sponges.

MOLLUSCS.—The most characteristic molluscs of the zone is *Taia elitoralis*, which is not known elsewhere but is closely allied to the fossil *T conica* from the Hsin-Dawng valley in the same district. It reaches a larger size than any other Gastropod of the lake except *Ampullaria*. *Hydrobioides nassa lacustris* grows larger here than in the Central Region. *Ampullaria winkleyi* is fairly common at some places, but *Planorbis exustus* does not come so far from the margin of the lake. The smaller Limnaeidae are perhaps more numerous in this zone than in any other; their shells are often a little darker in colour than in the Central Region.

FISH.—There is no fish peculiar to the Intermediate Zone, but the little Cyprinidae *Microrasbora rubescens* and *Sawbwa resplendens*, which are also common in the Central Region, perhaps breed in the former only, for it was only in this zone that we found the males in full breeding colour. *Barilius auropurpureus*, on the other hand, is neither so big nor so brightly coloured, though common enough, as in the Central Region. All weed-haunting species are abundant, *e.g.*, the Shan Carp (*Cyprinus carpio intha*), *Cirrhina latia*, *Ophiocephalus* spp., *Mastacembelus* spp., etc.

ANIMAL LIFE IN THE CENTRAL REGION.

This is the only part of the lake in which the fauna can be said to be completely lacustrine. In it most of the peculiar species (excluding insects) occur in abundance and in many respects it is the most characteristic of the three regions. A curious feature is the complete absence of sponges, a fact for which no explanation is at present forthcoming. A similar lack is that of Phylactolaematous Polyzoa, but this is a feature of other parts of the lake also. The bottom fauna is perhaps richer than elsewhere, and it was only in the Central Region that we found Pelecypoda.

PLATYHELMINTHES.—Small Planaria of very normal appearance (*P. burmaensis* and *P. annandalei*) were dredged from the bottom. The most interesting feature about them is the complete or partial absence of rhabdites from their integument. The aberrant Trematode or Temnocephaloid *Caridinicola* is common in the gill-chamber of *Caridina annandalei*.

ANNELIDA.—The only Oligochaete we collected was *Branchiura sowerbyi*, which in the semi-liquid mud of this region attains an unusual size and has as a rule its gills less well developed than in the Marginal Zone, in which the water is much less thoroughly oxygenated. Great length is necessary for a cylindrical animal in the peculiar mud of the Central Region, if it would maintain a vertical position. A small red leech of the actively predaceous family Herpobdellidae is found occasion-

ally on the bottom and a *Glossosiphonia*, probably the same as that taken in the Marginal Zone, is not uncommon on *Taia intha*.

POLYZOA.—The only Polyzoon seen was *Hislopia lacustris*, colonies of which often cover living shells of *Taia* and *Hydrobioides* and grow on the exposed part of the valves of *Physunio*. This animal also grows over posts in the water. Its growth must be rapid, for it is known to cover a post in a few weeks.

DECAPOD CRUSTACEA.—*Caridina annandalei* is very abundant among weeds and we dredged several specimens of *Potamon acanthicum* from the bottom.

INSECTS.—Adult aquatic insects are scarce in this region. At places where artificial breakwaters have been made by anchoring strips of floating islands a few individuals of *Gerris fossarum* and *G. nepalensis* may occasionally be seen on the surface, in the shelter of the breakwaters. A *Micronecta* also occurs beneath floating masses of *Ceratophyllum*.

The number of insect larvae, on the other hand, is enormous, but rather in individuals than in species. At the season of our visit (the latter part of February and the beginning of March) vast swarms of small midges, caddis-flies and may-flies issued from the water every evening at dusk. They consisted mainly of three species, a small Chironomid of a genus I have been unable to identify, a small may-fly of the family Baetidae and a small caddis-fly of the family Leptoceridae. All three species are able to live, if they survive the attacks of the fish *Barilius auropurpureus* (which feeds extensively upon them) and other enemies, for several days. By day they conceal themselves; we found them in abundance between our books and in every possible corner. Fortunately none of them were blood-suckers. In spite of the prodigious abundance of the midge we were unable to identify its larva; possibly it is a red "blood-worm" very like that of many European species and common in mud at the bottom. The larva of the caddis-fly lives in great numbers among weeds in a little horn-shaped case of consolidated silk. Its feet are fringed with long hairs and it swims about vigorously by means of them. The Ephemerid larva is also found among weeds. It is a rather sluggish little animal of the type normal in its family. Other larvae found in this region are those of numerous species of dragon-flies, Agrionidae and Aeschnidae among weeds and Libellulidae on the bottom. The commonest species are the Agrionids *Ischneura* sp. and *Pseudagrion microcephalum*. The only other larva that we found at all common was that of the Chironomid *Polypedilum*. This larva constructs a case of silk to which it affixes living Protozoa (*Epistylis*), and lives among weeds, feeding on the Protozoa and other small animals. No burrowing larvae were observed except the red "blood-worms."

MOLLUSCS.—All the characteristic molluscs of the lake (except *Taia shanensis* and *T. elitoralis* and the paludine species of the Marginal Zone) are to be found in large numbers in this region. *Taia intha* and *Physunio ferrugineus* are apparently endemic in it, while the widely distributed *Melania tuberculata* and *Pisidium casertanum* were not found in any other part of the lake. *Taia intha, Hydrobioides nassa lacustris*

and *H. physcus* are much the most abundant species. *Amnicola alticola* is also very common, and *Physunio ferrugineus* fairly so. The smaller Limaeidae occur in small numbers among weeds.

FISH.—All the fish of the lake (except the mud-loving eels and catfish and *Microrasbora erythromicron*) probably enter this region, but *Barbus schanicus*, which is not a true lacustrine fish, avoids it habitually and we have no evidence as to the occurrence of *Lepidocephalus berdmorei*, which is little more than a stray immigrant in the lake. The most characteristic species is *Barilius auropurpureus*, which swims in large shoals just below the surface of the water. *Chaudhuria caudata* is found among weeds.

The fauna of the Central Region (*i.e.*, the true lacustrine fauna) of the lake consist mainly, from a biological point of view, of two elements, *viz.*, animals that live among weeds and bottom forms. Surface organisms of all kinds are, at any rate in early spring, very scarce and even *Barilius auropurpureus* descends to the bottom in the heat of the day.

The bottom fauna includes comparatively few burrowing forms, probably on account of the tenuity of the mud, which renders burrowing for any but very small and light or extremely elongate animals difficult. Among the few burrowers are *Physunio ferrugineus*, which works its way through the mud with the aid of a sharp projecting "wing" and is never entirely submerged, a very small form of *Pisidium casertanum*, the Oligochaete worm *Branchiura sowerbyi* (which is much longer than usual in this position and, like the Unionid, only buries the anterior part of its body) and small red Dipterous (Chironomid) larvae. *Melania tuberculata* crawls habitually on the bottom, on which, as well as among weeds, *Taia intha* and the species of *Hydrobioides* are also to be found. We dredged a few small Planarians of normal appearance and some flattened Libellulid dragon-fly nymphs, also mud-crawlers.

Life is rich among the weed-thickets of this region. Most of the fish conceal themselves and probably spawn among them. The small Limnaeidae so characteristic of the lake as a whole, *Caridina annandalei* and the larvae of Agrionid dragon-flies and of the Trichoptera and Ephemerids that swarm in the evening in a winged state find their home here. The peculiar larva of the midge *Polypedilum* in its case (which is also its larder) decorated with living Vorticellid Protozoa, also lives amidst the thickets of *Ceratophyllum*. A prolonged search would certainly reveal other interesting forms. A peculiarity of the weeds of this region is the total absence of sponges and polyzoa.

The house-posts of our dwelling in the middle of the lake had an interesting fauna, which it was possible to observe in almost ideal conditions. The house had been erected only a few weeks before our visit, but the surface of some of the posts on which it stood was almost completely covered with large colonies of *Hislopia lacustris*, the upper parts of which were perishing as the water sank. Considerable numbers of the mollusc *Taia intha* sat on the posts, sometimes without moving from day to day, and the two commonest species of *Hydrobioides* crawled on them more actively. The curious fish *Discognathus lamta* also

frequented them, clinging to them with its peculiar lip, gradually swimming up them, browsing on the way on *Hislopia* and algae.

Groups of Animals represented.

Considered as a whole, the fauna of the lake is remarkably rich in fish and molluscs, both of which are abundant in species and individuals and include peculiar and apparently endemic forms. The Mollusca exhibit extraordinary plasticity and in several instances a very high degree of specialization in shell-form. The fish are almost equally remarkable. Included among them are several minute brilliantly coloured species and also the eel *Chaudhuria*, which is very small but not brilliantly coloured—a form so peculiar that a new family has had to be founded for its reception. A characteristic feature of most of the fish, doubtless correlated with the clearness of the water, is the large size of their eyes and the poor development of tactile organs such as barbels. The lower vertebrates, on the other hand, are poorly represented and in no way remarkable or highly specialized. Sponges are apparently absent altogether from the Central Region, though one species (*Ephydatia fluviatilis*) is common in the Intermediate Zone, while the Polyzoa are represented in the fauna only by the Ctenostomatous genus *Hislopia*, a species (*H. lacustris*) of which is common all over the lake. Notwithstanding a careful search, we were unable to find any Amphipod or Isopod Crustacea. Only two species of Decapoda penetrate as far as the Central Region, and the lower groups of Crustacea are apparently scarce throughout the lake. In the Marginal Zone numerous species of aquatic insects of the orders Odonata, Diptera, and Rhynchota occur, but beetles are scarce in all regions. In the Central Region the larvae of certain Diptera, Trichoptera and Ephemeridae swarm, but the number of species is limited. Dr. F. F. Laidlaw has kindly given me the following note on the Odonata in our collection :—

"The most interesting species in the collection is perhaps a small orange and black *Ischneura*, closely allied to *I. rufostigma*, Selys, from Bengal and Assam but quite distinct, and apparently new to science. A number of examples of the beautiful *Rhinocypha iridea*, Selys, hitherto recorded from Burma, form an addition to the Museum list of species; and *R. biforata*, Selys, is also represented. Specimens of a species of *Ceriagrion* present some difficulties in identification, they are possibly examples of my *C. olivaceum* recorded from the Abor country. The collection of larval forms is large and includes specimens belonging to species not represented amongst the adults; amongst others one that is possibly the larva of a *Disparoneura*. The adults, with the exception noted, are mostly to be referred to common and widely spread species. Possibly the season of the year was unsuitable for the obtaining of some species, but on the whole the collection of adults is not so rich as one would have expected from the variety of the larvae."

Some of these dragon-flies breed in the lake, notably the *Ischneura*, while others (*e.g.*, *Rhinocypha* spp.) are jungle forms only found in thickets on the hills. These latter probably breed in small streams.

GEOGRAPHICAL RELATIONS OF THE FAUNA.

The lower invertebrates of the lake and its connected waters throw little light on the geographical relations of the fauna, and the aquatic insects (none of which, of course, are completely aquatic in a literal sense) are still, with the exception of the Rhynchota and the Odonata, unknown. I will deal with the Rhynchota separately. Among the strictly aquatic forms we need consider only the Decapod Crustacea, the Mollusca and the fish. The facts about the geographical distribution of these groups will be found on pp. 37-38, pp. 81-82 and pp. 145-148. of this volume. They may be summarized as follows :—

33 genera are represented, of which 2 (fish) are endemic in the lake=*ca.* 6 per cent.

2 other genera (molluscs) are practically confined to the Shan Plateau, giving a total of four endemic Shan genera=*ca.* 12 per cent.

67 species and races have been found, of which 30 have been found only in the lake and connected waters, giving a percentage of *ca.* 45 per cent.

2 other species and two races are practically confined to the Shan Plateau, giving a total of endemic Shan forms of 34 =nearly 51 per cent.

The fauna is thus mainly a fauna endemic on the Shan Plateau, with a very large percentage of peculiar lake forms probably not existing outside the Inlé system. The only other elements that can be detected are (*a*) one consisting of widely distributed Oriental species, (*b*) one consisting of Indian forms found on both sides of the Bay of Bengal, (*c*) a very small Indo-Chinese element, represented by general affinities rather than common species, and perhaps faint traces of (*d*) an Eastern Palaearctic element. The true aquatic fauna of the Inlé system belongs, therefore, to that of the Indo-Burmese area, but represents a distinct off-shoot thereof. It will probably be found, when the upper waters of the Salween are investigated, that this offshoot is well established in the watershed of that river, in so far as it is not purely lacustrine.

A word may be said here about the aquatic Rhynchota. No less than 33 species, representing 20 genera, are known to occur in the Inlé system, and 13 (*ca.* 39 per cent.) are known only from that system. The rest are species widely distributed in India or the Oriental Region generally, with one Palaearctic species (*Gerris paludum*). No peculiar Indo-Chinese forms are found, and no endemic genera. The only genus not of very wide general distribution is *Perittopus*, which seems to be Malayan in origin but occurs in Assam as well as in Java, Malaya and Tenasserim. The number of endemic species is surprisingly large in view of the wide range of many aquatic bugs. The facts known about the Inlé representatives of this order, therefore, bear out what has been said as to the true aquatic fauna in the preceding paragraph. It is probable, however, that none of the Rhynchota are exclusively lacustrine.

Origin of the Fauna.

The aquatic and quasi-aquatic fauna of the Inlé district as a whole was separated from the common fauna of the Oriental Region at a remote but not extremely remote period. The fossil remains of the district are not sufficiently well known to cast much light on the precise period at which this occurred. The local fauna developed in circumstances that favoured plasticity but did not render peculiar adaptations to environment necessary. Primitive forms such as *Chaudhuria*[1] were able to survive side by side with highly modified forms such as *Sawbwa*, *Taia* and *Hydrobioides*. In still, deep lakes, with transparent water containing abundant salts of lime and other minerals, in a temperate climate free from extremes of cold or heat, with a heavy but not excessive rainfall, conditions were perhaps ideal for the rapid evolution and the preservation of peculiar forms, modified superficially but not changed in fundamental structure or adapted in direct correlation with their mode of life. On the one hand competition was less keen than in strictly tropical surroundings and physical barriers interfered with the immigration of alien forms ; on the other there was nothing to check the momentum of eccentricity and small peculiarities were intensified rather than eliminated. The communities of different lakes developed slight racial or even specific peculiarities, but the fauna as a whole remained uniform over a large area. With the growth and deepening of the old lakes of the Shan Plateau this process continued, but the day of the great lakes was soon over. The lakes appeared and grew deep, changed their communications from time to time, and finally shrank and for the most part disappeared, owing to allied causes—the dissolving action of water, the re-deposition in solid form of the salts dissolved, and the formation of peat and of finely divided insoluble matter. The insoluble debris of the rocks eaten away by water accumulated in the form of red soil and masses of peat were heaped up as vegetable remains were transformed into this substance, until most of the basins were filled. At some places lakes dried up owing to their water eating through soluble barriers of hard limestone, at others new lakes were formed by the deposition of calcareous dams. The Inlé Lake, which was probably the largest of the system, has survived, shrunken in area and shallowed, but still a lake. In it the fauna of the old lakes has become as it were concentrated. This fauna has lost the power to resume the normal characters of a swamp-fauna, or perhaps in its isolated state there has been no reason why it should do so ; it retains the peculiar features acquired in conditions quite other than those in which it now lives.

[1] Mr. R. H. Whitehouse, basing his view on a study of the structure of the tail, regards *Chaudhuria* as a highly specialized form. See p. 66 of this volume.

List of the Fauna of the Inle Lake System.

Only species that have been identified at least generically are included. Under the heading "Marginal Fauna" notes are given on species found in ponds or marshes, but the fact is noted in each instance.

Name	General Distribution.	Distribution in Lake System.			
		Marginal zone.	Intermediate zone.	Central Region.	Running water..
Protozoa.					
Epistylis flavicans, Ehrenb. ...	Cosmopolitan	...	...	On larval case of *Polypedilum.*	...
Cothurnia sp.	Genus cosmopolitan	...	...	On *Caridina* ...	...
Porifera.					
Spongilla lacustris var. *proliferens*, Annd.	Species cosmopolitan. Var. in India and Burma.	Scarce ...	...	...	...
Spongilla fragilis var. *calcuttana*, Annd.	Species cosmopolitan. Var. in Gangetic delta.	Do. ...	...	...	...
Ephydatia fluviatilis var. *intha*, Annd.	Species cosmopolitan. Var. only known from the lake.	Do. ...	Abundant ...	...	...
Turbellaria.					
Planaria burmaensis, Kab. ...	Only known from the lake ...	...	...	Common ...	...
Planaria annandalei, Kab. ...	Only known from the lake ...	...	...	Scarce ...	...
Planaria bilineata, Kab. ...	Only known from the lake basin ...	...	...	...	In hill streamlet.
Temnocephaloidea.					
Caridinicola sp. ...	Genus known from India, Ceylon, China and Japan.	...	...	Common on *Caridina.*	...

List of the Fauna of the Inle Lake System—*contd.*

Name.	General Distribution.	Distribution in Lake System.			
		Marginal zone.	Intermediate zone.	Central Region.	Running water.
Polyzoa.					
Hislopia lacustris, Carter ...	India ; Burma	Scarce ...	Abundant ...	Abundant ...	...
Hislopia malayensis, Annd. ...	Peninsular Siam ; Gangetic delta ...	...	Scarce ...	...	...
Oligochaeta.					
Chaetogaster annandalei, Steph.	Japan	...	In *Ephydatia* ...	...	...
Chaetogaster limnaei ?, v. Baer	Europe ; W. Himalayas ...	...	Do. ...	...	...
Chaetogaster bengalensis, Annd.	Gangetic delta	...	Do. ...	...	...
Eranchiura sowerbyi, Bedd. ...	Probably endemic in Eastern Asia ; also found in Europe.	Common ...	...	Common ...	In stream from hot spring.
Perionyx fulvus, Steph. ...	Gangetic delta	Scarce ...	...	...	Common in Yawnghwe River.
Crustacea.					
Potamon (Potamon) browneanum, Kemp.	Only known from the lake system ...	...	...	...	Common in streams.
Potamon (Potamon) acanthicum, Kemp.	Only known from the Shan States	Fairly common	...	Scarce ...	Do.
Potamon (Potamon) curtobates, Kemp.	Only known from the lake basin ...	Common in swamps.	...	...	...
Palaemon naso, Kemp. ...	Only known from the lake system ...	...	...	...	Abundant in river below lake.
Palaemon sp.	Probably identical with species from N. Shan States.	...	...	...	In warm spring.
Palaemon hendersoni, de Man ...	E. Himalayas ; hills of Assam and Upper Burma.	...	...	...	Fairly common.
Caridina annandalei, Kemp. ...	Tenasserim	Abundant ...	Abundant ...	Abundant ...	Less common.
Caridina weberi, de Man, var. ...	Species widely distributed in Malaysia and India.	Scarce ...	...	...	Common.

INSECTA.					
Odonata.[1]					
Pseudagrion microcephalum (Ramb.)	Oriental Region	Larva abundant	Larva abundant	Larva abundant	...
Ceriagrion olivaceum ?, Laidlaw	Abor Hills, Assam	Larva perhaps from this zone.	...	...	...
Ischneura, sp nov.	.....	Larva abundant	Larva abundant	Larva abundant	...
Rhinocypha iridea, Selys. ...	Burma	...	...	...	Larvae probably in jungle streams.
Rhinocypha biforata, Selys. ...	Burma ; Malay Peninsula ...	...	...	...	Do.
Rhynchota.					
Mesovelia vittigera,[2] Horv. ...	Syria, Egypt ; Oriental and Ethiopian Regions, New Guinea.	Common ...	...	...	...
Velia Y-alba, Paiva ...	Only known from the lake ...	A single specimen.	...	...	...
Microvelia burmanica, Paiva ...	Tenasserim	...	...	...	Common in small streams above lake.
Microvelia diluta, Dist. ...	Bengal	Small pool near Yawnghwe.	...	...	...
Perittopus breddini, Kirk. ...	Java ; Malay Peninsula ; Tenasserim	...	...	...	Common in small streams.
Gerris anadyomene, Kirk. ...	Ceylon ; Philippines	Small pool ...	...	...	...
Gerris nepalensis, Dist. ...	Northern India ; Tenasserim ...	Common ; also in ponds.	...	...	...
Gerris fossarum (Fabr.) ...	Bengal ; Malay to Philippines and Australia.	Abundant ...	Abundant ...	Occasional ...	...
Gerris nitida (Mayr.) ...	India ; Burma and Ceylon ...	Scarce ...	...	...	...
Gerris tristan, Kirk. ...	India ; Burma and Ceylon ...	Do. ...	...	...	...
Gerris paludum, Fab. ...	Palaearctic Region ; Upper Burma	Canal ; scarce	...	...	Small stream ; scarce.
Gerris spinolae, Leth. and Sev. ...	Oriental Region	Common ...	Common ...	Occasional ...	...
Ptilomera laticaudata (Hardw.) ...	Oriental Region	...	...	...	Common on jungle streams.
Onychotrechus lyra, Paiva ...	Only known from the lake system ...	...	...	...	On hill streams.
Ventidius distanti, Paiva ...	Only known from the lake system ...	...	...	...	Do.

[1] Our collection from the Inlé Lake, which is now in the hands of Dr. F. F. Laidlaw, has not yet been completely worked out.

[2] *Mesovelia mulsanti*, Buch. White. See Paiva, p. 20 in this volume, and Bergroth, *Philippine Journ. Sci.* XIII, p. 121 (1918)

List of the Fauna of the Inle Lake System—*contd.*

Name.	General Distribution.	Distribution in Lake System.			
		Marginal zone.	Intermediate zone.	Central Region.	Running water.
Insecta—*contd.*					
Rhynchota—*contd.*					
Metrocoris nigrofasciatus, Dist. ..	Himalayas ; Burma ; Malaya ; Siam	Common on ponds	...	...	...
Naboandelus signatus, Dist. ..	Gangetic delta	Common in this zone.	...	...	...
Rhagadotarsus kraepelini,[1] Bredd.	Oriental Region	Scarce ...	...	...	...
Ranatra varipes, Stal. ...	Widely distributed in Asia ...	From marsh; scarce.	...	...	...
Cercotmetus pilipes (Dall.) ...	Bhutan ; E. Himalayas ...	From marsh; scarce.	...	...	...
Sphaerodema rusticum (Fabr.) ...	India to Philippines ; China and Australia.	Common ...	...	...	...
Enithares templetoni (Kirby) ...	India ; Ceylon ; Peninsular Siam ...	...	...	...	Common in hill streams.
Enithares intha, Paiva ...	Only known from the lake ...	Scarce ...	...	...	...
Anisops niveus (Fab.) ...	Widely distributed in S. Asia ...	From muddy pool.	...	...	...
Anisops sardea (Herr.-Schaff.) ...	Widely distributed in S. Asia ...	From pool ...	...	...	...
Nychia infuscata, Paiva ...	Only known from the lake ...	Common ...	...	...	...
Plea quinquenotata, Paiva ...	Only known from the lake ...	Scarce ...	...	...	...
Plea areolata, Paiva ...	Only known from the lake system ...	...	...	...	One specimen from stream.
Corixa septemlineata, Paiva ...	Only known from the lake system ...	From pool ...	...	...	...
Corixa unicolor, Paiva ...	Only known from the lake system ...	Do. ...	...	...	...
Micronecta substriata, Paiva ...	Only known from the lake ...	Five specimens	...	...	...
Micronecta soror, Paiva ...	Only known from the lake ...	One specimen	...	...	...
Micronecta fulva, Paiva ...	Only known from the lake ...	Three specimens	...	...	...

DIPTERA.					
Anopheles barbirostris, v. d. W.	Widely distributed in S. E. Asia ...	Larva (scarce) in this zone.	...	...	...
Polypedilum sp.	.....	...	...	Larvae not uncommon.	...
MOLLUSCA.					
Gastropoda.					
Succinea indica, Pfeiffer ...	Himalayas	At edge: common.	...	...	...
Limnaea andersoniana, Nevill ...	Yunnan; Shan States	Occasional: one phase common in ponds.	...	...	One phase in streams.
Limnaea shanensis, Annd. ...	Only known from lake system ...	Scarce; common in ponds.	...	...	...
Limnaea mimetica, Annd. ...	Only known from lake	...	Rather scarce	Scarce ...	...
Planorbis exustus, Desh. ...	Oriental Region	Common at edge.	...	...	...
Planorbis velifer, Annd. ...	Only known from lake	...	Not uncommon	Less abundant	...
Planorbis trochoideus, Benson ...	Gangetic delta	Scarce ...	Do. ...	Not uncommon	...
Planorbis colathus, Benson ...	Himalayas; Ceylon; Siam ...	Do. ...	Do. ...	Do. ...	...
Planorbis caenosus, Benson ...	N. India; Ceylon	Do. ...	...	...	...
Melania tuberculata (Müller) ...	N. Africa; Ethiopian and Oriental Regions, etc.	...	...	Common ...	Common in muddy streams.
Melania terebra, Benson ...	.....	...	...	...	Do.
Melania baccata elongata (Gould)	Species in Shan States and Upper Burma. Var. only known from lake system.	In marshes ...	...	...	Do.
Paludomus ornata, Benson ...	Irrawadi and Brahmaputra ...	...	...	...	In runnel.
Hydrobioides nassa (Theobald)	Shan States	Common; also in ponds and marshes.	...	...	...
Hydrobioides nassa lacustris, Annd.	Only known from lake	Fairly common	Common ...	Common ...	...
Hydrobioides physcus, Annd. ...	Only known from lake system ...	Common; also in swamp.	Do. ...	Do. ...	...

[1] *Nacebus dux*, Dist. See Paiva, p. 26 in this volume, and Bergroth, *op. cit.* p. 122.

List of the Fauna of the Inle Lake System—*contd.*

Name.	General Distribution.	Distribution in Lake System.			
		Marginal zone.	Intermediate zone.	Central Region.	Running water.
Mollusca—*contd.*					
Gastropoda—*contd.*					
Hydrobioides avarix, Annd. ...	Tenasserim	...	...	...	In small stream of warm water.
Hydrobioides nana, Annd. ...	Only known from lake	Rather scarce	...	...	...
Amnicola alticola, Annd. ...	Only known from lake	Fairly common	Fairly common	Fairly common	...
Vivipara lecythis (Benson) ...	Assam ; Burma ; W. China ...	Very scarce ...	...	...	...
Taia naticoides (Theobald) ...	Shan States ; Upper Burma ...	Common in marshes.	...	...	In backwaters.
Taia theobaldi (Kobelt) ...	Shan States ; " Burma " ...	...	...	...	Common.
Taia shanensis (Kobelt) ...	S. Shan States	Common ...	...	...	...
Taia elitoralis, Annd. ...	Only known from lake	...	Rather scarce	...	...
Taia intha, Annd.	Only known from lake	...	...	Very abundant	...
Ampullaria winkleyi, Pilsbry ...	L. Burma	Common near edge.	Much scarcer ...	...	In stream from hot spring.
Pelecypoda.					
Physunio micropteroides, Annd....	Only known from Yawnghwe River	...	...	...	Common in mud.
Physunio ferrugineus, Annd. ...	Only known from lake	...	...	Common ...	...
Corbicula noetlingi, v. Martens	Shan States	In ponds and marshes.	...	...	Common in sluggish streams.
Pisidium casertanum (Poli) ...	Europe ; Siberia ; Japan ...	...	...	Not uncommon	Scarce ; in back-water.
Fish.					
Chaudhuria caudata, Annd. ...	Genus only known from lake ...	Scarce ...	Scarce ...	Scarce ...	...
Amphipnous cuchia (Ham. Buch.)	India ; Burma ; Malay Peninsula ...	Common ...	...	...	In sluggish streams.
Monopterus albus (Zuiew) ...	S. Asia east of Bay of Bengal ; N. China ; Japan.	Do. ...	...	...	Do.

Clarias batrachus (Linn.) ...	India to Philippines	Do. ...	...	...	Do.
Lepidocephalus berdmorei (Blyth)	Burma	Occasional ...	...	...	Common.
Nemachilus botia (Ham. Buch.)...	India ; Burma	...	...	...	In hill streams.
Nemachilus brevis, Boulenger ...	Only known from lake system ...	Abundant ...	Abundant ...	Abundant ...	In slow streams.
Nemachilus brunneanus, Annd.	Only known from Yawnghwe Valley	Do. ...	Do. ...	Do. ...	In slow and rapid streams.
Discognathus lamta (Ham. Buch.)	India ; Burma	Fairly common	Fairly common	Fairly common	In sluggish streams.
Discognathus[1] sp.	Only known from He-Ho ...	...	...	...	Do.
Cirrhina latia (Ham. Buch.) ...	India ; Burma	Abundant ...	Abundant ...	Abundant ...	...
Barbus sarana caudimarginatus, Blyth	Subsp., Upper Burma and Tenasserim ; species, India.	Do. ...	Less common	Less common	...
Barbus dukai, Day	E. Himalayas ; Burma ; Sumatra ...	...	...	...	In hill streams.
Barbus tor (Ham. Buch.) ...	Several local races in India ...	...	...	...	In streams and rivers.
Barbus nigrovittatus, Boulenger	Only known from Fort Stedman ...	...	...	...	? In streams.
Barbus schanicus, Boulenger ...	Only known from lake system ...	? Occasional ...	...	...	In larger streams.
Barbus stoliczkanus, Day ...	Burma ; ? India	...	...	...	In hill streams.
Barbus stedmanensis, Boulenger	.....	...	...	...	...
Cyprinus carpio intha, Annd. ...	Southern Shan States	Abundant ...	Abundant ...	Abundant ...	...
Sawbwa resplendens, Annd. ...	Genus only known from lake ...	Do. ...	Do. ...	Do. ...	...
Microrasbora rubescens, Annd. ...	Only known from lake system, also in ponds.	Do. ...	Do. ...	Do. ...	...
Microrasbora erythromicron, Annd.	Only known from lake system ...	Rather scarce ; common in rice-fields.	...	...	...
Barilius auropurpureus, Annd. ...	Only known from Yawnghwe Valley	Abundant ...	Abundant ...	Abundant ...	In sluggish streams.
Barilius ornatus, Sauvage ...	Menam River	...	...	...	? Rivers.
Notopterus notopterus (Pallas) ...	India ; Burma ; Siam ; Malaysia ...	Abundant ...	Abundant ...	Scarcer ...	In sluggish streams.
Mastacembelus oatesii, Boulenger	Only known from lake system ...	Common ...	Common ...	Common ...	Do.
Mastacembalus caudiocellatus, Boulenger	Only known from lake system ...	Do. ...	Do. ...	Do. ...	Do.
Ophiocephalus striatus, Bloch. ...	India ; Burma	Do. ...	Do. ...	Do. ...	...
Ophiocephalus gachua,[2] Ham. Buch.	Persia ; India ; Burma ; Malaysia, etc.	?	?	?	?

[1] The examination of a large number of specimens of *Discognathus* since my paper on the Inlé fish was written has removed all doubts as to this form being an undescribed species. I will describe it shortly in the *Records of the Indian Museum*, vol. XVI.

[2] Possibly the form I have called *O. harcourt-butleri* is the same as that identified by Boulenger as *O. gachua* (*Ann. Mag. Nat. Hist.* (6) XII, p. 198).

List of the Fauna of the Inle Lake System—*concld.*

Name.	General Distribution.	Distribution in Lake System.			
		Marginal zone.	Intermediate zone.	Central Region.	Running water.
Fish—*contd.*					
Ophiocephalus harcourt-butleri, Annd.	Only known from lake system ...	Abundant ...	Abundant ...	Abundant ...	In sluggish streams.
Ophiocephalus siamensis, Günther	Menam River	?	?	?	?
Danio aequipinnatus (McCl.) ...	.....	In rice-fields ...	...	...	...
Batrachia.					
Rana kuhlii, D. and B. ...	Tropical and Sub-Tropical Asia east of Bay of Bengal.	...	...	...	Larvae in hill streams.
Rana limnocharis, Wiegm. ...	Plains of S. Asia ; N. China ; Japan	Probably common.	...	...	...
Bufo melanostictus, Schneid. ...	Oriental Region	...	...	...	Larvae in hill streams.
Megalophrys montana, Kuhl. ...	Siam ; Malay Peninsula and Archipelago.	...	...	...	Do.
Reptitia.					
Cyclemys dhor shanensis, Annd....	Species, Assam to Malay Archipelago; sub-species only known from lake system.	Not uncommon	...	...	At edge of sluggish streams.
Trionyx sp.	?	?	?	?	...